## Terms:

The Bureau: Bureau of Resource Sciences.

The Code: Code of practice for the near-surface disposal of radioactive waste in Australia.

The Discussion Paper: A radioactive waste repository for Australia-Site Selection Study: Phase 3, Regional Assessment.

The Facility: a near-surface national waste repository for low and intermediate level radioactive wastes.

FoE, Fitzroy & We: Friends of the Earth, Fitzroy.

NH&MRC: the National Health and Medical Research Council.

The Process: the process of public consultation.

The Proposal: the proposal of a near-surface national waste repository for low and intermediate level radioactive wastes.

# Friends of the Earth, Fitzroy Policy

FoE, Fitzroy rejects the selection of Billa Kalina as the proposed region in which radioactive waste will be disposed. It repeats its call for radioactive waste of all types to be stored at above ground dry stores at the site of origin, and for waste minimisation practices to be introduced as an integral part of the industrial process of isotope production.

## Public concern versus “international guidelines”.

Friends of the Earth, Fitzroy notes the impressive durability of the Bureau’s proposal for near-surface radiological disposal. The proposal has weathered two phases of public consultation and a Senate Select Committee inquiry, which include thorough technical critiques, questioning of political motivations, questioning of underlying assumptions which have been found expedient, clear references to examples of near-surface disposal failures, and other expressions of deep concern in relation to its soundness. The proposal has traversed the process of public evaluation and emerged into the third and final phase of Regional Assessment essentially without alteration, modification, adjustment or accommodation.

After a process of ‘public consultation’ spanning six years, environmental organisations and concerned citizens are once again presented with a glossy document which professes to commence yet more ‘consultation’. In this document we are faced once again with the hackneyed assumption that:

> Near-surface disposal, in properly sited, designed and operated facilities, in accordance with international guidelines, is recognised as an appropriate method of management for low-level and short-lived intermediate level radioactive wastes, and has been safely practised in a number of countries for over 30 years.[1]

FoE, Fitzroy submits that the attempt to dump radioactive waste in a remote location is not environmental best practice. It has nothing to do with the safety of the Australian public. It is a politically motivated move that runs counter to basic environmental and waste minimisation principles. It is a move which will free the creators of radioactive waste from the burden of responsible management of it, and thus encourage them to recklessly create more.

A culture of “out of sight, out of mind,” which includes an expediency favouring interests vested in nuclear technologies and materials, is seminal to each phase of the Bureaus’ proposal. It pervades the code promulgated by the NH&MRC, which is the cornerstone upon which the proposal is built. It is a

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[1] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp iii.

culture which derives its abundant ambiguity directly from the International Atomic Energy Agency (IAEA) and the International Committee for Radiological Protection (ICRP). And, like the above organisations, the NH&MRC is indistinguishable from interests vested in the nuclear industry.

Interests represented on the Radioactive Wastes Classification Panel, which developed the NH&MRC code, include: the Australian Radiation Laboratory; the Australian Nuclear Science and Technology Organisation; and the Health Department of Western Australia. Each of these organisations are active in the production of radioactive wastes, or the promotion of nuclear technology.

FoE, Fitzroy submits that the best interests of public safety are not represented by the NH&MRC code which the Bureau's discussion paper sites as guidelines. Further, FoE, Fitzroy notes that not one of the persons on the Panel was an elected representative of the Australian people. None of those listed belong to an organisation that has a voting membership. Public accountability is zero. It is one of the least representative bodies of its kind within Australia. Yet this body was charged with devising a code, largely borrowed from IAEA and ICRP guidelines, to map out the manner in which underground burial of radioactive wastes will be approved.

The IAEA is often sited as the

> international organisation responsible for, amongst other things, developing standards and guidelines to ensure safe management of radioactive waste.[2]

What the Bureau fails to mention is that included "amongst other things" the IAEA is charged with promoting the use of nuclear technology all over the world. FoE, Fitzroy submits that the IAEA is enmeshed in a conflict of interest. An organisation which aims to promote a technology can not rightly discharge its responsibilities towards the toxins which that industry generates. It is appropriate that an organisation independent of a promotional interest be employed to evaluate the proper means and circumstances of radioactive waste storage.

FoE, Fitzroy submits that IAEA guidelines do not enjoy international consensus, recognition or accord. As such, the NH&MRC code which claims direct descent from them, would not enjoy acceptance from the international community either, let alone the local one. Listed below are some of the environmental and community-based organisations and groups, from all over the world, which **do not** recognise IAEA guidelines, nor do they agree with near-surface burial, nor any other form of "disposal" as an appropriate method of radioactive waste management:

Abalone Alliance/Energy Net
Alliance Against Uranium

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[2] National Radioactive Waste Repository Site Selection Study Phase 1: A report on public comment. August 1993. pp 7.

Alliance for Survival
Anti-Castor Coalition, Germany
Atom Count Down, Germany
BAN Nuclear Waste Coalition
Bellona Foundation, Norway
Campaign for Nuclear Disarmament (UK)
Canadian Coalition for Nuclear Responsibility
Centre for Health, Environment & Justice
Citizen Alert
Citizen's for Alternatives to Radioactive Dumping
Citizen's Nuclear Information Centre, Japan
Committee for Nuclear Responsibility
Downwinders
Earth Island Institute
Ecologia
Ecodefense (Russia)
Environmental Action and Information Centre
FACTS: For a Clean Tonawanda Site
Four Winds
Free the Planet
Florida Coalition for Peace & Justice
FMKK: Swedish Anti-Nuclear Movement
For Mother Earth, International (Belgium)
Friends of the Earth, International
Global 2000
Global Anti-Nuclear Alliance
Government Accountability Project
Grandmother's for Peace
Great Canadian Nuclear Waste Saga
Green Korea
Greenpeace International Nuclear
Healing Global Wounds
Indigenous Environment Network
International Physicians for the Prevention of Nuclear War
Jabiluka Alliance
KFEM: Korean Federation of Environment Movements
Movement Against Uranium Mining
N-Base: Scottish Anti-Nuclear Group
National Environmental Coalition of Native Americans (US)
Nuclear Free Local Authorities (UK)
Nuclear Free Philippines Coalition
Nuclear Guardianship Project
Nuclear Information Resource Service (US)
Nuclear Issues Coalition
Nuclear Waste Citizen's Coalition
Oeko-Institut, Germany
People for Nuclear Disarmament
Permanent People's Committee on Chernobyl

Physicians for Global Survival
Plymouth Nuclear Dumping Information Group (UK)
Prairie Island Coalition
Proposition One (US)
Public Citizen's Critical Mass Energy Project (US)
Public Shelter
Redwood Alliance
Save Ward Valley
Scotland Against Nuclear Dumping
Sierra Blanca Legal Defence Fund
SHAD Alliance
Shundahai Network (US)
St. Joe Valley Greens
Three Mile Island Alert
20/20 Vision (US)
Union of Concerned Scientists
United States Nuclear Weapons Cost Study Project
World Information Service on Energy

This list is by no means comprehensive, however it clearly demonstrates that the views of the IAEA, and by default, the NH&MRC are not shared by a broad cross-section of international opinion. It should be noted that many of these organisations represent people and communities which have had radioactive wastes "disposed" of near them, as such, their views, based upon living experience, are especially noteworthy. We recommend that the Bureau undertake to seek the views of these organisations as an integral part of their consultation process, and before we hear unfounded platitudes such as "internationally recognised" again. Indeed, under IAEA guidelines, "relevant experience" should be incorporated into the design, construction and operation of radioactive waste facilities.[3] FoE, Fitzroy demands that the Bureau deem the views of these organisations "relevant" to this process, and all aspects of radioactive waste management.

In consideration of the above facts, FoE, Fitzroy submits that the Bureau is abdicating its responsibilities to public safety because of its excessive reliance upon the code and IAEA guidelines in the proposal. Further, we submit that the Bureau has been unable to demonstrate a meaningful process of public consultation. To ensure a community voice on this issue, we recommend that a broad cross-section of community interests have at least majority representation on the committees of regulatory authorities which formulate policy for, and administer radioactive waste management.

## "Remote areas" are sacred lands.

The fact that the Bureau can use terminology such as "remote region" to describe traditional Aboriginal land, indicates a clear bias and lack of understanding in relation to Indigenous Australians. The site selection criteria

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[3] IAEA. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Art 9 (vi) & Art 14 (iv).

make no attempt to consider, let alone acknowledge that “Australia” is founded on Aboriginal land. Nor does it address the fact that Aboriginal culture and country are intimately bound together, and is a reality which non-indigenous Australians are still trying to understand.

The nuclear industry has perpetrated acts of genocide upon Indigenous people all over the world. For this very reason, amongst the organisations sited earlier, a number of them represent indigenous peoples.

Australia is no exception, Aboriginal land has been appropriated, cleared of its inhabitants and ruthlessly exploited by the nuclear industry. This includes nuclear weapons testing and other military experimentation, and the mining and milling of uranium.

The nuclear industry has not been of social, cultural or economic benefit to indigenous Australians. On the contrary, the impacts in the cases of weapons testing have been disastrous. The adverse impacts of uranium mining on Aboriginal culture and country are also well documented.[4] The continuing opposition of traditional custodian groups to mining on their lands is testimony to the conflict and degradation which uranium development has brought these communities. The lingering threat to people’s health and country are significantly due to the nuclear wastes generated by both weapons testing and uranium mining.

Contractual arrangements made by governments or mining companies, and forced upon traditional custodians have only served to institutionalise the marginalisation of Aboriginal communities from the citizen rights enjoyed by the wider Australian community. Indigenous people have been told to sacrifice their country, on the strength of vague and as yet unfulfilled promises of high standards of education, health, housing or any other of the many services which white Australia takes for granted. Given the history of non-indigenous appropriation and use of Aboriginal land, and in view of the biases inherent in the process so far, FoE, Fitzroy strongly suspects that, once again, Government and institutional pressures will attempt to force its agenda onto Aboriginal people.

FoE, Fitzroy submits that a culture which ignores the value of country as a life sustaining entity is one that is unsustainable. Non-indigenous Australians have much to learn from Aboriginal cultural values, values which have sustained their people for tens of thousands of years. In deeming Aboriginal land to be “remote” the Bureau separates land from its life-sustaining value. It is another manifestation of the culture which permeates pro-nuclear interests striving for self-perpetuation. It is an industry which is inherently unsustainable and life-threatening.

Frameworks for consultation between Indigenous people and regulatory authorities should address the inherent power discrepancy that exists between, on the one hand well resourced government departments and vested interests

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[4] Aboriginal Project Committee: Kakadu Region Social Impact Study 1997.

of regulatory authorities, and on the other, poorly resourced communities with inadequate access to fundamental citizen needs, such as health, housing and educational services. Traditional owner land rights should be given priority in any negotiation, to the extent that Indigenous communities can exercise a complete right of veto over proposed developments on their country. In essence, FoE, Fitzroy submits that Governments and regulatory authorities should recognise and formulate policy based upon the fact that Australia was founded on Aboriginal land. It should recognise that prior to European invasion, there were about 300 different indigenous nations, speaking their own distinct languages with a history of occupation stretching back at least 50,000 years. This sovereignty has not been formally ceded.[5] Attempting "public consultation" is not enough: there must be an implicit and explicit acceptance of Indigenous sovereignty.

## Site Selection: Criteria & Evaluation

FoE, Fitzroy notes that the selection criteria have not included the important variable of prevailing winds. Clearly this meteorological factor would impact upon the assessment of other criteria such as population, cultural/historical significance, or land tenure, and the important consideration of impact upon future generations. In the likely event that a near-surface disposal facility was abandoned and had been subject to water and wind erosion, in all probability, being downwind of the derelict dump site would be a crucial factor determining radiological exposure and risk of cancer mortality.

In the Phase 1 discussion paper, Figure 6 shows a schematic plan of the proposed facility, which includes an evaporation pond.[6] We are told that this structure will provide a repository into which surface water can drain, and for the retention of water which will percolate through the underground structure and wastes.[7] Water which traverses the storage structure and wastes may become contaminated and concentrate radioactive wastes in the evaporation pond. As a matter of course conditioning and storage of these residues will have to be undertaken. Factors such as prevailing winds must to be taken into consideration in implementing best practice monitoring of, for example, the proposed evaporation pond, and processing the radioactive residues likely to accumulate there.

In addition, some of the wastes decay products are radioactive gases.[8] In assessing the health and environmental impact of Radon gas, prevailing winds must be a significant factor. We submit that the omission of such an important variable as prevailing winds undermines the integrity of the site selection

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[5] Information Leaflet: You Are On Aboriginal Land. An outline of the PAY THE RENT concept which proposes a policy for recognition of Indigenous Sovereignty and financial arrangements stemming from such a recognition.

[6] A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992.

[7] Optcit pp 19

[8] Issues Paper Number 6: Radioactive Waste Disposal in Australia. Dr. Rod Panter, Science , Technology & Environment Group. Dept of Parliamentary Library, 1992. pp 3.

process. This omission extends to design requirements, which do not make any specific provision for isolating radioactive gases from the environment.[9]

FoE, Fitzroy submits that former criticisms made with respect to the evaluation of the selection criteria still apply. Each phase of the proposal has made use of ASSESS, described as a:

> computer-based software suite using geographic information to apply site selection criteria to indicate areas where . . . wastes could be disposed . . .[10]

One may gain the incorrect impression from the above that computer modelling would provide an infallible means of objectively evaluating the respective selection criteria. In correcting this assumption FoE, Fitzroy reiterates the important observation made by Dr. Alan Roberts in 1992:

> Any programmer, of course, knows that this is rubbish; that the relevant social and ethical values have either been missing from the calculations, or smuggled in as assumptions; the computer has no way of balancing them and arriving at a conclusion - only people can do that.[11]

Indeed, how is it that computer software is able to apply, yet alone evaluate selection criteria such as “special cultural and historical significance”? We are sceptical, for example, of the software’s ability to strip away what may be the culturally inappropriate assumptions made by white, middle-class scientists working in the Bureau of Resource Sciences about the “significance” of Aboriginal culture and country.

We are also mindful of Dr. Alan Robert’s observation that:

> . . . the report contains no suggestion that *an acceptable site may not be found.* Yet this is certainly one of the possible outcomes that an objective scientific study should have in mind; indeed, . . . it should have it *prominently* in mind.[12]

The current discussion paper perpetuates the assumption that the search for a site will indeed yield one, we therefore note the fundamentally unscientific

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[9] National Health and Medical Research Council. Code of Practice or the near-surface disposal of radioactive waste in Australia (1992) pp 23. Here the lack of precise engineering specifications is breathtaking. Again, the code is full of language which is open to subjective interpretation. Examples include: “suitable engineered barriers”; “minimise the possibility of water infiltrating”; “delay or prevent radionuclide migration”.

[10] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 6.

[11] Dr. Alan Roberts, Graduate School of Environmental Science, Monash University in Comments on: A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992. pp 4.

[12] Ibid pp 3.

nature of the process of site selection.[13] Indeed, the paper acknowledges that the premise for site selection is at root a political one, declaring in its foreword that:

> The Commonwealth Government considers that a national repository is needed for disposal of Australia's . . . radioactive wastes[14]

These pronouncements are compounded assumptions, including that:

> Near-surface disposal . . . in accordance with international guidelines, is recognised as an appropriate method of management for . . . radioactive waste . . .[15]

"Recognised" by the users of nuclear technology and materials, certainly. "An appropriate method of management" for those who generate the 60 odd cubic metres of radioactive wastes annually, without a doubt. That these assumptions pass for science is laughable. That these notions underlie the process of site selection is obvious, and as such the process cannot be regarded as anything other than an elaborate, expensive and very much less than scientific exercise.

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[13] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. "Next Steps" pp 17. The assumption continues on Fact Sheet 12 showing a schematic in which the site is selected before the end of 1998.

[14] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp iii.

[15] Ibid pp iii.

## No Time to Waste: a review of arguments for near-surface disposal

FoE, Fitzroy notes the overly dismissive attitude assumed by the Government towards Recommendation 17 of the Senate Select Committee on the Dangers of Radioactive Waste quoted in the discussion paper:

> In recommending a single facility, the Committee seems to confound the *particular* and *exclusive* requirements for safe storage or the various categories of radioactive waste.[16] (emphasis added)

We assume that the Bureau's use of the Government's response forms an integral part of its own rationale for the proposal.
FoE, Fitzroy notes that, on the contrary, the report of the inquiry has many detailed lists and inventories of the various categories of radioactive wastes, including their sources. It undertakes a wide-ranging discussion of the relative dangers of each waste category in its attempt to make a recommendation for waste management.[17] Indeed, the Committee was very specific about the design requirement for an above-ground National repository:

> Recommendation 18
> The Committee recommends that the national facility be adequately engineered to withstand all possible climatic conditions, no matter how unlikely.[18]

In making this recommendation, the Committee sited "reasons of safety and community confidence".[19] This recommendation stands in stark contrast to the vague assertion by the Department of Primary Industries and Energy, which maintains that a design for a repository would be considered only after a site had been selected.[20] Indeed, the Bureau openly states that the proposed design will not even prevent leakage of water, nor human, animal and plant intrusion.[21]

The response makes reference to the *particular* and *exclusive requirements* for safe storage of the various categories of radioactive wastes. Quite how these particular and exclusive requirements justify a near-surface disposal is unclear. In fact, the Bureau is very light on when it comes to *actual* requirements for near-surface disposal.

Requirements sited by the Bureau include:

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16 Optcit pp 3.

17 No Time to Waste: report of the Senate Select Committee on the Dangers of Radioactive Waste. April 1996. The Senate, Parliament House, Canberra. Chapter 3. Existing quantities and future creation of radioactive waste. pp 42-56.

18 Ibid para 7.35 pp 137

19 Ibid para 7.35 pp 137

20 A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 4.

21 A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 4.

1. IAEA international guidelines.
2. Short isolation period of low-level wastes.
3. No technical requirement for permanent above-ground storage.
4. Community concerns over site of origin disposal.
5. Abandonment by irresponsible individuals.
6. Community as beneficiaries of nuclear industrial process.
7. Care for future generations.

Let’s take these arguments in turn.

## IAEA international guidelines.

The Bureau hides behind the claim that:

> Internationally developed (IAEA) criteria for optimal siting of radioactive waste would preclude the siting of a repository within highly populated areas. Such criteria would also *suggest* that indefinite storage at the site of origin is technically less than ideal.[22] (emphasis added)

Use of the word "suggest" is instructive, it gives some insight into the ambiguous nature of IAEA promulgations in general. We note, for example, that the recently devised Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, referred to in the discussion paper, does not provide definitive criteria on dedicated site of origin storage, nor do they make any proscription that would preclude the siting in populated areas.[23] Indeed, it would be quite hypocritical of the IAEA to allow the siting and operation of nuclear power facilities in highly populated areas, such as for example, in Western Sydney, with all its attendant risks, yet specifically require that low-level waste be transported to remote areas for burial. If indeed this is the case, then Australian authorities ought steer clear of their bad example.

And again the Bureau assumes:

> For low-level and short-lived intermediate-level radioactive waste, international standards and practice clearly indicate that near-surface disposal is appropriate rather than storage as recommended by the Committee.[24]

We would like to note the following observation made in a research paper devised by the Department of the Parliamentary Library in 1992:

> . . . Australia has no clear guide from overseas as to the best method of disposal . . . Inexplicably, there is no hard-and-fast international recommendation on disposal from, say, the International Atomic Energy Agency which does not even define waste categories in its Safety Series publications. The national choice of methodology thus devolves to matters of cost, climate (wet or dry), degree of opposition to disposal, volume of national wastes, and so on.[25]

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[22] A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992. pp 7.

[23] IAEA. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Art 13 pp 9.

[24] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 3.

[25] Issues Paper Number 6: Radioactive Waste Disposal in Australia. Dr. Rod Panter, Science , Technology & Environment Group. Dept of Parliamentary Library, 1992

Further, having reviewed the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste FoE, Fitzroy submits that it is filled with language and phrasing which provide loopholes more than sufficient for the producers of radioactive waste to avoid the highest practicable standards of public safety for present and future generations, *no matter where or how the repository is sited*.

The fact that the Joint Convention allows for the disposal of radioactive wastes *at all* clearly undermines its authority as a standard for short, medium and long-term public and environmental safety.[26] Some examples of ambiguous language and phrasing are worthy of examination:

[26] IAEA. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Preamble (vii) pp 1.

> . . . that:
> (i) the design and construction of a radioactive waste management facility provide for suitable measures to limit possible radiological impacts on individuals, society and the environment, including those from discharges or uncontrolled releases;[27] (emphasis added)

FoE, Fitzroy submits that the design of a facility must specify all measures necessary to prevent all possible radiological impacts. That these "guidelines" allow for any radiological impacts at all is a dereliction of responsibility towards public safety. If the Joint Convention claims to be guidelines then they must specify the necessary measures. "Suitability" is too vague: suitable to whom? ANSTO, or the local Aboriginal community that lives next door to the remote near-surface disposal?

Further:

> . . . that:
> (i) the radiation exposure of the workers and the public caused by the facility shall be kept as low as reasonably achievable, economic and social factors being taken into account;[28] (emphasis added)

This principle, shared by the NH&MRC code, is fraught with problems and is, perhaps, one of the most discredited criteria used throughout the field of radiation protection. There is no doubt that the use of the word "reasonable" is treated far too liberally by many parts of industry, not the least of which are the mining , nuclear power and reprocessing sectors which have constantly abused the notion of "reasonably achievable". The whole interpretation of what is "reasonably achievable" is not based on science, but is a loophole to allow industry to balance profit and work practises against public and worker exposure and environmental contamination.

FoE, Fitzroy has long argued that the ALARA principle be changed to ALATA - as low as technically achievable, and to use of BAT - best available technology. The onus is then placed on industry, in this case the operators of the waste dump, to prove that they are employing the best technology to safeguard people and the environment. The issue of radiological exposure and health risks will be treated in more detail later in this submission.

**Short isolation period of low-level wastes.**

The Bureau states that one "rationale" for near-surface disposal is:

> that the isolation period required for this type of waste is relatively short and within the period over which it is

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[27] IAEA. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Art 14 (1) pp 9.

[28] IAEA. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. Art 24 (1) pp 13.

*reasonable to expect* that institutional control can be maintained.[29] (emphasis added)

FoE Fitzroy submits that this rationale does not offer a special case for near-surface disposal. In fact such conditions would equally lend themselves to above ground on-site storage. Further, we note the use of "reasonable to expect", yet another example of ambiguous phrasing entirely open to subjective interpretation.

**No technical requirement for permanent above-ground storage.**

The Bureau tries to argue that above-ground storage is only required for high-level waste which generate heat, maintaining that there is no "technical requirement for permanent above-ground storage" of other radioactive wastes.[30] FoE, Fitzroy disagrees. Small quantities of radium and other alpha-emitters found amongst the waste categories A, B and C, have half-lives that extend far beyond the proposed institutional control periods, and the mooted 300 years of engineered integrity of the proposed near-surface repository. The half-life of radium 226 is 1600 years, and gives rise to Radon, a gas, and its decay products which are the principle agents of lung cancer in uranium miners.[31] The fact of prolonged half-life would require a facility which specifically allows for retrievability of the waste, so that they can be removed to successive generations of on-site storage repositories over the period of radiotoxicity. The fact that Radium decays into a radiotoxic gas would require that the repository specifically have the technical means to safely isolate radioactive vapours from the environment. Near-surface burial will not provide a technical means to prevent radiotoxic vapours reaching the environment. Indeed, we remind the reader that the proposed near-surface disposal will leak and will not prevent human, plant or animal intrusion.[32]

**Community concerns over site of origin disposal.**

The Bureau makes mention of "community concern" for "unnecessary" site of origin storage of wastes. FoE, Fitzroy acknowledges that there is community concern surrounding this issue, as there is concern over every aspect of the nuclear industrial and medical process. FoE, Fitzroy and the international environment movement have continually stressed the complex and intractable nature of problems caused by the use of radioactive materials. In drawing attention to these problems we have advocated not only integral public consultation by, but actual community representation on the committees of regulatory authorities, which daily decide the use and management of radioactive materials. In this way, "community concern" can move from a notion which can be sited in an attempt to back up advocacy of remote burial of

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[29] Optcit pp 7.

[30] A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992. pp 7.

[31] Issues Paper Number 6: Radioactive Waste Disposal in Australia. Dr. Rod Panter, Science , Technology & Environment Group. Dept of Parliamentary Library, 1992. pp 3.

[32] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 4.

radioactive wastes, towards having an integrated and meaningful involvement in assessing the risks and benefits of the procedures in question. This view, for example, was shared by the Senate Select Committee on the Dangers of Radioactive Waste which recommended the need for community representation in the management of a national waste repository.[33]

Further, we submit that the concerns of an urban community ought not be exploited as a means of overriding the concerns of a remote community. The Bureau is silent as to why remote environments and communities must become radioactive sacrifice zones to satisfy the concerns of urban communities. We note also the Bureau's blind spot in relation to the concern of communities which live along the proposed transport routes that will carry radioactive cargoes to the remote dump. These concerns don't seem to figure in the Bureau's arguments for remote disposal. Indeed, we are told that a transport route:

> . . . will be determined in consultation with the appropriate State authorities.[34]

Clearly, the route of transportation doesn't register as a matter for community concern or public input for the Bureau. FoE, Fitzroy asks the Bureau: will the people who live along the transport route actually be informed? Will they be advised when radioactive cargoes pass through their communities?

FoE, Fitzroy submits that a full and frank flow of information on the dangers and risks of radioactive wastes presented to a community, in tandem with a full community representation on matters of waste management, will go a long way to address the concerns of urban populations. We note, however, that there is no perfect solution: that is the nature of the beast. The use of radioisotopes means long-lived radiotoxic wastes. However, the community must be allowed to assume its full responsibility, rather than permit use of its concerns by an unrepresentative regulatory authority to bury the problem out of sight and out of mind.

**Abandonment by irresponsible individuals.**

The Bureau claims that permanent site of origin storage has:

> . . . the attendant possibility for their abandonment by irresponsible individuals.[35]

FoE, Fitzroy agrees. This risk is inherent with the management of radiotoxic wastes, an inevitable by-product of the nuclear industry. We argue that any

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[33] No Time to Waste: report of the Senate Select Committee on the Dangers of Radioactive Waste. April 1996. The Senate, Parliament House, Canberra. Recommendation 20 para 8.63 pp 167.

[34] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 5.

[35] A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992. pp 7.

form of repository, especially remote near-surface disposal, is prone to the possibility of abandonment. We submit that remote near-surface disposal would enhance the possibilities of this risk by its very nature. Even within the limited institutional control period of 100 years, it is entirely possible that, because of remoteness, near-surface disposal would suffer from:

> *****difficulties of communication, that is the need to maintain telecommunication facilities over long distances;
> *****difficulties with access, that is roads or railroads washing out, or falling into disrepair;
> *****difficulties persuading properly trained staff to live and work in an area with few services;
> *****difficulties supplying the equipment and services needed to maintain the site.

Each of these factors would contribute to circumstances that could lead to total abandonment. Clearly, imposing the "tyranny of distance" on repository siting will not alleviate the risks of abandonment. In fact, for these reasons, remote siting would amount to irresponsible abandonment.

**Community as beneficiaries of nuclear industrial process.**

Use is made of the "beneficiary" argument to dismiss the case for above ground on-site storage. The claim that all Australians are beneficiaries of ANSTO exploitation of nuclear technology is an instructive example.[36] Medical isotopes generated by HIFAR can be imported, or manufactured with cyclotron technology, rather than derived by nuclear fission. The latter means of generating isotopes for medical use are far "cleaner" than a fission source which generates much larger quantities of radioactive wastes. There are optimistic signs that cyclotron technology using spallation methods can provide the complete range of radioisotopes needed for medical use.[37]

The struggle to procure sufficient research funding for this technology should be compared to the recent go-ahead given to replacing the current HIFAR fission reactor. Whilst research into cyclotron technology has been overshadowed by funding shortages, at least $300 million will be lavished on a new nuclear reactor. Such discrepancies led the Senate Select Committee to report on cyclotron development that:

> . . . the Government should look at all options for the future production of radioisotopes in Australia before deciding on the possible replacement of the existing reactor.[38]

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[36] A radioactive waste repository for Australia: Methods for choosing the right site. A discussion paper. NRIC, DPIE 1992. pp 7.

[37] "Cyclotrons: Can they be used to make Technetium 99m?" Information and research services. Dept of Parliamentary Library. Sept 1997. pp 2 & 3.

[38] No Time to Waste: report of the Senate Select Committee on the Dangers of Radioactive Waste. April 1996. The Senate, Parliament House, Canberra. para 4.44 pp 67.

A more enlightened approach would see Australians as the beneficiaries of research investment into cyclotron technologies, with every likelihood of eliminating the need to produce large quantities of radioactive waste generated by fission sources.
Instead, we are burdened by ANSTO's fixation upon an outmoded and dangerous technology which continues to threaten the health and livelihood of the surrounding population and generate high-level radioactive wastes, for which there is still no known method of safe storage or disposal over the period of time they remain lethal.

The contradictions of the ANSTO example extends further. Despite the clear objections of the Sutherland Shire community, ANSTO, the present Government and other agencies are all happy to strenuously advocate the siting of a new nuclear reactor above ground in a major population centre, yet will not countenance above ground on-site storage of low-level wastes, claiming the "continuing concern by some local communities".[39] The frank hypocrisy is staggering.

**Care for future generations.**

Much use is made of the claim that near-surface disposal will ensure that the burden of waste management "should not be left for future generations."[40] Yet the code which guides near-surface disposal clearly indicates institutional control periods of at least 100 years.[41] Clearly the burdens of waste management will extend into future generations, indeed if the code is properly observed, they must. However, at this point we should note that the draft version of the code, open for public comment in 1992, listed institutional control periods of 200 years.[42] FoE, Fitzroy notes that the NH&MRC concern for future generations appears to have a half-life of less than one year.

FoE, Fitzroy note that the half-lives of some of the radionuclides within the wastes range from a few decades to millions of years. For example, Americium 241 (half-life of 432 years) decays into Neptunium 237, which has a half-life of over 2 million years.[43]

Given the time scales involved, the 100 year control period is inadequate and seems quite arbitrary. We note that the chosen institutional control period appears to have been adopted for no other reason than to put a limit on the costs of the disposal. operation

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[39] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp 2.
[40] Ibid pp iii.
[41] National Health and Medical Research Council. Code of Practice or the near-surface disposal of radioactive waste in Australia (1992) pp 16
[42] Greenpeace Australia's response to the draft code of practice and associated guidelines of the near-surface disposal of radioactive wastes (1992). May 1992 pp 20.
[43] Greenpeace Australia's response to the draft code of practice and associated guidelines of the near-surface disposal of radioactive wastes (1992). May 1992 pp 20.

FoE, Fitzroy also notes the discrepancies of language with respect to policy pertaining to future generations. Peter O'Brien states that the Commonwealth Government considers:

> . . . management of this waste ***should not be left*** to future generations.[44] (emphasis added)

further the NH&MRC code states that the burden placed upon future generations:

> for the surveillance and control of waste . . . ***should*** be ***minimised***.[45] (emphasis added)

Clearly this means that burdens for future generations will not be excluded altogether. In further assessing the code's meaning one ought make reference to section 1.4 which specifically defines the use of the word "should" to indicate a "procedure or precaution which is to apply, ***wherever practicable*** . . ." (emphasis added). As opposed to the word "shall" which indicates that "the particular requirement is ***essential***"(emphasis added).[46] FoE, Fitzroy notes with disappointment that the code regards the issue of burdens upon future generations to be inessential. We also note that the use of "wherever practicable" is a term too loose to be of any value to future public safety, being open entirely to subjective evaluation it doesn't form a useful prescription. As such, we submit that the use of "concern for future generations" by the Bureau to argue for remote near-surface disposal, is in fact empty grandstanding. On the basis of the code's wording, present generations cannot be assured that the interests of their children are regarded as essential to NH&MRC considerations, nor the considerations of the Bureau, which heavily relies upon this code.

Further, in section 1.1, which outlines the code's purpose, it is stated that:

> . . . future risks or detriment will not exceed those currently accepted.[47]

Again, the terminology is far too ambiguous to be of use. We have demonstrated earlier that the risks associated with, and practise of near-surface disposal do not enjoy acceptance. This would preclude the burdening of future generations with our unacceptable risks.

## Radiological Exposure: threshold of credibility

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[44] A radioactive waste repository for Australia. Site Selection Study-Phase 3 Regional Assessment. Bureau of Resource Sciences. pp iii

[45] National Health and Medical Research Council. Code of Practice or the near-surface disposal of radioactive waste in Australia (1992) pp 9

[46] Ibid pp 3.

[47] National Health and Medical Research Council. Code of Practice or the near-surface disposal of radioactive waste in Australia (1992) pp 1.

## Historical Trends

Since 1927, when standards for radiological exposure were first developed, the threshold for “safe” dose has trended consistently downwards. This trend continues as risk estimates for radioactive exposure are found to be greater with every new research finding.

On average, the minimum permissible dose has been halved every 12 years. The long delays that occur between obtaining data and the implementation of the necessary controls serves to protect the nuclear industry, rather than workers and the public.

The current occupational exposure limits for Australian workers is no more than 50mSv in any one year; and a limit of 100mSv for any 5 year period (ie an average dose of 20mSv annually). The NH&MRC code allows a limit of 1mSv annual exposure for members of the public.

The current standard applies to all workers and the public regardless of age and gender. As the recent studies show, factors such as age can contribute to increased risk.

## Extensive and Continuing Research

The results of the following studies into radiological exposure are outlined separately below:

1. Time Related Factors in Radiation-Cancer Dose Response. (August 1997)
2. Santa Susana Field Laboratory Epidemiological Study.
(Sept 1997)
3. Unexpected Rates of Chromosomal Instabilities and Hormone level alterations in Namibian Uranium miners. (Nov 1996)

These are the most recent of a succession of studies which show that the present recommended levels of exposure are not safe, and in fact present serious health risks.

1. Time Related Factors in Radiation-Cancer Dose Response.[48]

### Background

Due to the US AEC & DoE shortcomings in research, outlined in appendix A, the US National Institute for Occupational Safety and Health has taken charge of funding allocation for studies of workers who received long term low level radiation exposure.

This study examines workers at the Oak Ridge National Laboratory, a secret facility of the US nuclear weapons program. The study was headed by Dr.

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[48] Time Related Factors in Radiation Cancer Dose Response. August 1997. Professor Steven B. Wing and Dr. David Richardson. National Institute for Occupational Safety and Health of the Centres of Disease Control and Prevention. University of North Carolina USA.

David Richardson and Professor Steve Wing of the University of North Carolina at Chapel Hill. The study was published in August 1997.

**The Study**
# 14,095 workers were examined. They were hired between 1943-1972, and followed until 1990.

# Workers at Oak Ridge were individually monitored for exposure to **external radiation**, primarily using film badges.

# As of 1990, of the 14,095 workers, 3,269 have died. 879 of theses deaths (26.9%) were due to cancer.

# Using the worker's film badge data, the study examined the difference in cancer mortality rates among workers with different levels of radiation exposure. These estimates are described as the percent increase in cancer rates per 10mSv radiation dose.

NB: In considering the findings for change in death rates per 10mSv dose, remember that workers in Australia are permitted to receive 10 fold this dose every 5 years.

**Findings**
i) Strong evidence of a positive association between low-level radiation and cancer mortality. Among ORNL workers, the effects of radiation ten years after the exposure was an increase in cancer deaths of 1.2% for every 10mSv received on the job.

ii)Associations between cancer deaths and radiation dose were stronger for cumulative doses received at older ages than for lifetime cumulative dose. Sensitivity to the damage caused by radiation appears to increase with age. Assuming a ten year lag between radiation exposure and death, a 4.98% increase in all cancer mortality was estimated per 10 mSv cumulative dose received after age 45.

iii) Risk estimates for low level radiation are many times larger that those which inform the current worker and public radiation protection standards.

iv) The study cautions that, whilst cancer mortality risk estimates are demonstrably higher, there hasn't been sufficient time to study the effects of "non-lethal" chromosomal damage and the effects this may have upon offspring of exposed workers.

**Comment**
Based on research findings Dr. David Richardson suggests standards for occupation exposures to low-level radiation should be reduced by ten-fold (to 2milliSieverts). For workers in uranium mines, who can receive substantial radiation exposures, these findings are of particular importance as it suggests they will have an increased likelihood of death by cancer. Questions remain about the potential non-fatal effects of exposure, including the effects of low

level radiation exposure on reproductive health, and on the occurrence of non-fatal cancers.[49]

2. Santa Susana Field Laboratory Epidemiological Study[50]

**Background**
The study examines workers at the US Government rocket testing facility at Santa Susana. Because of the shortcomings of previous studies initiated by US DoE, a rigorous selection process of research personnel was instigated to ensure independence and objectivity in the conduct of the examination.

The study was performed by a team of researchers for the University of California, Los Angelese, and was overseen by an Oversight Panel. The Oversight Panel Report was published in September 1997.

**The Study**
# Researchers reviewed medical and personnel records for 4,563 employees monitored for radiation between 1950 and 1993.[51]

# 875 workers exposed to **external radiation** at the plant have died, with 258 of those deaths attributable to cancer. Workers exposed to internal radiation suffered a similar proportion of cancer mortality, being 134 (27.3%) of the 441 deaths due to **internal exposure**.[52]

**Findings**
i) Evidence of cancers occurring from radiation at levels significantly lower than the regulatory limit. Recommend that current limits for radiation exposure be reconsidered by all regulatory and advisory bodies responsible for radiation protection.

ii) That the excess relative risk from “low dose” external radiation is at least 6 to 8 times greater than that assumed by current official risk factors which are based on extrapolation of the results of A-bomb survivor data to low doses.

iii) The study also confirmed a previously reported age-effect. For a number of cancer types, the risk increases with age at exposure. Regulatory standards based on the assumption of uniform risk throughout adulthood should be re-examined.

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[49] Information Leaflet, Roxby Action Collective, *from*: Dr. David Richardson and Prof. Steve Wing. Time Related Factors in Radiation Cancer Dose Response. National Institute for Occupational Safety and Health of the Centres of Disease Control and Prevention. University of North Carolina USA.
[50] Santa Susana Field Laboratory Epidemiological Study: Report of the Oversight Panel. Sept 1997.
[51] Rocketdyne Worker Health Study, Summary for current and former Rocketdyne/AI employees. 1997. California Department of Health Services, Occupational Health Branch.
[52] Ibid.

3. Unexpected Rates of Chromosomal Instabilities and Hormone level alterations in Namibian Uranium Miners.[53]

**Background**
According to the preamble of this study, a common problem in determining the health consequences of radiation exposure is factoring out other carcinogenic influences. The objective of the study was to determine whether long-term exposure to low dose uranium increases the risk of a biological radiation damage which would lead to malignant diseases and to design a dose-response model for these miners. The Namibian study provides a clear test case for the effects of low-dose long-term uranium exposure, due to the good air quality and lack of other industries with negative health effects.

The study was conducted by a research team drawn from the Department of Hematology on Oncology, the Berlin State Radiation Monitoring Centre and the University Medical Centre Benjamin Franklin, Free University Berlin. It was published in November 1996.

**The Study**
# 75 miners were randomly selected, ranging from 30 to 50 years in age with a minimum 10 years on the job.

# All subjects were screened for a variety of factors ensuring no:
* HIV.
* Radiation or cytostatic therapy.
* Viral infection 3 weeks prior to blood sampling.

# A questionnaire which included place of birth and migration history, demography and detailed occupational life history in the uranium mine was used.

# The highest radiation dose at the mine was measured at around **5mSv per annum** by the IAEA.

**Findings**
i) A six-fold increase of uranium excretion among the miners compared to the controls.

ii) A significant reduction in testosterone levels and neutorphil count.

iii) A threefold increase in chromosome aberrations in the miners.

iv) Multi-aberrant cells such as “rogue” cells were observed for the first time in miners which were formerly known only from short time high dosage radiation injury, eg from Hiroshima or Chernobyl.

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[53] Unexpected Rates of Chromosomal Instabilities and Hormone Level Alterations in Namibian Uranium Miners. Nov 1996. Prof. Dr. Eckard Thiel, Department of Hematology and Oncology, University Medical Centre Benjamin Franklin.

vi) The miners exposed to uranium are at an increased risk to acquire various degrees of genetic damage, which may be associated with an increased risk for malignant transformation.

vii) Direct comparisons of diagnosed cancer cases among all cancer cases recorded by the Namibian health authorities during the last 10 years shows a higher prevalence within the miner group.

## Safeguarding Workers.

The near-surface repository will be designed so that radiation doses to members of the public will be limited to 1mSv/year, consistent with the ICRP recommendations.

Yet the ICRP's recommendations have been criticised as being too lax [see Appendix A]. In Britain, the UK's National Radiological Protection Board (NRPB) criticised the ICRP and recommended that lower dose limits should be set. The current radiation dose limit which is recommended by the NRPB from a single installation is 0.5 mSv - half the level the NH&MRC is recommending for Australia's proposed national dump.[54]

When this was first pointed out, the NH&MRC claimed that the UK recommended limit is 0.5mSv because it has to take into account other man-made sources such as nuclear power stations. But the question must be asked: if the UK is able to limit public exposure doses from a single facility to 0.5mSv, why won't the NH&MRC match them? Lower than ICRP recommended annual exposure are also found in Germany at 0.3mSv, and the United States at 0.25mSv.[55] Clearly, the relative lack of nuclear power stations in Australia is an opportunity to limit radiation doses to members of the Australian public, not an excuse to allow higher doses from other sources.[56]

Standards of radiological protection have been critiqued by health experts, nuclear scientists, environmental and anti-nuclear organisations for decades. The consistent shortcoming has been the delay factor between discovery of radiation hazard and implementation of more stringent standards. These criticisms have been echoed in the Senate Select Committee on Uranium Mining and Milling Report, which recommended that:

> the results of verified research on health and safety of employees must be applied without delay. The Select Committee is especially critical if the long, drawn-out delay

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[54] Greenpeace response to "A radioactive waste repository for Australia: Site Selection study - phase 2 Discussion Paper". para 2.8 pp 2.

[55] Greenpeace response to "The draft code of practise for the near-surface disposal of low-level solid radioactive waste in Australia (1992). para 10.2 pp 10.

[56] Greenpeace response to "A radioactive waste repository for Australia: Site Selection study - phase 2 Discussion Paper". para 2.9 pp 2.

> in adoption of the latest international standards concerning radiation exposure.[57]

As the above sample of research findings indicate, Australian standards must be radically improved to begin to offer even rudimentary protection. Any Government or regulatory authority which fails to offer security in the work place, or to the public, from occupational and health hazards presented by radiological exposure is absconding from a fundamental responsibility to its citizens.

Setting radiation exposure standards in keeping with current research findings is likely to impact upon many work practises that are currently regarded as "acceptable". We note that attempts to implement the highest standards of protection will be met by resistance from the nuclear industry and their regulatory authorities. Nevertheless, the Australian public, for generations to come, are the beneficiaries of such initiatives.

FoE, Fitzroy submits that the results of the above research findings must be applied without delay. We note the following observation, which ought to serve as a guide for protection from radiotoxic exposure:

> Every dose of [ionising radiation] is an overdose.
>
> - Dr. George Wald
> Havard Biologist, Nobel Laureate

FoE, Fitzroy demands that exposure from sources other than background radiation and medical application, be limited to a 2mSv annual exposure for workers, and that exposure be limited to zero for the public.

## Towards User-Guards

Whilst the user-pays principle may lead to the worthy goal of waste minimisation, we submit that minimisation alone is not sufficient in itself. To assume full responsibility, the producers of radioactive waste must practise a culture of guardianship as they provide dedicated on-site storage.

With user pays and remote disposal, the waste producer is still divorced from the consequences of the wastes generated. Near-surface disposal with short institutional control periods is the cheapest option, presenting the most opportunity to accommodate extra costs by administrative adjustments.

If an institution or corporation argues strongly for the use of these technologies and materials, the strength of their conviction should also be manifest in how safely they care for the toxins produced. Friends of the Earth, Fitzroy submits that the producer should assume guardianship for the safe storage of their wastes.

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[57] Uranium Mining and Milling in Australia, The Report of the Senate Select Committee on Uranium Mining and Milling, 1997 pp 67.

Guardianship will institute a culture of responsible care of radioactive wastes by the producer. It recognises the extreme damage these materials inflict on all life-forms and their genetic codes. It is a culture which is committed to present and future generations to keep radioactive materials out of the biosphere. To this end, it requires the transmission to future generations of the knowledge necessary for their self-protection and on-going guardianship through time.[58]

Long after we have technically transcended the need for nuclear medicine, these are the qualities that we will have to continue to assume in order to safeguard the future from the radioactive wastes we have created today.

[58] "On the responsible care of radioactive materials." Nuclear Guardianship Forum Project. http://www.nonukes.org/ngl.htm

# APPENDIX A

## Review of international standards

International standards for radiological exposure are set by the International Committee for Radiological Protection. The scientific basis for these standards are derived from research into the populations of atomic blast survivors at Hiroshima and Nagasaki. The US Atomic Energy Commission is the agency which undertakes this research. It is the largest research undertaking by this agency, which has been one of the main proponents of research into radiological exposure in the United States. The US Department of Energy (DoE) has been the other major proponent of such research in the United States.

In recent years, both these agencies have received increased criticism and come under greater scrutiny for the institutional shortcomings in their research programmes.[59] Reviews by US Government inquiries into the operations of these agencies have found:

i) a lack of direction in the research programmes and an almost lackadaisical approach by the agencies to studying the health effects of low level radiation.

ii) that they were largely exempt from external review, such that funding proposals were not subject to substantial outside evaluations.

iii) a significant conflict of interest due to the fact that these agencies were themselves responsible for largescale environmental and occupational radiation exposures, yet they were also almost solely responsible for conducting research on the effects of these exposures.

iv) secret classification of research findings, and the almost universal restriction of scientific data collected, making an independent review of research impossible.

vi) sacking and vilification of research scientists who, on scientific grounds, had dissenting opinions from AEC and DoE.[60]

The consequence of these evaluations at the highest level was the decision that the assessment of occupational health in the nuclear industry become the responsibility of the National Institute for Occupational Safety and Health in the Centres for Disease and Prevention.[61]

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[59] Historical Context of Enclosed Study, Time Related Factors in Radiation Cancer Dose Response. August 1997. Professor Steven B. Wing and Dr. David Richardson. National Institute for Occupational Safety and Health of the Centres of Disease Control and Prevention. University of North Carolina USA.

[60] Why The Hiroshima/Nagasaki Life Span Study Is An Inadequate Study For Assessing The Effects of Low Dose Radiation Exposure on Workers in the Nuclear Industry. 1997 Dr. David Richardson

[61] Optcit.

Given that the AEC has suffered damaged credibility in relation to its research undertakings in the United States, this calls into serious question the studies into Japanese survivors of atomic bomb blasts, also undertaken by the AEC. Taken in conjunction with demonstrable shortcomings in the scientific method, outlined below, these studies should be re-evaluated as a basis for international standards and “world best practice”.

## Research into the Hiroshima & Nagasaki Survivors

The following is an outline of the scientific critique[62] which has been levelled at the AEC study into the effects of radiation exposure upon survivors of the Hiroshima and Nagasaki atomic weapon blasts. This study remains the basis for current risk estimates used to set environmental and occupational exposure limits.

Flaws in scientific methodology include:

i) the AEC started their study five years after the bombing had occurred. In the first year after the blast in Hiroshima, over 100,000 people had already died.

ii) the AEC has wrongly assumed that blast survivors were a normal population. In fact they are more likely to be amongst the healthiest portions of a population. Those who were more feeble, more vulnerable, or less fit died before the study began. The very old and very young, for example, died in great numbers. This healthier population may therefore have a lower risk of mortality resulting from exposure.

iii) unreliable estimates of exposure dose. None of the survivors were measured for dosage. Estimates of exposure are based upon recollections of where the person was in relation to the blast. Unknown factors may influence exposure, such as what barriers may have protected the person from exposure. Similarly, areas around ground zero were radioactive for weeks after the bombing. Therefore, travel through these areas may have effected exposure dosage. This factor isn’t accounted for in the AEC study.

iv) the study uses a population exposed to a single acute radioactive dose. This is a different exposure regime to uranium miners and other radiological workers, who tend to receive long-term low dose exposures.[63]

The recent change in international recommendations for occupational radiation exposures (from 50mSv annually to 20mSv) was a consequence of the revisions in dose estimates for the A-bomb survivors. These revisions were sought by environment and community organisations all over the world. While the changes are a move in the right direction, questions about the selection and

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[62] Why The Hiroshima/Nagasaki Life Span Study Is An Inadequate Study For Assessing The Effects of Low Dose Radiation Exposure on Workers in the Nuclear Industry. 1997 Dr. David Richardson

[63] Risk Estimates of Low -Level Ionising Radiation. May 1997. Prof. Wolfgang Kohnlein, Director of the Institute for Radiation Biology. University of Munster, Germany.

exposure estimates continue to plague any study of survivors of an atomic bomb attack. In addition, given the institutional and scientific shortcomings, this study cannot be used as the basis for international standards for radiological exposure.[64]

[64] Optcit.