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INQUIRY INTO NANOTECHNOLOGY IN NEW SOUTH WALES

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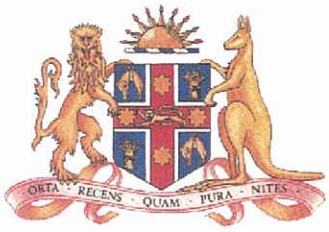

NSW GOVERNMENT SUBMISSION

TO THE

LEGISLATIVE COUNCIL INQUIRY INTO NANOTECHNOLOGY IN NEW SOUTH WALES

April 2008

INTRODUCTION

On 6 December 2007, the Minister for Science and Medical Research, the Hon Verity Firth MP, referred the terms of reference to Parliament for an inquiry into nanotechnology in New South Wales. The terms of reference are that the Standing Committee on State Development inquire into and report on nanotechnology in New South Wales, in particular:

a. current and future applications of nanotechnology for New South Wales industry and the New South Wales community;
b. the health, safety and environmental risks and benefits of nanotechnology;
c. the appropriateness of the current regulatory frameworks in operation for the management of nanomaterials over their life-cycle;
d. the adequacy of existing education and skills development opportunities related to nanotechnology;
e. the adequacy of the National Nanotechnology Strategy in the New South Wales context; and
f. the level of community understanding of nanotechnology and options to improve public awareness of nanotechnology issues.

The NSW Government welcomes this opportunity to make a submission to the Inquiry.

RESPONSE TO THE INQUIRY'S TERMS OF REFERENCE

Current and future applications of nanotechnology for New South Wales industry and the New South Wales community

In NSW and across Australia, research of materials/particles at the nanoscale is being undertaken in a variety of different scientific fields, including physics, materials science, chemistry, robotics, electronics, food science and biotechnology. In a number of fields, nanotechnology has made the transition from research to commercialisation.

Many everyday consumer products and manufacturing processes either currently incorporate aspects of nanotechnology or are poised to do so. For example, nanoparticles and nanomaterials are currently found in sunscreens and cosmetics, food, paints, powders and coatings, sporting products, electronics, medical devices, pharmaceuticals and textiles. Applications of nanotechnology are also being incorporated into manufacturing processes such as in steel and plastics fabrication.

Research, development and an increased incorporation of nanotechnologies in products will continue to significantly influence the way products are manufactured both in Australia and internationally, including in developing economies. Effective and responsible uptake of nanotechnologies in NSW will be important to the State's economic competitiveness and underpinning knowledge, research, production and manufacturing output.

NSW Government agencies are aware that nanotechnology is becoming incorporated in NSW's research and manufacturing sectors. The NSW Department of State and Regional Development (DSRD) has confirmed that there are at least 23 companies within NSW that use nanotechnology within their products. However, there is little specific information about the nature or scale of use of nanotechnology within NSW industry.

Some products that have been manufactured with nanotechnology components in NSW include:

- Datatrace DNA, which is a covert nanotechnology security system that can be added to the manufacturing process of most products to protect intellectual property, brands and products from counterfeiting;
- high-power, high-energy storage devices developed by Cap-XX to make smaller, thinner and longer running products such as mobile phones and medical devices; and
- Nanoprotect MG, a unique transparent nanotechnology treatment specifically designed for marine glass and plexiglass, which maintains its original clarity and transparency and provides long lasting protection from the build up of lime, salt and calcium.

Nanotechnology applications and developments are nascent. The consequent lack of industry and economic statistics is an important issue and is not unique to NSW or Australia. The international community faces the same hurdles in classifying and collecting industry statistics on the use of nanotechnology. This is due to nanotechnology's multidisciplinary nature and the fact that there are few classifying principles or guidelines that have been established or agreed to in this regard.

The health, safety and environmental risks and benefits of nanotechnology

The health, safety and environmental risks of nanotechnology are not fully known, nor are the potential benefits fully realised.

It is not possible to draw generalisations about nanomaterials because there are only a limited number of test results currently published in peer-reviewed scientific literature. Careful assessment of nanotechnology will be required to determine whether potential net benefits are likely to outweigh the risks associated with the life cycle of nanomaterials.

Because of the unique properties of nanomaterials, such as their very small size and large surface area to mass ratio, nanotechnology potentially exposes humans to new and increased risks, raising health, safety and environmental concerns. Nanomaterials may have chemical, physical and biological properties distinctly different and greater than fine particles of a similar chemical composition, which may lead to unpredicted effects. Further, free nanoparticles that are not linked to or embedded in other materials may be able to travel through the human body and other organisms, which may also result in unpredicted and possibly toxic effects.

To obtain a better understanding of the health and safety risks of nanotechnology, more research is required, particularly with regard to exposure levels and thresholds. The unique properties of nanomaterials need to be thoroughly assessed to ensure that their effects can be taken into consideration. Research outcomes can then be used to inform and guide the development of regulations. Regulators need to keep informed of emerging scientific evidence and incorporate this into policy making and risk assessment approaches.

NSW has a significant toxicology research capability, both on the human scale and environmental scale. However, it does not appear that there is a strong or developed nanotechnology focus in toxicology research. It is evident that there is opportunity and a need to coordinate this capacity, possibly through a network, to create assessment capacity relevant to research and industry sectors in NSW.

Nanotechnology is constantly under development and occupational health and safety (OHS) researchers and regulators lag behind the current industrial environment.

WorkCover's existing OHS legislation applies to the regulation of hazardous substances in the workplace and mandates an assessment of risks and an appropriate management of those risks. However, the NSW Government acknowledges that it is difficult to currently apply this legislation to nanomaterials because:

- it is not currently possible to undertake a risk assessment, as accurate and cost-effective monitoring and measuring instruments, reference materials and testing methodologies are still being developed internationally; and
- it is not possible to develop a risk management plan whilst risks cannot be assessed and whilst international standards have not been developed.

Until more is known about the health, safety and environmental risks of nanotechnology, the NSW Government supports industry adopting an 'As Low As Reasonably Achievable' (ALARA) precautionary approach to minimise the risk of exposure to nanomaterials. This approach was recommended by the Australian Safety and Compensation Council in relation to the nanotechnology industry's management of exposure.[1]

[1] Australian Safety and Compensation Council (ASCC), 2006, *A Review of the Potential Occupational Health and Safety Implications of Nanotechnology for the Department of Employment and Workplace Relations*, http://www.ascc.gov.au/NR/rdonlyres/AC17BA49-8BA1-43B8-BC08-219DE53781E6/0/ASCCReviewOHSImplicationsNanotechnology2006.pdf

The appropriateness of the current regulatory frameworks in operation for the management of nanomaterials over their life-cycle

There is debate surrounding whether or not current risk assessment methods, and therefore regulatory frameworks, are adequate in relation to nanomaterials. Development of the technology is moving faster than development of adequate methods for assessing toxicology of, or exposure to, nanomaterials.

Issues requiring resolution include: standardised means of measuring, classifying and testing nanomaterials for acute and chronic toxicity; whether recycling and disposal of products with fixed nanoparticles leads to significant releases of free nanoparticles and ensuing damage to human health and the environment; whether nanomaterials are more bioaccumulative and persistent than "normal" materials; and how nanoparticles behave in the environment or in living things.

Standards and Classifications
Developing nanotechnology standards and classifications is not as simple as it would be for one type of chemical or material. There are many different types of nanoparticles, with many different types of properties or structures, all with possibly different impacts and effects. Measuring, characterising and classifying these nanoparticles and nanomaterials represents a huge undertaking. In this regard, the NSW Government is pleased that, as part of the funding provided for the National Nanotechnology Strategy, the National Measurement Institute is to receive a state-of-the-art atomic force microscope to provide increased nanometrology capability within Australia.

Existing OHS Legislation
Existing OHS legislation provides a framework for the nanotechnology industry to use to manage risks in the workplace. NSW OHS legislation imposes obligations on all employers to implement risk management processes in all workplaces. Employers must ensure that hazards and risks are identified, assessed and eliminated or controlled.

The risk management approach involves a process of well-defined steps that, when taken in sequence, allow employers to make informed decisions about how best to avoid or control the impact of risks. These steps include:

- hazard identification to identify the problem;
- risk assessment to determine how serious the problem is;
- risk elimination or control to decide what needs to be done to solve the problem; and
- reviewing risk assessments and control measures if, for instance, new information becomes available about the hazardous nature of a substance or process.

There are difficulties in undertaking a risk assessment and developing a risk management plan in this area due to limited availability of information about toxicity, suitable measurement procedures, safe exposure levels and other specific risk measures.

WorkCover NSW developed a paper on nanotechnology which was tabled at the Australian Safety and Compensation Council meeting in August 2007. The paper outlines the health and safety, risk management and regulatory issues associated with nanotechnology and is available on the WorkCover NSW website (www.workcover.nsw.gov.au).

The specific activities currently being undertaken by WorkCover NSW are:

- working in conjunction with the Office of the Australian Safety and Compensation Council to develop and implement a program of work to address the occupational health and safety risks of nanotechnology;
- monitoring international developments regarding safety issues around nanotechnology;
- monitoring international and Australian patents for new nanotechnology applications;
- identifying companies in Australia/NSW that manufacture and sell nanotech products or components;
- identifying and monitoring products in Australia/NSW that include nanotech components;
- implementing a training package for WorkCover inspectors;
- seeking representation on the Standards Australia Nanotechnology Committee; and
- developing networks with stakeholders including industry groups such as the Australian Nanotechnology Business Forum.

Current regulations for industrial chemicals

Current Commonwealth regulatory procedures do not require an industrial chemical to be assessed for potential environmental or human health effects if it is a so-called existing chemical (that is, it is on the Australian Inventory of Chemical Substances). Even if an existing industrial chemical has been assessed, there is no legal requirement for the chemical to be reassessed if it is made into a form that is nano-sized. This issue applies to a number of the nanoparticles currently in use including titanium dioxide which has been formulated for use in sun screens. This could result in a serious gap in assessments and in environmental and public health protection.

Any consideration of the provision of a regulatory environment in NSW that is specific to nanotechnology use should be consistent with currently developing international and national measures. This will ensure that health, safety and environmental issues are addressed with appropriate consideration of effectiveness, regulatory burden and impact on NSW businesses and workers.

International approaches to regulation

Examples of regulations pertaining to nanotechnology in other countries may be illustrative for regulators in NSW and Australia.

For example, the UK Government's broad policy objectives focus on regulation, public engagement and research to underpin the responsible development of nanotechnologies. The UK Government is also interested in developing an evidence base to allow for a more informed debate about the nature of appropriate controls available to government. Some first steps by the UK Government in this area include a pilot Voluntary Reporting Scheme for engineered nanoscale materials that was launched in September 2006. The scheme will be assessed in 2008 to determine whether the introduction of compulsory reporting measures for manufactured nanomaterials is necessary.

In the United States of America in 2008, the Environmental Protection Agency launched the Nanoscale Materials Stewardship Program (NMSP), which is designed to help provide a scientific foundation for regulatory decisions by encouraging submission and development of information, including risk management practices for nanoscale materials from industry.

While voluntary actions can provide a valuable and timely starting point for addressing concerns in the short term, it is possible that regulations may be necessary to provide a level playing field and meet community expectations about safety, accountability and transparency.

The adequacy of existing education and skills development opportunities related to nanotechnology

Due to the breadth of science and technology encompassed by nanotechnology, the majority of education and related research will be carried out in university departments of chemistry, physics, engineering and medicine. For example:

- Macquarie University's Department of Physics is home to two nanotechnology research facilities focused on optical and laser processes;
- the University of Western Sydney (UWS) Nanotechnology Project transfers opportunities in nanotechnology from UWS to the manufacturing industries of the Campbelltown - Camden region;
- the University of Sydney is the lead institution in the Australian Microscopy and Microanalysis Research Facility – a lead national facility for the characterisation of nanoparticles and nanomaterials (co-funded by the NSW Government through the Science Leveraging Fund); and
- the Intelligent Polymer Research Institute (IPRI) at the University of Wollongong explores the science of electricity conduction through nanomaterials and undertakes research to exploit this in useful applications.

NSW is also home to a variety of Australian Research Council (ARC) Centres of Excellence and National Collaborative Research Infrastructure Strategy (NCRIS) nodes specialising in cutting-edge nanotechnology research. Some examples are listed below.

The ARC Centre of Excellence for Quantum Computers is a multi-university collaboration for the development of quantum computers that includes the University of New South Wales and the University of Sydney and encompasses major research infrastructure, including an extensive semiconductor nanofabrication facility (co-funded by the NSW Government through the NSW Science Leveraging Fund).

The ARC Centre of Excellence in Functional Nanomaterials, based at the University of Queensland, with nodes at the University of New South Wales and the University of Western Sydney conducts world-class research into the synthesis, characterisation and application of various nanomaterials, provides high quality training and fosters linkages between national and international groups. The Centre also has nanotechnology specific toxicology capacity.

The ARC Centre of Excellence for Electromaterials Science works to develop nano-science and nanotechnology related to the movement of electric charge within and between materials. This work is relevant to biomedicine, industrial processes, energy harvesting and energy storage. The Centre has a node at the University of Wollongong (co-funded by the NSW Government through the NSW Science Leveraging Fund).

As nano-industries expand, there will be an increasing demand for highly trained technicians and operators. As such, there is a need to find out more about the skill and knowledge requirements for technician and operator staff in this area. There is also a need to ensure that appropriate units of competency and qualifications are available to facilitate the training requirement at both the university and vocational education and training levels.

National training packages are designed and developed by industry to meet industry needs. Developers of training packages will need to be mindful of the growing need for specialist training for technicians and operators, and develop or revise appropriate units of competency. TAFE NSW is currently re-aligning its functions to ensure it can provide rapid service to industry in NSW to support existing and emerging skill needs.

At a secondary schools level, the curriculum in NSW schools is organised into eight learning areas. The learning areas of science and technology both provide opportunities for students to learn about nanotechnology.

In the study of science in years 7-12, students are required to consider and explore how some common technologies relate to the interactions within underlying scientific principles. In engaging in this study, students describe and discuss benefits of using a range of technologies including biotechnology and the ways in which technology has increased the variety of made resources. Nanotechnology provides one avenue for students to engage in and explore this aspect of NSW syllabuses. As further examples and applications of nanotechnology emerge, so will the opportunity for students to engage in discussions related to this emerging technology.

Students may also elect to study technology subjects such as Design and Technology, Engineering Studies, Industrial Technology, Food Technology, Textiles Technology and Agriculture. In these subjects, students are required to explore new innovations and emerging technologies. Nanotechnology provides an excellent example of such technologies and the development of resources targeting Years 9-12 would be of value to students and teachers.

The adequacy of the National Nanotechnology Strategy in the New South Wales context

Announced by the former Commonwealth Government in May 2007, the National Nanotechnology Strategy (NNS) is a $21.5 million dollar strategy delivered over 4 years. The new Commonwealth Government recently announced that the NNS would end in mid-2009, reducing the funding from $21.5 million over 4 years to $10.7 million over 2 years. At this time it is unclear how this will affect the initiatives under the NNS. The Commonwealth Government has also announced a broader review of the nation's innovation system with a focus on frontier science and emerging technologies. It is unclear at this stage how the innovation review will relate to the NNS.

Overall, however, the NNS is designed to draw together industry, research bodies, the community and governments to capture the benefits of nanotechnology for Australia. Key initiatives of the strategy include:

- a state-of-the-art atomic force microscopy for the National Measurement Institute to provide new calibration services for nanoscale standards in Australia
- a Health, Safety and Environmental Working Group to coordinate regulatory issues relating to nanotechnology;
- a public awareness and engagement program; and
- establishing the Australian Office of Nanotechnology.

The NSW Department of State and Regional Development (DSRD), along with representatives from other state and territory governments, are engaged with the Commonwealth Department of Innovation, Industry, Science and Research in the implementation of the NNS.

The NSW Government considers that this strategic approach will help guide and formulate activities nationally to address issues associated with the development of the nanotechnology industry in Australia. The Strategy has clear objectives that focus on three key areas for action. These are:

- the development of this new industry;
- a review of the regulatory frameworks to manage impacts on public health, OHS and the environment; and
- building capabilities in the area of the measurement of nanotechnology.

The NNS currently emphasises the uptake of nanotechnology throughout Australia. It is important to ensure that this is balanced at all times by effectively addressing health, safety and environmental concerns through the introduction of mechanisms that are timely and appropriately resourced.

The key concerns for NSW about the NNS are its uncertain status and the need for effective, timely action to address environmental issues.

The level of community understanding of nanotechnology and options to improve public awareness of nanotechnology issues

A report prepared for the Commonwealth Department of Innovation, Industry, Science and Research by Market Attitude Research Services (MARS)[2] in 2007 indicated high levels of interest and support for science in general among Australians. These levels have generally increased since a previous poll conducted in 2005, with 88% of Australians feeling 'positive' or 'very positive' about developments in science and technology.

In relation to nanotechnology, the report has identified that despite increased levels of awareness among Australians about nanotechnology, there remains a limited understanding of the detail of the topic, with 63% of respondents claiming to have an awareness of the term. This is compared to the 5% of respondents who knew in detail what nanotechnology means and how it works.

Also, when polled, 83% of Australians indicated that they are hopeful about the potential applications of nanotechnology in society. However 65% of respondents also indicated concern about the unknown and long term side effects of nanotechnology (this is a decline from 72% in 2005).

The NSW Department of State and Regional Development (DSRD) has engaged in a number of initiatives to increase the level of community awareness regarding nanotechnology. These include a series of workshops and seminars to small business on the applications of nanotechnology since 2001, including a recent workshop with the Society of Plastic Engineers (SPE) at the Parramatta office in March 2008.

The NSW Office for Science and Medical Research (OSMR), a division of DSRD, has engaged with the community through Science EXPOsed. OSMR organises the annual two day event with the NSW Department of Education and Training. It engages students from years 9 and 10 in the world of science and promotes science as a career choice.

In particular, there have been a number of nanoscience related activities at Science EXPOsed over the past two years, including a series of workshops

[2] DIISR – *'Australian community attitudes held about nanotechnology: Trends 2005 – 2007'* http://www.innovation.gov.au/Documents/MARSreport20070801094555.pdf Accessed: 18/03/08

with ABC presenter James O'Loghlin. These highlighted the applications of nanotechnology in the real world. Future initiatives are currently being organised through the upcoming Science EXPOsed plan for October 2008.