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*A Submission by **SMR Nuclear Technology Pty Ltd** to*

GenCost 2023-24 Consultation Draft

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EXECUTIVE SUMMARY

SMR-NT is concerned that the Australian Governments, Federal and State, are not receiving the complete up-to-date information to make an informed choice about the engineering and economic factors for the best mix of technologies for electricity supply.

For the GenCost 2023-24 report, CSIRO has again chosen not to receive expert advice on nuclear costs. Aurecon has again provided expert analysis of all technologies except nuclear. The last time that CSIRO obtained expert advice was from GHD in 2018 and, as raised in every nuclear inquiry since then, the accuracy of that analysis was very much in question, even to the extent that CSIRO admitted that the source of their high overnight cost was unclear.

CSIRO has attempted to prove that nuclear is too expensive to consider by quoting the cancelled UAMPS CFFP, but their analysis is misleading. We suggest that CSIRO should engage a consultancy with nuclear experience to review their analysis before the final version of GenCost 2023-24 is released. For example Hatch Consulting has extensive nuclear experience in Canada, USA and UK.

Source of the figures for the capital cost of an SMR

The last year that CSIRO contracted a company to produce SMR capital costs was GHD in 2018.

The high estimate of $16,000/kW was from GHD (2018), for a Gen IV (advanced reactor) to be constructed in 2035, with the source of the $16,000/kW said to be the WNA. The GHD figure was disputed in Federal and State nuclear inquiries and denied by the WNA. It is

inappropriate to use this figure and CSIRO admitted that 'the source was unclear". In the 2023-24 report CSIRO continues to state that the IEA *"Projected costs of electricity generation 2015 report* proposed that nuclear SMR typically costs 50% to 100% more than large scale nuclear and CSIRO claimed that using the 100% and recent nuclear costs justified the $16,000/kW figure.

The IEA updated their report in 2020 in their *Projected costs of electricity generation 2020 report.* This takes a more positive view of SMRs and instead of identifying an increase of cost of 50%-100% over large nuclear, the report now identifies that SMR costs could be lower. The IEA state this is due to:

"Simplification – passive mechanism improvements and greater design integration would reduce the number of components and result in containment building savings.

Standardisation – the lower power output of SMRs reduces the need to adapt to local site conditions, raising the level of design standardisation compared with large reactors.

Modularisation – smaller SMR size means that transporting their modules would be easier than for large reactors. In fact the degree of modularization increases considerably for power outputs of less than 500 megawatts of electrical capacity (MWe). This trend could be improved with more aggressive modularization techniques tailored to the logistical constraints and transport standards of each country. It is estimated that 60 – 80% factory fabrication levels are possible for SMRs with power outputs below 300 MWe (Lloyd, 2019)."

The continued use of this high figure due to a misinterpretation by GHD of an SMR project and an out-of-date IEA report is inappropriate.

CSIRO claim that this figure is also supported by the Economic and Finance Working Group SMR Roadmap EFWG 2019 Canada report.
This report surveys many countries. Table C-2: On Grid Inputs and Outputs Table for SMR-Evolutionary in 2030 has a high cost figure of CDN $9,476/kW = AUD 10,518/kW (current rate 1 CDN = 1.11 AUD).
Thus the EFWG report does not support a figure of anywhere near $16,000/kW, even with escalation and any additional allowance for Australian labour costs etc.

The Canadian report also states a 2030 low cost of CDN 4,837/kW = AUD $5,369/kW.
If CSIRO want to rely on the Canadian report, then it would be logical to use this low figure rather than the low figure of $15,844/kW for 2030 quoted in GenCost 2023-24 report table B.9.

Source of SMR capital cost figures for 2023

GenCost 2023-24 Consultation draft table B.9 *Data assumptions for LCOE calculations* for Nuclear SMR in 2023 has low and high capital figures of $31,138/kW.

CSIRO has produced this figure on their interpretation of the UAMPS (Utah Associated Municipal Power Systems) Carbon Free Power Project (CFFP) which planned to deploy a 6 module (total 462 MWeG) NuScale SMR at the Idaho National Laboratories (INL) site. UAMPS have over 45 members in 6 states, most are city utilities providing power in competitive markets. In 2021, there were 28 subscribers for the CFFP committed to a total of 103 MW at a LCOE of USD58/MWh (2020 $). The LCOE is the main *Economic Competitive Test (ECT)* for the project. At the January 2023 UAMPS briefing, it was announced that the LCOE had risen to USD 89/MWh (2022 $). As the LCOE was above USD 58/MWh, UAMPS members may withdraw from the project. For the project to proceed to the construction application stage, scheduled for January 2024, the 462 MWe plant output had to be 80% (370 MW) subscribed. By November 2023, it was clear that this was not going to be achieved and the project was mutually terminated.

The final LCOE for the project was USD 89/MWh = A$127 at the 0.7 rate used by CSIRO, so it would be expected that CSIRO's calculated LCOE would be of the same order. For their 2023 high Nuclear (SMR) LCOE figure in GenCost report 2023-24 Apx Table B.10 CSIRO has tabled a figure of $636/MWh – five times the high figure for the CFFP. CSIRO used a capital cost of $31,138/kW to obtain this figure, presumably from a total project cost. Aurecon provide CAPEX costs based on hypothetical projects and these are the Capital costs that CSIRO use for Table B.9 Data assumptions for LCOE calculations. As CSIRO state (draft p.15) "All costs are expressed in real 2023-24 Australian dollars and represent overnight costs". As Aurecon state "Project costs are highly variable and project specific" . For example, Aurecon do not include transmission costs, the CFFP budget includes transmission upgrades. Comparing total project costs with CAPEX costs is misleading.

It should also be noted that the NuScale design is new and has innovative features, for example the integrated steam generators, which will make the FOAK costs higher whereas the GE Hitachi BWRX-300 uses their existing licensed Economic Simplified Boiling Water Reactor (ESBWR) design and licensing basis to the fullest extent and is "designed to cost". GE Hitachi has been building Boiling Water Reactors (BWRs) since 1955.

Timing of deployment in Australia (GenCost draft section 2.4.5)

CSIRO quote a time of 15 years from a decision to build to first production for an SMR. The 15 years is not based on any analysis. The 15 years was given by ARPANSA as an immediate response to a question at a Senate inquiry.
GenCost Apx table B.9 Data assumptions for LCOE calculations lists a construction time for an SMR as 3 years which we would agree with. This means that the development period for an SMR would be 12 years, which we consider is too long.

CSIRO quote the projected time for the CFFP as further proof that 15 years is credible, without acknowledging that UAMPS asked for the project to be delayed as electricity demand was not increasing as expected. Also licensing of the first new generation SMR did

take the US nuclear regulator a long time and future SMR projects will benefit from the experience that the regulator has gained during this process. Although the deployment of an SMR in Australia would be a first for this country, it would already be licensed and proven in its vendor country and ARPANSA would be able to use the overseas licence and assistance from that regulator to speed up the licensing in Australia.

There is an example of a new nuclear reactor project in Australia. On 3rd September 1997 the Hon. Peter McGauran, Minister for Science and Technology, announced a replacement research reactor would be built at Lucas Heights. The construction licence was issued on 4th April 2002 by ARPANSA and the reactor entered production on 12 August 2006 – less than 9 years from decision to production. This multipurpose reactor (later named OPAL) is a much more complicated project than a power reactor and was a First of a Kind (FOAK) project.

An international example of nuclear construction is the four APR-1400 power reactors at the Barakah Nuclear Plant in the United Arab Emirates (UAE). The decision to deploy nuclear power was announced in April 2008 and construction of the first reactor completed in March 2018, again within 10 years. This project was from a "standing start" with no nuclear regulator or nuclear experience in the UAE, unlike Australia which has been involved in nuclear since the 1950's.
The International Atomic Energy Agency (IAEA) provided extensive support to the UAE as they did to Australia's OPAL project and would do again when Australia starts its nuclear power program.

As with the French nuclear power program in the 1970's, it demonstrates that nuclear projects can be completed in a ten-year timescale, if there is a will to succeed.

When Australia is looking at net zero by 2050, it is clear that there would still be time for nuclear power to make a significant contribution to our low emissions future, particularly as all the existing solar and wind plants will have to be replaced before 2050.

Development times for VRE projects and particularly supporting transmission can be long. In their report for GenCost 2023-24 Aurecon note that the development time for offshore wind is > 7 years.

Operations and Maintenance Data assumptions for LCOE calculations

With regard to nuclear O&M costs, the GenCost 2023-24 draft report Appx Table B.9 Data assumptions for LCOE calculations has SMR O&M fixed $200/kW, O&M variable 5.3/MWh as in previous reports.

The US EIA Feb 2021 report (Levelised costs of New Generation Resources in the Annual Energy Outlook 2021) includes O&M figures for new nuclear build in 2026:
Fixed O&M USD 15.51/MWh = AUD 22.2/MWh (rate 0.7)
Variable O&M USD 2.38/MWh = AUD 3.4/MWh (rate 0.7)

SMRs are expected to have lower costs because of the simple systems and passive safety systems requiring less maintenance.
I suggest CSIRO should review the AUD 200/kW fixed O&M figure for new build.

Some Concluding Points

All Australian governments and organisations look at the CSIRO-AEMO GenCost report as the authority on the costs of available technologies for electricity generation and base the economics of their energy policies on this document.

It is therefore vitally important that the GenCost report provides the best available information for all technologies. For many years, this has not been the case for SMRs. The last year that CSIRO engaged a company to produce a cost estimate for SMRs was in 2018 and the figures produced by GHD were widely considered to be inaccurate.

For the GenCost 2023-24 report CSIRO has attempted to use the cancellation of the UAMPS CFPP to prove that nuclear is too expensive to consider, but has produced misleading figures. We suggest that CSIRO should engage a consultancy with nuclear experience to review their analysis before the final version of GenCost 2023-24 is released. For example Hatch Consulting has extensive nuclear experience in Canada, USA and UK.

CSIRO has also attempted to prove that the deployment of SMRs would take too long, based on a comment at a Senate inquiry without any analysis.

SMR Nuclear Technology Pty Ltd has been pleased to provide this submission to the CSIRO GenCost 2023-24 Consultation Draft and as in previous years would be happy to clarify any issues.

Tony Irwin
Technical Director
January 2024