National Environment Protection
(National Pollutant Inventory) Measure

Technical Advisory Panel

Final Report
to the
National Environment Protection Council

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PREFACE

This is the final report of the Technical Advisory Panel (TAP) on the variation to the National Pollutant Inventory (NPI) National Environment Protection Measure (NEPM). The panel was formed in September 2005 to provide advice on a range of possible changes to the NPI. These included the possibility of incorporating transfers in reporting, altering the list of substances to be reported, adjusting thresholds and various other modifications (the terms of reference are listed in Appendix A). The full membership of the TAP can be found in Appendix B. At the first meeting of the panel it was decided to divide the tasks between two working groups. Group A worked on the issue of transfers and Group B dealt with the substance list, reporting thresholds and other terms of reference. Interim reports for both groups were released in February 2006. At the time of writing, the issue of whether to include greenhouse gases in the NPI was not referred to the TAP since there are a number of other national processes looking at this matter. The TAP noted that a primary goal of the NPI was to promote cleaner production.

The term of reference regarding transfers asked the TAP to *"recommend a definition of transfers and identify a preferred international substance-based framework for transfers that could be adopted by the NPI"* (Appendix A). The panel was aware that the proposal to alter the inventory in this fashion raises a number of significant issues including:

- the differentiation of an emission[1] from a transfer;
- whether to differentiate between on-site and off-site transfers;
- whether transfers should be reported separately from emissions to reduce definitional confusion;
- whether to include products or goods (eg mineral ores, agricultural products and chemicals)[2];
- whether to include tailings from mining or waste rock from mining, construction and road building;
- whether bulk materials (such as waste rock) should be reported as transfers if they exceed a minimum threshold percentage of specified substances;
- whether an impoundment or containment should be considered to be a release in the long term though emissions are already reported under the NPI;
- the meaning of long and short term containment;
- how the movement of intermediate materials from site to site should be handled;
- whether containment facilities should be graded with possibly different reporting requirements depending on storage security; and
- whether the list of substances reportable for transfers should vary from the current releases list.

All of these issues were considered by the TAP in its deliberations and taken into account by Group A.

The TAP also made reference to both the Australian and international experience with pollution inventories when considering the proposed variations to the substance list, thresholds and other terms of reference. Some of the significant documents consulted by the TAP are listed in Key References. In fulfilling its function the TAP considered

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[1] Emission refers to release, discharge or deposit to air, land or water

[2] Distinguishing wastes from non-wastes under Australia's *Hazardous Waste Act*, Information Paper No 2, June 2001, 4th edition

relevant international standards and the ways these apply to the Australian situation. The TAP noted the need to balance the demands for greater information by community groups with the need to justify any increased reporting burden on industry, given the Australian Government's current initiative on *"Reducing the Regulatory Burden on Business"* 2005.

Thanks are owed to the Australian Government Department of the Environment and Heritage for their research support and for the logistical assistance provided by the National Environment Protection Council Service Corporation. Thanks also to the Queensland Environmental Protection Agency, the NSW Department of Environment and Conservation, the Environment Protection Authority, Victoria, and the Australian Government Department of the Environment and Heritage for hosting our meetings.

EXECUTIVE SUMMARY & RECOMMENDATIONS

The TAP noted that the reporting of transfers was common in other pollutant inventories (see Appendix C) - the experience of the US and Canadian inventories proved particularly useful in assisting the panel's deliberations. Several definitions were reviewed and a definition that best suited the Australian situation was derived. The TAP considered pertinent issues such as the types of receiving facilities, the difference between on-site and off-site transfers, releases from receiving facilities, the differentiation of waste from useable product and the possible inclusion of waste rock, tailings and contaminated soil. Issues relating to reporting and thresholds were also considered.

The TAP reviewed the proposed variations to the substance list outlined in *The Final Report of the Review of the National Pollutant Inventory for the Department of the Environment and Heritage* (2005), section 4. The panel responded to the proposed variations only in order to stay within the terms of reference and meet the given timeframe. Should the substance list be reviewed in future, a more comprehensive and systematic approach that recreates the whole list of substances using data from Annex I of the European Union hazardous chemicals system is recommended. The TAP considered the inclusion of $PM_{2.5}$ and changes to reporting thresholds for PM_{10}, mercury and related substances. It also reviewed proposals for changes to the way PAHs and NO_x are reported.

The resulting recommendations of the TAP are listed below:

1) The TAP recommends that transfers be included in the NPI.

2) The TAP recommends that a transfer be defined as the transport or movement on-site or off-site of substances contained in waste* for:
    (a) containment;
    (b) destruction;
    (c) treatment which leads to:
        (i) reuse or recycling;
        (ii) purification;
        (iii) remediation; or
        (iv) immobilization; and
    (d) energy recovery.
    (*a waste is defined as any material that is not a product or an article)

3) The TAP recommends that only waste materials should be included under the 'transfers' definition.

4) The TAP recommends that reporting of the type of receiving or containment facility be mandatory.

5) The TAP recommends inclusion of off-site materials under the definition of 'transfers' and only those on-site materials where no further movement of the material occurs around the site.

6) The TAP recommends the reporting of any release to the environment during materials movements be reported under NPI 'emissions'. Transferred materials,

on the other hand, should be reported in the proposed separate 'transfers' database, also within the NPI reporting site.

7) The TAP recommends that the movement of all products be excluded from the definition of 'transfers'.

8) The TAP recommends that waste rock and associated overburden that have not been chemically modified should be excluded from transfers reporting. However, it is recognized that should any NPI substances be emitted from waste rock they are, and continue to be, reportable under the NPI. This is consistent with the Canadian NPRI.

9) The TAP recommends the reporting of transfers of contaminated soils and contaminated sediments be recorded in the 'transfers' database of the NPI.

10) The TAP recommends that database development work be undertaken for the 'transfers' register in order to allow subsequent transfers of the same waste to be tracked in a life cycle approach.

11) The TAP recommends that emissions and transfers be logged by reporters separately on the NPI website and that contextual information explaining the reasons behind this separation be supplied with each section.

12) The TAP recommends that the definition stated in recommendation 2 would not be applied to virgin materials, chemical intermediates, commodity products and waste rock.

13) The TAP recommends that the reporting thresholds for transfers be consistent with the reporting thresholds for emissions.

14) The TAP recommends that receiving facilities for transfers be graded according to whether they are closer either to best practice or the minimum statutory requirements.

15) The TAP recommends that transfer data are reported separately from emissions on the NPI website and that the following information fields should be reported by facilities:
    - substance name;
    - transfer quantity;
    - total waste quantity;
    - waste type;
    - estimation technique;
    - on-site or off-site transfer;
    - purpose of transfer (disposal, recycling etc); and
    - name and grade of receiving facility.

16) The TAP recommends that acrolein be included in the NPI reporting list owing to its toxicity, usage and potential for exposure.

17) The TAP does not recommend that 'air toxics' as a group should be included in the NPI reporting list, since each individual entry in the Priority Air Toxics Pollutant List has been considered for inclusion in the NPI reporting list on the basis of its chemical identity and properties, so no further action is required.

18) The TAP does not recommend that carbon tetrachloride be included in the NPI reporting list, as its uses have largely been phased out in Australia.

19) The TAP does not recommend that 1,2-dichloropropene be included in the NPI reporting list, as it is only a minor contaminant in 1,3-dichloropropene.

20) The TAP does not recommend that 1,3-dichloropropene be included in the NPI reporting list at this time, due to limited use. However, because 1,3-dichloropropene is classified as a carcinogen in the USA, this recommendation should be reconsidered if production or import data for products containing 1,3-dichloropropene indicates this is a chemical in widespread use.

21) The TAP does not recommend that hydrazine be included in the NPI reporting list because NICNAS does not report significant use in Australia.

22) The TAP notes that dichloromethane and methylene chloride are the same chemical and therefore there is no reason to add the latter to the reporting list, as it is already covered.

23) The TAP recommends that, as well as identifying chemicals by name, all chemicals on the NPI reporting list be identified by CAS number to avoid confusion.

24) The TAP does not recommend that ozone depleting chemicals be listed on the NPI reporting list because their use is being phased out.

25) The TAP recommends that the inclusion of methyl bromide in the reporting list be reviewed if its use continues.

26) The TAP does not recommend that organochlorine emissions from smelting be listed on the NPI reporting list to avoid singling out a particular industry and because OCs are a heterogeneous group. However, the TAP does support the reporting of individual OCs as appropriate.

27) The TAP recommends that PCBs be included on the NPI reporting list because of their importance as hazardous wastes and the large volumes that remain on hazardous waste inventories. PCBs should also be reported as transfers.

28) The TAP does not recommend that phthalates be included in the NPI reporting list as a generic group, but individual phthalates should be considered, following the completion of the NICNAS review. However, the TAP recommends that the current listings for specific phthalates be retained.

29) The TAP does not recommend that polybrominated flame retardants be included in the NPI reporting list as a generic group, due to their heterogeneous nature. However, individual PBFRs should be considered following the completion of the NICNAS review and consideration of monitoring data.

30) The TAP does not recommend that quinoline be included in the NPI reporting list due to its apparent low usage in Australia.

31) The TAP does not recommend that 1,1,2,2-tetrachloroethane be included in the reporting list as most of its uses have been phased out.

32) The TAP does not recommend that thallium be included in the NPI reporting list as most of its uses that may result in environmental releases have been phased out.

33) The TAP does not recommend that TDS, BOD and pH for water be included in the NPI reporting list as these are indicators of substances and are not substances in themselves.

34) With respect to the NPI reporting list, the TAP recommends the following:
    - Acrylamide - *delete*
    - Aniline - *delete*
    - Hexachlorobenzene - *retain*
    - 2-Ethoxyethanol acetate - *delete*
    - Ethyl butyl ketone - *delete*
    - 2-Methoxyethanol - *delete*
    - 2-Methoxyethanol acetate - *delete*
    - 4,4′-Methylene bis (2-chloraniline) MOCA - *delete*
    - Nickel carbonyl - *delete*
    - Nickel subsulphide – *delete from Category 2b threshold but retain as a Category 1 substance.*

    The justification for these recommendations is given in section 9.2.

35) The TAP recommends that the threshold for PM_{10} be maintained at Category 2a (that is, reporting is required when burning more than 400 tonnes of fuel).

36) The TAP recommends that PM_{10} speciation could be provided by the reporting site as an option to allow NPI reporters to provide additional relevant contextual information about PM_{10} emissions.

37) The TAP recommends that $PM_{2.5}$ emissions from combustion sources should be reported for the NPI, with the option of reporting from non-combustion sources to be reviewed at a future date.

38) The TAP recommends that the appropriate threshold for $PM_{2.5}$ would be Category 2a (burning more than 400 tonnes of fuel).

39) The TAP recommends that the threshold for mercury be reduced to 5kg. While it is recognized that the information available on mercury is not as definitive as one might prefer, it is considered that the toxicity of mercury is such that it would be appropriate to lower the threshold to 5kg given that:
    - environmental contamination with mercury is an ongoing concern;
    - adverse effects may occur from relatively low levels of mercury;
    - residues in some foods above the limits continue to be found; and
    - there may well be significant potential for release from users of lesser

amounts.

40) The TAP further recognized that the proposed reduction of the threshold for mercury to 5kg may well have a flow-on effect to other substances, including other heavy metals such as cadmium and lead. This will require further attention in the future as it is beyond the terms of reference of the current TAP.

41) The TAP recommends that the total mass of PAHs be reported using equation 2 (see text in section 10.4).

42) The TAP recommends that the TEQ approach (equation 1 – see text in section 10.4) and TEFs based on benzo[a]pyrene be used in reporting PAHs in the NPI.

43) The TAP was unable to establish a scientific or technical basis for a recommendation for reporting minima, other than values so low (for example 1mg) as to be impractical.

44) The TAP recommends that total NO_x emissions be reported as NO_2 equivalents (that is, on the basis of molecular weight of NO_2).

45) The TAP recommends that if another revision of the NPI reporting list is required at some point in the future, then consideration should be given to re-creating and updating the full NPI candidate list from chemicals that meet EU criteria for classification as environmentally hazardous in Annex I of the EU hazardous chemicals system.

46) The TAP referred a further term of reference, *if feasible, investigate the merits of reporting emissions that are below detectable limits as zero, or '-', or 'not detected'*, to the project team with a recommendation that this be done.

LIST OF ACRONYMS

AICS	Australian Inventory of Chemical Substances
APVMA	Australian Pesticides and Veterinary Medicines Authority
BAT	Best Available Technology
BOD	Biological Oxygen Demand
BREF	Best Available Technology Reference document
CAS	Chemical Abstract Service
CEPA	(former) Commonwealth Environment Protection Agency
DEC	Department of Environment and Conservation (NSW)
DEH	Department of Environment and Heritage
EC	European Commission
EPA Vic	Environment Protection Authority, Victoria
EPA	Environmental Protection Agency
EPER	European Pollutant Emission Register
EPHC	Environment Protection and Heritage Council
EU	European Union
EWC	European Waste Catalogue
HCB	Hexachlorobenzene
HVICL	High Volume Industrial Chemical List
KUR	Pollutant Release and Transfer Register (Sweden)
LPG	Liquefied Petroleum Gas
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NICNAS	National Industrial Chemicals Notification and Assessment Scheme
NO_x	Oxides of Nitrogen
NPI	National Pollutant Inventory

NPRI	National Pollutant Release Inventory (Canada)
OECD	Organisation for Economic Cooperation and Development
PAH	Polycyclic Aromatic Hydrocarbon
PBFR	Polybrominated Flame Retardant
PCB	Polychlorinated Biphenyl
PM_{10}	Particulate Matter less than 10 microns in diameter
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter
POTW	Publicly Owned Treatment Works
PRTR	Pollutant Release and Transfer Register
TAP	Technical Advisory Panel
TEF	Toxic Equivalency Factors
TEQ	Toxicity Equivalency Quantity
TRI	Toxic Release Inventory (USA)
UK	United Kingdom
USA	United States of America
USEPA	United States Environmental Protection Agency
USFDA	United States Food and Drug Administration
WFD	Waste Framework Directive (Europe)

GLOSSARY

Note: this is a common glossary for TAP reports A and B and the documents referred to by these reports (unless otherwise specified, the definitions below are quoted directly from the NPI *Glossary of Terms* at http://www.npi.gov.au/epg/npi/contextual_info/glossary.html).

acute exposure: exposure to a chemical for a short period of time, relative to the organisms life span, for example, 14 days or less for humans.

aggregated emissions data: estimates of the amount of a substance emitted to the environment annually from (a) facilities that are not reporting facilities and (b) anthropogenic sources other than facilities which emit a significant amount of that substance to the environment.

air quality: the condition of the air we breathe.

air toxics: gaseous, aerosol or particulate pollutants (other than the six criteria pollutants) present in the air in low concentrations with characteristics such as toxicity or persistence so as to be a hazard to human, plant or animal life (DEH. 2001. *Australian State of the Environment Report*. Canberra: http://www.deh.gov.au/soe/2001/glossary.html)

alkanes: chemical classification relating to the structure of hydrocarbons - alkanes have carbon atoms arranged in chains and contain no double or triple bonds.

alkenes: chemical classification relating to the structure of hydrocarbons - alkenes have carbon atoms arranged in chains and contain one or more double bonds.

alkyl: chemical classification of hydrocarbon groups attached to compounds - alkyl groups have carbon atoms arranged in chains and contain no double or triple bonds.

alkynes: chemical classification relating to the structure of hydrocarbons - alkynes have carbon atoms arranged in chains and contain one or more triple bonds.

ambient: refers to environmental conditions in the surrounding air or water, and not to conditions associated with an emission(s) or discharge(s).

aromatics (arenes): organic compounds that contain a benzene ring or have chemical properties similar to benzene.

aryl: chemical classification of hydrocarbon groups attached to compounds - aryl groups have carbon atoms arranged in aromatic rings.

benzene (C_6H_6): a colourless, liquid hydrocarbon. The molecular structure is that of six carbon atoms joined in a hexagonal ring. It is the simplest aromatic compound.

bioaccumulate: to accumulate in the tissues of plants and animals to a concentration higher than that of the surrounding environment.

bioavailability: a measure of the extent to which a substance is able to be absorbed by living organisms.

biochemical oxygen demand (BOD): the amount of oxygen required during the decomposition of organic matter by aerobic microbiological action. A water body polluted by biologically degradable organic matter loses some or all of its dissolved oxygen by the respiratory oxygen demand of the microorganisms consuming the organic matter. BOD5 (ie five days of BOD at 20degC) is a common measure of biodegradable pollution in water.

bioconcentrate: to become more concentrated in the tissues of plants and animals than in the surrounding environment.

biodegradable: able to be broken down into chemically-simpler compounds by micro-organisms (NPI, modified by TAP 2006).

biomagnification: the existence of a substance at successively higher concentrations with increasing trophic levels in ecosystem food chains. *cf.* bioconcentration.

biomass: the total mass of living organisms present in an area, ecosystem, environment or in a category of organisms.

biophysical: refers to biological phenomena interpreted in terms of physical principles.

by-products: secondary products, possibly of commercial value, which are obtained from the chemical or physical processing of material. "By-product" was a term used for a residual from processing, which being of no apparent usefulness at the time, became a waste and pollutant. The reverse can also occur, where a waste can become a by-product if it is saleable. The term was used to refer to a single component or mixture of residuals/pollutants prior to adoption of these terms (NPI, modified by TAP 2006).

carbohydrates: a group of organic compounds composed of carbon, hydrogen, and oxygen. The group includes the sugars, starches and cellulose.

carboxylic acid: an acidic organic compound containing one or more univalent carboxyl(-COOH) groups.

carcinogen: a chemical capable of inducing cancer.

carcinogenesis: the inception and development of a cancer - a carcinoma.

carcinogenic: able to induce cancer.

chemical: any element, compound or complex present as an entity or contained in a mixture.

chemical intermediate: any chemical substance produced during the conversion of some reactant to a product. Most synthetic processes involve transformation of some readily available and often inexpensive substance to some desired product through a succession of steps. All the substances generated by one step and used for the succeeding step are considered intermediates (Encyclopaedia Britannica: http://www.britannica.com/eb/article-9022782).

chronic exposure: exposure to a chemical for a relatively long period of time (for example, 365 days (one year) or more for humans).

chronic toxicity: a toxic effect which occurs after repeated or prolonged exposure. Chronic effects may occur some time after exposure has ceased.

cocarcinogen: a substance or agent that enhances or potentiates the effects of a carcinogen.

database: place where quantities of data are stored in an organised fashion.

de minimis: principle applies where a threshold concentration is established below which “the burdens of regulations yield a gain of trivial or no value” (TAP 2006).

diffuse data: data in the NPI from sources other than reporting facilities. Data includes sources such as motor vehicles and industry facilities that do not report themselves.

environment: the sum of all external conditions and influences affecting the life, development, and ultimately, the survival of an organism.

environmental fate: the end-condition and/or location of a substance after transport in the environment, with or without undergoing physical, biological and chemical interactions during the transport.

environmental transport: the movement through the biosphere of a substance (chemical, trace elements, etc), including the physical, biological and chemical interactions undergone by the substance.

facility: means any building or land from which a substance may be emitted, together with any machinery, plant, appliance, equipment, implement, tool or other item used in connection with any activity carried out at the facility; and includes an offshore facility.

flammability: a measure of the extent to which a substance will support combustion.

flash point: the temperature at which the vapours of a substance, mixed with air, spontaneously ignite.

half life: the time it takes for the mass, concentration or biological activity of a chemical to halve (TAP 2006).

halocarbon: a hydrocarbon with some hydrogen atoms replaced by halogen atoms such as chlorine or fluorine.

halogenated: containing one or more halogen atoms, ie fluorine, chlorine, iodine, bromine or astatine.

hazard: an intrinsic capacity associated with an agent or process capable of causing harm.

hazardous substances: substances which are capable of causing serious damage to human health. Serious damage is classed as being where a clear functional disturbance or morphological change, which has toxicological significance, results from repeated or prolonged exposure.

heat capacity: the energy in joules required to raise the temperature of a body or system by one degree Kelvin.

heterocyclic: a cyclic or ring molecular structure in which one or more of the atoms in the ring is an element other than carbon (common heterocyclics are pyridine, pyrrole, furan, thiophene, and purine).

hexane (C_6H_{14}): the sixth member of the paraffin series of hydrocarbons, existing in six different isomeric forms.

hexavalent: an atom able to bond with six other atoms.

hydrocarbon: an organic compound consisting exclusively of the elements carbon and hydrogen.

industry concentration: an average concentration calculated from results for industry sourced pollution over a one year period - the concentration at any time could be higher or lower than the annual average.

inert: a substance which has little or no chemical reactivity.

inorganic: substances not containing carbon-carbon bonds (*cf* organic).

ion: an atom or group of atoms which have gained or lost one or more electrons, and thus carry a positive or negative charge.

LC50: a concentration of a substance that produces death in 50% of a population of experimental animals after exposure for a period of time which is usually specified (eg '96 hour LC50'). This term is used when the substance exists in the organism's ambient environment at the specified concentration (for example, fish in water in which the substance is present at the specified concentration).

LD50: a dose of a substance that produces death in 50% of a population of experimental animals. It is usually expressed as milligrams per kilogram (mg/kg) of body weight. This term is used when the exposure pathway is by absorption of the specified dose.

leachate: liquid that has percolated through solid waste or other solids and has extracted materials from it by leaching.

median lethal concentration (LC50): a standard measure of toxicity - indicates the concentration (usually in air, water or food ingested) of a substance that will kill 50% of a group of experimental insects or animals.

metals: metallic elements mainly of high atomic weight, generally toxic to plant and animal life in low concentrations. These elements are often present in the environment in trace concentrations and exhibit biological accumulation. Examples include mercury, cadmium, arsenic and lead, which are toxic to humans in most forms or quantities. Arsenic is sometimes included in this group because it can exhibit toxicity like mercury, lead and cadmium, although strictly speaking it is a 'metalloid' – neither a metal or a non-metal. Some heavy metals are essential nutrients in low doses or of a particular valency, but toxic in higher doses or other valencies. Zinc is an example of the first kind (higher concentration) and chromium of the second kind (different toxicities occur for forms or species of different valency). Some are tolerated by other life forms, for example, sea-birds tolerate, and often have, high body-burdens of cadmium (NPI, modified by TAP 2006).

methanol, (CH_3OH): the first in the series of the simplest alcohols. It is highly poisonous to humans and many animals.

micrograms per cubic metre: one millionth of a gram of a substance in a cubic metre of air, soil or water. That is, 0.000000001 grams per litre of air, soil or water.

micrometre: 0.000001 metre, ie a millionth of a metre.

micron: see micrometre.

milligrams per cubic metre: one thousandth of a gram of a substance in a cubic metre of air, soil or water. That is, 0.000001 grams per litre of air, soil or water.

nanograms per cubic metre: one billionth of a gram of a substance in a cubic metre of air, soil or water. That is, 0.000000000001 grams per litre of air, soil or water.

nanometre (nm): 0.000000001 metre, ie a billionth of a metre.

neurotoxin: a substance which has adverse effects on the nervous system.

olefin: a class of unsaturated aliphatic hydrocarbons having the general formula C_nH_{2n} that contain one or more double bonds and therefore are chemically reactive. Ethylene is the simplest olefin. Those containing one double bond are called alkenes, and those containing two are called alkadienes or diolefins.

organic: substances containing carbon-carbon bonds. Historically, the term referred to substances which are part of or derived from living organisms, although most organic compounds now are synthetic. All living matter on earth includes carbon as a component. *See also* inorganic.

overburden: consolidated or unconsolidated material that overlies both grade ores and waste rock and may contain useful plant nutrients (TAP 2006).

ozone depletion: the natural equilibrium between chemical reactions forming and destroying stratospheric ozone is disturbed by the release of manufactured chemicals (DEH. 2001. *Australian State of the Environment Report*. Canberra: http://www.deh.gov.au/soe/2001/glossary.html).

ozone layer: a region in the stratosphere where there is a small, but significant, amount of ozone (DEH. 2001. *Australian State of the Environment Report*. Canberra: http://www.deh.gov.au/soe/2001/glossary.html).

oxidant, oxidising agent: an oxidant is a substance that accepts electrons during chemical reactions. These reactions often involve oxygen resulting in the formation of oxides. The rusting of steel is an example of this type of reaction.

oxidation state: the number of electrons to be added or subtracted from an atom in a combined state (ie in a chemical compound) to convert it to the elemental form.

oxygenates or oxygenated hydrocarbons: compounds which contain carbon, hydrogen and oxygen, for example alcohols.

PAH: *ref.* polycyclic aromatic hydrocarbons.

particulate matter, particulates, particles: discrete aggregations of matter, either solid or liquid (or a mixture) and larger than the individual molecules of the surrounding gas or air. *See also* PM_{10}.

PCBs (polychlorinated biphenyls): a group of chlorinated organic compounds that are non-corroding and resistant to heat and biological degradation; used as insulation in electrical equipment; can accumulate in some species and disrupt reproduction (DEH. 2001. *Australian State of the Environment Report*. Canberra: http://www.deh.gov.au/soe/2001/glossary.html).

pH: a measure of how acidic or alkaline a material, liquid or solid is. pH is presented on a logarithmic scale of 0 to 14. 0 represents the most acid, and 14 the most alkaline and 7 neutrality. pH is the negative log of the hydrogen ion concentration.

phenols: a class of aromatic organic compounds in which one or more hydroxy groups are attached directly to the benzene ring (eg phenol, cresols, xylenols, resorcinol, naphthols.)

PM_{10}: particulate matter which is less than 10 micrometres in diameter (a micrometer is one millionth of a metre) - also known as respirable particles.

$PM_{2.5}$: particles with aerodynamic diameters of up to 2.5 µm (DEH. 2001. *Australian State of the Environment Report*. Canberra: http://www.deh.gov.au/soe/2001/glossary.html).

pollutant: a chemical which may reduce the quality of the environment.

pollution: presence of one or more pollutants in the environment.

polycyclic aromatic hydrocarbons (PAH): a generic name for a broad group of compounds all of which have condensed benzene rings (hexagonal rings joined along common sides). Naphthalene is the simplest PAH. PAHs are, and have been historically, ubiquitous in the environment. They occur in smoke from burning wood and vegetation, from fossil fuel combustion and on burnt meat. They are present in much higher concentrations when a wood or coal fire is starved of adequate air or the petrol or diesel engine is emitting smoke. They are usually adsorbed onto particulates in the smoke from the above sources.

propene (CH_2:CH.CH_3): a colourless gas, the second member of the olefin series of hydrocarbons, produced as a co-product in the manufacture of ethylene. It is used in the manufacture of petrochemicals, polypropylene and high octane gasoline components by alkylation and polymerisation.

propylene: *see* propene.

reporting facility: means a facility that is required to report information under clause 9 of the (Australian) National Environment Protection Measure for the National Pollutant Inventory.

residuals: (1) a synonym for wastes and emissions. The substances discharged from a manufacturing or process plant in its wastes to the atmosphere, receiving waters and land. (2) (oil refining) the bottom product of a distillation process, produced to a commercial specification.

respirable particle: particle of the size, smaller than 10.0 microns, most likely to be deposited in the pulmonary portion of the respiratory tract. *Ref* PM_{10}.

solvent: a substance which dissolves or dilutes another.

source of emissions: an activity or process which can lead to the release of a pollutant.

speciation: refers to the subdivision of substances into groups which might be in different oxidation states, in soluble and insoluble forms, or combined in different ways that give rise to specific toxicity (TAP 1999). For example, compounds of chromium can be subdivided into groups defined by the oxidation state of chromium (eg III or VI) within the compound because of their differing toxicities. These species of chromium are listed separately under the NPI because of the different toxicity risks they pose (NPI, modified by TAP 2006).

substance: any natural or artificial entity, composite material, mixture or formulation, other than an article.

TEQ: for the NPI, polychorinated dioxins and furans are reported as total emissions - a total of the emissions from each of the species in this class of substances. However, dioxins and furans are often shown in toxic equivalents (TEQ), which is a means of scaling the emissions of each species of dioxin and furans according to their relative toxicity. Hence care should be taken when comparing NPI emissions of polychlorinated dioxins and furans with other sources of information (NPI). The TAP recommends that this method should also be applied to PAHs (TAP 2006).

tonne: one metric ton (1,000kg, or 1,000,000 grams).

toxicity: the quality, state, or relative degree of being toxic or poisonous. Toxicity relates to the ability of a chemical molecule or compound to produce injury when it reaches a susceptible site in the body. The damage may be permanent or transient.

unsaturated organic compounds: an organic compound having some of the carbon atoms in its molecule linked by two or three covalent bonds.

VOC: *see* volatile organic compounds.

volatile organic compounds: a general term which refers to a large and diverse group of substances, including hydrocarbons, oxygenates and halocarbons that readily evaporate at room temperature.

volatile: readily evaporates at room temperature.

volume/volume (or vol/vol): indicates that a concentration is described in terms of the volume of solute (or contaminant) as a proportion of the volume of solvent. Usually used for mixtures of liquids or gases.

waste: any material that is not a product or an article (TAP 2006).

waste rock: rock, that with its associated unconsolidated soil, has no useful purpose (TAP 2006).

weight/weight: indicates that a concentration or dose is described in terms of the weight of solute (or contaminant) as a proportion of weight of the solvent (or dosed organism).

SECTION A: TRANSFERS

1 INTRODUCTION

Australia's National Pollutant Inventory is one of a number of pollutant release and transfer registers (PRTRs) that have been adopted by OECD countries to provide publicly accessible information and, through disclosure, to encourage cleaner production. In doing so, they drive down releases which may present risks to human health or the environment.

The coverage of particular PRTRs varies from country to country, as does the language used to describe their constituent parts. For example, while most inventories include 'pollutant' in their title, the United States alone includes 'toxic' (Toxic Release Inventory, TRI) and Australia uses 'emissions' in place of 'releases' and 'inventory' in place of 'register'. There are also significant differences in the reporting lists of chemical substances, reflecting to some extent the scale and diversity of chemical operations in different countries and national assessments of risk.

It should be possible to take advantage of this linguistic variety, which offers an opportunity to differentiate the emissions data reported under the aegis of the present and presumably continuing NPI from those reported for transfers. This could be done by establishing a 'transfers register' under the NPI. Separating the reporting in this way would avoid vexatious summing of emissions and transfers to produce large but meaningless totals as the basis for criticism of industry and/or government. The recent NPI review (Environment Link 2005) noted that the NPI could be renamed to reflect the inclusion of transfers.

A significant difference between the various PRTRs is their differing treatment of transfers and so a variety of experience is available to inform the development of a transfer reporting system in Australia. Brief summaries of the status of transfers in a number of PRTRs are given in Appendix C.

2 NATIONAL ENVIRONMENT PROTECTION GOALS

Part 2 of the NPI NEPM (1998) included a number of goals that flow from a statement of desired environmental outcomes. While many of these statements are not relevant to the inclusion of transfers in a revised NPI, and some new goals will need to be devised to cover transfers, some of the existing goals have direct relevance. They are (using the NEPM numbering):

> 5. The desired environmental outcomes of the Measure are:
>
>   ...
>
>   (b) the minimization of environmental impacts associated with hazardous wastes; and
>
>   (c) an expansion in the re-use and recycling of used materials.
>
> 6. The national environmental protection goals established by this Measure are to assist in reducing the existing and potential impacts of emissions of substances and to assist government, industry and the community in achieving the desired environmental outcomes set out in clause 5 by providing a basis for:
>
>   ...
>
>   (b) the dissemination of information collected to all sections of the community in a useful, accessible and understandable form.

> 7. A database to be known as the National Pollutant Inventory will be established to:
>   (a) provide information to enhance and facilitate policy formulation and decision making for environmental planning and management;
>   …
>   (c) promote and assist with the facilitation of waste minimization and cleaner production programs for industry; government and the community.

The provisions of clause 8 for reporting by facilities to States and Territories, and provision of contextual data by the Australian Government, and annual dissemination will remain relevant.

However, there will be less need for provision of aggregated emissions data based on modelling, than there is in the case of emissions data. Should it be decided that the 'transfers register' should include such movements of products, then modelling would be needed because of the multiplicity of small transfers within such categories.

3 TRANSFER DEFINITIONS

3.1 PREVIOUS DEFINITIONS

Two reviews (Rae 2000; Environment Link 2005) have identified the need for a definition of transfers to be agreed. Rae recommended the following definition, and Environment Link 2005 used:

> Transfers are the transfer of a substance to an identified receiving place whether in pure form or contained in another matter and whether solid, liquid or gaseous. It includes transfers of a substance to an engineered landfill, a sewage treatment plant or a tailings dam, and removal of a substance from a facility to an identified place for destruction, treatment, recycling, reprocessing, recovery or purification (Environment Link 2005, p18).
>
> A transfer is the movement or transport of a substance to an identified receiving place, for management or storage whether in pure form or contained in other matter and whether solid, liquid or gaseous. It includes transfer of a NPI substance to an engineered landfill, a sewage treatment plant or a tailings dam, and removal of a substance from a facility to an identified place for destruction, treatment, recycling, reprocessing, recovery or purification.
>
> It does not include the transport of goods/products or waste rock or overburden from mining, construction, road works or quarrying. (Comment: use of the word "transport" here in the definition implies deliberate movement by some transport means, as distinct from an emission).

Environment Link also proposed a definition of engineered landfill.

Further definitions, for example of 'tailings dam' and 'processing', may be needed.

3.2 PROPOSED DEFINITION OF TRANSFER

The TAP sees a need for amplification of the definition of a transfer so that its applicability is made clear and exclusions are justified. The amplification begins here with a succinct statement and is followed in section 4 by a set of guidelines:

A transfer is the transport or movement on-site or off-site of substances contained in waste[3] for:

(a) containment;
(b) destruction;
(c) treatment which leads to:
    (i) reuse or recycling;
    (ii) purification;
    (iii) remediation; or
    (iv) immobilization; and
(d) energy recovery.

4 GUIDELINES FOR APPLICATION OF THE DEFINITION

4.1 RECEIVING FACILITIES

As discussed below in section 7 on the reporting format for transfers, information would need to be provided about the destination to which material has been transferred. This would cover engineered landfills, including those owned by municipalities (the language may vary between jurisdictions). Engineered containment dams, and similar facilities would also be included. Transfers to sewer (trade waste) would also be reportable under categories (c) (ii) and (c) (iii).

Recommendation

The TAP recommends that reporting of the type of receiving or containment facility be mandatory. Consideration should also be given to requesting voluntary information on the nature and management of the receiving facility as a means of acknowledging best practice.

Typical information might include transfer to municipal landfill or transfer to fully lined landfill, or transfer to tailings dam rated according to best practice (see the Best Practice Handbook by CEPA and the industry).

4.2 ON-SITE, OFF-SITE

It is widely accepted that transfers of material off-site should be included in the register of transfers. Most transfers of the type listed in section 4 could involve off-site transfer and such movements would be the norm. Questions are often raised about transfer to an on-site facility, such as a transfer of the residues of mineral extraction to a tailings dam, or ash from a power station to a storage site. It is understood that sites that can encompass such containment facilities can be much larger than those of industrial facilities typically found in urban areas. For such large sites, the on-site/off-site dichotomy loses some of its meaning. Nonetheless, to require reporting of all on-site transfers would involve companies in needless reporting of transfers from production equipment to storage tanks, or other process operations that might involve large quantities of material but still be confined on the industrial site. The *critical issue*, however, is not one of location, but of the ultimate fate of the material. While all off-site transfers would need to be reported, only those on-site transfers that do not involve subsequent movement of the material should be reported. This would cover the case of an on-site tailings dam or ash pit, to which transfers would need to be reported, but exclude the transfer of material to temporary on-site storage. Transfer to temporary off-site storage would need to be reported.

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[3] A waste is any material that is not a product or an article.

Recommendation

The TAP recommends inclusion of off-site materials under the definition of 'transfers' and only those on-site materials where no further movement of the material occurs around the site.

4.3 RELEASES ASSOCIATED WITH TRANSFERS

The reportable transfer data describe the movement of materials from one facility to another or on-site for containment, destruction, treatment or energy recovery. Should any environmental release occur during or after the transfer, it would be reportable to the NPI under the 'emissions inventory' as is currently the case under the existing NPI NEPM. This provision would apply, for example, to leakages from tailings dams or liquids leaching from landfills, or to emissions of solvent vapors at treatment facilities.

Recommendation

The TAP recommends that any release to the environment during the movement of materials be reported under NPI 'emissions'. Transferred materials, on the other hand, should be reported in the proposed separate 'transfers' database, also within the NPI reporting site.

4.4 WASTES ONLY TO BE INCLUDED

Transfer criteria would be applied to waste material even where that material may have further uses such as those going for recycling or energy recovery [categories (c) (i) and (c) (ii) and (d)]. Energy recovery would frequently involve combustion in cement kilns.

Recommendation

The TAP recommends that only waste materials should be included under the 'transfers' definition.

4.5 PRODUCTS EXCLUDED

Transfer criteria would not be applied to virgin materials, chemical intermediates or commodity products. Thus a register of waste transfers should not include transfer of chemical intermediates such as 1,3-butadiene or vinyl chloride, or movement of mineral products such as metal ore concentrates including yellow cake to refining or export locations. The regulations that already apply to such transfers are adequate for their control and often include public reporting as part of normal operations. Other goods and activities that would come under this exclusion could include distribution of petroleum and similar fuels from refineries and/or storages to sites where they will be combusted (eg power plants, airports) or stored temporarily before further distribution, as in the case of petrol and LPG at service stations, and lubricating oils at maintenance and production facilities. If such transfers were to be included in a register, direct reporting would be burdensome and is likely to generate data of doubtful value in relation to cleaner production.

The only PRTR, as far as the TAP is aware, that requires reporting of the movement of goods, is that of Sweden where such materials are termed 'products'.

Recommendation

The TAP recommends that the movement of all products be excluded from the definition of 'transfers'.

4.6 WASTE ROCK AND OVERBURDEN EXCLUDED

In a mining context, 'waste rock' includes sub-grade rock, compared to grade ore. Overburden includes all overlying soil which is not part of the ore or part of the sub-grade rock. These terms are applied where any of these materials are displaced during underground or surface mining operations. Also included would be all soil and rock removed in construction or road building as this is frequently relocated for such uses as grade levelling or other profile augmentation, and capping of landfills. Such transfers are normally approved by jurisdictions when the concentrations of contaminants, such as naturally occurring arsenic for example, are sufficiently low that the new use does not entail significant risk. Where this cannot be assured, the material is directed to an engineered secure landfill and would need to be reported to the revised NPI as a transfer with net emissions reported. It is not intended to exclude industrial by-products such as the red mud generated in alumina refining in this category of waste rock as this has been chemically modified in processing.

Reporting of the movement of waste rock has been a contested aspect of transfer registries where these exist. Excluding transfers of waste rock would align the Australian register with that of Canada, although exclusion from the Canadian registry is currently under review.

The US TRI requires reporting of movements of waste rock as a release to land of the designated components of the rock and also components of consolidated overburden. The substances of concern are often present at very low concentrations, or in the case of valuable minerals at concentrations below those that permit economic recovery of the substance. Thus, all metal mines would discard large quantities of rock that do contain the minerals of interest, but at concentrations regarded as 'below grade'. The case is often argued that these are naturally occurring substances, which is true, and that the substance of concern is irretrievably locked into the rock matrix, which is not always the case. The aerial oxidation of damp pyrite, which gives rise to sulfuric acid (and is the cause of acid mine drainage) means that this mineral cannot be regarded as 'irretrievably locked up' since fracturing the rock before its removal will expose at least some of the pyrite. However, this alone is viewed as not sufficient reason to require reporting of rock contents to a transfer register, since such substances in an acid discharge are already reportable to the NPI.

Other activities that involve the transport of rock and soil include road making, dam building, tunnelling and the preparation of sites for construction. However, these materials are not normally analysed so their hazard potential is largely unknown.

In its considerations, the TAP carefully weighed the science around the issues of transfers reporting for both waste rock and tailings materials. The focus of the TAP was on science-based risk assessment related to differing exposures. There were a number of pieces of scientific evidence considered to reach the concluding TAP recommendation on waste rock/soils. These included;

- Established knowledge that the health and environment risks posed by tailings and soil/waste rock are quite different. While some tailings materials are benign, most tailings pose a greater risk than soils and waste rock because of possible exposure to added processing reagents. In addition, in waste rock/soils, the concentrations of any substances of concern are low. The risk differences between waste rock and tailings go beyond particle size though the smaller particle size of tailings materials also make for higher exposures and therefore higher risk. Significant bird kills have been recorded in Australia in relation to tailings materials through surface exposure, but not in regard to waste rock/soils and this is testimony to the different risks posed.

- Recognition that emissions from waste rock are already reportable under the NPI, eg in leachates. The TAP decided that the current reporting requirement under the NPI for these emissions did address any significant risks around these materials. Should some components mobilise with time to appear in leachates then these are reportable annually. Hence, significant exposures from waste rock are already reportable as emissions under the NPI.

- Tailings facilities are engineered to varying extents to contain stored materials and the TAP has included in its report under 'Reporting Format', a process to allow the better grade storage facilities to be acknowledged under the NPI in the 'transfers register'. This was a deliberate inclusion by the TAP to encourage cleaner production.

- The TAP also weighed the value of requiring, under a new NPI, the building industry and the road-making, paving, tunnel-building and dam-building industries to report their transfers of waste rock/soils materials. This would likely also involve local governments. The small risks from the associated materials and the effort required around this added reporting was not viewed as warranted. An exception to this would be, as noted above, where soil or rock originated from a contaminated site, where it would need to treated as both a transfer and any emissions from a capping option reported.

Recommendation

The TAP recommends that waste rock and associated overburden that have not been chemically modified should be excluded from transfers reporting. However, it is recognized that should any NPI substances be emitted from waste rock they are, and continue to be, reportable under the NPI.

4.7 CONTAMINATED SOIL AND SEDIMENTS

Transfers of contaminated soil should be reported to the new register as transfers of the contaminants where these appear on the reporting list. The present National Environment Protection Measure for Assessment of Site Contamination includes a useful definition:

> Contamination means the condition of land or water where any chemical substance or waste has been added above the background level and represents, or potentially represents, an adverse health or environmental impact.

The Assessment of Site Contamination NEPM also defines:

> Investigation level as the concentration of a contaminant above which further appropriate investigation and evaluation will be required.

The matter of threshold concentrations is taken up again in section 6 of this document.

The case of marine or freshwater sediments transferred from one site to another during dredging operations at ports and harbours (technically relocation of 'dredging spoil') would be also be included.

Recommendation
The TAP recommends the reporting of transfers of contaminated soils and contaminated sediments be recorded in the 'transfers' database of the NPI.

4.8 CONFIDENTIALITY

Recognizing that some information about chemical substances and the volumes being handled could be commercially sensitive, the NPI includes the capacity for reporting 'in confidence', and information coming under this provision would not become publicly available. No reporting entity has sought to exercise this provision regarding emissions, but this provision needs to be specified for transfers reporting also, to protect intellectual property around processing. Such instances are likely to be sufficiently rare so as not to distort the activity picture provided by the register.

5 REPORTING LIST

Transfer criteria could be applied to a list of chemical substances related to, but not necessarily the same as, the reporting list of the NPI. Such a transfer reporting list would be determined on the basis of significant risk to health and environment, based on the concentrations and bio-availabilities of the chemical substances being transferred.

Notwithstanding this criterion, the TAP recommends that all NPI substances be included when determining transfers. Guidance should be provided in the industry guidance documents to assist facilities to estimate transfers. Note that the substance list has been reviewed by TAP Group B.

6 THRESHOLD(S)

Reporting thresholds in the NPI are set either by quantities handled by facilities (not merely the quantities released) – 10 tonnes/year for most substances on the NPI list – or by activity thresholds that, for example, relate to electricity generation. Thresholds of this type could be applied to a transfer register too, but further work would be needed to establish a suitable threshold quantity or quantities. The latter would apply in the case where different thresholds were established for different substances, on the basis of risk. The risk estimate was used as a blunt instrument in the original NPI to decide whether a substance should or should not go on the reporting list, but once the list was established the simplicity of having a common (or near-common) threshold was an important consideration in establishing reporting practice.

One substance has a higher reporting threshold (Total Volatile Organic Compounds - 25 tonnes/year) and two have thresholds based on quantity emitted to water rather than quantity handled (Total Nitrogen - 15 tonnes/year, and Total Phosphorus - 3 tonnes/year). In the present review of the NEPM, consideration is being given to reporting, for example for mercury, where significantly smaller quantities of more hazardous chemical substances are handled.

Another way to set the thresholds for waste transfers would be to base them on concentrations of the listed chemical substances. Under such a scheme, quantities would need to be reported once the threshold was exceeded, but this could lead to unnecessary complexity. Imagine the situation of a waste consigner who transfers waste every week or every month, sometimes having concentration above the threshold and sometimes below. A report of only the more concentrated waste would give an incomplete picture of the overall transfer activity.

However, should concentration be held to be a significant determinant of whether transfers need to be reported, there exist some tables of concentrations that would be a useful basis for adoption by the NPI, since they are risk based. For the sake of national consistency, it would make sense to align the threshold levels that would trigger the reporting of transfers to the registry with either the *investigation level* or the *response level* in the Contaminated Sites NEPM. There are no tabulated data for the latter since the approach has been to apply the NEPM on a site-specific basis, taking into account local factors such as use, access, bioavailability and so on, but *investigation levels for soil* are included in Schedule B (1) to the NEPM.

A similar data set is included in the Western Australian document *Assessment Levels for Soil, Sediment and Water*, and in documents from other jurisdictions in which the NEPM table has been adapted to reflect local conditions and priorities.

Recommendation
The TAP recommends that the reporting thresholds for transfers be consistent with the reporting threshold for emissions.

7 REPORTING FORMAT

The level of detail required in the transfers register should be kept to a minimum, as in the emissions inventory, consistent with the aims of the NPI to provide information that is 'useful, accessible and understandable' to government, industry and the community. A suggested database display that would meet these needs is presented below.

Table 1: The suggested format for recording transfers from Careful Chemicals Inc

Substance name	Transfer Quantity (kg)	Total Waste Quantity (as kg or tonnes)	Waste Type	Estimation Technique	On/Off-site transfer	Purpose of Transfer & receiving facility grade	Name of Receiving Facility
methyl ethyl ketone	1004	15,000 kg	R7	mass balance	off-site	treatment type c (i)	Waste Treatment Ltd
arsenic and compounds	604	350,000 t		direct measurement	off-site	containment facility - grade X	Larry Landfill Pty Ltd
arsenic and compounds	14	350,000 t		direct measurement	on-site	tailings dam - grade X	

The TAP recommends that the following information fields be reported by facilities:

- substance name;
- transfer quantity;
- total waste quantity;
- waste type;
- estimation technique;
- on-site or off-site transfer;
- purpose of transfer (disposal, recycling etc); and
- name and grade of receiving facility.

Inspection of the entries in the 'purpose of transfer' column of the table shows that it is envisaged that there should be a series of descriptions/definitions/identifiers/codes of various types of treatment or containment. These would need to be developed as part of the construction of the transfer register. Some guidance is available from the PRTRs of Canada and the UK (and possibly Sweden), which provide some information about the destination of the transferred waste. These codes could be entered into separate cells in an excel spread sheet or similar reporting vehicle, thus enabling sub-aggregation of the data for purposes of compiling national reports. For example, suitable codes would enable the reporting by the Australian Government of total quantities of waste going for energy recovery, reuse/recycling or destruction. Further, because of separation of reporting by higher and lower grade containment facilities, any improvements in the number of high-grade facilities (a desirable development) reporting would be evident as would an improvement in the quantity of material transferred to such high-grade facilities.

Some consideration has been given to the potential problem of multiple counting of quantities reported to the transfer register. This would occur when separate reports were made to the register on behalf of the same material at different stages of its life cycle. Simple double counting would render invalid any attempt to get a quantitative estimate of the total transfers or sub-totals for particular substances or geographical localities. One way to avoid double counting would be to extend the table to the right with a second set of columns showing the progress of such a transferred waste from the waste generator to the treater or to containment. The treater, of course, may combine the transferred waste with quantities of the same material obtained from other generators, which could complicate such a reporting regime. If the treater were to combine the chemical with other chemicals, there would be no problem in reporting further transfers but they would be under several headings, one for each substance.

While a usable report of two stages in the life cycle of a waste material could be done as described above, the possibility that there could be a third or more steps in the chain suggests that such a reporting format could become quite extensive. It would, however, be very informative, and so advice should be sought from NPI database managers about electronic ways to link information about various stages in the life cycle of a chemical waste so as to reveal the flow of material. It would be better to link a primary table to subsequent second or third tables where relevant, rather than to attempt a full life cycle table. Such approaches are consistent with current government initiatives (such as that of EPA Victoria) to encourage industry to develop life cycle approaches for their processes.

Recommendation
The TAP recommends that database development work be undertaken for the 'transfers' register in order to allow subsequent transfers of the same waste to be tracked in a life cycle approach.

Other ways of avoiding double counting could involve sorting of reports on the basis of the destinations they go to, and arranging reports in separate sections of the register, but there would seem to be advantages in a single table of reports from which particular sub-categories could be abstracted as required.

For some overseas PRTRs there have been issues where some parties have chosen to sum emission and transfer numbers as a reflection of reporter 'totals'. This approach has derived potentially misleading data.

This issue needs to be addressed, because should the NPI variation recommend transfers reporting, it will be important to clearly distinguish an emission from a transfer and thereby indicate why they are reported separately. This contextual information would need to be upfront on the website and not buried in archival documents. This contextual difference between emission and transfer is a key procedural issue.

Recommendation
The TAP recommends that emissions and transfers be logged by reporters separately on the NPI website and that contextual information explaining the reasons behind this separation be supplied with each section.

Overall, an improvement in the contextual data accompanying the NPI will lend to its credibility and assist in 'community right-to-know'.

SECTION B: CHANGES TO THE SUBSTANCE LIST, THRESHOLDS AND OTHER TERMS OF REFERENCE

8 INTRODUCTION

The TAP has been formed as part of the 2005 variation to the National Pollutant Inventory (NPI) National Environment Protection Measure (NEPM). At its first meeting in Brisbane in October 2005, the TAP divided its tasks between two working groups. Group B was given the task of dealing with a number of issues listed in the terms of reference for the Technical Advisory Panel (see Appendix A). These were outlined in the 2005 NPI review document:[1]

- review of substance list as identified in section 4.8 of the NPI Review Report 2005 (suggested inclusions);
- review of substance list as identified in section 4.9 of the NPI Review Report 2005 (suggested omissions);
- review the threshold for PM_{10};
- review the threshold for mercury;
- if included in the NPI, review the threshold for $PM_{2.5}$;
- investigate the merits of establishing reporting minimums for all substances; and
- recommend a standard for reporting oxides of nitrogen.

The issues are discussed below.

A further term of reference, *if feasible, investigate the merits of reporting emissions that are below detectable limits as zero, or '-', or 'not detected'*, was referred to the project team with a recommendation by the TAP that this be done.

To evaluate each of the proposed variations, the TAP followed the overarching principle in the terms of reference (Appendix A), viz *the panel's advice on substances should be based on an assessment of the risk a substance poses*. On this basis, and with the guidance given in term of reference 3, the TAP evaluated proposed variations against the following guiding principles:

1. human and/or environmental toxicity or persistence;
2. actual or potential exposure arising from production or use in Australia;
3. whether the substance was listed as a single substance or a homogeneous group of substances (heterogeneous groups of substances were excluded as a generic group); and
4. whether the substance was controlled or reported under other regulatory mechanisms.

Some chemicals that had been phased out of use were recommended for inclusion in the NPI list by the TAP because of their importance in the issue of transfers (Report A). Some chemicals or groups of chemicals were excluded at present until current reviews (eg by NICNAS) are completed.

9 VARIATIONS TO THE SUBSTANCE LIST

The original 1997 NPI list of 90 substances for emission reporting was derived from a candidate database of 394 chemical compounds and groups of compounds created by the first TAP.[2] This original list was created by selecting chemicals which had environmental risk phrases (R50-R59) in the European Union classification system for chemicals. These were:

- R50 very toxic to aquatic organisms;
- R51 toxic to aquatic organisms;
- R52 harmful to aquatic organisms;
- R53 may cause long-term adverse effects in the aquatic environment;
- R54 toxic to flora;
- R55 toxic to fauna;
- R56 toxic to soil organisms;
- R57 toxic to bees;
- R58 may cause long-term adverse effects in the environment; and
- R59 dangerous to the ozone layer.

The 1997 candidate list selected all chemicals classified in the EU system with risk phrases from R50 to R59 (394 substances).[3] The final 1999 reporting list (90 substances) was derived from the candidate list using a range of toxicity, environmental and exposure criteria.

The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) could assist NEPC in the review of the NPI reporting list, as they may be able to provide aggregate data to assist the TAP in considering the exposure component of the risk assessment for chemicals that are industrial chemicals. NICNAS is an Australian Government agency under the Department of Health and Ageing that assesses the health and environmental effects of industrial chemicals. Through its company registration and data collection systems, NICNAS collects manufacturing and import volume statistics.

The present TAP was not able to source the original list in electronic form, and a feasibility study was undertaken to establish if the list should be re-created. However, since 1997, the number of chemicals classified in the EU with environmental risk phrases has increased substantially. A comparison of the classifications in 1997 and 2005 (Table 1 - see above for 'R' classes) shows substantial differences.

Table 1: Comparison of 1997 and 2005 EU Chemical Risk Classifications

Risk phrase	**1997**	**2005**
R50	140	103
R50/R53		741
R51	64	4
R51/R53		442
R52	44	0
R52/R53		269
R53	222	137
R58	2	2
R59	5	4
Totals	**477**	**1702**

Recognizing there will be some overlap due to multiple entries, Table 1 shows that, while there were 477 entries in 1997, this has increased to 1702 entries in 2005. The use of combined risk phrases such as R52/R53 'very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment' in 2005 gave rise to a much larger list of chemicals than might have been anticipated.

Owing to the scale of the work required to re-create the chemicals database and the tight deadlines for the 2005 variation, the TAP took the view that it was not possible in the short-term to undertake anything other than consider the lists of chemicals for addition or omission to which the TAP had been referred.

However, it was agreed that if another revision of the NPI reporting list is required at some point in the future, then consideration should be given to re-creating and updating the full NPI candidate list from chemicals that meet EU criteria for classification as environmentally hazardous in Annex I of the EU hazardous chemicals system.[4] If this is to be undertaken then the timeframe would have to be considerably longer than that for the 2005 TAP review.

9.1 SUGGESTED INCLUSIONS IN THE NPI

The April 2005 Environment Link Final Report of the Review of the National Pollutant Inventory[1] noted that a number of respondents nominated substances for inclusion in the NPI Reporting List. These are discussed below.

9.1.1 **Acrolein** (CH_2=CH-CHO; CAS No 107-02-8)

Acrolein is a clear yellowish liquid (boiling point 53°C) with a burnt, sweet, pungent odour (odour threshold 0.16 ppm). It is flammable (highest flash point 18°C), has a high vapour pressure (274mm Hg) and a significant water solubility (206-270 g/L @ 25°C).

Acrolein is mainly used as a chemical intermediate. It is also used as a pesticide in irrigation channels to control algae and slime growth, and may be found in hazardous wastes sites. Acrolein is also formed when organic materials, such as petrol or oil, burn in bushfires or in building fires. Small amounts will also be found in tobacco smoke.

Exposure is by inhalation of vapours, skin or eye contact with the liquid and after swallowing contaminated materials.

Following single or short-term exposure, acrolein is irritating to the skin, eyes, respiratory and gastrointestinal systems, and can be corrosive. There are no data available for effects in humans after long-term exposure, although long-term repeated dose studies in animals using high doses indicate that acrolein causes systemic effects in a number of systems, including respiratory, reproductive, neurological and haematological systems. While the significance of these findings is uncertain, they may be applicable to occupational groups with moderate to high exposures.[5]

The half life of acrolein in the environment is quite short (in the order of days), and in the short-term, is toxic to plant life in aquatic systems.

In 1999, acrolein was not included in the list of 394 chemicals on the NPI candidate list.

The Australian Pesticides and Veterinary Medicines Authority (APVMA) lists acrolein on its Record of Approved Active Constituents for Agricultural Products (Approval

Nos. 44490, 44508 and 45644), all held by the Baker Petrolite Corporation (USA), where acrolein is formulated into the microbiocide Magnacide[6]. The APVMA Pubcris register product search engine notes that this product has been registered for use in Australia since 1970. It was not possible to identify an Australian contact for the product.

APVMA was contacted to establish if there are any data on manufacture or import volumes for acrolein as a pesticide that would identify it for inclusion on the NPI reporting list. APVMA declined to provide the information on the basis of 'commercial-in-confidence' issues.

No data has been reported to NICNAS on the import or production of acrolein.

Acrolein was listed on EU Annex I, when viewed in 2005, as flammable (R11), very toxic (R26), toxic (R24/25), causes burns (R 34) and very toxic to aquatic organisms (R50).

RECOMMENDATION

The TAP recommends that acrolein be included in the NPI reporting list owing to its toxicity, usage and potential for exposure.

9.1.2 Air Toxics

An agreed list of priority pollutants for consideration under the Air Toxics Program was selected from the *Report of the Technical Advisory Group on Prioritization of Air Toxics for Living Cities Air Toxics Program.*[6] These were:

- Acetaldehyde
- Acrolein
- Acrylonitrile
- Arsenic and compounds
- Benzene
- 1,3-Butadiene
- Cadmium and compounds
- Carbon monoxide (indoor air)
- Chromium (VI) compounds
- Dichloromethane
- Fluoride compounds
- Formaldehyde
- Lead and compounds (indoor air)
- Mercury and compounds
- Methyl ethyl ketone
- Methyl isobutyl ketone
- Methylene bis(phenylisocyanate)
- Nickel and compounds
- Oxides of nitrogen (indoor air)
- Polycyclic aromatic hydrocarbons (PAHs)
- Respirable particulate matter (indoor air)
- Polychlorinated biphenyls (PCBs)
- Phthalates
- Polychlorinated dioxins and furans
- Styrene
- Tetrachloroethylene

- Toluene
- Toluene-2,4-diisocyanate
- Total volatile organic compounds
- Trichloroethylene
- Vinyl chloride (monomer)
- Xylenes.

Of these, only acrolein and phthalates are not included on the present NPI reporting list. Acrolein is discussed above (section 9.1.1) and phthalates are discussed below (section 9.1.10). Further, the reporting of polycyclic aromatic hydrocarbons (PAHs) as total PAHs or benzo[a]pyrene equivalents is also considered in this report (section 10.4).

RECOMMENDATION

The TAP does not recommend that 'air toxics' as a group should be included in the NPI reporting list, since each individual entry in the Priority Air Toxics Pollutant List has been considered for inclusion in the NPI reporting list on the basis of its chemical identity and properties, so no further action is required.

9.1.3 Carbon Tetrachloride (CCl_4; CAS No 56-23-5)

Carbon tetrachloride is a clear, colourless, non-flammable volatile liquid with a characteristic sweet odour. It is poorly soluble in water but miscible with most other solvents.

Carbon tetrachloride was mainly used as an organic solvent and chemical intermediate.

With the exception of minor occupational uses where carbon tetrachloride may be used as a solvent (exposure to the liquid), most exposure to carbon tetrachloride is by inhalation of vapours.

Carbon tetrachloride is an irritant, and is toxic through inhalation, ingestion and skin exposure. The liver and kidney are target organs for carbon tetrachloride toxicity. The severity of the effects on the liver depends on factors such as species susceptibility, route and mode of exposure, diet or co-exposure to other compounds, in particular ethanol. Carbon tetrachloride induces hepatomas and hepatocellular carcinomas in mice and rats. The doses inducing hepatic tumors are higher than those inducing cell toxicity. Epidemiological studies have not established an association between carbon tetrachloride exposure and increased risk of mortality, neoplasia or liver disease in humans.[7]

Virtually all sources of carbon tetrachloride in the environment are from human activities. Carbon tetrachloride is toxic to fish and amphibians. Carbon tetrachloride is an ozone depleting chemical and manufacture or import of the chemical in Australia has been phased out under the Montreal Protocol on Substances that deplete the Ozone Layer (1987) and its amendments (1990, 1992), and is covered by the Commonwealth *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989.*

No data has been reported to NICNAS on the import or production of carbon tetrachloride.

In 1999, carbon tetrachloride was listed on the EU Annex I as carcinogen category 3

(R40), toxic (R23/24/25), danger of serious irreversible effects (R 48/23), harmful to aquatic organisms, may cause long term adverse effects in the aquatic environment (R52/53), and dangerous to the ozone layer (R59). The EU classification for carbon tetrachloride, when viewed in 2005, was unchanged from its 1999 classification.

Carbon tetrachloride was included in the NPI candidate list, but was not listed on the NPI reporting list.

RECOMMENDATION

The TAP does not recommend that carbon tetrachloride be included in the NPI reporting list, as its uses have largely been phased out in Australia.

9.1.4 Dichloropropenes

There are three 'dichloropropenes' - 1,2-dichloropropene (CAS No 563-54-2), 1,3-dichloropropene (CAS No 542-75-6) and 2,3-dichloro-1-propene (CAS No 78-88-6). Other CAS numbers have been allocated for various optical isomers of 1,3-dichloropropene.

The main commercial product appears to be soil fumigant 1,3-dichloropropene (trade name Telone, with a composition of 92-97% 1,3-dichloropropene of approximately equal *cis* and *trans* isomers). Other dichloropropenes appear to be isomers or structurally similar chemicals in the commercial product.

The TAP has been asked to consider two of these chemicals for inclusion in the NPI reporting list.

9.1.4.1 1,3-Dichloropropene (CH2Cl-CH=CH2Cl; CAS No 542-75-6)

1,3-Dichloropropene is a colorless, volatile liquid with a sweet smell, with a main use as a soil fumigant/nematocide. The main exposures are occupational, with irritant and toxic effects. 1-3-Dichloropropene is considered a probable human carcinogen in the USA.[8]

No data had been reported to NICNAS on import or production of any of the three dichloropropenes listed above. APVMA lists 1,3-dichloropropene on its *Record of Approved Active Constituents for Agricultural Products* (Approval Nos 52475, 52476, 52481 and 52747), held by Dow Chemicals[6]. The APVMA Pubcris register product search engine notes that this product has been registered for use in Australia since 2001.

APVMA were contacted to establish if there are any data on manufacture or import volumes for 1,3-dichloropropene as a pesticide, that would identify it for inclusion on the NPI reporting list. APVMA declined to provide the information on the basis of 'commercial-in-confidence' issues.

The Dow AgroSciences Australia website lists Telone as a soil fumigant available for use in Australia. It should be noted that the intended use of this chemical indicates that the entire production or import volume is discharged into the environment. The use of 1-3-dichloropropene as an agricultural chemical in Australia is considered minor.

In 1999, 1,3-dichloropropene was listed on the EU Annex I as flammable (R10), toxic if swallowed (R25), harmful if inhaled or in contact with skin (R20/21), irritating (R36/37/38), skin sensitization (R43) and very toxic to aquatic organisms, may cause long term adverse effects in the aquatic environment (R52/53). 1,3-Dichloropropene was included in the NPI candidate list, but was not listed on the reporting list. The EU classification for 1,3-dichloropropene, when viewed in 2005, was unchanged from its 1999 classification. Importantly, the EU is yet to include a carcinogen classification.

RECOMMENDATION

The TAP does not recommend that 1,3-dichloropropene be included in the NPI reporting list at this time, due to limited use. However, because 1,3-dichloropropene is classified as a carcinogen in the USA this recommendation should be reconsidered if production or import data for products containing 1,3-dichloropropene indicates this is a chemical in widespread use.

9.1.4.2 1,2-Dichloropropene (CH_2Cl-CCl=CH_3; CAS No 563-54-2)

1,2-Dichloropropene is not listed on EU Annex I.

RECOMMENDATION

The TAP does not recommend that 1,2-dichloropropene be included in the NPI reporting list as it is only a minor contaminant in 1,3-dichloropropene (see section 9.1.4.1).

9.1.5 Hydrazine (NH_2-NH_2; CAS No 302-01-2)

Hydrazine is a caustic, fuming, hygroscopic liquid with weak basic properties similar to ammonia. It decomposes on heating or when exposed to ultraviolet radiation to form ammonia, hydrogen, and nitrogen. This reaction can be explosive.

Hydrazine has a number of uses, including a chemical intermediate for a wide range of plastics, pharmaceuticals, dyes, photographic chemicals, electronics and as a corrosion inhibitor in water systems. It is also used as a monopropellant rocket fuel. While the use of rocket fuel is much greater in the northern hemisphere where it is used for Space Shuttle manoeuvres in space, rockets have been launched at the Woomera base in South Australia in recent years. It is not known if these rockets used hydrazine.

No data has been reported to NICNAS on import or production of hydrazine.

Hydrazine is irritating and a sensitizer. It causes toxic signs of nausea, vomiting, shaking and effects in nervous system, lung and liver. Long-term exposure to hydrazine (and the structurally similar 1,1-dimethylhydrazine) is associated with lung cancer.

Hydrazine is toxic to plants (including algae) and fish.

1,2-Diphenylhydrazine (CAS No 122-66-7) and phenylhydrazine (CAS No 100-63-0) were originally listed in the 1999 NPI candidate list. Hydrazine (CAS No 302-01-2) was not and was therefore not listed on the NPI reporting list.

The EU classification for hydrazine, when viewed in 2005, is flammable (R10), toxic (R23/R34/R25), causes burns (R34), may cause sensitization by skin contact (R43), may cause cancer (R45) and very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment (R50/53).

RECOMMENDATION

The TAP does not recommend that hydrazine be included in the NPI reporting list because NICNAS does not report its use in Australia.

9.1.6 Dichloromethane (also known as Methylene Chloride) (CH_2Cl_2; CAS No 75-09-2)

The TAP notes that nomination of methylene chloride for listing on the NPI reporting list is unnecessary as dichloromethane (the same chemical) is already listed on the NPI reporting list.

Data reported to NICNAS indicate that between 1,000 and 10,000 tonnes/year is imported or produced.

RECOMMENDATION

The TAP notes that dichloromethane and methylene chloride are the same chemical and therefore there is no reason to add the latter to the reporting list, as it is already covered.

The TAP recommends that, as well as identifying chemicals by name, all chemicals on the NPI reporting list be identified by CAS number to avoid such confusion in the future.

9.1.7 Ozone Depleting Substances

There are four chemicals listed on the EU Annex 1 with the risk phrase R59 dangerous to the ozone layer. These are methyl bromide (CAS No 74-83-9), carbon tetrachloride (CAS No 56-23-5), 1,1,1-trichloroethane (CAS No 71-55-6) and 1,1-dichloro-1-fluoroethane (CAS No 1717-00-6). All were listed with other risk phrases indicating toxicity and/or environmental effects.

The TAP considered that reporting of these or other ozone depleting substances on the NPI Reporting list was unnecessary as Australia was a signatory to the Montreal Protocol on Substances that Deplete the Ozone Layer (1987) and its amendments (1990, 1992), and had enacted the Commonwealth *Ozone Protection and Synthetic Greenhouse Gas Management Act* 1989 which ensures minimum and declining use of these substances.

Data have been reported to NICNAS on import or production of only one of these four chemicals, 1,1-dichloro-1-fluoroethane, in the amount of 100 to 1,000 tonnes/year.

The TAP noted that methyl bromide is a widely used fumigant (41 tonnes/year in agriculture plus an unknown quantity for quarantine) and, although phasing out is mandated under the Montreal Protocol, critical and essential uses continue.

RECOMMENDATION

The TAP does not recommend that ozone depleting chemicals be listed on the NPI reporting list because their use is being phased out.

The TAP recommends that the inclusion of methyl-bromide in the reporting list be reviewed if its use continues.

9.1.8 Organochlorine (OC) Emissions from Smelting

There are two issues with this particular term of reference. Firstly, identifying a specific industry as being a source of emissions for a specific chemical or group of chemicals is against the spirit of the NPI. Secondly, as a general principle, the TAP prefer reporting single chemicals or homogeneous groups. The TAP considers OCs to be a heterogeneous group.

RECOMMENDATION

The TAP does not recommend that organochlorine emissions from smelting be listed on the NPI reporting list to avoid singling out a particular industry and because OCs are a heterogeneous group. However, the TAP does support the reporting of individual OCs as appropriate.

9.1.9 PCBs

Polychlorinated biphenyls (PCBs) (CAS 1336-36-3) are mixtures of various isomers and congeners. There are 209 possible PCB congeners. They have molecular weights between 292 and 361 and extremely low water solubility. PCBs have been widely used as dielectric fluids for capacitors and transformers, as heat transfer fluids, plasticisers, lubricants and in many other industrial and commercial products. Due to their high lipid solubility and resistance to degradation, PCBs tend to bioaccumulate in terrestrial and aquatic environments and are globally distributed.[4]

Australia has a PCB Management Plan under which PCBs are being removed from service and destroyed using environmentally sensitive technology.

Import of PCBs into Australia ceased many years ago. However, PCBs remain an important hazardous waste by virtue of the large amounts previously imported, their intractability as a hazardous waste and the large volumes that remain on hazardous waste inventories. While PCBs are not likely to be a major environmental release, transfers will remain an important part of the PCB management plan.

RECOMMENDATION

The TAP recommends that PCBs be included on the NPI reporting list because of their importance as hazardous wastes and the large volumes that remain on hazardous waste inventories. Section A of this report also recommends that PCBs be reported as transfers.

9.1.10 Phthalate Esters

Phthalates are the most common group of chemicals used as plasticisers (plastic softeners) worldwide. They are used in a diverse range of products and applications such as automotive components, building and construction materials, adhesives, cables and wires, paints, personal protective equipment, toys and childcare articles, food contact materials, cosmetics and medical devices such as flexible tubing, intravenous

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[4] ANZECC & ARMCANZ (Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand). *National Water Quality Manage,ent Strategy: Australian and New Zealand Guidelines for Fresh and Marine Water Quality.* Canberra, 2000

bags and catheters. The Australian Inventory of Chemical Substances (AICS) lists more than 100 phthalates in use in Australia.

Concerns have been raised regarding the use of phthalates in Australia, due to the potential for adverse effects and their widespread use in consumer products.

In 2001, the European Commission listed the following phthalates on the EU list (Annex I of Directive 67-548-EEC) of substances due to evidence of potential or actual endocrine disrupting effects - DEHP, DINP, DBP, BBP, DIDP (CAS No 26761-40-0) (see list below).[9]

In Australia, in 2004, NICNAS conducted information searches and toxicity hazard screenings for thirty phthalates which appear to be those in most common use in Australia and/or overseas. The outcomes were, firstly, diethylhexyl phthalate (DEHP; CAS No 117-81-7) was declared as a Priority Existing Chemical (PEC) for a full risk assessment under the *Commonwealth (Industrial Chemicals) Notification and Assessment Act* 1989.

Secondly, it was recommended that screening assessments be conducted on six high volume phthalates:

- Diisodecyl phthalate (DIDP) CAS Nos 26761-40-0/68515-49-1
- Dimethyl phthalate (DMP) CAS No 131-11-3
- Di-isononyl phthalate (DINP) CAS Nos 28553-12-0/68515-48-0
- Dibutyl phthalate (DBP) CAS No 84-74-2
- Butylbenzyl phthalate (BBP) CAS No 85-68-7
- Diethyl phthalate (DEP) CAS No 84-66-2.

Thirdly, it was recommended that importation/manufacture volumes and uses were to be conducted on eight phthalates of known hazard and suspected low use:

- Di-n-octyl phthalate (DNOP) CAS No 117-84-0
- Dimethyl terephthalate (DMT) CAS No 120-61-6
- Bis(2-methoxyethyl) phthalate CAS No 117-82-8
- Ditridecyl phthalate (DTDP) CAS No 119-06-2
- Diallyl phthalate (DAP) CAS No 131-17-9
- Diisobutyl phthalate (DIBP) CAS No 84-69-5
- Di-n-hexyl phthalate (DNHP) CAS No 84-75-3
- Dicyclohexyl phthalate (DCHP) CAS No 84-61-7.

Lastly, it was recommended that importation/manufacture volumes and uses were to be conducted on fifteen phthalates of with limited hazard and use:

- Di-$C_{6\text{-}10}$-phthalate, CAS No 68515-51-5
- Diisoheptyl phthalate (DIHP) CAS No 41451-28-9/71888-89-6
- Di-$C_{7\text{-}9}$-phthalate, CAS No 68515-41-3
- Di-$C_{9\text{-}11}$-phthalate, CAS No 68515-43-5
- Undecyldodecyl phthalate (UDP) CAS No 116998-09-5
- Diisoundecyl phthalate (DIUP) CAS No 85507-79-5
- Diundecyl phthalate (DUP) CAS No 3648-20-2
- Diisooctyl phthalate (DIOP) CAS No 27554-26-3
- Dinonyl phthalate (DNP) CAS No 84-76-4
- Dipentyl phthalate (DPP) CAS No 131-18-0
- Di-$C_{7\text{-}11}$-phthalate, CAS No 68648-91-9
- Diisotridecyl phthalate (DTDP) CAS No 27253-26-5

- Di-n-propyl phthalate (DPrP) CAS No 131-16-8
- Diisohexyl phthalate (DIHexP) CAS No 68515-50-4/71850-09-4
- Di-C_{8-10}-phthalate CAS No 71662-46-9.

The above lists show wide variations in toxicity and hazard of phthalates, and in current understanding of the level of exposure in Australia. Hence, the suggestion to include phthalates as a generic group, until the current NICNAS review processes are complete, is unlikely to be beneficial to pollutant reporting.

Currently, there are two phthalate esters listed on the NPI reporting list – bis-2-ethylhexyl phthalate (CAS No 117-81-7) and dibutyl phthalate (DBP) (CAS No 84-74-2). These were identified for inclusion in the 1999 NPI reporting list. Data have been reported to NICNAS on import or production of these chemicals – bis-2-ethylhexyl phthalate in the amount of 10,000 to 100,000 tonnes/year, and DBP in the amount of 100 to 1,000 tonnes/year.

One chemical was nominated in the review - butylbenzyl phthalate (BBP) CAS No 85-68-7, as it is listed on the UK PRTR. This chemical is not listed on the EU Annex I. Data have been reported to NICNAS on import or production of BBP in the amount of 10 to 100 tonnes/year.

RECOMMENDATION
The TAP does not recommend that phthalates be included in the NPI reporting list as a generic group, but individual phthalates should be considered, following the completion of the NICNAS review. However, the TAP recommends that the current listings for specific phthalates be retained.

9.1.11 Polybrominated Flame Retardants

Polybrominated flame retardants (PBFRs) have recently attracted interest internationally and nationally with some chemicals within this group posing human health and environmental concerns. Polybrominated flame retardants comprise about 25% of the volume of flame retardants used on a global scale.

NICNAS has carried out various reviews of PBFRs since 2001. It has:
- conducted a preliminary assessment on PBFRs as a group;
- declared octabromobiphenyl (CAS No: 27858-07-7) and decabromobiphenyl (CAS No: 13654-09-6) as priority existing chemicals for assessment in July 2004;[5]
- removed octabromobiphenyl and decabromobiphenyl from the Australian Inventory of Chemical Substances, as no data were reported to the NICNAS HVICL on import or production of these chemicals, and no applications for their assessment were received by NICNAS after twelve months of declaration as priority existing chemicals[6];

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[5] NICNAS. Declaration of Octabromobiphenyl and Decabromobiphenyl as priority existing chemicals. National Industrial Chemicals Notification and Assessment Scheme *Commonwealth of Australia Gazette* **C7**: 66-69, 6 July 2004.

[6] NICNAS. Hazardous flame retardants removed from the Australian Inventory of Hazardous Substances regulations restricting information. National Industrial Chemicals Notification and Assessment Scheme *Commonwealth of Australia Gazette* **C12**: 17, 6 December 2005.

- declared pentabromodiphenyl ether (CAS No 32534-81-9) and octabromodiphenyl ether (CAS No 32536-52-0) as priority existing chemicals in January 2006[7],[8];

RECOMMENDATION

The TAP does not recommend that polybrominated flame retardants be included in the NPI reporting list as a generic group, due to their heterogeneous nature. However, individual PBFRs should be considered following the completion of the NICNAS review and consideration of monitoring data.

9.1.12 Quinoline (C_9H_7N; CAS No 91-22-5)

Quinoline, also known as 1-azanaphthalene, 1-benzazine, or benzo[b]pyridine, is a heterocyclic aromatic organic compound, first extracted from coal tar. It is used as a chemical intermediate in dye, plastics and agrochemical manufacture, and in metallurgical processes. It is also used as a solvent and biocide.

Quinoline vapours are irritating and can cause drowsiness and nausea. Long-term exposure has been linked to liver damage and carcinogenicity. However, while quinoline is listed in some toxicology databases (such as TOXNET), it is not listed on the EU Annex I. Further, there are 15 entries for compounds that have quinoline in their names, many with R5# (environmental) risk phrases.

No data have been reported to the NICNAS HVICL on import or production of quinoline.

In the absence of specific information on toxicity or environmental effects, it is not possible to make a determination about the inclusion of quinoline (or indeed, quinoline containing chemicals) in the reporting list. However its apparent low import or production volumes indicate that it is not a significant chemical in Australia.

RECOMMENDATION

The TAP does not recommend that quinoline be included in the NPI reporting list due to its apparent low usage in Australia.

9.1.13 1,1,2,2-Tetrachloroethane (Cl2CH-CHCl2; CAS No 79-34-5)

1,1,2,2-Tetrachloroethane is a volatile synthetic chemical that is used as a solvent and intermediate in the synthesis of other chlorinated hydrocarbons. The toxicological profile of this chemical has also not been well characterized. Because of its declining use, available data are confined to early limited studies. Inhaling high levels of 1,1,2,2-tetrachloroethane can cause fatigue, vomiting, dizziness and possibly unconsciousness. Breathing, drinking or repeated contact with the chemical for a long period of time can cause liver damage, stomach aches or dizziness. As with many chlorinated organic compounds, the liver is the most sensitive target organ in laboratory animals.

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[7] NICNAS. Declaration of Octabromodiphenyl ether as a priority existing chemical. National Industrial Chemicals Notification and Assessment Scheme *Commonwealth of Australia Gazette* **C01**: 20-24, 3 January 2006.

[8] NICNAS. Declaration of Pentabromodiphenyl ether as a priority existing chemical. National Industrial Chemicals Notification and Assessment Scheme *Commonwealth of Australia Gazette* **C01**: 14-18, 3 January 2006.

Environmental releases of 1,1,2,2-tetrachloroethane are mainly as vapours, with a moderate half life (in the order of months) but the chemical is not considered to be an ozone depleter.[10]

No data have been reported to NICNAS on the import or production of 1,1,2,2-tetrachloroethane.

1,1,2,2-Tetrachloroethane was listed on the EU Annex I, when viewed in 2005, as very toxic if inhaled or in contact with skin (R26/27), and toxic to aquatic organisms and may cause adverse long-term effects in the aquatic environment to aquatic organisms (R51-53).

RECOMMENDATION

The TAP does not recommend that 1,1,2,2-tetrachloroethane be included in the reporting list as most of its uses have been phased out.

9.1.14 Thallium (Tl; CAS No 7440-28-0)

Before the mid 1970s, the major use of thallium was as a rat poison - a practice since phased out because of the high toxicity of thallium compounds. More recently, thallium has been used in photoelectric cells, lamps, electronics, semi-conductors and in organic catalysts. Thallium isotopes are used in imaging procedures for the evaluation of myocardial disease.

Human exposure to thallium occurs by oral, dermal or inhalation routes. Thallium is released into the atmosphere from industrial operations such as coal-fired power plants, smelting operations and cement factories. Following release, thallium can either be inhaled or settle from the atmosphere and contaminate surface water or soil. In humans, acute exposures produce hair loss, nervous system symptoms and problems in the reproductive system. Because plants take up thallium, the primary non-occupational sources of thallium exposure are through the consumption of fruits and vegetables grown in contaminated soil and the use of tobacco products.[11]

No data have been reported to the NICNAS HVICL on the import or production of thallium.

Thallium was listed on the EU Annex I, when viewed in 2005, as very toxic if inhaled or swallowed (R26/28), danger of cumulative effects (R33) and may cause adverse long-term effects in the aquatic environment to aquatic organisms (R53).

RECOMMENDATION

The TAP does not recommend that thallium be included in the NPI reporting list as most of its uses that may result in environmental releases, have been phased out.

9.1.15 TDS, BOD, pH for Water

The role of the TAP is to assess chemicals for inclusion in the NPI candidate and reporting lists as substances of significance in Australia. The nomination of total dissolved solids (TDS), biological oxygen demand (BOD) and pH for water falls outside the scope of this term of reference as they are not substances. TDS is a summation of mostly-low toxicity substances such as salt, while the other two are effects, not causes.

RECOMMENDATION

The TAP does not recommend that TDS, BOD and pH for water be included in the NPI reporting list as these are indicators of substances and are not substances in themselves.

9.2 SUGGESTED DELETIONS FROM THE NPI

As part of the 2005 review of the NPI reporting list, ten chemicals were recommended for deletion (based on there being no reporting for these substances since the NPI was established).

The 1999 NPI reporting list normalized scores for health, environment and exposure for these chemicals are listed in Table 2.

Table 2: Chemicals recommended for deletion: scores from 1999 NPI reporting list

Chemical name	Health	Environment	Exposure	NICNAS HVICL
Acrylamide	1.7	2.5	0.7	Not reported
Aniline	2.0	2.2	0.8	Not reported
Hexachlorobenzene	1.2	3.0	0.7	Not reported
2-Ethoxyethanol acetate	3.0	0.0	2.0	Not reported
Ethyl butyl ketone	0.7	2.0	1.0	Not reported
2-Methoxyethanol	1.2	0.0	2.5	Not reported
2-Methoxyethanol acetate	1.2	0.0	2.5	Not reported
4,4′-Methylene bis(2-chloraniline)	1.3	3.0	0.9	100 tonnes/year
Nickel carbonyl	2.5	1.5	1.3	Not reported
Nickel subsulfide	2.0	1.7	1.3	Not reported

MOCA, or 4,4′-methylene bis(2-chloroaniline) (CAS 101-14-4), is an aromatic amine used as a curing agent for isocyanate-containing polymers, and has established carcinogenic properties. Data have been reported to NICNAS on import or production of this chemical in the amount of 100 tonnes/year. Virtually all the MOCA will become chemically incorporated into the polymer in which it is added during manufacture, therefore exposure only occurs during the manufacturing process. Environmental exposure through breakdown of polymers is not considered a significant source. This is sufficient to indicate that there are no substantial emissions to the environment.

Nickel represents a problem in interpretation, in that an annual import/production volume of between 10,000 and 100,000 tonnes of nickel (CAS No 7440-02-0) was reported to NICNAS. This is a generic term, and it is unlikely that nickel carbonyl or nickel subsulfide have large uses and/or releases in Australia.

With regard to nickel carbonyl (CAS 13463-39-3), there are two nickel refineries in Australia – one at Kwinana in Western Australia and the other at Yabulu in Queensland. Neither uses the Mond process that extracts nickel using carbon monoxide to create nickel carbonyl. Therefore nickel carbonyl is unlikely to be a high volume chemical in Australia.

It is more difficult to determine the significance of nickel subsulfide (CAS 12035-72-2). Some sulfides of nickel are formed through the processing of nickel containing sulfide ores to the metal, for example nickel matte, and it would seem likely that workers employed in the roasting and smelting processes in the nickel refining industry would be exposed mainly to nickel dust containing nickel oxide and subsulfide. Whether this constitutes a problem in environmental releases remains unresolved. It is therefore considered prudent that reporting should continue.

Hexachlorobenzene (HCB) (CAS 118-74-1) is a highly chlorinated chemical which is persistent in the environment. It is nominated under the Stockholm Convention on Persistent Organic Pollutants but is no longer imported into or manufactured in Australia (as a by-product of the manufacture of chlorinated solvents). The only known location of HCB is at one site in the Sydney area (Orica), where a considerable quantity is in controlled storage, governed by an HCB management plan. Along the lines of PCBs (section 9.1.9), HCB is of potential interest for reporting as a transfer, and hence should be retained on the NPI list.

For all of the listed chemicals except MOCA, there has been no reporting to NPI. It is quite apparent that if no reporting for these chemicals has occurred in the years that the NPI reporting list has been operating, then the exposures scores should be amended to a lower number (presumably zero).

However, the health and environment scores for some of these entries are quite high, and unless it can be guaranteed that these chemicals are not in use in Australia, these substances should be periodically reviewed with a view to inclusion in the reporting list.

RECOMMENDATION

With respect to the NPI reporting list, the TAP recommends the following:

- Acrylamide - *delete*
- Aniline - *delete*
- Hexachlorobenzene - *retain*
- 2-Ethoxyethanol acetate - *delete*
- Ethyl butyl ketone - *delete*
- 2-Methoxyethanol - *delete*
- 2-Methoxyethanol acetate - *delete*
- 4,4′-Methylene bis(2-chloraniline) MOCA - *delete*
- Nickel carbonyl - *delete*
- Nickel subsulfide – *delete from Category 2b threshold but retain as a Category 1 substance*

10 THRESHOLDS FOR PARTICULATE MATTER, MERCURY AND OTHER SUBSTANCES

Air can be contaminated by a range of very different particles such as dust, pollen, soot, smoke or liquid droplets. Particulate matter (PM) is a term that describes matter that is suspended, rather than dissolved in air. Particulates can vary in size (from 10 nm to over 100 µm), shape and composition. There are both natural and anthropogenic sources of particulates. Natural sources include wind blown dust, volcanoes and forest fires. Primary anthropogenic sources of PM include road transport (while all forms of road transport emit PM, diesel vehicles emit a greater mass of particulate/vehicle kilometre), point source combustion sources (especially coal combustion) and some industrial processes (mining, construction, some manufacturing industries). Generally, anthropogenic particulate emissions have been dropping since the 1970s.

In general, the smaller and lighter a particulate is, the longer it will stay in the air.

Larger particles (greater than 10 µm in diameter) tend to settle to the ground by gravity in a matter of hours whereas the smallest particles (less than 1 µm) can stay in the atmosphere for weeks and are mostly removed by deposition or precipitation.

Historically, the health effects of suspended particulate matter have focused on smoke and smog.[12] Long-term exposure to particulate matter (as described below) for years or decades is associated with elevated total, cardiovascular and infant mortality, and effects on the respiratory and immune system.[13] More recently, epidemiological studies have linked exposure to other forms of particulate matter with health effects in human beings.[14, 15]

Particulate matter containing particles of a size of 10 µm or less is known as PM_{10}. These particulates can stay suspended for long periods of time and can reach many parts of the respiratory system if inhaled.[16] Particulate matter containing particles of a size of 2.5 µm or less is known as $PM_{2.5}$. These particulates can stay suspended for even longer periods of time that PM_{10}, and can reach most parts of the respiratory system if inhaled.

Standards for PM_{10} and $PM_{2.5}$[17] were established to identify those particulates that are likely to be inhaled by humans, and theses have become a generally accepted measure of particulate matter in air in North America and Europe.

Particulate matter, as well as other substances, is listed as a 'criteria pollutant' in Australia's Ambient Air Quality NEPM. The standards and goals for these pollutants are reproduced in the Table 3 (from the *National Environment Protection (Ambient Air Quality) Measure* website:
www.ephc.gov.au/nepms/air/air_nepm.html, viewed February 2006).

Table 3: Ambient Air Quality NEPM Standards and Goals

	Averaging period	Maximum concentration	Goal within 10 years maximum allowable exceedences
Carbon monoxide	8 hours	9.0 ppm	1 day a year
Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year none
Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year none
Lead	1 year	0.50 µg/m3	none
Particles as PM_{10}	1 day	50 µg/m3	5 days a year

The question has arisen as to whether diesel emissions from transport companies should be reported separately. This is answered by the fact that such emissions are covered in the calculation of aggregated emissions.

10.1 PM_{10}

10.1.1 Threshold for PM_{10}

The TAP considered the proposal that the threshold for PM_{10} should be changed to Category 1 from Category 2a. It was noted that the Category 1 threshold applied to 10 tonnes of use and this was not appropriate for PM_{10}, as most NPI reporters would not meet the criteria (reporters do not always knowingly handle 10 tonnes a year of PM_{10}). Most PM_{10} emissions reported were the result of combustion. Further, most non-combustion PM_{10} was from non-anthropogenic sources. Hence the TAP recommends that the threshold for PM_{10} be maintained at Category 2a (that is, reporting is required when burning more than 400 tonnes of fuel).

Many of the overseas PRTR systems that were investigated had reporting thresholds as tonnes of PM_{10}. There were, however, differences in the types of industries that were included on overseas and Australian lists. On considering these, the TAP came to the view that a Category 2a threshold would be simpler to apply and would allow industries to easily determine if reporting was needed. In contrast, a Category 1 threshold (10 tonnes) would require many additional industrial facilities to undertake calculations of PM_{10} emissions to see if they were over the threshold or not.

RECOMMENDATION

The TAP recommends that the threshold for PM_{10} be maintained at Category 2a (that is, reporting is required when burning more than 400 tonnes of fuel).

10.1.2 Speciation of PM_{10}

A proposal to recommend speciation of PM_{10} was also considered by the TAP. This option would allow for providing additional context for PM_{10} emissions, such as in situations where background levels were naturally elevated. For example, the reporter may wish to provide additional information on the chemical composition of the fine particles in situations where the background levels were naturally elevated or where chemicals composition may indicate high or low toxicity.

RECOMMENDATION

The TAP recommends that PM_{10} speciation could be provided by the reporting site as an option to allow NPI reporters to provide additional relevant contextual information about PM_{10} emissions.

10.2 $PM_{2.5}$

There is increasing concern over the effects of smaller particles such as $PM_{2.5}$ on human health. Considerably more information has become available to show that $PM_{2.5}$ gives a better correlation with severe respiratory impacts in humans than PM_{10}. Health effects and dose-response relationships are summarized by NEPC and include short-term mortality and hospital admissions and long-term mortality, including lung cancer and cardiopulmonary disease.[18] This includes Australian studies that use nephelometry data as a surrogate for $PM_{2.5}$. The inclusion of $PM_{2.5}$ is in line with current moves for emission reporting in the UK, EU and elsewhere.

Although the understanding of emissions may be less advanced, there has been progress in characterizing Australian emissions and emission factors, supported by ambient $PM_{2.5}$ measurements. State reporting of ambient $PM_{2.5}$ measurements in Australia have established that most of the ambient $PM_{2.5}$ is from motor vehicles and bushfires, with contribution from wood burners in cooler climates.[19] The *National Environment Protection (Ambient Air Quality) Measure* is resulting in a network of $PM_{2.5}$ equivalence sites across all Australian states from January 2004.[20] The contribution of $PM_{2.5}$ from industry to localized levels is not currently known, and if emissions from industry are a minor component of regional levels, this is useful public information. The issue of emission factors is discussed under the heading of "Measurement of $PM_{2.5}$" (section 10.2.1).

The TAP considered the option of reporting $PM_{2.5}$ emissions from fuel burning only because of the combustion emphasis associated with this size of particulate. For example, $PM_{2.5}$ emissions from fuel use by mining vehicles would be reportable to NPI but not $PM_{2.5}$ emissions from other mining operations (eg wheel dust). The reporting of PM_{10} emissions from non-fuel activities would ensure that the community is kept informed of overall fine particle emissions, and the large uncertainties associated with emission factor calculations for non-fuel emissions of $PM_{2.5}$[9] would result in very unreliable figures for $PM_{2.5}$ overall. Uncertainties with emission estimations are not unique to mining activities, and the TAP was concerned that the reporting of emissions of a particular pollutant from a small range of activities would undermine the real value of developing an emissions inventory, which is to put emissions from one sector in the context of total emissions from all sectors, to allow efforts for reductions to be prioritized. To properly assess the contribution of emissions from industry, this could be revisited in future when further progress has been made with developing suitable emission factors. The NPI would be a good avenue for assessing the contribution of $PM_{2.5}$ emissions from industry.

RECOMMENDATION

The TAP recommends that $PM_{2.5}$ emissions from combustion sources should be reported for the NPI, with the option of reporting from non-combustion sources to be reviewed at a future date.

10.2.1 Measurement of $PM_{2.5}$

In line with NPI reporting guidelines, there is no obligation on industry to measure $PM_{2.5}$. Facilities are allowed to use emission factors, mass balance, engineering calculations or some other technique.

If industries wish to undertake measurements, useful information is contained in the NSW Protection of the Environment Operations (Clean Air) Regulation 2002, which uses the Approved Methods for the Sampling and Analysis of Air Pollutants in NSW.[21] This includes method OM-5 for measuring in stack concentrations of PM_{10}, which in turn calls up USEPA Methods 201 or 201A (In-stack, CRS, 1997, http://www.epa.gov/ttn/emc/promgate.html). The US EPA has developed Draft Method CTM-040, which is similar in principle to USEPA Methods 201 and 201A but captures the $PM_{2.5}$ size fraction. Practical problems arise with retro-fitting existing stacks because of the size of the 2.5 μm cut-off cyclone.[22]

There is a range of emission factor data available in international databases, such as US EPA (AP-42) for a large range of processes.[23] There has been some activity in validating

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[9] SKM. Improvement of NPI Fugitive Particulate Matter Emission Estimation Techniques. RFQ 0027/2004. Sinclair Knight Merz, Perth, 2005

factors for some Australian processes (for NSW the DEC *air emissions inventory project* has developed $PM_{2.5}$ emissions estimates from domestic, biogenic, commercial, industrial, off-road mobile and on-road mobile sources).[24] For NPI purposes, it is likely that modelling using emission factors from PM_{10}, or even total particles, would suffice for NPI reporting. Further refinement may improve emission factors for some processes that are not currently well represented.

10.2.2 Threshold for $PM_{2.5}$

With PM_{10} recommended for Category 2a, no sound reason exists to have a different threshold for $PM_{2.5}$.

RECOMMENDATION

The TAP recommends that the appropriate threshold for $PM_{2.5}$ would be Category 2a (burning more than 400 tonnes of fuel).

10.3 MERCURY

Exposure to mercury is a well established environmental health hazard. Recent studies show that mercury exposure may still arise in the environment, and increasingly in occupational and domestic settings.[25] Children are particularly vulnerable to mercury intoxication, which may lead to impairment of the developing central nervous system, as well as pulmonary and nephrotic damage.[26, 27]

Data are available on some sources of environmental releases of mercury. Data from North America suggest that the main sources are coal fired electric utilities (55-70%), industry and commerce (7%), municipal waste combustion (6%), mercury cell chloralkali plants (4%), hazardous wastes incinerators (4%) and lime manufacturing (3%).[28] However, other sources, such as the re-release of mercury from contaminated sources is poorly understood and the subject of concern.[29]

One source of mercury release is from crematoria.[10] Mercury vapour is released from dental amalgams (containing up to 50% mercury) by the incineration of human remains.[11] It has been estimated in the UK that one crematorium emits about 5 kg of mercury a year.[12] Elevated mercury levels have been found in the hair of exposed crematoria workers, but at levels lower than those found in other groups of workers exposed to mercury. The UK government has introduced requirements for mercury filtering equipment to be installed in crematoria by 2012.

The toxicity of mercury and the release of mercury vapour to the environment close to crematoria provide supportive evidence to reconsider the threshold for reporting of mercury to the NPI.

10.3.1 Reporting of Mercury to Pollutant Transfer and Release Inventories

Mercury is currently required to be reported to the Australian NPI at the Category 1 threshold of 10 tonnes per year.

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[10] Mills, A. Mercury and crematorium chimneys. *Nature* 345: 615 1990.

[11] Maloney, S.R., Phillips, C.A., Mills, A. Mercury in the hair of crematoria workers. *Lancet* 352: 502, 1998.

[12] Burton, V.J. Too much mercury. *Nature* 351: 704, 1991.

Other countries have lower thresholds:

- UK – 1 kg for emissions to air and 0.1kg for emissions to water;
- USA – 10 pounds (4.5kg);
- Canada – 5kg.

The threshold in Canada was lowered from 10 tons to 5kg in 2000. The reasons given for this decreased threshold were that *"minimal releases of mercury (and its compounds) may result in significant adverse effects and can reasonably be expected to significantly contribute to exceeding the lower thresholds".* Canada has also committed to develop a standard to reduce mercury emissions from coal-fired electric power generation (considered a significant source).

10.3.2 Australia

In Australia, the situation with releases of mercury has been the subject of a specific investigation recently.[30] Some of the outcomes included in the executive summary from this report are as follows:

- the main sources of reporting under the current NPI were coal combustion for electricity generation, refining of mineral ores and metallurgical coke production;
- use of mercury as a raw material in Australia was identified for two manufacturers – one for dental amalgams and one for chemicals, which also had a recovery operation;
- the potential for relatively high mercury emissions was identified for the dental industry, instrument and electrical component decommissioning, fluorescent light and high intensity globe disposal and crematoria; and
- the problems with mercury (release) are not well understood.

It was also noted within the report that Australian limits for mercury residues in foods are only set for species living in an aquatic environment (for example tuna, shark, scallops, prawns, yabbies). When measured, mercury levels exceeding the limits were found in some samples of shark and crab.

The TAP noted that the significant reduction recommended for the reporting threshold for mercury raises two issues. Firstly, that any future comprehensive revision of the NPI list along the lines of that suggested in the preamble of section 9 should also examine thresholds for substances on the list and, secondly, the thresholds for substances similar to mercury is recommended. UNEP has undertaken a review of mercury over the last few years, and this has been followed by reviews of lead and cadmium.

RECOMMENDATION

The TAP recommends that the threshold for mercury be reduced to 5kg.

While it is recognized that the information available on mercury is not as definitive as one might desire, it is considered the toxicity of mercury is such that it would be appropriate to lower the threshold to 5kg given that:

- environmental contamination with mercury is an ongoing concern;
- adverse effects may occur from relatively low levels of mercury;

- residues in some foods above the limits continue to be found; and
- there may well be significant potential for release from users of lesser amounts.

It is further recognized that the proposed reduction of the threshold to mercury to 5kg may well have a flow-on effect to other substances, including other heavy metals such as cadmium and lead. This will require further attention in the near future as it is beyond the terms of reference of the current TAP.

10.4 REPORTING OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHS)

Polycyclic aromatic hydrocarbons (PAHs) commonly refers to a large class of organic compounds containing two or more fused aromatic rings made up of carbon and hydrogen atoms. They constitute a large class of compounds formed mainly by incomplete thermal breakdown (for example, combustion or pyrolysis) processes. The most significant toxic effect of exposure to PAHs is carcinogenicity. Various studies have shown that PAHs are found in industrial emissions, fossil fuel combustion emissions, motor vehicle exhaust, used oils, domestic heating and cooking emissions, and tobacco smoke. These studies have also shown that the PAHs in these mixtures are the main contributors to their carcinogenic potential.[31]

10.4.1 The Toxic Equivalent Quantity Method

PAHs invariably occur in mixtures, the composition of which are complex and vary with the generating process. Chemicals that exert their toxicity by the same mechanism of action can have their toxicity expressed in terms of one member of that group, which is usually the most toxic member. This is called the Toxicity Equivalency Quantity (TEQ) Method. Conventionally, the most toxic member is allocated a nominal score (normally 1) and the toxicity of the other members of the group allocated a proportion of that value (for example 0.01). These values are termed toxic equivalency factors (TEFs) that are consensus-derived values obtained from multiple biological and toxicological endpoints.[32,33] The toxicity of a mixture of chemicals can then be calculated by summing the amount present of each constituent multiplied by its TEF.

The TEQ is usually expressed and determined as the concentration of the reference chemical, but for the purposes of NPI this can be converted to mass. The TEQ is determined by using the formula in equation 1:

Equation 1:

$$TEQ = \sum\{(\text{Mass}[\text{Compound1}] \times \text{TEF1}) + \ldots (\text{Mass}[\text{Compound}] \times \text{TEFn})\}$$

where the subscripts identify the chemical, for example, the first compound is [Compound1], Mass[Compound1] is its mass and TEF1 is its toxic equivalency factor.

The most widely used example of a TEQ approach is that for polychlorinated dioxins and furans, where the toxicity of each congener is expressed as a fraction of the most toxic congener (2,3,7,8-tetrachlorodibenzo-*p*-dioxin or 2,3,7,8-TCDD). Reviews of the use of TEFs were published by the WHO in 1998[34] and US EPA in 2000.[35] More recently, PCBs have been added to the TEQ approach for dioxins, owing to a similarity in toxicity to the dioxins.[35]

The method has also been applied to polyaromatic compounds,[36] endocrine disrupting chemicals such as natural and synthetic sex hormones (for example [37,38,39,40]) and tricresyl phosphates.[41] In the absence of more definitive data, the TEQ approach is a legitimate method for assessing the toxicity of groups of similar chemicals to human health and the environment.

When there is no consensus or there are only data from individual experiments for individual biological endpoints then the relative toxicity values are termed relative potencies (REPs) rather than TEFs.[42]

10.4.2 The TEQ Method and Polycyclic Aromatic Hydrocarbons

The TEQ method has been applied to PAHs using TEFs based on two different chemicals - benzo[a]pyrene and 2,3,7,8-tetrachloro dibenzo-*p*-dioxin. At this stage there are no TEFs based on 2,3,7,8-TCDD, there are only REPs.[43,44,45,46,47] In contrast, there are number of different sets of TEFs for PAHs based on benzo[a]pyrene.[36,48,49,50,51,52,53,54,55] These are presented in Table 4.

The TEFs for PAHs by various authors differ (Table 4). The first set of TEFs developed by the US EPA reflect the general lack of knowledge of the potencies of PAHs at the time they were developed. The basis for the US EPA TEFs was a simple division of PAHs into two groups - carcinogenic given a value of 1 and non-carcingenic given a value of 0. It was rapidly realized that this was an overly conservative approach and TEFs were developed that differentiated between the potency of the carcinogenic PAHs. Other differences between TEFs developed by various authors arise from the fact that the TEFs are calculated using different methods.[56] For example, Nisbet and LaGoy[51] felt that many of the preceding TEFs were unnecessarily precise and they rounded the values off to the nearest order of magnitude.[57]

The TEQ method based on benzo[a]pyrene TEFs has been widely adopted by regulatory authorities including the World Health Organization, Environment Canada, Health Canada, the US EPA, USFDA, UK Environment Agency, NSW DEC and the Danish EPA. In addition, they are widely used in the scientific literature (see for example [56,57,58]).

Whilst this method has been widely adopted it is not universally accepted. There are a number of assumptions made in deriving TEFs which are not always tested or met.[59] In addition, Goldstein[60] and Fitzgerald et al.[61] have published data that *"calls into question the common use of toxicity equivalence factors based on BaP for assessing risk from complex PAH mixtures."*[61] They argue that TEFs should potentially be based on a PAH other than benzo[a]pyrene. They do not argue that TEFs should be replaced by a different method.

10.4.3 Total Concentration of Polycyclic Aromatic Hydrocarbons

There are a number of different approaches that could be used, and have been adopted by various regulatory authorities, in reporting PAH concentrations in the equivalent of the NPI:

1 the concentration of each PAH is reported unless it is below its reporting threshold;

2 only the total concentration of the PAHs is reported; and

3 various combinations of the two above approaches.

Table 4. Toxic equivalency factors for polycyclic aromatic hydrocarbons based on the toxicity of benzo[a]pyrene

Reference Chemical	EPA36	Chu and Chen48	Clement49	Thorslund 50	Nisbet and LaGoy51	USEPA52	Al Yakoob et al†,53	Al Yakoob et al‡,53	OEHHA54	USFDA55
Naphthalene	0	-	-	-	0.001	-	-	-	-	-
Acenaphthylene	0	-	-	-	0.001	t	-	-	-	-
Acenaphthalene	0	-	-	-	0.001	-	-	-	-	-
Fluoprene	0	-	-	-	0.001	-	-	-	-	-
Phenanthrene	0	-	-	-	0.001	-	-	-	-	-
Anthracene	0	-	0.32	-	0.01	-	0.32	0.06	-	-
Fluoranthene	0	-	-	-	0.001	-	-	-	-	0.02
Pyrene	0	-	0.081	-	0.001	-	0.081	0.2	-	0.13
Benzo[a]anthracene	1	0.013	0.145	0.145	0.1	0.1	0.145	0.62	0.1	0.014
Chrysene	1	0.001	0.0044	0.0044	0.01	0.001	0.0044	0.37	0.01	0.013
Benzo[jb]fluoranthene	1	0.08	0.14	0.12	0.1	0.1	-	-	0.1	0.11
Benzo[k] fluoranthene	1	0.004	0.066	0.052	0.1	0.01	-	-	0.1	0.07
Benzo[a]pyrene	1	1	1	1	1	1	1	1	1	1
Indeno(1,2,3c,d)pyrene	1	0.017	0.232	0.278	0.1	0.1	-	-	0.1	0.25
Dibenzo[ah]anthracene	1	0.69	1.1	1.11	1	1	-	-	0.4	1.05
Benzo[ghi]perylene	1	-	0.022	0.021	0.01	-	-	-	-	0.03
Benzo[j]fluoranthene									0.1	
Bibenz[a,h]acridine									0.1	
7h-dibenzo[c,g]carbazole									1	
Dibenzo[a,e]pyrene									1	
Dibenzo[a,h]pyrene									10	
Dibenzo[a,i]pyrene									10	
Dibenzo[a,l]pyrene									10	
5-nitroacenapthene									0.01	
5-methylchrysene									1	
1-nitropyrene									0.1	
4-nitropyrene									0.1	
1,6-dinitropyrene									10	
1,8-dinitropyrene									1	
6-nitrocrysene									10	
2-nitrofluorene									0.01	
7,12-dimethyl benzanthracene									21.8	
3-methylcholanthrene									1.9	

†Based on a carcinogenic endpoint ‡ Based on a mutagenic endpoint

The total concentration of PAHs is determined using the formula in equation 2:

Equation 2:

$$\text{Total [PAH]} = [\text{PAH1}] + [\text{PAH2}] + \ldots [\text{PAHn}]$$

where the subscripts denote different PAH compounds and the square brackets denote the concentration. The equation assumes the concentrations of the PAHs are expressed in the same units and are measured in the same media. Although the NPI is concerned with total mass of substances, the TEQ approach can be adapted by converting to mass, after the calculations have been completed.

RECOMMENDATION

The TAP recommends that the TEQ approach (equation 1) and TEFs based on benzo[a]pyrene be used in reporting PAHs in the NPI. The decision regarding which set of TEFs to use is difficult, but the differences between the various sets are not large. The Nisbet and LaGoy and the OEHHA set of TEFs covers the most PAHs.[51,54] On this basis it might be appropriate to combine these sets of TEFs and use the resulting set of TEFs for the NPI.

The TAP recommends that the total mass of PAHs be reported using equation 2.

11 REPORTING MINIMA

While it seems intuitive that a minimum reporting value could be established, it was recognized that some highly toxic contaminants may have some problems associated with them, and that specifying a 1kg, or even a 1g limit, could, under certain circumstances, still be problematic.

Further, specifying minima based on some measure of toxicity, for example 1g for highly toxic, 10g for toxic and 1kg for harmful chemicals, still presents difficulties for chemicals with specific toxic properties (such as carcinogenicity or environmental persistence) and for groups of chemicals.

The TAP was unable to establish a scientific or technical basis for a recommendation for reporting minima, other than values so low (for example 1mg) as to be impractical.

12 REPORTING OF OXIDES OF NITROGEN

Nitrogen (N) forms oxides in which nitrogen exhibits each of its positive oxidation numbers from +1 to +5. As the proportions of nitrogen and oxygen atoms can vary in a nitrogen 'oxide' molecule, they are usually abbreviated to the generic term NO_x.

Environmentally, oxides of nitrogen are usually variable in chemical composition with the two major NO_x pollutants being nitrogen dioxide (NO_2) and nitric oxide (NO, in equilibrium with low levels of N_2O_4). The primary anthropogenic sources of NO_x are motor vehicles (50-60%), electric utilities (20-25%), industrial and commercial organizations (20-25%) and residential sources (about 1%) that burn fuels. NO_x emissions from internal combustion engines are almost entirely NO, with a small proportion (typically about 5-10%) being NO_2. Oxides of nitrogen (NO_x) are a class of compounds formed during combustion that are respiratory irritants and that react with volatile organic compounds to form ozone.[62] In the atmosphere, the oxides of nitrogen are rapidly oxidized to nitrogen dioxide (half-life about 50 days). Nitrogen dioxide (NO_2) forms nitric acid (HNO_3) when it dissolves in water (for example, water vapour) and is a major source of acid rain.

Ambient Air Quality NEPM reporting is for ambient concentrations of NO_2, not NO_x, as the health-based exposure standard is based on exposure to NO_2. The actual method for determining ambient NO_2 levels is based on analysis by chemiluminescence which, in this case, measures the concentrations of NO_x and NO, and calculates NO_2 by subtraction. The US EPA also reports NO_2, rather than NO_x.

The most appropriate basis for reporting emissions of total NO_x is using the molecular weight of NO_2. This procedure is the standard used for reporting ambient concentrations and stack emission reports worldwide. The US EPA AP42 document expresses emission factors for total NO_x as NO_2 equivalents.[23] Evidence was presented to the TAP that many of the US EPA emission factors (based on NO_2 equivalents) were directly converted to metric units for use in the NPI manuals, hence only minor modification may be required to most factors in the NPI manuals. The *NPI EET Manual for Boilers* and the *NPI EET Manual for Internal Combustion Engines* were cited as having NO_x emissions expressed as NO_2. Furthermore, most licence reporting for state environment agencies require NO_x to be reported as NO_2 equivalents, and this amendment would ensure equivalent reporting to NPI.

RECOMMENDATION
The TAP recommends that total NO_x emissions be reported as NO_2 equivalents (that is, on the basis of molecular weight of NO_2).

One issue was raised during consultation about whether there are different biological potencies for the different oxides of nitrogen. Preliminary enquiries revealed that there may be, but relative potency factors (equivalent, say to benzo[a]pyrene for PAHs) may not be easy to come by. NO_2 is a known respiratory irritant, and other oxides of nitrogen have similar modes of action but to different degrees. The science to support toxicity equivalents for oxides of nitrogen, along the lines of that for PAHs, has not yet developed sufficiently for the TAP to recommend this approach at present.

13 CONCLUSIONS

The NPI reporting list was developed in 1997-98 by a Technical Advisory Panel which used rigorous criteria based on international classification recommendations. The original list of 90 chemicals and groups of chemicals has been used since the NPI was established in 1999.

Review of the NPI in 2005 led to a re-examination of the list and suggestions were made about improving the quality of the reporting list, based on new evidence, the experience with reporting from 1999 to 2005, and a better understanding of the nature of some environmental releases.

The Technical Advisory Panel was re-formed, and asked to consider the suggestions made flowing from the review process, according to the terms of reference in Appendix A. This included evaluating some specific suggestions for inclusion or deletion of specific substances or groups of substances.

At meetings in Brisbane, Sydney, Melbourne and Canberra in late 2005 and early 2006, the Technical Advisory Panel considered a range of matters. Largely, the TAP considered that the existing arrangements with NPI reporting were working well, recommending only a few changes to existing NPI reporting list arrangements, being:

- Acrolein and PCBs be included on the reporting list.
- Aniline, 2-ethoxyethanol acetate, ethyl butyl ketone, 2-methoxyethanol, 2-methoxyethanol acetate, 4,4′-methylene bis(2-chloraniline) and nickel carbonyl be deleted from the list.
- Nickel subsulfide be retained on the list as a Category 1 substance but deleted from Category 2b threshold.
- PM_{10} speciation could be provided by the reporting site as an option to allow

NPI notifiers to provide additional information about PM_{10} emissions.

- $PM_{2.5}$ from combustion sources should be reported for the NPI with a Category 2a threshold.
- The threshold for mercury be reduced to 5kg.
- Total NO_x emissions be reported as NO_2 equivalents (that is, on the basis of molecular weight of NO_2).

It is further recognized that the proposed reduction of the threshold to mercury to 5kg may well have a flow-on effect to other substances, including other heavy metals such as cadmium and lead. This will require further attention in the near future as it is beyond the terms of reference of the current TAP.

A number of other substances or groups of substances listed by the 2005 review for further consideration were evaluated but the TAP recommended no change to these, although some were noted for further evaluation at a future review, should additional data become available.

The TAP also recommended that, as well as identifying chemicals by name, all chemicals on the NPI reporting list be identified by CAS number to avoid any future confusion of names. This was implemented in the current TAP report.

The TAP was unable to establish a scientific or technical basis for a recommendation for reporting minima, other than values so low (for example 1mg) as to be impractical.

A further term of reference, *if feasible, investigate the merits of reporting emissions that are below detectable limits as zero, or '-', or 'not detected'*, was referred to the project team with a recommendation by the TAP that this be done.

The TAP did recommend that if a further review of the NPI reporting list is considered at some future date, that sufficient time be given to re-creating the candidate list from which the original 1999 reporting list was generated, so that a more comprehensive review can be made.

14 ENDNOTES

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15 KEY REFERENCES

In considering these issues the TAP made reference to both Australian and international experience with transfers and pollution inventories (a summary of various overseas experiences can be found in Appendix C).

Some of the key documents consulted by the TAP include:

- The Commonwealth Department of Environment and Heritage (2005) *NPI Update on Other Countries and Their Use of Transfers* (Appendix C)
- *OECD Resource Compendium of PRTR Release Estimation Techniques Part 3: Summary of Techniques for Off-Site Transfers*
- US EPA 2003 *TRI Public Data Release eReport*;
- The WA Department of Environmental Protection (1999) *Kalgoorlie NPI Trial Report;*
- *The final report of the Review of the National Pollutant Inventory for the Department of the Environment and Heritage* (2005);
- *The Final Report to the NEPC* (1999) by the former NPI TAP;
- *The information release on Red Dog Mine and the TRI* (23 September 2005) by Teck Cominco Alaska
- *Précis of submissions to the NPI Review*, Department of the Environment and Heritage (2005);
- Annex IV of the Basel Convention;
- *The NEPC Report on Movement of Controlled Waste Between States & Territories*;
- Australia Environment Protection Agency, *Best Practice Environmental Management in Mining: Tailings Containment*, June 1995;
- Material from the US, UK and Canadian pollution inventory websites.

APPENDIX A – NPI NEPM VARIATION 2005 TECHNICAL ADVISORY PANEL TERMS OF REFERENCE

The Technical Advisory Panel (TAP) will report to the National Environment Protection Council (NEPC) via the project team established to prepare the NEPM variation.

The time available for TAP deliberations is restricted and the panel should provide recommendations by 30 November 2005. The panel should note that there may be additional issues to consider both during and following the statutory NEPC consultation period scheduled to occur from April to June 2006. Further direction in relation to such issues will be provided as required.

1. The function of the TAP is to:
   - review the substance list as identified in sections 4.8 and 4.9 of the NPI Review Report 2005;
   - review the thresholds for PM_{10}, Mercury and, if included on the NPI, $PM_{2.5}$ (and, if relevant, the thresholds for other substances);
   - recommend a definition of transfers and identify a preferred international substance-based framework for transfers that could be adopted by the NPI;
   - investigate the merits of reporting PAHs as benzo[a]pyrene (equivalent);
   - investigate the merits of defining a range of reporting minimums for all substances;
   - investigate the merits of reporting emissions that are below detectable limits as zero (or "-" if feasible); and
   - recommend a standard for reporting oxides of nitrogen; and
   - provide advice on how the NPI NEPM should be varied as a result of these investigations.

2. Greenhouse gas emissions are also being considered for inclusion in the NPI and advice may be required on this matter at a later stage.

3. In formulating its advice to the NEPC, the TAP should take account of the NPI Review Report 2005 and:
   - the Technical Advisory Panel Report 1999;
   - the goals and guidelines of the NPI;
   - recent international PRTR reviews;
   - whether information on emissions of a nominated substance is already collected by an existing mechanism, noting any restrictions on that information;
   - international reporting obligations of relevance to Australia;
   - relevant Australian and international standards and guidelines;
   - the precautionary principle; and
   - any supplementary information provided by the project team.

4. The panel's advice on substances should be based on an assessment of the risk a substance poses. It should be noted that a full risk assessment process may be

difficult in most instances and the panel's professional judgment will serve as a proxy if this information is not available.

5. In considering the risk associated with a substance the panel should have due respect to the following criteria:
   - environmental effects - taking into account acute toxicity, chronic toxicity, persistence and bio-accumulation of a given substance to arrive at a score for its potential effect on the environment;
   - human health effects - taking into account acute toxicity, chronic toxicity, carcinogenicity and reproductive toxicity of a given substance to arrive at a score for its potential effect on human health; and
   - exposure - taking into account the potential release in Australia (from point sources and diffuse sources) and the bio-availability of a given substance to arrive at a score for exposure.

6. The panel's considerations and advice will be open and transparent and provided for the public record.

7. Should the TAP recommend that a substance be placed on the NPI substance list, the panel will also recommend a threshold level for the substance having due regard to the points outlined above.

APPENDIX B – TECHNICAL ADVISORY PANEL MEMBERS & PROJECT TEAM LIAISON

TECHNICAL ADVISORY PANEL

Chair
Dr Michael Howes, Griffith University

Group A: Transfers
Professor Ian Rae (Team Leader), University of Melbourne
Dr Peter Glazebrook, Rio Tinto Technical Services
Mr John Hogan, formerly EPA Victoria
Dr Peter Nadebaum, GHD

Group B: Substance List, Thresholds & Other Terms of Reference
Associate Professor Chris Winder (Team Leader), University of New South Wales
Dr John Chapman, NSW Department of Environment & Conservation
Dr Neill Stacey, Southern Cross Pharma Pty Ltd
Dr Michael Warne, CSIRO

NPI PROJECT TEAM LIAISON

Ms Jo Brennan/Ms Sarah Thomas, DEH
Ms Debbie Lawrence, DEH
Mr Ian Newbery, NEPC Service Corporation
Ms Monina Gilbey, NEPC Service Corporation

APPENDIX C –
THE STATUS OF TRANSFERS IN PRTRS

(Prepared by the Australian Government Department of the Environment and Heritage 2005)

1 INTRODUCTION

The inclusion of transfers in the National Pollutant Inventory (NPI) in Australia is under consideration. As part of the Aarhaus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (1998) <www.unece.org/env/pp/documents/cep43.pdf>, many EU countries have implemented or are developing pollutant release and transfer registers (PRTRs). The United States and Canada have already implemented PRTRs that include transfers. The purpose of this document is to provide a summary of international PRTR programs, specifically in relation to:

- definitions of transfers
- treatment of transfers, and
- reporting mechanisms.

2 ISSUES

Transfers need to be clearly defined. They include substances that are moved off-site for disposal, treatment, recycling, purification etc. They may also include substances that are stored on-site, either for final disposal or further treatment.

Transfer reporting is not currently required under the NPI National Environment Protection Measure (NEPM). However, it was the intention at the time of implementing the NPI NEPM that transfers would eventually be included. Without transfers it is difficult to identify where pollutants are being generated, not just where they are emitted. Issues related to transfers include the differentiation between emissions and transfers, whether transfers should be reported separately from emissions and whether materials such as tailings and waste rock should be reported as transfers.

Current examples from other countries may prove valuable. One of the terms of reference for the Technical Advisory Panel (TAP) is to recommend a definition for transfers and to identify a preferred international substance-based framework for transfers that could be adopted by the NPI.

3 OTHER COUNTRIES – PREVIOUS INFORMATION

The main source of previous information on PRTRs is a questionnaire sent to the OECD. Eight countries (including Australia) had a PRTR system in place in 1999 that covered air, water and land. Of these eight countries, six included off-site transfers. The most advanced in terms of providing information to the public were the United States and Canada. Both of these countries include transfers, but not necessarily to facilities such as tailings dams.

4 CURRENT WEBSITE INFORMATION

CANADA

Transfers off-site are reported. Reported emissions can be found on the internet, and there is flexibility in deriving reports, for example on specific substances and/or specific locations. Transfers are displayed alongside emissions, as transfers for disposal and transfers for recycling. Reports show the total on-site release, the total transfers for disposal and the total transfers for recycling. There is no indication of where the substances are being transferred to for disposal.

Mining operations (removal of rock, ore or overburden up to and including primary crushing, as distinct from further processing or other use of mined materials) are exempt from reporting to the NPRI. This confirms previous advice to the effect that transfers to tailing dams are not reported, but emissions are. Transfers are reported for other off-site disposals and further treatments. Listed substances in tailings would not be reported unless they left the tailings impoundment or other forms of on-site containment (question 20 "*Guide for Reporting to National Pollutant Release Inventory 2002*" Environment Canada p114).

However, the exemption for extraction and all activities up to and including primary crushing may be removed for the 2006 reporting year ("*NPRI Mining Sub-Group, Final Report of the Mining Exemption Workshop May 17-18, 2005*"). Three options have been presented for dealing with waste rock and tailings:

Option 1	maintain status quo for tailings and waste rock. Currently releases to the environment from tailings or waste rock areas are reported to the NPRI, but substances contained in materials added to tailings or waste rock areas are not reported.
Option 2	require reporting of NPRI substances in tailings and waste rock as on-site disposal.
Option 3	require reporting of NPRI substances in tailings as on-site disposal but maintain status quo for waste rock.

Industry stakeholders support option 1. Their view is that tailings are a form of storage, and should not be reportable as releases. They also note that the level of risk in a large waste rock pile or tailings dam is not a function of mass and that the material will contain natural elements that may pose little or no risk when present in large quantities. This contrasts with other situations where substances may be present in small quantities but create high risk.

Canadian environmental groups present a different view, arguing that tailings, for example, could exist indefinitely should industry have no plans for further use or movement of the materials. They argue that this makes it disposal not storage.

UNITED STATES

In the US system, transfers off-site for disposal, treatment, recycling, energy recovery from combustion must be reported. Estimates for on-site treatment, recycling, and energy recovery from combustion are also reported separately. The maximum amount of the chemicals present on-site at the facility during the year must also be reported. This includes storage, and so would cover tailings dams. However, it is important to keep in mind that the US system deals with facilities in a fundamentally different way to the NPI. For NPI, all facilities are 'in unless exempted' as compared with the US TRI, where all facilities are 'out unless explicitly listed'.

The transfers data on the website are presented as total on-site releases and total off-site releases. A further report gives the breakdown of the substance/s transferred by transfers to recycling, transfers to energy recovery, transfers to treatment, transfers to POTWs (publicly owned treatment works – municipal sewage treatment plants), non-metals and other off-site transfers. A similar report gives the breakdown of waste by recycled on-site, recycled off-site, energy recovery on-site, energy recovery off-site, treated on-site, treated off-site, quantity released on and off-site, total production waste managed, and non-production waste managed.

Releases to land within the facility boundary are reported, and this includes disposal to landfill, land treatment/application, surface impoundments (uncovered holding areas) and other land disposal methods (such as waste piles) or releases to land (such as spills). This could include tailings dams, and evidence for this is on the internet report for the metal mining industry where large amounts of metals are reported as released to land on-site.

There have recently been a number of lawsuits filed by the National Mining Association regarding the inclusion of hard rock mining in the Toxic Release Inventory (TRI). The contentious issue is the reporting of waste rock as an emission. Mining companies are able to get an exemption based on *de minimus* (certain chemicals present in mixtures or proprietary products that are below certain levels), overburden (unconsolidated material that overlies a deposit of useful material or ores) or some mining activities (for example, coal extraction).

In April 2003 the US District Court in Washington DC ruled that mine operators do not have to report trace metals in waste rocks to TRI. Although 'naturally occurring' toxic chemicals in waste rock are not exempt from TRI reporting obligations, the Court determined that non-PBT chemicals present in the waste rock below concentrations of 1% (or 0.1% for OSHA carcinogens) are eligible for the *de minimus* exemption. Note, however, that concentrations of certain toxic chemicals in waste rock may be above *de minimus* levels for certain mining facilities (62 Fed. Reg. 23834, 23858-59 (May 1, 1997).

Up until the Barrick vs EPA court case, lawsuits and petitions had been unsuccessful, and mining facilities still had to report the listed substances in waste rock.

UNITED KINGDOM

The United Kingdom report transfers. Data are accessible on the internet, and transfers are displayed alongside emissions. However, emissions to land are not reported.

The method for reporting waste transfer data from 2003 has changed from previous years. Greater detail is now provided by the facility in terms of waste type and disposal or recovery route. Currently, transfers off-site are divided into waste and special waste (see next paragraph on special waste). These two types of waste are reported as disposal (to landfill, incineration or other) or as recovery (as a fuel, recycling or other).

From 2003, facilities were required to report waste transferred using the European Waste Catalogue (EWC) codes to categorize the waste, and Waste Framework Directive (WFD) codes to categorize the disposal or recovery of the waste transferred off-site. This means that specific substances are not reported, rather types of waste.

Transfers are defined as off-site transfer of waste. Waste has quite a complicated meaning in this system, and relies on EU and English regulations to define the type of waste. For 2002, all waste being transferred had to be reported but was divided into 'special waste' and 'non-special waste'. Special waste has particular meaning under Special Waste Regulations 1996 SI no. 972 (see below). Under this definition of special waste, waste to tailings dam would be unlikely to apply unless it was considered toxic or fell into one of the other similar categories. By comparison, the EU definition does mention some types of tailings waste specifically (EC Directive 2000/532/EC). The codes for the final disposal of the transferred waste are given in another directive (EC Directive 75/442/EC) that is similar to the codes quoted as an example in the Rae Review Discussion Paper 2000.

Justification for the inclusion of transfers was outlined in an information document on the Environment Agency website. The most important justification for including transfers was:

> to encourage industry to reduce waste volumes, to move to use of more environmentally friendly materials and to move away from disposal to recovery techniques (Whitwell 2002).

<u>UK Environment Agency – Definition of 'Special Waste'</u>

Special waste was required to be reported in the 2002 pollution inventory in England and Wales. The definition of special waste comes from the regulation *Special Waste Regulations 1996 SI no. 972*. To be defined as special waste, the waste has to:

2 (1) (a) have a 6 digit code in the schedule 2, part 1; and

(b) display any of the properties in schedule 2 part 2 (which include toxicity, be carcinogenetic etc);

(2) or is a controlled waste that has some of the properties in schedule 2 part 2 (the more serious properties such as toxicity).

However, it will not be a special waste if:

(5) it is below the thresholds given in schedule 2 part 3, for example total concentration of the substances classified as harmful is greater than or equal to 25%.

This is a summary of the regulations. Should the precise details be required, the complete regulation should be obtained via the Environment Agency website.

EUROPEAN COMMUNITY

The first set of data for the European Pollutant Emission Register was published in February 2004 on the Internet. Only emissions to air, water and transfers to wastewater treatment plants (indirect releases to water) are reported.

The EC are developing BREFs, which are BAT (Best Available Technology) Reference documents. A BREF for management of tailings and waste rock was released in July 2004 and discusses best practice for management of tailing and waste rock.

SWEDEN

Sweden has a Pollutant Release and Transfer Register (KUR), which records the amount of chemicals that are emitted to air and water and the substances that leave the facility as products or waste. The data are from annual reports by large facilities. Individual chemicals are reported in the waste from a facility. The register was put on to the internet in 2003.

Transfers are reported as waste. Information is available on the internet, and customized reports can be made (for example, on the English language website specific substances and counties can be found). Transfers are identified in the media column, which gives emissions for a substance to air, water, waste and product. There is no total for each destination, although the total for the substance is given. Codes are given beside the emission figures, although a legend does not seem to be given to explain the codes. They could be an indication of accuracy or of destination.

There are no specific guidelines on the English website regarding which facilities must report and which have exemptions. However, it does seem that mining operations do report. It is possible that transfers to tailings dams are reported, depending on their definition of waste. For example, in 2001 Kirunagruvan (a mining company) reported lead emissions of 12,600 kg to waste, 14,507 kg to product, 1.5 kg to air and 0.4 kg to water. The large amount of lead to waste could be in the slag or tailings.

IRELAND

Water and air surveys are reported but the last annual air quality monitoring report was released on the web in 1999. Like Sweden, the Irish EPA does their own monitoring and the results may not include reported emissions from industry. According to the 1999 survey, Ireland reports to emissions to air, land and water so there may be more results not shown on the website.

CZECH REPUBLIC

Latest information in English on their website was a commitment to focus on implementing a PRTR in 2001. However, there is no indication (at least in English) whether the system has been developed or status of progress.

DENMARK

No direct information on a PRTR although there is a published report called *Nature and the Environment 2002* that does describe some pollutant emissions. This country was not listed as having an operating system in 1999. There is a map of chemicals in the aquatic environment called ATLAS, which shows data from 1975 until 1999. However this may only be for some discrete points in Denmark, and does not seem to cover the entire country.

NORWAY

Transfers are reported as waste generated and to whom the waste is transferred. It is possible that this could be total waste, and not chemical specific.

The Norwegian Environment Agency has data on their 'State of Environment' website. Data can now be accessed on the Internet. Depending upon the substance, emissions of a pollutant can be seen by region, and by source type. For example, data for mercury emitted to the air can be seen for the whole country only, but it is displayed from 1990-2001 and by industry. Particulates can be seen by region. On the English language website, there were no emissions to land and no transfers displayed, however advice from the Norwegian Environment Agency indicates that information on transfers is collected if they are transfers off-site. Therefore if a tailings dam is on-site, it will not be reported. Industries are required to report this information under permits issued under the Pollution Control Act. There is no indication that this policy has changed, but the information is not displayed at present.

JAPAN

The Japanese pollutant inventory includes transfers. Due to difficulties with the English documents on the website, information is sparse. However, from a handbook on iron casting, it seems that substances land-filled within a factory are not classed as a transfer. Waste transferred outside a factory is classified as a transfer. Given the English language difficulties, not enough is known to verify their policy on transfers.

NETHERLANDS

Transfers to water are reported. This includes from sewer systems and estimations from non-reporting facilities. From the "Emissions in the Netherlands 1999 and 2000" report in English, and information provided by Pieter van der Most in November 2003 on "Wastewater Transport Module", it seems that the transfers to sewer reported by industry are used to calculate the contribution of industry to the water. While transfers are not reported directly, they are reported as part of the final discharge to water.

Emissions to soil data are collected (p7, Emissions in the Netherlands 1999 and 2000). Industry emissions of total nitrogen and total phosphorous to soil are given in the report (p39). The substances emitted to soil may also become part of the leaching calculation for emissions to water.

GERMANY

According to a survey completed around 1999 or 2000, a report for the European Pollutant Emission Register (EPER) was being developed, which was due for submission in June 2003.

SWITZERLAND

Pilot projects were undertaken in 1997 and 2000. The results from the latest pilot project in 2003 should be available shortly, and should include emissions to air and water.

FRANCE

Website was in French, so limited information could be gathered. Air and water emissions are reported on the website, but unable to determine whether transfers were included.

FINLAND

An air emissions inventory appears on the Environmental Ministry website. However, there is no information on a water or land emissions inventory.

5 SUMMARY

While a number of European Union and other countries have developed or are in the process in developing a pollutant release and transfer register, there are only a few that have an accessible, English language website that can used to evaluate their

policies on transfers. These countries are the United States, Canada, Sweden, the United Kingdom, the Netherlands and Norway.
The six countries specified have transfers in their pollutant registers. However they have approached the definition and reporting of transfers differently.

The United States gives comprehensive information on the substances transferred off-site for treatment and disposal, and breaks this information down into a number of categories. These reports clearly show the amount of substances that are recycled or treated compared to those disposed of to sewage treatment or other facilities. Interestingly, the US includes disposal on-site as a release to land, which means that tailings dams may come under this definition. From the report of metal mining industries, the large amounts of metals released to land seem to confirm this.

Canada also displays substance transfer information alongside the emission release data, and breaks down the off-site transfers as recycling and disposal. On-site disposal methods are not included, and only emissions from the disposal, such as leaks from tailings dams, are reported.

Sweden reports substance transfers as waste and product. Although the English website is not comprehensive, the report on one of the mining facilities showed that a large amount of metal went to waste, and this was almost the amount which went to product. This may indicate that tailings or waste rock are included in the definition of waste.

Norway did not have an English translation for their website database, so it was difficult to see whether transfers are reported alongside emissions. Data on waste generation and where the waste is transferred to is collected, and it appears that the waste is not reported as specific substances. Only transfers off-site are considered, and therefore disposal to tailings dams may not be included.

The United Kingdom (England and Wales) now reports transfer information, although this is currently in a transition stage. Facilities report substances transferred off-site as waste or special waste for disposal or recovery. The next reporting year will see codes used for the type of waste and disposal or recovery method. This will give more information on the disposal and recovery of waste, but may not refer to specific substances, rather the type of waste. It may however cover some types of tailings from minerals processing.

The Netherlands reports on transfers in a different way to other countries. Rather than reporting the transfers separately, the contribution of industry emissions to the final water or soil destination is reported. For example, the 1999-2000 report gave the industry contribution of total nitrogen to soil, and the industry proportion of metals to water. The advantage of this is that the community can see which industries are contributing substances to the water and land around them. The disadvantage is that specific facilities may not be identified as contributors, nor how much they contribute. However, the on-line database was not accessed and this information may be presented on this or in another form.

6 CONCLUSIONS

The implementation of pollutant release and transfer registers in most countries has included transfers. However, the type of transfer information collected, and the way it is presented, differs.

Most countries only report off-site transfers, with the US being the main exception. This means that most substances disposed of in tailings dams are not reported, although any leaks or emissions are.

Transfer information is displayed alongside emission data as either waste or transfer, while categories for recovery and disposal are added in some countries to give more information on the fate of the substances. Where the UK (and possibly others) have moved towards categorizing the waste into codes, information on individual substances will be lost but more information on the waste destination will be gained. The Netherlands seem to present transfer information as part of the total emissions to the environment, which can be useful from a community point of view but does not identify the individual facility contribution and hence may not target the significant polluters.

Many countries make use of existing licensing and reporting requirements to collect the data required for a PRTR. Countries may also have specific reasons why they focus on the total amount of waste rather than substances, or only look at off-site rather than on-site disposal options. That there are at least six countries incorporating transfers into their PRTRs does indicate that this can be useful in meeting PRTR goals.

7 REFERENCES

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Swiss Pollutant Emission Register Information <http://www.umwelt-schweiz.ch/buwal/eng/fachgebiete/fg_stoffe/projekte/swissper/index.html>

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