From: Geoff Fincher
To: Committee, Nuclear Energy (REPS)
Subject:
Date: Monday, 18 November 2024 5:22:48 PM
Attachments: Fincher Select Committe submission corrected.pdf

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Dear Secretariat,

Please find attached a corrected version of my previous submission to the House Select Committee on nuclear energy.

The corrections I have made relate to any implication in my initial submission that the Nuclear Energy and Net Zero symposium was convened by the two Australian scientific academies (AAS and ATSE). This was incorrect and those errors have been corrected in the attached 'Corrected Version'. I apologise for the need to correct this submission.

For the record, I would like to make it clear that the submission is from me as an individual and that the version of the NE&NZ Symposium Summary on the ATSE website is available only to ATSE Fellows and has not been subject to the comprehensive editing by ATSE. Hence, my submission does not necessarily reflect the views of either the AAS or ATSE.

With best wishes,

Geoff Fincher

Submission to the House Select Committee on Nuclear Energy

(Corrected Version)

Background

On 20th June 2024, an afternoon symposium entitled "Nuclear Energy and Net Zero" was convened in Adelaide. The overall aim of the symposium was to discuss the possible role, if any, of nuclear energy in Australia's push towards net zero carbon emissions.

Here, I would like to make a few general points, which will be focused on the main issues of concern that have been expressed by the general public in relation to Australia's potential inclusion of nuclear energy in our move towards to net zero carbon emissions.

Radiation danger to human health

Nuclear reactors have developed a poor reputation, mainly because of the high levels of radioactive material used and the potential for the escape of this radioactive material into the environment. There have been three major accidents involving large nuclear reactors, namely at Three Mile Island in the USA (1979), at Chernobyl in Russia (1986) and at Fukushima in Japan (2011). What have we learned from these three meltdowns?

a) Technological lessons have been learned and industry experts generally agree that the advances in nuclear reactor technology have reduced the chances of a similar meltdown or accidental release of radioactivity in the future to be essentially zero.
b) A very small number of human deaths or serious illnesses can be directly attributed to the three accidents. Indeed, analyses of the safest energy sources show that the safest sources with respect to the loss of human lives from accidents or air pollution are solar and nuclear energy, which have recorded 0.02 and 0.03 deaths per terawatt hour, respectively. These can be compared with values of 24.6, 18.4 and 2.8 deaths per terawatt hour for coal, oil and natural gas, respectively.

Conclusion: *Nuclear reactors pose little if any threat to human health or longevity.*

Disposal of spent nuclear fuel

In most current nuclear reactors, only a small proportion of the total radioactivity is used to generate usable energy. The remainder is stored or otherwise disposed of in a number of ways. These spent fuels can have half-lives of up to 1 million years. The general public is rightly concerned about the amount of this material and its safe storage or disposal. The primary concerns are related to the potential of the material to enter waterways or human or livestock food chains. Developing technologies are successfully addressing these concerns.

a) The amount of unused radioactivity can be drastically reduced and at the same time a much higher percentage of the total radioactivity of the nuclear fuel can be used for the generation of electricity. This higher efficiency of fuel usage is achieved by 'closing the nuclear cycle". Up to 10-fold more energy can be extracted from spent fuel in this manner, with concomitant decreases in the need for storage or disposal of spent fuel.
b) A portion of the energy generated in the nuclear reactor can be used to dramatically reduce the half-lives of the spent fuel, through a process known as transmutation. In this process the 'heavy' (i.e. high atomic weight) radionuclides in the spent fuels can be physically fragmented (transmuted) into 'lighter' radionuclides that have much shorter half-lives. For example, a

nuclear power plant manufacturer in Denmark is able to reduce spent fuel storage times from 10,000 to 300 years and even shorter half-lives have been achieved elsewhere for spent nuclear fuel.

c) Reliable technologies are available for the long-term storage of spent nuclear fuel and Australia has multiple sites where the spent fuel could be stored safely for centuries. Indeed, the local community in Kimba in South Australia recently approved the development of a local spent fuel storage facility, which was subsequently overruled by a citizen's jury.
d) International organizations monitor these issues, including the International Atomic Energy Agency, which oversees the IAEA Convention on Nuclear Safety, and the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

It is noteworthy that wind and solar farms also have a problem with spent wind turbine blades and solar panels, which have a finite life and cannot at this stage be recycled. Instead, they are being buried in landfills.

Conclusion: Requirements for long-term storage of spent fuel are decreasing rapidly, the half-lives of the spent fuel are becoming much shorter and suitable sites for storage of the material are readily available, in Australia and overseas. These perceived threats have therefore been laid to rest.

Cost and time overruns

The general public has been assured by opponents to nuclear power that the construction of large nuclear reactors is prohibitively expensive and is routinely plagued with unacceptably lengthy time overruns.

The most recent large nuclear power plant to be commissioned is the UAE reactor, for which cost estimates range from $20B to $32B. It took 9 years to build (2012-2021) and experienced several technical delays. The reactor was built by a Korean company. The UAE is planning a second reactor and, if the same company and basic reactor design are used, the cost and construction time are expected to be considerably lower.

About 30 countries are considering, planning or starting nuclear power programs, despite the perceived difficulties with cost and time delays. These countries are not necessarily wealthy. For example, Bangladesh, Egypt and Turkey are constructing their first nuclear power plants. Countries with aging reactors, including Japan and France, are upgrading and modernizing their reactors.

The Danish company Copenhagen Atomics is mass manufacturing thorium reactors at the rate of approximately one per day and estimate that the installation time of their reactors is 1,000-fold faster than construction times for conventional large nuclear reactors. These are smaller reactors with much lower inherent radioactivity than conventional uranium-based reactors but can be linked in series depending on local power requirements.

It is generally considered that the installation of renewable energy systems, such as wind and solar, are relatively fast, although one must compare installation times with the amount of energy produced. However, it is important to acknowledge that emerging renewable energy sources such as pumped hydro and off-shore wind are also beset with massive cost overruns, extended construction times and technical difficulties.

A potentially limiting factor with renewable energy sources is the availability of minerals such as copper and zinc that are essential for the construction of solar panels and wind turbines. Current world production of these minerals must be dramatically increased to meet the demand required for hitting our net zero targets through solar and wind alone. The IEA estimates that opening a new copper mine takes an average of 16 years.

While the current Australian government has baulked at cost estimates of less than $70B for developing a nuclear energy industry here, in a 2023 study the Universities of Melbourne and Queensland and Princeton University calculated that the cost of reaching net zero emissions by 2060 (including the replacement of all current fossil fuel exports) by relying completely on wind and solar and excluding nuclear, is $7-9 Trillion.

Conclusion: Claims that nuclear reactors are impossibly expensive and take too long to build, compared with wind and solar infrastructure, are simply not sustainable and are not supported by current evidence. It is hypocritical bias to single out and dismiss either nuclear energy or renewables on the basis of cost and time overruns.

The large footprint of wind and solar energy facilities

A concern increasingly raised by Australian regional communities relates to the large areas being cleared and allocated for wind and solar energy farms, with associated resistance against the construction of new and lengthy power transmission lines. More specifically, the concern relates to the construction of these wind and solar farms on productive agricultural land or at locations that interfere with valuable native ecosystems. An example here is the potential damage on-shore wind farms on the Nullarbor Plain might cause to underground limestone cave ecosystems

Central Australia has vast areas of sunny and windy country, where large scale solar and wind farms could be sited with minimal impact on agricultural production. However, these remote locations bring with them the need for long transmission lines, as mentioned above. In addition, solar and wind farms require relatively huge areas of land (100's of hectares each) compared with large nuclear reactors, which require just a few hectares of land. Further, nuclear energy plants could be located at sites of existing coal-powered electricity generators, which have the required transmission lines in place.

Conclusion: In this case, public concern for our future energy needs are focused on the large footprints of solar and wind farms and the need for multiple new transmission lines to be constructed.

Final comment

I wish to place on record that I support the development of renewable energy sources for our journey to net zero carbon emissions, but I am not yet confident that renewables will be capable of providing all our energy needs, including a robust baseload supply. I am also concerned about widespread claims on the faster deployment and lower costs of renewable energy sources, compared with nuclear power plants. In many cases these claims are exaggerated and are not supported by any credible scientific or economic evidence.

Emeritus Professor G. B. Fincher AO FAA FTSE DSc

18 November 2024