

**Thorium Power Ltd. News Update
November 30, 2007**

Letter from the CEO

Dear Stockholders:

We are pleased to share this latest news update, which includes company news as well as industry-related developments.

Company News

We are particularly enthused about the recent coverage in *Platts' NuclearFuel*, the leading industry trade publication, and *MIT Technology Review*, the university's influential and prestigious journal. The articles further validate the positive progress we are making on many fronts. The *MIT Technology Review* piece commented on the "Thorium Energy Independence and Security Act of 2007" and extensively covered Thorium Power's ongoing mission to make thorium fuel the new industry standard: "Westinghouse evaluated Thorium Power's system as an option for burning surplus military plutonium, and the company predicted that this would be 'substantially' cheaper, quicker, and more effective than burning plutonium with uranium." Meanwhile, *Platts' NuclearFuel* reported on the recent presentation at the Emerging Fuels Conference and commented on our increasing focus on commercial deployment: "A number of developing countries now wanting to build nuclear reactors for the first time [have told] Thorium Power they 'do not want to be perceived either domestically or internationally as developing weapons' – '[if] there is a proliferation resistant fuel cycle available, it ranks high on their list of desires.'"

Industry Developments

Nuclear energy continues to generate attention, interest and support across the board: In *Climate change: Everyone's business*, the Confederation of British Industry called for 12 nuclear power reactors to be constructed as part of the UK's climate change strategy. Also, Prime Minister Brown addressed environmental campaigners and reiterated the necessity of deriving all energy from low-carbon and zero-emission sources such as nuclear power. Meanwhile, the Intergovernmental Panel on Climate Change's *Summary for Policy Makers* reiterated the importance of nuclear power as a climate change mitigation technology, and advocated nuclear energy as a viable and timely option. On the India front, we witnessed some highly encouraging developments, which further confirmed that the US-India deal remains on track. As part of its protocol, the IAEA initiated consultations with top Indian officials to discuss specific measures to ensure nuclear safeguards. This positive step marks yet another milestone towards the completion of the deal.

Once again, these latest developments support our unique positioning as a source of solutions to address the major industry concerns – how to solve proliferation, reduce waste and improve profitability.

Very Truly Yours,

Seth Grae

Chief Executive Officer

Thorium Power in the news

MIT Technology Review – Cleaner Nuclear Power? Congress pushes for another look at thorium fuel, saying it could reduce the amount of high-level nuclear waste produced by reactors (11.27.07) – The journal covers Thorium Power's mission and comments on Senator Hatch's "Thorium Energy Independence and Security Act of 2007," which aims to ease concerns about nuclear waste by requiring DOE to develop standards for reactors to use thorium fuel rather than uranium. The article quotes Seth Grae who notes that Thorium Power is focusing its marketing efforts on developing countries in the Middle East, Asia, and Latin America that are looking to build their first reactors; and where non-proliferative fuels will make it easier to finance reactor construction.

Platts Nuclear Fuel – Thorium Power plans VVER tests, eyes US market Emerging sellers keeping spot U price in check (11.19.07) – The leading industry trade includes an interview with Thorium Power's Ernie Kennedy at the recent Emerging Fuel Cycles conference in London. It goes on to focus on the Company's commercialization activities before reiterating the introduction of the "Thorium Energy Independence and Security Act of 2007."

India Business Insight – Priming For Power (11.24.07) – The newspaper reports that Thorium Power Inc. is among the companies vying for construction and equipment contracts worth \$100 billion in India's efforts to raise nuclear power production.

General nuclear news

World Nuclear News – CBI: nuclear power has "major potential" (11.27.07) – The news source covers the recent report from the Confederation of British Industry. Titled *Climate change: Everyone's business*, the report calls for 12 new nuclear power reactors for the UK as part of its climate change strategy.

The Guardian – Brown to endorse new generation of nuclear power (11.26.07) – The paper reports on PM Brown's recent call for an acceleration of nuclear power, which he presented at the annual address to the Confederation of British Industry. Brown backs nuclear energy as a key solution to the climate change crisis.

The Hindu – EU closely watching India's discussions with IAEA (11.26.07) – The paper reports that the European Union said it was "closely watching" India's negotiations with the global atomic watchdog on a safeguards agreement necessary for its civil nuclear deal with the US and it would be up to the member states to decide their stand at the Nuclear Suppliers Group.

World Nuclear News – USA supports new nuclear build in Armenia (11.23.07) – The news source reports that the USA has signaled its commitment to help Armenia with preliminary studies for the construction of a new nuclear power plant.

The Hindu – We won't back out of nuclear deal: Pranab Mukherjee (11.22.07) – The paper reports on recent comments by India's External Affairs Minister Pranab Mukherjee. The minister notes that the Indian government is not contemplating backing out of the Indo-U.S. civil nuclear deal and that India and the U.S. agree on the text of an "Agreement for Cooperation" that has already received Cabinet approval.

World Nuclear News – European energy developments on fast track (11.23.07) – The news source reports that the European Commission has announced plans to speed up energy technology developments including Generation IV reactors and that a cross-party group of 56 members of the European Parliament have signed a declaration calling for nuclear to be maintained and developed in the European Union.

World Nuclear News – India begins safeguards talks with IAEA (11.22.07) – The news source reports on meetings in Vienna, Austria between top Indian officials and the International Atomic Energy Agency (IAEA) concerning specific measures to ensure nuclear power materials in India are used for only peaceful purposes.

Agence France Presse – India, IAEA launch consultations over nuclear safeguards (11.21.07) – The news wire reports on the IAEA's formal launch of consultations with India, which are aimed at securing the landmark civil nuclear deal between New Delhi and Washington.

World Nuclear News – Brown Goes Green (11.20.07) – The industry paper reports on UK prime minister Gordon Brown's announcement to environmental campaigners that he wants all energy for electricity and heat to come from low-carbon sources by 2050 and that new nuclear is a possibility, as is making carbon capture compulsory.

World Nuclear News – IPCC notes role of nuclear in summary report (11.19.07) – The news source reports on the Intergovernmental Panel on Climate Change's (IPCC's) *Summary for Policy Makers* report. The publication reiterated the importance of nuclear power as a currently available commercial climate change mitigation technology, and advocated nuclear power as an option before 2030.

World Nuclear News – NEA calls on governments to plug nuclear skills gap (11.14.07) – The industry news source reports that member states of the OECD's Nuclear Energy Agency (NEA) have unanimously adopted a statement on the need for qualified human resources in the nuclear field, reflecting the general need for qualified specialists to support the nuclear renaissance.

World Nuclear News – Calls for multinational licensing (11.13.07) – The news source reports that Areva chair Anne Lauvergeon called for international coordination in the licensing of new nuclear power projects as a way to speed up the development of the nuclear industry. Lauvergeon delivered her comments at the World Energy Congress in Rome on November 12.

World Nuclear News – IEA: Follow through on climate promises (11.07.07) – Politicians must follow through on their climate change rhetoric, said the International Energy Agency (IEA), or current policies would lead to a 57% increase in carbon dioxide emissions by 2030.

World Nuclear News – British decommissioning plans (11.07.07) – The industry news source reports that the UK will spend about \$17.4 billion on dismantling its old nuclear power and research facilities up to 2011, according to a plan published today.

The Advertiser (Australia) – Uranium alternative (11.03.07) – The paper reports on the promise of thorium and its ability to transform highly enriched weapons-grade uranium-235 and plutonium-239 into less dangerous materials.

Cleaner Nuclear Power?

Congress pushes for another look at thorium fuel, saying it could reduce the amount of high-level nuclear waste produced by reactors.

By Peter Fairley

MIT Technology Review

November 27, 2007

Senators representing several Western states, including Utah's Orrin Hatch and Senate Majority leader Harry Reid, of Nevada, are working on legislation to promote thorium. They say it's a cleaner-burning fuel for nuclear-power plants, with the potential to cut high-level nuclear-waste volumes in half.

"They're concerned about the spent fuel from nuclear reactors ending up in their states," says Seth Grae, president of thorium-fuel technology developer Thorium Power, based in McLean, VA.

Nuclear watchdogs say that Thorium Power's technology has real potential. Moreover, they say that the legislation is needed. It would force the Department of Energy (DOE) and the Nuclear Regulatory Commission, which regulates the nuclear industry, to create new offices at the agencies to study thorium-fuel options and promote their use abroad.

"It makes a lot of sense in my view," says Thomas Cochran, director of the nuclear program at the Natural Resources Defense Council, in Washington. He says that congressional action is needed to overcome resistance within the DOE to exploring thorium.

Using thorium in existing reactors means rethinking the "once through" nuclear fuel cycle employed today in most countries, including the United States. The cycle starts with uranium-oxide fuel enriched in the fissile uranium isotope U235. Fission of the uranium in a reactor generates heat to drive a nuclear power plant's turbines, and it produces a highly radioactive blend of fission breakdown products, including plutonium that can be recovered to make nuclear weapons. Other fission products slow the chain reaction, requiring replacement of fuel every one or two years. The spent fuel is removed and stored on site, awaiting burial.

The DOE is working on a high-level waste repository at Yucca Mountain, in Nevada. But the facility won't open for at least another decade, and there is little political will to build more such sites. Meanwhile, Private Fuel Storage, based in Salt Lake City, is proceeding with a controversial interim storage site on Native American land, with a 20-year license and an option to renew. "That's quite a stopover," says Grae.

Thorium Power was launched in 1992 to commercialize a process that reduces the amount of toxic waste produced by traditional reactors. The process was developed by the late nuclear scientist Alvin Radkowsky, a seminal designer of the U.S. Navy's reactors and early commercial nuclear plants. Radkowsky's scheme relies on both thorium and uranium fuels, making it more complex on the front end. But doing so keeps most of the fuel in the reactor longer, and it produces waste that's less toxic.

Each fuel assembly carries a mix of two different fuel rods. The majority are rods containing pellets of thorium oxide. The thorium can't sustain a chain reaction on its own like U235 can, but it can absorb neutrons to form another fissile isotope of uranium that will: U233. In Thorium Power's design, these neutrons are supplied by the remaining rods, which are solid alloys of zirconium and fissile U235-enriched uranium.

Grae says that Thorium Power's hybrid-fuel assemblies are designed to perform as drop-in replacements for uranium-oxide fuel in pressurized water reactors, the most common reactor design worldwide. The reactors require only minimal modifications. The most important adjustment is the use of more-precise cranes to insert and remove fuel assemblies to enable separate extraction of the uranium rods. Grae says that this is key to the waste reduction because most of the thorium stays in the reactor core for nine years. (The uranium rods, like conventional uranium-oxide fuel, are swapped out more frequently.)

Thorium Power plans to test this fuel system within three years, starting in a pressured-water reactor in Russia. The tests will be conducted in partnership with the Kurchatov Institute, a nuclear research center in Moscow. The institute has been testing the endurance of Thorium Power's fuel materials for four years while simultaneously scaling up a uranium-zirconium extrusion process to produce the 3.5-meter rods used in the Russian reactors.

If the rods endure, experts expect that Thorium Power's scheme will succeed because the hybrid thorium-and-uranium fuel concept is already proven. Several early gas-cooled nuclear reactors of the 1950s and '60s used a seed-and-jacket fuel scheme conceptually similar to Thorium Power's. And a few early water-cooled reactors such as the first reactor at Indian Point, NY, operated in the 1960s and '70s with fuel rods filled with a thorium-uranium blend. However, thorium fell out of favor as the nuclear industry standardized around uranium, particularly after uranium fuel slumped to rock-bottom pricing following the accident at Three Mile Island in 1979.

Dumping fuel every two years looks less appealing today, with uranium prices rising rapidly and high-level waste piling up at commercial reactors across the United States. Thorium fuel also responds to growing concern over proliferation of fissile materials that could be used in nuclear weapons. Thorium's byproducts produce intense gamma radiation, making them hard to handle by would-be bomb makers. Thorium Power is focusing its marketing efforts on developing countries in the Middle East, Asia, and Latin America that are looking to build their first reactors; Grae bets that a design that impedes proliferation of nuclear weapons will make reactors easier to finance in such countries. The company is also looking to India, which hopes to exploit its large thorium reserves.

The challenge for thorium proponents is that the DOE already advocates another fuel cycle that promises to cut waste and manage proliferation risks: a so-called closed fuel cycle, whereby chemical reprocessing recovers plutonium from spent uranium fuel for reuse in conventional reactors.

Reprocessing is central to the DOE's Global Nuclear Energy Partnership (GNEP), whereby major nuclear players such as the United States would guarantee uranium fuel supply to countries that promise to return spent fuel--the plutonium within which could be used to make nuclear weapons.

The GNEP has many critics who argue that the reprocessing of spent fuel will be costly, will increase rather than limit the risk of diversion of fissile materials, and will do little to reduce high-level waste volumes. The DOE's plan is to burn recovered plutonium by blending it with uranium. This produces a hotter and more toxic spent fuel that can only be burned in breeder reactors. Those reactors have, to date, proved infeasible at commercial scale. (See "The Best Nuclear Option.")

Grae insists that Thorium Power could benefit, in the long run, from stepped-up reprocessing because its fuel system provides a better outlet for the recovered plutonium: replacing uranium as the neutron source for Thorium Power's thorium-fuel rods. In 2005, nuclear-technology giant Westinghouse evaluated Thorium Power's system as an option for burning surplus military plutonium, and the company predicted that this would be "substantially" cheaper, quicker, and more effective than burning plutonium with uranium.

Platts NuclearFuel

November 19, 2007

Thorium Power plans VVER tests, eyes US market

Lead test assemblies of thorium fuel are planned to be loaded into one of the VVER-1000 reactors at Kalinin near Moscow in 2010 as part of a multi-year demonstration program, Ernie Kennedy, a member of US company Thorium Power Ltd.'s technical advisory board, told a London conference October 31.

He said the idea is to demonstrate the new fuel, which consists of a central "seed" assembly surrounded by a thorium blanket, in a VVER and "then expand to other PWRs and then perhaps BWRs," for which the thorium fuel design is more difficult.

However, Thorium Power's director of corporate affairs and investor relations, Peter Charles, said in a separate interview that reorganization of Russia's nuclear sector had slowed finalization of contracts for the VVER test irradiation under an April 2007 agreement with Red Star, a Rosatom design bureau. He added that Thorium Power was shifting its emphasis from plutonium disposition — the origin of the Russian partnership — toward commercial deployment of thorium-based fuel in the US.

Addressing an IBC fuel cycle conference in London, Kennedy said the Kalinin demonstration would require an amendment to the reactor's licensing permit, which Charles said has been sought. Elektrostal will manufacture the Kalinin test assemblies, Kennedy said. The VVER-1000's configuration makes it "relatively easy" to design the thorium assemblies without having to change reactor internals or refueling machine, he said.

Kennedy said that while it's feasible to use thorium fuel in PWRs designed by Westinghouse or Areva, "that development is not as well along" as in VVERs. As for BWRs, "it is very difficult to do a seed-and-blanket assembly in a BWR," so there has been "not much work in that area."

Development work and testing in Russia, he said, is less expensive than in the West, "and the work's been excellent from what I've seen." Part-length fuel rods representative of the Thorium Power fuel design have accumulated about four years' irradiation in the IR-8 test reactor at the Kurchatov Institute in Moscow, an irradiation planned to continue for several more years, he said. There has also been some extensive thermal-hydraulic testing, he said, both on single rods and meter-long mockups of full seed-and-blanket assemblies.

At a public scoping meeting associated with DOE's Global Nuclear Energy Partnership program in March, Thorium Power CEO Seth Grae described those tests and said one of the meter-long assemblies was meant to simulate conditions in a Western PWR design (NF, 26 March, 5).

Proliferation-resistant

Thorium Power — based in McLean, Virginia — focuses on the development, design and testing of thorium-based fuel for existing and future commercial reactors. The fuel is designed to be proliferation-resistant and to reduce the volume of spent fuel, according to company documentation (<http://www.thoriumpower.com>). The company has been developing the seed-and-blanket fuel assembly technology since its founding in 1992.

The Thorium Power fuel is specifically designed not to be recycled or reprocessed, Kennedy said. A number of developing countries now wanting to build nuclear reactors for the first time had told Thorium Power they "do not want to be perceived either domestically or internationally as developing a weapons program," he said. "If there is a proliferation resistant fuel cycle available, it ranks high on their list of desires," he said.

Charles said spent thorium seed-and-blanket fuel would be "very difficult" to reprocess because of gamma radiation, and "wouldn't be worth it" because the seed assemblies would contain very little fissile material and a lot of minor actinides. In the seed-and-blanket assembly, a central metallic "seed" consisting of either uranium-zirconium or plutonium-zirconium fuel rods is surrounded by a thorium-uranium dioxide blanket.

Kennedy said the thorium in the blanket reduces the proliferation risk of fissile materials in the spent fuel because, under irradiation, the thorium is converted to fissile U-233, which is burned in-situ over the life of the fuel assembly. Also, the thorium fuel cycle leads to the production of only small amounts of plutonium and the isotopic content of that plutonium makes it more unsuitable for weapons than normal reactor-grade plutonium.

For countries that want to consume excess plutonium, plutonium in the seed of the thorium fuel assembly can be burned “about three times faster and at somewhere between a third and half the cost of the mixed-oxide process,” he said, referring to more conventional uranium-plutonium oxide fuel now used in LWRs.

Three seed designs

Thorium Power’s current development work in Russia is looking at three different assembly designs for the VVER 1000-type reactor, he said. All three have a thorium blanket, but the seed fuel is either uranium-zirconium, reactor-grade plutonium and zirconium, or weapons-grade plutonium and zirconium. The seed fuel is designed for three operating cycles, he said, or three years assuming annual cycles. “The blanket stays in residence for nine years, or nine cycles,” he said.

The nine cycles enable efficient U-233 in-situ burning — “a primary contribution to the overall reduction in waste in the blanket assemblies,” he said. Kennedy said the Kalinin VVER-1000 demonstration is expected to last a minimum of three years. “We would like to take it all the way to seven years to show the full life of the blanket,” he said.

Charles said by telephone November 15 that the development work with Kurchatov Institute had been funded partially by US government grants of between \$4 million and \$8 million over the past decade or so, as part of the weapons-plutonium disposition program under which the US and Russia were to denature 34 metric tons each of excess weapons Pu. He added that private investors had “at the very least matched those figures” over that period, contributing between \$5 million and \$10 million to the effort.

But now that the Russian Pu disposition program has shifted its emphasis away from MOX in VVERs and towards Pu fuel in fast reactors, Thorium Power, too, is shifting away from Pu-based fuel, he said. “The MOX people are not our competitors,” he told Platts. “If people realize there is a need for disposition of plutonium, we’ll be there,” but “our main focus [now] is pretty much commercialization.”

According to a recent report in EnergyWashington Week, Utah Senator Orrin Hatch “is drafting legislation to ease concerns about nuclear waste by requiring DOE to develop standards for nuclear reactors to use thorium fuel rather than uranium.” A measure known as the “Thorium Energy Independence and Security Act of 2007” is expected to be offered for consideration during upcoming negotiations on a final energy bill, the report said.

Hatch is believed to seeking an appropriation of some \$250 million over the next five years to get DOE and NRC started on thorium fuel development and licensing, said Charles. He said Thorium Power had “been in touch with the senator.”

Charles said that although thorium seed-and-blanket fuel for Western PWRs would still need to be tested, “a certain amount of data could be used” from the Russian tests to save time. “We feel comfortable that the transition to AP1000 [fuel] will be done with very few technical hurdles,” he said.

Thorium Power, founded by Alvin Radkowsky, who worked with Admiral Hyman Rickover on early PWR fuel development, went public on October 6, 2006 via a takeover by Novastar Resources, a commercial thorium mining venture. The company was renamed at the takeover.

—*Pearl Marshall, London; Ann MacLachlan, Paris*

Priming For Power - Contracts Worth \$100 Billion Are Up for Grabs with India's Efforts to Raise Nuclear Power Production
India Business Insight
November 24, 2007

Contracts worth \$100 billion are on offer with India's efforts to raise nuclear power production. General Electric Co, Areva, Westinghouse Electric Co (which makes nuclear reactors), Bechtel (a construction company), and Thorium Power Inc (a fuel processing company) are all hoping to get a piece of this \$100- billion pie. About 60 percent of the business generated by the new nuclear plants will involve construction and equipment contracts.

The rest will comprise contracts for fuel processing technologies and safety services. The major segments that are expected to benefit are transformers and switchgears, cables and electric rotating machinery, wires, and energy meters.

Thorium Power plans VVER tests, eyes US market Emerging sellers keeping spot U price in check

By Pearl Marshall, London; and Ann MacLachlan, Paris

Platts Nuclear Fuel

November 19, 2007

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CBI: nuclear power has "major potential"

World Nuclear News

November 27, 2007

British business has suggested 12 new nuclear power reactors for the country as part of a climate change strategy. In *Climate change: Everyone's business*, the Confederation of British Industry (CBI) called for positive decisions on nuclear to be made fast.

The new report was unveiled on 26 November at the CBI's annual conference. The London event saw prime minister Gordon Brown assure business leaders a UK nuclear policy would be announced early in the new year, following the governments consideration of the recent public consultation.

The CBI's report was compiled by its Climate Change Task Force of 19 leading employers including RWE npower, BP, Shell, Siemens, Rolls-Royce, and the London Stock Exchange. Task force's chair and BT chief executive, Ben Verwaayen wrote in his foreword: "This report has not been written by evangelists but by business people."

In the power sector, legislation must be passed in the next year to enable some 25% of the UK's power generation infrastructure to be replaced in a timely manner. There must be a diverse range of low-carbon power sources. One of these could be nuclear power, said the CBI, with the construction of the first of 12 new plants starting in 2013, and one per year following that.

This would be a very low-cost way of avoiding carbon dioxide emissions. The report used similar assumptions to the government's recent white paper: saving one tonne of carbon dioxide by building nuclear would cost about Eur2. Saving the same by building onshore wind power would cost more like Eur62 per tonne.

Nuclear power was ranked as the joint-second most significant way to abate carbon emissions, with twice the potential of wind power or carbon capture and storage. Improvements to building infrastructure came first, with lighting and appliance efficiency equal to nuclear. The CBI saw 12 nuclear and 1600 wind generators as having "major potential" to provide about 50% of electricity by 2030, with 20 carbon capture and storage power plants adding more low-carbon capacity.

The CBI task force identified consumers as a primary force in transforming to a low-carbon way of life, firstly through their choice of lifestyle and purchases, which account for 35% of emissions. Furthermore, consumers could influence another 25% of emissions from retail, food, wholesale and agriculture. With the right information and incentives, consumers could create the right market for business to respond to, said the report.

However, these developments would only be possible after strong leadership from the government in setting appropriate frameworks of incentives for consumers and business. In addition, government must come up with a way to price carbon, and internationally a post-2012 international agreement on greenhouse gas emissions is essential.

Brown to endorse new generation of nuclear power
By Patrick Wintour and David Adam
The Guardian
November 26, 2007

Gordon Brown will call for an acceleration of nuclear power today in a speech to business leaders designed to show he is focused on the long term and will not buckle in the face of negative headlines.

During his annual address to the Confederation of British Industry, the prime minister will also give his personal endorsement of the third runway project at Heathrow.

He will tell business leaders: "Long-term reforms will intensify and be stepped up. We must leave behind the old policies of yesterday and plan for new long-term policies which will serve us better tomorrow. There are no answers to be found in old and outworn dogmas."

Today's speech is likely to draw fire from environmentalists, who will also be looking at how the CBI intends to tackle climate change in the long term.

The government said in a consultation paper last week "a strong case" existed for an expansion of Heathrow. But Brown will go further: British prosperity depends on the third runway, he will say.

"We know that even as we place strict environmental limits on noise and air - pollution and ensuring aviation pays its carbon costs, we have to increase the capacity of our airports, particularly Heathrow," he will say. "Our prosperity depends on it. Britain as a world financial centre must be readily accessible to the world". A third runway and sixth terminal would increase the number of flights at Heathrow from 470,000 a year to more than 700,000 and destroy the village of Sipson, which borders the current Heathrow site.

On nuclear power Brown will say: "We must and will take the right long-term decisions to invest now for the next generation of sustainable and secure energy supplies."

He was forced by the courts to hold a second, as yet incomplete, consultation on building nuclear stations so he will not make an announcement today in case he is accused again of pre-empting the outcome. But it is clear that he sees a new generation of stations as vital to Britain's energy security and emission targets.

Brown's decision to tackle two of the most contentious issues - and tackle environmental concerns along the way, comes as Alan Milburn warns that Labour must develop a sense of forward progress.

Interviewed in Australia, where he worked closely on the victorious campaign of the country's new Labor prime minister, Kevin Rudd, the former cabinet minister said there were "lessons in common" between the political situations in Britain and Australia. "For Britain the lessons are very straightforward. Any party of government has to ... look ready to deal with new challenges," he said. "Elections are all about the future."

Speaking after this weekend's Australian election, Milburn warned that "the hardest thing of all is for a party to renew itself in office and keep on winning".

A close friend of Tony Blair, he is believed to be unhappy at Labour's failure to hold a contested leadership election this year. In remarks some may interpret as aimed at Brown, he said that Australia's longstanding prime minister, John Howard, lost because his government had "developed a sense of invincibility" after 11 years in power.

"There was a sense of tiredness and staleness and it was not until the election was called that his Liberal party tried to find any sense of forward momentum and new policy," he said.

Milburn has been in regular contact with Rudd since he took over as leader of Australia's Labor party last year. He has advised him on campaign strategy and speeches, celebrating a landslide victory on Saturday night with the new PM at his headquarters in Brisbane.

He attributed Labor's victory, which leaves Australia's conservative coalition out of power at federal and state level across the country, to its leader's "strong sense that he had to be the change". He was "a man with a plan, fresh ideas and new energy who captured the mood of the country".

He said he became "good friends" with Rudd after leaving government for the second time in 2005 - a move that did not rule out talk that he might have challenged Brown for the Labour leadership.

EU closely watching India's discussions with IAEA
The Hindu
November 26, 2008

New Delhi (PTI): The European Union on Monday said it was "closely watching" India's negotiations with the global atomic watchdog on a safeguards agreement necessary for its civil nuclear deal with the US and it would be up to the member states to decide their stand at the Nuclear Suppliers Group.

"The European Union is committed to the Nuclear non-Proliferation Treaty and it is in this context we are following with great interest the discussion India is having with the International Atomic Energy Agency," Ambassador and Head of the Delegation of the European Commission to India Daneile Smadja told reporters here.

She said the EU understands India's interests in civil nuclear cooperation and its growing needs of energy.

"We have to wait for negotiations with the IAEA. We will work on a common position. We are trying to reach the maximum consensus and arrive at a common European position on this issue," Portuguese Ambassador to India Luis F C Mendes said.

Smadja and Mendes were speaking at a press conference ahead of the eighth India-EU summit to be held here on Friday.

USA supports new nuclear build in Armenia
World Nuclear News
November 23, 2007

A statement of cooperation to develop planning studies for a preliminary environmental impact assessment and feasibility study was signed by representatives of both governments in a ceremony at the Armenian Ministry of Energy in Yerevan on 21 November.

At the signing ceremony, US Charge d'Affaires Joseph Pennington said, "The US government supports the building of a new nuclear unit." The results from the studies will be used by Armenia to choose "the best technical solutions and project logistics," according to the US embassy in Yerevan. Pennington noted that the studies would also serve as a basis for negotiations with potential international suppliers and financiers.

According to press reports, the US is to provide \$2 million for the studies, which Armenian energy minister Armen Movsisyan says should be complete by September 2008. Movsisyan anticipated that a new unit could be completed within 5 years once construction began.

Earlier in 2007, Russia agreed to build a new 1000 MWe nuclear power plant in Armenia in return for minority ownership of it. At the time, the Armenian energy minister announced a \$2 billion feasibility study, to be carried out with Russia, the USA and the IAEA.

Armenia operates one Soviet-designed VVER-440 nuclear unit at Metsamor, which supplies over 40% of the country's energy needs. It started up in 1979 and is much the same as those which the EU insisted be shut down before Bulgaria and Slovakia joined the EU (though it is adapted to be robust seismically). The EU and neighbouring Turkey have expressed concern about the continuing operation of the plant, which was shut down after a major earthquake in 1988 prompted questions about its safety. It restarted in 1995 and continues to operate despite numerous calls for its closure.

European energy developments on fast track
World Nuclear News
November 23, 2007

The European Commission's (EC's) Strategic Energy Plan starts off by recognizing that without a dedicated policy to accelerate development and deployment of cost-effective low carbon technologies, Europe will be hard-pressed to meet its carbon emission targets. The energy innovation process as it stands is beset by weaknesses: "There is neither a natural market appetite nor a readily discernible short-term business benefit for such technologies," the Commission notes. According to Janez Potocnik, Commissioner for Science and Research, "We have the chance to be world leaders in low carbon technologies, but if Europe doesn't act together more effectively, we will squander that opportunity and the economic benefits of the transition to a low carbon economy will go elsewhere."

The Strategic Energy Technology Plan, described as "a comprehensive plan to establish a new energy research agenda for Europe," is the EC's attempt to overcome such problems. It focuses on joint planning and cooperation. In particular, it includes the commitment to set up a series of new, high priority European Industrial Initiatives and proposes strengthening industrial research and innovation by aligning European, national and industrial activities. It also recommends the creation of a European Energy Research Alliance to ensure much greater cooperation among energy research organizations.

The plan identifies maintaining European competitiveness in "fission technologies" and long-term waste management solutions as one of the next decade's key challenges towards meeting 2020 targets. Completing preparations for the demonstration of new generation (Generation IV) fission reactors and construction of the ITER fusion facility figure in the key challenges to meet in the next 10 years if 2050 commitments are to be met.

In a separate development, 56 members of the European Parliament have signed a declaration calling for nuclear power to be maintained and developed as a key component of a low-carbon energy future for the European Union (EU). Members from all political groups within the parliament except the Green/EFA group signed the declaration, supporting "the optimal use of existing nuclear capacity and the building of new nuclear power plants to help meet significant future electricity demand" while recognizing that all low-carbon power generation technologies would be needed in future.

Vice President of the European Parliament Alejo Vidal Quadras, who presented the declaration, said: "I believe the Parliament is now willing to show political leadership in the promotion of broader policy mechanisms that support nuclear energy as a low-carbon technology." The declaration is the result of a multi-stakeholder initiative launched by European nuclear industry association Foratom and other European business, electricity and energy bodies.

We won't back out of nuclear deal: Pranab Mukherjee
The Hindu
November 22, 2007

NEW DELHI: The government is not contemplating backing out of the Indo-U.S. civil nuclear deal, External Affairs Minister Pranab Mukherjee told the Lok Sabha on Wednesday.

When India completed negotiations for an India-specific safeguards agreement with the International Atomic Energy Agency and for adjustment of guidelines with the Nuclear Suppliers Group, the deal would be sent to the U.S. Congress for approval for operationalisation, he said in a written reply.

Mr. Mukherjee said India and the U.S. agreed on the text of an "Agreement for Cooperation" that had received Cabinet approval.

To another question, Minister of State in the Prime Minister's Office Prithviraj Chavan said India's atomic programme could develop "much faster" if international cooperation was allowed.

Uranium in short supply

Replying to a query on the use of thorium for generation of atomic energy, he said India needed to have international cooperation to acquire uranium technology and fuel, which was insufficient in the country.

"The government is trying for international cooperation in this sector and also trying to convince the House to allow it to obtain uranium to speed up the process of atomic nuclear fuel," Mr. Chavan said in a veiled reference to the Indo-U.S. deal.

Pointing out that all countries had uranium-based nuclear programmes, he said India was deficient in natural uranium and whatever reserves existed would be exhausted after some time.

"If the government is allowed to go for international cooperation, there will be enough uranium available that will speed up our nuclear programme much faster," the Minister said.

He sought to scotch the impression that the government was not exploiting thorium, available in sufficient quantity, to develop the nuclear programme.

"India's thorium utilisation technology is more advanced than anywhere in the world," the Minister said, adding it did not need international cooperation to develop this.

"We will not delay by even one day ... having some kind of energy independence, if the House permits international cooperation."

India begins safeguards talks with IAEA
World Nuclear News
November 22, 2007

Head of India's Department of Atomic Energy, Anil Kakodkar, met IAEA director general, Mohamed ElBaradei, on 21 November at the IAEA building in Vienna. They will discuss methods by which the IAEA would be able to ensure the security of nuclear materials in India and the complete separation of India's nuclear power sector from its nuclear weapons program.

This safeguards process is essential to bringing India into the mainstream of the global nuclear industry. In particular, an India-specific safeguards agreement would be required for the bilateral trade deal between India and the USA.

India has enjoyed some international nuclear trade in recent years with Russia, whose companies are building two pressurized water reactors at Kudankulam. However, India has been told that no more business can be conducted under that particular deal because it was made on the assumption that IAEA safeguards would soon be in place.

Since 2005 the USA has been the driving force behind mainstreaming India and President George Bush agreed a nuclear cooperation text with prime minister Manmohan Singh. That deal is currently mired in Indian politics, but is likely to be revived in coming months, with successful conclusion to these IAEA-India talks being seen as a major motivating factor.

India, IAEA launch consultations over nuclear safeguards
Agence France Presse
November 21, 2007

VIENNA, Nov 21: India and the UN nuclear watchdog formally launched consultations on Wednesday that are needed to secure a landmark nuclear deal between New Delhi and Washington.

International Atomic Energy Agency chief Mohamed ElBaradei and the head of India's atomic energy commission, Anil Kakodkar, met at the IAEA headquarters in Vienna, the agency said in a statement.

"Dr ElBaradei and Dr Kakodkar agreed to initiate consultations on an India-specific safeguards agreement. For this purpose, an Indian team will have meetings this week with the IAEA Secretariat in Vienna," the statement said.

The meeting – the first time the two men have met formally – was brief.

Kakodkar and Indian ambassador Sheel Kant Sharma arrived at 11am (1000 GMT) and left again around 40 minutes later without making any comment to reporters.

Before the US-India deal can go ahead, New Delhi must first negotiate an agreement allowing the UN nuclear watchdog to monitor its civilian nuclear reactors. It must also win approval of the so-called Nuclear Suppliers Group, which controls global atomic trade.

Kakodkar and ElBaradei met just a day before the IAEA's 35-member board was scheduled to sit down to a two-day meeting on a range of different topics, most importantly ElBaradei's latest report on Iran.

There was no official indication as to how long the talks might last or the possible outcome.

But diplomats say that it was likely to take some time, possibly weeks, for New Delhi and the IAEA to reach agreement on India-specific safeguards.

Earlier this year, it had been thought that the IAEA board might be able to approve such an accord at its November meeting.

But fierce political wrangling in India over the deal, which even threatened to bring down the government, has set back any such expectations.

Under Indo-US deal, India, which is not party to the Nuclear Non-Proliferation Treaty, will separate its civilian and military programmes and place 14 of its 22 nuclear plants under international safeguards in return for civilian nuclear technology.—AFP

Brown goes green
World Nuclear News
November 20, 2007

UK prime minister Gordon Brown has told environmental campaigners he wants virtually all energy for electricity and heat to come from low-carbon sources by 2050. New nuclear is a possibility, as is making carbon capture compulsory.

Speaking at a WWF seminar on 19 November, Brown set out a number of measures his government is planning to cut carbon emissions. Brown said it was an imperative to have a "major drive to decarbonise our energy sources." One part of that, "potentially," could be new nuclear power, said Brown

Brown said an announcement based on the nuclear consultation would come next year, rather than immediately before the Christmas break as previously thought. Until the consultation response is made, ministers must be careful to surround references to nuclear power with caveats.

Hosts of the meeting, WWF, notably withdrew from the nuclear consultation along with several other green groups, saying it was flawed. However, a statement from the group coinciding with Brown's speech pandered to him by not challenging his words.

Besides considering new nuclear, other supply-side initiatives Brown spoke about were a GBP1 billion (\$2 billion) investment in renewables, and that carbon capture and storage could be made mandatory for UK fossil-fuelled power stations if it proves technically and commercially viable. Subsidy from the Renewables Obligation is to be made available to tidal lagoons and barrages of below 1 GWe capacity.

At present, nuclear is the UK's largest source of low-carbon energy, supplying 7.5%. All renewables currently total 2%, but this is proposed to triple by 2015. One notable renewable project is the 8600 MWe Severn Barrage, which could generate 5% of UK electricity. It is currently at the feasibility study phase.

All these potential initiatives would form part of a medium-term plan based on a climate change bill due sometime next year. It would place caps on emissions with five-year "carbon budgets" set by an independent committee. International caps and carbon markets are seen as being the best way to facilitate a global market-driven change to low-carbon ways of life.

Brown plans a consultation next year to identify ways to achieve his targets.

IPCC notes role of nuclear in summary report
World Nuclear News
November 19, 2007

The Summary for Policy Makers (SPM) is a 23 page distillation of the IPCC's *Synthesis Report*, which itself is a compilation of the thousands of pages written in the reports of three working groups, whose detailed reports were published earlier this year. More than 800 contributing authors and more than 450 lead authors were involved in the writing of the Fourth Assessment Report (AR4), with a two stage review stage that involved more than 2500 climate change experts.

The SPM reports that warming of the climate system is unequivocal, as is now evident from observations of increases in global average temperatures, widespread melting of snow and ice and rising sea levels.

Global greenhouse gas emissions from human sources have increased 70% since 1970, with over a quarter of all greenhouse gas emissions coming from energy supply.

For future changes in temperature and sea level rise the IPCC reports different predictions for different increases in atmospheric carbon dioxide (CO₂) concentrations. Best estimates of temperature increases range from 2.0 to 6.1 degrees C, with sea levels rising by between 0.4 to 3.7 m, not including any rise due to melting ice.

Final CO₂ atmospheric concentration (ppm)	Period of peak CO₂ emissions	Change in CO₂ emissions by 2050 (%)	Global average temperature increase (degrees C)	Global average sea level rise due to thermal expansion (m)
350 - 400	2000 - 2015	-85 to -50	2.0 - 2.4	0.4 - 1.4
400 - 440	2000 - 2020	-60 to -30	2.4 - 2.8	0.5 - 1.7
440 - 485	2010 - 2030	-30 to +5	2.8 - 3.2	0.6 - 1.9
485 - 570	2020 - 2060	+10 to +60	3.2 - 4.0	0.6 - 2.4
570 - 660	2050 - 2080	+25 to +85	4.0 - 4.9	0.8 - 2.9
660 - 790	2060 - 2090	+90 to +140	4.9 - 6.1	1.0 - 3.7

A wide range of mitigation options available to reduce greenhouse gas emissions were listed from sectors including energy supply, transport, buildings, industry, agriculture, forestry and wastes. In the energy sector nuclear power was listed as a commercially available option, alongside improved supply and distribution efficiency; fuel switching from coal to gas; renewable heat and power (hydropower, solar, wind, geothermal and bioenergy); combined heat and power and early applications of carbon dioxide capture and storage (CCS).

By 2030 the IPCC expect CCS for gas, biomass and coal-fired electricity generating facilities; advanced nuclear power; advanced renewable energy, including tidal and wave energy, concentrating solar, and solar photovoltaics to be commercially available.

Policies and measures shown to be environmentally effective include reduction of fossil fuels subsidies and carbon taxes, although resistance by "vested interests" may make such measures difficult to implement, said the IPCC.

NEA calls on governments to plug nuclear skills gap
World Nuclear News
November 14, 2007

The NEA Steering Committee for Nuclear Energy warned, "If no action is taken on this issue, the nuclear sector risks facing a shortage of qualified manpower to ensure the appropriate regulation and operation of existing nuclear facilities as well as the construction of new ones in those countries wishing to do so."

In its statement, the NEA said that the nuclear industry faces three particular problems: retaining existing skills and competences, particularly in countries which have not yet decided to replace existing, ageing facilities; developing and retaining skills and competencies in areas such as decommissioning and radioactive waste management; and, supporting a revival of nuclear power in countries wishing to do so with an ageing workforce and declining programs.

It said that these problems are affected by the increasing liberalization of electricity markets, which has resulted in utilities downsizing their workforces and research facilities in order to cut costs. In addition, there has been a decrease in government funding for nuclear research.

According to the NEA, "The actions taken by governments have varied, with improvements in some areas and little change in others. In some countries, specific plans to support universities have been successful in reversing the declining trends of the number of graduates in nuclear engineering and related disciplines."

It added, "Most countries have recognised the need to secure qualified human resources in the nuclear energy field, *inter alia*, due to the long lead time in existing programs and consideration of new energy production options. Although some progress has been achieved, more needs to be done."

The NEA makes three recommendations to its member governments. Firstly, it suggests that regular assessments are carried out of both the requirements and availability of qualified human resources to match identified needs. Secondly, governments, academia, industry and research organizations should collaborate both nationally and internationally. Thirdly, governments, whether or not they chose to use nuclear energy, should encourage large, high-profile, international research and development programs.

Skills in the UK

One particular OECD country which is looking at redeveloping its nuclear power sector in coming years is the UK, where indigenous gas-cooled reactors are ageing and could be replaced by light-water-cooled ones. In that country, the workforce faces an age and skills gap.

One aspect of the government's response has been to establish a National Skills Academy to develop a standardized and coordinated approach to education, training and skills development in the nuclear sector. The Skills Academy will be a wholly-owned subsidiary of Cogent, the Sector Skills Council for the chemicals, pharmaceuticals, nuclear, oil and gas, petroleum and polymer industries. It will assist nuclear employers in tackling the current and future skills barriers and challenges facing the UK nuclear industry.

Jean Llewellyn, project director of the National Skills Academy for Nuclear, recently told *The Times* newspaper that no British university currently offers a dedicated nuclear engineering honours degree course. However, Imperial College is set to launch a course next year. Until then, the UK nuclear industry is recruiting from other engineering disciplines and training people up. Llewellyn said, "If we don't address this issue now we will have no alternative but to recruit skilled staff from overseas."

EDF Energy, a UK subsidiary of Electricite de France (EdF), has proposed participating in the construction of new nuclear power plants in the UK, should the government decide to do so. However, the company's human resources director, Tim Boylin, has said it would have to look to its French parent company to supply the specialist nuclear workers needed. Boylin told *Personnel*

Today, "Given the current level of UK nuclear activity, the skillset is likely to be depleted so it makes lots of sense to look to places with more active engineering expertise."

EdF itself has announced plans to recruit almost 10,000 new workers in France during the next five years as the company expands in nuclear generation and renewable energy. Between 2007 and 2009, the company also plans to replace less than half of its 12,750 retiring workers. In 2006, EdF employed 156,524 people, compared with 161,310 in 2004.

Calls for multinational licensing
World Nuclear News
November 13, 2007

"The licensing process is long. We are in a system where we have to re-license every time we want to develop a new project," said Lauvergeon. She said the need to restart every time was very costly and, "it would make sense to get a fast-track system."

The competitiveness of nuclear energy improves significantly with economies of scale, with the standardisation of reactor designs being a potential major driver in this in future. With a small number of manufacturers and a small number of designs, serialised construction of standard power plants would lead to faster construction times, cheaper power and enhanced safety for every country. Reducing financial risk in this way would be expected to lead to more positive decision-making by investors.

Lauvergeon's words come after other initiatives to internationalize reactor licensing. In 2005 the Multinational Design Evaluation Programme (MDEP) was established, administered by the OECD Nuclear Energy Agency, through which national regulators are working to pool technical data and converge regulations and practices in order to avoid duplication of work. Participating in MDEP are Canada, China, Finland, France, Japan, South Africa, South Korea, Russia, the UK and the USA.

Dale Klein, the chair of the US Nuclear Regulatory Commission, which itself chairs the MDEP Steering Group, told the International Atomic Energy Agency General Conference on September: "By working together, we can provide clear, concise, and internationally accepted guidance to the designers and architects of these new facilities on safety and security requirements."

In the commercial nuclear industry, the World Nuclear Association has established the Cooperation in Reactor Design, Evaluation and Licensing Working Group (Cordel). It is comprised of representatives of power generators and reactor vendors and aims to stimulate dialogue between nuclear industry firms and national and international nuclear regulators. Its aim is to achieve a better convergence of safety standards globally for Generation-III and III+ reactors, while also laying the foundation for future Generation-IV reactors.

Cordel chair, Bob Brown of GE-Hitachi Nuclear Energy, said that while national regulatory authorities would retain sovereign responsibility for reactor licensing in their respective countries, some degree of harmonization in regulation could ensure the maximum gains offered by standardization to all parties involved.

Michael Micklinghoff of EOn, the vice-chair of Cordel, added: "We are convinced that international standardization of nuclear designs will lead to benefits in safety, economics, plant quality, predictability of deployment time and cost. This will also be reflected positively in the general public and political perception of nuclear energy."

IEA: Follow through on climate promises
World Nuclear News
November 7 2007

The IEA's annual *World Energy Outlook* put forward two projections of the world's energy use to 2030. The Reference Scenario is based on climate protection policies already in place while the Alternative Policy Scenario envisages all new policies currently under discussion being adopted.

In both cases the increases in energy use were dominated by the needs of China and India, both of whom are so large and developing so rapidly that they could account for 45% of the Reference Scenario's 55% increase in energy demand.

Furthermore, those nations are expected to meet their needs largely through a huge expansion in the use of coal for power generation. This was identified by the IEA as the main global driver in global warming.

The IEA said that heading off the pollution of a coal expansion would require governments to place energy efficiency and conservation in a central role and that nuclear power and renewables could make a major contribution. In the longer term, capturing and storing carbon emissions from coal power plants would be very promising, particularly in China, India and the USA where coal use is set to grow fastest. All governments 'must focus' on this, the IEA stressed, saying: "There has so far been more talk than action in most countries."

In addition, the Alternative Policy Scenario showed that action taken should be more intensive than that currently proposed. The scenario foresaw a 27% increase in global carbon dioxide emissions by 2030, meaning a stabilisation of carbon dioxide at 550 parts per million (ppm) and an average temperature increase of 3 degrees C.

In a scenario based around stabilisation at 450 ppm, the level thought to limit warming to 2 degrees C and avoid catastrophic effects, the required emissions savings came from "switching to nuclear power and renewables" as well as improved efficiency in fossil-fuel use in industry, buildings and transport and widespread deployment of carbon capture devices.

British decommissioning plans
World Nuclear News
November 7, 2007

The Nuclear Decommissioning Authority (NDA), which was established in 2005 to oversee an ambitious project to manage the safe long-term management of the UK's nuclear legacy, has put the plan out for public consultation until the end of January 2008.

The bulk of the spending will go to clean-up and decommissioning of the various facilities at the Sellafield and Dounreay sites, which are to receive \$1.174 billion and \$309 million in work per year.

The NDA is also managing the ten pioneering Generation-I Magnox nuclear power plants, spending typically between \$62 million and \$124 million on each per year.

Two of the plants, Oldbury and Wylfa, are still operating and contribute about \$350 million per year in revenue from electricity sales. Similarly, some commercial operations at Sellafield such as reprocessing of used nuclear fuel generate revenues totalling \$1.650 billion per year.

In total the NDA expects to spend \$2.82 billion on clean-up in 2008/9 - about half its expenditure of \$5.690 billion . It should receive \$2.542 billion in revenue. Monies earned by NDA go to the government as the ultimate owner of the state-developed facilities, and the government separately allocates the NDA a budget for clean-up.

Estimates of figures for the period 2009/10 and 2010/11 figures are broadly the same overall, with the exception that revenue from electricity generation will finally cease in 2010 as Wylfa retires.

Uranium alternative
By Professor Stephen Lincoln
The Advertiser (Australia)
November 3, 2007

A safer, more plentiful nuclear fuel is in our backyard.

IS this too good to be true? A fuel that offers to reduce climate-change gases and consume dangerous weapons-grade plutonium and uranium? Uranium has a new competitor: the dense silvery metal thorium-232. Named after Thor, the Norse god of thunder, the slightly radioactive thorium-232 is three times as plentiful as uranium.

Australia has 300,000 tonnes of it in the form of monazite sands, a quarter of the world's known deposits. Thorium-232 is not a nuclear fuel. However, it is very close to being one.

Thorium-232, when hit by a neutron, can change into uranium-233, which is a nuclear fuel similar to the uranium-235 used in nuclear reactors now.

What are all those weird numbers tacked on at the end of familiar-sounding names?

Hydrogen is the atom with the lightest nucleus. It is named hydrogen-1. The thorium-232 nucleus is 232 times heavier than hydrogen-1. The hydrogen-1 nucleus is a single positive subatomic particle, or proton, while the thorium-232 nucleus has 90 protons and 142 neutrons. The neutral neutron is of similar mass (weight) to the proton.

When uranium-233 is "burnt", a neutron strikes a uranium-233 nucleus which splits into lighter nuclei - otherwise known as fission products - and more neutrons. These "loose" neutrons then go on to strike another uranium-233 nucleus, forming what is known as a "chain reaction". As the nucleus breaks apart, it generates heat which may be used to produce high-pressure steam to drive electricity turbines.

However, when the thorium-232-produced uranium-233 is split by a neutron, it does not produce enough extra neutrons to sustain the energy-producing chain reaction. It needs an extra "injection" of neutrons.

This is where weapons-grade nuclear materials come into the picture.

Since the nuclear weapons non-proliferation treaty of 1968, the dismantling of nuclear warheads has made redundant hundreds of tonnes of highly enriched weapons-grade uranium-235 and plutonium-239.

These explosives must be stored safely to avoid accident and theft.

Thorium-232 reactors offer a path to transform these metals into less dangerous materials.

Fuel rods containing mainly thorium-232 can be "primed" with a smaller amount of either uranium-235 or plutonium-239. This provides the neutrons to transform the more stable thorium-232. These primed thorium-232 rods have another, commercially attractive advantage: they can be used in existing conventional nuclear reactors. Without the weapons-grade plutonium-239 and uranium-235, thorium-232 reactors will need another source of neutrons. This can be produced by electrically driven linear accelerators. These shoot a "beam" of neutrons into the thorium-232 to keep it "burning".

These accelerators can be switched off, stopping the thorium-232 reaction immediately.

Because there is three times more thorium than known uranium deposits, it promises a longer-lasting source of non-renewable energy. And "burnt" thorium-232 produces less long-lived radioactive waste than its counterpart.

So is electricity generated from thorium-232 likely to be available soon?

The answer is probably not for a decade at least. Although some experimental thorium-232 reactors are running, no commercial electricity-generating plant is operating.

It is probable that India, which has large supplies of thorium, may be the first nation to use this energy source commercially.

Stephen Lincoln is a Professor of Chemistry at the University of Adelaide and is the author of Challenged Earth. An Overview of Humanity's Stewardship of Earth, published by Imperial College Press.

The "other" nuclear fuel

oThere is three times more known thorium than uranium. A quarter of these reserves are in Australia.

oThorium cannot sustain a nuclear chain reaction alone, making it a safer fuel and reducing its usefulness as a weapon.

oThe radioactive waste produced by thorium has a shorter life span than normal uranium fuels.

neutron

Thorium-232 neutron

Uranium-233

Fission products and Energy = mc^2