The present status of the debate of the use of nuclear power in Australia.

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[redacted]

1. Only four years ago it would have been unlikely that any person when considering nuclear power would have even thought about Australia. Between 1972 and 2006 the issue of the Australia's involvement in the nuclear industry focused primarily on the mining and export of uranium. Any debate on nuclear energy was confined to the fringes of society and even then the suggestion of nuclear power for domestic purposes would have been not so politely ignored. The most recent debate began in 2006.

2. Following the announcement by the then Prime Minister John Howard in early 2006 that the development of nuclear power was an option for meeting Australia's energy needs and responding to greenhouse emissions, the Prime Minister appointed a taskforce to undertake a comprehensive review of the nuclear cycle. The review was known as "The Review on Uranium Mining Processing and Nuclear Energy in Australia".[2] It was announced on 6 June 2006 and a draft report was released for public comment on 21 November 2006, the final report was presented to the Prime Minister in late 2006.

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[2] Hereafter referred to as the "Switkowski review" after the Chairman of the Review Panel.

3. The review also called for initial public comment in August 2006 and received over 230 submissions from interested parties. As noted in this summary:

> *"Participation in the nuclear fuel cycle is a difficult issue for many Australians and can elicit strong views. This report is intended to provide a factual base and analytic framework to encourage and form community discussion.*
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> *Australia's demand for electricity will more than double before 2050. Over this period, more than two-thirds of existing electricity generation will need to be substantially upgraded or replaced and new capacity added. The additional capacity will need to be near zero greenhouse gas emitting technology if Australia is just to keep greenhouse emissions at today's level."*[3]

4. The push for new-build nuclear was recognised by the Economist in September 2007 when its front cover was headlined: "Nuclear power's new age".[4] But as the leader noted: "Managed properly, a nuclear revival could be a good thing. But the industry and the governments keen to promote it look like repeating some of the mistakes that gave it a bad name in the first place…The nuclear industry needs to persuade people that it is clean, cheap and safe enough to rely on without a government crutch. If it can't it doesn't deserve a second chance."[5]

5. Much has changed in Australia since 2007. The Labor party under Kevin Rudd won the December 2007 election and the debate about nuclear energy was shelved. Recently the Labor party was returned to office, but as a minority government.

6. For the purpose of this presentation I have made a number of assumptions and need to make some disclaimers.

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[3] Switkowski Review, p.1
[4] The Economist, September 8th-14th, 2007. The Economist magazine, which named coal as the number 1 public enemy on its front cover in 2004, is not a usual supporter of new-build nuclear power, opposing the need to provide sovereign risk guarantees and other non-free market mechanisms to enable the construction and operation of nuclear power plants.
[5] The Economist, Leader, September 8th 2007, p.11

7. Whilst from 2005-2007, there were a number of Government White Papers and discussion papers and a reawakening of debate about the future of nuclear power in Australia, the election of the ALP ended any further consideration at a government level. The recent re-election of Julia Gillard as a minority Prime Minister, relying of Green and independent support, means that there is no possibility of any further consideration of nuclear power in the life of this parliament.

8. Without changes to Commonwealth (national) legislation the can be no development of nuclear power in Australia. It is also likely, for reasons discussed below, that any legislation passed that would facilitate nuclear power would be subject to a challenge in the High Court of Australia on constitutional grounds. So any government willing to champion nuclear energy must be prepared for an extensive legal and public relations campaign. This is not likely in the current political climate.

9. So from the outset this paper can only truly consider the hypothetical notion that a government is elected that is fully committed to establishing a nuclear power industry in Australia. Assuming that is the case, this paper then looks at what that government would have to do to achieve that outcome.

10. The second assumption that has been made is that climate change has been discounted in considering the financial viability of nuclear power in Australia. Australia is the highest per-capita emitters of greenhouse gases (GHG) in the world. Whilst Australia's overall emission are small[6], Australia is a per capita global polluter of appalling proportions. Most of this is due to the reliance on coal-fired power stations but this is coupled by massive energy inefficiencies and waste. There is no doubt that Australia will be forced to take massive steps to reduced GHG emissions, however these will be required to be taken in the short and medium term. Proponents of nuclear power who argue that nuclear power in Australia is an answer to climate change use numbers that have no reference to

[6] Although still 1.4% of global emissions.

the real world and seriously weaken any arguments in support of the development of nuclear power.

11. The Switkowski Review in Chapter 7 looks at the issue of climate change. Making a number of assumptions in relation to emissions it compares the savings of replacing coal fired power stations with new-build nuclear. The fast-build scenario has the first nuclear power plant on-line in 2020 with additional plants added from 2025, growing to a capacity of 25GW by 2050. By 2020 this is calculated to reduce annual emissions by almost 150 Mt CO2-e.[7] In the slow-build case the first nuclear plant comes on-line in 2025, additional capacity is added from 2030, and total capacity is 12 GW in 2050. This reduces emissions by over 70 Mt CO2-e in 2050.[8]

12. The Review makes the comparison between new build nuclear and existing brown coal , black coal or CCGT power plants. The Energy White Paper[9] in its discussion on energy efficiency, as a mechanism to address GHG emission reductions notes that adoption of those measure having a less than 4-year payback would increase annual GDP by AU$975 million and abate approximately 10 Mt CO2-e annually.

13. The optimistic estimates in the Review was based on replacing black coal generation with nuclear and assumed that each 1 GW nuclear plant reduces annual emissions be approximately 6 Mt CO2-e. At a cost for new-build nuclear of $3 billion[10] and a lead in time of 10-15 years it can be seen that nuclear new build is not, for Australia, a timely nor cost effective response to climate change.

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[7] Switkowski Review, Chapter 7, p.97.
[8] Switkowski Review, Chapter 7, p.98.
[9] Commonwealth of Australia, 2004, cited: www.pmc.gov.au/energy_future, (The Energy White Paper).
[10] "Climate Change and Nuclear Power in Australia", Speech delivered to University of Melbourne by Dr Ziggy Switkowski, 12 June 2007.

14. In his essay "Reaction Time: Climate Change and the Nuclear Option", Professor Ian Lowe cited Barry Naughten, formerly a senior economist with the Australian Bureau of Agricultural and Resources Economics (ABARE):

> "..a major model-based analysis by the International Energy Agency in June 2006 analysed cost-effectiveness of technologies that could together reduce emissions at 2050 by 60 per cent. Not all these scenarios included expanded nuclear. Indeed, the IEA noted that many of its members-states opposed such expansion. But even in a scenario where such expansion was assumed, nuclear was found to account for only 6 per cent of the total emission abatement compares with 44 per cent from improved end-use energy efficiency, with the remain 50 per cent from a variety of other technologies."[11]

15. The third assumption that I have made is that there will however be implemented in Australia a carbon tax in the short term and some sort of emissions trading scheme in the mid-term. Both these measures will have the result of making coal-based power more expensive and will also prevent the development of any further coal-fired power stations.

16. I would also like to make the following disclaimer.

17. This paper is written on a speculative assumption that a government has been elected seeking to develop nuclear power in Australia. I have not sought to indicate whether I support or oppose nuclear power. Nuclear power in Australia is a highly charged and emotive issue. At present there are significant barriers to any further consideration of nuclear energy in Australia. But any debate about this issue must be as factual as possible. Over 15% of the world's energy is produce by nuclear energy, and significant resources are being spent on research and development of the next generation of nuclear power plants.

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[11] "Reaction Time", Ian Lowe. Quarterly Essay, Issue 27, Black Ink, Australia, 2007.

18. In December 2009, The Economist, reported on "nuclear's next generation"[12]. This report looked at the work of the Generation IV International Forum ("the GIF") and potential development of a new breed of nuclear reactors. It highlighted the significant resources being spent on these developments.

19. For these reasons it is important to continue the debate. In this paper, whilst I have highlighted the issues as they currently affect any further development I have also suggested that the first step in the process must be the development of an appropriate legislative framework a national approach to the regulation and also the construction and operation of nuclear power plants in Australia. This is the first step without which I can see no future for nuclear power in Australia.

Australia and its future energy needs

20. The 2004 White Paper "Securing Australia's Energy Future"[13] ("the Energy White Paper") set out 3 priorities for Australia and its energy needs: prosperity, security and sustainability. The Report, prepared by the energy Task Force accepted that there was a projected increase in Australia's energy needs by 50% by 2020. This would be met by up to AU$37 Billion in investment in energy developments.[14]

21. The Energy White Paper noted:

> Australia's access to domestic energy resources is amongst the best in the developed world. Australia has sufficient stationary energy sources to meet its electricity and heating needs for hundreds of years, significant petroleum resources, and good access to imported petroleum products.[15]

22. This is a crucial matter. For most economies are nett energy importers, especially China, Republic of Korea, Japan and Europe. Australia is a significant energy

[12] The Economist Technology Quarterly, December 12, 2009, pp.14-17.
[13] Energy White Paper
[14] Energy White Paper, p.2.
[15] Energy White Paper, p.21.

exporter. The introduction of nuclear power into the mix in Australia may actually have a negative impact of energy security due to the need to be reliant on third-parties to process and enrich the uranium. There is one obvious advantage to the cocaine-like addiction to coal generated power in Australia – it can simply be dug up and burnt. No processing or reprocessing or enrichment is required.

23. The Switkowski Review was based primarily in the context of the required demand for Australia's electricity to be expected to continue to grow at an average rate of 2% per year from 2005 more than doubling by 2050.

24. However, as the review noted, the significant exporting of energy by Australia, through the mining and exporting of coal, coal gas and uranium, is compared to the consumption of fossil fuels including coal, oil and gas that contributes to more than 60% of Australia's greenhouse gas emissions. Australia currently relies on black and brown coal for approximately 70% of its power and energy needs. In respect of electricity generation in 2003, black coal produced 128 TWh, brown coal 50 TWh, gas 34 TWh and hydro 16 TWh for a total generation of electricity of 234 TWh.

25. Australia contains approximately 38% of known low-cost global reserves and 23% of global uranium is produced in Australia. The obvious benefits in an age of energy security can be seen by the acknowledgment that Australia's resources for low-cost reserves of uranium would be sufficient to meet Australia's nuclear energy needs even assuming the high-level targets in the Switkowski report.

A short overview of the nuclear industry in Australia.

26. The history of Australian involvement in the nuclear fuel cycle is illustrative of an advanced OECD country taking initial steps to develop and promote the nuclear technology and then abandoning the nuclear option to continue its reliance on coal and other fossil fuels. Uranium was first discovered in Australia in 1894 and during and after World War II, the UK and Australian Governments conducted explorations to find and exploit potential uranium deposits.

27. Following the initial civilian nuclear reactor commencing operations in 1955, the High Flux Research Reactor (HIFAR) was commissioned at Lucas Heights in 1958. The reactor was run under the auspices of the Australian Atomic Energy Commission (AAEC) which was established in 1953. The HIFAR was initially constructed as a mechanism for testing materials that were to be then used in the development of a fully fledged nuclear power plant.

28. From 1969 until 1971, the government of the time considered the development of nuclear power and in particular a site a Jervis Bay in the south coast of NSW (but actually a territory of the Commonwealth and under the direct jurisdiction of the Commonwealth) as a site for Australia's first nuclear power plant. Although some development of roads occurred, the plan to develop a nuclear power plant was abandoned in 1971.

29. Australia did come close to being a nuclear energy producer. As noted by Owen:

> Currently, Australia has no commercially operating or planned nuclear power reactors and, as a nation well endowed with low-cost reserves of coal, this position would have been unlikely to change in the foreseeable future were it not for the threat of an impending global environmental crisis arising from the combustion of fossil fuels and a government commitment to a solution based upon a 'technology fix' through its international Climate Action Partnerships.
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> However, this has not always been the case. Following the report of a feasibility study, in October 1969 the then Prime Minister (Gorton) announced that the Commonwealth government would construct a 500 MWe nuclear power station on Commonwealth land at Jervis Bay on the south coast of New South Wales. Tenders were obtained, and site preparation and environmental studies were undertaken by the Australian Atomic Energy Commission (AAEC). This was viewed as just the beginning of a substantial commitment by Australia to nuclear power. At the Australian and New Zealand Association for the Advancement of Science conference in May 1971, the Chairman of the AAEC, Sir Phillip Baxter, was quoted as stating that Australia's nuclear power capacity would reach 22.5 GWe by 1995, and 36 GWe by the year 2000, or 27.2 and 32.8 per cent respectively of projected total installed electricity capacity from all sources. (Both of these projections were way off beam. Installed electricity capacity from all sources was actually 37.7 GWe in 1995 and 46.6 GWe in the year 2000, whereas Baxter's projections

> implied capacity of 82.7 GWe and 110GWe respectively in those years.) Baxter's crystal ball was abruptly shattered just a few months later when the Jervis Bay project was deemed to be uneconomic and all construction plans deferred. Subsequently the project was abandoned and the prepared site now serves as a car park."[16]

30. In 1972, the ALP under Gough Whitlam was elected to power and all plans for the development of a nuclear power industry in Australia were shelved. It was not until 2006 that there had been any serious discussion in Australia about the development of a nuclear power industry.

31. Any activity around nuclear focussed on the Lucas Heights Research facility. The Australian Nuclear Science and Technology Organisation ("ANSTO") was created in 1987 to replace the Australian Atomic Energy Commission ("AAEC"). The AAEC was established in 1953 and Lucas Heights, about 35km south of the Sydney CBD, was selected as a site for a nuclear research facility. In 1958 the High Flux Australian Reactor was commissioned at Lucas Height.

32. The 10 megawatt HIFAR was a multi-purpose reactor used for research and making radioactive products for Australian nuclear medicine and industry. Moata was a very small 100 kilowatt reactor used mainly for materials testing and teaching. HIFAR, which shut down in 2007 after 49 years of operation, and Moata, which ended 34 years service in 1995, are being managed in care and maintenance programs while full decommissioning plans are concluded and approved.

33. In 2006 the 20MW Open Pool Australian Light water reactor (OPAL) was commissioned, replacing HIFAR.

34. Additionally, and perhaps importantly, Australia was also the site of combined UK-Australian nuclear tests and both Maralinga in South Australia and Montebello Islands of the north-west coast of Western Australia. These tests occurred over a period from 1955 to 1963 and included exposing Australian

[16] Owen, 2006, p.197.

servicemen and indigenous people to the effects of fall-out. A Royal Commission into the atomic tests was conducted and delivered its report in 1985. A consequence of this report and its findings was further clean-up costing AU$100 million , which was completed in 2000, and a payment of compensation in 1994 of AU$13.5 million to the local Maralinga Tjarutja people.

35. Debates in the 1980s and 1990s centred on the involvement of Australia in the mining and export of uranium and the treatment of nuclear waste from Lucas Heights. The development of a number of uranium mines were the subject of extended and bitter political debate which ultimately led to the adoption by the ALP in 1982 of a “3 mines policy” which enabled the continuation and exploitation of existing uranium mines without allowing for any further mines to be opened. Under the government of John Howard, a further mine at Honeymoon has been development which has only recently started to produce uranium for export.

Figure 1 Uranium mines and areas of uranium exploration, 2005

From: Figure 2.1 Switkowski Report, p.22

The key findings of the Switkowski Review

36. The Switkowski review[17] produced, perhaps not surprisingly, a generally supportive document that proposed as an option a series of steps to achieve a potential of 25 reactors by 2050 producing approximately a third of Australia's estimated electricity needs. However the review also identified a number of impediments to Australia's increased participation in the nuclear fuel cycle.

[17] Switkowski Report, p.2ff.

The fuel cycle

37. For the purposes of this paper it is important to recognize that any consideration of the development of nuclear power must be assessed from the total fuel cycle. In 2010 it is not possible to consider the construction of a nuclear power plant in isolation. Unlike coal, a product which can be mined and then shipped to a coal fired power plant for burning, there are many more complex steps required to convert uranium deposits into power.

38. Also when consideration is given to the low-carbon footprint of nuclear it must be acknowledged that the operation of the nuclear power reactor may be low in GHG emissions, the production and development of both the fuel and the reactor itself will involve the production of GHGs. To this end Owen uses a life cycle analysis (LCA) when considering the economics of nuclear energy.[18]

39. The total fuel cycle comprises a number of activities, the possible combinations of which provide the various fuel cycle options. These activities are:

(a) uranium mining and milling;
(b) uranium refining and conversion to hexafluoride;
(c) uranium enrichment;
(d) fuel fabrication;
(e) reactor operation;
(f) spent fuel storage;
(g) spent fuel reprocessing;
(h) radioactive waste management; and
(i) decommissioning of nuclear facilities[19]

40. Owen uses the following LCA definition:

> Life-cycle analysis involves the following methodological steps:
> - Definition of the product cycle's geographical, temporal, and

[18] Owen, p.199.
[19] Owen, p.198.

technical boundaries;
- Identification of the environmental emissions and their resulting physical impacts on receptor areas; and
- Quantifying these physical impacts in terms of monetary values[20]

An overview of the key findings of the Review

41. The review identified that there was a serious skill shortage as a consequence of the inactivity of the Australian Government and Australian industry in nuclear reactor management and development.

42. The decommissioning of the HIFAR and the replacement of HIFAR with the Open Pool Australian Light Water Reactor (OPAL) in 2006 makes the facility at Lucas Heights the only nuclear reactor in Australia. It is only used for research and the production of medical isotopes. It is not permitted by legislation to be used for power generation.

43. The Review identified that there was potential for $1.8 billion of annual value if Australian uranium was processed domestically. It was clearly noted that there were significant commercial and technological barriers to market entry including the concerns expressed that the stages of the development of nuclear fuel had impacts on Australia's obligation under the Nuclear Non Proliferation Treaty.

44. The report identified that nuclear power was likely to be between 20% and 50% more costly to produce than power from a new coal fired power plant at current fossil fuel prices in Australia.

45. It identified that the earliest possible time at which energy could be delivered to the national electricity grid would be 10 years, although a 15 to 20 year timeframe was more probable. This assumed a 2010 start date. It was suggested that at the outset there should be the establishment of a single national nuclear regulator

[20] Owen, p.199.

supported by an organisation with skilled staff. Again, staff shortage for such a regulator was identified as a significant impediment.

46. One scenario advocated by the review was for the deployment of nuclear power with 25 reactors producing a third of the nation's electricity by 2050 and it was noted that this position was already surpassed by France, South Korea, Sweden, Belgium, Bulgaria and Hungary.

47. In respect of the issue of health and safety, the report drew considerable distinctions between the types of current reactor designs, and those the subject of the incidents at Three Mile Island in 1979 and the Chernobyl nuclear disaster in 1986.

48. It was also clearly identified that the issue of disposal of nuclear waste was a significant impediment both in the costing of the lifecycle analysis of the nuclear fuel cycle and in public acceptance of nuclear power. The proposal referenced the decision by the Federal Government to seek to identify a national waste repository for low-level waste. The question of disposal of high-level waste including spent nuclear fuel was identified as an issue with the suggestion of appropriately engineered deep underground repositories as being a suitable response. However, the issue of reprocessing of spent nuclear waste was also highlighted as an issue that required resolution.

49. One of the key aspects identified as a significant impediment for any future nuclear energy development in Australia was the need for a strong and transparent regulatory regime. The current legal situation was also given some consideration. The review acknowledged that it would be a necessary pre-requisite to any further consideration that legislation would need to be enacted to enable the development of nuclear power. Presently, the development of nuclear power, and indeed the trans-shipment of the materials needed to produce nuclear power, are restricted or prohibited in all States in Australia.

50. As a federal constitutional system, the Constitution of Australia provides under s.51 the powers of the Commonwealth Parliament. These are enumerated powers such as anything not falling within s.51 of other provinces of the States. There is nothing in the Constitution that provides the Commonwealth with any power respect to the generation of electricity or indeed the creation and development of nuclear power. The question of a constitutional challenge to any Commonwealth legislation purporting to overrule State legislation with respect to the planning and siting of a nuclear power plant is a very real one.

51. The Review was tasked with considering Australia's involvement from the mining and export of uranium to the conversion, enrichment and fuel fabrication and the use of nuclear fuel for the production of energy.

52. The processes enumerated by the Switkowski Review identified the issue of conversion, enrichment and fuel fabrication.

53. In terms of processes, the uranium oxide is required to be converted into uranium hexafluoride (UF_6) for enrichment. Four (4) companies supply more than 80% of the world's uranium conversion services and it was noted that no new investment or real production expansion has occurred since 2000. In terms of conversion, it was acknowledged that the capacity is adequate to meet demand in the near to medium term.

54. Following conversion, there is the requirement then to enrich the uranium to increase the share of U235 in uranium from its naturally occurring 0.07% to between 3% and 5%. Enrichment, it was noted, was classed as a nuclear proliferation-sensitive technology because of its potential to be used to produce weapons grade material[21]. The enrichment market was also concentrated and structured around a small number of suppliers in the United States, Europe and Russia. The report noted that it was charactered by high barriers to entry,

[21] Switkowski Review, p.4

included limited and costly access to technology, trade restrictions, uncertainty around the future of secondary supply and proliferation concerns.

55. The third step in the process is the fabrication and assembly into appropriate reactor fuel of the enriched uranium. The Switkowski review noted that fuel fabrication market is characterised by customisation, with the specification designs dependent upon reactor designs and the fuel management strategy of each power utility.

56. Three (3) main suppliers currently provide approximately 80% of the global fuel demand and indications are that capacity significantly exceeds demand.

57. One of the clear messages from the Review was that whilst nuclear power was an international proven technology that was competitive with fossil fuel base load generations, current estimates suggested that nuclear power would on average be 20% to 50% more expensive to produce than coal fired power if pollution, including carbon dark side emissions was not priced.

58. The prime focus on the electricity generation side of the equation, including the cost of new build for nuclear reactor, was clearly predicated on the need for a fossil fuel based carbon tax which was cited in the main report as being in the order of AUD $15 to $40 per tonne of carbon dioxide equivalent.

59. It is clear from another major report produced in May 2006 for ANSTO by Professor John Gittus[22], that the cost of generating electricity in Australia for coal and CCGT was approximately AUD $40 to $43 per MWe.h (dollars per mega watt electricity hour). The cost of generating electricity of coal rises to approximately $80 per MWe.h if there is an internalised cost for potential damage due to carbon emissions and rises to AUD $52 per MWe.h for CCGT. Even under Gittus' hypotheses, any new build of nuclear power remains greater in terms of cost of generating electricity until the nuclear power plant is the 5th to 9th

[22] Gittus, J, "Introducing Nuclear Power to Australia – an economic comparison", May 2006, ANSTO.

plant of an already built type of nuclear power plant. Gittus' report uses a scenario where Australia will build a copy of the AP1000 power plant.[23]

60. The other significant matter identified in the Switkowski Review as providing an issue to be addressed was the safe disposal and treatment of both low-level and high-level waste. As is noted clearly in the report; *"no country has yet implemented permanent underground disposal of high-level radioactive waste"*.[24]

61. The previous Federal Government moved on the identification of sites for low-level waste but was required to use it power with respect to territories to seek to approve those in the Northern Territory of Australia when locating sites in specific states became politically difficult.[25]

62. The regulation issues acknowledge that the establishment of nuclear fuel cycle facilities including enrichment plants, fuel fabrication plants, power plants and reprocessing facilities, were prohibited under the *Environment Protection and Biodiversity Conversation Act 1999* (the EPBC Act) and the *Australian Radiation Protection and Nuclear Safety Act 1998* (the ARPANS Act). These Acts would need to be amended to repeal those prohibitions prior to any involvement of an Australian or foreign company in the development of nuclear power.

63. The report noted that the need for appropriate regulatory supervision would also create a significant burden on Australia's existing scientific community and would likely require the importation of both workers and regulators from overseas countries. Given that the IAEA already identifies that there are approximately 439 reactors already in operation with approximately 36 nuclear reactors under construction, the strain on the international nuclear scientific community in providing for building 25 reactors in Australia would seem insurmountable.

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[23] Gittus, p.43. Gittus also considered a number of economic scenarios and options to produce a detailed assessment of the economics of new-build nuclear in Australia. The Report has also been the subject of criticism. See also the Research Report on the Economics of Nuclear Power by Greenpeace, November 2007.
[24] Switkowski Review, p.6.
[25] *Radioactive Waste Management Act 2005* (Cth).

64. The report also identified the importance of community involvement in the development of any nuclear industry:

> *Community acceptance would be the first requirement for nuclear power to operate successfully in Australia. This would require informed discussion of the issues involved, including the potential costs and benefits of nuclear power. Important aspects to explain would be the full cost basis for nuclear power, including a suitable mechanism to set aside funds progressively over the life of the operation of a power station, in order to make provision for decommissioning and waste management and disposal.*[26]

65. A further aspect that has been raised in the context of the debate about the nuclear fuel cycle is the issue of nuclear fuel leasing. Nuclear fuel leasing refers to the supply of fuelled reactors and the subsequent management of the reactor spent fuel essentially as a whole of life concept. One of the scenarios proposed to the Switkowski Review was the requirement that any Australian uranium should be subject to some internationally approved nuclear leasing arrangement such that Australia, or the company supplying the uranium, would be ultimately responsible for the end use product.

66. As noted by the report:

> *"the nuclear fuel leasing concept in Australia relies on the appropriate local disposal of high-level waste that would arrive from the use of Australian uranium leased by overseas utilities"*[27]

67. As the development of the nuclear industry grows and indeed as Australia's involvement in the nuclear industry increases, whether from the export of uranium or from any potential involvement in the utilisation of nuclear fuel for the generation of power, a significant growth in transport of nuclear waste will occur. As identified by Mark Beaufoy[28] there is a significant increase in the amount of material of a radioactive nature being transported by sea. The estimates of 20

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[26] Switkowski Review, p.13.
[27] Switkowski Review, p.43.
[28] Beaufoy, M, "Is the Law of the Sea ready for nuclear leasing", The Macquarie Journal of International Comparative Environmental Law, 2006, Vol. 3, p.91

million movements annually include all radioactive materials including those related to medicine, agriculture, research, manufacturing, non-destructive testing and minerals exploration. However, the World Nuclear Association reports that, *"some 300 sea voyages have been made carrying spent nuclear fuel or separate high-level waste over a distance of 8,000,000 km"*. [29]

68. For example, in Japan, the article notes that since 1969 more than 160 shipments of spent fuel have taken place from Japan to Europe for reprocessing involving more than 4,000 casks and moving several thousand tonnes of highly radioactive spent fuel.[30]

69. In addition, Australia has also exported spent nuclear waste from Lucas Heights to Dounreay in Scotland for the purposes of reprocessing.

The Regulatory Regime in Australia

70. The Switkowski Report highlighted the need for significant legislative reform required for the introduction of nuclear energy in Australia.

A question of power

71. As noted above Australia has a federal system of government. Under the Australian Constitution the Commonwealth government has certain enumerated powers for which it is entitled to pass laws under s.51. All other matters are reserved for the States. If the Commonwealth has the power to make a law, there is also a provision under s.109 of the Constitution for a Commonwealth law to override a State law to the extent of any inconsistency.

72. The States may also agree to refer a matter to the Commonwealth for the purposes of allowing the Commonwealth to pass a law not otherwise provided for in the Constitution. This has been done on a number of occasions, in particularly with respect to family law matters. For example, the Commonwealth has the power to

[29] Beaufoy, p.100.
[30] Beaufoy, p.100.

legislate with respect to marriage and divorce but this did not extend to de facto relationships or the consequences following separation of un-married partners.

73. The are six states and two territories[31] in the Commonwealth. The Commonwealth has the power to override the territory governments and has done so in the recent past. Recent legislation in respect of a site of a low level hazardous waste facility in the Northern Territory in one example. As discussed below under the location of nuclear power plants currently the most likely locations for a nuclear power plant would be the ACT and Jervis Bay in southern NSW, which is a part of Commonwealth land, designed as the port for Canberra, the nation's capital, and which was the site chosen in the 1960s for Australia's first nuclear power plant. Such plans did not eventuate.

74. Section 51 provides for the Legislative powers of the Parliament however nothing relating to energy production or nuclear power exists in the document. Drafted in the late 1890s and adopted in 1900 it stays silent on many modern matters.

51. The Commonwealth has used s.51(xxix) External Affairs power to extend the reach of Commonwealth law in a number of ways, including with respect to the domestic implementation of obligations created under treaties. It is under this head of power that the Commonwealth established RPANSA[32], as implementing its obligations under international treaty.

52. The Australian Nuclear Science and Technology Organisation ("ANSTO") was established in 1987 to replace the Australian Atomic Energy Commission, that had been set up in 1953. It is primarily a research organisation but is also required to manage and store radioactive material and radioactive waster arising from its activities. It also has a commercial aspect. [33]

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[31] New South Wales, Victoria, Queensland, South Australia, Western Australia, Tasmania and the territories of the North Territory and the Australian Capital Territory.
[32] The Radiation Protection and Nuclear Safety Authority.
[33] S.5 (1) The functions of the Organisation are:

53. Australia is a party to the international legal instruments relevant to its current nuclear activities and is implementing all current international obligations through domestic law and administrative arrangements. Under the Treaty on the Non-Proliferation of Nuclear Weapons (NPT), Australia has undertaken to accept International Atomic Energy Agency (IAEA) safeguards set out in the Agreement between Australia and the IAEA for the Application of Safeguards in Connection

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(a) to undertake research and development in relation to:
(i) nuclear science and nuclear technology; and
(ia) the application and use of nuclear science and nuclear technology; and
(ii) the production and use of radioisotopes, and the use of isotopic techniques and nuclear radiation, for medicine, science, industry, commerce and agriculture; and
(iii) such other matters as the Minister directs; and
(b) to encourage and facilitate the application and use of the results of such research and development; and
(ba) to condition, manage and store radioactive materials and radioactive waste, arising from:
(i) the Organisation's activities (including the production of radioactive materials for other persons); or
(ii) the activities of companies in which the Organisation holds a controlling interest (including the production of radioactive materials for other persons); or
(iii) the use by other persons of radioactive materials produced by the Organisation or such companies; or
(iv) the activities of other persons who are specified in the regulations; and
(bb) to condition, manage and store radioactive materials and radioactive waste generated, possessed or controlled by the Commonwealth or a Commonwealth entity; and
(bc) to condition, manage and store radioactive materials and radioactive waste at the request of:
(i) a law enforcement agency; or
(ii) a Commonwealth, State or Territory agency responsible for the management of emergencies or disasters;
including, but not limited to, radioactive materials or radioactive waste involved in, or arising out of, a radiological incident or a radiological emergency; and
(bd) to condition, manage and store radioactive waste that has been, or is to be, sent to Australia under contractual arrangements relating to the conditioning or reprocessing of ANSTO spent nuclear fuel; and
(c) to produce, acquire, provide and sell goods, and to provide services, that are:
(i) in connection with the production and use of radioisotopes, and the use of isotopic techniques and nuclear radiation, for medicine, science, industry, commerce and agriculture; or
(ia) in connection with the conditioning, management and storage of radioactive materials or radioactive waste; or
(ib) in connection with nuclear science and nuclear technology; or
(ic) in connection with the application and use of nuclear science and nuclear technology; or
(ii) otherwise in connection with matters related to its activities; and
(d) to act as a means of liaison between Australia and other countries in matters related to its activities; and

(e) to provide advice on aspects of:
(i) nuclear science and nuclear technology; and
(ii) the application and use of nuclear science and nuclear technology; and
(iii) other matters related to its activities; and

with the NPT. Australia has also ratified the Additional Protocol to its safeguards agreement with the IAEA.

54. Australia is a party to the Convention on the Physical Protection of Nuclear Material (CPPNM).[34] The Convention establishes the standards for the physical protection of nuclear material and nuclear facilities. The IAEA Information Circular INFCIRC/225/Rev.4 provides detailed guidance on the physical security standards applicable to nuclear material and facilities. Australia implements the standards in the CPPNM and INFCIRC/225/Rev.4.[35]

55. Australia is a party to the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management. The Joint Convention establishes a harmonised approach to national waste management practices and standards. Australia is also a party to the Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter[36] and the Convention for the Protection of the Natural Resources and Environment of the South Pacific Region.[37] International transport of radioactive material is subject to two sets of rules: transboundary movement rules and technical standard rules.[38] The IAEA Transport Regulations reflect international best practice and are incorporated into Australian domestic legislation.[39]

56. The following table, taken from the Switkowski Review, shows the complexity of the current regulatory environment for the mining, transportation and management of material within the nuclear fuel cycle.

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[34] Australia is in the process of ratifying the Amendment to the Convention on the Physical Protection of Nuclear Material that will strengthen the Convention.
[35] Although IAEA Information Circulars are not directly binding on countries, the standards outlined in INFCIRC/225/Rev.4 have been widely implemented among IAEA member states.
[36] Also known as the London Convention.
[37] Also known as the SPREP Convention.
[38] For example, the standard of packaging for the transportation of radioactive material.
[39] Switkowski Report, p.117ff.

Table 9.1 Regulatory responsibility across levels of government for nuclear activities in Australia

Activity	Regulatory responsibility	Key Legislation/Regulations
Uranium Mining	Commonwealth	*Safeguards Act 1987Atomic Energy Act 1953* *Environment Protection and Biodiversity Conservation Act 1999* *Environment Protection (Alligator Rivers Region) Act 1978* *Aboriginal Land Rights (Northern Territory) Act 1976*
	Northern Territory (mining permitted only at existing uranium mines)	*Mining Act 1980Mining Management Act 2001*
	South Australia (mining permitted only at existing uranium mines)	*Mining Act 1971 Development Act 1993* *Radiation Protection and Control Act 1982* *Roxby Downs (Indenture Ratification) Act 1982* *Environmental Protection Act 1993*
	New South Wales & Victoria (exploration and mining prohibited)	*Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986 (NSW)* *Nuclear Activities (Prohibitions) Act 1983 (Vic)*
	Queensland & Western Australia (exploration permitted, government policy prohibits new uranium mines)	
	Tasmania (no legislative prohibitions on exploration or mining)	
Conversion, enrichment, fabrication and nuclear power generation	Commonwealth (prohibited)	*Environment Protection and Biodiversity Conservation Act 1999* *Australian Radiation Protection and Nuclear Safety Act 1998* *Safeguards Act 1987*
	New South Wales & Victoria (prohibited)	*Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986 (NSW)* *Nuclear Activities (Prohibitions) Act 1983 (Vic)*
Transportation	Commonwealth	*Safeguards Act 1987*
	Northern Territory, South Australia, Queensland, Western Australia, New South Wales, Tasmania & Victoria (transportation of radioactive material permitted, comply with the ARPANSA Transport Code)	*Radioactive Ores (Packaging and Transport) Act (NT)* *Radiation Protection and Control Act 1982 (SA)* *Radiation Safety Act 1999 (Qld)* *Radiation Safety (Transport of Radioactive Substances) Regulations 1991 (WA)* *Radiation Control Regulations 1993 (NSW)* *Radiation Protection Regulations 2006 (Tas)* *Radiation Act 2005 (Vic) (to come into force September 2007)*
Waste Management	Commonwealth	*Commonwealth Radioactive Waste Management Act 2005*
	States and Territories	*Radiation Safety Act 1975 (WA)* *Radiation Control Act 1977 (Tas)* *Radiation Safety Act 1999 (Qld)* *Radiation Protection and Control Act 2004 (SA)* *Radiation Act 1983 (ACT)* *Radiation Control Act 1990 (NSW)Radiation Protection Act 2004 (NT)* *Radiation Act 2005 (Vic)*

	Western Australia, South Australia & Northern Territory (transport and storage of nuclear waste prohibited)	*Nuclear Waste Storage and Transportation (Prohibition) Act 1999 (WA)* *Nuclear Waste Storage Facility (Prohibition) Act 2000 (SA)* *Nuclear Waste Transport, Storage and Disposal Prohibition Act 2004 (NT)*
Nuclear Research[40]	Commonwealth	*Australian Nuclear Science and Technology Organisation Act 1987* *Australian Radiation Protection and Nuclear Safety Act 1998* *Safeguards Act 1987*
Export and Import Control	Commonwealth	*Customs Act 1901*[41]

57. Under the Australian Radiation Protection and Nuclear Safety Act 1998 (Cth), ("the ARPANSA Act") [42] there is a prohibition on the operation of a nuclear installation which includes a nuclear fuel fabrication plant; a nuclear power plant; an enrichment plant; or a reprocessing facility. This legislation would need to be amended to permit the operation of a nuclear power plant. To do so would require a majority in both houses of Parliament, which the present government does not have.[43]

58. It can be noted from the table that in NSW and Victoria there is specific prohibition on the generation of nuclear power. In 2007 Queensland also banned

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[40] Radioactive material generated by ANSTO that is used in medical, research and industrial applications is regulated by state and territory legislation

[41] As outlined in *Customs (Prohibited Exports) Regulations 1958* and the *Customs (Prohibited Imports) Regulations 1956*.

[42] Section 10. Prohibition on certain nuclear installations

(1) Nothing in this Act is to be taken to authorise the construction or operation of any of the following nuclear installations:

(a) a nuclear fuel fabrication plant;
(b) a nuclear power plant;
(c) an enrichment plant;
(d) a reprocessing facility.

(2) The CEO must not issue a licence under section 32 in respect of any of the facilities mentioned in subsection (1).

[43] There is also a prohibition of the grant of approval for any nuclear installations under the Commonwealth's environmental impact assessment legislation, the *Environmental Protection and Biodiversity Conservation Act 1999 (Cth)* at s.140A and s.146A. Nuclear actions and nuclear installations are defined under s.22 of the EPBC Act. Under s.21 "nuclear actions", including the mining of uranium and the transport of radioactive waste require an approval by the Minister for the Environment.

nuclear power stations, nuclear facilities and radioactive waste dumps under the *Nuclear Facilities Prohibition Act 2006 (Qld)*.

59. Under the NSW legislation, s.8 provides as follows:

> **8 Constructing or operating certain nuclear facilities prohibited**
>
> (1) In this section:
> ***nuclear facility*** means:
>
> (a) a facility for the conversion of uranium ore into uranium hexafluoride or any other chemical in order to enable its enrichment,
> (b) an isotope separation plant or other facility for the enrichment of nuclear material,
> (c) a fabrication plant or other facility for transforming nuclear material into a form suitable for use as fuel in a nuclear reactor,
> (d) a nuclear reactor, whether or not designed for the purpose of generating electricity,
> (e) a reprocessing plant or other facility for the chemical separation of fuel that has been irradiated in a nuclear reactor, or
> (f) a separate storage installation for the storage or disposal of any nuclear material (including radioactive waste material) in the nuclear fuel cycle, being nuclear material used in or resulting from any of the facilities described in paragraphs (a)–(e).
>
> (2) A person shall not construct or operate a nuclear facility.
>
> Maximum penalty: 1,000 penalty units.
>
> (3) Nothing in this section prevents:
> (a) the construction or operation, under an Act of the Commonwealth, of a nuclear facility by the Australian Atomic Energy Commission or by any authority of the Commonwealth that replaces that Commission,
> (b) the construction or operation of a facility for the storage or disposal of any radioactive waste material resulting from the use of nuclear materials for research or medical purposes or for any other purpose authorised under the *Radioactive Substances Act 1957*, or
> (c) the operation of a nuclear powered vessel.

60. Furthermore the State is also prohibited from constructing or operating a nuclear reactor to generate electricity. [44]

> **9 State authorities not to construct or operate nuclear reactors to generate electricity**
>
> Without affecting the generality of this Act, nothing in any other Act authorises an authority of the State (including an electricity generator within the meaning of the *Energy Services Corporations Act 1995*) to construct or operate, or to approve or permit the construction or operation of, a nuclear reactor for the purpose of generating electricity or any other form of energy.

61. The Queensland legislation adopts similar provisions to the Victoria legislation but inserts in s.21 the requirement for a state plebiscite to be held if the Commonwealth takes steps towards the construction of a prohibited nuclear facility in Queensland. [45]

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[44] The provisions of the *Nuclear Actitivies (Prohibition) Act 1983 (Vic)* are similar:
s8. (1)A person shall not construct or operate—
(a) a mill for the production of uranium or thorium ore concentrates (except where permitted under section 6);
(b) a facility for conversion or enrichment of any nuclear material;
(c) a facility for the fabrication of fuels for use in nuclear reactors;
(d) a nuclear reactor or a nuclear power reactor;
(e) a facility for reprocessing spent fuel; or
(/) a facility for the storage or disposal of any nuclear materials (including any waste) resulting from any of the processes or facilities described in paragraphs *(a)* to *(e)*.

[45] s. **21 Plebiscite if the Commonwealth takes steps for a prohibited nuclear facility**
(1) This section applies if the Minister is satisfied the government of the Commonwealth has taken, or is likely to, take any step supporting or allowing the construction of a prohibited nuclear facility in Queensland.
(2) Without limiting subsection (1), the Minister may be satisfied as mentioned in subsection (1) if the Minister is satisfied the government of the Commonwealth—
(a) has taken, or is likely to take, steps to make or amend a law of the Commonwealth or to exercise any power under a law of the Commonwealth to facilitate the construction of a prohibited nuclear facility in Queensland; or
(b) adopts a policy position of supporting or allowing the construction of a prohibited nuclear facility in Queensland.
(3) The Minister must take steps for the conduct of a plebiscite in Queensland to obtain the views of the people of Queensland about the construction of a prohibited nuclear facility in Queensland.

62. In 2007, Western Australia also introduced legislation[46] that would have prohibited the construction of a nuclear power plant. The legislation did not pass before a change in government.

63. Absent however a specific obligation created by an international treaty there exists a real question of whether the Commonwealth would have the power to pass legislation that would allow for the construction and development of a nuclear power plant in any State. The Commonwealth has the power to pass laws that affect the Northern Territory and the Australian Capital Territory.

64. Planning remains a state matter. Currently there is no provision in any State planning law that would permit an application to be made to build a nuclear power plant.

Transport and shipment of nuclear material.

65. Most States and Territories prohibit the transport and storage of nuclear waste. Most States significantly regulate the transportation of items involved in the nuclear fuel cycle, including uranium and fuel.

66. As noted in the Switkowski Review:

> U_3O_8, which is classified as a Class 7 Dangerous Good, is transported by rail, road and sea in 200 litre drums packed into shipping containers (Class 7 is a United Nations classification for Dangerous Goods applying to radioactive materials). Australian regulatory standards for transport meet international standards. However, uranium transport restrictions arise from: negative public perceptions; regulations that exceed international standards; and consolidation in the international shipping industry that limits the scheduled routes and ports where vessels carrying uranium can call (and Australia requires trans-shipment countries to have agreements in place). The effect is to reduce the choice of shipping firms and routes, increasing delays and costs.

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(4) The Minister must take the steps required by subsection (3) at a time the Minister considers most advantageous to the health, safety and welfare of the people of Queensland.

[46] *Nuclear Facilities Prohibition Bill 2007 (WA).*

> Higher levels of security in transport modes apply in the current heightened security environment.
>
> Such factors contribute to the reluctance of some transport companies, local councils, and the federal and state governments, to be involved in or allow transport of uranium. For example, governments in New South Wales, Victoria, Queensland and Western Australia have refused permission to allow export of uranium through their ports, leading to scheduling difficulties, higher costs and extended delivery times. Restrictions on transport may limit expansion of Australian uranium exports.[47]

67. It can be seen from the above discussion that the current federal structure, without any clear head of constitutional power for the Commonwealth makes for a very confused and complex legal regime. Without some rationalisation of the legal regime there are significant disincentives for the development of the nuclear power industry in Australia.

Locating potential nuclear power plants

68. Currently opinion polls indicate that about 50% of the Australian population opposes nuclear energy[48] with two-thirds saying that they would oppose the building of a nuclear power plant in their local area. In a recent publication the Australia Institute[49] considered the question of locating nuclear power plants. The debate promoted by then Prime Minister Howard in 2006-2007 and the Switkowski Review discussed the options for 12-20 reactors in Australia to be built over the next 30 years. The Australia Institute Report looked at the possible sites for such reactors and the implications that follow.

69. Planning and development matters fall in the jurisdiction of the States and territories. Any approvals for the construction of a nuclear power plant would thus

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[47] Switkowski Report p.30
[48] "Siting Nuclear Power Plants in Australia, were would they go?" Andrew Macintosh, Research Paper No 40, Australia Institute, January 2007.
[49] The Australia Institute is a progressive think-tank based in the ACT (one potential location for a nuclear power plant).

need to satisfy state based Ministerial approvals. Without some form of overriding mechanism for assessment and approvals it is likely that each state and territory could impose its own guidelines and criteria on any proposed nuclear power plant.

70. Based on four primary criteria 19 sites were identified. The four criteria adopted were:

- proximity to appropriate existing electricity infrastructure;
- proximity to major load centres (i.e. large centres of demand);[50]
- proximity to transport infrastructure to facilitate the movement of nuclear fuel, waste and other relevant materials[51]; and
- access to large quantities of water for cooling[52].

71. Seven secondary criteria were then used to identify potential issues for those sites (which are referred to below). The selected sites were:

- in Queensland – Townsville, Mackay, Rockhampton, Gladstone, Bundaberg, Sunshine Coast and Bribie Island;
- in New South Wales and the Australian Capital Territory – Port Stephens, Central Coast, Botany Bay, Port Kembla and Jervis Bay/Sussex Inlet;
- in Victoria – South Gippsland, Western Port, Port Phillip and Portland; and
- in South Australia – Mt Gambier/Millicent, Port Adelaide and Port Augusta/Port Pirie.[53]

72. Having identified, through the reference to recent Australian opinion polls and research carried out in Japan, that "when people assess the value of nuclear power at a general level, they weigh both the perceived risks and potential benefits. Yet when it comes to a siting situation, perceived risks become the overriding factor and the weighting given to potential benefits is greatly diminished"[54] the paper then identified that, in common with all major infrastructure projects, early site identification was essential for project assessment.

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[50] Switkowski Review, p.55
[51] Macintosh, p.8
[52] Macintosh, p.9
[53] Macintosh, p.1
[54] Macintosh, p.4

73. Macintosh noted:

> The degree of concern about nuclear power suggests that the domestic debate about establishing a nuclear energy industry must consider possible locations for power plants. At the most basic level, the public cannot accurately evaluate whether it is willing to support a nuclear industry unless it has an idea about where the power plants are likely to be located. In the absence of this information, the Government is asking the community to make decisions in the abstract without being fully informed. Further, from a practical perspective, if the Government wants to proceed with the establishment of a nuclear industry, early identification of potential sites provides decision-makers with a greater opportunity to persuade the relevant communities to support the construction of nuclear power plants in their local areas. In addition, local opposition to siting decisions is likely to have a profound impact on the manner in which any future nuclear industry develops, meaning that it is critical that siting issues are discussed at the earliest possible opportunity.

74. Having considered the 4 primary criteria Macintosh considers the specific characteristics of each of the sites.[55] These were:

- Population density;
- Geological and seismological issues;
- Atmospheric conditions;
- Security risks;
- Sensitive ecological areas;
- Heritage areas;
- Economic issues.

75. In respect of population density it is suggested that nuclear power plants be located in sparsely populated areas. Referring to Finland, which was also studied by the Switkowski Report, Macintosh states:

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[55] In respect of the need for water Macintosh relies on an assessment by Dr Ian Rose for the Queensland government that concluded that the preferred option for nuclear power stations would be 'one based on evaporative cooling from a reliable fresh water source'. However as Macintosh notes at p.9 "due to the current condition of Australia's freshwater resources, it seems more likely that nuclear power plants would use seawater for cooling purposes".

> In order to minimise health and safety risks, regulators often require staged buffers around nuclear power plants. For example, in Finland, the Radiation and Nuclear Safety Authority (STUK) has identified three zones. The first zone is the site of the power plant and it extends to approximately one kilometre from the facility. Within this area, permanent settlement is prohibited and the operator of the facility should have authority over all activities carried out in the area. The area can include a public road, but only if the volume of traffic is small and the traffic can be diverted elsewhere in an emergency.
>
> The second zone (known as a protective zone) extends to approximately five kilometres from the facility. Development is restricted in this zone to exclude sensitive activities (for example, hospitals) and high density settlements and prevent unsuitable growth in the number of permanent residents.
>
> The third zone (the emergency planning zone) extends to about 20 kilometres from the facility. Plans are required to be prepared for this area to ensure the evacuation of people in an emergency. Guidelines issued by the Authority state that:
>
> > [t]he emergency planning zone may not contain such populations or population centres as would render impossible the efficient implementation of rescue measures applicable to them (STUK 2000, p. 4).[56]

76. Similar guidelines are applicable in the USA.[57] It must be noted that in Australia the only operating nuclear facility has been located in an urban population zone since its construction. The 10MW HIFAR (replaced in 2007) and the 20MW OPAL Reactor are located at within 4km of the suburb of Lucas Heights. Development around Lucas Height has increased to the extent that it is now a suburban environment rather than a rural-residential setting.

77. In respect to geological and seismological issues the following criteria were identified[58]:

- the prevalence and likely magnitude of earthquakes;

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[56] Macintosh, p.10
[57] United States (US) Code of Federal Regulation (USCFR 2003) and regulatory guidelines issued by the US Nuclear Regulatory Commission (USNRC 1998).
[58] As noted by Macintosh at p.11; "Japan is located in one of the most seismically active regions in the world, yet it currently has 56 nuclear reactors and plans to build another 12".

- the prevalence and likely magnitude of seismically-induced floods and tsunamis;
- soil and rock stability;
- slope stability; and
- proximity to aquifers and risk of groundwater contamination.

78. In respect to atmospheric conditions two issues where considered. The first was whether extreme weather events could affect the safe operation of the nuclear power plant and the second was how atmospheric conditions could affect the dispersion of radioactive materials and other pollutants from both routine releases and accidents.[59]

79. In respect to the final four secondary criteria these were matters applicable to all large infrastructure projects that required the project to be assessed to ensure that adverse environmental and economic impacts were minimised.

80. In providing an assessment of the constraints and opportunities at each of these sites[60] one of the interesting issues that arise is that only 4 of the sites identified did not have an existing coal or gas fired power station in the same area. The issue of co-location is an interesting one. Certainly if nuclear is to replace coal then there may exist some infrastructure benefits in such co-location.

81. The second issue is that the island state of Tasmania was excluded due to it reliance on existing hydro and both Western Australia and the Northern Territory was excluded on the basis that they are not connected to the national energy market (NEM).[61]

82. Again the Report was to identify potential sites based on specific criteria. Macintosh made no assessment of the fact that in Queensland, New South Wales

[59] Macintosh, p.12.
[60] Macintosh, Table 1,p.16-23.
[61] Macintosh, p.24.

and Victoria, the possible location of 16 of the 19 sites, the construction and operation of a nuclear power plant is prohibited under state legislation.

Conclusions

83. It can be seen that there are some significant barriers to any future development of nuclear power in Australia. Leaving aside the societal issues of a long term opposition to nuclear power there are economic, technical and regulatory issues.

84. Whether or not the nuclear industry can persuade the Australian public in general, and local communities in particular, to allow the building of a nuclear power plant the key regulatory issues need to be addressed as a priority.

85. As a first step Australia needs to development national comprehensive legislation for the regulation of nuclear power. This should include a national scheme for the assessment of any proposals to build nuclear plants, including any proposals for community and public consultation and avenues for legal challenge to any approvals. Such legislation should also provide for a national body to oversee and manage the transport of radioactive material and waste.

86. Without a national framework, underpinned, by a transparent national regulatory system, a proponent would face an uncertain future.

87. Ultimately the decision to actually build a nuclear power plant in Australia will be driven by economic considerations. At present even the most optimistic assessments of the nuclear industry conclude that it is not currently profitable. Assuming that the first step is completed, and Australia does adopt a carbon tax or an emission trading scheme, the price of nuclear power becomes competitive. But until Australia decides that it can no longer support the coal industry and repudiates coal burning electricity generation nuclear power will remain on the horizon.