Chemical Spill Response Information System of the Association of American Railroads

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ABSTRACT

Many information sources present worthwhile data concerning hazards of and responses for accidental chemical spills. Most sources, however, consider only the acute effects of a spilled substance and provide little information concerning the long-term cleanup, which is typically considered unrelated to the emergency response. This concept is erroneous and costly. To combat this problem, the Association of American Railroads has undertaken a program to bridge the gap between the first response and the longer-term environmental cleanup. Two information systems have been developed and targeted at two basic levels of spill response. The Emergency Action Guides are intended for the first responder. These are printed commodity-specific pamphlets designed to assist those who are first on the scene until chemical or technical assistance can be obtained. To support chemical or technical decisions, a computerized system, the Industrial Chemical Accident Response Information System (ICARIS), was developed and integrated with a series of environmental and mathematical models to allow real-time assessment of chemical release problems. The design considerations inherent in both systems promote the evaluation of the long-term consequences associated with emergency spill response activities. The current capabilities of the computer information system as well as the design and development of the Emergency Action Guides are described.

The first-response actions used to control a chemical spill may have a profound impact on the long-term cleanup of the spill. Information generally available to first responders is limited in scope and usually presents little information with which to evaluate long-term cleanup problems. An even greater limitation of many information sources is their being tied to one or two spill situations with no provisions accounting for the uniqueness of an individual spill.

When an accident occurs, the first group on the scene with responsibility for handling the release is usually the local police or fire service. The level of training and equipment they obtain is usually related to the size of the community and the local emphasis placed on the relative danger of a chemical release. At the community level, training and equipment priorities may not include hazardous material spills.

This is a sensible approach. It is easy to spend several thousand dollars in training costs alone to establish a special-response team. In many communities the likelihood of using that team may be so remote that several groups would be trained and equipment shelf lives exceeded before an accident occurred. When the number of other emergencies is considered in comparison with a chemical release, the potential chemical accident often becomes insignificant.

In a number of publications the guidelines for first response to a chemical accident are discussed. Hazardous Materials; Emergency Response Guidebook of the U.S. Department of Transportation (1), Emergency Handling of Hazardous Materials in Surface Transportation (2) of the Association of American Railroads (AAR), manuals issued by the U.S. Coast Guard from their Chemical Hazards Response Information System (CHRIS) data base, and others are widely distributed. These sources, however, provide information for first response only and do not consider any problems beyond the acute threat of the substance.

DESCRIPTIVE DATA

In 1979 AAR began an intensive collection of information describing those commodities commonly carried nationally by rail. During the data-collection phase, two primary user groups were identified. Group 1 includes the railroad response personnel, chemists, biologists, and others with an environmental or chemical background. Group 2 was identified as the first responders, generally firefighters and police. Because of the variability in training received by first responders nationally, this group was assumed to have knowledge relating only to the identification of commodities via placards or shipping documents but little training in the characteristics of spilled chemicals.

To accommodate these two groups, two separate methods of data presentation were pursued, a computer communication system and a printed information source. The data collected by AAR for presentation to both user groups consists of 180 descriptive entries per commodity, grouped into four major categories:

1. General information, which includes 48 elements to identify the chemical, including synonyms, trade names, the different codes [that of the Intergovernmental Maritime Consultive Organization (IMCO), the Standard Transportation Commodity Code (STCC), and the United Nations code (UN)], useful shipping information, and some physical constants;
2. Chemical information, which includes 35 elements that describe the properties of each chemical;
3. Health and hazard information, which consists of 40 data elements describing the hazards of an uncontrolled release of the chemical, including response guidelines, health hazards, and protective clothing needed; and
4. Environmental effects information, which includes 52 data elements, including toxicity, pollution effect, and interreaction data.

Each data point listed in Table 1 was collected from current and reliable sources. Each entry is referenced back to the original data to allow the

TABLE 1 Data Fields

1 Commodity Name
2 Other Shipping Names
3 Synonyms and Tradenames
4 Chemical Formula
5 Molecular Weight
6 Constituent Components (% Each)
7 49 STCC
8 CAS Registry Number
9 OHM-TADS Accession Number
10 Standard Industrial Code
11 IMCO Designation
12 UN Designation
13 CHRIS Identifier
14 Manufacturers
15 Common Uses
16 Percentage Shipped by Rail
17 Usual Containers
18 DOT Placard and Form Number
19 Physical State as Shipped
20 Physical State as Released
21 Shipping Temperature
22 Color
23 Odor Characteristics
24 Threshold Odor Concentration
25 Absolute Odor Threshold
26 Median Recognition Threshold
27 Upper Recognition Threshold
28 Population Perception Threshold
29 Population Identification Threshold
30 Individual Perception Threshold
31 Threshold Odor Number
32 Odor Index
33 Taste Characteristics
34 Lower Taste Threshold
35 Median Taste Threshold
36 Upper Taste Threshold
37 Flash Point
38 Lower Flammable Limit
39 Upper Flammable Limit
40 Lower Explosive Limit
41 Upper Explosive Limit
42 Explosiveness
43 Autoignition Temperature
44 Burning Rate
45 Toxic Combustion Products
46 Behavior in Fire
47 Electrical Ignition Hazard
48 Stability
49 Specific Gravity (Liquid)
50 Specific Gravity (Vapor)
51 Density
52 Density at Shipping Temperature
53 Vapor Pressure
54 Vapor Pressure at Shipping Temperature
55 Solubility in Water
56 Solubility in Other Chemicals
57 Solution Color
58 Melting Point
59 Freezing Point
60 Melting/Freezing Behavior
61 Boiling Point
62 Boiling Behavior
63 Heat Capacity (Constant Pressure)
64 Heat Capacity (Constant Volume)
65 Heat of Combustion
66 Heat of Decomposition
67 Heat of Solution
68 Latent Heat of Vaporization
69 Latent Heat of Fusion
70 Latent Heat of Sublimation
71 Thermal Conductivity
72 Thermal Conductivity at Shipping Temperature
73 Surface Tension
74 Interfacial Tension With Water
75 Viscosity
76 Viscosity at Temperature
77 Saturation Concentration
78 Saturation Concentration at Shipping Temperature
79 Diffusivity
80 Diffusivity at Shipping Temperature
81 Polymerization Potential
82 Heat of Polymerization
83 Reactivity With Water
84 Reactivity With Other Chemicals
85 Toxic Reaction Products
86 Vapor Weight-Volume Conversion Factor
87 Emergency Resources
88 Emergency Telephone Numbers
89 Notification Requirements
90 Public Health Hazards
91 Evacuation Guidelines
92 Incompatible Materials
93 Conditions to Avoid
94 Unusual Hazards
95 Corrosiveness
96 NAS Hazard Classification
97 NFPA Hazard Classification
98 Field Detection, Identification, and Quantification Techniques
99 Field Detection Limits
100 Laboratory Detection, Identification, and Quantification Techniques
101 Laboratory Detection Limits
102 Containment Techniques for Airborne Materials
103 Containment Techniques for Ground Contamination
104 Containment Techniques for Surface Water Contamination
105 Containment Techniques for Ground Water Contamination
106 Neutralization Materials
107 Neutralization Techniques
108 Extinguishing Materials
109 Extinguishing Techniques
110 Symptoms of Inhalation
111 First Aid for Inhalation
112 Symptoms of Percutaneous Absorption
113 First Aid for Percutaneous Absorption
114 Symptoms of Ingestion
115 First Aid for Ingestion
116 Aspiration Potential
117 Nonspecific Symptoms
118 Nonspecific First Aid
119 Time to Onset of Symptoms
120 Routes of Entry
121 First Aid Equipment Required
122 Respiratory Protection Required
123 Protective Clothing Required
124 Location of Primary Hazard
125 Safe Handling Procedures
126 Precautionary Actions
127 Short-Term Exposure Limits (Maximum Time/Maximum Concentration)
128 Freshwater Species
129 Saltwater Species
130 Animal Species
131 Avian Species
132 Plant Species
133 Human Toxicity
134 Bioaccumulation Potential
135 Food Chain Concentration Potential
136 Threshold Limit Value
137 Other Standards
138 Recommended Drinking Water Limit
139 Inhalation Toxicity Index
140 Maximum Pool Radius/Spill Size
141 Diameter at Base of Solid Pile/Spill Size
142 Fugitive Dust or Particulate Emissions
143 Maximum Downwind Extent of Vapor Cloud/Bounding Effect/Spill
144 Maximum Crosswind Extent of Vapor Cloud/Bounding Effect/Spill
145 Total Hydrocarbon Emissions
146 General Air Pollution Information
147 Downstream Concentration Factor
148 Sinking Velocity
149 PH of Aqueous Solution
150 Biological Oxygen Demand
151 BOD impact on Biodegradation
152 Biodegradation Rate
153 Chemical Oxygen Demand
154 Theoretical Oxygen Demand
155 Total Organic Carbon
156 Industrial Water Fouling Potential
157 Effects on Water Treatment Process
158 General Water Pollution Information
159 General Soil Chemistry
160 Soil Penetration Depth/Soil Type/Soil Dosage
161 Minimum Soil Sterilization Concentration
162 Estimated Half-Life in Soil/Soil Type/Soil Dosage
163 Estimated Diffusion in Soil/Soil Type/Soil Dosage
164 Absorption Materials/Absorption Techniques/Absorption
165 Adsorption Materials/Adsorption Techniques/Adsorption
166 Activated Carbon Dosage/% Reduction by Activated Carbon Adsorption
167 Gelation Materials/Gelation Techniques/Gelation Effectiveness
168 General Cleanup Information
169 Availability of Countermeasure Materials
170 In-Situ Amelioration Techniques/In-Situ Amelioration Effectiveness
171 Onsite Disposal Limitations
172 Chronic Hazards
173 Synergistic Materials (Toxicity)
174 Antagonistic Materials (Toxicity)
175 Environmental Fate
176 Toxic Daughter Products
177 Sampling Locations
178 Disposal Techniques/Disposal Effectiveness
179 Required Agency Coordination
180 General Disposal Information

user to identify which of the more than 40 sources was used for that item of information.

The commodities characterized (listed in Table 2) were restricted to those moved in bulk quantity. Selection was based on the number of car loadings in decreasing order. The list now includes 134 commodities that represent more than 98 percent of the chemical traffic on the railroads.

COMPUTER COMMUNICATION

The computer medium was selected to provide the swiftest method of communicating large volumes of data as well as state-of-the-art predictive information to trained responders on the scene. This system, known as the Industrial Chemical Accident Response Information System (ICARIS), is designed to mesh up-to-date chemical data with state-of-the-art predictive modeling to provide the user with a dynamic method for assessing the adequacy of their response activities. ICARIS is housed on AAR's IBM 370 system and can be accessed by remote terminal over the telephone network.

The principal advantage of this system is that it allows a site-specific analysis of a spill situa-

TABLE 2 Commodities Listing

1. Acetaldehyde
2. Acetic Acid, Glacial
3. Acetic Anhydride
4. Acetone
5. Acetone Cyanohydrin
6. Acrolein
7. Acrylic Acid
8. Acrylonitrile
9. Adipic Acid
10. Allyl Chloride
11. Ammonium Hydroxide
12. Ammonium Nitrate Fertilizer
13. Anhydrous Ammonia
14. Aniline Oil, Liquid
15. Arsenic Trioxide
16. Asphalt
17. Benzene
18. Bromine
19. Butadiene, Inhibited
20. Butene
21. Butyl Acetate
22. Butyl Acrylate
23. Butyl Alcohol
24. Butyraldehyde
25. Calcium Carbide
26. Carbolic Acid or Phenol
27. Carbon Bisulfide
28. Carbon Dioxide, Liquefied
29. Carbon Tetrachloride
30. Chlorine
31. Chlorobenzene
32. Chloroform
33. Chloroprene
34. Chlorosulfonic Acid
35. Chromic Acid
36. Creosote
37. Cresol
38. Cyclohexane
39. Di-N-Propylamine
40. Dichlorodifluoromethane
41. Diisobutylene
42. Dimethylamine, Anhydrous
43. Epichlorohydrin
44. Ethyl Acetate
45. Ethyl Acrylate, Inhibited
46. Ethyl Alcohol
47. Ethyl Chloride
48. Ethylene
49. Ethylene Glycol Monoethyl-ether
50. Ethylene Glycol Monoethyl-ether Acetate
51. Ethylene Oxide
52. Ferric Chloride Solution
53. Formaldehyde
54. Fuel Oil No. 1
55. Fuel Oil No. 2
56. Fuel Oil No. 4
57. Fuel Oil No. 5
58. Furfuryl Alcohol
59. Gasoline
60. Hexamethylene Diamine
61. Hexane
62. Hydrochloric Acid
63. Hydrocyanic Acid, Liquefied
64. Hydrofluoric Acid, Anhydrous
65. Hydrofluosilicic Acid
66. Hydrogen Chloride
67. Hydrogen Peroxide, Solution
68. Isobutyl Acetate
69. Isobutyraldehyde
70. Isopentane
71. Isoprene
72. Isopropanol
73. Liquefied Petroleum Gas
74. Maleic Anhydride
75. Meta Nitrochlorobenzene
76. Methanol
77. Methyl Bromide
78. Methyl Chloride
79. Methyl Ethyl Ketone
80. Methyl Isobutyl Ketone
81. Methyl Mercaptan
82. Methyl Methacrylate
83. Monochlorodifluoromethane
84. Monoethanolamine
85. Monomethylamine, Anhydrous
86. Motor Fuel Antiknock Compounds
87. Nitrating Acid
88. Nitric Acid, Fuming
89. Nitrobenzene
90. Octanol
91. Oleum
92. Ortho Nitroaniline
93. Ortho Nitrochlorobenzene
94. Para Nitrochlorobenzene
95. Pentane
96. Petroleum Naphtha
97. Phosphatic Fertilizer
98. Phosphoric Acid
99. Phosphorus Pentasulfide
100. Phosphorus
101. Phosphorus Trichloride
102. Potassium Hydroxide Solution
103. Potassium Nitrate
104. Propionaldehyde
105. Propionic Acid
106. Propyl Acetate
107. Propylene Oxide
108. Rosin Solution
109. Silicon Chloride
110. Sodium Chlorate
111. Sodium Cyanide, Solid
112. Sodium Hydrosulfide
113. Sodium Hydrosulfite
114. Sodium Hydroxide
115. Sodium Metal
116. Sodium Nitrate
117. Spent Caustic Soda Solution
118. Spent Sulfuric Acid
119. Styrene Monomer, Inhibited
120. Sulfur Chloride
121. Sulfur Dioxide
122. Sulfuric Acid
123. Tetrahydrofuran
124. Thorium Ore
125. Titanium Tetrachloride
126. Toluene
127. Toluene Diisocyanate
128. Trichloroethylene
129. Trimethylamine
130. Uranium Hexafluoride
131. Vinyl Acetate
132. Vinyl Chloride
133. Vinylidene Chloride, Inhibited
134. Xylene

tion. The complex environmental interactions are discussed not in terms of broad generalities, but rather in terms of the specific peculiarities of the location of the spill. This method allows a more complete and specific evaluation of the individual situation.

The major limitation of the system is tied directly to the current understanding of chemical and environmental interactions. The number of environmental variables that affect chemical behavior is quite large, and this interaction is very complex. Hence, the use of spill models, at least now, must be considered in light of the assumptions intrinsic to each model. This requires expertise and training not generally available to the first-response community.

ICARIS now performs three basic functions. These include data retrieval, air dispersion modeling, and chemical property estimation.

The design of the computer program is straightforward and requires a minimum of computer training for operation. Generally, the system is menu driven, presenting the user with a question and a fixed set of choices. The main menu (Figure 1) allows the user to select from among the five major packages currently on line. Selection 1 is a search that allows the user to print data organized into prearranged categories of information for each commodity requested. Option 2 allows the user to print individual items of information as needed. Option 3 allows the user to select any number of chemicals and receive a chemical-by-chemical printout of all the reaction information contained in the data base. Option 4 involves the evaporation air dispersion model and allows the calculation and subsequent plotting of the vapor dispersion for a given region. The model currently in use is the Shell Development Corporation's Spills Model, written by M.T. Fleischer. Option 5 allows the user to select from among 19 techniques for calculating various chemical properties.

The estimation techniques in option 5 were included because many of the properties contained,

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**************************************************
*                                                *
*                    ICARIS                      *
*                                                *
* INDUSTRIAL CHEMICAL ACCIDENT RESPONSE INFORMATION *
*                                                *
*                    SYSTEM                      *
*                                                *
*                                                *
*       THE ASSOCIATION OF AMERICAN RAILROADS    *
*                                                *
*                    1983                        *
*                                                *
**************************************************

  ARE YOU OPERATING A HARDCOPY TERMINAL?
  ENTER (YES/NO):  NO

  DO YOU NEED HELP?
ENTER (YES/NO):  NO

WHAT TYPE OF SEARCH DO YOU WANT?

     1 = CATEGORICAL

     2 = ITEM BY ITEM OR RANGE

     3 = CHEMICAL SYNERGIES

     4 = AIR DISPERSION MODEL

     5 = CHEMICAL PROPERTIES ESTIMATION TECHNIQUES

     6 = QUIT
?
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FIGURE 1 ICARIS main menu.

such as rate of hydrolysis, carbon absorption ratios, thermal diffusivity, and volatility from soil, are either site dependent or not reported in the literature. These data are often necessary for the prediction of a chemical's behavior in air, water, or soil.

The last option allows the user to terminate processing within ICARIS.

Future enhancements to ICARIS will be of three basic types:

1. Increase in commodity coverage,
2. Increase in data describing each commodity, and
3. Increase in the number and reliability of environmental models.

Items 2 and 3 are dependent on basic research into the behavior of chemicals in the environment. The use of ICARIS as a planning and training tool is also being explored.

EMERGENCY ACTION GUIDES

The most dangerous and critical aspect in handling a chemical release is the initial response. A system such as ICARIS would be ideal in a first-response situation; however, the expense at the community level to purchase terminals and train personnel hardly justifies its use.

The ultimate cost of a spill is highly dependent on the adequacy of the first response. Because railroads generally rely on local agencies for that response, the AAR has developed the Emergency Action Guides (EAGs). The design of the EAGs was the result of an intensive review of past accidents as well as currently available information resources.

Definitions

Two major definitions evolved from the accident review. The first is the definition of "first response," which in the context of the EAG is the time in an accident's chronology beginning when a unit or agency with equipment and manpower is summoned to the scene of an accident for the purpose of mitigating the effects of the accident until the time when that unit or agency obtains specialized assistance in handling the accident. Inherent in this definition is the assumption that outside expertise will be required to successfully handle the accident.

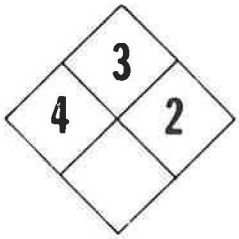
The second definition is that of "first responder." Again in the context of the EAG, a first responder is a unit or agency with equipment and manpower arriving first on the scene of a chemical spill for the purpose of mitigating the hazards associated with the spill, whose training in chemical spill response may be limited solely to commodity identification techniques. This definition assumes that first responders are acquainted with the concept that chemicals may pose a threat to life and health.

These definitions served to limit the intended scope of the EAGs.

Accident Chronology

The next part of the developmental process was to analyze the chronology of a chemical spill by looking at reports of past accidents as well as the experiences of personnel within the AAR's Bureau of Explosives. Within this chronology, information requirements were outlined. Further review of past incidents indicated what information was available at

ACRYLONITRILE
Flammable Liquid
RQ 100/45



General Information

Acrylonitrile is a clear colorless liquid with a strong pungent odor. It is used in insecticides and to make plastics, fibers, and other chemicals. It has a flash point of 32°F. It may polymerize if contaminated with strong bases or if the container is subject to heat as in fire conditions. Prolonged exposure to the vapors or skin contact may result in death. It is lighter than water and is soluble in water. Its vapors are heavier than air. Toxic oxides of nitrogen are produced during combustion of this material. It weighs 6.7 pounds per gallon.

CHEMICAL/PHYSICAL DATA

Solubility in Water: Soluble in water, 7.35 parts in 100 parts water
Solubility in Other Chemicals: Miscible in alcohol and ether, soluble in acetone and benzene
Specific Gravity (Liquid): 0.8074 at 68°F (20°C)
Boiling Point range: 171 to 172°F (77.5 to 77.9°C) at 1 atm
Melting Point: -118.3°F (-83.5°C)
Freezing Point: -118.3°F (-83.5°C)
Molecular Weight: 53.06
Heat of Combustion: -7930 cal/g
Vapor Pressure: 67 mmHg at 59°F (15°C)
Flash Point: Liquid 32°F (0°C) Open & Closed Cup
Autoignition Temperature: 898°F (481°C)
Burning Rate: Unknown
Stability: Stable, when inhibited; may violently polymerize when uninhibited or chemical inhibitor has been exhausted through exposure to heat
Corrosiveness: Corrosive to metals containing alloys of copper, brass or aluminum
Reactivity with Water: Soluble in water with no reaction
Reactivity with Other Chemicals: Reacts violently with strong acids like sulfuric acid, potassium hydroxide, and sodium hydroxide. Attacks copper and copper alloys. In high concentrations acrylonitrile will attack aluminum.

IDENTIFICATION

Shipping Names: Acrylonitrile
Synonyms and Tradenames: Propenenitrile, vinyl cyanide, Acritet, Acrylon, acrylonitrile monomer, Carbacryl, cyanoethylene, Fumigrain, Millers Fumigrain, Ventox, cyano-ethylene
Chemical Formula: CH_2CHCN
Constituent Components (% each): 98-100% pure
49 STCC: 49 064 20
UN Designation: UN 1093
IMO Designation: 3.1
Physical State As Shipped: Liquid
Physical State As Released: Liquid
Color of the Shipped Material: Colorless liquid
Odor Characteristics: Mild, pungent, onion, garlic, or horseradish.
Common Uses: Raw material for synthetic fibers, synthetic resins, synthetic rubbers, antioxidants, pharmaceuticals, dyes, surfactants, and chemical synthesis.

FIGURE 2 Cover page of EAG.

ACRYLONITRILE
Flammable Liquid

POTENTIAL HAZARDS

GENERAL HAZARDS

Threshold Odor Concentration: 0 0031-50 4 ppm

Unusual Hazards: EXTREMELY DANGEROUS, may emit hydrogen cyanide gas when heated or burned Highly flammable and may explosively polymerize when heated NIOSH considers acrylonitrile to be an occupational carcinogen

Short Term Exposure Limits: 4 ppm for 30 min (NIOSH)

Time Weighted Average (TWA): 2 ppm for each 8 hours of a 40 hour workweek (OSHA)

Conditions to Avoid: Exposure to visible light or contact with acids, amines, strong alkalies, copper, copper alloys, ammonia or oxidizing agents may cause polymerization. Avoid exposure to heat or flame. Direct exposure to large concentrations may result in cyanide poisoning. Cyanide effects may be delayed for up to 72 hours.

HEALTH HAZARDS

Public Health Hazards: Vapors and liquids are poisonous. If on fire or involved in fire, acrylonitrile may explosively polymerize. Acrylonitrile may threaten public or industrial water supplies if spilled into water sources.

Hazards to Skin or Eye Contact: Liquid may be absorbed through skin. Contact with liquid may cause chemical burns. Prolonged contact may cause weakness, headaches, abdominal pain, and vomiting. Severe exposures may result in cyanide poisoning. Contact with eyes may cause severe irritation or burns.

Hazards of Inhalation: Breathing vapors may irritate nose and throat. Prolonged breathing of low concentrations may cause weakness, headache, sneezing, abdominal pain and vomiting. Breathing concentrated vapors may cause collapse and convulsions and may possibly result in cyanide poisoning. Symptoms may be delayed several hours after exposure.

Hazards of Ingestion: Swallowing acrylonitrile may cause lightheadedness, nausea, vomiting and abdominal pain. Victim may collapse and go into convulsions. Symptoms may be delayed for several hours after exposure.

FIRE HAZARDS

Lower Flammable Limit: 3 05%

Upper Flammable Limit: 17 0%

Behavior in Fire: Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back. If acrylonitrile is on fire or involved in fire, it may polymerize and explode.

Hazardous Combustion Products: Unknown, fumes may contain hydrogen cyanide gas and oxides of nitrogen.

EXPLOSION HAZARDS

Lower Explosive Limit: 3.05%

Upper Explosive Limit: 17.0%

Explosiveness: Very reactive. Explosive polymerization may occur in presence of concentrated alkaline materials, fire or strong acids. Acrylonitrile that has lost its inhibitor may violently polymerize spontaneously, especially on exposure to light or heat.

PROTECTIVE CLOTHING AND EQUIPMENT

Protective Clothing Required: Equipment should provide protection from direct contact with acrylonitrile. This may include rubber boots, gloves, face and eye protection, and resistant clothing. Compatible materials include neoprene, buna-N, polyvinyl alcohol, polyethylene, Ryton, or latex rubber.

Respiratory Protection: In concentrated or unknown concentrations of acrylonitrile use only self-contained breathing apparatus or supplied air respirator with full facepiece.

FIRST AID

Nonspecific Symptoms: The ACUTE EFFECTS OF EXPOSURE TO ACRYLONITRILE MAY BE DELAYED FOR SEVERAL HOURS AFTER EXPOSURE. Symptoms may include headache, dizziness, eye irritation or painful sensitivity to light, flushed face, increased salivation, shallow breathing. Skin contact may cause reddening and eventual dermatitis. Severe exposures may result in cyanide poisoning. Any person suspected of being exposed should be kept under medical surveillance.

First Aid for Inhalation: Remove victim to fresh air. Get medical attention immediately. For CYANIDE POISONING ONLY, break amyl nitrite pearle under victim's nose. Administer amyl nitrite for 15 seconds each minute. If breathing becomes difficult or breathing has stopped, administer artificial respiration. Get medical attention immediately. (Caution: administration of mouth-to-mouth resuscitation may expose the first aid personnel to the chemical contained within the victims lungs or vomitus.)

First Aid for Skin and Eye Contact: Flush eyes immediately with water for at least 15 minutes. Remove all contaminated clothing. Wash contaminated areas with soap and water. Get medical attention immediately.

First Aid for Ingestion: If conscious, induce vomiting by administering strong solution of salt water. If unconscious, DO NOT induce vomiting get medical attention immediately. For CYANIDE POISONING ONLY, break amyl nitrite pearle under victims nose. Administer amyl nitrite for 15 seconds each minute. If breathing becomes difficult or breathing has stopped, administer artificial respiration. Get medical attention immediately.

FIRE RESPONSE

Extinguishing Materials: Fight fire with carbon dioxide, dry chemical, or alcohol foam.

Extinguishing Techniques: EXPLOSION HAZARD, fight fire from a safe distance only. Use alcohol foam, dry chemical or carbon dioxide. Water may be ineffective as an extinguisher, but useful to cool containers exposed to fire, apply as spray or fog.

FIGURE 3 Inside page 1 of EAG.

ACRYLONITRILE
Flammable Liquid

SPILL RESPONSES

General Information. Keep unprotected personnel upwind of spill or leaks. Eliminate ignition sources. Contain spill for salvage or disposal. Avoid runoff into storm sewers and ditches which lead to natural waterways. Advise proper authorities and downstream sewer and water treatment operations.

AIR SPILL

TECHNIQUE

ALCOHOL FOAM — Blanket over pools of acrylonitrile with alcohol foam. Foam will reduce evaporation slowing the release of acrylonitrile vapors into atmosphere.

CONSEQUENCE

The effects of alcohol foam are short term. As foam breaks down, release of acrylonitrile vapors will increase. Foam breakdown will add to the volume of the spilled chemical.

MITIGATION

Remove spilled chemical. Do not use pumps, tubes or other devices which have copper, brass or aluminum components that could come in direct contact with acrylonitrile as it will react with these materials. Continue foam applications until spilled product is removed.

TECHNIQUE

WATER FOG KNOCKDOWN — Water fog water will condense acrylonitrile vapors on water droplets and remove vapors from atmosphere.

CONSEQUENCE

Water runoff will contain varying concentrations of acrylonitrile.

MITIGATION

Collect and remove all water runoff. Do not use pumps, tubes or other devices which have copper, brass or aluminum components that could come in direct contact with acrylonitrile as it will react with these materials. Protect response personnel by avoiding contact with vapors or liquid unless wearing appropriate protective clothing.

LAND SPILL

TECHNIQUE

CONTAINMENT DIKES — Acrylonitrile can be contained by building dikes using earth or other materials.

CONSEQUENCE

Contained acrylonitrile may percolate into soil or seep through dike material. This may result in loss of contained product.

MITIGATION

Remove contained material with explosion proof equipment as soon as possible to prevent spread of contamination. Be alert to conditions which may add to spill volume such as fire hose runoff or rainwater which may overfill impoundments. Consult qualified experts for safe removal techniques. Do not use pumps, tubes or other devices which have copper, brass or aluminum components that could come in direct contact with acrylonitrile as it will react with these materials.

TECHNIQUE

ABSORPTION — Absorb spilled liquid using materials such as fly ash, peat moss, vermiculite, polypropylene pillows and quilts, saw dust, commercial sorbents, or activated carbon.

CONSEQUENCE

Sorbents will immobliize spill and help control the spread of spilled acrylonitrile. They will also help reduce the vapor hazard. Sorbents however, must be handled with care as they will be contaminated and represent a health and fire hazard.

MITIGATION

Remove contaminated sorbents to safe storage by mechanical means. Do not use pumps, tubes or other devices which have copper, brass or aluminum components that could come in direct contact with acrylonitrile as it will react with these materials.

WATER SPILL

TECHNIQUE

CONTAINMENT DIKES — Contaminated water can be contained by diking upper and lower bounds of affected water to limit volume of water affected. Dikes can be made from soil, clay, or other natural or commercial materials. Where possible, line collection basins with compatible impervious material to contain product.

CONSEQUENCE

Acrylonitrile mixes with water to give solution that may be toxic to plant and animal life. Earthen dikes may become saturated with water and seep through or collapse.

MITIGATION

Remove contaminated water with explosion proof equipment. Do not use pumps, tubes or other devices which have copper, brass or aluminum components that could come in direct contact with acrylonitrile as it will react with these materials.

TECHNIQUE

STOP USAGE — Notify downstream industrial and municipal users to stop intake. Stop intake of heavily contaminated water for drinking and industrial use.

CONSEQUENCE

Alternative water supplies may be needed to accommodate industrial and home use.

MITIGATION

Provide alternative water sources until water supply can be used again.

FIGURE 4 Inside page 2 of EAG.

various times in the accident versus the information needed to effect a more favorable response within the first-response time frame.

Once information needs had been established, data were organized according to the following scheme:

1. Identification,
2. Health effects,
3. Protective equipment,
4. First aid,
5. Acute hazard response, and
6. Environmental response.

Resource Evaluation

Data requirements having been identified and organized, existing information sources were evaluated for content and clarity of presentation.

The following major deficiencies were observed in this review:

1. Identification was generally limited to one or sometimes two systems,
2. Health information was vague and inadequately characterized,
3. Protective equipment sections were often generic in nature,
4. Spill response sections were generally limited to one or two responses applied to all situations with no discussion of the possible consequences of a response, and
5. Overall descriptions of a substance generally provided little insight into how it might be expected to behave beyond what would be immediately observed.

The foregoing analysis was taken into consideration when compiling the EAG. The priorities in organization were identification and health effects, and the presentation of data was designed to overcome the deficiencies observed in other response guides.

Each EAG consists of three pages. The cover page (Figure 2) provides a general discussion of the chemical's properties and its anticipated behavior. Although the potential hazards intrinsic to a substance may be great, the substance's actual behavior is highly dependent on the spill situation. This introduction is provided to give the responder a perspective from which to evaluate the remaining information. In addition, chemical and physical properties and identification information are provided.

Health and hazard information is detailed on the next page (Figure 3). This includes health effects, fire and explosion data, protective clothing, and first aid material.

Inside page 2 of the EAG (Figure 4) provides the response information for air, land, and water spills. The most significant improvement over other guides is the adoption of the format in which the response consequences and mitigation are detailed. This section of the guide is designed to convey the idea that adverse consequences may result from the application of a particular response technique. If the responder is aware of this problem, plans can be made to eliminate or control for this possibility.

The categories air, land, and water each contain several response options. A single response is not always applicable to every situation. With a list of multiple responses, the user is encouraged to evaluate the uniqueness of a particular spill and apply the most effective response, not the one most frequently cited.

The layout of the EAG is predicated on the assumption that a user would scan the document from front to back, top to bottom, and left to right. This organization follows the priority scheme commodity identification, hazard identification, protection, and action.

SUMMARY

Safety in transportation is a primary concern of the U.S. rail industry. The research conducted in tank car design, head shields, shelf couplers, and thermal protection has contributed enormously to the reduction in the type of accidents observed 15 years ago. Although it is recognized that some accident factors are uncontrollable, handling an accident properly is of paramount importance. The EAGs, as well as other programs such as the development of a chemical and medical reference and the identification of chemical combustion products, are targeted at increasing the understanding of spill behavior. Through this understanding, better and faster cleanup technologies and management will undoubtedly result.

Quality of information is the first step. By identifying the two basic user levels, the information needs of each can be more completely satisfied. Through ICARIS, state-of-the-art assessment of a spill can occur. Improvements to ICARIS will come as the science of chemicals in the environment becomes more advanced.

The development of the EAGs was based on the observed need for a more complete understanding of chemical spill management on the part of the first responder. The considerations used in the EAG development were selected to enhance that understanding.

REFERENCES

1. Hazardous Materials; Emergency Response Guidebook. Materials Transportation Bureau, U.S. Department of Transportation, 1980.
2. Emergency Handling of Hazardous Materials in Surface Transportation. Bureau of Explosives, Association of American Railroads, Washington, D.C., 1981.