Submission to SA Nuclear Fuel Cycle Royal Commission: Professor John Quiggin, University of Queensland

My submission is addressed to question 3.2:

Are there commercial reactor technologies (or emerging technologies which may be commercially available in the next two decades) that can be installed and connected to the NEM?

My response to this question is in two parts

1. The only plausible contender is the Westinghouse AP-1000, along with possible modifications of this design.

2. Even for this design there is no prospect of deployment in Australia before 2040.

On point 1, given the requirement for safety standards appropriate to a developed country, it is necessary to rule out obsolete Generation II and (early) Generation III designs, along with reactors from middle-income and less developed countries with inadequate safety standards, notably Russian and China. Hence, attention should be confined to Generation III+ designs from advanced industrial countries, most notably those in North America, Western Europe and Japan.

Furthermore, any design should have a substantial record of safe and economical operation. As a country with no experience in the operation and management of nuclear power, Australia should not consider adopting 'leading edge' or 'first of a kind' designs, where the risk of failure is impossible to estimate, but has historically been high.

A minimal requirement would be 100 reactor years of operation. This would be sufficient to yield estimates of capacity factors and provide evidence on whether operational projections were valid.

It should be noted, however, that a track record of 100 reactor years provides only limited evidence on risks of catastrophic failure. A risk of catastrophic failure once every 100 reactor years might seem small. But if Australia were to construct 10 reactors (the probable minimum to achieve industry-wide scale economies) with a standard operating life of 40 years, the mean number of catastrophic failures would be four. Hence, a requirement for a track

record of only 100 reactor years of operation is very generous.

There is currently no Generation III+ design satisfying even these minimal conditions. However, on current (considerably delayed) plans there should be eight AP1000 reactors operating by 2020 or 2021. If these are completed as projected, there is the prospect of further deployment in the 2020s, so that the required experience would be realised sometime after 2030.

There is no serious prospect of any of the competing Gen III+ designs from developed countries being constructed in sufficient quantities to achieve 100 reactor years of operation in a relevant time frame. The most relevant contenders are the EPR (three reactors currently under construction or proposed) and Candu reactors (no reactors currently under construction or proposed)

Suggestions that more advanced designs (including Gen IV reactors, small modular reactors, fusion reactors, and thorium-based reactors), might be available within a relevant time-frame are fanciful. These designs have so far not implemented even in prototype form. I have developed this point further

http://johnquiggin.com/2014/04/20/another-one-or-more-bites-the-dust/

On point 2, I append an article published in *Inside Story*. This shows that, even if Australia could match the construction rates observed in the US, the time necessary to up a regulatory infrastructure and undertake greenfield site selection would delay the commencement of generation until at least 2050. Since the publication of this article, further construction delays have been announced for both US and Chinese AP1000 projects. On the basis of more recent US experience, even a 2040 startup date for Australia appears highly optimistic.

Here is a timeline which would be consistent with such a startup date. It may be observed that every stage in the process employs highly optimistic assumptions. For example, five years is allowed for a process running from initial site selection to the commencement of construction work. Projects far less complex and controversial than nuclear power plants routinely encounter delays longer than this. Similarly, a ten-year timeframe for construction would represent a substantial improvement on recent projects in the US and Europe.

May 2016: Royal Commission reports favourably on nuclear power

2017: SA government adopts pro-nuclear policy

2017-2020: Australia wide debate leads to majority support for nuclear power, and election of a Commonwealth Parliament willing to support nuclear power

2021-2023: Develop and legislate framework for nuclear power, create and staff nuclear regulatory agency, develop regulations covering safety, site selection, accident evacuation policy, waste disposal etc

2024-2030 License designs including safety standards etc. Receive proposals for construction

2026-2030 (in parallel) Select sites for up to 10 reactors, hold public hearings, issue and review environmental impact statements. Overcome local opposition and develop sites

2030-2040 Construct plants, undertake testing, connect to grid.