THE **Warren** CENTRE
FOR ADVANCED ENGINEERING LTD

3rd November 2014

Energy Green Paper Taskforce
Department of Industry
GPO Box 9829
CANBERRA ACT 2601

Email: www.ewp.industry.gov.au

To the Energy Taskforce

I have pleasure in submitting to you this response addressing nuclear energy, from The Warren Centre for Advanced Engineering. The White and Green Paper processes come at an important stage in Australia's energy development. I am pleased on behalf of my organisation to contribute our views to the consultation process and look forward to learning of your findings.

Yours sincerely,

**Ashley Brinson**
**Executive Director**



**The Warren Centre for Advanced Engineering Ltd**
School of Information Technologies Building, J12 THE UNIVERSITY OF SYDNEY NSW 2006 • Tel (02) 9351 3752 • Fax (02) 9351 2012
Email: warrenc@sydney.edu.au • Internet: www.thewarrencentre.org.au • ABN: 27 132 821 688

**Established within the Faculty of Engineering in 1983 to mark 100 years of engineering education at The University of Sydney**

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FOR ADVANCED ENGINEERING LTD

**Small Modular Nuclear Reactors**
**Project for Independent Base Load Power Supply Options for Off Grid/Remote Australia**

**RESPONSE TO THE DEPARTMENT OF INDUSTRY'S ENERGY GREEN PAPER**

**This response specifically addresses small modular reactors (SMRs)**

## SUBMISSION

This Response is made for the purpose of expanding the Green Paper's reference to the potential for nuclear energy and in particular the application of SMRs, Attachment 3, page 71 of the Energy Green Paper 2014.

## INTRODUCTION

The Commonwealth has sole jurisdiction and responsibility for nuclear energy by virtue of international nuclear treaties. Commonwealth policy setting is important in guiding the public debate and future of nuclear energy in Australia.

The Warren Centre (TWC) has had an active nuclear energy task force since 2011. This task force has focused on SMRs, being production units of < 250 MWe, of which there are many land based types under development worldwide. A number of these are potentially suitable for electricity production in remote areas and 'end of the line' applications in the East & West Coast Transmission Grids, to assist power flow, voltage and frequency control and complement the less stable supply from renewable energy.

TWC believes there is discernible and growing realisation in Australia that nuclear energy can be part of the low-carbon, non-fossil fuel mix in decades to come. Ideally, this would lead to a change in current policies of governments of both political persuasions, which are antipathetic to nuclear power. Investigation into the pros and cons of SMR technology for inclusion in the energy mix could well take place as a consequence of a positive nuclear position adopted in the White Paper, which TWC would support.

SMRs are in development globally and may offer a lower cost foray into nuclear energy generation in the near term. SMRs, once fully developed, tested and certified, will be able to provide safe, cost efficient electricity and heat, with low levels of waste.

SMRs are of comparatively simple design, will be factory manufactured under quality controlled conditions, relatively speedy to install, incorporate passive safety systems, with a life of up to 60 years, amenable to decommissioning and relocation, small Environmental Protection Zones (EPZ) i.e. minimum site area for safety, with fuel canister removal and return to supplier for disposal or reprocessing.

There are significant efficiency gains that arise from the nuclear reaction which can offer greater energy output per unit of fuel when compared with the combustion of coal. This efficiency, coupled with the long range life cycle of SMRs, could offer greater price stability than fossil fuel derived energy, a concept that is worthy of greater examination for industry and non-industrial applications. The examination and potential expansion of energy production industries would add to the Australian Government's recent announcement of seeking investment to lift our competitiveness and provide more opportunities in technology and high value manufacturing. Nevertheless, public perception is not attuned to advances in nuclear activity and, in particular, SMRs.

The contention of nuclear energy and its role in Australia's future warrants a collaborative study of SMR applicability that provides some policy certainty by way of Government and industry involvement. The result would be up-to-date, locally relevant information for public review.

Australia, through ANSTO, has a capable, working nuclear workforce which would provide the initial foundation for any potential expansion of the industry. Australia is also growing intellectual capability in the field of nuclear energy with the establishment of Nuclear Engineering at the University of New South Wales.

TWC believes there is a need now to address an on-the-ground Australian evaluation of tailored modular nuclear power generation for consideration in the future energy mix.

## PROPOSAL

To address the need for the evaluation described above, TWC proposes that the White Paper should recommend that a collaborative Study and Report ( co-funded by Government & Industry) should be commissioned which would independently evaluate the applicability of SMRs as a potential power supply in Australian off-grid remote and specific on-grid 'end of the line' locations.

A formal Submission to Government for support and shared funding with industry of such an Investigation and Report will be made in the near future by TWC.

The TWC believes it is important to stress that the proposed Study and Report will be restricted to the potential role of SMRs only in applicable Australian contexts.

## RATIONALE FOR THE WHITE PAPER SUPPORT

Australia's electrical energy sourcing and distribution system is unusual when compared with other developed countries. It has an elongated eastern grid, a western grid and a number of isolated systems serving major resource industries (e.g. Mt Isa and Pilbara) which have growth potential. There are also some relatively remote end-of-grid locations which are not overly robust and, if strengthened, would enhance agricultural and resource value adding and potential for water desalination, aiding decentralisation, adding significant economic and social value. SMRs could provide a solution that is relatively easy to mobilise for such locations.

Today's remote isolated utilities are powered by gas and diesel and solar systems. These isolated systems could benefit from the inclusion of one or more SMR units into the existing energy supply mix, either as air cooled or water cooled units, depending on location. While nuclear energy has a high up front capital cost compared with gas and diesel, asset life is long and operational costs are low, resulting in stable power prices with competitive levelised cost of energy.

## STUDY CATALYST

A TWC survey by two senior TWC members in 2011~12 was made of parties potentially interested in up-to-date comparative fuel-source technical data, plant suitability for Australian conditions and capital and operating costs, of SMR sourced power for remote locations. These parties included resource companies, some State Governments and utilities. The states covered, in the on-the-ground survey, were Western Australia, South Australia, Victoria, New South Wales and Queensland. Industrial consumers included principal iron ore and base metal miners in Western Australia, Queensland, Victoria and South Australia.

There was acceptance from all major resource companies of the need for contemporary SMR data for planning purposes and to inform a stable policy environment. Commitment from the Australian Government to explore this technology would enable a properly resourced examination to be undertaken with full support from industry.

## POSSIBLE STUDY SITES and STUDY METHODOLOGY

The program will first review the potential study sites indicated below, plus others that may be identified, to establish the operating requirements for remote area applications and the broad range of industrial processes that need to be considered. Harsh environmental conditions requiring air cooling and transport access will be key physical factors.

- Mt Isa augmentation/replacement of existing gas fired plant, air cooled (isolated grid with significant resource and primary industry value adding upside)
- Olympic Dam augmentation/replacement of existing gas fired plant, air cooled (potential for significant expansion and product value adding)
- Coastal Pilbara augmentation/replacement of existing gas fired plant, sea water cooled (established long term resource base)
- Inland Pilbara i.e. Roy Hill, new stand-alone site, air cooled
- Mixed development site , Eyre or Yorke Peninsula, South Australia, serving agriculture and fish processing value adding, resource development, port operations, desalination and transport, air and/or water cooled and grid connected
- Hybrid site, end-of-line e.g. Broken Hill, to be integrated with current wind and possible solar projects, air cooled and grid connected
- Selected locations accessible to established robust grid, replacing fossil fuelled base load plant e.g. Dubbo/Nyngan/Broken Hill.

The program will first review the potential study sites indicated above, plus others that may be identified, to establish the operating requirements for remote area applications and the broad range of industrial processes that need to be considered. Harsh environmental conditions requiring air cooling and transport access will be key physical factors.

Following selection of the study sites and the establishment of operating requirements, current and potential energy sources will be assessed to establish comparative power cost benchmarks.

Working groups will be established in three areas- technology, application and regulation.

- The Technology group will evaluate the emerging SMR technologies and their potential for commercial application, with particular reference to licensing, commercial availability, supplier pedigree, safety, fuel handling, waste disposal, transport of reactors, emergency shut-down, maintenance, and training requirements. This work will be centred predominantly in the USA employing specialist engineers from the project manager Worley Parsons, a firm with an established nuclear power track record.

- The Application group will study the real life application of the selected SMRs to Australian conditions taking into account availability of finance for this class of reactor, estimates of capital and leasing expenses, operating costs, power costs with forecast escalation and installation lead times. The capital and operating costs will be projected for SMR sourced power over a 20 to 60 year life span to compare these with conventional technologies.

- The Regulation group which will involve Australian Nuclear Science and Technology Organisation, ANSTO, will look at the options for a regulatory framework evaluating safety and environmental expectations with particular relevance to new emerging nuclear energy nations.

The project will proceed in three phases – data gathering, scenario modelling/testing and reporting.

The final phase will be to report the outcome to government and stakeholders. A web site will be established to facilitate this process and a number of reports published. The results will be presented through seminars and technical sessions and media connections, established at project inception.

**STUDY TEAM**

The project has been provisionally nominated by TWC and will be supervised by a steering committee chaired by TWC appointees.

A project advisory panel will be established under the leadership of Professor Barry Brook who holds the Foundation *Sir Hubert Wilkins Chair of Climate Change* at the Environmental Institute at the University of Adelaide. The Advisory Panel will provide strategic guidance to the project. Professor Brook will be joined by Dr Adrian Paterson, CEO of ANSTO and Dr George Dracoulis, Professor Emeritus, Dept. of Nuclear Physics, Australian National University.

Project management services will be provided by Worley Parsons an Australian listed engineering and project Services Company, an established international provider of nuclear engineering services. ANSTO will support the project with world-class advice on research, regulatory and safety regimes and innovation in nuclear technology.

For and on behalf of
TWC Project for Independent Base Load
Power Supply Options for Off-Grid/Remote Australia
The Warren Centre

**Ashley Brinson**
**Chief Executive**