"An industry update on global nuclear power and the opportunities for Australia"

Presentation by Dr Selena Ng (AREVA)

to the Annual Meeting of the Four Societies

(Australian Nuclear Association, Nuclear Panel of Engineers Australia,

Australian Institute of Energy and The Royal Society of NSW)

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Summary

Dr Ng commenced her presentation by outlining the capabilities of the AREVA group, which has a Head Office in Paris and facilities in many countries. She described AREVA as an integrated supplier to the nuclear power industry with its activities including uranium exploration, uranium mining (Canada, Niger and Kazakhstan), conversion, enrichment, nuclear fuel fabrication, construction of nuclear power stations, used fuel recycling and management of nuclear waste. AREVA does not operate nuclear power stations or final waste disposal facilities. The group's revenue in 2008 was €13B (A$26B) with an order book of €48B (A$96B) and it has over 75,000 employees worldwide. It has contributed to the construction of 100 nuclear power plants worldwide (25% of the world's plants) of which 81 are in Europe. The newest AREVA nuclear power plant design, known as EPR ™* of 1600 MWe capacity is under construction in Finland, France and China. AREVA's presence in Australia is mainly in the electrical transmission and distribution industry, as well as in uranium exploration.

Dr Ng then discussed the expected increase of about 2.5B in the world's population by 2050, with an associated demand for energy and especially electricity. This demand driver could see an increase in electricity from 20,000 to 30,000 terawatt-hours per year from 2008 to 2030 or over 2% per year on average. There are reasonable prospects that the 372 GWe of nuclear electricity in 2008 (or about 16% of the world's electricity) will increase to 635 GWe by 2030, a 70% increase or over 3% per year. If achieved, this increase requires the building of over 300 GWe of new nuclear plants (taking life extensions and reactor shutdowns into account) representing at least 180 new plants if they each had a capacity of 1600 MWe like the new AREVA plants. At present, France produces 80% of its electricity from nuclear plants. China by comparison produces only about 2% of its electricity from nuclear plants but has an ambitious program to produce 16% by 2030, and this needs two plants to be built every year.

Uranium resources are more widely distributed worldwide than oil and gas resources and this leads to greater resource security for countries which have sparse coal, oil and gas resources. This is one reason why many countries are turning to new nuclear build, including those with some nuclear plants already, some countries which had planned to close down existing nuclear plants and some new countries. A second factor is that climate change is being discussed seriously in many countries, especially in those with high carbon emissions (Europe, India, China, Japan, Australia). Many international organisations have endorsed nuclear power as important in reducing carbon emissions.

* EPR ™ is a trademark of the AREVA group

Many environmentalists criticise nuclear power for the emissions from the mining and processing of uranium but international studies have shown that the carbon emissions from the whole nuclear fuel cycle are far lower than those from fossil fuel cycles and are comparable with, or lower than, carbon emissions from many renewable sources of energy.

Dr Ng then discussed the issues which concern the general public and the difference between risk perception and risk reality. She posed the question: “Do you think it is safer to travel by air or by car.?” She commented that numbers, data and statistics of probabilities of accidents or deaths play only a small role in the public’s perception of risks. She commented also on the difference in perception of risk if the action was undertaken voluntarily instead of being imposed, was under the control of the person as opposed to control by authority, or was seen to give a clear benefit to the person. Although many thought flying was dangerous, driving a car is much more dangerous.

A nuclear accident is very low in the list of dangerous events compared to a coal mine accident and the risk of death from radiation is much lower than the risk from a car accident or cancer from smoking. The public thinks differently and believes “radioactivity is toxic and dangerous”. Dr Ng spent some time explaining that the world is a radioactive place with radiation coming from the earth, the atmosphere and the food we eat, and that it is part of all our bodies (due to radioactive isotopes of potassium and carbon). This natural level of radiation that we experience, and the levels that can be measured around nuclear power plants and fuel cycle facilities, are very low compared to the level of radiation that can cause death or serious injury. Fifty six deaths were attributed to the accident at Chernobyl over 20 years ago (including 28 plant workers who died from Acute Radiation Syndrome). About 4,000 more are expected to die eventually from cancer due to the massive release of radioactive material. Most of the consequences of this accident could have been prevented if the reactor had had a containment structure. This was demonstrated by the only other core-melt accident at Three Mile Island in the USA in 1979, which did not cause any radiation injuries or result in a significant radioactive release to the environment. Modern Western-designed reactors are invariably equipped with containment buildings to prevent the release of radioactivity if an accident should occur. She referred to the improved safety features of current designs such as the new AREVA EPR ^{TM*} reactor.

Dr Ng then turned to the public perceptions of risk from terrorism. She explained how difficult it would be for a terrorist group to obtain the fissile uranium or plutonium required for a bomb from civil nuclear plants in which the normal materials used were not suitable for making bombs anyway. The most probable risk was a terrorist making a dirty bomb, that is, mixing a radioactive material stolen from a hospital or commercial irradiation plant with a conventional explosive. Although this would create panic in the public and might kill persons near the explosion, the radioactivity consequences would be low. The chance of a successful 9/11 attack on a nuclear power plant by terrorists is low and the consequences of such an attack would be low because of the massive containment building and other safety features. Even flying a large aircraft into a typical modern reactor would have a very small consequence as compared with the Chernobyl accident.

Another public concern is the belief that radioactive waste could not be managed safely for long periods. Dr Ng explained that radioactive waste is separated into at least three kinds, low level, intermediate level and high level. The first two kinds do not pose long term risks and their safe

management has been widely demonstrated. The volume of high level waste is relatively small but the radioactive content poses two major problems which must be managed: firstly, plutonium isotopes and minor actinides with very long half lives, e.g 24,100 years for Pu239; and secondly, fission products with half-lives up to a few hundred years.

The problem of disposing of high level waste would be greatly reduced by reprocessing to remove uranium and plutonium for recycle. Technical experts consider that this high level waste can be packaged and safely buried deep underground, and that the funds provided by the users of nuclear power are sufficient to ensure this is done. The USA has operated a deep underground repository for its defence wastes for many years but is having difficulty obtaining approval for its proposed repository at Yucca Mountain in Nevada which is opposed by that state. Finland and Sweden have operated deep prototype repositories for some forms of spent fuel and are constructing final repositories for operation by 2020. Most other major countries with nuclear power stations are still identifying the most suitable sites for deep repositories.

Dr Ng then discussed the challenges and opportunities for nuclear power in Australia. The present government does not support the introduction of nuclear power in Australia even though it supports an expansion of uranium mining for use in overseas nuclear power stations. The review by the previous government chaired by Dr Switkowski had concluded that nuclear power could produce electricity at about $40-60 per MWh which was higher than that from coal but lower than from solar and wind, and that nuclear would become competitive even with coal if an effective price was put on carbon emissions from in future. This review and others had not persuaded the present government to allow nuclear power to be considered in the future energy mix. She did not see a likelihood of change in this policy unless the government's preferred energy sources of coal (with capture and sequestration of carbon dioxide), supported by solar, wind and hot rock sources, failed to meet its expectations.

With regard to combating weapons proliferation, Dr Ng pointed out that Australia is a world leader. It had established the Canberra Commission on Elimination of Nuclear Weapons in 1995 and the new Commission on Nuclear Non-Proliferation and Disarmament in 2008.

Dr Ng concluded by referring to two opportunities that Australian inventions offered to the world's nuclear industry. The first was the SILEX (Separation of Isotopes by Laser Excitation) process which was currently being developed in the USA by a General Electric/Hitachi consortium and which might lead to construction of an enrichment plant in the USA. The second was the SYNROC process for treatment of highly radioactive waste before disposal underground, which had been developed extensively by ANSTO and was currently being evaluated particularly for the treatment of wastes left over from nuclear weapons programs in the UK and USA. Besides uranium mining for export, these two inventions, together with efforts in nuclear non-proliferation, were the short-term opportunities seen for Australia pending a change in the government's attitude to upgrading uranium or nuclear power.

Summary by Dr Clarence Hardy, Dr Don Higson, and Dr Neil McDonald, ANA & Engineers Australia Nuclear Panel. Dr McDonald is also a member of the Engineers Australia National Fuel and Energy Committee.

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About the speaker - Dr Selena Ng is currently responsible for developing AREVA's nuclear activities in the Asia-Pacific Region and is based in Melbourne. She holds a BSc (Hons) from Monash University, a PhD in Theoretical Physics from the University of Cambridge and a Diploma in Management from the Collège des Ingénieurs. She worked for a number of years at AREVA's Headquarters in Paris on used fuel recycling and non-proliferation issues before returning to Australia in 2007.