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Hazardous materials incidents reporting: Results of a nationwide trial*

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Abstract

The results of a trial of reporting incidents involving hazardous materials on a nationwide basis are described. All major Australian State/Territory Fire Brigades agreed to provide standardised information on incidents involving hazardous materials to the Australian National Occupational Health and Safety Commission for six months, as part of a feasibility study for establishing a permanent Australian System for Hazardous Materials Incident Reporting (ASHMIR). A total of 523 incidents were reported during the trial, indicating an incidence of over 1000 a year. Two thirds of the incidents involved petroleum products, of which the main risk was flammability. The most common type of incidents were spills (42%) and leaks (37%). One Boiling Liquid Expanding Vapour Explosion (BLEVE) was also reported. The day on which the highest number of incidents occurred was Friday, the lowest on Sunday. Peaks in incidents reporting occurred on Monday mornings and Friday afternoons. The trial was useful from an operational perspective and identified a number of areas for attention. The trial also provided some information for further refinement of ASHMIR, should it be implemented in Australia.

Introduction

Incidents involving hazardous substances in the form of spills, explosions or fires occur frequently and highlight a number of needs, including the need to minimise the number and intensity of incidents occurring in the future.

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*The conclusions reached and scientific views expressed in this paper are solely those of the authors. These do not necessarily reflect the views and policies of Worksafe Australia.

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In the USA, the Superfund Amendments and Reauthorization Act (SARA) of 1986 contains provisions for emergency planning and the right of communities to obtain information on chemical releases. A National Response Centre exists to collect information, the Department of Transportation has a Hazardous Material Information Centre Database, and the Environmental Protection Agency has the Acute Hazardous Events Database. However, comprehensive data on the numbers of deaths, injuries and evacuations remain unknown [1]. No comparable systems exist on a nationwide basis, though initiatives, of various scope and success exist in the United Kingdom, The Netherlands and Canada [2].

Incident reporting has been in development in Australia for a number of years. Significant advances have been made in New South Wales, and to a lesser extent in other states of Australia, in the application of risk assessment techniques to major hazard planning and management [2]. However, the need for a centralised and uniform hazardous material incident reporting (HMIR) system as an input into the assessment process for major hazards and disaster planning in the Australian context has been argued [2].

The first step in recognising and establishing an Australian System for Hazardous Material Incident Reporting (ASHMIR) was the publication of the National Occupational Health and Safety Commission (Worksafe Australia) discussion paper *Hazardous material incident reporting: Proposal for a minimum data set*, released in January 1988 [3]. The ultimate purpose of ASHMIR was to "provide a clear and concise understanding of the sequence of events that lead to failure, so as to prevent similar accidents from occurring during the manufacture, use, storage or distribution of hazardous materials" [4].

The discussion paper provided an outline of the types of incidents to be reported, and supplied suggested criteria for reporting and formatting. The system aimed to provide a uniform national database from which to develop control strategies for these incidents.

Essentially, the Discussion Paper:

- proposed that a national reporting scheme be established in Australia for reporting incidents involving hazardous materials;
- outlined the types of incidents to be reported;
- provided suggestions for reporting criteria and formats; and
- included options for simplified reporting.

Thirty-seven submissions from industry, union, emergency services and Government organisations were received by Worksafe Australia during the three-month public comment phase. Thirty-five organisations gave broad support for further development of ASHMIR including strong support for a national reporting system from all the major Australian fire brigades. It was recognised that any such system should be:

- similar to the Australian Fire Incident Reporting System (AFIRS), based on

the Australian Standard for Reporting Incidents Involving Fires, AS 2577 [5]; and
- capable of integration into international databases such as the UK Health and Safety Executive/Safety and Reliability Directorate's Major Hazard Incident Data Service (MHIDAS).

Trial reporting

Interest in the development of the proposed reporting system was such that fire brigades in all Australian States and Territories under major Australian fire authorities agreed to participate in a trial of six months duration, developed by Worksafe Australia.

The Worksafe Australia Hazardous Material Reporting Trial ran for six months from 1 May to 31 October 1989.

The main objectives of the trial were:
- to assess the usefulness of a Hazardous Materials Incident Reporting System;
- to make a preliminary assessment of the range of hazardous materials incidents that occur in Australia; and
- to identify what information needs, reporting formats and resources were required if an ongoing system were to be established.

Methods

The reporting form

The hazardous material incidents report form used in the trial was developed by Worksafe Australia in conjunction with reporting authorities.

The reporting authorities also received codes for the various data elements, definitions and explanations of the various terms to be used, and special instruction sheets on weather terms and the national grid reference. Wherever possible, the AFIRS method of coding was applied and ultimately, the majority of fields were taken from AFIRS, and specifically, the Australian Standard "AS 2577–1983 Australian National Fire Data — Incident Report" [5]. This had a number of advantages:
- it ensured that the fire brigades need not change their reporting style;
- those fire brigades already familiar with the AFIRS system were able to provide much of this information through this medium;
- it enabled continuity in the collection of incidents reported involving fires and hazardous materials;
- it promoted "user friendliness".

Other fields were adopted from the Major Hazard Incident Database Service (MHIDAS). This is a database established on a world-wide basis to record haz-

ardous materials incidents which occur anywhere in the world and present major risks to the public [6]. Some MHIDAS data elements were also included after a careful examination of the system.

Design of the coding system and organisation of sub-fields, inner fields and cross fields was obtained from the New South Wales Board of Fire Commissioners. This was exceptionally useful because of the Board's ongoing experience with the AFIRS system and with computer-based data management and analysis of fire incidents reports.

Hazardous material incidents report forms were sent to all major Australian fire brigades at the commencement of the trial. On completion of the six-months trial, incidents reports were returned to Worksafe Australia.

The trial recorded both fires and spills involving chemicals inside or outside of site boundaries, which required the involvement and/or action by the fire brigades. An up to one page description of the incident was also sought from the reporting authorities. The fire brigade personnel who carried out the incidents reporting were either already experienced in this regard or were briefed by their research and data management staff.

An example of a completed Hazardous Material Incident Reporting Report, with explanation of the codes used, is attached at Appendix 1.

Data handling and analysis

The reports received were entered into a dBase III plus® database. Data analysis was carried out with dBase III plus programming and the presentation of the results was made with a Lotus 1-2-3® spreadsheet program.

Data elements selected for analyses were those which seemed particularly relevant for a short term study. No attempt was made in the data analysis to individually deal with each one of the many fields, sub-fields and cross-fields, nor is there sufficient data for a tree analysis.

Data were checked, where possible, against press clippings. Complementary incidents reporting data was obtained from one major industrial company. However, the data set was too small to be used for validation purposes.

Results

Two approaches in the analysis of the reports were taken:

(1) Reports were scrutinised for general trends (see below).
(2) Studies were carried out for specialized information for chosen type of incidents and their causes, on a national and individual State/Territory basis. These were reported in the report of the Trial, submitted to the Standards Development Standing Committee of the Australian National Occupational Health and Safety Commission [7].

General trends

The following notable trends were observed in the Trial.

Number of reports

There were 523 incidents reported during the trial. Table 1 shows the distribution of the number of reported incidents each month by State/Territory through Australia:

There appears to be an inconsistency with the numbers of reports from at least one state (Victoria). This is discussed later. On a national level, the highest number of incidents, occurred in May (over 140), with August coming next with just under 130 incidents. October had the lowest (under 40) number of incidents. There are no other noteworthy trends.

Type of incident

These are shown in Fig. 1. Spills and leaks were the most common descriptions of hazardous material incidents, with 42% and 37% of total incidents, respectively. This finding in turn ties in with the number of petrol incidents on the road. Contamination and explosions were rated the lowest, with 1.4% and 1.8% each. One Boiling Liquid Expanding Vapour Explosion (BLEVE) was also reported, in Victoria.

Nearly sixty percent of the total incidents involved "fixed properties" (data not shown). There was no pattern to the type of property involved with the incident, and they were reported in roughly equal proportions from basic industry, manufacturing and storage sites. There was also a large "other fixed property" component (shops, domestic dwellings, recreation areas and so on). The problem of better definition of fixed properties has been identified in improving the reporting form for future use.

Mobile properties accounted for just over 40% of all incidents (data not shown), with the major component being road transport. Water transport (6%) and rail transport (1%) were minor components.

TABLE 1

Number of incidents by state

State/Territory	Number of incidents reported						
	May	Jun.	Jul.	Aug.	Sep.	Oct.	Total
Victoria	111	19	59	103	45	12	349
South Australia	7	18	12	9	12	16	74
Western Australia	6	6	17	8	10	5	52
New South Wales	15	2	3	8	7	7	42
Australian Capital Territory	1	1	0	1	1	0	4
Queensland	1	0	0	0	0	0	1
Northern Territory	0	0	1	0	0	0	1
Total	141	46	92	129	75	40	523

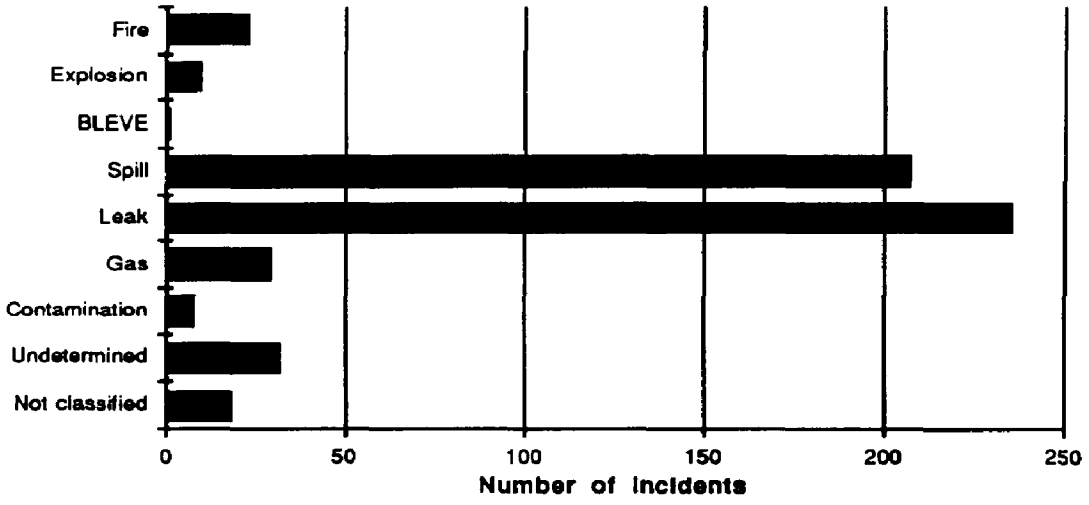

Fig. 1. Distribution of reported incidents by type.

The trial also collected information on the amount of hazardous material spilled. The commonest amount involved in a spill or leak was 10 litres or kilograms.

Number of injuries by incident

A total of 439 people were injured in incidents reported during the trial. One fatality was also reported.

Data were collected on the numbers of fire-fighter personnel or other people injured in incidents. There were 67 injuries to fire-fighter personnel and 372 injuries to others. These are shown in Table 2.

In 515 of 523 incidents (98%), no fire-fighter personnel were injured, and in 441 incidents (84%), no other people were injured. The highest number of people injured in any one incident was 92 (all nonfire-fighter personnel).

Looking at the incidents involving spills and leaks, it was common for decontamination procedures not to be performed and for fire fighters to wear only basic turn-out gear. This appears to be one area for further action.

Incident by hazardous material

Data were collected on the main hazardous material by United Nations (UN) Number. A total of 106 UN Numbers were reported in the 523 incidents. Table 3 shows the UN Numbers for incidents involving hazardous materials with UN Numbers with a frequency of three and over during the trial reported period.

On a national scale, the chemical UN numbers of 1203 (motor spirit), 1270 (petroleum oil), 1971 (methane) and 1075 (liquefied petroleum gas — LPG) have the highest number of occurrences in hazardous material incidents, with

TABLE 2

Number of people injured

Number of injuries/ incident	Incidents involving			Number of injured:		
	Fire-fighters	Others	Both	Fire-fighters	Others	Total
0	515	441	436	0	0	0
1	3	47	49	3	47	50
2	0	12	12	0	24	24
3	2	6	7	6	18	24
4	2	2	4	8	8	16
5	0	3	3	0	15	15
6	0	1	1	0	6	6
7	0	3	3	0	21	21
10	1	1	1	10	10	20
12	0	1	1	0	12	12
15	0	1	1	0	15	15
20	0	1	1	0	20	20
32	0	1	1	0	32	32
40	0	1	1	0	40	40
52	0	1	1	0	52	52
92	0	1	1	0	92	92
Total	523	523	523	27	412	439

352 incidents (67% of total incidents). Presumably, this is a reflection of the amount of petroleum products transported and used in Australia.

Incident by dangerous goods class and main risk

Data were also collected on the main hazardous material by dangerous goods (DG) classification. Figure 2 shows that all dangerous goods classes were represented except radioactive substances (Class 7) and miscellaneous substances (Class 9). The data are also shown by DG subclass in Table 4.

The high numbers of incidents in the flammable gases and liquids classes probably represents again the high proportion of petroleum products being transported in Australia. Also, relatively high numbers of incidents with poisonous substances (Class 6.1) and corrosive substances (Class 8) are noteworthy.

Day and time of incidents

The number of incidents a day was relatively constant, with a peak at the beginning of the week, a small decrease till midweek, an increase later in the week, with a final low incidence on Sunday (see Table 5).

More revealing is the time of incident. This is shown in Fig. 3. These were

TABLE 3

Incident by UN Number

UN Number	Name of material	Number of incidents	
		Absolute	Relative (%)
1203	Motor spirit	156	30.0
1270	Petroleum spirit	107	20.5
1971	Methane	53	10.1
1075	Petroleum gases, liquefied	36	6.9
1789	Hydrochloric acid	17	3.3
1005	Ammonia	13	2.5
1001	Acetylene, dissolved	6	1.1
1160	Dimethylamine solution	4	0.8
1710	Trichloroethylene	4	0.8
1017	Chlorine	4	0.8
1307	Xylene	3	0.6
2031	Nitric acid (non-fuming)	3	0.6
1917	Ethylacrylate (inhibited)	3	0.6
1824	Sodium hydroxide, solution	3	0.6
1748	Calcium hypochlorite	3	0.6
2927	Poisons, corrosive, N.O.S.[a]	3	0.6
2789	Acetic acid, glacial	3	0.6
1993	Flammable liquids, N.O.S.[a]	3	0.6
1830	Sulphuric acid	3	0.6
1223	Kerosene	3	0.6
	Other materials	93	18.0

[a]N.O.S. — Not Otherwise Specified.

divided into four 6-hour blocks, from 12:00 midnight to 6:00 a.m.; 6:00 a.m. to 12:00 noon; 12:00 noon to 6:00 p.m.; and 6:00 p.m. to 12:00 midnight. Predictably, the lowest number of incidents occcurred between 12:00 midnight and 6:00 a.m., with the highest number of incidents during the hours of 6:00 a.m. and 6:00 p.m. (that is, during the main business hours).

There were two interesting findings:

(1) Hazardous material incidents are more frequent on Mondays between 6:00 a.m. and noon and on Fridays between noon and 6:00 p.m. This suggests that Monday mornings and Friday afternoons are the most incidents prone parts of the week.

(2) The number of incidents on Saturday is similar to those reported during weekdays, indicative of significant commercial activity at the weekend. However, Saturday incidents are spread fairly evenly throughout the whole day, whereas on weekdays there is a lull early in the morning. The weekday average for the 12:00 midnight to 6:00 a.m. period was 3.8, on Saturday it was 15. This is worthy of closer attention.

Fig. 2. Distribution of reported incidents by main Dangerous Good-class.

TABLE 4

Incident by main dangerous goods class and subclass

Dangerous goods classification		Number of incidents	
Class	Main risk	Absolute	Relative (%)
1	Explosives	8	2
2.1	Flammable gas	107	23
2.2	Non-flammable gas	13	3
2.3	Poisonous gas	29	6
3	Flammable liquid	219	47
4.1	Flammable solid	4	1
4.2	Spontaneously combustible	4	1
4.3	Dangerous when wet	1	0.2
5.1	Oxidising substances	11	2
5.2	Organic peroxides	1	0.2
6.1	Poisonous (toxic) substances	33	7
6.2	Infectious substances	1	0.2
7	Radioactive substances	0	0
8	Corrosive substances	32	7
9	Miscellaneous substances	0	0

TABLE 5

Distribution of day of incident (see also Fig. 3)

Day	Number of incidents
Monday	81
Tuesday	77
Wednesday	69
Thursday	77
Friday	90
Saturday	81
Sunday	48

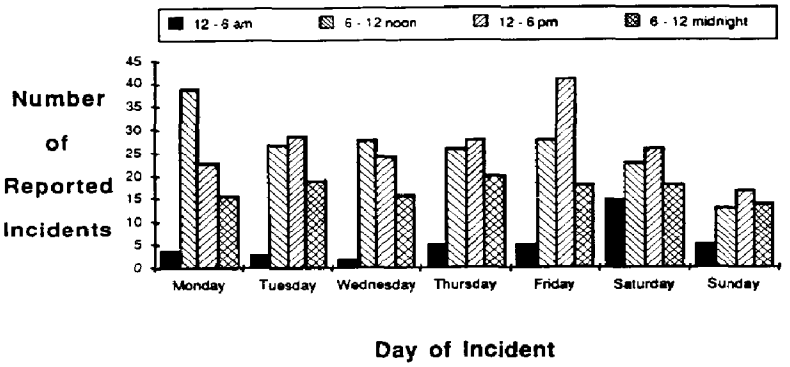

Fig. 3. Distribution of reported incidents by day and time. Note the raised levels on Monday mornings (6 a.m.–noon) and Friday afternoons (noon–6 p.m.). The high Saturday night level is also worthy of note, as well as the low total of reported incidents on Sundays.

Discussion

Main trends in hazardous materials incidence reporting

The trial provides an insight into hazardous materials incidents in Australia. This is reflected by the preponderance of incidents involving petroleum products. Other incidents worthy of attention include the transport of poisons and corrosives in bulk.

The finding of highest incidence on Monday mornings, Friday afternoons and Saturday is also worthy of attention.

Useful information is also available from other sources. For example, a review of 89 chemical (described as nonradioactive) releases in Louisiana in 1986 showed that natural gas and chlorine were the most commonly involved materials, and there was little overlap between data sources at the national, state and local level [8]. Lastly, and perhaps most salient, less than 30% of these incidents were identified from national reporting systems [8].

Data elements for reporting HMIR

The data elements selected for the hazardous material incident reporting were from two main sources: the Major Hazard Incident Database Service (MHIDAS) [6] and AS 2577, the Australian Standard for reporting incidents involving fires [5]. The data elements varied in their degree of usefulness and their ability to be incorporated into data analyses. One important factor for further consideration was that criteria for reporting should also include factors such as the time and resources required to deal with the incident, the total cost of the incident (including property losses, lost time and costs of clean-up and disposal).

A second important outcome of the trial analysis was that the field specifications need to allow the reporter more flexibility in the choice of the descriptors used in each field. A flexible approach would provide a larger number of descriptors per field. This would result in a much clearer overall picture for each incident.

Interpretation of scope of reporting

In general, reporting of hazardous materials incidents was quite consistent and of a high standard. However, it is evident that the interpretation and attitudes of the reporting authorities made a big difference in the reporting of incidents. For example, the South Australian Metropolitan Fire Brigade advised that they attended a total of 398 incidents designated as "gas leaks and fuel spillages", but that they only reported 43 as part of the trial. The great majority of the other 355 miscellaneous spillages would most likely be attendance at road traffic accidents, where petrol, LPG, diesel fuel, coolant or lubricants were spilled. These were not reported because of their frequency and the usually small quantities of material involved. It appears that all Brigades except the Melbourne Metropolitan Fire Brigade took this approach.

The Melbourne Metropolitan Fire Brigade reported all such incidents because the officers of the Brigade felt that the total amount of spilled material involved would add up to a significant quantity. Thus, the difference in reporting the incidents is large, that is, Victoria reported a total of 349 incidents while South Australia reported 74 incidents and New South Wales reported 42.

Also, some brigades handled reporting differently where the hazardous material caused a fire. As all brigades already have standard reporting criteria for fires, an unknown number of hazardous materials incidents were not included in the trial.

Clearly, it needs to be established whether incidents reporting criteria were uniformly understood and uniformly applied by the reporting authorities or whether the detailed instructions were lacking. As collection of data on minor petrol spillages is unlikely to be commensurate with the value of the informa-

tion obtained, it is possible that these will not be required to be reported if a permanent ASHMIR system is to be introduced in Australia.

Further refinements for ASHMIR

At the implementation stage two important aspects of ASHMIR need to be expanded:

(1) An estimation of the population at the installation at which the particular incident occurred, as this could have an important bearing on other similar installations where such incidents might be prevented.

(2) The estimation of the total amount of hazardous substances stored and/or transported, as accurate data on the amount of stored and/or transported hazardous substances would put the extent of a type of incident in perspective, that is on an objective rather than subjective scale.

Should an ASHMIR system be established, all emergency services responding to hazardous material incidents will have to be identified. ASHMIR reporting forms would then have to be made available to all emergency services (fire brigades in most cases) to ensure all incidents are reported.

ASHMIR: *The future*

At the October 1990 meeting of the Standards Development Standing Committee (SDSC) of the Australian National Occupational Health and Safety Commission (Worksafe Australia), the report of Trial Reporting was discussed [7]. The committee noted the report, considered the need for implementation of ASHMIR, and agreed that significant financial resources would be required for any organisation undertaking coordination of an ongoing system. Matters which need resolution include:

- which organisation should have the responsibility for ASHMIR;
- what resources would be required to maintain ASHMIR;
- which organisations should contribute data to ASHMIR;
- how should data be provided to the coordinating organisation;
- what sort of reports should the coordinating organisation provide.

An information paper on the trial was submitted to the National Occupational Health and Safety Commission at its twenty-second meeting, 5 December 1990 [9].

The need for comprehensive and reliable data on hazardous material incidents remains. This would improve the health and safety of the Australian public, assist in the continued improvement of occupational health and safety in the workplace and assist in protection of the environment.

The advantages of developing a national hazardous material incidents reporting system are:

- the ability to track chemical incidents data for trend analysis and risk assessment;
- the ability of the system to supply information to key private and public

sector agencies concerned with occupational health and safety or emergency service issues, for example, fire brigades, small regions or even states can compare for themselves the trends in their own cases with the National/State trends and deduce ideas beneficial to themselves; and
- the ability to be part of an international chemical incidents data service.

Results of the trial showed that an Australian System for Hazardous Material Incident Reporting could identify the type and frequency of incidents, thus allowing identification of areas most amenable to corrective action. A number of findings have already been identified which could be evaluated further. Indeed, new protective equipment has been designed and used in dealing with severely hazardous incidents.

It is probable that the introduction of a separate reporting system for another type of incident (hazardous materials) would not be acceptable to reporting authorities (in the main, the emergency services) as they already participate in a reporting system for fires — AFIRS [5]. Therefore, any new reporting requirements would be better incorporated as a modification and extension of the AFIRS system. Indeed, most fire brigades in Australia would be happy to consider modifying their existing reporting systems for fires if a suitable system compatible with AFIRS was developed.

With the commitment from the users to remedy causes of incidents identified in the findings of an Australian System for Hazardous Material Incident Reporting Scheme the number of incidents causing injury and death to Australians and destruction of property could be minimised.

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Appendix 1

Hazardous Material Incident Report

INSTRUCTIONS: See attachments listing data elements and HAZMAT terms explained. For items marked with an asterisk (*), use code(s) as in attachment. Insert comma between codes when using multiple codes.

1. BRIGADE INDENTIFICATION XXXXXXXXXXXX
2. INCIDENT NUMBER XXX 3. CALENDAR DATE DAY/MONTH/YEAR XX / XX /1989
4. ALARM TIME 0238 hrs 5. TIME OF ARRIVAL 0245 hrs
6. INCIDENT CONCLUDED DATE DAY/MONTH/YEAR XX / XX /1989
7. INCIDENT CONCLUDED TIME 2045 hrs
8. STATISTICAL LOCAL AREA XXX XXXXXXXXXXXX
9. AUSTRALIAN MAP GRID REFERENCE / E /N XXXXX / XXX / XXX
10. REGISTRATION NO (if mobile property) Not Applicable
11*.HAZMAT IDENTIFICATION (MULTIPLE CODES MAY BE USED)

UN NUMBER	CHEMICAL NAME	TRADE NAME	PHYSICAL STATE (USE CODE NO)
1830	Sulphuric acid 95%	None	2 (Liquid, slurry)

12*. HAZMAT INCIDENT DESCRIPTION 5 (Leak); 6 (Gas cloud) (MULTIPLE CODES MAY BE USED)
13*. HAZARDS ENCOUNTERED MAIN 22 (Non-flammable gas) 8 (Corrosive) SUBSIDIARY None (MULTIPLE CODES MAY BE USED)
14*. (A) QUANTITY OF HAZMAT RELEASED OR CONSUMED 6 (Above 10,000 L)

* (B) ESTIMATED PERCENTAGE OF HAZMAT RELEASED OR CONSUMED 1
(Less than 10 L)

15*. FIXED PROPERTY USE 861 OR MOBILE PROPERTY TYPE N/A
(Industrial chemical storage)

16*. ORIGIN OF RELEASE 14 (Tank container)

17*. HAZMAT INCIDENT CAUSE 173 (Corrosion)

18*. TYPE OF ACTION TAKEN 44 (Neutralise with soda ash)
(MULTIPLE CODES MAY BE USED)

19. NUMBER OF INCIDENT-RELATED INJURIES
Brigade 0 Other 0 Undetermined/not reported -

20. NUMBER OF INCIDENT-RELATED FATALITIES
Brigade 0 Other 0 Undetermined/not reported -

21*. METHOD OF DECONTAMINATION 1 (Wash down and allow to flow to drains)
(MULTIPLE CODES MAY BE USED)

22*. RESPIRATORY PROTECTION USED 1 (Compressed air breathing apparatus)

23*. PROTECTIVE CLOTHING USED 2 (Turnout gear with chemical gloves)
3 (Chemical splash suit)

24*. SPECIALIST DISPOSAL EQUIPMENT USED 5 (Transfer tankers)
(MULTIPLE CODES MAY BE USED)

25*. EQUIPMENT SUPPLIER 3 (Private)

26*. PROBLEMS ENCOUNTERED DURING INCIDENT 8 (Weather)
(MULTIPLE CODES MAY BE USED)

27*. OTHER AGENCIES INVOLVED 1 (Police)
(MULTIPLE CODES MAY BE USED) 2 (Ambulance)
4 (State Pollution Authority)
10 (Dangerous Goods Authority)
17 (Local Council)
18 (Company representative)

28*. TYPE OF WEATHER ENCOUNTERED Variable through clean-up operations
(MULTIPLE CODES MAY BE USED) 11 (Clear)
12 (Fine)
13 (Sunny)
21 (Overcast)
24 (Rain)
42 (Light winds - 10 knots or less)

29*. TEMPERATURES ENCOUNTERED AT INCIDENT SCENE Variable
2 (10-15°C); 3 (15-20°C); 4 (20-25°C)

30*. AVAILABILITY, USEFULNESS AND ACCESSIBILITY OF EMERGENCY WARNING AND FIRST STRIKE INFORMATION

COMMENTS: Adequate

31. BRIEF DESCRIPTION OF INCIDENT

Leak in two 1400 tonne storage tanks containing sulphuric acid (concentrated). Approximately 20 tonnes leaked - confined to area of about 50 square metres. Covered with soda ash and sand. Contaminated material removed by tanker to XXXXXXXX. Remainder transferred by tankers to other storage facilities.