MEDIA RELEASE

Scientist Ben Selinger takes on Jabiluka information role

Uranium mining company Energy Resources of Australia Ltd has appointed scientist Ben Selinger of the Australian National University as Issue Advocate for the Jabiluka uranium mine.

Emeritus Professor Selinger's mandate is to provide public information on uranium mining that is factual, fair and honest and to encourage rational debate and discussion on the issue.

Prof Selinger, also a highly regarded consumer advocate, said his appointment recognised the need for the public to be provided with truthful, dispassionate and clear explanation of scientific matters relating to Jabiluka and to uranium mining generally.

"My mission is not about resolution but about offering explanation, interpretation and understanding – elements often clouded in the debate so far," Prof Selinger said.

"In Australia, uranium mining is a highly controversial issue. Research shows it has split our population down the middle.

"And when the issue is coupled with concerns about the impact on Kakadu National Park, the argument can become even more complex, contentious and emotional.

"I believe there needs to be a more informed public debate about the merits, or otherwise, of uranium mining.

"It is an important industry for Australia, it generally gets a bad press and we really ought to rationally test whether this is deserved.

"It is my view that the Jabiluka mine is an ecologically sustainable development and that it can coexist with a national park," Prof Selinger said.

Professor Selinger will undertake his role as Issue Advocate by meeting with Parliamentarians, conservationists, fellow scientists and journalists.

He will also seek to engender public discussion on the issue through the mass media.

- 4 June 1999

Contact: Martine Haley, Jackson Wells Communications 02 990 44 333 or 0414 44 99 37

The Selinger Terms of Reference

1) The company (Energy Resources of Australia) is funding the position of Issue Advocate for a period of three months in the first instance.
2) The Issue Advocate position is neither in the employ of ERA nor accountable to the company for anything other than the conduct of these terms of reference.
3) The Issue Advocate may vary these terms of reference in consultation with the company.
4) The position of Issue Advocate is to be occupied by a scientist in a relevant field of expertise with experience in the resolution of divisive social, political and environmental matters.
5) The position is established to provide the public with objective, dispassionate and clear explanation and interpretation of scientific matters relevant specifically to the Jabiluka issue and to uranium mining in general.
6) The position is also established to counsel the company on public opinion and understanding as it relates to these matters.
7) The position should be seen as an expert bridge between the company and the public, and the public and the company, with a mandate to encourage public information, debate and discussion which is rational, factually based, fair and honest.
8) The Issue Advocate has ERA's full approval to speak on scientific matters relevant to Jabiluka, and to uranium mining in general. However, this appointee is not expected to be qualified in, nor does s/he have approval to speak on, aspects of Aboriginal Affairs as they relate to the Company's operations.
9) The Issue Advocate shall report formally to ERA each month in relation to the position and its activities. This and all other material received or issued by the Issue Advocate shall be available to the public.
10) The Issue Advocate is authorised by the company to speak freely to the media, to organise and convene public and other meetings, to issue written statements and other documentation and to undertake any other activities compatible with these terms of reference.
11) It is emphasised that this mission is not about resolution but about offering explanation, interpretation and understanding.
12) Professional and administrative assistance will be afforded the Issue Advocate to enable these terms of reference to be executed appropriately.
13) At the end of the initial three month period, the Issue Advocate may be asked (a) to continue for a further specified period, (b) to write a report with recommendations to ERA, (c) both.

Professor Emeritus Ben Selinger FTSE FRACI

Academic Qualifications

- BSc (Hons) in surface chemistry - University of Sydney
- MSc in electron spin resonance spectroscopy - University of Sydney
- PhD - the excimer fluorescence of naphthalene derivatives in surfactant micelles - Technical University of Stuttgart, Germany
- DSc - Australian National University

Academic Distinctions

- Member of the Royal Institution of Great Britain
- Fellow of the Australian Academy of Technological Sciences and Engineering
- Fellow of Australian Academy of Forensic Sciences
- Fellow of the Royal Australian Chemical Institute
- Alexander von Humboldt Fellow

Community Involvement

- Chair, Homebush Bay Environmental Reference Group (Olympic Coordination Authority)
- Member, ACT Environment Advisory Committee
- Foundation Chair, National Registration Authority for Agricultural and Veterinary Chemicals (1991-94)
- Chair, Scheduled Wastes Working Group (1992-93)
- Chair, ANZECC Independent Panel on Intractable Waste (1991-92)
- First consumer representative on Food Standards Committee of NHMRC (1973-4)
- Chair and member, Standards Australia committee on chemicals, plastics, household soaps and detergents, sunscreens, sunglasses and paints
- ACT Commissioner, National Occupational Health and Safety Commission (now Worksafe Australia)
- Former Council member of the Australian Consumers Association
- Consultant for ANZECC on disposal of chlorinated wastes

Publications

- Author of *Chemistry in the Marketplace* (Harcourt Brace, 5th ed, 1998), and *Thinking with Fourier: MacFourier* (Oxford University Press, 1991)
- Extensive publications in chemistry (over 150 papers)
- Challenged the dominant legal opinion on forensic evidence in such major cases as Chamberlain (dingo) Case, and Vietnam Veterans (Agent Orange) Inquiry

TOWARDS AN INFORMED PUBLIC DEBATE ON URANIUM

Ben Selinger

"And the fish are safer from uranium than from aluminium or fire ash..."

INTRODUCTION

When asked to perform the duties of issue advocate for the scientific aspects of uranium mining at Jabiluka even I – battle hardened after years of controversy involving science and politics and a believer in taking these issues squarely into the realm of public discourse – was taken aback.

After all, uranium mining is an issue that deeply divides Australians. It polarises us into camps of almost equal size. Except for the notion of mining adjacent to a national park, which we oppose 3 to 1.

Uranium is part of many cycles, not only bombs and nuclear waste but also applications ranging from medical and metallurgical, home safety and bore water probes. Thus the *mining* of uranium deserves to be judged on its own merits and quality of operations.

Science has an important contribution to make to a debate on uranium mining at Jabiluka and, indeed, elsewhere in Australia. My issue advocacy articulates the notion that "scientists are wanted on tap but not on top"[1].

It is unfair and counterproductive to come to the science with a closed mind and a preconceived ideological position.

The mining of uranium at Jabiluka needs to be treated on its own merits in terms of what science has to offer. It needs to be judged against the evidence not driven by prejudice or perception. When so evaluated, it becomes no demon but merely another human intervention in nature that needs to be managed, that can be managed and that is being managed.

Let me take you on a journey to show you how.

Upon considering this advocacy, I would be happy for the reader to at least conclude: "I accept that the science is fine, but..."

After all, the political journey is through a very different landscape.

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[1] Attributed to Winston Churchill during World War 2, reference unknown.

OVERVIEW

Nothing in life is certain except death, taxes and public disputation ... about death, taxes and the rest.

In the final analysis we all must have a residual confidence in the people who run various aspects of our lives. We cannot be totally risk averse. So, while rightly suspicious of a "trust me" approach, at the same time we have to take a lot on trust.

One way of testing trust is experiential – we take our first plane trip and don't crash or we go swimming in the surf and don't see a shark and eventually figure the odds are with us.

A more sophisticated test is to take information from one party and ask for comment from another. Or, even better, to have the matter debated before us.

Which brings me to the topic at hand. The scope and quality of scientific research related to the Ranger uranium mine in Australia's Northern Territory over a 20 year period of focussed activity reveals that all likely, and many unlikely, aspects have been investigated and the results published and internationally peer reviewed by a wide range of experts.

There can be no reasonable doubt as to the high integrity of this research.

Uranium mining is almost unique in having a regulatory authority with its own scientists and research program which (unlike food and pesticide regulators) does not rely only on information supplied by the industry to be regulated[2]. The mine is open for inspection. Tourist operators have a visit to the tailings pit on their calling card.

Over the years, ERA has always responded positively to criticism of the mine's operations. Such criticism has always been addressed and conditions modified as a result. This has been the case even when criticism was unreasonable or related to unlikely scenarios.

One might conclude that reasonableness sometimes leads to excess. Far from resulting in mutually beneficial outcomes, as proponents and opponents move closer together, responsiveness leads to further claims and demands.

This has certainly been the case at Ranger. The goalposts, once moved, creating unreasonable expectations that they will be moved again no matter how spurious the critique, no matter how extravagant the demand.

A healthy and generally agreed approach to the problem of shifting environmental goal posts is The Precautionary Principle.

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[2] I was foundation chair of the National Registration Authority for agricultural and veterinary chemicals 1991-1994. It was always a frustration that regulation operated only on paper input without resources to do one's own in-house experimental research.

THE PRECAUTIONARY PRINCIPLE

The Precautionary Principle states that:

The level of certainty required in a situation is directly related to the lack of information available on its consequences as well as on the severity of those consequences, should they eventuate.

- Exhaustive investigations and reviews over nearly three decades have generated extensive information about the Alligator Rivers region where Jabiluka is located.
- The Government's current inquiry into the Jabiluka project is the ninth major investigation since the discovery of uranium in the region in 1971.
- Twenty years of mining and milling in the region have provided information on actual impact.
- For most of that 20-year period the Supervising Scientist has undertaken a multi-disciplinary environmental research program in the Alligator Rivers Region looking for possible environmental impacts. The scope and depth of the information collected is probably unparalleled anywhere in the world. The Supervising Scientist was set up by Whitlam and maintained by Fraser and consequent governments to provide public confidence in the mining enterprise at Kakadu.
- In 1977 the Fox inquiry concluded "the hazards of mining and milling uranium, if those activities are properly regulated and controlled, are not such as to justify a decision not to develop Australian uranium mines".
- The accumulated knowledge and information from the past twenty years has only served to validate this conclusion.
- If anything 'the hazards of mining and milling uranium' have been diminished by experience and the development of better technology.
- A vast array of tests, analyses, reports and inquiries have contributed to a wealth of published knowledge, which has the potential to ensure Jabiluka is one of the world's most advanced mines in terms of safety, environmental integrity and rehabilitation potential.

The Precautionary Principle applied to this rich body of knowledge suggests that we may evaluate the impact of uranium mining at Ranger, and its prospects at Jabiluka, with considerable certainty.

MINING & THE URANIUM DEBATE

Uranium mining involves digging ore out of the ground and concentrating it to pure uranium oxide which contains 0.7% of the fissile U-235.

It takes 100 grams of typical uranium ore to reach the activity of a single domestic smoke detector. On concentration to uranium oxide the level rises the level to about 300 smoke detectors.

The Ranger material is transported to Darwin in containers and shipped overseas where it is enriched from 0.7% to about 4% for power stations.

By contrast, weapons grade uranium is 99% enriched and very expensive to produce. The depleted uranium left behind (uranium 238) is very low in radioactivity and is used as ballast in aeroplane wings and yacht keels as well as for tank armour and artillery shell tips.

Matters relating to the nuclear fuel cycle and the desirability or otherwise of nuclear energy as a component in supplies for a world increasingly concerned by greenhouse emissions from the continued large scale burning of high carbon fossil fuels are not part of this brief.

Such matters are very important – but they are separate matters requiring separate consideration and separate debate.

The nuclear energy industry is now 50 years old. Reactor waste has to be stored under water at the reactor for about 50 years until it has cooled sufficiently for transfer to long-term storage. This issue is pressing and the lack of a solution may end the future of nuclear energy. Russia is currently 'cutting' weapons grade 99% uranium with about twenty times the 0.7% refined oxide to give 4% energy grade and selling that into the energy market. This very desirable and commendable action has meant regulating the market for uranium.

The most important radioactive waste elements from a nuclear power station remaining after the first 50 years are caesium-137 and strontium-90 (beta and gamma emitters) with half-lives of about 30 years. Containment is required for at least 600 years. After that, the dominant elements are plutonium, americium, curium and neptunium (alpha emitters). After one million years these decay to around the level of the ore from which uranium was mined. Around 100,000 years is the accepted required storage time.

CONCERNS & COUNTER CONCERNS

The UNESCO mission[3] that investigated Jabiluka and its proximity to Kakadu National Park raised some scientific concerns that are canvassed here.

A degree of uncertainty about the quality of the hydrological modelling carried out in designing the water management plan for the mine site

The crux of criticism of the quality of hydrology modelling comes from the report of Wasson *et al*[4] which asserts that the distribution of annual rainfall is skewed (page 17) and draws conclusions about the estimation of the 1:10,000 annual rainfall.

A computer model is only as good as its assumptions and in this case the assumption seems flawed in theory:

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[3] Report to 22nd session of UNESCO World Heritage Committee, Kyoto Japan, 30 November – 5 December 1998.

[4] "Submission to the World Heritage Committee by some Australian Scientists (Wasson, White. Mackey & Flemming), approx June 22 1998, p 17. [As reproduced in "Assessment of the Jabiluka Project", Report of the Supervising Scientist to the World heritage Committee, Environment Australia , April 9 1999.

"Annual rainfall is a sum of random variables and even though they are not independent they are often only weakly dependent. Therefore the central limit theorem will come into play and imply that the distribution of total rainfall is approximately normal - in particular will have small skewness"[5].

It seems flawed in practice:

"However, when the Oenpelli annual rainfall record is tested for normality (RHU), the tests proved that these annual rainfall totals are close to a normal distribution; the coefficient of skewness is small"[6]

Skewing can make highly unlikely events more likely.

The possible impacts on catchment ecosystems

The most radioactive component that could enter the environment is the tailings. The radium concentration in the solid tailings at Ranger is about 40,000 Bq/kg.

This should be compared to the natural concentration of radium in the particulate matter carried by Magela Creek past Ranger of about 200 Bq/kg. So the enhancement of radium in the tailings is about 200:1.

The efficiency of uranium extraction in the Ranger mill is about 95% so uranium concentration in the solid tailings is about 2000 Bq/kg. On the floodplain the concentration of uranium is fairly constant over the plain area at about 50Bq/kg. So the enhancement of uranium in the tailings is about 40:1.

As observed previously, the tailings dam at Ranger is on the tourist track for interested parties to come and visit.

Water management at the mine

There will be no release of dirty water from the Jabiluka mine site.

- **Process Water.** Water from ore milling activity that ends up in tailings is never released but allowed to evaporate.
- **Restricted Release Water.** Water that was or could have been in contact with the ore stockpile or the mill but was not used in extraction of ore is also retained. (At Ranger application was made to release some of this water under close supervision and at the required level of dilution at the height of one wet season but as there was significant community concern the release was not carried out). At Jabiluka there will be a total containment zone from which water will not be released. This will hold the water that will run off the small stockpiles of ore and mineralised waste that will be maintained at the site prior to shipment of ore to Ranger for milling. Mineralised waste will be returned underground as backfill.
- **Run-off.** Water that has been in contact only with waste rock (containing less than 0.02% uranium oxide) is continuously monitored and allowed to flow out. All releases are checked beforehand and water quality is monitored chemically and biologically up and downstream of the mine.

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[5] Generally recognised by all the professional statisticians.

[6] Section 2.3 in the review carried out by a panel of four scientists established through the International Council for Science (ICSU) at the request of the World Heritage Committee of UNESCO to review the scientific issues associated with the proposed mining at Jabiluka [undertaken 22 April and 13 May 1999]

Worst case scenario

If the tailings from Ranger were to escape into the Magela floodplains they would be diluted in the 600 km^2 of water and radiation levels would rapidly become indistinguishable from natural background levels caused by natural erosion. Such an occurrence has never happened during mining at Ranger and can't happen in the preferred option for Jabiluka. The danger is not from radioactivity but *temporary* toxicity to marine life (until rapid dilution) from the heavy metal uranium (which, like lead and mercury, is poisonous).

The natural release of aluminium at the beginning of the wet season is very toxic to fish[7]. This also is relieved by dilution from more rain.

View of the supervising scientist

The Report of the Supervising Scientist, prepared with assistance from experts at the CSIRO, the University of Melbourne, the University of NSW and the Bureau of Meteorology concluded:

"Contrary to the views expressed by the (UNESCO) Mission the natural values of Kakadu National Park are not threatened by the development of the Jabiluka uranium mine and the degree of scientific certainty that applies to this assessment is very high. There would appear, therefore, to be no justification for a decision by the World Heritage Committee that the natural World Heritage values of Kakadu National Park are in danger as a result of the proposal to mine uranium at Jabiluka."

Peter Wellings was manager of Kakadu National Park for 18 years and has now joined the Supervising Scientist at ERISS. There has always been a symbiotic relationship between the Park and the Mine.

CAN MINING & HERITAGE COEXIST?

The proposal to mine uranium at Jabiluka needs to be considered in the context of broader economic and environmental issues – and especially in terms of what constitutes ecologically sustainable development.

There are some persuasive positive reasons underpinning uranium mining at Jabiluka:

- Nuclear energy accounts for 17 percent of global electricity generation and for the foreseeable future will be a significant contributor to the global solution to greenhouse gas emission.
- Jabiluka's significant economic benefits to Australia include earnings of an estimated $4,000 million in export income.

If Australia is to remain a major exporter of minerals and at the same time be the custodian of some of the world's best national parks (protecting biodiversity and indigenous heritage) then both activities will need to coexist. The same is true for agriculture[8].

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[7] see 5,600 dead fish in Ja Ja billabong, 1979 discussed later "The Park Pre-heritage", page 9

[8] "Sustaining Australia's Land: A Time for Action" Michael Archer (Director Australian Museum) Australasian Science, May 199, p 19-20

ERA believes that coexistence or dualism can work and has developed a long list of reasons in support. I reproduce them because, on balance, I find them to be convincing.

- All mining at Jabiluka will be by underground operations. The underground void will be progressively backfilled with very low-grade uneconomic ore from the Ranger mine. The mine is out of sight of tourist roads and wetlands and occupies a tiny 'footprint' in an enormous Park. Jabiru township (now needed for tourism as well as mining) is much larger.
- The environmental performance of the existing Ranger operation (a 400 hectare mine site versus 19 hectare mine site for Jabiluka) has shown that mining development can coexist with adjacent areas of World Heritage significance without adverse environmental impacts.
- Management strategies for Jabiluka will be compatible with management intent of the park.
- There will be no release of dirty water from Jabiluka. This will dramatically reduce the possibility of adverse impacts on delicate downstream ecosystems.
- No significant risks will be associated with the haulage of ore from Jabiluka to Ranger (under ERA's preferred option). Shipments of the product from Ranger to Darwin will continue under existing proven arrangements.
- All stormwater run-off within the "Total Containment Zone" which surrounds key facilities at the proposed site will be contained by a 8.5-hectare retention pond. Water contained within the site will then be disposed of through evaporation and recycling.
- The retention pond is designed to withstand a one in 10,000-year rainfall event. It has been lined with a double layer synthetic membrane that prevents seepage to groundwater.
- Under ERA's preferred option the milling and processing of Jabiluka ore will take place at the existing Ranger facility. The company has determined that there would never be a tailings dam at Jabiluka but that either all tailings would be returned underground, or excess tailings that could not be stored underground would be deposited in purpose-built pits to below sea level[9].
- Jabiluka ore will be transported to Ranger along a dedicated 22.5 km haul road. Tailings from the Jabiluka ore, when combined with the Ranger ore, will be deposited in the mined out Ranger # 1 and # 3 open-cut pits and capped with clean waste rock.
- Special erosion control measures have been introduced at the mine site and will be constructed along the haul road to Ranger to prevent soil being washed into natural water courses and causing turbidity in local streams.
- Water quality at Jabiluka will be constantly measured to immediately detect any adverse effects downstream and to introduce measures to fix any problems.
- Once operations at Jabiluka are completed, the mine site will be rehabilitated. In time, evidence of any mining will not be very obvious.

ERA's preferred option to mill and process at Ranger is currently not supported by the traditional landowners.

[9] Jabiluka PER. Milnes, A R, Hall, J W, Jackson, A & Shirvington, P J (1998) Jabiluka Mill Alternative: synopsis of key issues and processes. *ERA Limited, August 1998.* 16pp.

The company has received the prerequisite approvals to build a stand-alone facility at Jabiluka. This advocate strongly recommends, on the grounds of common sense, that negotiations continue to ensure that it is the preferred option that is implemented.

KAKADU PRE-HERITAGE

Prior to the environmental rehabilitation undertaken with the simultaneous establishment of the Ranger mine and Kakadu, 100,000 non-native buffalo weighing on average over one tonne each thundered through the park[10]. Feral pigs and horses also called Kakadu home.

Input from ERA has assisted Kakadu rid itself of many of its unwelcome visitors and also financed attempts at eradication of exotics such as the mimosa that clogs floodplains and the salvinia that chokes waterways. The advancing cane toad threatens many native species - in particular quolls (native cats), goannas and dingos. Protecting against the toads will require funds not forthcoming for threats in other areas such as Queensland.

Kakadu National Park is reported to have the highest thunderstorm activity of any place on the planet. The Park experiences no less than six extreme seasons annually and the weather stretches from flood (945 to 2223 mm per year[11]) to drought – every year. The park is also subject to earth tremors[12]. From a geomorphic perspective it is likely that many of the massive rockfalls along the escarpment, particularly those that have sheltered Aboriginals and thus been cultural sites, have been triggered by seismic activity in the past. AGSO is now commissioned to place sensitive vibration monitors and re-appraise seismic activity in the light of criticism about the intensity of blasting.

Water rushes over the landscape and early in the season it is quite acid (possibly from dissolved aluminium) with a pH of 4.5 - 5.0. This natural acid rain accounts for fish kills in the billabongs[13]. Later in the season the pH rises to a more normal value of pH equal to 6.

[10] Peter Wellings, ex Manger of the Park for 18 years, personal communication, 13.05.1999
[11] Metrological statistics 1971 to 1998. The best estimate for a one in 10,000-year event is 2460 mm ± 190 mm.

[12] ABC documentary 'Kakadu', in the series 'Gardens of Eden', May 1999

[13] Dr Tony Milne, Ranger mine manager, personal communication, 12.05.99

Ja Ja billabong was a source of drinking water for the prospectors working for Pancontinental. At the end of the 1979 dry and beginning of the wet season the first couple of showers washed white encrustations of (probable) aluminium salts (formed during the dry on the billabong bank like rising damp) into the billabong[14].. *Around 1,500 barramundi and 4,000 catfish quickly died.* The pH was measured at 3.5 (level of Coca Cola). Disposal of this natural disaster biomass was not a pleasant task.

In addition to input of acidic waters, the vast majority of fish kills in isolated billabongs are due to de-oxygenation of the waters by flushing into them, the ash from natural or management fires. These chemical alterations simply suffocate the fish. There may be a very minor component caused by input of toxins from decaying vegetation, especially that from fruits of pandanus[15].

Flooding acidic water also takes with it uranium ore naturally exposed at the surface.

For example about 170 kg of uranium is washed from natural sources into the Magela floodplains (600 km2) every year[16] and eventually out to sea. The natural uranium loading in the sediments of these waters is 1 to 4 mg/kg and these flood plains are closely monitored because they are downstream of Ranger Mine. On the other hand, the enormous volume of this catchment provides a high dilution factor.

The orebodies were formed in the first instance by precipitation of metals from acidic fluids emanating from deep-seated fault structures during a continent-scale mountain-forming event at around 1850 million years ago (the Barramundi Orogeny). Metals were deposited in fault structures by changes in pressures and temperatures. While the main metal precipitated was uranium, other metals deposited include copper, gold, and platinum-group elements. Subsequent earth movements over the next 1400 million years concentrated these metals to form discrete deposits throughout the Top End[17]. Similar events also produced other deposits of zinc, nickel, tin and copper and gold (without associated uranium), many of which have been mined. The uranium-rich bodies may be detected using gamma detectors in aircraft flying at around 50m altitude or less, but only if the uranium is not covered by barren soil or water.

RADIATION

Radiation in the background

Around 140g of potassium in our bodies has 16mg of a natural radioactive isotope that contributes the major part (0.2 mSv/yr) of our internal exposure to radiation.

Naturally occurring background levels of radiation typically range from 1.0 to 3.5 millisieverts (mSv) a year.

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[14] Mark Sonter, consultant Radiation adviser to ERA and former adviser to Pancontinental, pers. comm., 31.05.99

[15] Andrew Browne, Consulting Geologist ERA, pers comm 01.06.99

[16] Dr David Jones, ERA ES, personal communication, 11.05.99

[17] Andrew Browne, Consulting Geologist ERA, pers comm 01.06.99

In Australia the normal background is 2 mSv but there are populated places overseas (including Europe and the USA) where levels are much higher, often in the 30 - 50 mSv range. 50 mSv is the lowest threshold at which conservative estimates suggests cancer could be caused.

Jabiluka is set in an area of normal natural background radiation, with some spots where concentrations are naturally higher, for example in the nearby billabongs.

Granites, such as used in monuments and city buildings are rich in uranium, thorium and potassium and show mild radioactivity (around 1μSv/hr). A rudimentary comparison of activity can be made by reading the counts per minute (cpm) close to the surface[18].

Thus buildings in Collins Street Melbourne fall into groups showing surface readings of around 50 and around 100 counts per minute (cpm) compared to Ranger tailings where six readings on two samples gave 640 - 890 cpm).

Radiation in consumer products

The core of a domestic smoke detector is actually a tiny piece of synthetic radioactive element – americium 241. It has an activity of 30,000 Bq (atomic decays per second), about the same as 100g of Jabiluka uranium ore. It was made in a nuclear reactor from plutonium that was, in turn, made in a nuclear reactor from uranium. The radiation ionises the surrounding air and allows it to conduct electricity, sounding an alarm when smoke interferes with this process.

The smoke detector is a microcosm of the nuclear debate. It is clear that the safety benefits offered by the smoke detector far outweigh any risk to health. Smoke detectors are perfectly safe, while the americium 241 is fully enclosed within its own unit on the ceiling. It's what happens after the smoke detector has outlived its useful life (about 10 years) which really counts. With a half-life of 430 years, the unit must – as required on the label – be returned, then recycled or stored out of harm's way for a few thousand years.

The humble smoke detector is not a lone case. Recently, some 8,000 older-style ZE 22/3 electricity meters were recalled to be replaced with a more efficient model. The meters all contain a hot water control relay which used radium or tritium as an ionising aid. Again - perfectly safe in place, but requiring careful disposal. Wrongful disposal of these meters recently set off a Geiger counter at a Queensland tip.

They are much more careful at Ranger.

The exposure of miners to radiation

The Jabiluka EIS found that even for the most exposed workers (underground development crews and supervisors) radiation doses would be less than 60% of internationally recognised standards. With appropriate equipment, the annual dose for these workers will be about 12 mSv a year, compared with the international recommended level of 20 mSv a year (5 year average).

[18] Ian Hore-Lacy, General Manager, Uranium Information Centre, Melbourne

Staff will be multi-skilled to ensure they are not assigned to single high exposure activities such as production drilling for long periods. This will allow ERA to further reduce yearly radiation exposure.

Overall average exposure of uranium miners to radiation is about 4 mSv per year and is decreasing.

The work related exposure of international flight attendants is currently estimated by the UN to have reached 3 mSv per year[19] and is rising. At Mt Isa many years ago, a gamma reading was taken on the airstrip (0.5 μSv/h) and then again at cruising altitude of 30,000 feet (6 μSv/hr). At say 1000 hrs flying at cruise altitude per year, the extra exposure of the flight crew works out to 5.5[20] mSv/yr.
Well might you ask during your next on board safety demonstration why the hostess is not wearing a radiation monitor as is legally required in all other occupations with similar exposure levels. Without sheaves of lead to stop the cosmic rays, or flying at sea level, longer, higher and polar flights will see even more exposure.

For comparison the effective radiation dose equivalents for X-ray medical examinations[21] for gastro-intestinal tract examinations, angiography and CAT scans range from 4-7 mSv per examination. Some of these go much higher, depending on length of exposure, setting on the equipment, skill of surgeon and/or radiographer.

Exposure of the public to Jabiluka radiation

Radiation levels from the mine will be well below international guideline levels and there will be no health risk to the general public.

Australian radiation protection legislation specifies that the public must not be exposed to additional radiation, above background radiation, of more than an average 1 mSv a year. Analysis of the Jabiluka proposal shows the potential exposure levels for the public will be 0.1-0.5 mSv a year. This is 50% less than the recognised standards.

MINING PROCESS

The mining process itself (and subsequent rehabilitation) determines the impact a mine has on the environment.

Being an underground mine Jabiluka will have a significantly reduced impact compared to Ranger.

ERA's preferred option is to mill and process Jabiluka ore at Ranger and offers the best environmental outcome for the project.

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[19] Sources and Effects of Ionising Radiation', UN Scientific Committee on the Effects of Atomic radiation UNSCEAR 1993 Report, 1993, p 38

[20] Mark Souter, consultant Radiation adviser to ERA and former adviser to Pan Continental, pers. comm., 31.05.99

[21] Sources and Effects of Ionising Radiation', UN Scientific Committee on the Effects of Atomic radiation UNSCEAR 1993 Report, 1993, p 231

Tailings

Maximum ore stockpile volumes at the site will be 20,000 tonnes of ore and 150,000 tonnes of waste rock. No permanent dumps of mineralised waste will be established at the mine site as all mine waste recovered during the underground operations will be returned underground as backfill.

Both #1 and #3 pits at Ranger have ample capacity to contain all the tailings generated from Ranger and Jabiluka ore.

Trucks leaving both the Ranger and Jabiluka sites will pass through a wash down facility. Radiation levels in and around the site will be constantly monitored by state-of-the-art detection equipment.

Air

Radioactive elements and their compounds are solids and thus easy to control, except radon. Radon is a very heavy gas and has a radioactive half-life of a few days, decaying to a radioactive solid[22] Radon comes from radium which, in turn, comes from uranium and thorium. So radon emission is found wherever there is uranium ore or thorium. Thorium is very common in granites (used in buildings) and in monazite (dark) beach sands that are often mined for minerals[23]. The incandescent mantle in gas fired incandescent camping lanterns (from India) are still made from thorium oxide. Others are labelled non-radioactive and use rare earth metal oxides in the mantles.

Radon is a problem when it accumulates; such as in well insulated cellars (in granite areas) or poorly ventilated mines. Australians' exposure to radon is very low (little granite) and our exposure to gamma is also low because our soils are leached of minerals and few of our population lives at high altitude. On several occasions waste sand from sand mining operations was used under houses and in schools. This had to be removed.

Overall, Australians have one of the lowest exposures to radiation in the world.

Radon monitoring goes on continuously around areas once mined, currently mined and in the undisturbed environment.

The Jabiluka mine has been designed to ensure the radiation exposure of mine workers is maintained at low levels by using a once-through ventilation system with about double the normal airflow for underground mines.

The design includes high airflow velocities, single pass use of fresh air in the ore body, positive exhaust on the stopes and ore passes and a flexible development and exhaust layout for stope ventilation.

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[22] ignoring synthetic radio-krypton(half life ten years)

[23] http://www.uic.com.au/uip25.htm

SITE REHABILITATION

Ranger pond / Kakadu wetlands

The photograph illustrating the natural beauty of Kakadu wetlands is featured in a report prepared for the United Nations Commission on National Parks and Protected Areas[24].

A similar photograph (depicting the same scene) features for the month of December 1999 in the Australian Wilderness Society annual calendar[25]. Ironically the photograph in each case is of the Ranger mine Retention Pond #1 with the tailings dam just visible in the middle ground behind trees.

Nabarlek

Nabarlek in Arnhem Land is an example of a modern mine that has closed and been successfully rehabilitated[26]. Mined by Queensland Mines in a single campaign in the dry season of 1979[27], the ore was stockpiled and milled on site from 1979 -1989. Operations returned the tailings directly to the mined out pit (as is planned for Jabiluka). Decommissioning took place in 1994-95[28]. Rehabilitation was planned from the outset and adjusted to changing circumstances and technology. The pond was dredged and sediments placed in the pit. Both were filled and revegetated[29]. The area is still under constant monitoring and weed control will be maintained until no longer necessary[30].

Rehabilitation of Ranger is being planned along similar lines to Nabarlek. Contrasting aerial photographs of the current Ranger mine and one of the proposed final landforms is shown in a ERA publication[31].

Fraser Island

Fraser Island is the world's largest sand island with an area of 163 000 hectares. Between late 1975 and December 1976 D M Minerals mined approximately 150 hectares in the south-east. At the end of 1976 mining ceased when the Commonwealth prohibited exports as a consequence of the Fraser Island Environmental Inquiry.

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[24] IUCN/UICN Gland, Switzerland, 1994, page 44. "Evidence of Australia's former land connections with New Guinea and Asia is protected within Kakadu National Park. Its wetlands provide wintering habitat for Asiatic waders". Photo Jim Thorsell IUCN

[25] 1999 Australian Landscape Calendar, The Wilderness Society Inc, 130 Davey St Hobart, Tas 1988

[26] http://www.uic.com.au/nabarlek.htm

[27] 'The decommissioning and rehabilitation of the Nabarlek uranium mine, northern Australia' P.W. Waggitt, Supervising Scientist Group, Environment Australia, Environmental Issues and Management in Energy and Mineral production, Pasamehmetogiu & Ozgenoglu eds, 1998 Balkema, Rotterdam, ISBN5410 956 4, p431-435

[28] The Labor Government's maximum three uranium mine policy killed the expectation of further mining

[29] On site inspection 12.05.99. Although the plant species do not yet match the surrounding ones, acacias are beginning to be replaced by eucalypts. From the air, the difference in appearance of the very small patches involved is marginal.

[30] Nabarlek has a part-time population of one.

[31] 'Rehabilitation at Ranger', ERA Jan 1992, updated 1997, p 10

Today, the casual visitor would have difficulty in distinguishing mined from unmined sites and only experienced ecologists would note the revegetation tends to occur with a progression of plants that in the early stages at least does not match the surroundings.

A detailed study of the evolving ecological restoration has been reported[32]. As in Nabarlek acacias are the first trees to grow back and in time will be replaced by eucalypts.

The Olympic site

Australia is a leader in the area of mine rehabilitation technology. It has more recently been applied to the Southern Hemisphere's most polluted industrial site, Homebush Bay, Sydney[33].

Fifty years of unfettered industrial abuse required $137 million worth of remediation.

Techniques have been progressively improved since rehabilitation of the Bicentennial Park (1988), the Olympic site itself (1998) and now the Millennium parklands being prepared for 2000.

CONCLUSION

The scope and depth of the available scientific information on this project meets the *information* requirement for the Precautionary Principle. This information has been gathered over a long period of time by various organisations and people; it has been published, refereed and covers a broad spectrum of sciences.

The *consequences* requirement is met by the fact that the level of radioactivity involved in all aspects of the project is modest by the standards of normal background and other occupational and public exposures to radiation. Even with total lack of confidence in the science and technology there is reassurance that if the whole enterprise went kaput the resultant slightly elevated radiation levels would be minor and soon disperse into the background. A uranium mine is not a nuclear reactor. And the fish are safer from uranium than they are from aluminium or wood ash from fires!

In my view, the Precautionary Principle is well met and the proposed Jabiluka uranium mine will proceed to become a very successful example of ecologically sustainable development.

June 4, 1999

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[32] 'Ecosystem Restoration following mineral sand mining – legacies from Fraser Island, J. Davie (QUT), G. Bowman (CSIRO soils), G.Balderson (Pivot Mining), Australasian Industry Mining Council Environment Workshop 1991, Perth, October 1991. Proceedings. Vol 1. Dickson ACT:AMIC pp 76-98.

[33] I am currently Chair of the Homebush Bay Environmental Reference Group. Consultancy undertaken for the Australian Olympic Co-ordination Authority