A NEW NUCLEAR POLICY FOR LABOR

Ken McLeod of the Tuross Head NSW Branch

Contact: Turlinja@bigpond.net.au

AS I understand it, Labor's nuclear policy is that:

> **"Labor will prohibit the establishment of nuclear power plants and all other stages of the nuclear fuel cycle".**

Speaking at the Sydney University Labor Club on 26 April 2006, while giving the 2006 H. V. Evatt Annual Lecture, Anthony Albanese, Shadow Minister for the Environment, said:

> *"Nuclear energy doesn't add up economically, environmentally or socially. After more than 50 years of debate, we still do not have an answer to the issues of nuclear proliferation or of nuclear waste."*

In Sydney on 7 MARCH 2006 Kim Beazley, speaking on the threat of climate change said that

> *"Labor's clear position is that nuclear power is not appropriate for Australia. The economics of nuclear power simply don't stack up here."*

Now, while this policy may have been well-founded when it was created decades ago, it faced the certainty that one day, sooner or later, technological developments will overcome the risks of nuclear power and leave Labor stuck with a policy that makes no technical or economic sense, and at the same time exclude possible solutions to Global Warming and exhaustion of world oil supplies.

History is full of laws that were made ridiculous with the passage of time and scientific and technological developments. Remember the British law[1] that required a man waving a red flag to precede every horseless carriage? Remember also the Tennessee law prohibiting the teaching of evolution; the 1930s British law that required all aircraft to be bi-planes? No chance of building a Hurricane or Spitfire then, and no chance of winning the Battle of Britain. [2]

Remember also Thalidomide? That was quite rightly banned in the 1970s but has been now approved for treatment of multiple myeloma, (a cancer of the bone marrow) [3].

So it is with nuclear power. Recent developments lead to the conclusion that sooner or later, nuclear power will be safe and economic. Notice I said "nuclear", not "uranium".

Under development today is a nuclear reactor that offers no possibility of a meltdown, generates power inexpensively, creates no weapons-grade by-products, and burns up existing high-level waste as well as old nuclear weapon stockpiles. The small amount of waste produced by such a reactor is radioactive for a mere few hundred years rather than tens of thousands. A number of teams around the world, including Australia, are now working to make it a reality. What makes this reactor different, and Labor's nuclear policy so myopic, is its fuel, **Thorium.**

The conventional nuclear fuel cycle runs on refined uranium ore. The ore needs to be 'enriched', boosting the proportion of U-235 in the ore. Nuclear reactors require around 3 per cent to 5 per cent of U-235, while nuclear weapons often require 85 per cent or more. One by-product is plutonium, used in nuclear weapons.

The new technology reactors run on Thorium. Thorium is on the periodic table two places to the left of the only other naturally occurring actinide, uranium. This means thorium and uranium share several characteristics.

According to Sydney University's Dr Reza Hashemi-Nezhad, a nuclear physicist who has been studying the thorium fuel cycle, the most important point is that both can absorb neutrons and transmute into fissile elements. "From the neutron-absorption point of view, U-238 is very similar to Th-232", he said.

It's these similarities that make thorium a potential alternative fuel for nuclear reactors. But it's the unique differences between thorium and uranium that make it a potentially superior fuel. First of all, unlike U-235 and Pu-239, thorium is not fissile, so no matter how much thorium is assembled in one unit, it will not start a chain reaction. This means that it cannot undergo nuclear fission by itself and it cannot sustain a nuclear chain reaction once one starts.

Also, the waste produced from burning thorium in a reactor is dramatically less radioactive than conventional nuclear waste. Where a uranium-fuelled reactor will generate tonnes of high-level waste that stays radioactive for tens of thousands of years, a reactor fuelled only by thorium will generate a fraction of this amount, and it stays radioactive for only 500 years - after which it would be as manageable as coal ash. The small amount of short-lived waste from thorium reactors might also be much less of a problem if recent promising research bears fruit. Research at the Ruhr University in Bochum, Germany, that shows that by encasing certain radioisotopes in metal and chilling them close to absolute zero, it ought to be possible to slash their half-lives to just a few years[4].

Thorium has another remarkable property. Add plutonium to the mix - or any other radioactive actinide - and the thorium fuel process will incinerate these elements. It will consume nuclear waste as part of the power-generation process. It could not only generate power, but also act as a waste disposal plant.

Why don't we use thorium reactors now? The main disadvantage (and advantage) of thorium is that it is not vigorously fissile, so it needs a source of neutrons to initiate the reaction. Thorium cannot maintain criticality on its own; that is, it cannot sustain a nuclear reaction once it has been started. That's why a reactor using thorium fuel is often called a 'sub-critical' reactor.

Ironically, one of the reasons the world went down the uranium path 65 years ago, instead of the thorium path, is precisely because it was the by-products that were wanted, to make nuclear weapons.

The main technical problem until now has been providing thorium fuel with enough neutrons to keep the reaction going, and do so in an efficient and economical way.

In recent years two new technologies have been developed to do just this.

The first gets around the sub-criticality of thorium by creating mixed fuels using a combination of enriched uranium, plutonium and thorium.

The primary benefit of this system is that it can be used in existing nuclear plants with slight modification, such as Russian VVER-1000 reactors. Moscow's Kurchatov Institute IR-8 research reactor is already running on Thorium. Other benefits are that it will consume discarded nuclear warheads and waste.

The second design does away with the requirements for uranium or plutonium altogether, and relies on thorium as the primary fuel source. This design, the Accelerator Driven System (ADS), was proposed by Italian Nobel physics laureate Carlos Rubbia, a former director of one of the world's leading nuclear physics labs, CERN, the European Organisation for Nuclear Research. (The ADS reactor is sometimes called the "Energy Amplifier.")

An ADS reactor is sub-critical, which means it needs help to get the thorium to react. To do this, a particle accelerator fires protons at a lead target. When struck by high-energy protons the lead releases neutrons that collide with nuclei in the thorium fuel, beginning the fuel and power generation cycles.

If the particle beam is switched off, it is impossible for the thorium fuel to continue the nuclear process, or to enter a chain reaction and cause a meltdown. Instead, the fission will immediately begin to slow to a stop and the fuel will cool down. According to Dr Hashemi-Nezhad, a sub-critical reactor such as this has clear safety benefits over uranium reactors. "It has zero chance of a Chernobyl-type accident," he said.

Another major advantage of this design is that it requires only thorium as fuel.

Thorium is an element in which Australia is well blessed - we have the largest known thorium reserves in the world [5]. Thorium mining is also less complex than uranium mining; and the ore does not require enrichment before use in an ADS reactor.

In a non-proliferation sense, there are also good reasons to prefer a sub-critical thorium reactor, as it is impossible to make weapons-grade materials from thorium.

So, is the ADS reactor economically viable? CERN, (the European Organization for Nuclear Research) thinks so. It has released a detailed report covering the financial viability of the ADS design for power generation, and found it to be at least one-third the cost of coal and less than one-quarter the cost of natural gas power plants[6]. All power plants, including nuclear, have high establishment costs, but CERN stresses that a long-life ADS reactor will be highly competitive compared to fossil and renewable energy fuels.

Dr Hashemi-Nezhad has been working on the ADS reactor concept with colleagues in Germany, Russia, India and Eastern Europe, and is enthusiastic about it. "The future of nuclear reactors is in ADS because it operates in a sub-critical condition. Only under this condition it is possible to transmute waste isotopes while gaining energy and producing fuel at low cost. And it's safe," he said.

With around 25 per cent of the world's thorium deposits found in Australia, Dr Hashemi-Nezhad argues it is essential that we take the lead in this new technology. “The Australian government must make a significant investment in this work. It is also essential for Australian universities to support the training of young scientists in the field of nuclear technology, at present there is an obvious shortage of applied nuclear science skills in Australia,” he said.

Dr Hashemi-Nezhad’s calculations show that Australia’s known thorium reserves are sufficient for clean nuclear energy production for six thousand years at a rate equivalent of two million barrels of oil per day.

Meanwhile, other countries are not waiting for John Howard’s nuclear debate.

In 2005, India unveiled its design of "A Thorium Breeder Reactor (ATBR)", which will produce 600 MW of electricity for two years with no refuelling. Construction is now well advanced. India has gone down the thorium path because of its large thorium deposits and small uranium reserves.

Note that in his 2006 Evatt Annual Lecture, Anthony Albanese not once referred to thorium. Nor did Mr Beazley in his climate change blueprint, although this is now a hot topic in the power industry. Indeed, Mr Albanese’s and Mr Beazley’s speeches focused entirely on the dangers of uranium. Labor seems to be entirely ignorant of the differences between uranium and thorium reactors.

Prime Minister Howard, ever the sly old fox, is no doubt aware of the potential of thorium and other new technologies, and once again is poised to make us in Labor look like the troglodytes some of us are.

Am I saying that thorium reactor is the “magic bullet” that will solve all our energy problems and at the same time reverse global warming? Of course not! There is still much work to be done to improve the technology and the economics. I use thorium reactors only as an example to show that Labor's nuclear policy is rapidly being overtaken by technological developments, and should be based on reality, not gut reactions and an ignorance of science.

One form of Nuclear Power does, or soon will, add up economically, environmentally and socially. We do have answers, or soon will, to the issues of nuclear proliferation and nuclear waste. And there are other forms of nuclear power coming over the horizon; Pebble Bed Reactors, Nuclear Fusion[7], and Cold Fusion is still being researched[8]. Shall we oppose them also?

Labor is the little man with the red flag walking ahead of the horseless carriage.

So, I propose that Labor's New Nuclear Policy should be:

"Labor will support any nuclear industry if

it is shown to be safe and economic."

The advantages of this new policy are:

1 It gives our elected representatives the flexibility to support new technologies that are proven to be safe and economic, and to oppose those technologies that are not.

2 It will encourage our universities to offer appropriate training in nuclear physics.

3 It will encourage our bright young people to become qualified in nuclear physics and to remain in Australia once qualified.

4 It holds the promise of helping to solve our energy problems.

5 It holds the promise of helping to solve Global Warming.

6 It opens up opportunities for Australian industry and workers.

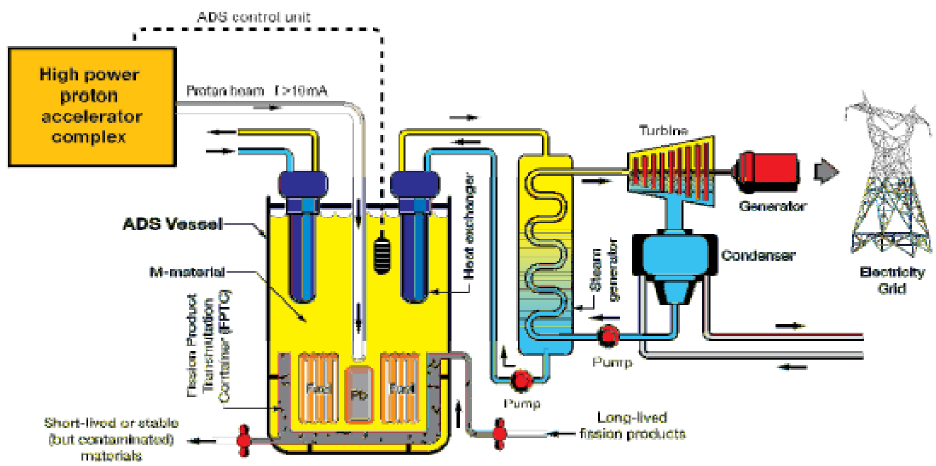
Ken McLeod 11 June 2007

MORE INFORIMATION:

Thorium is found in small amounts in most rocks and soils where it is about three times more abundant than uranium and is about as common as lead. Soil commonly contains an average of around 6 parts per million (ppm) of thorium.

Thorium occurs in several minerals, the most common being the rare earth-thorium-phosphate mineral, monazite, which contains up to about 12% thorium oxide, but averages 6-7%. There are substantial deposits in several countries (see table). Thorium-232 decays very slowly (its half-life is 1.405×10^{10} years, about three times the age of the earth) but other thorium isotopes occur in its and in uranium's decay chains. Most of these are short-lived and hence much more radioactive than Th-232, though on a mass basis they are negligible.

Pure thorium is a silvery white metal that retains its lustre for several months. Common consumer applications of thorium are in gaslight mantles, alloying with magnesium, coating tungsten wires used in electronic equipment, gas tungsten arc welding electrodes, and in heat-resistant ceramics**.**



An Accelerator Driven System equipped with a long-lived fission product transmutation (incineration) facility. A high power proton accelerator is coupled to the subcritical assembly producing spallation neutrons in the lead target which sustain the chain reaction in the core. The fuel rods are made of mixed oxides of thorium and U-233 (or plutonium and minor actinides from the nuclear waste of the conventional reactors). M-material in the diagram referrers to the environment that acts as neutron and heat storage medium as well as neutron moderator.

From "Accelerator Driven Sub-critical Nuclear Reactors for Safe Energy Production and Nuclear Waste Inceration" S R Hashemi-Nezhad, Australian Physics Vol 43 No 3 (2006) 90-96

SEE ALSO:

COSMOS MAGAZINE, APRIL 2006. “New age nuclear”

See Also: University of Sydney – News
http://www.usyd.edu.au/news/84.html?newsstoryid=1095

See Also: several reports on the ABC; Radio National, World Today, Quantum, and Lateline.

http://www.abc.net.au/melbourne/stories/s1616020.htm

http://www.abc.net.au/worldtoday/content/2006/s1657467.htm

http://www.abc.net.au/quantum/scripts98/9820/thoriumscpt.htm

http://www.abc.net.au/lateline/content/2006/s1616273.htm

REFERENCES AND ENDNOTES:

[1] The *Locomotives Act 1865* was introduced by the British parliament as one of a series of measures to seriously control the use of mechanically propelled vehicles on British public highways during the latter part of the 19th century. Some feel that the laws were put in place to suppress motor car development in the United Kingdom because of the financial interests that government and other establishment personalities had in the railway industry. The Locomotive Act 1865 (Red Flag Act):

- Set speed limits of 4 mph (6 km/h) in the country and 2 mph (3 km/h) in towns.
- Stipulated that self-propelled vehicles shoud be accompanied by a crew of three: the driver, a stoker and a man with a red flag walking 60 yards (55 meters) ahead of each vehicle. The man with a red flag or lantern enforced a walking pace, and warned horse riders and horse drawn traffic of the approach of a self propelled machine.

[2] See the two aircraft below, and their resemblance. The biplane is the Hawker Fury, in the mid 1930s Britain’s front-line fighter. When the requirement for biplanes was lifted, it was developed into the Hawker Hurricane, the monoplane on the right.


[3] Thalidomide is indicated as maintenance therapy for prevention and suppression of cutaneous manifestations of erythema nodosum leprossum (ENL) recurrence. Treatment of multiple myeloma after failure of standard therapies. http://www.tga.gov.au/docs/html/adec/adec0229.htm

[4] Radium-226, found in spent nuclear fuel and the sludge left over from uranium mining, has a half-life of 1600 years. Research by Professor Claus Rolfs shows that by encasing it in a metal and chilling it to about 4 kelvin, it might be possible to reduce its half-life to less than two years. See Institute of Physics "Physics Web" 31 July 2006 "A cool solution to waste disposal" http://physicsweb.org/articles/news/10/7/13 and New Scientist 21 October 2006 "Half-life heresy: Accelerating radioactive decay." Rolfs is now working on more tests with physicists at CERN.

[5]

World thorium resources
(economically extractable):

Country	Reserves (tonnes)
Australia	300 000
India	290 000
Norway	170 000
USA	160 000
Canada	100 000
South Africa	35 000
Brazil	16 000
Other countries	95 000
World total	1 200 000

source: US Geological Survey, Mineral Commodity Summaries, January 1999

[6] European Organization for Nuclear Research, CERN/LHC/96-01 (EET) "A Preliminary Estimate of the Economic Impact of the Energy Amplifier" Fernandez, Mandrillon, Rubbia, Rubio.

[7] However, the nuclear industry jokes that "Fusion Power is 40 years away - and always will be."

[8] Cold Fusion Times: http://www.std.com/~mica/cft.html and NewScientist 5 May 2007 "Cold fusion - hot news again? 05 May 2007 Bennett Daviss Magazine issue 2602