
Associate Professor Thomas Faunce

BA LLB(Hons) B Med. PhD.

College of Law and College of Medicine, Biology and the Environment

Faculty of Law, Bdg 5

CANBERRA ACT 0200

Submission to
National Industrial Chemicals Notification and Assessment
Scheme
Proposal for Regulatory Reform of Industrial
Nanomaterials

CONTENTS

Executive Summary	4
1. What is the significance and/or consequence of this working definition for ‘industrial nanomaterials’?	5
General Points	5
Exclusion of particles of size greater than 100 nanometers	6
Novel properties of Nanomaterials	6
Inclusion of Nanoparticle Agglomerates in the Definition?	7
Intentionally produced Nanomaterials	7
Recommendations Q1	8
2. How do you think the proposal to limit access to exemptions for nanoforms of new chemicals will contribute to protecting health and the environment?	9
Submission Q2	9
3. Describe any ways in which you think self-assessment by an independent third party could be used to effectively achieve the same results?	10
Submission Q3	10
4. If in R&D, what, if any, practical issues arise from the proposed administrative amendment for annual reporting of R&D exemptions? Would it require a significant increase in reporting? If so – how much?	11
Submission Q4	11
5. What are your views on the impact of the proposal to regulate nanoforms of new chemicals with the above changes to the permit and certificate categories? Can you identify additional advantages or disadvantages?.....	11
Submission Q5	12
6. What are your views on a system that is sufficiently flexible to amend permit conditions where new data indicate a new risk profile?	13
Submission Q6	14
7. What are your views on the impact of the proposal for mandatory once-off, use specific reporting for nanoforms of ‘existing chemicals’? Can you identify additional advantages or disadvantages?.....	15
Submission Q7	15
8. Explain how you think the potential burden of once-off, use specific reporting could or could not balance community expectations in relation to health and environmental standards?.....	16
Submission Q8	16
9. What are your views on making the information gathered through streams 1A and 1B publicly available?	17
Submission Q9	18
10. What are the advantages and disadvantages of the introduction of a system that required a mandatory notification and assessment program for nano-forms of existing chemicals? What are the reasons for this answer?.....	18
11. What are current issues that affect the feasibility of such a program?	19

12. What are your views on making information gathered from assessments of nano-forms of existing chemicals publicly available?.....	19
13. How might an integrated approach provide for more effective regulation of industrial nanomaterials compared to the package proposed (for nano-forms of new and existing <i>chemicals</i>) in sections 3a and 3b?.....	20
Submission Q13	20
Conclusion	21

Executive Summary

- The proposed definition of industrial nanomaterials is too narrow for an effective regulatory focus.
- That definition should be expanded to include concepts of novel chemical and physical properties on nanomaterials, bioreactivity and biocompatibility
- The regulatory system developed for industrial nanomaterials in Australia should involve an **iterative regulatory loop**. Perhaps the best model in Australia at present for this is that utilised to assess cost-effectiveness data for placement of new prescription pharmaceuticals on the Pharmaceutical Benefits Scheme. It involves the initial presentation of safety data by manufacturers, assessment of the data by a government-coordinated committee of experts, cross-checking of the data by independent groups of academics, the power to request further data, outsource the performance of additional testing or to perform that testing or modelling in house, a final regulatory decision based on transparent criteria, a review mechanism, public summary documents of regulatory decisions and increasing amounts of post-marketing surveillance with regulators possessing the power to place bans or request compliance with additional conditions as necessary.
- Whatever system is adopted should permit and endorse the precautionary principle.
- Regulation in this area should not be crisis driven.
- Public pronouncements that new nanotechnologies with public health and/or environmental benefits have been developed with tax-payer funds at Australian universities should coincide with announcements that the federal government is investing in regulatory initiatives supporting the safe use of nanotechnology.

SUBMISSION

This submission answers, as requested, specific questions posed by this reform process.

1. What is the significance and/or consequence of this working definition for 'industrial nanomaterials'?

We understand that NICNAS has developed a **working definition** consistent with international definitions (within the Organisation for Economic Co-operation and Development (OECD) as well as national and international regulatory authorities) as follows:

... industrial materials intentionally produced, manufactured or engineered to have specific properties or specific composition, and one or more dimensions typically between 1 and 100 nanometers

Submission Q1

General Points

We agree that this working definition for industrial nanomaterials may not be adequate for effective regulatory purposes. Aspects of the definition that are too narrow include:

- Size – cut off should not be exclusively limited to 100nm because of factors such as agglomeration and binding to proteins, capacity for novel chemical and physical properties above that scale.
- Intentionally produced – does not adequately take into account industrial nanomaterials that may be accidentally produced and present in mixtures of some percentage, as a result of production methods such as grinding.
- Mixtures not included – some composite materials may be a mix of nano and non-nano forms, and may display novel nanoscale properties
- The definition does not emphasise the concept of insolubility
- The definition does not emphasise the concept of biopersistence
- The definition does not take account of internal structure of a nanoparticle that may be most important in its bioreactivity
- In summary, this is predominantly a size-based definition that does not take account of the novel chemical properties of nanoparticles

Late in 2009 a nanoparticle decree was approved by the Council of the European Union. The relevant definition of a nanoparticle was “an insoluble or biopersistent and intentionally manufactured material with one or more external dimensions, or an internal structure, on the

scale from 1 to 100nm.¹ On the basis of a recommendation by the European Commission's Scientific Committee on Consumer Products manufacturers are required to notify authorities of the presence of nanoparticles in cosmetic products in order to facilitate 'focused market surveillance by member states.' This shows, we argue, a recognition (not present in the draft definition here) to include not only concepts of insolubility and biopersistence but also novel chemical and physical properties as revealed by pre and post-regulatory approval data.

Exclusion of particles of size greater than 100 nanometers

Researchers from the London School of Economics and Political Science (LSE) and the Project on Emerging Nanotechnologies (PEN) at the Woodrow Wilson International Center for Scholars have suggested that the unique chemical and physical properties of nanomaterials extend to materials above 100 nanometres, in some cases up to 300 nanometres.² Work on carbon nanotubes has revealed that 100 nanometers is certainly not the cut-off point for potential toxicity in the form of mesothelioma and fibrogenic hazard.³ Arguably, use of the word 'typically' in the definition provides some flexibility, however it also adds ambiguity as to whether engineered nanomaterials measuring between 100 and 200 nanometres (for example, 105nm or 195nm) in all dimensions will fall outside the definition or not. Clear definitions, which can be consistently applied, are essential for promoting regulatory transparency and consistency.^{4,5} Including unique physical and chemical properties of nanoparticles is not inconsistent with this provided that the process for establishing such properties is transparent and rigorous.

Novel properties of Nanomaterials

The working definition focuses on those materials whose size falls 'typically between 1 and 100 nanometres'. The proposed definition could prevent nanomaterials that are greater than 100 nanometres from being subject to NICNAS's regulatory scheme even where the small particulate size of the chemical (say, less than 300nm) significantly changed its risk characteristics compared to its conventional form. The singular focus of such a **size-based definition** detracts from the equally important attribute of nanomaterials, namely their **novel physical and chemical properties**. Moreover, some materials may not be exclusively

¹ Stafford N. New nano rule for EU cosmetics. *Chemistry World* 2010; 7 (1): 6.

² Linda Breggin, Robert Falkner, Nico Jaspers, John Pendergrass and Read Porter. 'Securing the Promise of Nanotechnologies' September 2009

³ Bastús, N. G., Casals, E., Vázquez-Campos, S. and Puentes, V. (2008). Reactivity of engineered inorganic nanoparticles and carbon nanostructures in biological media. *Nanotoxicology*. 2 (3): 99 - 112.

⁴ Justin G. Teeguarden, Paul M. Hinderliter, Galya Orr, Brian D. Thrall and Joel G. Pounds 'Particokinetics In Vitro: Dosimetry Considerations for In Vitro Nanoparticle Toxicity Assessments' *Toxicological Sciences* 2007 95(2):300-312.

⁵ Michael J. Pitkethly. 'Nanomaterials: The driving force' *Nanotoday* December 2004: 20-29.
CRICOS Provider No. 00120C

composed of nanoparticles. Such **nanoparticle composites** or mixtures of nano and non-nano forms could nevertheless display novel properties, including ones relevant to toxicity such as slow release, but will not fall clearly within the definition. Researchers from the LSE and the PEN at the Woodrow Wilson International Center for Scholars have suggested that from a regulatory point of view it is the unique chemical and physical properties of nanomaterials that should be of primary interest.⁶

Inclusion of Nanoparticle Agglomerates in the Definition?

The rapid development and commercialization of new nanomaterial products including catalysts, cosmetics, drug delivery systems, tools for microbiology and medicine, semiconductors, and coloring agents includes not just materials that remain in biosystems within the <100 nm range, but also those that once they are in the human body form agglomerates larger than 100 nm.⁷ Discrete nanoscale particles, less than 300nm for example, tend to deposit at higher concentrations in the alveoli (regions of the lungs where gas exchange occurs), whereas agglomerated materials with diameters larger than 100 nm deposit at higher concentrations in the upper airway.⁸

The proposed definition does not clarify whether agglomerates and aggregates that are larger than 100 nanometers will be considered as industrial nanomaterials. The EU Scientific Committee on Emerging and Newly Identified Risks (SCENIHR) stated that the definition of nanomaterials may need to be tweaked to include larger agglomerates and aggregates which are above 100 nanometers.⁹ Another industrial example is the manufactured nanoformulation of ZnO in cosmetics. It forms an aggregate by extremely strong bonding between the primary particles and does not disperse easily. The aggregates also cohere to form agglomerates of particles with sizes of more than 100 nm and virtually all of the ZnO in final products is considered to be agglomerate. Hence, ZnO agglomerates would not be covered by the proposed definition. This also suggests the definition should be broadened beyond size and shape to include unusual bioreactivity and biocompatibility (not present in macro-scale equivalents).

Intentionally produced Nanomaterials

The working definition excludes products that are unintentionally produced. Consequently, it would result in excluding particles with size less than 100 nanometers in one or more

⁶ Linda Breggin, Robert Falkner, Nico Jaspers, John Pendergrass and Read Porter. 'Securing the Promise of Nanotechnologies' September 2009

⁷ Justin G. Teeguarden, Paul M. Hinderliter, Galya Orr, Brian D. Thrall and Joel G. Pounds 'Particokinetics In Vitro: Dosimetry Considerations for In Vitro Nanoparticle Toxicity Assessments' *Toxicological Sciences* 2007 95(2):300-312.

⁸ Oberdörster et al, 2004; International Commission of Radiological Protection, 2003.

⁹ Risk Assessment of Products of Nanotechnologies, SCENIHR Opinion adopted on 19 January 2009: http://ec.europa.eu/health/ph_risk/committees/04_scenihr/docs/scenihr_o_023.pdf.
CRICOS Provider No. 00120C

dimensions that have been unintentionally generated from the disintegration of aggregates and agglomerates (which have dimensions between 100 and 1000 nanometers and physiochemical properties that pose safety concerns) in the presence of weak mechanical forces or in solvents. Thus, the definition is narrowly focussed on deliberately produced nanomaterials rather than merely emerging as a by-product in activities not targeted for the production of these particles such as combustion processes or welding.

Recommendations Q1

- Clarify and extend the definition of 'industrial nanomaterials' to include chemicals with a particle size greater than 100 nanometers if they are demonstrated to produce chemical reactions or exhibit properties that differ from their bulk scale equivalents and in this way resemble particles below the 100nm limit. This determination could be made on a case-by-case basis. The approach to go beyond 100 nanometers has been followed by the Federal Office for Public Health (FOPH) and the Federal Office for the Environment (FOEN) in Switzerland. FOPH and FOEN have stated that 500 nanometers should be used to define nanomaterials in order to avoid excluding any nano-specific risks.¹⁰
- Agglomerates and aggregates which grow from primary particles of dimensions less than 100 nanometers or which break down into particles of dimensions less than 100 nanometers must also be included within the definition of 'nanoparticles' and subject to nanotechnology-specific risk assessment and exposure metrics if they are demonstrated to produce chemical reactions or exhibit properties that differ from their bulk scale equivalents and resemble particles below the 100nm limit.
- Furthermore, while a definition is important as it helps clarify what classifies as nanomaterials, it is crucial, especially in the nascent stages of a technology, to not be particularly tied to a definition. The regulatory scheme should be flexible enough to gather information on materials that undergo a change in their toxicity because of changes to their particle size but are potentially outside the immediate definition. Thus, it should be stressed that the definition is to serve as a guide only. Doing so will afford NICNAS the flexibility to regulate those nanomaterials which slightly exceed the putative size range but exhibit novel chemical and physical properties.
- The definition should emphasise the concepts of insolubility and biopersistence, as well as take account of internal structure of a nanoparticle that may be most important in its bioreactivity and biocompatibility and give it different chemical and physical properties to its macro-scale equivalent.
- Commonly used methods of particle sizing currently include transmission electron microscopy (TEM), scanning electron microscopy (SEM), optical spectroscopy (UV-vis),

dynamic light scattering (DLS), and fluorescence polarization. Each method possesses its own inherent uncertainties. Hence, the definition should be supplemented with guidelines for companies to ensure they corroborate their results with one or more additional methods the desirable means of sizing or aggregation determination. Alternatively, NICNAS should be funded by the Federal Government to outsource safety research to independent laboratories where the submitted data from manufacturers can be verified.

2. How do you think the proposal to limit access to exemptions for nanofoms of new chemicals will contribute to protecting health and the environment?

Proposal concerning NICNAS exemption categories

(Low volume, transshipment and R&D)

NICNAS proposes to administratively exclude nanomaterials from exemption categories where human and/or environmental exposure can reasonably be anticipated (see below).

The rationale for this proposal is as follows:

- *The uncertainty surrounding the hazards, exposure and risk assessment methodologies for these novel materials means that the determination of 'no unreasonable risk' or 'non-hazardous', both of which are prerequisites to a range of exemptions, is not expected to be straightforward;*
- *The current lack of comprehensive information on the properties and health, safety and environmental effects of these novel materials;*
- *The need for a case by case approach through assessment by NICNAS to ensure consistency, for successful and responsible development of nanotechnology.*

Low volume exemptions

NICNAS proposes to administratively exclude nanomaterials which are new chemicals from low volume/low concentration exemptions, thereby shifting a post-market audit activity to a pre-market assessment (ie. new nanomaterials to be assessed under permit or certificate categories prior to commercialisation).

Transshipment exemption

NICNAS proposes to continue transshipment exemptions of nanomaterials, on the basis that any hazard is adequately contained in terms of impacts on human health and the environment in Australia. These chemicals remain in containers under customs control until they leave Australia within 30 days, hence no human or environmental exposure can reasonably be anticipated.

R&D exemptions:

No restrictions are proposed for the introduction of new nanomaterials under the R&D exemption category due to their limited use (i.e. only in an R&D or analytical setting) and the assumption that they are handled only by trained personnel in a controlled environment. This approach is consistent with comparable overseas regulatory arrangements.

Slight changes to administrative arrangements for annual reporting of chemicals introduced under the R&D exemption category are proposed so that all nanomaterials introduced in volumes over 100g/year will be declared as nanomaterials and identified by their full chemical name. NICNAS will monitor the reporting threshold of 100g/yr to determine whether this needs to be revised in the future.

In summary, the exemption categories for new nanomaterials will be:

- *Low volume cosmetic and non-cosmetic exemptions – not available*
- *Low concentration (<1%) non hazardous cosmetic exemption – not available*
- *Transshipment exemption – available and current requirements unchanged*
- *R&D exemptions – available with minor administrative change to annual reporting requirements*

Potential impacts:

The potential advantages and disadvantages of this proposal are:

Advantages:

- *Restrictions will only be applied to circumstances where human and environmental exposure can reasonably be anticipated;*
- *Administrative arrangements enable reconsideration of decisions if new information regarding the safety of nanomaterials becomes available.*
- *Any potential risks to human health and the environment will be identified and addressed through pre-market assessment;*
- *Industry innovation will not be impacted because R&D exemptions will be retained;*
- *Knowledge of new nanomaterials being used in R&D will aid NICNAS in identifying trends and prioritising future regulatory efforts.*

Disadvantages

- *Low volume/low concentration exemptions will not be available to industry and*
- *notification fees will apply.*

Submission Q2

In general terms we support the approach taken here. If rigorously implemented it will represent an application of the precautionary principle. We support continuing R&D exemptions in this context.

¹⁰ <http://www.bag.admin.ch/themen/chemikalien/00228/00510/05626/index.html?lang=en>
CRICOS Provider No. 00120C

The removal of low volume cosmetic, non-cosmetic and low concentration non-hazardous exemptions will, to some extent, simplify NICNAS's assessment scheme for new chemicals. Besides simplifying the process, it is equally important that NICNAS be adequately funded and technologically resourced so as to be able to outsource independent research and testing.

- The two R&D exemptions will continue to be available and have been subject to one administrative change, namely that companies are required to make a declaration of nanomaterials for quantities greater than 100g. This reinforces the problems with a predominantly size-based definition as mentioned earlier. Companies, for example, may be at liberty to not make a declaration of nanomaterial where the material was an agglomerate of size greater than 100 nanometers in all dimensions. For example, since the bulk of nanosized ZnO tends to form agglomerates greater than 100 nm in size, virtually none of it will need to be declared.
- The first R&D exemption is subject to a volume restriction of 100g in any 12 months per application. If two or more companies jointly apply, the volume is split between the applicants. For example, where two companies jointly apply for the exemption, they will be able to produce up to 200gs in 12 months. Freedom for companies to produce increased quantities merely by applying jointly should be changed to limit the volume capacity to 100g in any 12 months per application.
- The second R&D(manufactured) exemption is not subject to any volume restrictions. Manufacturers are required to fill out Form 6, Advice of Introduction, prior to the introduction of the chemical. However, Form 6 does not require manufacturers to submit risk or toxicity data as would be the case if the system developed (as we advocate) involved an **iterative regulatory loop** where manufacturer data is independently analysed reassessed and repeated if necessary then subjected to ongoing critique. Of particular concern are products containing free nanomaterials or nanomaterials which are not properly fixed in the material of the product and that may be released thus resulting in exposure of workers and/or the environment. As such, R&D (manufactured) exemption should be based on additional volume restrictions.

3. Describe any ways in which you think self-assessment by an independent third party could be used to effectively achieve the same results?

SubmissionQ3

If this means a manufacturer funding a consultant research company to investigate the initial toxicities of its new chemical, then would be a similar start to the **iterative regulatory loop** that is involved with regulatory safety assessment of Therapeutic Goods. That data would be only a first step. It would be critiqued by government-appointed experts who could outsource

to academic units of research for comparative data. Approvals could be made with conditions and subject to post-approval surveillance requirements to be undertaken by the manufacturer for regular submission to the regulator. There may need to be a review or resubmission process created. In this instance a good model is that utilised by the Pharmaceutical Benefits Advisory Committee (PBAC). In the PBAC model initial data is presented by the manufacturer, critiqued by a government subcommittee and independent academic unit, then all the data is reviewed by the PBAC until a decision is reached. This can be subject to an independent review (a quality assurance exercise with no power to overturn the original PBAC decision but only to advise if key points have been missed or misunderstandings have arisen.

4. If in R&D, what, if any, practical issues arise from the proposed administrative amendment for annual reporting of R&D exemptions? Would it require a significant increase in reporting? If so – how much?

Submission Q4

The only reporting requirement that has been imposed is to make a declaration of nanomaterials for quantities greater than 100g.

- This poses a practical problem since businesses and government have to clearly understand what falls within the definition of nanomaterials.
- While the minimal declaration requirement is unlikely to add significantly to individual businesses' reporting requirements; it will significantly increase NICNAS's burden of assessing all the reported and declared nanomaterials. NICNAS needs to be strengthened in terms of its scientific knowledge base, reporting oversight capacity, and ability to conduct assessment of the reported nanomaterials in an independent laboratory. Inadequate resources, both money and trained people, is a problem for NICNAS as it is for all other federal regulatory agencies. Public pronouncements that new nanotechnologies with public health and/or environmental benefits have been developed with tax-payer funds at Australian universities should coincide with announcements that the federal government is investing in regulatory initiatives supporting the safe use of nanotechnology.

5. What are your views on the impact of the proposal to regulate nanoforms of new chemicals with the above changes to the permit and certificate categories? Can you identify additional advantages or disadvantages?

Submission Q5

NICNAS must ensure that both nano-forms of existing chemicals, and nano-forms of new chemicals, be assessed for safety in an **iterative regulatory loop** involving a system whereby data provided by manufacturer, is subjected to independent government and academic unit critique and then finally a NICNAS determination before a new nanomaterial can be used. The precautionary principle should be a manifest part of the decision-making in this regulatory process.

If such a regulatory process is not created this will fuel the case for the precautionary principle to be applied and a moratorium on the commercial use of nanomaterials until the safety science catches up and risk assessment procedures can be validated.

NICNAS should make information on the types and quantities of nanomaterials used, and their use in particular products and industrial chemicals must be made freely available, including through product labelling. NICNAS should pursue mandatory regulation of nanomaterials. Transparency in regulation of nanomaterials is essential. Risk assessment reports should be published in full.

If a nano version of a chemical has different characteristics and presents different risks then it should be assessed and regulated according to its specific risks. We recommend that all nanomaterials should presumptively be treated as new substances under the NICNAS regulatory system (i.e. any registration or permit or approval valid for larger sized particles – “bulk materials” - of the same substance would not be considered sufficient for nanomaterials) unless the manufacturer proves that the properties of the materials at the nanoscale are relatively similar to its bulk form. This has been recommended by the UK Royal Society and The Royal Academy of Engineering in 2004.¹¹

Issues surround the suitability of the Permit Categories for Regulating Industrial Nanomaterials. NICNAS in general does not have the power to ban chemicals but rather it can recommend risk management actions to relevant regulators. At most, when NICNAS is notified of a new chemical, after assessment and issuing an assessment certificate, NICNAS can place conditions on the use of the assessed chemical and permitted uses can be annotated on the AICS. This power should be broadened to allow NICNAS to ban those nanomaterials that are proven as a result of operation of the **iterative regulatory loop** process proposed here to be toxic or have insufficient data regarding their toxicity and life-cycle assessments.

There are other potential regulatory problems with NICNAS's proposed assessment scheme:

- The level of assessment of chemicals undertaken by NICNAS is less intensive than those undertaken by the other federal chemical regulatory agencies. The regulatory scheme for industrial chemicals in Australia, as well as in most countries around the world, is a “lighter touch” than for therapeutics (including prescription

¹¹ Nanoscience and nanotechnologies: opportunities and uncertainties:
<http://www.nanotec.org.uk/report/chapter10.pdf>.
CRICOS Provider No. 00120C

pharmaceuticals), agriculture and veterinary chemicals. This should be changed such that all nanomaterials, whether being as assessed by NICNAS or TGA or APVMA are subject to uniform and adequate risk assessment methodology.

- Once hundreds of new nanomaterials come on to the market, there will probably be a need for not just one new assessment but for hundreds, and there is a question of planning ahead for regulator workload. A relevant factor here is that NICNAS is a cost-recovered agency, whereby new chemicals assessments incur a fee and assessors can be brought into the organisation as the workload demands. Whether this model needs to be modified to allow for a significantly increased future workload needs to be part of the regulatory evaluation now. Establishing NICNAS with its own testing laboratory could provide a strong capacity-building exercise for young Australian scientists.

6. What are your views on a system that is sufficiently flexible to amend permit conditions where new data indicate a new risk profile?

Proposal concerning NICNAS notification categories (Permits and certificates)

How the permit and certificate system works:

The NICNAS permit system applies to new chemicals introduced in relatively low volumes, for specific purposes (eg commercialisation trials), in controlled circumstances or prior to completion of a full assessment. Specific application and assessment criteria (eg no unreasonable risk determinations) and maximum durations apply for all permits. While upfront data requirements are lower than for certificates, NICNAS can request additional data where it is required to determine no unreasonable risk. Use conditions can be stipulated for permits and these are auditable by NICNAS, enabling authorised post market compliance.

While certain permits may be renewed under specific conditions, these chemicals are not listed on the inventory and as such introducers are known to NICNAS through permit applications.

In contrast, the NICNAS certificate system has more extensive upfront data requirements. There are self-assessment options in this category for industry that are allowed under specific circumstances, such as polymers that meet low concern criteria for human health and the environment and chemicals that are non-hazardous, where this data can be supplied.

Proposal

Four concurrent strategies are proposed to apply to certificates and permits:

- *Addition of a declaration by the notifier on the permit or certificate application forms stating that the chemical is a nanomaterial.*
- *More specific information (such as particle size, shape and other specific information on properties) will be required under specified conditions, refer to flow chart in Attachment 6).*
- *Nanomaterials will be administratively excluded from self-assessments on the basis of the uncertainty concerning their hazard. Self-assessments are intended for chemicals or polymers that are non-hazardous. This change will ensure that the hazard status of the nanomaterials and the risk posed by the notified uses will be assessed by NICNAS.*
- *Permit conditions or specific secondary notification conditions will apply to conventional chemicals assessed by NICNAS, where it can be reasonably assumed that a nano-form may be introduced in the future (see flow chart Attachment 6).*

Features that make a permit system suitable for nanomaterials:

Assessing new nanomaterials under a permit category has the advantage that NICNAS can determine if the criterion for no unreasonable risk is met consistently across nanomaterials being considered on a case by case basis. In addition NICNAS can stipulate enforceable use conditions, amend these conditions, or revoke the permit. This may be important in the current environment, where new information on these nanomaterials is being generated.

Consistent with current practice for conventional chemicals, a permit will only be issued when the applicant has demonstrated "no unreasonable risk" or "low hazard" as required under the Act. The Director can refuse to approve an application for renewal, or revoke a permit under specific conditions outlined in the legislation.

Features that make a certificate system unsuitable for nanomaterials:

NICNAS, however, only has a limited ability to impose conditions of use for certificates (annotation of the inventory). NICNAS can make recommendations to standard setting bodies when national standards are warranted. These national standards must be embodied in

state/territory legislation to be enforceable.

Chemicals under certificates are placed on the Inventory (existing chemical) five years after the certificate is issued (unless immediate listing is specifically requested by the applicant) enabling legal introduction by any number of companies without further prior notification to NICNAS.

Potential impacts:

The advantages and disadvantages of the above proposal are:

Advantages:

- The proposal will enable NICNAS to identify and assess new nanomaterials introduced into Australia.
- Introducers will be aware of circumstances under which particle size data likely to be required.
- Additional data concerning specific health/environmental effects of the chemicals will only be requested where these data are required for risk assessment.
- Nano-forms of assessed conventional chemicals introduced in the future will be re-notified to NICNAS as appropriate

Disadvantages:

- There will be an increased burden on introducers when additional data are sought, however it is anticipated that the large majority of introducers should have access to this information.
- One certificate category, ie self-assessments, will not be available, therefore nanomaterials will need to be notified under non-self assessed categories. This change is required to ensure that human health and environmental standards are maintained in relatively uncertain circumstances.

Submission Q6

In general terms we support the regulatory flexibility implicit in this proposal. The capacity to impose regulatory conditions through the permit system is important. To function effectively there will still need to be room for either routine or ad hoc testing of compliance and cross-checking of data.

No effective governance regime for nanomaterials will be born perfectly formed and complete; hence, the NICNAS permit system must be adaptive. One of the drivers for change will be the results of ongoing research on toxicology and the environmental impact of nanomaterials. Another driver is the emergence of consensus in the international and scientific community regarding any definitions, threshold limits on the volume or weight of nanomaterials that may be produced. The permit system does seem to be adaptive in these respects, if NICNAS were given adequate investigative powers to enforce the relevant conditions and check the data produce.

- The system needs to be transparent with capacity for community groups and non-governmental organizations to make comments and object.¹²
- An effective governance regime for nanomaterials will need to be reflective and continuously monitored for quality assurance.
- An adaptive regime will start out simple and over time the regime's details are likely to be different for each of the many nanomaterials. By learning from the process of governing relatively simple existing products it should be possible to have structures in place for dealing with more complex, later-stage products as they emerge.¹³

¹² Stirling, A. Sci. Technol. Hum. Val. 33, 262–294 (2008).

7. What are your views on the impact of the proposal for mandatory once-off, use specific reporting for nanoforms of 'existing chemicals'? Can you identify additional advantages or disadvantages?

Submission Q7

The advantage would be that it would start the regulatory process in a transparent way that companies could factor into their business plans. The disadvantage is that highlighting it is "once off" would send a signal that the regulator might not seek (as it should) additional data where that originally provided was inadequate or require post-approval surveillance by the manufacturer.

It would be a big advantage for the Australian public if NICNAS had power to make its own regulatory investigations with the assistance of expert reports it could commission from academic units and committees as does the TGA and PBAC. This standardisation of regulation would be an attractive feature to a public seeking to be assured on the safety of nanotechnology

Costs wouldn't necessarily be disproportionately high for small- and medium-sized enterprises. They would be in a similar position as Australian drug manufacturers who must acquire safety data as a condition of regulatory approval- a cost that is factored into their price. Since much innovation in emerging technologies (nanotechnology and biotechnology, for instance) comes from small companies around the world, attention must be given to providing incentives for companies to do proactive testing of their products. A number of ways exist to do this. One could include providing research grants to do environmental health and safety via NICNAS sponsored programs that will ensure that small, high-tech, innovative businesses became a significant part of the federal government's R&D efforts. Another possibility is to provide research, education, and technical guidance and support to small and medium-sized companies.

- The level of demand on government and the level of transparency differ substantially between the government collecting and generating information itself or requesting that information be provided voluntarily by companies. If the government decides that it needs to collect and generate information itself, resources and expertise need to be allocated to the job, however, the information generated in most cases will be publicly available, thus ensuring a high level of transparency. On the other hand, if the government asks companies to voluntarily provide information about environment and health safety issues, fewer resources will have to be allocated to oversee the submissions; however, in many cases, the information generated will have to be classified as confidential business information in order to get companies to participate in the voluntary program.
- Mandatory rather than voluntary submission of data should start a regulatory process which involves various bodies critiquing that data before a decision is made. Such an **iterative regulatory loop** will benefit the industry by leading to greater understanding of the

¹³ Roco, M. J. Nanopart. Res. 6, 1–10 (2004).
CRICOS Provider No. 00120C

relationship between form and material properties, and enabling the control of processes at the nanoscale and the design materials with specific properties. The commercialisation of such advanced functional materials requires that they can be made in a predictable, reliable way, and in sufficient quantities. Until that is achieved production will be limited to academia and R&D departments within industry.

- A recent report from the Royal Commission on Environmental Pollution (RCEP) in the UK devotes much attention to difficulties that arise in policy-making because of the paucity of data on environmental and health impacts of nanomaterials.¹⁴ Earlier reports from the US Food and Drug Administration (FDA),¹⁵ a highly-cited article in *Nature*¹⁶ and various other reports also identify the main problem with current frameworks for regulation or risk assessment as being insufficient knowledge. The paucity of data collected makes it obvious that a mandatory reporting regime is required. In January 2009 the California Department of Toxic Substances Control (DTSC)¹⁷ issued a 'Chemical Information Call-in' formally asking for "information regarding analytical test methods, fate and transport in the environment, and other relevant information from manufacturers of carbon nanotubes." If NICNAS were to take first step towards mandatory regulation, such step could be followed by other regulatory organizations as well.

8. Explain how you think the potential burden of once-off, use specific reporting could or could not balance community expectations in relation to health and environmental standards?

Submission Q8

Once-off use specific reporting will be unlikely to reassure the public or practically ensure a reduction in hazards from novel nano-materials. A better approach is to require each new nanochemical product to make a submission to a NICNAS evaluation process of its safety data which involves multiple critiques and if necessary the generation of comparator data. The public will want to see a robust regulatory process with feed-back loops process like that used by the Food and Drug Administration (FDA) in the United States or the Therapeutic Goods Administration (TGA) in Australia. They will not be able to understand substantial differences in regulatory approach should occur because a manufacturer decides to market a new nanomaterial in an industrial or domestic setting where it is not a therapeutic good.

¹⁴ Novel Materials in the Environment: The Case of Nanotechnology (RCEP, 2008); available at <<http://www.rcep.org.uk>>.

¹⁵ Nanotechnology Task Force Report 2007 (FDA, 2007); available at <<http://www.fda.gov/nanotechnology/>>.

¹⁶ Maynard, A. *et al.* *Nature* 444, 267–269 (2006).

¹⁷ The Department of Toxic Substances Control, <http://www.dtsc.ca.gov/TechnologyDevelopment/>

3B Regulatory 'package' for nano-forms of 'existing chemicals'.

How the system for existing chemicals currently works:

Many industrial nanomaterials in international commerce have conventional forms which are on the AICS and are therefore considered to be existing chemicals. All regulatory requirements applicable to conventional existing chemicals also apply to their nanoforms.

A current issue with this system:

To date, voluntary calls for information on nanomaterials that may give us insight into use of nanoforms of existing chemicals have had limited success both nationally and internationally (eg in UK, USA). This has been attributed to a range of potential reasons including the nature of the voluntary calls, the lack of incentives for industry to respond and possibly a lack of awareness or certainty about when a particular chemical falls within the definition of a nanomaterial. The response to NICNAS's most recent Call for Information elicited limited information.

Limitations of the system for existing chemicals in relation to nanomaterials:

The following limitations have been identified in the current NICNAS Existing Chemicals Program in relation to assessing and managing the risks of nanomaterials:

- Inability to reliably identify introducers of nanoforms, given that under the legislation calls for Information can only be mandated when NICNAS is considering declaration of chemicals for priority review;
- Most conventional chemicals on the Inventory have not been assessed, therefore the nano-form can be legally introduced without notification to, and, assessment by NICNAS;
- Any existing risk management measures have been assigned on the basis of the characteristics of the conventional form of the chemical;
- It may not be apparent to introducers of nanomaterials that secondary notification provisions (which operate for assessed chemicals) apply to their nano-forms. Therefore any uncertainty in relation to unique hazards posed by nanoforms may not be addressed.

Proposal

Two distinct short- to medium-term activities have been identified to run concurrently to address the limitations outlined above. These are:

Stream 1A – A voluntary once off, use specific reporting program leading to.....

Stream 1B – A mandatory once off, use specific reporting program,

AND

Stream 2 – examine the feasibility of a mandatory notification and assessment program.

Stream 1A

Voluntary pre-introduction once-off; use specific, reporting of all nanomaterials is proposed as the first step. NICNAS will compile an internal database of the information collected to inform further consideration of its strategy for nanoforms of existing chemicals.

Stream 1B

Stream 1B will be a sequential progression of Stream 1A, to a mandatory pre-introduction once-off, use specific, reporting program when legislative change is enacted to implement outcomes from the NICNAS Existing Chemicals Program Review, a separate activity currently underway. The outcome of the review is a proposal to de-link mandatory information gathering powers from NICNAS assessment products and this change will facilitate implementation of a mandatory reporting program for nanomaterials.

Potential impacts

The advantages and disadvantages of a reporting program are:

Advantages

- Builds a database of information on nanoforms of existing chemicals in use in Australia,
- Assists in identifying nanomaterials of potential concern for further NICNAS review,
- Increases public confidence by facilitating regulatory oversight of nanomaterials in Australia and focussing NICNAS efforts,
- The voluntary reporting proposal (stream 1A) provides an opportunity for industry to develop appropriate processes to respond to a mandatory reporting program as a next stage (stream 1B).

Disadvantages

- The program would incur an extra, once-off use specific, reporting burden on industry.
- In addition NICNAS will have to set up mechanisms to appropriately manage and use the information reported to us.

9. What are your views on making the information gathered through streams 1A and 1B publicly available?

Submission Q9

We agree that these proposals in general would assist with the valuable goals of building a database of information on nanoforms of existing chemicals in use in Australia, identifying nanomaterials of potential concern for further NICNAS review, increasing public confidence by facilitating regulatory oversight of nanomaterials in Australia and focussing NICNAS efforts and providing an opportunity for industry to develop appropriate processes to respond to a mandatory reporting program as a next stage.

Providing balanced information to the public on properties of nanomaterials, their risks and benefits is important to achieve public trust in the regulatory scheme. Transparency, including openness about uncertainties and knowledge gaps, is essential for public trust in the technology as well as the government's ability to regulate the technology.

Although information regarding nanomaterials in Streams 1A and 1B is likely to be highly technical, the introduction of these materials in commercial products has ethical, legal, social impacts and should be considered a major democratic challenge. Studies have shown there is both significant concern and a lack of knowledge amongst citizens and in particular consumers and workers about the properties and use of nanomaterials and the potential risks they may be using or working with. This proposal may be a useful way of commencing a necessary regulatory process without frightening off industry investors.

10. What are the advantages and disadvantages of the introduction of a system that required a mandatory notification and assessment program for nano-forms of existing chemicals? What are the reasons for this answer?

The proposed system of mandatory notification builds a database of information on nanoforms of existing chemicals in use in Australia, it assists in identifying nanomaterials of potential concern for further NICNAS review, it increases public confidence by facilitating regulatory oversight of nanomaterials in Australia and focussing NICNAS efforts and provides an opportunity for industry to develop appropriate processes to respond to a mandatory reporting program as a next stage (stream 1B). We do not see as a disadvantage the fact that the program would incur an extra, once-off use specific, reporting burden on industry. Industry will be able to factor such regulatory costs into its pricing model and the opportunity cost of subsequently being subjected to tort litigation should be weighed.

The reasons for this answer are that the public and regulators need to know what nanomaterials are being released into the community and environment, not just to correlate risk research and data collection but because they may have cumulative impacts.

11. What are current issues that affect the feasibility of such a program?

The main difficulty is that the reporting system must eventually become the first step in an iterative regulatory loop that will require an investment of government funds to establish. This will need to be done eventually and regulation in this area should not be crisis-driven.

12. What are your views on making information gathered from assessments of nano-forms of existing chemicals publicly available?

This should be done. A good model in this respect is the Public Summary Document generated after Pharmaceutical Benefits Advisory Committee (PBAC) decisions and placed on the PBAC website. The PBAC also allows the public to know what is about to be assessed and to make submissions prior to a regulatory assessment. This would be good practise here also.

PROPOSAL FOR MORE COMPREHENSIVE REGULATION

Stream 2

Concurrent with activities identified in stream 1, NICNAS is exploring the feasibility of implementing a more comprehensive regulatory proposal for nano-forms of existing chemicals that addresses triggers identified in the Monash Report and acknowledges:

- *the lack of comprehensive information on properties, and health, safety and environmental effects of nanomaterials and*
- *the uncertainty surrounding the applicability of conventional hazard, exposure and risk assessment methodologies and is consistent with ongoing national and international efforts to address these challenges.*

It is desirable that such a program include:

- *the ability to reliably identify introducers of nanoforms of existing chemicals,*
- *knowledge of specific nanoforms of existing chemicals being introduced, volume information and use scenarios,*
- *the ability to ensure human health and safety and environmental protection is maintained through enforceable conditions of use, where such measures are warranted,*
- *health and environmental risk assessments to be based on the best available scientific information,*
- *the ability of the regulator to obtain "non-standard" information relevant to the risk assessment on a case by case basis,*
- *adopting measures to protect human health and/or the environment where the best available scientific information is insufficient to support safety of the material,*
- *the ability to review risk assessment decisions as new scientific information becomes available,*
- *the regulatory impost on industry is commensurate with the risk posed by these materials (to the extent this can be determined up front).*

Proposal:

The NICNAS new chemicals permit framework could be used as a potential model (modified as required).

The features of the permit framework that are suitable for this purpose include:

- *nanomaterials will be assessed on a case by case, using best available scientific information*
- *NICNAS can request "non-standard" information relevant to the risk assessment as required*
- *assessed nanoforms of existing chemicals will not be included on the inventory and each introducer will need to seek "permission to introduce" (for example through a "permit" application) therefore NICNAS will have knowledge of introducers of specific nanomaterials at all times.*
- *the ability to impose mandatory, auditable conditions of introduction when granting "permission to introduce"*
- *the ability to amend permit conditions or revoke permits (hence introduction) should significant adverse health and environmental effects be identified.*
- *provisions for recognising commercially confidential information.*
- *However, some features of the current permit framework for conventional new chemicals may not be suitable for this purpose. These are:*
 - *the current data requirements for conventional chemicals may be inadequate for risk assessment of nanoforms of existing chemicals,*
 - *maximum durations (currently up to 4 years depending on permit type) and therefore the need to seek further permissions to introduce may be an unjustified burden on industry, particularly in the absence of adverse effects being identified,*
 - *risk assessment reports are not published in full therefore the transparency of the assessment process is limited.*

At this stage we are only seeking stakeholder views on the feasibility of implementing a mandatory notification and assessment program for nanoforms of existing chemicals. Further stakeholder consultations including regulatory impact analysis will be undertaken prior to a finalising the reform proposal.

Potential impacts:

The advantages and disadvantages of a mandatory notification and assessment program for nanoforms of existing chemicals (on preliminary consideration only) are identified below:

Advantages

- *Provide significant public assurance that potential risks presented by industrial nanomaterials that are nanoforms of existing chemicals are adequately identified and managed,*
- *Potential health and safety issues will be addressed systematically before the chemical enters the marketplace,*
- *Decisions can be revisited and revised (as required) when new information becomes available.*

Disadvantages

- *The proposal will require legislative amendment and will therefore take time to implement.*
- *This proposal will have cost implications for business and possibly downstream users.*

3C *The principle of an integrated approach for industrial nanomaterials within the NICNAS framework as a longer term strategy.*

Sections 3a and 3b collectively provide a proposed approach for regulating nano-forms of new and existing chemicals. After consultation, suitable reform options will be progressed in the short to medium term future.

As a longer term proposal, NICNAS is seeking preliminary views on the principle of integrating the approach for industrial nanomaterials, within the NICNAS framework, as a longer term strategy.

Further exploration of this approach will be complemented as:

- 1. NICNAS gains experience through the implementation of proposals in sections 3a and 3b.*
- 2. Further national and international scientific activities builds on knowledge in this area. a*

13. How might an integrated approach provide for more effective regulation of industrial nanomaterials compared to the package proposed (for nano-forms of new and existing chemicals) in sections 3a and 3b?

Submission Q13

The regulatory system developed for industrial nanomaterials in Australia should involve an **iterative regulatory loop**. Perhaps the best model in Australia at present for this is that utilised to assess cost-effectiveness data for placement of new prescription pharmaceuticals on the Pharmaceutical Benefits Scheme. It involves the initial presentation of safety data by manufacturers, assessment of the data by a government-coordinated committee of experts, cross-checking of the data by independent groups of academics, the power to request further data, outsource the performance of additional testing or to perform that testing or modelling in house, a final regulatory decision based on transparent criteria, a review mechanism, public summary documents of regulatory decisions and increasing amounts of post-marketing surveillance with regulators possessing the power to place bans or request compliance with additional conditions as necessary.

Conclusion

Greater assurance needs to be given to all stakeholders that there is a whole of government approach to ensuring the effective regulation and responsible development of nanotechnology in Australia. The government should be clear that health and environmental issues raised by this technology should be treated with a precautionary approach. Regulatory agencies such as NICNAS, TGA and APVMA must be consistent in the development of a nationally coordinated regulatory framework for all nanomaterials.

NiCNAS should be authorized to outsource testing and a certification system should be established for testing of industrial nanomaterials in Australia. In time moves should be made for the establishment of an independent NICNAS testing laboratory which would have a valuable capacity building impact on Australian science. Implementation of reforms should involve a central whole of government steering committee and be auditable across all sectors of industry, including downstream use. Measures such as mandatory reporting can help industry if effectively implemented by creating a level playing field. NICNAS should introduce enforceable conditions to ensure compliance and to recover costs from non-compliant companies

Yours Sincerely

Dr Thomas Faunce,

