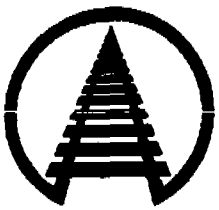


ASSOCIATION OF AMERICAN RAILROADS

SAFETY AND CASUALTY PREVENTION

BUREAU OF EXPLOSIVES

ANNUAL REPORT OF HAZARDOUS MATERIALS TRANSPORTED BY RAIL

YEAR 1993

JULY 31, 1994

Report BOE 93-1

CMA 110085

SPECIAL NOTICE

Due to a computer processing error, the information on the number of hazardous materials carloads for the years 1989 through 1991 were overestimated in previous Annual Reports on Hazardous Materials By Rail. AAR detected and corrected this error and has changed the data in this report to reflect the corrected figures. Because of this error, comparisons of data from 1989 through 1991 Annual Reports on Hazardous Materials By Rail and 1993 data from this report is difficult. Should you have any questions please see page 20 for a point of contact.

The Association of American Railroads, Bureau of Explosives has maintained records on railroad accidents and incidents involving explosives and other dangerous goods since its inception in 1907. It has maintained a computerized data base of railroad hazardous materials incidents since 1975. It is from this database that most of these statistics are derived.

For the purpose of the Bureau's database an ***accident*** is a situation in which a railcar of hazardous material derails, catches fire, explodes, suffers a serious sideswipe or involves a death. It does not have to release its contents, meet any dollar damage figure, or any other requirement. An ***incident*** is classified as the unintentional release of a hazardous material while in transportation (including loading and unloading). This release does not usually involve an accident. An incident may also be referred to as a Non-Accident Release (NAR). The numbers of incidents found in this report may vary from those reported by DOT's Reseach and Special Programs Administration (RSPA) and Federal Railroad Administration (FRA) because of the definitions of accident and incident as well as the fact that the Bureau's data base does not record fuel leaks from locomotives.

While hazardous materials are transported by rail in various types of rail cars such as tank cars, covered hoppers, gondolas, box cars, and trailers and/or containers on flat cars (TOFC/COFC), the majority (70%) of hazardous materials move in tank cars. This percentage has varied over the past several years but has generally declined from 82% in 1982 to the present level. This decline has been primarily due to the increasing use of TOFC/COFC and intermodal portable tanks.

Of the 1,205 Non-Accident Releases in 1993, 1,077 or 89% were from tank cars. Of the remainder, 120 came from TOFC/COFC service and 8 from all the other car types. Because most hazardous materials continue to be transported in tank cars and the vast majority of leaks are from these containers, this report deals primarily with tank cars.

This report is based on information on railroad hazardous materials releases maintained by the AAR's Bureau of Explosives, and information available from the U.S. Department of Transportation. Railroads are required to report train accidents/incidents to the Federal Railroad Administration (FRA), including those that result in the release of a hazardous material, if they meet or exceed certain reporting requirements. Railroads (as well as all transporters of hazardous materials) are required to report to the Department of Transportation (DOT) any incident involving the unintentional release of a hazardous material or hazardous waste during transportation (including loading, unloading, and temporary storage), even if it is not involved in an FRA reportable train accident (See Appendix for explanation of reporting requirements). The vast majority of U.S. and Canadian railroads voluntarily provide the AAR with copies of the Hazardous Materials Incident Reports filed with DOT. These DOT5800.1 reports, along with on-scene reports from Bureau of Explosives Inspectors and several other sources, are combined, compared, and distilled to produce the information which goes into the Bureau Accident/Incident Database. Because of the multiple sources of data and the finer detail, we feel this

information is more precise than that kept by other sources.

All information contained in this report dealing with non-accident releases of hazardous materials are derived from the AAR's Accident/Incident Database. All information pertaining to derailments and train accidents is derived from FRA statistics.

Railroad industry statistics for the transportation of hazardous materials show that over the past seven years the frequency of non-accident hazardous materials releases as a percentage of hazardous materials carloads has declined by a very small amount (See Graph #1). This decline is due to increased safety efforts of the railroad industry, increased awareness and concern of chemical shippers, changes in rail car fittings and design, deregulation, and increased spending on railroad physical plant.

Non Accident Releases (NAR's) of hazardous materials consist of leaks, splashes, as well as venting from safety relief devices. The majority of the reported non-accident releases involve relatively small quantities of hazardous materials, usually less than 100 gallons. Of the 1,077 non-accident releases from tank cars in 1993, 637 or 59% were due to loose or defective fittings (see BOE Report BOE 93-2). Releases from pressure relief devices accounted for 401 or 37%.

The number of loaded rail car originations used in this report are obtained from TRAIN II, the AAR's railcar interchange data base. All of the major freight railroads and many of the short lines and regional railroads report their waybill information, car interchanges, and car locations to TRAIN II. Estimates vary as to the extent of the traffic captured by TRAIN II, but for the purposes of this year's report AAR assumes it captures 90% of all rail traffic in the U.S.

The railroads use the seven (7) digit Standard Transportation Commodity Code (STCC) to set rates as well as track the types of commodities moving by rail. All hazardous material traffic is assigned a Product Class STC Code and a HazMat Code. The HazMat Code begins with the two digits "49". This "49" designation is intended to flag hazardous materials, not for rating purposes. Hazardous wastes are assigned a STC Code which begins with "48". These unique numbers enable the railroads to track their hazardous material and hazardous waste shipments, electronically prepare shipping papers in accordance with DOT regulations, and provide required emergency response information, keyed to the STCC number.

Figure #1 is a list of the top 125 hazardous materials transported ***in tank cars*** by rail. This information was obtained from TRAIN II. These commodities make up approximately 95% of the movements of hazardous materials in tank cars. The list is ranked by total tank car originations.

FIGURE #1

1993 Top 125 Hazardous Commodities Movements
By Tank Car Originations

RANK	HAZ MAT CODE	COMMODITY	DOT HAZARD CLASS	TOTAL TANKCAR ORIGINS
1.	49 352 40	Sodium Hydroxide	8	82,573
2.	49 300 40	Sulfuric Acid	8	64,867
3.	49 457 70	Molten Sulfur **	9	61,281
4.	49 057 52	Liquefied Petroleum Gas	2.1	55,562
5.	49 205 23	Chlorine	2.3	47,057
6.	49 042 10	Anhydrous Ammonia **	2.2	44,553
7.	49 092 30	Methyl Alcohol	3	27,428
8.	49 302 47	Phosphoric Acid	8	21,383
9.	49 057 92	Vinyl Chloride	2.1	20,414
10.	49 057 06	Butane (LPG)	2.1	20,337
11.	49 057 81	Propane (LPG)	2.1	19,921
12.	49 045 09	Carbon Dioxide, Ref. Liq.	2.2	17,685
13.	49 072 65	Styrene Monomer, Inhib.	3	15,750
14.	49 302 28	Hydrochloric Acid	8	14,746
15.	49 057 82	Propylene (LPG)	2.1	12,232
16.	49 057 66	Propane/Propylene (LPG)	2.1	10,834
17.	49 151 68	Fuel Oil	CL	10,772
18.	49 091 52	Denatured Alcohol	3	10,414
19.	49 057 47	Isobutane (LPG)	2.1	10,318
20.	49 151 13	Fuel Oil	CL	9,353
21.	49 057 04	Butadiene	2.1	9,086
22.	49 151 17	Fuel Oil, #2	CL	8,257
23.	49 411 96	Elevated Temperature Material	9	8,228
24.	49 082 24	Methyl Tert-Butyl Ether	3	8,186
25.	49 081 75	Gasoline	3	8,065
26.	49 201 08	Ethylene Oxide	2.3	8,018
27.	49 151 10	Fuel Oil	CL	7,963
28.	49 092 15	Fuel, Aviation, Turbine	3	7,731
29.	49 101 65	Crude Oil, Petroleum	3	7,686
30.	49 057 78	Vinyl Chloride	2.1	6,618
31.	49 091 51	Denatured Alcohol	3	6,241
32.	49 057 67	Petroleum Gases, Liquefied	2.1	6,218
33.	49 151 12	Fuel Oil	CL	6,112
34.	49 212 20	Phenol, Solid	6.1	5,916

FIGURE 1 (cont.)

RANK	HAZ MAT CODE	COMMODITY	DOT HAZARD CLASS	TOTAL TANKCAR ORIGINS
35.	49 057 68	Petroleum Gases, Liquefied	2.1	5,915
36.	49 411 39	Elevated Temperature Material	9	5,825
37.	49 356 45	Hexamethylenediamine Sol.	8	5,711
38.	49 300 42	Sulfuric Acid, Spent	8	5,623
39.	49 072 70	Vinyl Acetate	3	5,479
40.	49 151 20	Fuel Oil #6	3.3	5,188
41.	49 066 20	Propylene Oxide	FL	5,107
42.	49 081 10	Benzene	3	4,946
43.	49 093 51	Xylene	3	4,834
44.	49 152 59	Petroleum Naphtha	CL	4,432
45.	49 072 50	Methyl Methacrylate Monomer	3	4,383
46.	49 352 30	Potassium Hydroxide	8	4,261
47.	49 064 20	Acrylonitrile	3	4,111
48.	49 302 48	Phosphoric Acid	8	4,061
49.	49 313 03	Acetic Acid, Glacial	8	4,057
50.	49 081 32	Cyclohexane	3	3,880
51.	49 081 77	Gasoline	3	3,609
52.	49 122 10	Fuel Oil	3	3,785
53.	49 601 31	Env. Hazardous Substance, n.o.s.	9	3,462
54.	49 205 08	Sulfur Dioxide	2.3	3,437
55.	49 057 50	Isobutane (LPG)	2.1	3,278
56.	49 215 75	Toluene Diisocyanate	6.1	3,271
57.	49 091 66	Ethylene Dichloride	3	3,271
58.	49 057 02	Butane	2.1	3,198
59.	49 093 05	Toluene	3	3,139
60.	49 183 35	Hydrogen Peroxide Sol.	5.1	3,070
61.	49 122 15	Butyl Acrylate	CL	2,918
62.	49 151 85	Combustible Liquid, n.o.s.	CL	2,855
63.	49 102 59	Petroleum Naphtha	3	2,714
64.	49 081 05	Acetone	3	2,700
65.	49 151 11	Fuel Oil	CL	2,697
66.	49 161 41	Phosphorus, White	4.2	2,593
67.	49 101 85	Flammable Liquid, n.o.s.	3	2,380
68.	49 091 17	Butyl Alcohol	3	2,339
69.	49 300 30	Oleum	8	2,282
70.	49 131 68	Formaldehyde Solution	CL	2,211
71.	49 300 24	Hydrogen Fluoride	8	2,209
72.	49 151 67	Fuel, Aviation, Turbine	CL	2,173
73.	49 313 04	Acetic Anhydride	8	2,142

FIGURE 1 (cont.)

RANK	HAZ MAT CODE	COMMODITY	DOT HAZARD CLASS	TOTAL TANKCAR ORIGINS
74.	49 216 13	Organophosphorus Pesticide Liq, Toxic	6.1	2,068
75.	49 314 05	Acrylic Acid	8	2,010
76.	49 092 37	Methyl Alcohol	3	1,984
77.	49 092 05	Isopropanol	3	1,952
78.	49 187 74	Ammonium Nitrate Solution	5.1	1,882
79.	49 215 98	Phenol, Molten	6.1	1,813
80.	49 072 10	Acetaldehyde	3	1,754
81.	49 151 01	2-Ethyl Hexanol	CL	1,668
82.	49 302 08	Corrosive Liquid, n.o.s.	8	1,626
83.	48 105 60	Waste Flammable Liquid, n.o.s.	9	1,587
84.	49 365 40	Corrosive Liquid, n.o.s.	8	1,571
85.	49 187 65	Sodium Chlorate Solutions	5.1	1,550
86.	49 411 02	Other Reg. Substances (*Caprolactum*)	9	1,516
87.	49 323 42	Ferric Chloride Sol.	8	1,479
88.	49 057 07	Butene (LPG)	2.1	1,477
89.	49 091 60	Ethyl Acetate	3	1,446
90.	49 101 02	Alcoholic Beverage	3	1,439
91.	49 091 46	Ethyl Alcohol	3	1,389
92.	49 092 43	Methyl Ethyl Ketone	3	1,382
93.	49 365 28	Corrosive Liquid, n.o.s.	8	1,360
94.	49 633 30	Env. Haz. Sub. n.o.s. (*contains Creosote*)	9	1,368
95.	49 057 15	Butylene	2.1	1,373
96.	49 091 41	Denatured Alcohol	3	1,373
97.	49 352 68	Sodium Hydrosulfide Sol.	8	1,347
98.	49 302 21	Corrosive Liquid, n.o.s.	8	1,346
99.	49 045 03	Argon, Ref. Liquid	2.2	1,322
100.	49 102 53	Methyl Tert Butyl Ether	3	1,302
101.	49 661 50	Env. Haz. Sub. (Phthalic Anhydride)	9	1,301
102.	49 057 48	Isobutylene (LPG)	2.1	1,271
103.	49 081 83	Hexane	3	1,269
104.	49 057 61	Methyl Chloride	2.1	1,235
105.	49 081 25	Carbon Disulfide	3	1,202
106.	49 104 90	Aromatic Concentrates	3	1,164
107.	49 131 94	Glycol Ethers	CL	1,105
108.	49 091 28	Butyl Acetate	3	1,099
109.	49 210 27	Hydrogen Cyanide, Anhydrous	2.3	1,067
110.	49 104 44	Rosin Solution	3	1,056
111.	49 072 15	Ethyl Acrylate, Inhib.	3	1,041
112.	49 300 26	Hydrofluorosilicic Acid	8	1,020

FIGURE 1 (cont.)

RANK	HAZ MAT CODE	COMMODITY	DOT HAZARD CLASS	TOTAL TANKCAR ORIGINS
113.	49 122 67	Fuel, Aviation, Turbine	3	1,081
114.	49 152 45	Oil, n.o.s.	CL	1,002
115.	49 403 64	Formaldehyde Solution	9	982
116.	49 102 45	Oil. n.o.s.	3	964
117.	49 323 29	Ferrous Chloride Solution	8	964
118.	49 103 20	Pulp Mill Liquid	3	955
119.	49 613 87	Environmentally Hazardous Sub.	9	953
120.	49 205 04	Hydrogen Chloride, Ref. Liq	2.3	952
121.	49 411 61	Maleic Anhydride	9	934
122.	49 055 10	Dimethylamine, Anhydrous	2.1	867
123.	49 057 91	Propane	2.3	842
124.	49 187 75	Hydrogen Peroxide Solutions	5.1	839
125.	49 081 82	Hexanes	3	832

* (Under the current DOT Regulations Anhydrous Ammonia can be shipped as either a Division 2.2 or 2.3 material. Molten Sulfur can be shipped as a Division 4.1 or Class 9. For the purposes of this report we have combined the movements of Anhydrous Ammonia under the Division 2.2 Haz Mat Code and the movements of Molten Sulfur under the Class 9 Haz Mat Code).

YEAR	TOTAL TOP - 125	TOTAL ALL HAZMAT
1993	907,472	1,497,464
1992	872,643	1,361,817
1991	852,342	1,359,373
1990	1,077,124	1,404,203
1989	1,175,281	1,523,774
1988	837,985	1,153,926

Explanation of Hazard Class/Divisions used in Figure #1

2.1 - Flammable Gas
2.2 - Non-Flammable Gas
2.3 - Poison Gas
3 - Flammable Liquid
4.2 - Spontaneously Combustible
5.1 - Oxidizing Material
6.1 - Poisonous Material
8 - Corrosive Material
9 - Miscellaneous/ORM
CL - Combustible liquid

An examination of **Figure #1** will show that the same commodity name appears more than once. Due to differing contract rates, product differences, and shipper differentiation, a commodity with the same DOT proper shipping name, i.e., Liquefied Petroleum Gas, may be assigned several different Haz Mat Code numbers. For the purposes of transportation, they all present the same kind of hazard.

Figure #2 takes this situation into account and ranks the top 25 commodities by total rail volume (combining both tank car and other car types) by name, with those commodities with the same (or similar) names grouped together. These 25 commodities account for approximately 74% of all the hazardous materials shipped by rail.

There are two columns of numbers used in this figure. The left column provides the number of carload originations for the individual STC Code and the right column provides a total for all of the STC Codes associated with that commodity name.

Figure #2 points out that the highest volume of hazardous material shipped by rail is Freight Rate Shipments/Freight Forwarder Traffic/Shipper Association Traffic. These are loads of hazardous materials which are being shipped under special contract rates, intermodal traffic (trailer or container on a flat car) which may contain more than one type of a hazardous material, and freight forwarder traffic. The amount of hazardous materials in these shipments can vary from a single package to the entire load.

FIGURE 2

1993 Top 25 Hazardous Materials By Rail Volume

RANK	HAZ MAT CODE	HAZ CLASS	COMMODITY NAME		TOTAL
1.	4950150	–	Freight Rate Shipments	313,751	380,581
	4950130	–	Freight Forwarder Traffic	63,463	
	4950110	–	Shipper Association Traffic	3,367	
2.	4905752	2.1	Liquefied Petroleum Gas (LPG)	55,615	151,688
	4905781	2.1	Propane	20,104	
	4905706	2.1	Butane	20,353	
	4905782	2.1	Propylene	12,233	
	4905766	2.1	LPG (propane/propylene)	10,847	
	4905747	2.1	Isobutane	10,318	
	4905767	2.1	LPG (butylene/isobutane)	6,219	
	4905768	2.1	LPG (butane/butylene)	5,915	
	4905750	2.1	Isobutane	3,285	

FIGURE 2 (cont.)

	4905702	2.1	Butane	3,201	
	4905707	2.1	LPG	1,486	
	4905748	2.1	Isobutylene	1,271	
	4905791	2.1	LPG	842	
3.	4935240	8	Sodium Hydroxide (Caustic Soda)		82,631
4.	4930040	8	Sulfuric Acid		64,912
5.	4945770	9	Molten Sulfur		61,300
6.	4904210	2.2	Anhydrous Ammonia		44,553
7.	4920523	2.3	Chlorine		44,545
8.	4909230	3	Methyl Alcohol		27,442
9.	4915113	CL	Fuel Oil	9,669	27,225
	4915110	CL	" "	8,143	
	4915112	CL	" "	6,362	
	4915111	CL	" "	3,051	
10.	4905792	2.1	Vinyl Chloride	20,429	27,047
	4905778	2.1	" "	6,618	
11.	4930247	8	Phosphoric Acid		21,448
12.	4904509	2.2	Carbon Dioxide, Ref. Liquid		17,877
13.	4909152	3	Denatured Alcohol	10,414	16,655
	4909151	3	" "	6,241	
14.	4907265	3	Styrene Monomer, Inhibited		15,759
15.	4930228	8	Hydrochloric Acid		14,777
16.	4918310	5.1	Ammonium Nitrate Fertilizer		14,010
17.	4915168	CL	Fuel Oil, Diesel		11,306
18.	4915117	CL	Fuel Oil #2		9,980
19.	4905704	2.1	Butadiene		9,087
20.	4918723	5.1	Sodium Chlorate		8,851
21.	4941196	9	Elevated Temperature Material		8,228
22.	4908224	3	Methyl Tert Butyl Ether		8,186
23.	4908175	3	Gasoline		8,122
24.	4909215	3	Fuel, Aviation, Turbine		7,731
25.	4910165	3	Crude Oil, Petroleum		7,688

TOTAL - TOP 25 COMMODITIES 1,091,629

Figure #3 takes these same 25 commodities and shows their historic ranking for the past 5 years. As demonstrated in this list, the seven consistently highest volume hazardous materials are Anhydrous Ammonia, Chlorine, Liquefied Petroleum Gas (LPG), Molten Sulfur, Sodium Hydroxide, Sulfuric Acid, and Methyl Alcohol. These commodities accounted for 31% of all hazardous materials originated in 1993 and 46% of the tank car originations.

FIGURE 3

Historic Ranking of Hazardous Materials Carloads

COMMODITY	1993 CARLOADS	1993 RANK	1992 RANK	1991 RANK	1990 RANK	1989 RANK
Shipper/Freight Assoc.	380,581	1	1	1	1	1
Liquefied Petroleum Gas	151,688	2	2	2	2	2
Sodium Hydroxide	82,631	3	3	3	3	3
Sulfuric Acid	64,912	4	5	5	5	6
Molten Sulfur	61,300	5	4	4	4	4
Anhydrous Ammonia	44,553	6	6	6	6	5
Chlorine	44,545	7	7	7	7	7
Methyl Alcohol	27,442	8	8	8	10	9
Fuel Oil	27,225	9	11	10	11	11
Vinyl Chloride	27,047	10	9	9	9	10
Phosphoric Acid	21,448	11	10	11	8	11
Carbon Dioxide, Ref. Liq.	17,877	12	14	12	15	14
Denatured Alcohol	16,655	13	17	17	20	19
Styrene Monomer, Inhibited	15,759	14	15	14	14	13
Hydrochloric Acid	14,777	15	16	16	16	15
Ammonium Nitrate	14,010	16	13	13	13	12
Fuel Oil, Diesel	11,306	17	12	15	12	16
Fuel Oil #2	9,980	18	23	–	–	–
Butadiene	9,087	19	18	–	–	–
Sodium Chlorate	8,851	20	19	20	–	–
Elevated Temperature Material	8,228	21	—	–	–	–
Methyl Tert Butyl Ether	8,186	22	–	–	–	–
Gasoline	8,122	23	21	21	18	18
Fuel, Aviation, Turbine	7,731	24		–	–	–
Crude Oil, Petroleum	7,688	25	20	18	17	17

Figure #4 takes some of the major DOT hazard classes and portrays the non-accident leakage frequency for these hazard classes. Where a particular commodity or commodities

are responsible for a majority of the leaks in that hazard class, the commodity(ies) name and individual leak rate is shown. This figure demonstrates that Anhydrous Ammonia, LPG, Sulfuric Acid, Hydrochloric Acid and Phosphoric Acid, the top movers in tank cars, are also the top leakers. The exception to this is Chlorine, which has a leak rate of 0.16 per 1000 (7 out of 44,520 carloads) tank cars shipped. This exception may be due to the hazard of the material, the type of tank car chlorine is shipped in (DOT 105) and the standardized valving arrangement.

FIGURE 4

Leakage Frequency By Hazard Class

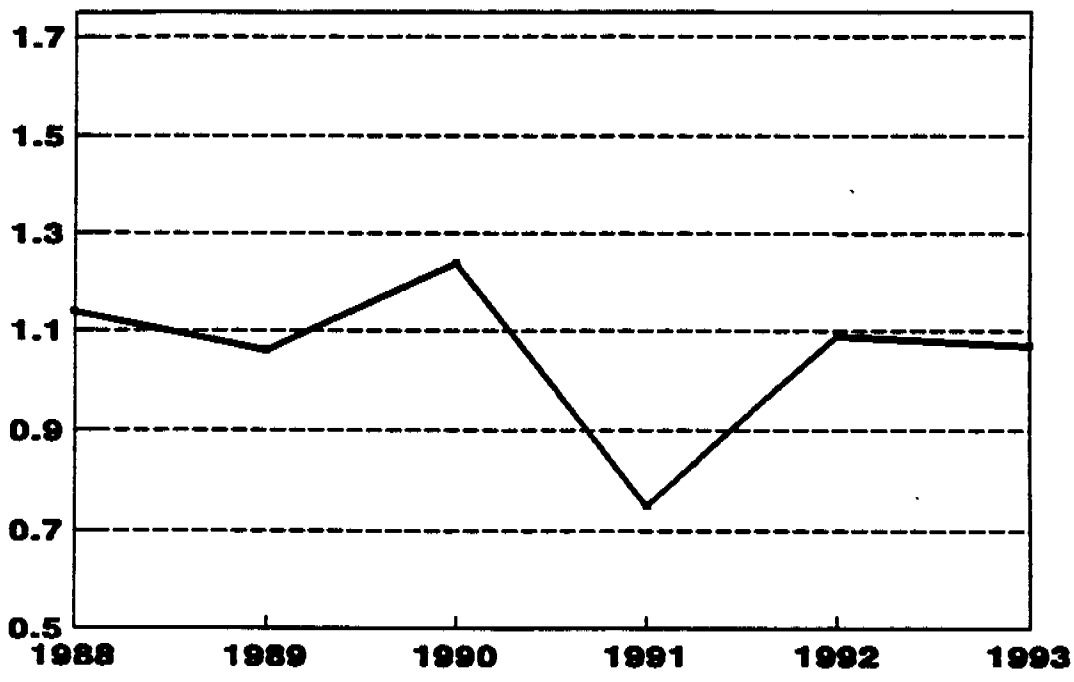
	1988			1989			1990			1991			1992			1993		
(1) Commodity/ HAZARD CLASS	Car Leaks	(2) Cars Shipd	(3) Rate	Car Leaks	Cars Shipd	Rate	Car Leaks	Cars Shipd	Rate	Cars Leaks	Cars Shipd	Rate	Cars Leaks	Cars Shipd	Rate	Cars Leaks	Cars Shipd	Rate
LPG	61	134	0.46	71	175	0.41	133	155	0.85	64	222	0.29	55	148	0.37	45	152	0.30
DIVISION 2.1 (Flammable Gas)	73	164	0.45	78	215	0.36	142	190	0.75	75	266	0.28	60	190	0.36	59	196	0.30
Ammonia	67	54	1.24	62	67	0.93	68	56	1.21	59	71	0.83	68	52	1.31	80	44	1.82
DIVISION 2.2 Nonflammable Gas	135	125	1.08	151	152	0.99	139	134	1.04	107	161	0.66	114	62	1.83	134	66	2.03
Chlorine	Regulated as a non-flammable gas in these years ...												6	45	0.13	7	45	0.16
DIVISION 2.3 (Poison Gas)	0	1	-	0	2	-	0	2	-	0	11	-	13	67	0.19	12	55	0.22
CLASS 3 (Flammable Liquid)	237	188	1.26	247	214	1.15	246	211	1.17	189	254	0.74	200	188	1.06	228	209	1.09
COMBUSTIBLE LIQUID	74	62	1.19	82	91	0.9	74	90	0.82	74	114	0.65	57	92	0.62	74	82	0.90
DIVISION 6.1 (Poison B)	8	12	0.67	1	15	0.07	7	14	0.5	7	17	0.41	12	16	0.75	8	26	0.31
Sulfuric Acid	110	51	2.16	118	71	1.66	148	64	2.31	116	80	1.45	165	58	2.84	159	65	2.45
Phosphoric Acid	26	27	0.96	66	32	2.06	75	31	2.42	65	35	1.86	74	28	2.64	110	25	4.40
Hydrochloric Acid	65	11	5.91	172	15	11.5	173	14	12.4	108	20	5.40	92	14	6.57	69	15	4.60
CLASS 8 (Corrosive Mat'l)	394	223	1.77	532	273	1.95	575	253	2.27	449	311	1.44	525	230	2.28	511	242	2.11
HAZARDOUS WASTE	3	2	0.15	10	3	0.33	14	4	0.35	13	6	0.22	8	4	2.0	9	4	2.25
OTHERS	61	81	0.75	64	129	0.5	61	122	0.5	61	179	0.34	58	105	0.55	42	130	0.32
TOTAL	985	857	1.15	1165	1092	1.07	1258	1018	1.24	975	1308	0.75	1047	954	1.09	1077	1010	1.07

1. Selected commodities are included in hazard class totals. TOTAL includes Other hazard classes.
2. 'Cars Shipd' is loaded tank car originations (x1000) as reported to TRAIN II
3. 'Rate' is number of leaking incidents divided by 'Cars Shipd'. (Leaks per 1,000 cars shipped).

Graph #1 plots non-accident hazardous materials tank car leakage frequency between the years 1988 and 1993.

GRAPH #1

Tank Car Leakage Frequency
(per 1,000 carloads)

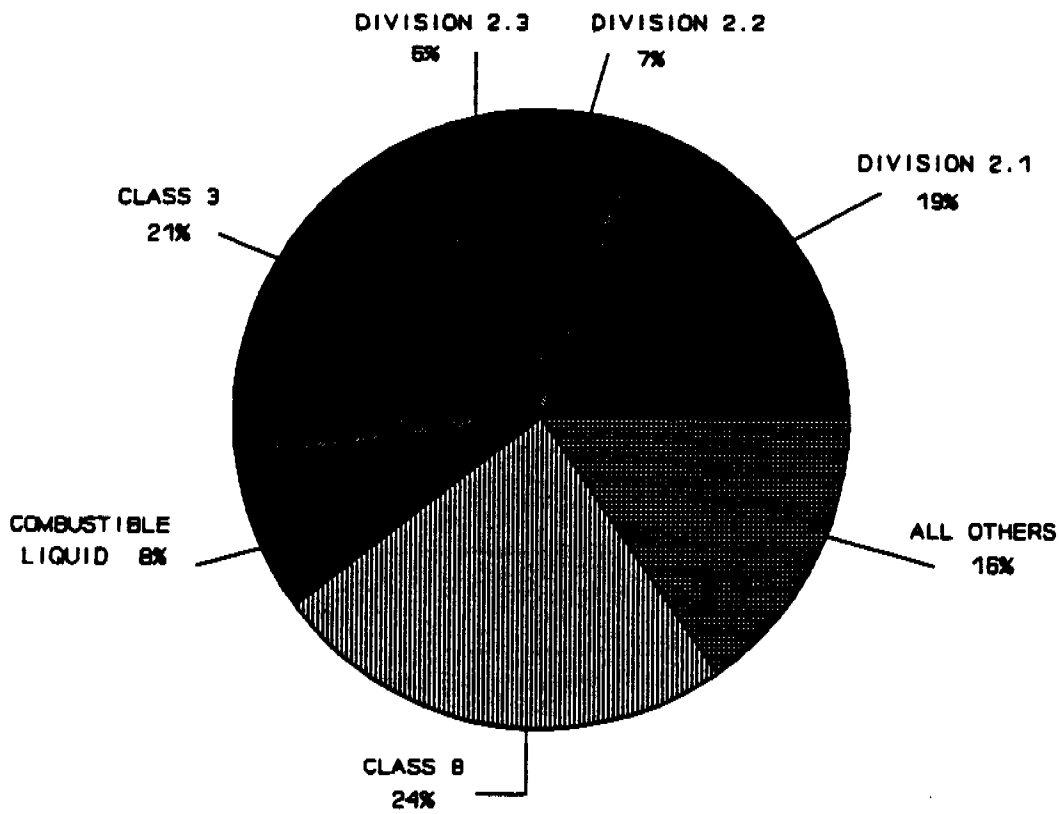


YEAR

The AAR, the Rail Progress Institute (RPI) and Chemical Manufactures Association (CMA) have worked together to form several task forces and working groups to address methods of eliminating Non-Accident Releases. These groups have focused on tank car equipment, securement, loading and unloading procedures and operating practices. Many of the ideas and procedures developed by these groups have begun to be implemented. As shown by Graph #1 results from these efforts have had some effect.

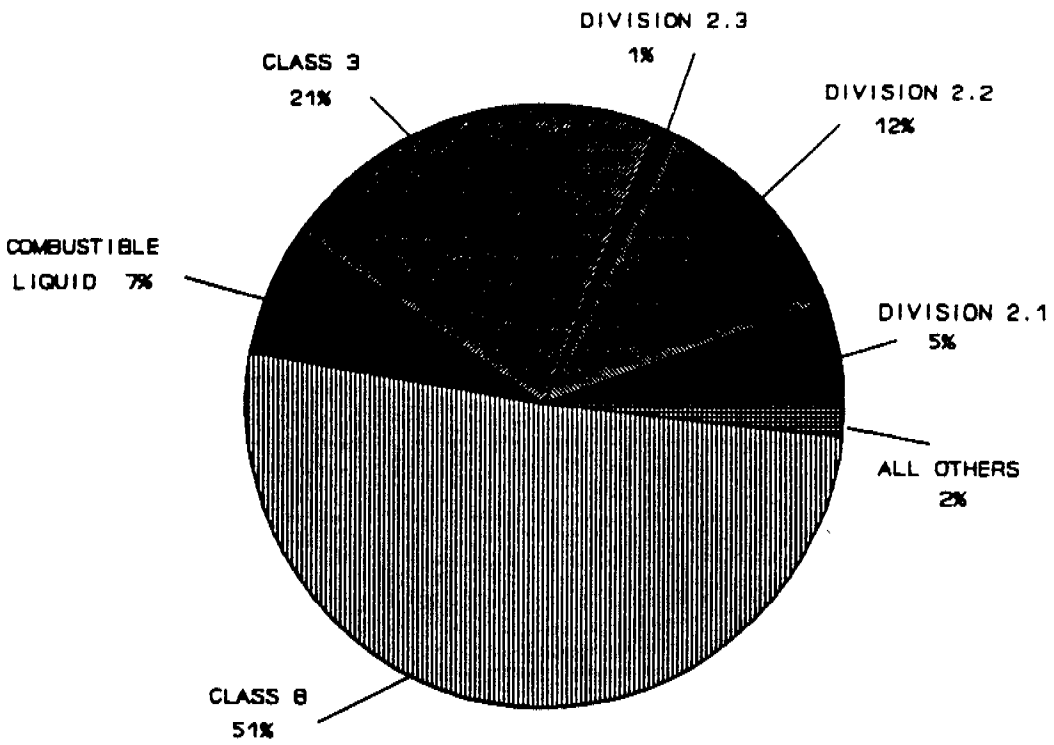
Graphs #2 and #3 display tank car originations by DOT hazard class and non-accident tank car leaks by hazard class. These two graphs reveal several things: while corrosive materials account for 24% of tank car originations, they are responsible for 51% of the leaks. This is due to the fact that the extremely corrosive nature of many of these products limits the use of a spring loaded safety relief device, which reseals itself after functioning, to those made of specialized materials. These cars are equipped with rupture disks which function only once and then remain open. These rupture disks are vulnerable to improper installation by shippers and pressure spikes encountered while shifting tank cars into and out of rail yards.

GRAPH #2
Tank Car Movements By DOT Hazard Class
Year 1993



The AAR Tank Car Committee prohibited the use of lead disks as of January 1, 1989. A comparison of the figures for 1989 and 1990 releases due to rupture disk failures (Figure

GRAPH #3
Tank Car Leaks By DOT Hazard Class
Year 1993



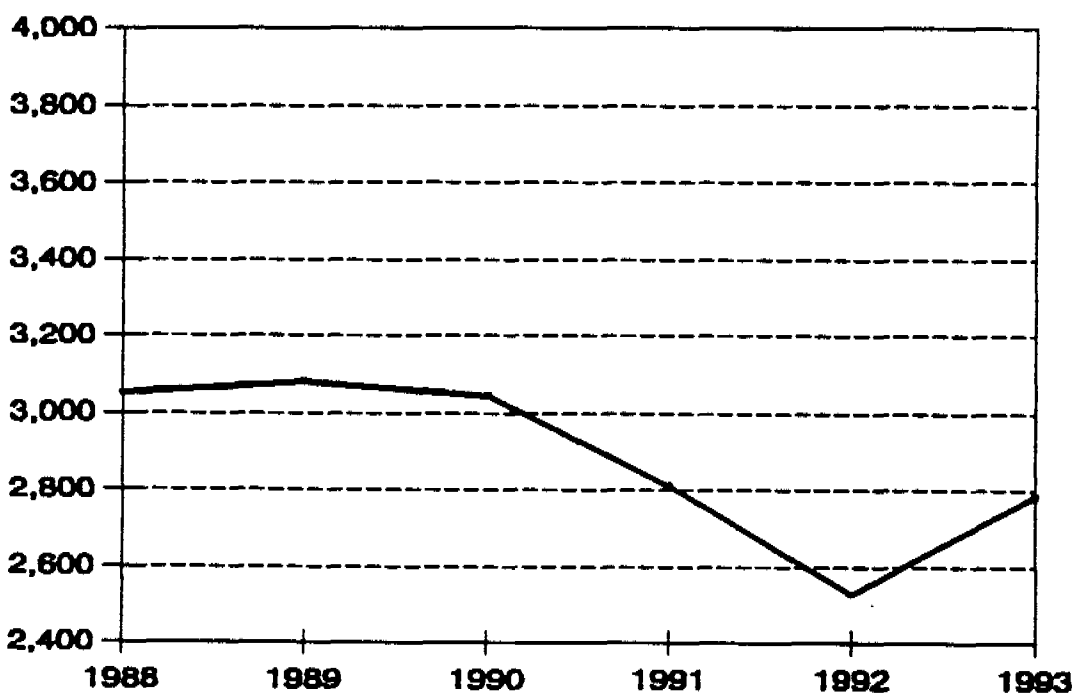
5) shows a significant increase in the failure rate for this type of pressure relief device. This may be related to the more brittle nature of some of the materials substituted for lead rupture disks as well as improper installation. Some of these broken rupture disks can be attributed to the shipper overloading the car while others may be caused by train handling.

The second thing these graphs show is the disparity between percentage shipped by hazard class and the percentage leaked by hazard class. Class 3 (Flammable liquids) account for 20% of the originations and 21% of the leaks yet Combustible liquids accounted for 8% of the originations and 7% of the leaks. These materials are shipped in the same type of general service tank car. Division 2.1 (Flammable gas) accounted for 19% of originations and only 5% of the leaks, yet Division 2.2 (Non-flammable gas) accounted for 7% of originations and 12% of leaks. This is somewhat unusual in that many of the same type of cars are used in both services (LPG in the fall and winter and Anhydrous Ammonia in the spring and summer). Since they are the same car types and have the same valving arrangements the difference in the leakage percentage is difficult to explain. An additional factor in the leak rate for Division 2.2 (non-flammable gases) is the shipment of Carbon

Dioxide and other refrigerated liquids in tank cars equipped with pressure regulators. These pressure regulators periodically function to release pressure which cools the contents. These releases are captured as Non-Accident Releases. (For a more detailed description of non-accident releases by commodity and by source of leak see report BOE 93-2).

The information displayed in **Graph #4** plots the number of train accidents reported to the FRA for the years 1988 through 1993. This graph shows that the number of train accidents went up in 1988 and 1989 but have genreally declined since then.

GRAPH # 4
Train Accidents



YEAR

Graph 5 plots the number of train accidents in which hazardous material cars were damaged or derailed along with the number of accidents in which a hazardous materials car released its product as a result of the derailment. These releases range from the loss of the entire load due to a catastrophic tank failure to "minor" seepage from otherwise secure tank car fittings when they roll over.

It is interesting to note that while overall train accidents have generally declined over the past several years (see Graph #4), the number of those accidents involving damage to cars containing hazardous materials has gone up. This is partially due to the increasing number of commodities which DOT has chosen to regulate during this period i.e., Molten Sulfur and Elevated Temperature Materials.

GRAPH #5

Train Accidents Involving Haz Mat

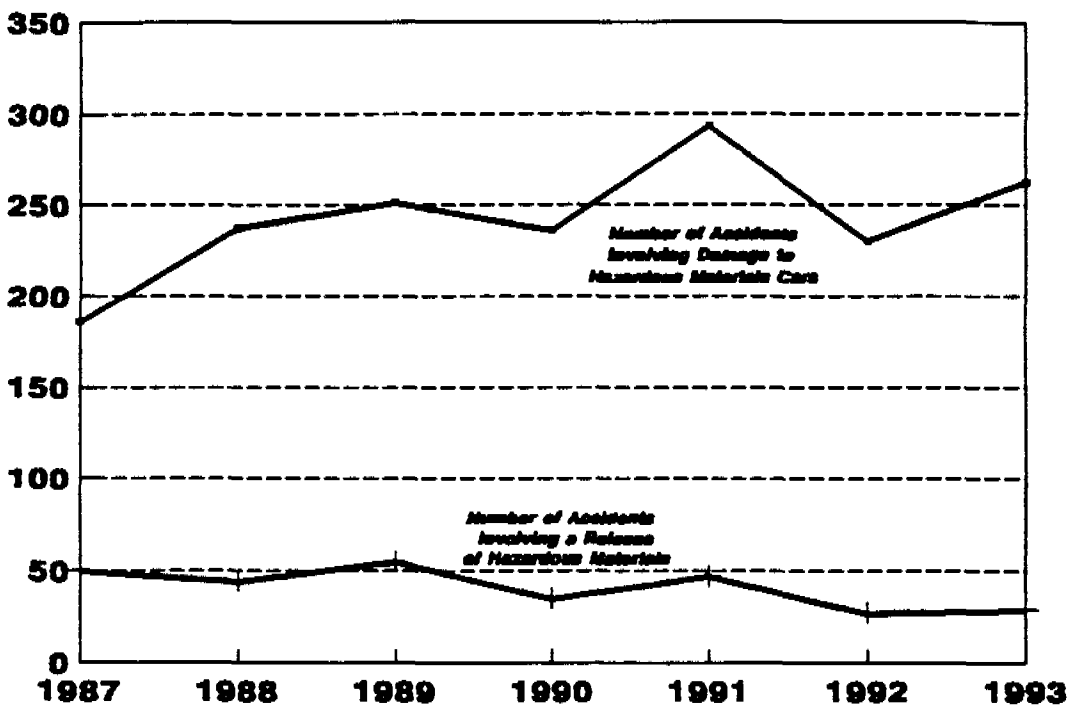


Figure #5 is a detailed summary of railroad hazardous materials accidents and incidents for the year 1993.

The major problem these figures portray is the constantly high number of Non-Accident Releases of hazardous materials from tank cars, the majority of which are due to burst rupture disks on tank cars in corrosive material service. The Inter-Industry Task Force, comprised of representatives of AAR, CMA,and RPI has proposed various solutions to this problem and have published their results. Many of their recommendations have been adopted by both the rail carriers and chemical shippers.

Four major changes which could reduce the releases due to burst rupture disks are being implemented without the need to obtain an exemption from DOT. These are (1) increasing the outage in the car, (2) reducing coupling speeds, (3) equipping tank cars in corrosive material service with safety vent baffles and (4) equipping them with safety vaives which resist the corrosive effects of the material. Other changes, such as reducing the safety vent orifice size, eliminating the safety vent on tank cars in corrosive material service ("Total Containment") or the use of 135lbs or 165lbs rupture disks require exemptions or regulatory changes by DOT.

FIGURE 5

1993 Detailed Summary

HAZ MAT ORIGINATIONS:	1988	1989	1990	1991	1992	1993
Total Tank Cars *(48 & 49 STCC only)*	857	1092	1018	963	954	1009
Total Haz Mat Cars reported	1153	1523	1404	1359	1361	1497
Estimated Total [1] (x1000 for all the above)	1268	1675	1615	1506	1497	1646
NON-ACCIDENT RELEASES:	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
TOTAL LEAKING TANK CARS [2]	985	1165	1257	975	1047	1077
Sources of leaks:						
Safety Device	352	499	563	441	473	461
(Valve Functioned)	(77)	(91)	(79)	(56)	(51)	(55)
(Disk Ruptured)	(206)	(336)	(388)	(334)	(369)	(346)
Bottom Fittings	174	172	152	139	141	117
Manway	280	323	362	253	285	287
Liquid line	106	126	141	97	105	129
Other Top Fittings	108	120	144	98	116	130
Shell or Head	50	39	34	21	31	39
DERAILMENTS [3]:	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**
NUMBER OF TRAIN ACCIDENTS:						
- *involving Hazardous Material Cars:*	475	517	466	525	482	559

Continued on next page

FIGURE 5 (cont.)

	1988	1989	1990	1991	1992	1993
NUMBER OF TRAIN ACCIDENTS *(continued)*:						
- *in which a Haz Mat Car Damaged or Derailed:*	237	251	236	293	230	262
- *involving a Release:*	44	55	35	47	27	29
- *resulting in an Evacuation:*	32	28	20	28	11	15
- *number of Cars Releasing Hazardous Materials:*	74	84	90	84	33	58

CASUALTIES DUE TO HAZ MAT[4]:	1988	1989	1990	1991	1992	1993
Injuries	36	36	73	75	116	65
Fatalities	0	0	0	0	0	0

NOTES:

1. *These data have been multiplied by a factor to yield an estimated total. It is estimated that for the years 1984 through 1986 TRAIN II captured about 80% of actual U.S. originations. It is estimated that for the years 1987 through 1989 TRAIN II captured approximately 90% of actual U.S. originations. In 1990 TRAIN II captured approximately 85%. In 1991 and 1992 it is estimated that it captured approximately 90%.*
2. *These numbers denote individual leaks; this includes multiple leaks from the same car.*
3. *Data obtained from the Federal Railroad Administration.*
4. *Data obtained from Research & Special Programs Administration (RSPA) of DOT.*

Figure #6 shows the number of tank car loads, all car type loads, and the number of leaking tank cars for each DOT Hazard Class.

FIGURE 6

1993 Car Loadings
by DOT Hazard Class

Hazard Class	Tank Car Loads	All Car Loads	Leaking Tank Cars
Division 1.1 thru 1.6 (*Explosives*)	4	6,566	0
Division 2.1 (*Flammable Gas*)	195,915	196,812	59
Division 2.2 (*Non-Flammable Gas*)	66,185	68,096	135
Division 2.3 (*Poison Gas*)	56,556	56,722	12
Class 3 (*Flammable Liquid*)	209,304	216,260	227
Combustible Liquid	81,595	86,707	74
Class 4 (*Flammable Solid*)	3,584	7,409	1
Division 5.1 (*Oxidizer*)	9,039	42,022	24
Division 5.2 (*Organic Peroxide*)	43	94	0
Division 6.1 (*Poison B*)	25,997	31,253	8
Class 7 (*Radioactive Material*)	0	217	0
Class 8 (*Corrosive Material*)	242,446	249,725	511
Class 9	96,549	124,720	17
Hazardous Waste **	(1283)	(8,906)	(4)

NOTE: - The number of car loads for Freight Rate/Shipper Association is not included in this figure because this description can fit one or more of the DOT Hazard Classes listed above.

*** The numbers for HAZARDOUS WASTE are included in the totals for CLASS 9 materials. They are broken out for reference only.*

Figure #7 is the railcar originations, terminations and incidents listed by state. The originations and terminations are based on TRAIN II waybill data and reflect only the amount of hazardous materials traffic which originated or terminated in that state. It does not count "overhead" traffic (that traffic which originated or is destined for one state yet passes through another). Leak and splash data is derived from AAR's Accident/Incident Data Base. All figures are for tank car and other types of railcars combined.

FIGURE 7

1993 Hazardous Materials
Originations And Terminations By State

STATE	ORIGINATIONS	TERMINATIONS	INCIDENTS LEAKS/SPLASHES
AK	57	629	0
AL	22,073	24,497	39
AR	5,980	14,797	52
AZ	11,007	18,482	18
CA	77,525	111,049	159
CO	12,330	22,769	24
CT	94	2,005	1
DC	0	34	0
DE	7,337	5,247	3
FL	29,399	74,960	20
GA	37,701	43,231	33
IA	15,431	11,855	4
ID	7,378	11,236	6
IL	182,088	135,523	66
IN	14,979	16,485	17
KS	31,458	22,432	17
KY	17,841	27,612	12
LA	121,414	45,012	76
MA	9,024	14,310	2
MD	6,463	15,372	11
ME	5,554	9,076	0
MI	14,953	24,981	28
MN	13,815	21,836	8
MO	14,160	14,549	53
MS	24,251	18,869	6
MT	5,973	16,284	9
NC	29,133	41,300	32
ND	4,269	7,602	2
NE	6,065	10,485	33
NH	266	2,353	0
NJ	40,685	45,875	9
NM	18,205	10,080	5
NV	4,091	12,423	24
NY	26,941	23,156	12
OH	35,404	35,148	49

STATE	ORIGINATIONS	TERMINATIONS	INCIDENTS LEAKS/SPLASHES
OK	15,550	12,259	12
OR	10,032	19,447	19
PA	25,059	37,373	23
RI	21	1,121	0
SC	7,309	26,071	6
SD	52	683	0
TN	26,119	34,098	20
TX	214,458	171,821	171
UT	10,572	16,127	36
VT	20	3,647	0
VA	7,311	20,774	26
WA	20,734	33,483	8
WI	4,196	9,091	8
WV	16,733	14,839	4
WY	19,763	6,122	20

This is Part One of AAR's Annual Report on Hazardous Materials Transported by Rail (BOE 93-1). Additional information on Non Accident Releases by commodity by source of leak is avail. in Part Two of this report (BOE 93-2). Questions concerning any information contained in this report should be directed to Paul Williams, Manager, Operations Analysis, Bureau of Explosives, Association of American Railroads.

Additional copies of the combined report are available for $25 from:

Association of American Railroads
Bureau of Explosives
50 F Street, NW
Washington, DC 20001

APPENDIX

Department Of Transportation reporting requirements:

Research and Special Projects Administration (RSPA) requirements for a hazardous material incident:

Each carrier who transports hazardous materials shall report to the Department of Transportation any incident which occurs during the course of transportation (including loading, unloading, and temporary storage) in which, as a direct result of hazardous materials any one (or more) of the following occurs:

- o A person is killed; or
- o A person receives injuries; requiring his or her hospitalization; or
- o Estimated carrier or other property damage exceeds $50,000; or
- o An evacuation of the general public occurs lasting one or more hours; or
- o One or more major transportation arteries or facilities are closed or shut down for one hour or more; or
- o The operational flight pattern or routine of an aircraft is altered; or
- o Fire, breakage, spillage, or suspected radioactive contamination occurs involving shipment of radioactive material; or
- o Fire, breakage, spillage, or suspected radioactive contamination occurs involving shipment of etiologic agents; or
- o A situation exists of such a nature (e.g., a continuing danger to life exists at the scene of an incident) that, in the opinion of the carrier, it should be reported to the Department of Transportation even though it does not meet the criteria of 49CFR Section 171.15(a)(1), (2), or (3); or
- o There is an unintentional release of a hazardous material from a package (including a tank car) or any quantity of hazardous waste has been discharged.

Federal Railroad Administration (FRA) reporting requirements:

- o Any impact between railroad on-track equipment and an automobile, bus, truck, motorcycle, bicycle, farm vehicle, or pedestrian at a rail-highway grade crossing; or
- o Any collision, derailment, fire, act of God, or other event involving operation of railroad on-track equipment (standing or moving) that results in more than $6,300_1$ in damages to railroad on-track equipment, signals, tract, track structure,or roadbed; or
- o Any event arising from the operation of a railroad which results in:
  - The death of one or more persons;

- Injury to one or more persons other than railroad employees, that requires medical treatment;
- Injury to one or more employees that requires medical treatment or results in restriction of work or motion for one or more days, one or more lost work days, transfer to another job, termination of employment, or loss of consciousness;
- Occupational illness of a railroad employees diagnosed by a physician.

1 - Amount changes every two years by regulation.