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Submission

Submarine Institute of Australia

05/PROP/2040

SUBMISSION REPORT ON THE DEVELOPMENT OF THE NON-FOSSIL FUEL ENERGY INDUSTRY IN AUSTRALIA

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A SUBMISSION BY THE SUBMARINE INSTITUTE OF AUSTRALIA TO

THE HOUSE OF REPRESENTATIVES STANDING COMMITTEE ON INDUSTRY AND RESOURCES SHALL INQUIRE INTO AND REPORT ON THE DEVELOPMENT OF THE NON-FOSSIL FUEL ENERGY INDUSTRY IN AUSTRALIA.

A SUBMISSION BY THE SUBMARINE INSTITUTE OF AUSTRALIA INCORPORATED

1. INTRODUCTION

1.1 THE TERMS OF REFERENCE

This submission will focus on the strategic importance of Australia's uranium resources and relevant industry developments.

We are conscious of the limitations of the TOR and see them as one piece of a large jig saw. The Institute suggests it is difficult to draw sensible or balanced conclusions without addressing the questions raised by the inquiry in the context of the broader context of an Australian energy policy, global developments in the energy field and, more broadly, of Australia's longer term strategic outlook and defence force capability planning.

The Institute takes a wide view of 'industry', within which we include Australia's nuclear academic, medical, engineering, technology and mining capabilities.

Finally, as is appropriate for an Institute focused on matters submarine, we wish to draw out some of the defence implications arising from consideration of this issue, particularly as they might apply to Australia's submarine capability in the future.

2. DISCUSSION

2.1 AN AUSTRALIAN ENERGY POLICY

Australia's energy policy promulgated in the White Paper Released by the Government in June 2004 [1] addresses many of the issues; however it dismisses nuclear power generation as an option for Australia without any serious examination. It is time to re-examine this issue – 'events of the past 10 months have shot the ground out from under the white paper'. [2]

The questions to be addressed in such a policy examination would include:

- What are Australia's energy requirements in the medium to longer term? This should include:
  - *Energy required to desalinate fresh water.*
  - *Reducing our dependency on hydro carbons for transport.*
  - *Reducing our green house emissions.*

[1] Securing Australia's Energy Future, Australian Government, June 2004
[2] No Time To Be Over A Barrel, Allan Fels & Fred Brenchley, AFR, 5 May 2005.

- What technical options exist to meet these?
  - *These are well canvassed in the 2004 White Paper, with the notable exception of nuclear power.*
- What is the world energy situation and trends for the medium term, say 30-50 years?
  - *Including those of global energy supply and demand.*
  - *ABARE predicts that world energy demand will more than double in the period 2010 – 2050.* [3]
    - *How will this affect our access to the increasing amount of oil we will need to import and the price we will have to pay for it?*
  - *Australia's energy demand grew by 28% in the period 1990 – 98 and is forecast to grow by at least this much again by the end of the decade*[4].
- How can Australia's greenhouse gas emissions be reduced to improve out environment and meet our global obligations to reduce emissions?
  - *Australia's stationary energy sector accounts for 48% of our total green house gas emissions, electricity generation accounts for 69% of green house gas pollution produced by this sector*[5].
- What is Australia's capabilities to meet its future energy needs against this backdrop?
- What is nuclear energy's role in meeting these needs within this context?
  - *In the USA, where it supplies 20% of electrical energy,* [6] *nuclear generated electricity maintained its position as the cheapest producer of electricity last year.* [7]
- What is the industry, academic, engineering and technology capability required to underpin this contribution to Australia's energy supplies?

3. AUSTRALIA'S NUCLEAR INDUSTRY CAPABILITY AND ABILITY TO CONTRIBUTE TO THE GLOBAL ENERGY AND ENVIRONMENTAL SOLUTIONS

3.1 A Source of Uranium For Fuel

Australia has an outstanding strategic asset in its uranium stocks:

- The largest stock of the world's known, economically recoverable uranium. [8]

[3] Nuclear Option Looms Large, Alan Mitchell, AFR 16-17 April 2005
[4] COAG Energy Policy Details – 8 June 2001
[5] Current Energy Situation, The Sustainable Energy Authority Victoria
[6] A Case For Nuclear Generated Electricity, Scott W Heaberlin, table 7.4
[7] Going Nuclear: It's The New Green, Leslie Kemeny, The Age, 28 April 2005.

- The second largest producer of uranium from mines in 2003 (Canada was the largest). [9]

This standing is more impressive given the restrictions on the development of uranium mines in Australia.

Yet we do not fully exploit our world standing, we confine our industry to mine and mill the ore and leave the value adding of further processing to convert, enrich and produce fuel elements for power production to the end users of our ore.

- By restricting Australian industry's capacity to process the uranium ore the we restrict the economic return for our resources and deny ourselves the industry capability that would evolve from such activity.
  - *The breakdown of costs to operate a typical light water power reactor in the USA indicates that these additional 3 processing steps represent almost half the fuel costs to fuel the reactor.* [10]

An important consideration that this inquiry should address is the relationship between a more fully developed nuclear industry and Australia's role as an adherent and a proponent of the Nuclear Non- Proliferation Treaty (NPT).

- The NPT is a matter of great political and strategic significance.
- As a long-term supporter of the NPT, supporter of the IAEA and, since the mid-70s, proponent of a strict international nuclear safeguards regime, Australia has an enviable record in advocating extended controls on the proliferation of nuclear armaments.
- But Australia's role would acquire additional substance were it to be backed by a modern, efficient and properly regulated nuclear industry.

4. INDUSTRY, ACADEMIC AND R&D CAPABILITY

A promising start in the fields of nuclear education, research and development and engineering made by Australia in the 1950s has withered to a very low level.

- Australia's only school of nuclear engineering established at the University of NSW was disbanded in 1986 under considerable funding and political pressure. [11]
- Whilst ANSTO provides a national capability to advise on matters nuclear today, one wonders where the next generation of engineers and scientists will come from?

[8] Supply of Uranium, World Nuclear Association, August 2004
[9] World Uranium Mining, World Nuclear Association, July 2004
[10] Nuclear Engineering, Ronald Allen Kneif, Table 17-1
[11] A Power Too Good To Refuse, Leslie Kemeny, The Australian Newspaper, 30 March 2005.

4.1 PUBLIC PERCEPTIONS

There can be no doubt that the trenchant opposition of conservation groups to all things nuclear has been a major political factor in Australia's policy.

This stance against the nuclear power industry has not been validated by history.

- Despite the unfortunate accidents at Three Mile Island and Chernobyl, nuclear power has proved to be an extremely safe form of energy generation.
  - *These are the only major accidents to occur in over 11,000 cumulative reactor years of operation in 32 countries.* [12]
  - *The Chernobyl plant would never have been certified for operation under the regulatory regimes of Western countries* [13] *with nuclear power industries, due to reactor design shortcomings and lack of safe guards.*
- Despite these two accidents, nuclear power accounts for the lowest number of world wide deaths per million Megawatts of electricity generated in primary energy production in the 22 year period 1970 - 92 [14].The figures were:
  - *Coal – 342*
  - *Natural Gas – 85*
  - *Hydro – 883*
  - *Nuclear – 8*
- The waste generated by the nuclear fuel cycle requires careful handling, storage and disposal. The industry has a good record in doing so.
- For example in the US nuclear power industry no serious incidents were recorded in the 30 year period 1966 – 1997, 15 the popular image that waste from nuclear power stations poses an unmanageable risk or will overwhelm storage capacity overstates the case:
  - *Reprocessing the spent fuel removes a significant portion of the long term radioactive isotopes and allows this material to be reused in fuel to generate power.*
  - *Having taken this step the radioactivity of the balance falls quickly, it is 1/1,000 of the original level in 40 years and falls to the toxicity of the original ore in 300 years.* [16]

[12] Safety of Nuclear Power Reactors, World Nuclear Association, November 2003.
[13] A Case For Nuclear Generated Electricity, Scott W Heaberlin, p119.
[14] Safety of Nuclear Power reactors, World Nuclear Association, November 2003.
[15] A Case For Nuclear Generated Electricity, Scott W Heaberlin, Table 6.2
[16] Nuclear Electricity, Nuclear Waste, World Nuclear association, Chapter 5.1

- *The volume of waste generated is very low, typically less than 1% of the volume of ash generated from a coal fired power station.* [17]
- *Put another way, a 1,000 Megawatt Pressurised Water Reactor would produce 3 cubic metres of spent fuel per year.*
  - *This would be significantly reduced by reprocessing this spent fuel as only 3% of the original spent fuel emerges as high level waste from this process.* [18]
  - *This can be placed in a stable form, such as vitrification into glass blocks* [19] *pioneered by Australian scientists at ANU.*
  - *The balance of 97% the fuel can be recycled into new fuel.* [20]
- *Storing this waste safely to allow the radioactive decay to take place is important, but is not an insuperable problem.*
- *By comparison, the proposal that we should sequester and store CO2 from coal fired power stations would leave an enduring and growing legacy of stored gas with enduring toxicity.*

❖ Greenhouse emissions are a major global issue and a critical measure for any future construction of additional power generation in Australia.

- *Globally, burning coal produces about 9 billion tonnes of CO2 each year, 70% from power generation.* [21]
  - *Technologies to sequester and store the CO2 are perhaps 10 years off, the technical and economic viability have yet to be demonstrated.* [22]
- *Renewable energy sources such as solar and wind, can only be expected to meet a minor portion of the world's demands for electricity.*
- *In Australia's case they currently meet about 5% and this is only expected to grow slowly from this low base to approximately 10%.* [23]
- *Renewable energy sources suffer from a number of limitations as a base load power source; this is reflected in the relatively low potential expected from them above. They are relatively expensive compared to nuclear power.* [24]

[17] A Case For Nuclear Generated Electricity, Scott W Heaberlin, Table 6.5.
[18] Nuclear Electricity,World Nuclear association, Nuclear Waste, Chapter 5.1 - Nuclear Waste.
[19] Nuclear Engineering, Ronald Allen Kneif, p 570.
[20] A Case For Nuclear Generated Electricity, Scott W Heaberlin, p192.
[21] "Clean Coal Technologies", World Nuclear Association paper, July 2004
[22] Securing Australia's Energy Future, Australian Government, June 2003, p 75.
[23] Ibid, p 26.
[24] Nuclear Option Looms Large, Alan Mitchell, AFR, 16-17 April 2005.

Nuclear is the only technology currently available with a demonstrated ability to meet the base load electricity requirements in an economic and safe fashion, without adding significantly to the world's green house gas problem.

There can be no doubt that the anti nuclear campaign has been very successful in generating fear and concern in the minds of the public about nuclear generated electricity.

Achieving a more balanced and accurate understanding can best be addressed as part of a complete review of Australia's medium to long term energy needs and solutions to meet it, as advocated in the preceding section of this submission.

5. THE DEFENCE ASPECTS

There are many issues relating to the defence aspects of a developed nuclear industry in Australia. While the SIA appreciates that these issues go well beyond the terms of reference of this inquiry, it may be useful to summarise some of them for future reference. They include the role of nuclear energy as a power source for ships and submarines.

6. NUCLEAR ENERGY AS A POWER SOURCE FOR SHIPS

Small reactors, operating on similar principles to the Pressurised Water Reactors used in Western, second generation power stations have been used to provide energy (steam) to propel merchant ships, surface warships and submarines for 50 years.

- In the West they have proved to be reliable and safe, allowing mobility unrestricted by the need to refuel for the duration of the reactor fuel cycle, typically 10 years.
- More recently, submarine reactors have been designed to operate for the life of the vessel, 30-40 years without the need to refuel.
- Merchant ship applications have generally been confined to specialist vessels such as ice breakers.
- In warships the cost of construction and ownership has now restricted this technology to high value units, such as aircraft carriers and submarines.

7. WHY DOES AUSTRALIA HAVE A SUBMARINE CAPABILITY?

To appreciate the importance of submarine force in the defence of Australia it is necessary to summarise the capabilities they provide:

- A unique ability to operate in waters and under air space controlled by another, without counter detection, or causing a diplomatic incident.
- This provides an ability to operate throughout our region of interest conducting surveillance and intelligence gathering where necessary.
- The long distances involved require submarines with a long range and endurance, such as Australia's Collins Class 10,000 nautical miles and 10 weeks, to be effective.
- Submarines require a disproportionate amount of effort to counter and certainty can not be assured – there is always an element of doubt as to their location and intentions.
- In periods of tension the submarine force therefore provides a strong deterrent against an opponent escalating a situation to conflict.
- In the event of conflict, submarines are able to operate in an opponent's critical areas to observe and report back and when directed, conduct offensive operations.

8. REGIONAL SECURITY TRENDS AND THE IMPLICATIONS FOR THIS CAPABILITY

Australia's maritime interests stretch from the Persian Gulf, the source of much of our hydrocarbon energy, north to the North West Pacific and into the South West Pacific. Within this extensive region a number of maritime security trends can be noted in warship and surveillance capabilities.

Perhaps the most striking are the programmes China and India have underway to modernise and extend their maritime capabilities. To consider just some of the trends in submarine forces:

- The number of submarines is increasing and the level of capability rising as 9 [25] countries in the region acquire this capability for the first time or modernise and update their existing capability.
- China operates the largest regional submarine force.
  - *Their fleet includes both nuclear propelled attack submarines, nuclear propelled and armed ballistic missile submarines and conventional diesel electric submarines.*
  - *China is expending significant resources to modernise its' submarine force, utilising the latest technology, acquired from Russia.*

[25] Iran, Pakistan, India, Singapore, Malaysia, Indonesia, Taiwan, China, Japan

- India has a programme underway to acquire a current generation nuclear propelled attack submarine capability from Russia and is modernising its fleet of conventional submarines with Western and Russian vessels.

Air, surface and anti submarine surveillance systems in the region are also improving as new technologies and capabilities are introduced.

The bottom line is a growing degree of complexity and capacity to conduct offensive maritime operations by regional players and an increasingly difficult operating environment for Australia's submarines.

- Australia's submarines are a critical part of the Australian Defence Force's capacity to counter these trends.

9. THE ADVANTAGES OF NUCLEAR PROPULSION IN SUBMARINES

Nuclear propulsion allows the submarine to proceed at high speed without endurance constraints and frees it from having to expose itself to recharge its batteries.

- Nuclear propulsion confers impressive mobility that allows the submarine to respond quickly, (a particular advantage in the short notice contingencies expected to arise in our region) and greatly reduces the risk of counter detection of the submarine.

- Whilst non nuclear, air independent propulsion technologies, such as fuel cells, are available (and being introduced in regional submarines), these are of limited power and endurance, restricting the submarine's mobility when using this energy source.

- Non nuclear, air independent propulsion is generally used whilst loitering in an operating area to reduce the risk of counter detection; it does not improve the submarine's mobility on long transits or overall endurance without refuelling per se.

Given that the trends in the security environment noted above continue, it is highly likely that Australia will choose to replace its' submarine capability as Collins nears the end of life in 2020-2025.

The replacement of the Collins Class will undoubtedly require an air independent capability to operate safely and effectively in the more demanding security environment likely to prevail.

Nuclear propulsion should be considered as one of the options to meet this requirement given the mobility and endurance advantages.

- The potential demand for nuclear submarine propulsion in a new generation of long range submarines would of course depend on the changing strategic situation in which Australia might find itself.

10. THE INDUSTRY REQUIREMENTS TO SUPPORT A NUCLEAR POWERED SUBMARINE CAPABILITY

It is generally accepted that a nuclear industry, based on an indigenous power generation capability is essential to sustain a nuclear propelled submarine capability:

- ❖ All of the countries operating or introducing nuclear propelled submarines in our area of interest have an indigenous nuclear power capability.
- ❖ Without this capability in service support and maintenance would become extremely expensive and highly dependent on an overseas supplier.

11. THE LINK FROM NUCLEAR POWER GENERATION TO NUCLEAR WEAPONS

Power generation and its associated fuel cycle do not necessarily or easily lead to a nuclear weapons capability. It is possible to have either without the other.

- ❖ The levels of fuel enrichment for power generation are much lower at 2-5% than that of 95% required for constructing a nuclear weapon. [26]
- ❖ By products from used reactor fuel can be reprocessed to achieve these levels, but this is not a simple process, liable to be detected and is controlled under the Nuclear Proliferation Treaty. [27]

[26] A Case For Nuclear Generated Electricity, Scott W Heaberlin, p 165.
[27] Nuclear Engineering, Ronald Allen Kneif, p 602.

12. CONCLUSIONS

The June 2003 Energy White Paper concludes that Australia's energy requirements in the medium term can not be met without significant expansion of the base load electrical generation capacity. [28]

There are a number of issues which arise from consideration of this Paper:

- Renewable energy sources, whilst they should be fully exploited, will be unable to meet this additional requirement.
- Australia's gas reserves offer an additional power generation capability, particularly suited to short term load requirements, but can not meet the long term base load requirement economically.
- The current coal based capability poses significant green house emission problems.
- Further expanding the base load generation capability based on coal would only exacerbate this problem.
- Carbon sinks, carbon sequestration and other technologies to clean up coal fired power stations emissions appear unlikely to overcome these problems and pose economic and environmental issues – not least of the latter is the lasting legacy of stored CO2, should the technology prove feasible.
- The recent developments in the world energy supply have fundamentally altered the basis upon which Australia's energy policy has been drawn.

Although it was not considered in the Energy White Paper, nuclear energy would appear to have a significant contribution to make to meeting Australia's energy requirement.

- There are significant technical, regulatory and public policy issues to be addressed in resolving these questions.
- These issues will take some years to resolve.
- The time has come to address these issues.

This review is a small step on that path, but is addressing only a small portion of the question.

Australia's nuclear industry is at the minimalist end of the spectrum.

- It is probably sufficient to support the current deliberations; however it would require significant expansion, including investment in tertiary education to support the necessary expansion of industry to meet Australia's future requirements.

[28] Securing Australia's Energy Future, Australian Government, June 2003, p 69.

Regardless of the decision on utilizing nuclear energy for electrical power generation, the possibility exists to broaden Australian industry's capability by value adding and involving our current mining and milling industry in the preparation of nuclear fuel pellets for power stations.

These steps would enhance our flagging standing in the NPT regime and improve our capability to positively influence global outcomes.

Nuclear propulsion for warships, particularly submarines offers significant operational advantages in the regional security environment likely to prevail in the medium term (15-20 years).

Future decisions on Australia's submarine capability should consider the option of nuclear power.

This option will not be practicable without the support of a broadly based nuclear industry in Australia.

13. RECOMMENDATIONS

The Submarine Institute of Australia recommends that the Committee should:

- Note the need for development of an energy policy that addresses Australia's medium to longer term energy requirements and identifies solutions to meet it, including a full and dispassionate examination of the utility of nuclear power.
- Recognize that their report under the current terms of reference is a limited, but important contribution to this need.
- Note the wider implications for the use of nuclear energy that might arise from such broader considerations.
- Recognize that Australia's uranium resource represent a significant, growing national and global strategic asset.
- Consider the further development of the Australian nuclear industry to 'value add' to the use of Australia's uranium resources in the fuel cycle for nuclear power generation.
- Recognize the opportunity to support future defence requirements and enable future options to meet Australia's strategic circumstances by the use of nuclear propulsion for warships, particularly submarines that would arise from an enhanced nuclear industry.

The Submarine Institute of Australia would welcome the opportunity to elaborate on any aspect of the issues it has raised in this submission.