

Appendix F:
Section 32 Explanation

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1 Introduction

This report documents the development of the Hazardous Facility Screening Procedure from its origin to its current form.

In early 1991, the Auckland City Council began the development of its District Plan. As part of this process, the Council adopted a new, effects-based approach to the management of hazardous substances to better reflect the philosophy of the Resource Management Act 1991 (RMA). The Auckland City Council developed a model termed the Preliminary Risk Assessment Procedure (PRAP) to serve as a tool for deciding whether a proposed development involving hazardous substances should be permitted, or be subject to a consent application.

A number of submissions on the Auckland City District Plan subsequently identified shortcomings in this model, and a review of the procedure began in November 1993. The original PRAP was revised, and is now named Hazardous Facility Screening Procedure (HFSP).

In 1995, the HFSP was embedded in a framework for managing substances and the document entitled *Land Use Planning for Hazardous Facilities*, also known as the 'Red Book', was published. A review of that document and the HFSP was undertaken in 1999 to reflect upcoming changes under the HSNO legislation and accommodate feedback received from users of the HFSP. This revised version was available only in electronic form from the Ministry for the Environment website (*Land Use Planning Guide for Hazardous Facilities, Interim Draft December 1999*). However, it took another two years before the HSNO Regulations were finalised. The 1999 interim draft was revised accordingly and subsequently published early in 2002.

This background report outlines the history of the HFSP and its development, and the scientific basis of and justification for the HFSP.

2 Background

2.1 What are hazardous substances?

In the past, hazardous substances have been defined by pieces of legislation such as the Dangerous Goods and Toxic Substances Acts. These Acts were principally concerned with the risk that substances and activities pose to property, people and human health. Historically, emphasis has been placed on minimising risk to human life, while relatively little regard has been paid to the risk of environmental damage. As a result, threats to the environment were often poorly controlled.

Legislative changes have moved away from this anthropocentric view of the world, with consideration now being given to the environment as a whole. The RMA, as amended by the Hazardous Substances and New Organisms Act 1996 (HSNO), defines a hazardous substance as:

'Hazardous substance' includes, but is not limited to, any substance defined in section 2 of the Hazardous Substance and New Organisms Act 1996 as a hazardous substance.

For the purposes of the HFSP, the RMA definition for hazardous substances is adopted. This means that environmentally damaging substances such as oils or high BOD substances may also be considered hazardous for resource management purposes, in addition to those hazardous substances covered by the HSNO legislation. The HSNO Act provides the following definition of a hazardous substance:

"Hazardous substance" means, unless expressly provided otherwise by regulations, any substance –

- (a) With one or more of the following intrinsic properties:*
 - (i) Explosiveness*
 - (ii) Flammability*
 - (iii) A capacity to oxidise*
 - (iv) Corrosiveness*
 - (v) Toxicity (including chronic toxicity)*
 - (vi) Ecotoxicity, with or without bioaccumulation or*
- (b) Which on contact with air or water (other than air or water where the temperature or pressure has been artificially increased or decreased) generates a substance with any one or more of the properties specified in paragraph (a) of this definition.*

2.2 History of the HFSP

When the Auckland City Council (ACC) began work on its District Plan in 1991, the requirements of the RMA led to the consideration and adoption of a new approach to the assessment and management of hazardous substances and facilities that use or store these substances. It was intended to provide a focus on off-site effects, including effects on the environment. It is important to note that on-site effects on human health are addressed by the Health and Safety in Employment Act 1992 (HSE Act) and are basically not considered by the HFSP.

An integral part of the ACC approach was the attempt to develop a simple system of preliminary risk assessment that could be applied to any hazardous facility. The proposed system relied on the separate assessment of the hazard potential of a substance, its physical form, and the manner in which it was used or stored.

After the release of a discussion document, the Auckland City Council held a number of seminars for industry groups, community and environmental groups, the Auckland Regional Council and adjoining territorial local authorities. This consultation led to the development of the initial "risk assessment procedure" that was subsequently redrafted for inclusion into the Proposed District Plan (see Auckland City Council, 1992).

In brief,²⁰ the procedure worked on the principle that potential adverse effects of a hazardous substance could be determined by its hazard potential and the risk of the substance:

- becoming exposed to an ignition source
- being left unprotected against contact with other substances which might cause a physical or chemical reaction
- coming in contact with the human skin, mucous membranes, respiratory or digestive systems, or
- being released into the environment.

The hazard potential was defined by the intrinsic properties of the substance, while the risk of causing damage through the above events was determined by the amount stored or used and the manner in which the substances were handled.

The PRAP involved the determination of the hazard potential of a substance in three categories:

- Explosion/Fire: with emphasis on damage to property, the built environment and people
- Health: with emphasis on the well-being, health and safety of human beings and
- Environment: with emphasis on possible adverse effects on ecosystems and natural resources.

This was followed by the identification of a Standard Threshold together with a Risk Factor in order to calculate an Effective Threshold for the control of hazardous facilities and substances. The Standard Threshold (T) was based on the physical characteristics of a substance and the potential effects that these might generate. This threshold formed the basic standard against which a site- and use-specific Risk Factor (M) was applied. This risk factor took into account the conditions under which the particular substance was used or stored. The result was an Effective Threshold (L) which was specific for each facility, substance and activity. The Effective Threshold for a proposed development could then be compared with levels identified in a consent status table which indicated whether the proposal would be permitted, controlled, discretionary or prohibited in the zone it wanted to establish in.

2.3 The initial review process

Submissions on the proposed Auckland City District Plan identified some shortcomings in the model and a concern about the general lack of scientific justification for this approach. At this stage, other territorial local authorities in New Zealand had adopted the PRAP method in their own district plans, and the need for an independent review became evident.

The review was initiated by Environment Waikato and the Auckland Regional Council in November 1993. A core group consisting of staff of these two councils, the Auckland City Council and a consultant was formed. This group subsequently approached other territorial local authorities and regional councils for assistance with funding of the review project. Financial contributions from 36 local and regional councils were obtained, and four independent risk assessment experts from Australia and New Zealand were contacted to assist with a full technical review of the PRAP and to develop a revised procedure, should this become

²⁰ A full description of the original PRAP is provided in the discussion document entitled *The Management of Hazardous Substances and Facilities*, Auckland City Council, April 1992.

necessary. The process was carried out in close co-operation with the Ministry for the Environment.

As part of the review process, an evaluation of the 'traditional' New Zealand list approach and overseas screening methods for hazardous substances was undertaken to assess their applicability to the New Zealand regulatory environment. These included the traditional list approach as used by the US Environmental Protection Agency (USEPA), the UK CIMAH regulations, the Dow/Mond Indices, the US National Fire Protection Association (USNFPA) regulations, and the New South Wales SEPP 33 Guidelines.²¹ None of these methods were thought to be suitable to provide an adequate focus on the environment and to satisfy the effects-based approach required by the RMA.

One of the findings of the review referred to the purpose of the procedure, which is the screening of proposed developments involving hazardous substances to determine whether a consent is required or not, rather than an actual risk assessment of the proposed facility. To better reflect this purpose, the procedure was renamed the Hazardous Facility Screening Procedure, or HFSP.

Throughout the review process and subsequent revision of the original method, advice was sought from a number of interested parties, including the New Zealand Fire Service and various industry representatives. In July and August 1994, two workshops were held to introduce the reworked procedure to interested parties and to provide an opportunity for input. A second draft document was circulated in October 1994 to elicit further comment, and submissions on the Auckland City Isthmus Plan were heard in December 1994. A comprehensive review of these submissions was undertaken, and in some cases further meetings were held with submitters. As a result, the review process has been lengthy, but has incorporated a wide range of input from those involved in hazardous substances management.

Comments and submissions were taken into account as much as possible. *Land Use Planning for Hazardous Facilities* was released in June 1995.

2.4 The second review

In 1997/98, the Auckland Regional Council carried out a survey of HFSP users to identify relevant issues with the document overall and the HFSP in particular. Various comments were made about a lack of user-friendliness of the planning document and perceived complexities of the procedure. A review was initiated and funded by the Ministry for the Environment with the aim of producing a revised planning guide, to be published by the Ministry. A complementary *Assessment Guide for Hazardous Facilities* was also prepared.

The review started in 1998 and concentrated on the presentation of the planning guide and the HFSP. Various aspects of the procedure were identified which could be simplified without compromising its purpose and integrity. A significant aspect of the review was the modification of the hazardous substance classification criteria used for the HFSP to account for the changes brought about by the HSNO legislation.

²¹ NSW Department of Planning, 1997: State Environmental Planning Policy No. 33, Hazardous and Offensive Development Application Guidelines.

The draft of the new Planning Guide was scrutinised by a group of peer reviewers from industry, central and local government and published on the MfE website as an interim draft awaiting the completion of the HSNO regulations.

When the HSNO regulations came into force in July 2001, the Ministry for the Environment and ERMA NZ began to collaborate in developing various training material and courses to assist practitioners with working under the new hazardous substance regulations. As part of this, the interim version of the *Land Use Planning Guide for Hazardous Facilities* was checked again to ensure that it is compatible with the HSNO regulations. The Guide was published in early 2002.

3 Evaluation of management approaches

The challenge of developing an appropriate control mechanism for facilities using or storing hazardous substances lies in the eventual ease of administering and complying with the process. What is needed is an approach that identifies those facilities and activities that are liable to cause problems and allows others to operate without undue interference. Any system that generates an unwieldy bureaucracy is bound to fail, while at the same time decision-making should be carried out on the basis of objective evaluation of a proposal.

The basic approaches to managing hazardous substances are summarised below.

3.1 Performance-based approach

A performance-based approach involves the setting of acceptable risk contours either around industrial/commercial areas, or between industrial areas and residential or retail areas. Any performance standard would be based on the requirement that no hazardous activity should lead to risk levels in excess of some limit outside of the relevant contour. A similar but higher risk parameter could also be set at the site boundaries. The advantage of this approach is that operators are provided with some certainty regarding what is expected of them. Cumulative effects from a number of facilities in close proximity are also taken into account.

However, the certainty provided by this approach depends on the accuracy and consistency with which risks can be measured, and generally requires a full quantitative risk assessment, which would be onerous for small facilities. In addition, the characteristics of risk (i.e. the actions leading to the risk, the probability of mishap and the severity of the outcome) may change between activities or substances, thus making it difficult to quantify different types of risk in a common way.

The chief disadvantages of this approach, therefore, are the cost of adequately determining existing and acceptable levels of risk and of defending such assessments against technical or legal challenges.

3.2 Process- or substance-based approach

The process- or substance-based approach uses a more qualitative assessment, and is similar to the approach used in most district schemes of the past. This approach relies heavily on process and substance lists such as those used by the Auckland Regional Council in New Zealand, the USEPA, the CIMAH and USNFPA regulations and the Dow/Mond Indices, and quantity thresholds to determine consent procedures.

A number of problems arise with this approach, not the least of which is identifying the effects the rules are designed to control. It may also be difficult to justify, in quantitative terms, a certain threshold limit as the relationship between these limits and the implied level of acceptable risk may be vague. A further problem with substance or process lists is that they take no account of the more variable aspects of risk such as management practices, safety procedures etc. Substance lists in particular can never be complete because of the number of new chemicals being produced, and cannot take account of any cumulative risk presented by numerous substances held on the same site.

The use of substance lists does have the advantage that overseas information and experience can be readily adopted. This is likely to reduce a council's information costs and may make this approach more legally defensible.

3.3 Effects-based approach

The third alternative may be seen as a hybrid approach involving the partial identification of potential effects and the application of threshold quantities to control these effects. This approach, which has been chosen for the HFSP, relies on an assessment of both the intrinsic hazard of a substance, and the risk inherent in any activity using that substance. The results from these assessments are then compared against a series of threshold quantities. These thresholds are determined on the basis of the effect (or range of effects) being controlled for, rather than on the basis of substances or processes, as is the case with the substance approach.

The principal advantage with this approach is that it focuses on effects rather than the activity or substances used, and so is more comfortably in line with the requirements of the RMA. However, difficulties exist with selecting appropriate thresholds for each of the effects being controlled, which should be determined by reference to the physicochemical characteristics of substances which typically generate the effect in question, as well as local and site-specific conditions. The Dow/Mond Indices and the SEPP 33 Guidelines take this approach in part, but lack the focus on human health and environmental effects that has been developed for the HFSP.

4 Development of the hazardous facility screening procedure

4.1 Introduction

The HFSP has been developed over a period of one year, following a review of its predecessor, the Auckland City Council's Preliminary Risk Assessment Procedure. Although the HFSP retains many features of the PRAP model, a number of key aspects have been modified to align the new method with accepted risk management theory.

An attempt was also made to simplify the method as much as possible without compromising the scientific integrity of the approach. It is important to recognise the purpose of the HFSP as a screening tool that determines whether a proposed development involving hazardous substances will be permitted in a given area or whether it will require a consent application. The HFSP cannot be used directly to decide the outcome of an application.

4.2 Concept

The HFSP focuses on the potential adverse effects of the use or storage of hazardous substances in a given area or environment. In doing so, it takes into account the hazard of a substance, site-specific conditions and the risk it poses, where:

- hazard is principally defined by the intrinsic properties of a substance
- risk is defined by the probability of the release of the substance combined with the potential consequences of that release.

Potential effects are categorised into three types:

- Fire/Explosion Effects: concerned with damage to property, the built environment and safety of people
- Human Health Effects: concerned with the well-being, health and safety of people
- Environmental Effects: concerned with damage to ecosystems and natural resources.

In general, any substance to be used or stored on a site is assessed for its potential effects for each of these types, and is then assigned a Base Quantity (B) which defines the amount that would be allowed to be used or stored on the site, if the site was located in a typical heavy industrial zone. This quantity is then adjusted according to site- and substance-specific characteristics, resulting in a value termed the Adjusted Quantity (A). In the next step, the quantity of the substance that is proposed to be used or stored on the site (Proposed Quantity Q) is divided by the Adjusted Quantity (A), resulting in a Quantity Ratio (Q) for each Effect Type which is a dimensionless numerical value pertaining to the substance being assessed. The Quantity Ratios for the different substances to be held on the site are then added together, and the sum of these is compared with a Consent Status Index in a Consent Status Matrix table. Consent Status Matrix tables are unique to each council, as the chosen indices depend on the risk levels considered to be appropriate by the local community.

In summary, the HFSP is a method that assesses the potential adverse effects of the use or storage of hazardous substances in a site-specific context, based on accepted risk management theory and scientific evidence. The HFSP can be applied to all substances, and the calculations to arrive at the Quantity Ratio value which can be looked up in the Consent Status Matrix table is comparatively simple.

4.2.1 Classification of hazardous substances

The classification of hazardous substances in the HFSP is based predominantly on the classification system adopted in the HSNO classification scheme. They in turn adopt criteria of the United Nations Recommendations for the Transport of Dangerous Goods (UNRTDG), 11th Revised Edition, and the criteria for the classification of environmental toxicants are based on the Global Harmonisation System Organisation promoted by the Organisation for Economic Co-operation and Development (OECD).

The HFSP does not rely on the primary risk of a hazardous substance as per the UNRTDG for control, but classifies all potential hazards of a substance in a manner compatible with the hazard classes under the HSNO legislation.

4.2.2 Definition of base quantities

The HFSP Base Quantities have been derived using the professional experience and judgement of the risk experts involved in the review process, and are to some extent based on the New South Wales SEPP 33 Guidelines. These Guidelines were developed using risk modelling by the SAFETI risk assessment computer programme.

Other sources such as the UK CIMAH regulations were also consulted. It should be noted, however, that both the CIMAH regulations and the SEPP 33 Guidelines were developed to regulate large industrial hazardous facilities; as a result, some of the values adopted in these documents were deemed to be inappropriate for the small and medium-sized facilities that are screened by the HFSP.

To ensure that the HFSP Base Quantities are applicable to the majority of developments in New Zealand, discussions were held with Dangerous Goods Officers and the Technical Liaison Officer of the New Zealand Fire Service in the Auckland Region. Further validation of Base Quantities was obtained through comparisons with threshold quantities used elsewhere in the world and those provided in the Auckland Regional Council (ARC) Substances List.

Another feature relating to the setting of the Base Quantities is, with some exceptions, the application of a logarithmic scale to reflect the difference in risk between highly hazardous substances and those having a lower hazard. This approach is based on the assumption that the effects of hazardous substances decrease exponentially with distance, as is demonstrated with respect to the effects of heat radiation. In the HFSP, and therefore applicable to screening purposes only, the logarithmic scale is expressed by using a respective weighting of 1:3:10 for low, medium and highly hazardous substances throughout.

It is noted that some consolidation of hazard categories has occurred in comparison with the 1995 'Red Book'. In the 1995 document, highly hazardous substances were split into two categories, which has now been reversed in line with the HSNO approach.

4.2.2.1 Base thresholds for explosive substances

a) HSNO classification

For a full description of this class of substances the wording of the relevant HSNO Regulations should be referred to.

- Subclass 1.1* *Substances and articles that have a mass explosion hazard.*
Examples: TNT, ANFO, Powergel, Tovex, HE primers and boosters and gun (black) powder.
- Subclass 1.2* *Substances and articles that have a projection hazard but not a mass explosion hazard.*
Examples: bombs, grenades, rockets, and some pyrotechnics.
- Subclass 1.3* *Substances and articles that have a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard.*
Examples: propellant powder, some display fireworks, classified shot gun and rifle powder.
- Subclass 1.4* *Substances and articles that present no significant explosive hazard.*
Examples: toy fire works, safety cartridges.

Subclass 1.5 *Very insensitive substances that have a mass explosion hazard.*
 Examples: proprietary explosives such as Powergel Gold.

Subclass 1.6 *Extremely insensitive articles that do not have mass explosion hazard.*

Subclasses 1.4 and 1.6 have not been included in the HFSP because by definition they do not represent a significant mass explosion hazard and are not expected to have significant off-site effects. This approach has also been adopted in the SEPP 33 Guidelines.

b) *Determination of base quantities and comparison with other substances lists*

Source*	Subclass 1.1	Subclass 1.2	Subclass 1.3
HFSP	0.1 t	1 t	3 t
SEPP 33	0.1 t	1 t	5 t
ARC	0.5 (TNT equivalent) **		
USEPA			
CIMAH			5 t

* ARC: Auckland Regional Council (1988): *Substances List*. USEPA: USEPA (January 1992) Title III List of Lists, Consolidated List of Chemicals subject to Reporting under the Emergency Planning and Community Right to Know Act. EPA 560/4-92-011. CIMAH: Control of Industrial Major Accident Hazards Regulations 1984. United Kingdom.

** The ARC Substances List listed three explosive substances; all other substances were screened at 0.5 (TNT equivalent).

It has been considered desirable that ultimately there is a linkage between the past licensing levels for explosive substances under the Explosives Act 1957 and the Base Quantities in the HFSP, and that planning applications involving explosive substances are dealt with jointly by the local regulatory authority and the relevant explosives experts in the Department of Labour. However, as the Explosives Act used a classification for explosive substances that is different from the current HSNO/UN classification system, it is difficult to establish this linkage. Therefore, the Base Quantities for explosive substances in the HFSP have been based on the SEPP 33 Guidelines, and have been agreed to by the risk experts, Dangerous Goods Officers and the Technical Liaison Officer of the New Zealand Fire Service.

The SEPP 33 Guidelines provide an acceptable threshold for Subclass 1.1 explosives in a heavy industrial area. The threshold is based on a modelled overpressure of 7 kPa at the site boundary, assuming a 10-metre distance from the boundary and a typical explosion scenario.

The CIMAH regulations (as referred to in an early draft of the Code of Practice for Managing Hazards to Prevent Major Industrial Accidents, Department of Labour – OSH) provide threshold quantities for explosive substances that range up to 5 tonnes. Explosive substances are listed in the category ‘Group 4 – Explosive Substances’, but as individual substances are not identified by the UN classification no values have been noted for Subclasses 1.1 and 1.2.

4.2.2.2 Base quantities for gases

a) HSNO classification

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

Class 2.1.1A Flammable gases: high hazard

Gases or gas mixtures which at 20°C and a standard pressure of 101.3 kPa:

- are ignitable when in a mixture of 13% or less by volume with air, or
- have a flammable range with air of at least 12% regardless of the lower flammability limit.

Class 2.1.2A Flammable aerosols

b) Determination of base quantities and comparison with other substances lists

Source	Classes 2.1.1 A and 2.1.2 A
HFSP:	
compressed gas	10,000 m ³
liquefied gas	10 t
SEPP 33:	
compressed gas	10 m ³
liquefied gas	1 t *
ARC	0.25–2 t **
USEPA	
CIMAH	20 t

* SEPP 33 does not have adjustment factors. The HFSP Base Quantity has been set to be the same as the SEPP 33 threshold once the Adjustment Factor for substance form (FF1) is applied.

** ARC Substances List: 250 kg for hydrogen, 1 t for acetylene, 2 t for ethylene.

c) Class 2.1.1A and 2.1.2A: Flammable gases and flammable aerosols

In the HFSP, Class 2.1 gases can be assessed by their weight (tonne) or volume (m³), whichever is convenient, depending on whether the gas is liquefied or compressed. Because it is a dimensionless number, the Quantity Ratio will be unaffected by the choice of measurement units.

The HFSP uses an Adjustment Factor (FF1) for substance form to derive an Adjusted Quantity (A) for gases that is similar to the quantities given in the ARC Substances List and the initial screening quantities developed for the SEPP 33 Guidelines. Overall, the derivation of Base Quantities for flammable gases has been based on the latter. The SEPP 33 Guidelines provide acceptable thresholds for these gases in a heavy industrial area, based on a modelled heat radiation at the site boundary of 12.6 kW/m² over 30 seconds, assuming a 10 metre distance from the boundary and a typical release scenario. It should be noted that the SEPP 33 threshold for compressed gases (10m³) is much lower than that adopted for the HFSP (10,000m³) because it is based on a specific release scenario (i.e.. a jet fire from a puncture) rather than the total storage volume.

d) *LPG*

In the HFSP, LPG is treated separately because it is more strictly regulated than other flammable gases. LPG is given a Base Quantity of 30 tonnes which equates to 3 tonnes after applying the Adjustment Factor FF1 for substance form. This quantity is compatible with similar allowable quantities used in various district schemes in the past in New Zealand.

4.2.2.3 Base quantities for flammable liquids

This group includes flammable liquids comprising liquids, mixtures of liquids, or liquids containing solids in suspension which give off a flammable vapour at specific temperatures.

a) *HSNO classification*

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

- Class 3.1A:* *Flash point: < 23°C*
 Initial boiling point: < 35°C
- Class 3.1B:* *Flash point: < 23°C*
 Initial boiling point: > 35°C
- Class 3.1C:* *Flash point: ≥ 23°C; ≤ 60°C*
- Class 3.1D* *Flash point: > 60°C but ≤ 93°C*
- Class 3.2A* *Liquid desensitised explosives: high hazard*
- Class 3.2B* *Liquid desensitised explosives: medium hazard*
- Class 3.2C* *Liquid desensitised explosives: low hazard*

b) *Determination of base quantities and comparison with other substances lists*

Source	3.1A (Class 3 PG I)	3.1B (Class 3 PG II)	3.1C (Class 3 PG III)	3.1D (Combustible liquids)
HFSP	10 t	10 t	30 t	100 t
SEPP 33	9 t	15 t	15 t	100 t*
ARC**	2 t	2 t	4 t	10 t
USEPA***				
CIMAH	5000 t	5000 t	20 t	

* Class 3 C is not considered in the SEPP 33 Guidelines, but was modelled in the earlier drafts.
 ** Values in the ARC Substances List are based on above ground storage.
 *** The USEPA does not have planning threshold quantities for flammable liquids in a manner similar to the HFSP. Instead, the release of a flammable liquid must be reported to the National Response Centre under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA, or 'Superfund') if the release quantity is equal to or greater than their Reportable Quantity (RQ). Generally the RQs range from 1–2500 kg.

HFSP Base Quantities for flammable liquids were developed using the professional experience and judgement of the risk experts involved in the review process, and are predominantly based on the SEPP 33 Guidelines. The SEPP 33 thresholds for flammable liquids in a heavy industrial area are based on a modelled heat radiation of 12.6 kW/m² over 30 seconds at the site boundary, assuming a distance of 10 metres from the boundary and a typical release scenario. The Guidelines also demonstrate that there is a logarithmic relationship between the quantities of flammable liquids and the distance to the site boundary, given a specific heat radiation at the boundary.

In discussion with the peer review risk experts it was therefore decided that a logarithmic scale overall better reflects the actual differences in risk between highly hazardous and other hazardous substances, as long as this concept is applied to a screening process only. A logarithmic scale has been introduced to the HFSP by using a relative weighting of 1:3:10 for low, medium and highly hazardous substances.

On this basis, the quantity of 15 t for category C (UN Class 3 PGIII) substances, as used in the SEPP 33 Guidelines, is not appropriate and has been increased, while the Base Quantity for category B (UN Class 3 PGII) substances has been decreased. The approach of the HFSP to category B (UN Class 3 PGII) substances is therefore slightly more conservative than that of the SEPP 33 Guidelines.

Base quantities for liquid desensitised explosives are the same as for solid desensitised explosives (refer 4.2.2.4) as these substances have a closer relationship with each other than with those in Class 3 generally.

4.2.2.4 Base quantities for flammable solids

This group includes flammable solids, flammable solids that are self-reactive, flammable solid desensitised explosives, flammable spontaneously combustible substances, and flammable solids that are dangerous when wet.

a) HSNO classification

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

- Class 4.1.1A readily combustible solids and solids that may cause fire through friction: medium hazard*
- Class 4.1.1B readily combustible solids and solids that may cause fire through friction: low hazard*
- Class 4.1.2A self-reactive substances: Type A*
- Class 4.1.2B self-reactive substances: Type B*
- Class 4.1.2C self-reactive substances: Type C*
- Class 4.1.2D self-reactive substances: Type D*
- Class 4.1.2E self-reactive substances: Type E*
- Class 4.1.2F self-reactive substances: Type F*
- Class 4.1.2G self-reactive substances: Type G*
- Class 4.1.3A solid desensitised explosives: high hazard*
- Class 4.1.3B solid desensitised explosives: medium hazard*

- Class 4.1.3C solid desensitised explosives: low hazard*
- Class 4.2A spontaneously combustible substances: pyrophoric substances: high hazard*
- Class 4.2B spontaneously combustible substances: self-heating substances: medium hazard*
- Class 4.2C spontaneously combustible substances: self-heating substances: low hazard*
- Class 4.3A solids that emit flammable gas when in contact with water: high hazard*
- Class 4.3B solids that emit flammable gas when in contact with water: medium hazard*
- Class 4.3C solids that emit flammable gas when in contact with water: low hazard*

The HSNO classification for flammable solids is more complex than the UN Classes for these substances, and this has been reflected by the HFSP through using the same sub-classes as those in the HSNO Regulations. However, the systems which have been used to derive the base quantities focus on the UN Classes, and comparison is made on this basis.

b) Determination of base quantities and comparison with other substances lists

Source	UN Class 4.1	UN Class 4.2	UN Class 4.3
HFSP	1/10/30 t	1/10 t	1/10 t
SEPP 33	10 t	1 t	1 t
ARC	0.1 t*		
USEPA	0.25 t		
CIMAH			

* The ARC Substances List names only phosphorus in this class of substances.

The HFSP Base Quantities have been derived using the professional experience and judgement of the risk experts involved in the review process, and are to a large extent based on the SEPP 33 Guidelines.

4.2.2.5 Base quantities for oxidising agents and organic peroxides

a) HSNO classification

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

- Class 5.1.1A Oxidising substances that are liquids or solids: high hazard*
- Class 5.1.1B Oxidising substances that are liquids or solids: medium hazard*
- Class 5.1.1C Oxidising substances that are liquids or solids: low hazard*
- Class 5.1.2A Oxidising substances that are gases*
- Class 5.2A Organic peroxides: Type A*
- Class 5.2B Organic peroxides: Type B*
- Class 5.2C Organic peroxides: Type C*
- Class 5.2D Organic peroxides: Type D*
- Class 5.2E Organic peroxides: Type E*

Class 5.2F *Organic peroxides: Type F*

Class 5.2G *Organic peroxides: Type G*

b) *Determination of base quantities and comparison with other substances lists*

Source	Class 5.1	Class 5.2
HFSP	1/10/10 t (10,000 m ³)*	1/10/30 t
SEPP 33	5 t	10 t
ARC	0.5 t	0.025 t
USEPA		
CIMAH		5 t

* For permanent/compressed gases, measured at 20°C and 101.3 kPa.

For Class 5.1 substances, the threshold quantities in the HFSP and SEPP 33 Guidelines are roughly within the same order of magnitude. The actual base quantity is aligned with the HSNO divisions within UN Class 5.1. A similar approach has been adopted for UN Class 5.2, based on discussion with staff from the Environmental Risk Management Authority (ERMA).

A base quantity has also been introduced for permanent/compressed gases with the capacity to oxidise. These substances are rare. The value is the same as for flammable gases.

4.2.2.6 *Base quantities for toxic substances*

This group includes poisonous substances that are liable to cause death or injury or harm to human health if swallowed, inhaled, or contacted by skin.

a) *HSNO classification*

For a full description of this class of substances the relevant HSNO Regulations should be referred to. Gases with toxic properties (UN Class 2.3) are also included in HSNO Class 6.1.

<i>Class 6.1A:</i>	Oral toxicity LD ₅₀ (mg/kg):	≤ 5
	Dermal toxicity LD ₅₀ (mg/kg):	≤ 50
	Inhalation toxicity dust/mist LC ₅₀ (mg/l):	≤ 0.05
	Inhalation toxicity vapours LC ₅₀ (mg/l):	≤ 0.5
	Inhalation toxicity gases LC ₅₀ (ppm):	≤ 100
<i>Class 6.1B:</i>	Oral toxicity LD ₅₀ (mg/kg):	> 5 – 50
	Dermal toxicity LD ₅₀ (mg/kg):	> 50 – 200
	Inhalation toxicity dust/mist LC ₅₀ (mg/l):	> 0.05 – 0.5
	Inhalation toxicity vapours LC ₅₀ (mg/l):	> 0.5 – 2
	Inhalation toxicity gases LC ₅₀ (ppm):	> 100 – 500
<i>Class 6.1C:</i>	Oral toxicity LD ₅₀ (mg/kg):	> 50 – 300
	Dermal toxicity LD ₅₀ (mg/kg):	> 200 – 1,000
	Inhalation toxicity dust/mist LC ₅₀ (mg/l):	> 0.05 – 1
	Inhalation toxicity vapours LC ₅₀ (mg/l):	> 2 – 10
	Inhalation toxicity gases LC ₅₀ (ppm):	> 500 – 2500

<i>Class 6.1D:</i>	Oral toxicity LD ₅₀ (mg/kg):	> 300 – 2000
	Dermal toxicity LD ₅₀ (mg/kg):	> 1000 – 2000
	Inhalation toxicity dust/mist LC ₅₀ (mg/l):	> 1 – 5
	Inhalation toxicity vapours LC ₅₀ (mg/l):	> 10 – 20
	Inhalation toxicity gases LC ₅₀ (ppm):	> 2500 – 5000

HSNO acute toxicity category 6.1E is not used for the HFSP as substances in this category have lesser potential for off-site effects and are considered to be appropriately controlled by other statutes.

b) Determination of base quantities and comparison with other substances lists

Source	Class 6.1 A (PG I)	Class 6.1 B (PG II)	Class 6.1 C (PG III)	Class 6.1 D	[UN Class 2.3]
HFSP	1 t/ 50 m ^{3*}	1 t/ 50 m ^{3*}	10 t/ 150 m ^{3*}	30 t/ 500 m ³	
SEPP 33	1 t	1 t	5 t		20m ³
ARC	0.001–0.1 t	0.001–0.1t**			2.3(a): 0.001–0.01 t 2.3(b): 0.2–1 t
USEPA	0.05 t***				2.3(a): 0.005–0.25 t 2.3(b): 0.05–0.5 t
CIMAH	0.001–20 t	5–20 t	5–20 t		0.001–0.01 t

* For permanent/compressed gases, measured at 20°C and 101.3 kPa.

** The ARC Substances List lists substances as being very toxic or toxic.

*** Based on threshold quantities for TDI, Toluene-2,6-diisocyanate and Sodium selenite. TDI is generally accepted as an appropriate base for setting land use planning threshold quantities for very toxic substances.

Base quantities for toxic substances in the HFSP have been based on the professional experience and judgement of the risk experts involved in the review process, and on thresholds used in other countries. The rationale for the classification of toxic substances under the HSNO Act has also been taken into account and were confirmed by discussion with staff from the Environmental Risk Management Authority (ERMA).

As is the case throughout the HFSP, the Base Quantities are roughly based on a logarithmic scale (Low = 1, Medium = 10, High = 30), as it is assumed that the release of a toxic substance and subsequent exposure of a receptor follows a logarithmic model.

It should be noted that the CIMAH regulations used in the UK allow wide variation for the base threshold quantities. The HFSP has generally followed the same approach but has used the logarithmic scale to be consistent with the approach adopted for the other substances.

The ARC Substances List and the US substances list identify highly toxic substances only, and do not cover the full range of toxic substances used by industry. This explains why the quantities appear to be low, which is appropriate for highly toxic substances. In contrast, the HFSP considers the full range of toxic substances, and allows a progressive increase in the threshold quantities depending on toxicity rating. For highly toxic substances the HFSP threshold quantity values are similar to threshold quantities used elsewhere in the world.

It is noted that the Base Quantities for Class 6.1 C substances adopted in the HFSP is higher than those in the SEPP 33 Guidelines. The thresholds for Class 6.1 substances in the SEPP 33 Guidelines are not based on scientific evidence or modelling, but professional judgement. It is also important to note that the SEPP 33 Guidelines only consider the primary hazard of a substance rather than the full spectrum of hazards. The HFSP takes account of multiple hazards of a substance in the way that Base Quantities of different Effect Types and hazard levels have been, as far as possible, calibrated against each other.

Overall, for the most toxic substances, the HFSP closely follows the thresholds set by the ARC Substances List, and the USEPA and CIMAH thresholds which are highly conservative. However, the HFSP permits comparatively larger quantities of less toxic substances so as not to unnecessarily restrict the handling of common substances with a low or medium toxicity rating, such as petrol.

c) UN Class 2.3: Toxic gases

As is the case for Class 2.1 gases, the HFSP uses an Adjustment Factor (FH1) for substance form to set an Adjusted Quantity (A) for gases that are in the same order of magnitude as the initial screening quantities developed for the SEPP 33 Guidelines. The Guidelines adopt 20m³ for all toxic gases, except for chlorine, ammonia and sulphur dioxide. In the ARC list the quantities ranged from 200–500 kg. The CIMAH regulations give threshold levels ranging from 1 kg to 50 tonnes, presumably because the regulations were developed for large scale industries located in suitably zoned areas. Nevertheless, the regulations provided useful information for the determination of HFSP Base Quantities.

4.2.2.7 Base quantity for corrosives

a) HSNO classification

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

Class 8.2A, 8.2B and 8.2C Substances that are corrosive to dermal tissue following different durations of exposure

b) Determination of base thresholds and comparison with other substances lists

Source	Class 8.2 A	Class 8.2 B	Class 8.2 C
HFSP	1 t	10 t	30 t
SEPP 33	10 t	50 t	100 t
ARC			
USEPA	0.05–0.5 t		
CIMAH	5 t*		

* These substances were classified as being highly reactive in the list that was referenced. This list is from an early draft of the Code of Practice *Managing Hazards to Prevent Major Industrial Accidents*, OSH. The current code does not contain such a list.

The base quantity has been validated against threshold quantities used elsewhere in the world and the ARC Substances List, and have also been agreed to after discussions with Dangerous Goods Inspectors and with the risk experts involved in the review process.

4.2.2.8 Base quantity for ecotoxic substances

Ecotoxic substances are substances exhibiting a toxic effect on species other than humans, based primarily on the toxicity to aquatic life and selected terrestrial species.

a) HSNO classification

For a full description of this class of substances the relevant HSNO Regulations should be referred to.

Class 9.1A Substances that are very ecotoxic in the aquatic environment

Class 9.1B Substances that are ecotoxic in the aquatic environment

Class 9.1C Substances that are harmful in the aquatic environment

Class 9.1D Substances that are slightly harmful to the aquatic environment or are otherwise designed for biocidal action

b) Determination of base quantities and comparison with other substances lists

Source	Category A	Category B	Category C
HFSP SEPP 33* ARC USEPA CIMAH	3 t	30 t	100 t

* The SEPP 33 Guidelines do not cover environmentally damaging substances. Effects from such substances are addressed by separate legislation in New South Wales.

Generally, ecotoxic and environmentally damaging substances are not considered in the references that have been used for the calibration of the HFSP. However, the RMA requires that all effects are taken into account, which is a major shift from previous approaches to hazardous substances management in that historically only effects on human health and safety and to property were addressed.

In determining the base quantities for the Environmental Effect Type, the logarithmic scale used throughout the HFSP has been employed. The concept has been discussed previously, and is considered appropriate in an environmental context as well because the effects from the loss of containment of an ecotoxic or environmentally damaging substance, following mixing and dilution, follow a logarithmic model.

The base quantities values have been agreed to after discussions with Dangerous Goods Inspectors and the risk experts involved in the review process.

4.2.3 Derivation of adjustment factors

The Adjustment Factors (F) have been developed in conjunction with the Base Quantities; therefore, the explanation for the Adjustment Factors should be read in conjunction with the explanation for the Base Quantities. Adjustment Factors were calibrated so that the generated Adjusted Quantities (the product of Base Quantities and Adjustment Factors) are representative of hazardous substance quantities which would generate no significant off-site effects in the case of a release, if held on a facility in a typical heavy industrial zone, and after taking into account substance- and site-specific considerations. The values were validated against overseas criteria.

The Adjustment Factors also account for different ranges of industry types. Not all industries are sited in similar locations, have the same characteristics or use hazardous substances in the same way. Hence, there is a need for Adjustment Factors to account for these variations so that the focus of controls may be on potential effects, rather than being based on substances or industries lists. Previous control systems treated all industries in a similar manner regardless of the manner in which substances were used or stored, and did not take into account the sensitivity of the surrounding environment.

The Adjustment Factors take into account:

- the physical state of the substance
- the temperature of storage or use
- separation distances to the site boundary
- sensitivity of the surrounding environment.

The derivation of Adjustment Factors has been based on both risk modelling data and professional expertise and experience. The New Zealand and Australian experts involved in the review process in 1994 provided substantial input in this area. Comment was also sought from professionals with sound practical experience in hazardous substances management, such as Dangerous Goods Inspectors and the New Zealand Fire Service Hazardous Substances Liaison Officer based in Auckland.

4.2.3.1 Derivation of adjustment factors for the fire/explosion effect type

a) *FF1: Substance form – solids = 1*

Flammable solids do not add significantly to risks because of their substance form. In an incident in which such substances are ignited, solid flammable substances will essentially remain where they are placed. Their main risk is destruction of property; hence the value of 1.

b) *FF1: Substance form – liquids and powders = 1*

Although they are somewhat more mobile than solids, liquids and powders are not considered to add considerably to risks. Essentially, their main risk is destruction to property and heat effects. In most cases of land-based incidences involving bulk quantities of flammable liquids, their mobility is impaired by secondary containment systems, and fire effects are generally contained within the bunded compound area. For these reasons, a value of 1 has been assigned.

c) *FF1: Substance form – gas (at 101.3 kPa and 20°C) = 0.1*

The use of this factor is for the potential loss of control or containment of flammable gases stored in large quantities. Flammable gases have the ability to mobilise and quickly expand into a gas cloud which, if ignited, and dependent on the surroundings, can cause significant fire/explosion damage. The value of 0.1 is also based on the professional experience and judgement of the peer reviewers, and on calibration and validation against the SEPP 33 Guidelines.

d) *Weight (tonnes) or volume (cubic metres) measure*

Generally, most substances are packaged or delivered on the basis of weight. For the HFSP, tonne is the base unit used. However, for gases that are compressed, a cubic volume has been used to assist with the use of the model, because converting cubic metres to mass for compressed gases is a complex calculation. For the HFSP, compressed gases should be assessed by volume, i.e. cubic metres, rather than attempting to convert back to the weight of the compressed gas. In contrast, liquefied gases should be assessed by their weight. It should be noted that using tonnes or cubic metres does not affect the determination of the Quantity Ratio, as this is a dimensionless numerical value.

e) *Flammable vapours*

The HFSP is not intended to consider flammable vapours arising from the storage or use of flammable liquids. Vapours are generally released in smaller quantities in a loss of containment situation, unlike a leakage occurring from a storage tank containing a compressed or liquefied gas. Vapour build-up is considered to be a worker safety issue controlled by the Health and Safety in Employment Act. If vapours ignite upon the loss of containment of a flammable liquid, the effect would initially be confined as a pool fire type situation. For these reasons, flammable vapours are not considered for this Adjustment Factor.

f) *FF2: Separation distance to site boundary*

This Adjustment Factor has been included to give some bonus to proposed developments that offer adequate separation distance of their plant or storage area to the site's boundary. For fire/explosion risks the effects diminish with distance. Therefore, it was considered that the HFSP could allow greater quantities of hazardous substances to be stored if there is the ability to have adequate separation distances within the site. The value of 30 metres and the increase in quantity have been based on work carried out by the New South Wales Department of Planning, using computer-based risk modelling methods. It is possible to have 'sliding' changes of allowable threshold quantities versus separation distance, but this would complicate the HFSP procedure unnecessarily. Not all effects from accidental releases of hazardous substances behave in the same way, and having 'sliding changes' for the whole range of hazardous substances would detract from the HFSP model as a 'simple' screening tool.

g) *FF2: Separation distance from site boundary – < 30 metres = 1*

No increase in quantities is allowed for if the site boundary distance is up to 30 metres, which is considered to be the base point.

h) FF2: Separation distance from site boundary – > 30 metres = 3

If the 30 metre requirement is satisfied, allowable hazardous substances quantities are increased by a factor of 3. This 30 metre value links in with the 1:3:10 scale based on the professional experience and judgement of the peer review experts and has been calibrated against the SEPP 33 Guidelines. The results are somewhat more conservative in some cases for different hazardous substances, but in general it allows an increase in hazardous substances without affecting the consequences of any unplanned release of such hazardous substances.

A factor of 3 is also provided in the case of sub-facilities if the separation distance is more than 60 metres, which reflects the assumption of an 'invisible' boundary at 30 metres between the neighbouring sub-facilities (2 x 30 metres = 60 metres).

i) FF3: Type of activity – use = 0.3

The HFSP defines use as:

the manufacturing, processing or handling of a substance or mixture of substances for a particular activity without necessarily changing the physical state or chemical structure of the substance involved. This includes mixing, blending and packaging operations, but does not include the filling or drawing of substances from bulk storage tanks unless the processing is permanently connected to the bulk storage, and does not include loading out and dispensing of petroleum products.

The HFSP has penalised the use of a hazardous substance because this type of activity normally involves a high frequency of handling operations. Generally, the more frequently a substance is handled, the greater the chance of an incident because of human error or malfunction of handling equipment. In the majority of industrial accidents, it is normally during the use or handling of the hazardous substance that the event occurs. In the Dow Index, the general process hazards factor also includes penalties for materials handling and transfer. The factor of 0.3 has been assigned in accordance with previous considerations of determining low, medium and high effects for the Adjustment Factors based on the logarithmic scale used throughout the HFSP.

j) FF3: Type of activity – above ground storage = 1

The Base Thresholds for fire/explosion have been based for above ground storage, hence the value of 1.

k) FF3: Type of activity – underground storage = 10

This Adjustment Factor applies to flammable liquids only. For these substances, if stored underground, there are well developed Codes of Practice and regulations that prevent or mitigate their accidental release to the environment; in other words, the primary reason for storing these substances underground is to reduce their exposure to fire risks. Underground storage of liquid substances that are not flammable would be assessed on a case-by-case basis.

Given these restrictions, an Adjustment Factor of 10 has been assigned to underground storage tanks for flammable liquids.

4.2.3.2 Derivation of adjustment factors for the human health effect type

a) FH1: Substance form – solid = 3

The exposure pathways for solid hazardous substances to affect human health are limited unless a person is directly exposed. A value of 3 has been chosen to be consistent with the FF1 Adjustment Factor for the Fire/Explosion Effect Type, and to recognise that solids present less of a hazard than liquids or toxic gases.

b) FH1: Substance form – liquids, powder = 1

The base quantity has been based on the liquid form of a hazardous substance, hence the value of 1.

c) FH1: Substance form – gas (at 101.3 kPa and 20°C) = 0.1

Toxic gases have the ability to mobilise very quickly, and are a major concern because of their ability to cause widespread health effects or even death. The appropriate measures required for minimisation of toxic gas risks are very similar to those required for fire and explosion safety. For this reason, a factor of 0.1 has been assigned. Toxic gas is treated as a high hazard.

d) FH2: Separation distance to site boundary (gases only) – < 30 metres = 1

No increase in toxic gas quantities is allowed if the distance to the site boundary is less than 30 metres.

e) FH2: Separation distance to site boundary (gases only) – > 30 metres = 3

Toxic gases in the HFSP model are already well controlled with the setting of the base quantity and the FH1 Adjustment Factor of 0.1, hence the relaxation of the allowable quantities if the facility can provide a separation distance of more than 30 metres. If the 30 metre requirement is satisfied, toxic gas quantities may be increased by a factor of 3. Dispersion gas modelling has shown that toxic gas quantities can be increased without affecting the expected concentration levels compared to that modelled for 10 metres separation. Modelling for toxic gas has used a Gaussian plume dispersion model, using worst case atmospheric conditions.

f) FH3: Type of activity – use = 0.3

The justification for assigning an Adjustment Factor of 0.3 is similar to that provided for the Fire/Explosion Effect Type, Adjustment Factor FF3.

g) FH3: Type of activity – above-ground storage = 1

The base quantities for human health have been based on above ground storage, therefore no further adjustment is necessary.

h) FH3: Type of activity – underground storage = 10

This Adjustment Factor applies to Class 3 flammable liquids only. The rationale for assigning this Factor is the same as for the FF3 Adjustment Factor for the Fire/Explosion Effect Type and has been discussed above.

4.2.3.3 Derivation of adjustment factors for the environmental effect type

a) FE1: Substance form – solids = 3

For reasons already discussed, solids generally present lower hazards than liquids, powders or gases. For this Adjustment Factor, liquids and powders have been set as the benchmark. Therefore, in keeping with the scale of low, medium, and high risks discussed for the preceding Adjustment Factors, solids are given a 'credit' by assigning a value of 3.

b) FE1: Substance form – liquids and powders = 1

This factor has been set at 1 because liquids and powders have been taken as the base in determining hazards to the environment.

c) FE1: Substance form – gas (at 101.3 kPa and 20 °C) = 0.1

The same factor as for gases with toxic properties has been adopted for gases with ecotoxic properties. It is noted that most gases with ecotoxic properties are also toxic.

d) FE2: Environmental sensitivity – normal = 1

This adjustment factor has been included to provide for protection of the aquatic environment, which is the most susceptible to contamination. In many instances, industrial areas are located next or near to major water resources such as harbours, streams, lakes, estuaries, wetlands and the sea. Aquifers and water supplies have been included in the definition of a water resource.

e) FE2: Environmental sensitivity – adjacent to a water resource = 0.3

Based on the above considerations, the potential risk of contaminating a water resource is increased if a development is sited in close proximity to it. A value of 0.3 has been assigned based on the low, medium and high hazard scale discussed in the FF2 Adjustment Factor for the Fire/Explosion Effect Type.

The term 'adjacent' needs to be defined on a case-by-case basis depending on the geological and hydrological circumstances, type of aquatic environments and uses.

f) FE3: Type of activity – use = 0.3

The justification for assigning an Adjustment Factor of 0.3 is similar to that provided for the Fire/Explosion Effects Type Adjustment Factor FF3.

g) FE3: Type of activity – above-ground storage = 1

The base quantity for environmental effects have been based on above ground storage, therefore no further adjustment is necessary.

h) FE3: Type of activity – underground storage = 3

This adjustment factor applies to flammable and combustible liquids only. For these substances, if stored underground, there are well developed Codes of Practice and regulations that prevent or mitigate their accidental release to the environment; in other words, the primary reason for storing these substances underground is to reduce their exposure to fire risks. Underground storage of liquid substances that are not flammable would be assessed on a case-by-case basis.

The value for this factor has been set at 3. This limits permitted underground storage of flammable liquids to 90 tonnes, which corresponds to approximately 100,000 litres for many of these substances, the quantity currently stored underground at some of the larger service stations in the Auckland region.

It is acknowledged that allowing higher quantities of flammable liquids to be stored underground can increase the environmental risk. To account for this potential increase, the facility must comply with the performance standards described in the *Code of Practice for the Design, Installation and Operation of Underground Petroleum Storage Systems* (Department of Labour – OSH), or other codes that achieve the same performance standards.

4.2.4 Development of quantity ratios

In the HFSP, the Quantity Ratio is calculated by dividing the Proposed Quantity (Q) of a substance to be used or stored by the Adjusted Quantity (A). The result is a dimensionless numerical value for each substance to be held on the site. The Quantity Ratios for each substance can then be added together to generate a total Quantity Ratio which may be compared with the indices set in the Consent Status Matrix tables.

The concept of a dimensionless number representing each substance was introduced to account for the cumulative effect of more than one substance being held on the same site, following discussion of this issue with the risk experts involved in the review process.

5 Consent status matrix

5.1 Purpose

The Consent Status Matrix is a management tool to determine the quantity of hazardous substances that may be used or stored in different land use zones. This is reflected in the actual values assigned to the Consent Status Indices for the different land use zones.

The HFSP has been calibrated for maximum hazardous substance quantities in a heavy industrial zone, on the basis that no significant off-site effects would be expected to occur in the event of an accident involving hazardous substances. Based on this supposition, the Consent Status Index in the Consent Status Matrix has been set at a value of 1 for a typical heavy industrial zone.

5.2 Consent status matrix

Having set the Consent Status Index in a heavy industrial zone at 1, corresponding indices for less hazardous land use zones – such as residential or commercial – should be set at less than 1. To define appropriate indices for other land use zones, reference was made to land use risk criteria used in other countries. These land use risk criteria are similar to those developed by the New South Wales Department of Planning in Australia, on which the HFSP trigger levels have been based.

The New South Wales Department of Planning has set the following risk criteria for the death of an individual person in specific land use zones as follows:

Land use	Suggested criteria (risk per million per year)
Hospitals, schools, child care facilities, old age housing	0.5
Residential, hotels, motels, tourist resorts	1
Commercial developments including retail centres, offices and entertainment centres	5
Sporting complexes and active open space	10
Industrial	50

The above risk criteria have been based on the premise that the risk of accidental death due to industrial developments should not significantly increase the risk of death from other accidental causes for people located in sensitive land uses. Sensitive land uses include residential type developments, hospitals, childcare facilities, rest homes and schools. However, in risk management it is thought acceptable that risk levels be higher in industrial zones because:

- people voluntarily accept higher risks by taking employment in industry
- people normally spend only a third of their day in an industrial area, while they may spend up to 24 hours a day in residential areas.

Using the above quantitative land use risk criteria used by the New South Wales Department of Planning it is possible to set trigger levels for zones other than a heavy industrial zone. In a conservative approach, residential zones should have threshold quantities that are 50 times lower than those set for heavy industrial zones. The Consent Status Indices for other zones may be derived correspondingly according to the risk criteria shown above.

It should be noted that the New South Wales risk criteria have been developed for risk that is quantitatively assessed. In the HFSP, risk is not assessed in this way, as the procedure merely screens out activities that may have adverse off-site effects, based on threshold quantities for hazardous substances. Activities that are deemed, by the HFSP, to be in this category are then required to undergo a risk assessment.

In developing the Consent Status Indices for other zones, the Consent Status Matrix should take account of generally accepted risk management theory, in that commercial use may be subjected to more risk than that afforded to residential developments.

The Consent Status Indices in the Consent Status Matrix have been developed on a generalised basis in consultation with risk experts from Australia and New Zealand. The indices are not intended to be used for:

- deciding where to site a hazardous facility that is screened out as being a discretionary activity, or
- making an absolute judgement as to the risk posed by a facility that is screened out as being a discretionary activity.

6 References

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