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Accident Management Orientation Guide

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PREFACE

This report was prepared by Systems Technology Laboratory, Inc., 2045 North 15th Street, Arlington, Virginia 22201 under contract FO4611-82-C-0052 with the Air Force Rocket Propulsion Laboratory (AFRPL), Edwards Air Force Base, California 93523. Mr. John Marshall was COTR for AFRPL. The project was also jointly sponsored through the Federal Railroad Administration (FRA), Office of Research and Development. Mr. David Dancer was COTR for FRA.

This technical report has been reviewed and is approved for publication in accordance with the distribution statement on the cover and on DD Form 1473.

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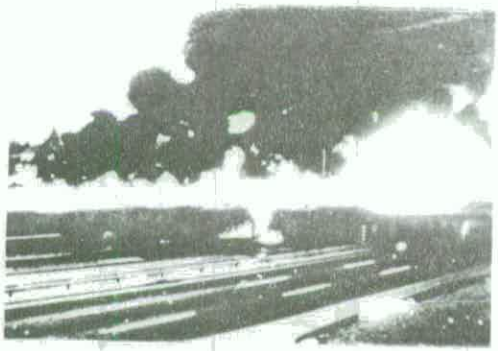
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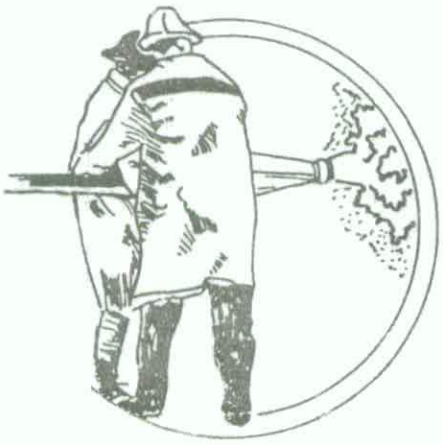
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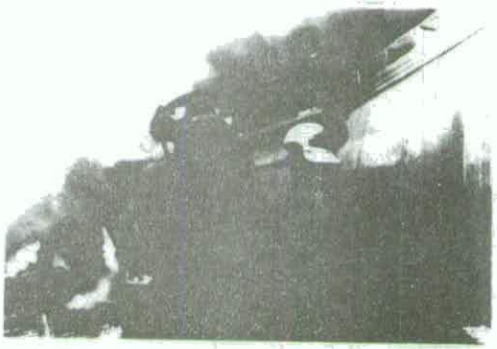
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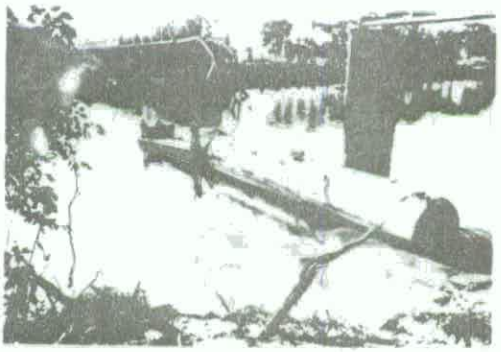
This Accident Management Orientation Guide is dedicated to all members of the Federal, State and local emergency response community as well as carriers, shippers, specialized emergency response teams, wreckage removal contractors and cleanup/disposal contractors who have or will risk their lives in the mitigation of hazards associated with hazardous materials transportation accidents. These accidents can be devastating, like those shown in the following figures.













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INTRODUCTION

The Accident Management Orientation Guide addresses decisions to be made for all phases of on-scene emergency hazardous materials response operations from initial notification of emergency response personnel through departure from the accident scene of the cleanup/disposal teams, to resumption of normal operations.

A Guide which addresses all phases of hazardous materials (HM) accident management is needed for several reasons. First, the scene of a HM transportation emergency can be one of confusion, misinformation, and hysteria. Sound, expeditious decision-making is continually required on-scene to address immediate safety issues, to mitigate longer term hazards to life, property and the environment and to monitor changing conditions on-scene. Unfortunately, the best decisions are not always made under these stressful and dangerous conditions. Managing the interaction of Federal, State, and local government agencies as well as carrier, shipper, specialized emergency response teams, wreckage removal contractor and cleanup/disposal contractor, each with input into the decision-making process, requires time not only for discussion of options but also involves time to mold often widely differing ideas and viewpoints into a coherent management strategy. A strategy is needed to utilize to the fullest the technical expertise of each emergency response organization on-scene in developing sound strategies for mitigating the on-scene hazards. This Guide presents such a strategy for systematically addressing and handling the hazards posed by an accident involving HM.

Second, there are currently several accident response/handling manuals and training courses available; however, not one discusses and integrates all phases of accident management. A "Guidelines Manual" recently completed under contract to the Air Force Rocket Propulsion Laboratory (AFRPL) (Contract no. FO4611-80-C-0046) titled "Post-Accident Procedures for Chemicals and Propellants" integrates all phases of an accident requiring attention by decision-makers into one manual. This manual includes appropriate chemical/physical data on twenty eight HM and guidelines for post-accident procedures such as hazards assessment and mitigation, cargo transfer, wreckage removal and cleanup/disposal. However, this document covers only twenty eight specific chemicals. Other manuals such as the USCG Chemical Hazards Response Information System, DOT Emergency Response Guidebook, EPA Manual for the Control of Hazardous Materials Spills and the AAR Emergency Handling of Hazardous Materials in Surface Transportation do provide response guidelines for several HM, but fail to supply adequate information for the management of all phases of an accident. Thus, this Guide has been

designed to manage an accident in its entirety from beginning to end. Experience has shown that actions taken in one area of emergency response operations impact every other area of accident response. Consequently, there is a real need for a system which considers and integrates the necessary on-scene emergency response operations into a logical pattern. This need is also fulfilled by this Guide.

Third, HM transportation accidents occur and will continue to occur; however, the severity of these accidents has decreased. Within the past five years the chemical and railroad industry formed a Task Force to develop means to reduce the number and severity of rail transportation accidents involving hazardous materials. This Task Force accelerated many previously mandated equipment improvements such as the retrofit of shelf couplers, head shields and thermal protection. In addition to equipment improvements, this Task Force also accelerated improvements in the areas of accident response, transportation and system safety analysis.

Rail is, by far, the safest method of transportation of hazardous materials. With a significant increase in the number and variety of hazardous materials being transported by rail, the emphasis on safety needs to be continued. In the last five years in the U.S. alone there were in excess of 900 releases of HM from rail cars involved in derailments and yard accidents; over 100,000 people were evacuated because of potential exposure to these materials; equipment damage losses were in excess of $187 million; and total rail accident costs exceeded $1.4 billion.

Canada has had similar experience with response to HM transportation accidents. In Mississauga, Ontario, Canada (a suburb of Toronto) in 1979 a HM accident occurred which resulted in the evacuation of 217,000 residents. Was this evacuation necessary? More guidance and improved decision-making capabilities are clearly needed.

These facts all point to the need for better handling and management of HM accidents. Since HM production, shipment, and end use in other products are a vital part of our technical society for economic growth and productivity, it is likely that shipment of HM will continue and perhaps even increase during the next decade. The purpose of this Guide is, therefore, to improve the response preparedness and sharpen the decision-making skills of emergency response personnel who find themselves facing an accident involving one or more hazardous materials. This Guide will assist decision-makers in mitigating hazards and alleviating the threat to the public and the environment posed by severe transportation accidents.

To assist in the use of this volume a list of acronyms and a glossary of terms has been prepared.

GLOSSARY OF ACRONYMS AND TERMS

AAR	-	Association of American Railroads
ADAPTS	-	Air Deliverable Antipollution Transfer System
AFRPL	-	Air Force Rocket Propulsion Laboratory
ASTM	-	American Society of Testing and Materials
CCP	-	Communications Command Post
CFR	-	Code of Federal Regulations
CHEMTREC	-	Chemical Transportation Emergency Center
CHLOREP	-	Chlorine Emergency Plan
CHRIS	-	Chemical Hazards Response Information System
CMA	-	Chemical Manufacturers Association
COTR	-	Contracting Officer's Technical Representative
CPU	-	Central Processing Unit
DOT	-	Department of Transportation
EMT	-	Emergency Medical Team
EOD	-	Explosive Ordinance Disposal
EPA	-	Environmental Protection Agency
ER	-	Emergency Response
FEMA	-	Federal Emergency Management Agency
FRA	-	Federal Railroad Administration
GC-MS	-	Gas Chromotography-Mass Spectrometry
HACS	-	Hazard Assessment Computer System
HM	-	Hazardous Materials
IR	-	Infrared
LEL	-	Lower Explosive Limit
LPG	-	Liquefied Petroleum Gas
MTB	-	Materials Transportation Bureau
NA	-	North American
NFPA	-	National Fire Protection Association
NRC	-	National Response Center
NRT	-	National Response Team
NTSB	-	National Transportation Safety Board

OHMTADS - Oil and Hazardous Materials Technical Assistance Data System
OSC - On-Scene Coordinator
PEL - Permissible Exposure Limit
PPM - Parts Per Million
PSI - Pounds Per Square Inch
RCRA - Resource Conservation and Recovery Act
RRC - Regional Response Center
RRT - Regional Response Team
SOA - State-of-the-Art
SOP - Standard Operating Procedure
STCC - Standard Transportation Commodity Code
TLV - Threshold Limit Value
UEL - Upper Explosive Limit
UN - United Nations
USAF - United States Air Force
USCG - United States Coast Guard
UV - Ultraviolet

AMBIENT CONDITIONS: Temperature and atmospheric pressure conditions of the surrounding environment. Reference point is 59°F (15°C) and 14.7 psi (1.03 kg/cm^2).

ANHYDROUS: Containing no water. Relative quantitative measure of water in a chemical compound below a certain limit.

BOILING POINT: The temperature at which the vapor pressure of a liquid is equal to or very slightly greater than atmospheric pressure. (Normal boiling point is 212°F or 100°C for water).

BREACH: Puncture, tear, hole or rupture in a vessel that allows the contents to be released.

CHEMTREC: Abbreviation of Chemical Transportation Emergency Center. A division of the Chemical Manufacturers Association established as an emergency information source for transportaton accidents involving hazardous materials (e.g., flammable, toxic or explosive).

CHLOREP: Abbreviation for Chlorine Emergency Plan. The Plan provides for the chlorine manufacturer closest to the emergency site to provide technical assistance, regardless of whose product is involved.

COMBUSTIBLE LIQUID: A liquid that has a flash point between 100°F (37.8°C) and 200°F (93.3°C) except any mixture having one component or more with a flash point at 200°F (93.3°C) or higher, that makes up at least 99 percent of the total volume of the mixture.

COMBUSTIBLE MATERIAL: A substance which will burn.

COMMODITY INCOMPATIBILITY: The situation whereby chemicals are capable of interacting with each other to create a hazard or unsafe condition and thus must be handled, packaged, stored and shipped with certain prescribed precautions.

COMMUNICATIONS COMMAND POST: A central facility (mobile or fixed) which functions as an interlink to coordinate the different sources of information and communications at and away from the accident scene.

COMPATIBLE MATERIAL: Having no undesirable reaction or physical effect with or upon another material.

COMPRESSED GAS: A material or mixture, when enclosed in a container, has an absolute pressure exceeding 40 psi at 70°F (27.6 N/cm^2 at 21°C) or, regardless of the pressure at 70°F (21°C), has an absolute pressure exceeding 104 psi at 130°F (71.7 N/cm^2 at 54°C); or any liquid flammable material having a vapor pressure exceeding 40 psi absolute (27.6 N/cm^2) at 100°F (38°C) as determined by ASTM Test D-323.

CONTAINER: Any vessel used to ship hazardous materials in the transportation environment (e.g., tank cars, drums, portable tanks, cylinders, etc.).

CONTAINER STRUCTURAL INTEGRITY: The existing condition of a container's structural components with respect to its original design and its capability to safely retain its contents as intended.

CORROSIVE MATERIAL: A material that causes visible destruction or irreversible alterations in human skin tissue at the site of contact, or in the case of leakage from its packaging, a liquid that causes severe corrosion to steel.

CRITICAL PRESSURE: The pressure required to liquefy a gas at its critical temperature.

CRITICAL TEMPERATURE: The maximum temperature at which a gas can be liquefied. Above the critical temperature point the substance will remain in the gaseous state regardless of the pressure applied.

DECONTAMINATING AGENT: An agent having a desirable controlled reaction rate or solvent action which is used to purge materials, components, systems or areas of residues or contaminants.

DENT: A depression or hollow made by a blow or by pressure on a container's surface.

DIKE: An earth or concrete barrier intended to contain a spill at an accident.

DISPATCHER: One who controls the movement of vehicles/persons (e.g., trains, trucks, fire, police).

EXPLOSION: The sudden release of energy usually in the form of large volumes of gas which exert pressure on the surrounding medium. Depending on the rate at which energy is released, an explosion can be categorized as a deflagration, a detonation, or a rupture of a pressure vessel.

EXPLOSIVE: Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion (i.e., with substantial instantaneous release of gas and heat).

EXPLOSIVE LIMITS: The upper and lower limits of the vapor concentration (percent by volume in air) of a material that can explode when ignited with an external energy source in a confined area. Also commonly referred to as flammable limits.

FIRE POINT (IGNITION TEMPERATURE): The lowest temperature at which a flame is continuously supported over a liquid surface upon exposure to an open flame.

FIREPROOF: A material which will not continue to burn after removal from contact with a hot flame ignition source.

FLAMMABLE: A material which is easily ignited in air, oxygen, or other supporting atmosphere.

FLAMMABLE LIMITS: The upper and lower vapor concentration of fuel to air which will ignite in the presence of external ignition sources; often also referred to as the explosive limits. Flammable limits in atmospheres other than air are also identified.

FLAMMABLE LIQUID: Any liquid having a flash point below 100°F (37.8°C).

FLASH POINT: The lowest temperature at which a liquid surface may be momentarily ignited by open flame.

GALVANIC CORROSION: Corrosion due to an electrical current action on two dissimilar metals in the presence of an electrolyte.

GAS CHROMATOGRAPHY-MASS SPECTROMETRY (GC-MS): This is a combination of two chemical instrumentation techniques. Gas chromatography involves the separation and identification of the components of a mixture by volatilizing the sample into a carrier gas stream and passing it through a bed of special packing and comparing the times for the various components to be released from the packing. Mass spectrometry involves the acceleration of ions through an accelerating electrical field and then through a strong magnetic field. The ions are then separated by mass as they traverse the field at varying velocities which can then be used to identify compounds. The combination of these techniques especially with microprocessing has made the GC-MS a powerful analytical tool.

GEL: A colloid in which the disperse phase has combined with the continuous phase to produce a viscous, jelly-like product.

GOUGE: A groove or cavity scooped out in a surface.

HACS: Computerized portion of USCG Chemical Hazards Response Information System (CHRIS). Abbreviation for Hazard-Assessment Computer System.

HAZARD: A situation which may result in death or injury to personnel, or in damage to property; including effects of fire, flash, explosion, shock, concussion, fragmentation, corrosion and toxicity.

IGNITION TEMPERATURE: The lowest temperature at which combustion can be supported continuously on exposure to any ignition source.

IMPINGEMENT: An external source of fire that is applying heat and energy to a container. The container or its contents may or may not be on fire.

IRRITATING MATERIAL: A substance which gives off dangerous or intensely irritating fumes when exposed to air or upon contact with fire.

LIQUEFIED GAS: Substance which is gaseous at room temperature and has been converted to a liquid under controlled pressure and temperature.

LONGITUDINAL AXIS OF CAR: The lengthwise axis of a car.

MASS SPECTROMETRY: A method of chemical analysis in which ions are passed in a vacuum first through an accelerating electrical field and then through a strong magnetic field. This has the effect of separating the ions according to their mass, as they traverse the magnetic field at different velocities (electromagnetic separation).

MISCIBLE: Liquids capable of being mixed.

NATIONAL RESPONSE CENTER: The Coast Guard operated response center that provides telephonic assistance during emergencies and accidents.

OHMTADS: Abbreviation for Oil & Hazardous Materials Technical Assistance Data System. An on-line information retrieval service which can assist on-scene responders in identifying hazardous materials from limited on-site information such as material color, smell, etc.

OXIDIZER: A substance that spontaneously releases oxygen at room temperature or upon heating. Can react vigorously with organic and combustible materials.

PLACARD: Inverted, color-coded flat square placed on vessels transporting hazardous materials. Must be located on all four sides of the vessel, and can be used to aid material identification.

POISON A: A gas or liquid so toxic that an extremely low percentage of the gas or the vapor formed by the liquid is dangerous to life.

POISONOUS GAS: A toxic or irritating gas or volatile liquid that is harmful to living tissue when applied in relatively small doses.

POLYMERIZE: A chemical reaction, usually carried out with a catalyst, heat or light, and often under high pressure, in which a large number of relatively simple molecules combine to form a chain-like macromolecule.

PYROPHORIC: Spontaneously ignitable in air.

RADIOACTIVE MATERIAL: A material which spontaneously emits alpha or beta rays and sometimes also gamma rays by the disintegration of the nuclei of atoms.

RAILROAD: Any steam, electric, or other railway which carries passengers for hire or cargo in transport.

SPECIFIC GRAVITY: The ratio of the mass of a given volume of liquid to the mass of an equal volume of water at a given temperature.

SURFACTANT: Any compound that reduces surface tension when dissolved in water or water solutions, or which reduces interfacial tension between two liquids, or between a liquid and a solid.

THRESHOLD LIMIT VALUE: The average concentration of toxic gas to which most workers can be exposed during working hours (8 hours per day, 5 days a week) for prolonged periods without adversely affecting their health. (See also the complete

definition "Threshold Limit Values for Airborne Contaminants Adopted by ACGIH," by the American Conference of Governmental Industrial Hygienists, 1014 Broadway, Cincinnati, Ohio 45202.)

TOXIC: Poisonous. A toxic material will cause physiological damage to the human body.

TRAIN CONSIST: One type of shipping paper which lists goods shipped and other required information.

ULLAGE: The unfilled space in a tank or container, also known as "outage."

UNIFORM CLASSIFICATION NUMBER: The specific number assigned to commodities being transported by rail.

VAPOR SUPPRESSION: The process of retaining vapors or preventing them from escaping from a liquid surface.

WAYBILL: A shipping document prepared by the carrier of a shipment of goods that contains details of the shipment, route, and charges.

HOW TO USE TABBED SECTIONS

The management of a hazardous materials (HM) transportation accident involves the on-scene coordinator (OSC) and other emergency response (ER) personnel making complex decisions affecting not only the mitigation of hazards on-scene, but also the lives of exposed civilians, ER personnel, property, and the environment. The purpose of this Guide is to establish a systematized, logical sequence for addressing and mitigating the hazards at a HM accident. This is presented as a decision scenario shown in Figure I. Please note that each major decision sequence is color-coded. The tabbed section of the Guide which explains each sequence in detail is also color-coded for ease of use. Table I presents the steps necessary to utilize the decision scenario.

Emergency response operations performed on-scene typically follow a logical sequence of events. The first area of accident management is usually the notification of ER personnel, arrival on-scene of various ER groups and initial response efforts. This is followed closely by efforts to identify the HM involved. The Accident Management

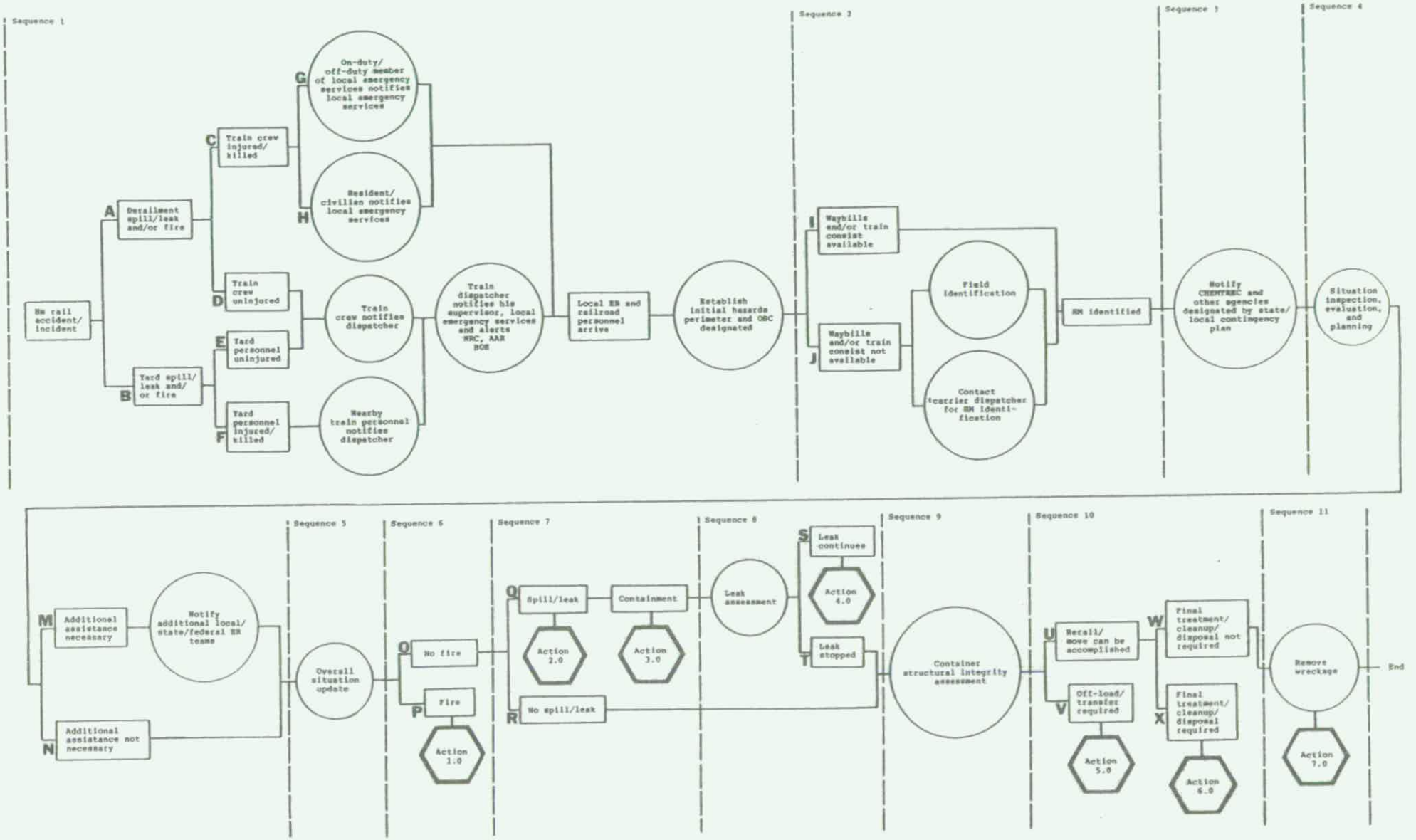


FIGURE 1. DECISION SCENARIO FOR HAZARDOUS MATERIALS ACCIDENT MANAGEMENT

TABLE I. RESPONSE TO HAZARDOUS MATERIALS RAILROAD ACCIDENT

Step	Guideline
1.	The HM rail incident occurs. Identify accident type.
	A. Derailment: Proceed to Step 2.
	B. Yard: Proceed to Step 3.
2.	Assess train personnel status.
	C. Injured/killed: Proceed to Step 4.
	D. Uninjured: Proceed to Step 5.
3.	Assess yard personnel status.
	E. Uninjured: Proceed to Step 5.
	F. Injured/killed: Proceed to Step 6.
4.	G. On-duty/off-duty member of local emergency services. Proceed to Step 8.
	H. Resident/civilian notifies local emergency services by two-way radio or telephone. Proceed to Step 8.
5.	Train crew notifies dispatcher by two-way radio, telegraph or telephone. Proceed to Step 7.
6.	Nearby train personnel notifies dispatcher by two-way radio, walkie-talkie or telephone. Proceed to Step 7.
7.	Train dispatcher notifies railroad officials, local emergency services (fire, police), alerts National Response Center at (800) 424-8802 and Association of American Railroads Bureau of Explosives at (202) 835-9500. Proceed to Step 8.
8.	Local emergency response personnel arrive on-scene. Proceed to Step 9.
9.	Police establish initial hazards perimeter, set up road blocks, local OSC is designated as per local contingency plan and sets up command post at a safe distance upwind of the accident. Proceed to Step 10.
10.	Attempt to identify HM involved. Are waybills and/or train consist available?
	I. Yes: Proceed to Step 12.
	J. No: Proceed to Step 11.

Step	Guideline
11.	Perform field identification. View tank cars involved in accident to identify any relevant information such as placards, UN numbers, tank car stenciling, car numbers, material odor, and color. Contact carrier dispatcher for HM identification. Proceed to Step 12.
12.	Positive identification of HM is made. Proceed to Step 13.
13.	Notify CHEMTREC at (800) 424-9300 and other agencies designated by State/local contingency plan. Proceed to Step 14.
14.	Perform initial situation inspection, evaluation, and planning. Assess if additional assistance is necessary. M. Yes: Proceed to Step 15. N. No: Proceed to Step 16.
15.	Notify additional local/State/Federal ER teams. Proceed to Step 16.
16.	Perform overall situation update. Proceed to Step 17.
17.	Assess if there is fire involvement (material on fire, fire in area, fire impingement on other containers). O. No: Proceed to Step 18. P. Yes: Proceed to Action 1 (Water Not Available or Insufficient Quantity).
18.	Assess presence or absence of spill or leak. Q. Spill/leak: Proceed to Action 2 (Spill/Leak), then to Step 19. R. No spill/leak: Proceed to Step 21.
19.	Attempt to contain runoff by constructing dam, dike or berm. Proceed to Action 3 (Suggested Containment Methods). Proceed to Step 20.
20.	Assess if leak can be stopped. T. Yes: Proceed to Step 21. S. No: Proceed to Action 4 (Leak Continues).

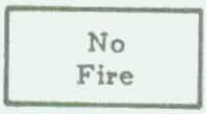
TABLE I (cont'd)

Step	Guideline
21.	Assess the container's structural integrity. Proceed to Step 22.
22.	Determine whether tank car can be rerailed/moved or if off-load/transfer is required. U. Rerailing/moving can be accomplished: Proceed to Step 23. V. Off-load/transfer required: Proceed to Action 5 (Off-Load/Transfer Required).
23.	Assess if final treatment/cleanup/disposal is required. W. No: Proceed to Step 24. X. Yes: Proceed to Action 6 (Treatment/Cleanup/Disposal).
24.	Perform wreckage removal operations. Proceed to Action 7 (Remove Wreckage).

Orientation Guide has been structured to consider the overall general sequence of events following a HM accident. This overall sequence includes:

- Sequence 1: Notification and Initial Response
- Sequence 2: HM Identification
- Sequence 3: Activation of State/Local Contingency Plan
- Sequence 4: Initial Situation Inspection, Evaluation and Planning
- Sequence 5: Situation Update
- Sequence 6: Fire/No Fire
- Sequence 7: Spill/Leak
- Sequence 8: Leak Assessment
- Sequence 9: Container Structural Integrity Assessment
- Sequence 10: Transfer/Cleanup/Disposal
- Sequence 11: Wreckage Removal

Throughout the text specific symbolism will be used to represent situations and reactions on-scene. These symbols will be given as follows:



Situation

This symbol is used to designate specific situations that occur. Example: No Fire.



Reaction

This symbol is used to designate specific actions taken by personnel given a situation. Example: Leak Assessment.



Action

This symbol is used along with the title Action and a specific number coming vertically from a situation to designate specific actions where situations are extremely dangerous or present requirements are beyond the limited availability of resources on-scene. Example: Action 1 - No water or insufficient water supply.

This Accident Management Orientation Guide presents general information guidelines which may also be of use to local, State and Federal ER personnel, cleanup/disposal contractors, carriers, shippers and wreckage removal contractors. Sections 1 through 11 present guidelines for working through each of the ER sequences. Information necessary for consideration in making optimal decisions is provided for each decision sequence.

Two sample scenarios using the decision logic have been prepared and are presented in Sections 12 and 13. Section 12 details the sequence of ER operations following a HM derailment involving propane and anhydrous ammonia; Section 13 provides the sequence of ER operations following a HM yard accident involving acrylonitrile and vinyl chloride.

1. NOTIFICATION AND INITIAL RESPONSE

When a HM transportation accident occurs it is imperative that local emergency response personnel are notified quickly and with precise accident details. The type and location of an accident and the nature of train/yard personnel casualties will often determine the available notification mechanism. Figure 1-1 identifies the sequence of events for notification and initial response. If a train derailment has occurred proceed to Section 1.1, but if the accident involves a yard accident proceed to Section 1.2.

1.1 DERAILMENT SPILL/LEAK AND/OR FIRE (SCENARIO SEGMENT A)

If the HM transportation accident is a derailment resulting in a spill, leak or fire, the extent and nature of train crew casualties needs to be determined. If the train crew has been injured/killed proceed to Section 1.3. However, if members of the train crew are not injured proceed to Section 1.6.

1.2 YARD SPILL/LEAK AND/OR FIRE (SCENARIO SEGMENT B)

If the HM transportation accident is in a yard resulting in a spill, leak or fire the casualties to yard personnel need to be determined. If members of the yard crew have been injured/killed proceed to Section 1.8. However, if members of the yard crew are uninjured proceed to Section 1.7.

1.3 TRAIN CREW INJURED/KILLED (SCENARIO SEGMENT C)

If members of the train crew involved in the derailment are injured/killed, they will not be able to notify their dispatcher or anyone else that an accident has occurred. When this is the case, initial accident notification is usually made by someone who happens to be nearby and sees or hears the accident such as a resident/civilian or an on-duty/off-duty member of local emergency services. Go to Section 1.4 for a discussion of notification by nearby residents/civilians. For notification by on-duty/off-duty members of the local emergency services proceed to Section 1.5.

1.4 RESIDENT/CIVILIAN NOTIFIES LOCAL EMERGENCY SERVICES (SCENARIO SEGMENT H)

Civilian members of the community should immediately advise a local emergency response dispatcher (i.e., fire, police, medical) that an accident has occurred. Even though several individuals may contact the same dispatcher about the incident, this

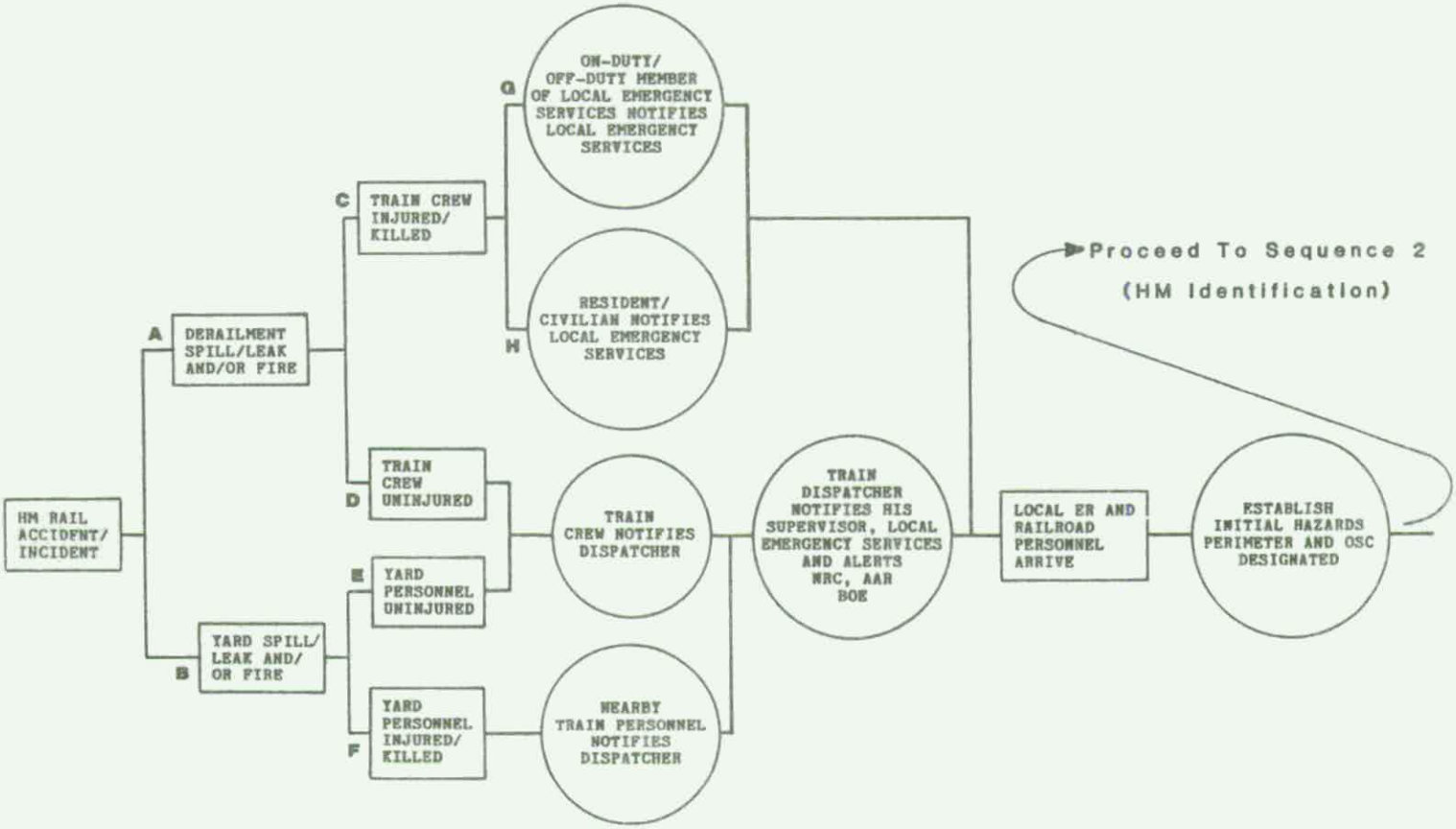


FIGURE 1-1. NOTIFICATION AND INITIAL RESPONSE - SEQUENCE 1

causes no problem. The important point is that no time is wasted, because this immediate notification can allow the local emergency services to respond on-scene promptly. The first few minutes are vital for successful response. This contact is usually by telephone and the telephone numbers for the local emergency services are located in the front pages of the local telephone directory. These should include at the minimum the following emergency response organizations:

- Police
- Fire
- State Police
- Poison Control Center

Each citizen who observes an accident should contact the local dispatcher instead of assuming that someone else will notify the appropriate official or agency. Although notification of the accident by the citizen to the local dispatcher is usually by telephone, sometimes an accident occurs in a remote area where there is no telephone service available. When this is the case, citizens band ("CB") radio, emergency channel nine should be used for contacting the local emergency services. There may even be a "Ham" operator nearby. If radio communications are not available, prior to leaving the accident scene and seeking emergency assistance the citizen should quickly note accident location, presence of fires, injuries or fatalities, etc. A passerby or citizen should not endanger himself by entering the accident area. Members of the civilian population should render medical assistance to those injured only if they are trained and qualified and can do so without exposing themselves to unnecessary danger.

Proceed to Section 1.12.

1.5 ON-DUTY/OFF-DUTY MEMBER OF LOCAL EMERGENCY SERVICES NOTIFIES LOCAL EMERGENCY SERVICES (SCENARIO SEGMENT G)

In some instances, a HM transportation accident may first be seen by an off-duty or on-duty member of the local emergency services. This was the case at HM transportation accidents in Youngstown, FL, in 1978, and Crestview, FL in 1979. When a member of the local emergency services observes a HM transportation accident he should immediately notify his local dispatcher using standard operating procedures. Prior to this notification, a preliminary assessment of the situation should be done noting specific accident information as indicated below. Again, the member of the emergency services should not expose himself to unnecessary danger.

1. Accident Location: e.g., near milepost 97 at the border of the town of Construct, TN.

2. Hazardous Materials Being Transported: This information can be found on carrier waybills and train consist. These documents are usually carried by the train crew. Examples of a typical waybill and train consist are given in Figures 1-2 and 1-3, respectively.

3. Amount of Material Released: This is somewhat difficult to estimate unless an entire tank car has ruptured. Data on the quantity of a HM being transported in each tank car are provided on the individual shipment waybills. If a vapor cloud or pool is forming from container leaks this should also be noted as well as details of cloud color and odor.

4. Injuries or Fatalities: Check with the train crew to identify if any injuries or fatalities have occurred. If so, relay this information to the dispatcher, perform initial first aid appropriate to your level of training and have the dispatcher contact local emergency services to request emergency medical assistance.

5. Number and Types of Cars Damaged: Provide any preliminary details of the number and types of cars damaged or derailed as a result of the HM accident.

6. Accident Site Conditions, Including Meteorological, Topographical, Demographic and Hydrogeological: These factors provide general conditions of the area which influence vapor dispersion patterns, population evacuation, and groundwater/soil/vegetative contamination.

After the local emergency services dispatcher has been notified and has been given available information concerning accident conditions, the emergency services personnel should remain on-scene to provide emergency assistance as needed until additional response units arrive. Proceed to Section 1.12.

1.6 TRAIN CREW UNINJURED (SCENARIO SEGMENT D)

When an accident occurs and members of the train crew are uninjured the conductor or other train personnel are required under railroad standard operating procedures

PLACE SPECIAL SERVICE PASTERS HERE

ORIGINAL

FREIGHT WAYBILL

Form T-6A

CAR INITIAL AND NUMBER	KIND	1ST TRAILER INITIAL AND NO.	PLAN	NO. CARS	CAR HEIGHT	LENGTH OF CAR ORDERED	LENGTH OF CAR FURNISHED	MARKED CAPACITY ORDERED	MARKED CAPACITY FURNISHED
		LENGTH FT IN.			FT. IN.	FT IN	FT IN		

C.L. TRANSFERRED TO	KIND	2ND TRAILER INITIAL AND NO.	PLAN	WAYBILL DATE	WAYBILL NUMBER
		LENGTH: FT IN.		TIME:	BY:

STOP AT THIS CAR AT

NO STATION STATE

TO

CONSIGNEE AND ADDRESS AT STOP

1 ST

2ND

FROM NO. STATION STATE

BILLED AT NO. STATION STATE

ROUTE

ROUTING "A" IF AGENTS "S" IF SHIPPER'S

SHIPPER'S FULL NAME AND ADDRESS

CUSTOMER CODE

RECONSIGNED TO STATION STATE

RWC

SHIPPER/INVOICE NUMBER | B/L NUMBER | B/L DATE

CONSIGNEE'S FULL NAME AND ADDRESS

CUSTOMER CODE

ORIGINAL WAYBILL REFERENCE

WEIGHED AT

GROSS TARE ALLOWANCE NET

FINAL DESTINATION AND ADDITIONAL ROUTING

SECOND TRAILER MOVED ON WAYBILL NUMBER

IF SUBJECT TO SECTION 7 OF CONDITIONS WRITE "YES"

PREPAID OR COLLECT

PREPAID

SPECIAL INSTRUCTIONS OR TRAILER DELIVERY INSTRUCTIONS

1st TRAILER NO

DELIVER TO

DRAYMAN

2nd TRAILER NO

DELIVER TO

DRAYMAN

DATE REV. W/B PREPARED

COMMODITY CODE

SEALS:

NO. OF UNITS	DESCRIPTION OF ARTICLES SPECIAL MARKS AND EXCEPTIONS	WEIGHT	RATE	FREIGHT	ADVANCES	PREPAID

OUTBOUND JUNCTION STAMPS HERE

YARD STAMPS ON BACK

FIRST JUNCTION	SECOND JUNCTION	THIRD JUNCTION	FOURTH JUNCTION	DESTINATION STAMP

FIGURE 1-2. SAMPLE FREIGHT WAYBILL

11GATX	47828L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTV	NOL	0660957
11GATX	47828	DANGEROUS			
12NATX	33978L	T6090704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0710960
12NATX	33978	DANGEROUS			
13GATX	49291L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660960
13GATX	49291	DANGEROUS			
14GATX	48099L	T5490704904210DSVL84BONNIE	FLCFINDUST MNMTVA	NOL	0660955
14GATX	48099	DANGEROUS			
15NATX	34175L	T3990704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0700948
15NATX	34175	DANGEROUS			
16GATX	49258L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660973
16GATX	49258	DANGEROUS			
17GATX	47906L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660956
17GATX	47906	DANGEROUS			
18GATX	93444L	T3990704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660849
18GATX	93444	DANGEROUS			
19GATX	55836L	T6090704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660859
19GATX	55836	DANGEROUS			
20GATX	48505L	T6090704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660954
20GATX	48505	DANGEROUS			
21GATX	47872L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660959
21GATX	47872	DANGEROUS			
22GATX	47878L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660946
22GATX	47878	DANGEROUS			
23GATX	47876L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660949
23GATX	47876	DANGEROUS			
24GATX	47834L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660951
24GATX	47834	DANGEROUS			
25GATX	47874L	T5490704904210DSVL847BONNIE	FLCFINDUST MNMTVA	NOL	0660963
25GATX	47874	DANGEROUS			
26MP	718772L	L153070FEED AA 883TAMPA	FLTAMINDEPEMNMTTA	NOL	0560630
27GATX	92097L	L4070SULPHURAAYL872GREENBAY	FLFARINDUSTMNMTBV	NOL	0440605
28GATX	09341L	L105070DRGCHEMAAD 647BRUNSWICK	GAHERCULES MNMXWX	NOL	0510592
29NATX	23367L	T1050704908105DSX1040MIAMI	FLASHCHEMICMNMJMI	NOL	0520597

FIGURE 1-3. PARTIAL TRAIN CONSIST

to notify their dispatcher immediately. This can be done by two-way radio, telegraph or telephone (see 49 CFR Section 220.47). Accident information described in Section 1.5 should be provided to the carrier's dispatcher. Proceed to Section 1.8.

1.7 YARD PERSONNEL UNINJURED (SCENARIO SEGMENT E)

When yard personnel are uninjured following a yard HM transportation accident they should immediately notify their dispatcher as outlined in Section 1.8.

1.8 TRAIN CREW/YARD PERSONNEL NOTIFY DISPATCHER

As stated in Sections 1.6 and 1.7 whenever a HM transportation accident occurs and the train crew or yard personnel are uninjured they should immediately notify the carrier's dispatcher by telephone, telegraph or two-way radio with pertinent information on accident type, location, casualties, involvement of HM, fires, and other on-scene conditions. Proceed to Section 1.11.

1.9 YARD PERSONNEL INJURED/KILLED (SCENARIO SEGMENT F)

When a HM transportation accident occurs in a yard facility and the yard personnel are injured or killed any other nearby yard personnel should notify the carrier dispatcher. See Section 1.10.

1.10 NEARBY YARD PERSONNEL NOTIFY DISPATCHER

Whenever yard personnel are injured/killed other nearby yard personnel should notify the service dispatcher by telephone or two-way radio and provide as much of the information detailed in Section 1.5 as possible. Proceed to Section 1.11.

1.11 TRAIN DISPATCHER NOTIFIES RAILROAD SUPERVISOR, LOCAL EMERGENCY SERVICES AND ALERTS NRC, AAR/BOE

The rail carrier is responsible for immediately notifying Federal, State and local officials and agencies when an accident involving releases of HM occurs. The railroad dispatcher will notify a railroad supervisor who will either direct the dispatcher to do the notification or handle it himself. The dispatcher will then contact the local fire, police, and medical emergency services. The local emergency response communications coordinator should promptly notify all concerned organizations and not assume that the carrier's dispatcher has done so. This will further assure that proper authorities have been notified.

The rail dispatcher should have a predesignated list of officials with telephone numbers to be contacted in the event of an accident. These lists should be developed through a cooperative effort between rail carriers transporting hazardous materials and those jurisdictions through which the materials are being shipped. Table 1-1 identifies a few of the appropriate officials/agencies to be contacted initially. The local emergency response unit dispatcher will notify units to respond on-scene as required. Once the accident has been reported it is important that the community HM emergency response communications network be activated immediately.

The following organizations may be contacted to provide assistance:

1. National Response Center: (800) 424-8802
2. CHEMTREC: (800) 424-9300
3. AAR Bureau of Explosives: (202) 835-9500

Proceed to Section 1.12.

1.12 LOCAL EMERGENCY RESPONSE AND RAILROAD PERSONNEL ARRIVE

When local emergency response and railroad personnel arrive they should organize and plan initial ER operations as shown in Figure 1-4 and as detailed in Section 1.13.

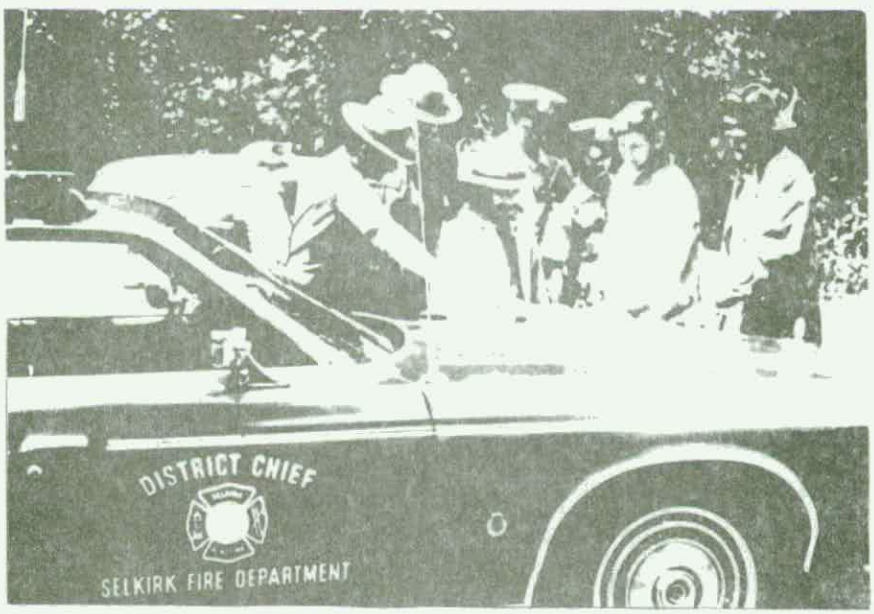


FIGURE 1-4. INITIAL ORGANIZATION AND PLANNING MEETING

TABLE 1-1. APPROPRIATE OFFICIALS/AGENCIES TO BE NOTIFIED INITIALLY

RESPONSE CHECKLIST

		Yes	No	NA*
1.	Have the proper authorities been notified?			
	CHEMTREC (800) 424-9300	—	—	—
	County/City			
	Sheriff (or Police Dept.)	—	—	—
	County Health Department	—	—	—
	Fire Department	—	—	—
	Hospitals	—	—	—
	Public Works	—	—	—
	Water Department	—	—	—
	Water Resources	—	—	—
	Fish and Game	—	—	—
	Air Pollution District	—	—	—
	State			
	Bureau of Disaster Preparedness	—	—	—
	Department of Health	—	—	—
	Department of Transportation	—	—	—
2.	Have adequate safety precautions been taken in the accident area?	—	—	—
3.	Have you identified the HM?	—	—	—
4.	If unidentifiable, do you know who to contact for proper identification?	—	—	—
5.	Are adequate communications available?	—	—	—

* Not Applicable

1.13 ESTABLISH INITIAL HAZARDS PERIMETER, DESIGNATE OSC, SET UP COMMAND POST

When local emergency response and railroad personnel arrive on-scene they should:

1. Expect HM to be involved.
2. Set up road blocks and establish hazards perimeter to control access and keep on-lookers and unauthorized personnel at a safe distance from the scene. See Figure 1-5.



FIGURE 1-5. RESPONSE PERSONNEL AT HAZARDS PERIMETER

3. Avoid walking into or touching any spilled material.
4. Avoid inhalation of all gases, fumes and smoke even if no hazardous materials are involved.
5. Do not assume that gases or vapors are harmless because of lack of smell.
6. Designate an on-scene coordinator especially if more than one person is involved in an emergency response action, (predesignation during emergency action preplanning is strongly recommended) so that everyone **knows who is in charge of handling the incident.**
7. Establish a command post in a convenient location at a safe distance upwind from the incident to provide a coordination and communications center to control all response activities as shown in Figure 1-6. The command post may be set up at a local school, warehouse, mobile trailer or office building.

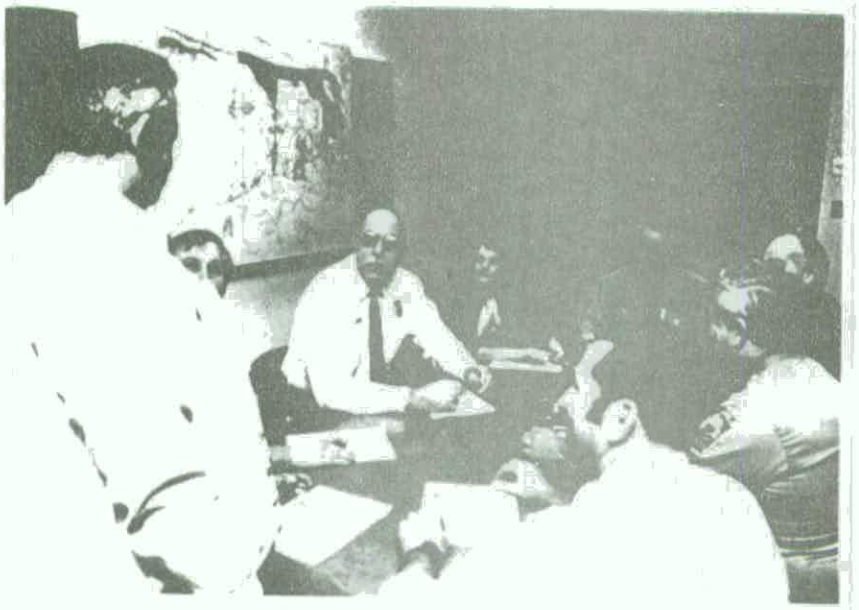


FIGURE 1-6. COMMAND POST

8. Use the Table of Isolation and Evacuation Distances from the 1982 DOT Emergency Response Guidebook to determine the appropriate initial isolation and evacuation distances to keep nonessential ER personnel and passersby away from the accident scene.

9. Establish a communications system (radio, telephone, computer interface) at the command post.

Proceed to Section 2.

2. HAZARDOUS MATERIALS IDENTIFICATION

This section discusses Sequence 2 of the decision scenario designed to assist ER personnel in positively identifying HM involved in an accident. Figure 2-1 presents the sequence of activities needed to identify HM involved in an accident.

The first step in identifying the contents of a derailed, damaged rail car is to determine if the waybills or train consist are available. The availability of waybills or train consist documentation is established when local ER personnel arrive on the scene of a railroad accident, find the train crew and obtain the proper documentation. A typical waybill and train consist used in the transportation of HM by rail are shown in Section 1. If the waybills or train consist are available proceed to Section 2.1. However, if the waybills or train consist information are not available proceed to Section 2.2.

2.1 WAYBILLS AND/OR TRAIN CONSIST AVAILABLE (SCENARIO SEGMENT I)

Information such as tank car numbers, car contents, weight of materials being transported and sometimes initial remedial emergency actions are available on or accompanying the waybills and train consist.

Train consist and waybill documentation are important tools in identifying the contents of a tank car involved in a transportation accident. For rail shipments, the train consist and waybills are usually kept by a member of the train crew, usually the conductor. Waybills identify contents of a rail tank car and provide the quantity and weight of the commodity, the DOT placards required, the DOT description, hazards classification, United Nations (UN) number of the material, Standard Transportation Commodity Code (STCC), the Uniform Classification Number (rail) for the specific commodity being transported and sometimes general emergency response information. Waybills or some exempted (DOT accepted) documentation are required under the Hazardous Materials Transportation Act to accompany a shipment of hazardous materials. In reality this does not always happen and then additional information must be sought to identify materials. Following an accident, rail personnel should seek out representatives of the emergency response community and supply any documentation or assistance they can to help identify the materials involved. Further, the rail crew should also identify not only involved cars that contain hazardous materials but also their position in the train for possible interaction with other HM which could increase hazards and risks to arriving emergency responders. This information can be obtained from the train consist. Many railroads and shippers currently provide printed emergency response procedures with the documentation for each hazardous commodity being transported.

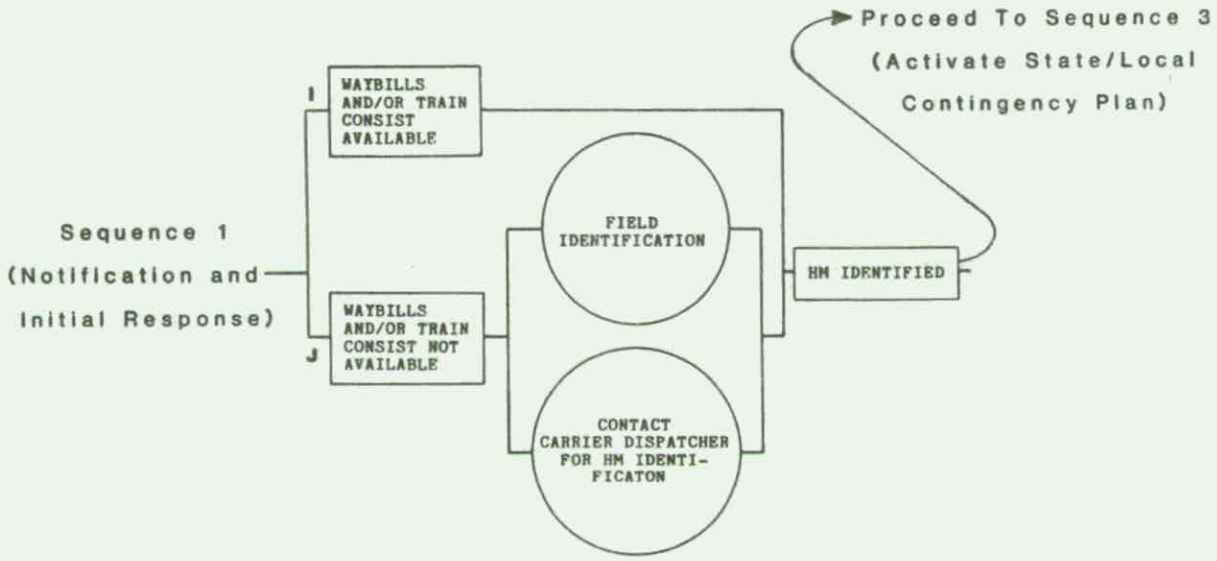


FIGURE 2-1. HM IDENTIFICATION - SEQUENCE 2

Once this information is recovered and the HM positively identified, proceed to Section 3 (Activate State/Local Contingency Plan). If the waybills or train consist are not available from the train crew then the HM can be identified by contacting the carrier dispatcher or through field identification methods as detailed in Section 2.4.

2.2 WAYBILLS AND/OR TRAIN CONSIST NOT AVAILABLE (SCENARIO SEGMENT J)

When the waybills and/or train consist documentation can not be found, are not available or do not appear to be consistent with the train makeup, local ER personnel should contact their service dispatcher with this information. The ER personnel should also note any markings on the tank car, such as tank car number, stenciling, placards or UN numbers. The service dispatcher should then contact the railroad dispatcher to obtain the HM identification information.

2.3 CONTACT CARRIER DISPATCHER FOR HM IDENTIFICATION

When waybills or train consist documentation can not be found or do not appear to be consistent with the train makeup, local ER personnel should contact their service dispatcher with this information. The service dispatcher should then contact the railroad dispatcher to obtain HM identification information. Having a pre-established working agreement between the locality and carrier would be mutually beneficial. The railroad dispatcher will either be able to identify the tank car contents based upon available information such as tank car number or UN number provided by ER personnel or will call the shipper to request HM identification information.

If the shipper can identify the HM involved proceed to Section 3 (Activate State/Local Contingency Plan).

If during the course of attempting to identify the HM involved in the accident, neither the train crew, the carrier dispatcher nor the shipper have documentation then field identification methods described in Section 2.4 can be used.

2.4 FIELD IDENTIFICATION

To identify HM involved in an accident when supporting documentation is unavailable any one or a combination of the following field identification methods can be used:

- Visual methods such as placards, markings or container shapes/designs;

- External communications data systems such as CHEMTREC, USCG/NRC, OHMTADS, etc.; and
- Sensing methods using equipment specifically designed to identify commodities.

2.4.1 Visual Methods

Several visual methods for on-scene identification of hazardous materials contained in rail cars exist. These include:

- DOT placarding system in conjunction with the United Nations (UN) or Standard Transportation Commodity Code (STCC) identification numbers; and
- Observation of markings, specific coloration, size, shape and appurtenances on containers.

These methods are best used in conjunction with other available methods to identify a material involved in an accident. Positive identification is necessary for response personnel to mitigate hazards associated with a specific accident properly.

2.4.1.1 DOT UN Identification Number/Placard System

All DOT regulated hazardous commodities shipped by rail have been assigned a UN or NA number. The railroads also use a Standard Transportation Commodity Code (STCC) number. If either of these numbers is known, but the commodity name is not known, the material may be identified by referencing the UN or NA number in the DOT 1982 Hazardous Materials Emergency Response Guidebook or either the UN, NA or the STCC number in the AAR guide, Emergency Handling of Hazardous Materials in Surface Transportation.

The DOT placards are indicators of the primary hazards associated with specific classes of hazardous materials such as explosives, compressed gases (nonflammable and flammable), flammable liquids and solids, oxidizing materials, poisonous materials, irritating materials, corrosive materials and radioactive materials.

The new placard/UN numbering system is shown in Figure 2-2. When the UN numbers are used on the placards, the orange panel is not required. However, the appropriate placard must be used in conjunction with the UN numbers on the orange panels.

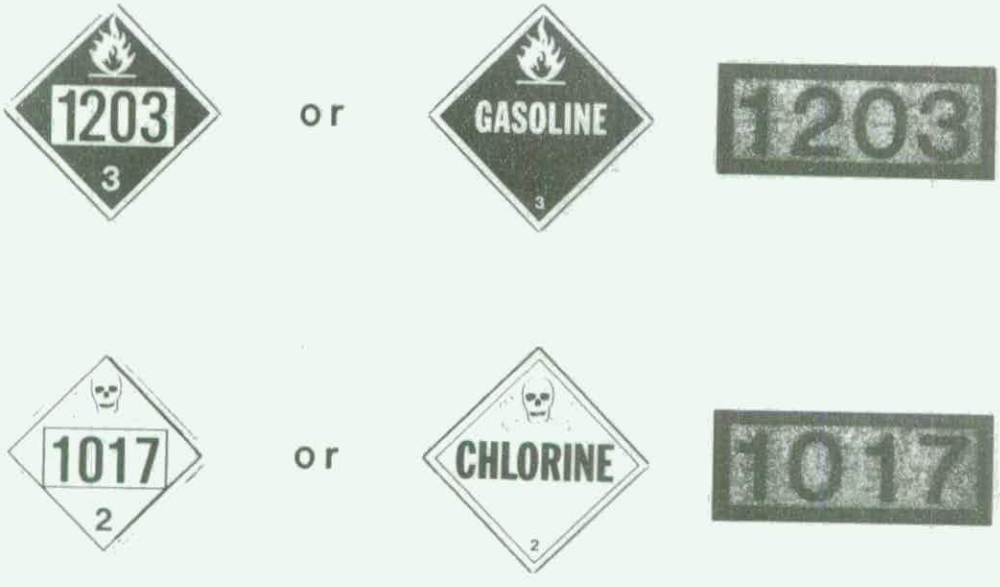
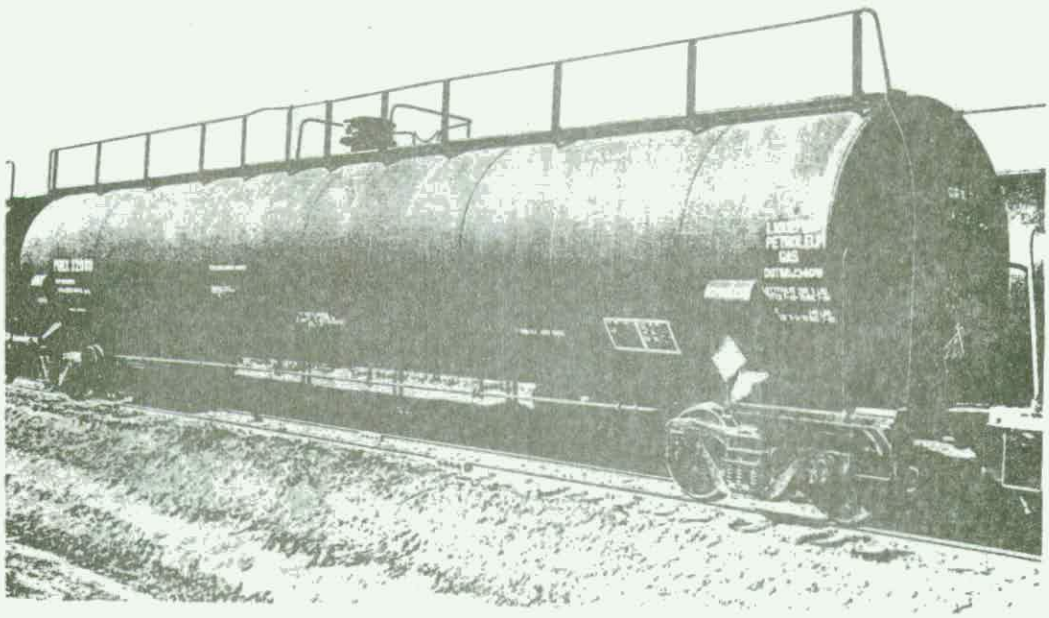


FIGURE 2-2. DOT PLACARD VARIATIONS

2.4.1.2 Markings, Coloration, Shape of Containers

Regulations require that certain commodities in transportation have the name of the commodity stenciled on the tank car or container. An example of specific service stenciling for an LPG tank car is shown in Figure 2-3. This stenciling can be a useful identification tool as an indicator of tank contents. Further, as shown in Figure 2-4, shipments of hydrocyanic acid (Poison A) are indicated by a white car with bright red candy striping.

The DOT tank car specification numbers indicate information about the car. A typical tank car specification might read DOT 111 A 60 ALW.



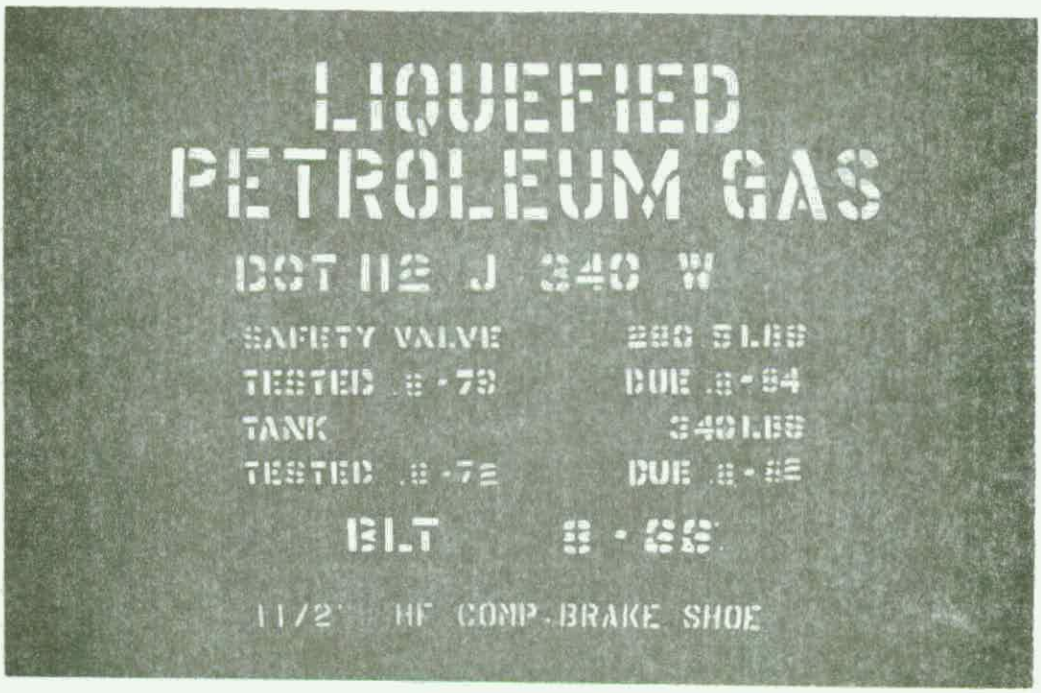


FIGURE 2-3. LPG TANK CAR SERVICE STENCILING

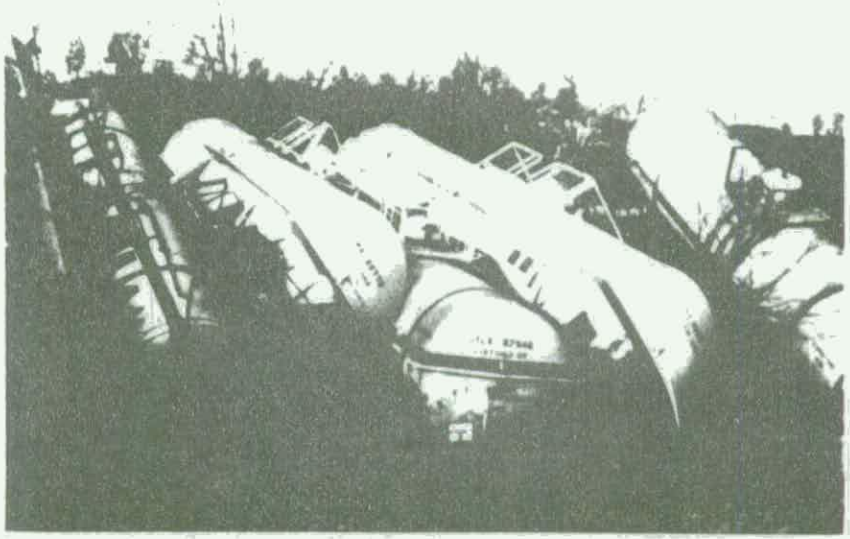


FIGURE 2-4. HYDROCYANIC ACID TANK CAR MARKINGS

DOT is the authorizing agency.

111 is the class designation.

'A' is merely a spacer separating the class designation and tank test pressure. In the case of 112 and 114 compressed gas tank cars, the letters 'S,' 'J,' or 'T' can replace 'A.' 'S' indicates the car has a head shield; 'J' indicates the car is equipped with a head shield and a thermal protection system enclosed in a metal jacket; and 'T' indicates the car has a head shield and a non-jacketed thermal protection system.

60 is the tank test pressure in psi.

AL indicates a tank material other than steel.

'W' indicates fusion welded construction. 'F' denotes a forge welded tank and 'X' denotes fusion welded longitudinal tank seam and forge welded head seams. If no suffix appears, the tank has seamless construction.

Although these specifications do not give a specific identification for the commodity they give additional information which may assist the responder.

2.4.2 External Communications Methods

Telephonic assistance networks such as the USCG National Response Center and CHEMTREC can assist a caller in identifying a material given some on-scene information such as markings, placards, color, odor, dispersion pattern, behavior (e.g., reactivity), etc. If the information is adequate, these groups may be able to provide preliminary handling and firefighting procedures until expert assistance arrives. Computerized systems can further augment data transmission to an accident scene.

Several telephonic information retrieval systems are available for obtaining chemical data which would be useful to on-scene response personnel to identify and mitigate the hazards associated with a HM transportation accident. Table 2-1 is a list of applicable retrieval systems, type of organization providing the service, information and type of on-site response assistance which can be obtained. Table 2-2 is a list of on-line information retrieval services which provide information in the form of an annotated bibliography or listing of applicable topic references. Access to some of these on-line retrieval systems could help on-site responders with quick response time.

2.4.2.1 Oil and Hazardous Materials Technical Assistance Data System (OHMTADS)

The OHMTADS computerized information retrieval service has more than 1,150 oil and hazardous materials on file. OHMTADS is an on-line interactive computer system which can provide emergency information to on-scene responders in identifying a hazardous material from limited on-site information such as material color, smell, etc. There are 126 parameters for each material in the file which include descriptions of physical, chemical, biological, toxicological, transportation and commercial data. The criteria for the inclusion of a material in the data base include spill history, production volume, exposure and toxicity data.

This system allows the identification of unidentified materials by using a random access feature. Physical or chemical characteristics of the materials involved are input and the system generates a list of the probable materials. These materials are then displayed on the user's CPU. System search components can take an interactive mode which prompts the user to input additional material or accident data until the material's identity may be confirmed.

The oil and hazardous materials spill coordinator at the EPA Regional office (Regional Response Center) provides access to OHMTADS or an on-line computer search can be performed through the University of Indiana. Table 2-3 lists the hazardous spill coordinators for each of the EPA Regional Offices.

2.4.2.2 U.S. Coast Guard Chemical Hazards Response Information System (CHRIS)

This system is comprised of four user manuals, a hazard assessment computer system (HACS) and the National Response Center (NRC). The four manuals are:

- Vol. 1. CG-446-1 - Condensed Guide to Chemical Hazards. Provides vital information on hazardous chemicals that are shipped in large quantity by marine transportation.

TABLE 2-1. LISTING OF SOME AVAILABLE INFORMATION/ASSISTANCE SOURCES FOR HAZARDOUS MATERIALS SPILLS

Information Source	Type of Organization	Type of Information Assistance*	Access
EPA Oil and Hazardous Materials - Technical Assistance Data System (OHMTADS)	Federal	2*	EPA Regional Office, University of Indiana (24-hour on-line capability)
Coast Guard Chemical Hazards Response Information System (CHRIS)	Federal	2*	National Response Center through OSC. Regional Response Center District Offices: See Table 2-4
Coast Guard National Strike Force	Federal	1	National Response Center (800/424-8802)
U.S. Army Technical Escort Center Chemical Emergency Response Team	Federal	1	Dept. of Army Operation Center (301) 671-4381 After duty hours - (301) 671-2773
Chemical Transportation Emergency Center (CHEMTREC)	Industry sponsored	2,3	CHEMTREC (800/424-9300 or 202/483-7616 in Washington, D.C.)

1. Respond to scene with trained personnel if required.
2. Provide information on identity, hazards, or what to do.
3. Refer to knowledgeable contact.

* On-line computer available.

TABLE 2-1 (cont'd)

Information Source	Type of Organization	Type of Information Assistance	Access
Pesticides Safety Team Network	Industry sponsored	1,2,3	Through CHEMTREC (800/424-9300 or 202/483-7616 in Washington, D.C.)
Transportation Emergency Assistance Plan (TEAP)	Canadian, privately sponsored	1,2,3	Each regional Control Center has a 24 hour number.
Chlorine Emergency Plan (CHLOREP)	Privately sponsored	1,2,3	Through CHEMTREC (800/424-9300 or 202/483-7616 in Washington, D.C.)

TABLE 2-2. TYPICAL INFORMATION RETRIEVAL SYSTEMS

INFORMATION SOURCE	ON-LINE COMPUTER SYSTEM?	PHONE #
CHEMICAL INFORMATION SYSTEM (CIS)	YES	(800) 368-3432
OCCUPATIONAL HEALTH SERVICES	YES	(212) 752-4530
DIALOG INFORMATION SERVICES	YES	(415) 858-2700
ILLINOIS INSTITUTE FOR ENVIRONMENTAL QUALITY LIBRARY	YES	(217) 785-2388
INSTITUTE FOR SCIENTIFIC INFORMATION	YES	(215) 386-0100
INFORMATION HANDLING SERVICES	YES	(714) 556-9404
NATIONAL TECHNICAL INFORMATION SERVICE	YES	(703) 487-4600
NIOSH TECHNICAL INFORMATION CENTER	YES	(513) 684-8326
SPILL CONTROL ASSOCIATION OF AMERICA	NO	(313) 552-0500
NASA SCIENTIFIC & TECHNICAL INFORMATION OFFICE	YES	(202) 453-2910
GLOBAL ENGINEERING DOCUMENTATION SERVICES	NO	(800) 854-7179
BATTELLE COLUMBUS LABORATORIES	NO	(919) 549-8965
NEW ENGLAND RESEARCH APPLICATION CENTER	YES	(203) 486-4533
UNIVERSITY OF NEW MEXICO	NO	(505) 277-3622

TABLE 2-2 (cont'd)

Information Source	On-line Computer System	Contact
U.S. Dept. of Commerce, Maritime Administrator	no	212/967-5136
National Bureau of Standards Fire Technology Library	no	301/921-3246
NASA - Aerospace Safety Research & Research & Data Institute	no	216/443-4000 Ext. 285
Chemical Abstract Service Ohio State Univ.	no	614/421-6940
Computer Search Center Illinois Institute of Technology Research Institute	no	312/225-9630
Fire Research Section Southwest Research Institute	no	512/684-5111 Ext. 2415
Environmental Engineering Div., Texas A&M Univ.	no	713/845-3011
Toxicology Data Bank, National Library of Medicine	no	301/496-1131
Hazardous Material Technical Center (Operated by the Dynamic Corporation for the Defense Logistics Center)	no	800/638-8958 or 301/468-8958

TABLE 2-3. EPA REGIONAL EMERGENCY RESPONSE OFFICES

REGION 1

Chief, Oil & Hazardous Materials Section
Surveillance and Analysis Div.
60 Westview Street
Lexington, MA 02173
(617) 861-6700 (Office)
(617) 223-7265 (Emergency)

REGION 2

Chief, Emergency Response Branch
Environmental Services Div.
Edison, NJ 08837
(201) 321-6657 (Office)
(201) 548-8730 (Emergency)

REGION 3

Chief, Environmental Emergency Section
6th & Walnut Streets
Curtis Building 3ES30
Philadelphia, PA 19106
(215) 597-9899 (Office)
(215) 597-9898 (Emergency)

REGION 4

Chief, Emergency Remedial & Response Branch
345 Courtland Street, NE
Atlanta, GA 30365
(404) 881-3931 (Office)
(404) 881-4062 (Emergency)

REGION 5

Chief, Superfund, Oil & Hazardous Materials Coordinator
Environmental Services Div.
5SEES
536 South Clark Street
Chicago, IL 60605
(312) 353-2318 (Office)
(312) 353-2103 (Emergency)

REGION 6

Chief, Emergency Response Branch
6ESE, 1201 Elm Street
First International Building
Dallas, TX 75270
(214) 767-2720 (Office)
(214) 767-2666 (Emergency)

REGION 7

Chief, Emergency Planning & Response Branch
Environmental Services Div.
25 Funston Road
Kansas City, KS 66115
(913) 236-3888 (Office)
(913) 236-3778 (Emergency)

REGION 8

Chief, Emergency Response Branch
Environmental Services Div.
1860 Lincoln Street
Denver, CO 80295
(303) 234-6069 (Office)
(303) 234-2259 (Emergency)

REGION 9

Chief, Emergency Response Section
T-3-3
Field Operations
Toxic & Waste Management Div.
215 Fremont Street
San Francisco, CA 94105
(415) 974-8131 (Office/Emergency)

REGION 10

Chief, Environmental Emergency Response Team
Environmental Services Div.
1200 6th Avenue
Seattle, WA 98101
(206) 442-1295 (Office)
(206) 442-1263 (Emergency)

Anchorage, Alaska
(907) 586-7619 (Emergency)

- Vol. 2. CG-446-2 - Hazardous Chemical Data Manual. Contains similar information to Vol. 1 as well as data in terms of the chemical, physical, and toxicological properties of hazardous chemicals.
- Vol. 3. CG-446-3 - Hazard Assessment Handbook. Contains methods for determining the source strength of spilled hazardous chemicals as well as procedures for estimating the toxic, flammable and explosive hazards for the materials contained in the HACS system.
- Vol. 4. CG-446-4 - Response Methods Handbook. Provides information on techniques for handling spills of the materials in CHRIS. The Appendix to CG-446-4 lists manufacturers of equipment that could be used in the event of a spill.

HACS, the computerized counterpart of CHRIS Volume 3, provides detailed hazard assessment information. CHRIS Volume 3 identifies methods for hand calculating the spill situation. The Coast Guard recommends that HACS be used because it provides sophisticated, rapid and more accurate evaluation of the spill situation than by the manual method. HACS has been designed for estimating release information of spills into water and the output is basically for use by the OSC through the NRC in Washington, D.C.

Coast Guard Regional Offices have CHRIS Manuals available for use in the event of an emergency. The HACS can be accessed for emergencies directly through the Department of Transportation National Response Center, USCG Regional Response Center or Coast Guard District Office. Table 2-4 lists the Coast Guard Regional Offices and the telephone numbers to contact in the event of a hazardous materials spill. The National Response Center at (800) 424-8802 should also be contacted.

2.4.2.3 U.S. Coast Guard National Strike Force

The Coast Guard's National Strike Force is part of the National Contingency Plan established under the authority of the Federal Water Pollution Control Act Amendments of 1972, Section 311. As needed and specified in the National Contingency Plan, equipment and trained personnel are provided to aid the on-scene coordinator during Phase III (Containment and Countermeasures), Phase IV (Cleanup, Mitigation and Disposal) and Phase V (Documentation and Cost Recovery). The East, West, and Gulf Coasts each have a Coast Guard Strike Team. Each team is comprised of about 19 personnel with three or four officers and can effectively respond to a pollution incident in its area with at least four persons responding within two hours and at full strength in 12 hours. The strike team supplies communication support, assistance and advice on ship salvage, diving and removal procedures.

TABLE 2-4. DEPARTMENT OF TRANSPORTATION, U.S. COAST GUARD DISTRICTS

1st Coast Guard District, 150 Causeway Street, Boston, MA 02114, Duty Officer: (617) 223-6978.

2nd Coast Guard District, 1430 Olive Street, St. Louis, MO 63101, Duty Officer: (314) 353-7110.

3rd Coast Guard District, Governors Island, New York, NY 10004, Duty Officer: (212) 668-7298.

5th Coast Guard District, Federal Buidling, 431 Crawford Street, Portsmouth, VA 23705, Duty Officer: (804) 398-6231.

7th Coast Guard District, Room 1018, Federal Building, 51 SW 1st Avenue, Miami, FL 33130, Duty Officer: (305) 350-5611.

8th Coast Guard District, Hale Boggs Federal Building, 500 Camp Street, New Orleans, LA 70130, Duty Officer: (504) 589-6298.

9th Coast Guard District, 1240 East 9th Street, Cleveland, OH 44199, Duty Officer: (216) 522-3984.

11th Coast Guard District, Union Bank Building, 400 Oceangate Boulevard, Long Beach, CA 90822, Duty Officer: (213) 590-2315.

12th Coast Guard District, 630 Sansome Street, San Francisco, CA 94126, Duty Officer: (415) 273-7611.

13th Coast Guard District, 915 2nd Avenue, Seattle, WA 98174, Duty Officer: (206) 442-5886.

14th Coast Guard District, Prince Kalanianaole Federal Building, 300 Ala Moana, Honolulu, HI 96850, Duty Officer: (808) 546-2170 (commercial only), AUTOVON - (315) 430-0111.

17th Coast Guard District, P.O. Box 3-5000, Juneau, AK 99802, Duty Officer: (907) 586-7340 (commercial only), AUTOVON - (317) 388-7340.

On-scene coordinators anywhere in the U.S. can request the services of the National Strike Force by contacting the National Response Center 24-hour emergency telephone number (800/424-8802). Specific details and any pertinent information about the accident should be given.

2.4.2.4 Chemical Transportation Emergency Center (CHEMTREC)

CHEMTREC (service of Chemical Manufacturers Association) maintains an emergency 24-hour telephone number (800/424-9300 or 202/483-7616 in Washington, D.C.) for emergencies involving the transportation of chemicals. If the chemical is identified, CHEMTREC will assist by providing "cookbook" cautionary measures that can be used on-site. CHEMTREC will then contact the shipper of the chemical, obtain necessary information as well as assistance and follow-up. The CHEMTREC system is not computerized but it contains over 45,000 product and trade name listings considered by manufacturers to be their primary items of shipment.

CHEMTREC is mainly a medium for putting the caller and chemical shipper or manufacturer into contact with each other when an accident occurs because the chemical manufacturers will have the necessary data concerning the properties of their products. CHEMTREC is also available as a contact point for such organizations as the Chlorine Institute providing CHLOREP (a chlorine emergency plan for chlorine spills), the National Agricultural Chemicals Association (spills of pesticides), the Fertilizer Institute (ammonia spills) and the Department of Energy (radioactive materials).

When contacting CHEMTREC, as much of the following information as possible should be provided:

- Name of caller and call back number;
- Location of problem;
- Shipper or manufacturer;
- Container type;
- Rail car number;
- Carrier name;
- Consignee; and
- Local conditions.

2.4.2.5 Additional Sources of Material Information

There are many handbooks, reference texts and organizations which may prove helpful in the event of a hazardous materials spill. Any person or organization who may be confronted with a HM spill emergency should have access to the commonly used references and should be aware of knowledgeable groups available. A representative list can be found in Table 2-5.

2.4.3 Sensing Methods

The state-of-the-art of practical hazardous materials sensing technology is relatively unsophisticated. To date there are no instruments commercially available to local ER personnel capable of remote specific hazardous materials identification. A few experimental systems have been tested and have been applied in specific applications, however, due to cost considerations are not realistically affordable by most municipalities.

Non-remote sensing has more currently available techniques with several commercial instruments using radiation absorption techniques (IR, UV, visible); mass spectrometry; gas chromatography; gas chromatography-mass spectrometry (GC-MS); and specific material chemical reactions and parameter measurement techniques (pH, conductivity, colorimetric indicators, gas and vapor detectors).

The GC-MS and dispersive IR analyzer show promise for near-term development into field usable identification systems. However, the methods to detect specific materials are currently the most practical and broadly applicable for accident site use. These methods include specific colorimetric detector tubes, water analysis kits, gas and vapor detectors and dosimeters.

2.4.3.1 Colorimetric Indicators

Detector tubes are a type of visual colorimetric indicator comprised of a sealed glass cylinder with chemically-treated packings designed to react with a specific gas or vapor. Typically, a calibrated pump is used to draw a vapor sample through the tube and the length of stain or degree of color change determined from calibration charts. These indicators are manufactured by Mine Safety Appliances Company (MSA), National Draeger, Inc., Bendix/Gastec (National Environmental Instruments, Inc.) and Matheson Gas Products (Division of Hill Ross, Inc.), and possibly other firms.

TABLE 2-5. SELECTED HAZARDOUS MATERIALS REFERENCES

1982 Emergency Response Guidebook

Department of Transportation
Research and Special Programs Administration
Materials Transportation Bureau

Manual for the Control of Hazardous Materials Spills: Volume I - Spill Assessment and Water Treatment Techniques

Environmental Protection Agency

Emergency Handling of Hazardous Materials in Surface Transportation

Association of American Railroads
Bureau of Explosives

Guidelines Manual Post Accident Procedures for Chemicals and Propellants

Systems Technology Laboratory, Inc.
AFRPL/FRA

The Condensed Chemical Dictionary

Van Nostrand Reinhold Company

Chemical Hazards Response Information System (CHRIS) Volumes I-IV

U.S. Coast Guard

Hazardous Materials Spills Conference, Annual Proceedings

Pocket Guide to Chemical Hazards

Department of Health and Human Services (NIOSH)
Department of Labor (OSHA)

Code of Federal Regulations: 49 Transportation Parts 100-177

TABLE 2-5 (Cont'd)

Control of Hazardous Chemical Spills by Physical Barriers

Environmental Protection Agency
Office of Research and Monitoring

Fire Protection for Chemicals

National Fire Protection Association

Standard Transportation Commodity Code

Association of American Railroads

Chemical Hazards Response Information System for Multimodal Accidents (CHRISMA)

Department of Transportation
U.S. Coast Guard
Office of Research and Development

Managing Hazardous Substances Accidents

Al Smith, Jr.
McGraw-Hill

Hazardous Chemicals Data Book

Noyes Data Corp.

One of the major shortcomings in the application of colorimetric detectors to hazardous materials emergencies is that they are generally material-specific and of very limited use for identification of unknowns or mixtures, which is the usual case in accidents. However, where the presence of a material is suspected, these indicators might add to the evidence towards verification.

2.4.3.2 Water Analysis Kits

Several kits have been developed for analysis of hazardous materials in water. The two major types differ basically in the nature of the tests involved. One uses non-specific, chemical-class tests for detection of pollutant presence, the other gears tests for specific contaminant identification. The first type kit is commercially available from HAC Chemical Co., while the second is still under evaluation by the EPA. The problem with both types of analysis kit is that training is required both to perform and interpret results.

2.4.3.3 Gas and Vapor Detectors

There are many different vapor detectors available for many different applications and varying levels of sensitivity. There are instruments which measure concentrations in percent by volume in air; instruments for specific ranges of explosives or flammable vapors (alkane hydrocarbons); instruments for broad ranges of combustibles; and instruments which do not depend on combustion for their operation. Examples of gas and vapor detectors are given in Figures 2-5 through 2-8. These figures show the HNU Systems Model PI101 photo-ionizer, the Analytical Instrument Development, Inc. Model 910 Organic Vapor Meter, Foxboro MIRAN-1A ambient air analyzer and the MSA Model 2A Explosimeter, respectively.

2.4.3.4 Dosimeters, Personal Monitors, Alarms

These are also items which indicate danger levels of exposure for individuals in the vicinity of hazardous materials releases. An example of this type of device is the American Gas & Chemical Company Leak-Tec HS-5 Hydrogen Sulfide Sensitive Indicator, a personal monitor for a toxic gas which can be worn by responders. There are also portable alarms which respond to specific HM or oxygen deficient environments. Because these units are specific for given materials they would not be applicable to a broad or unknown range of hazardous atmospheres.

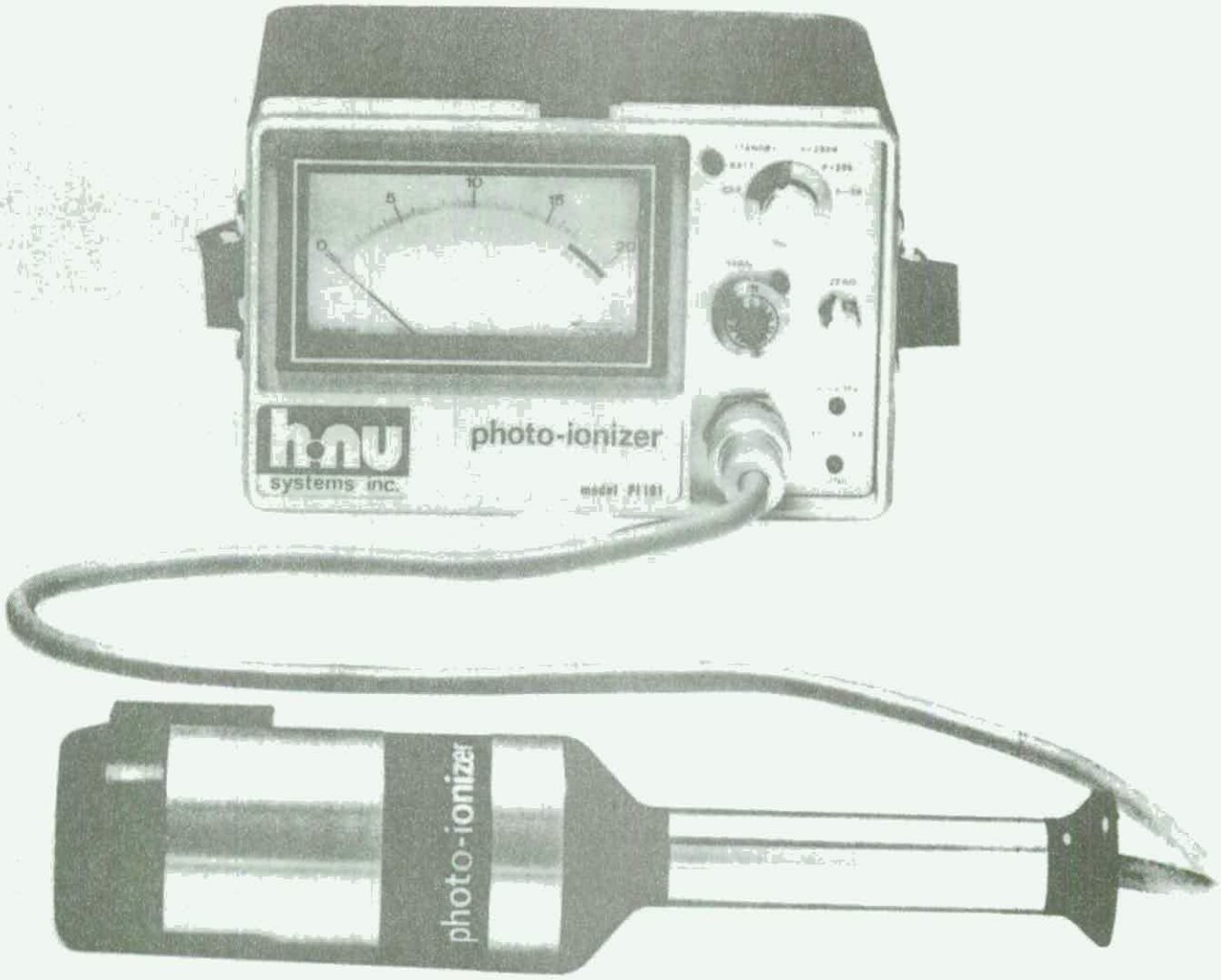


FIGURE 2-5. HNU SYSTEMS MODE PI101 PHOTO-IONIZER

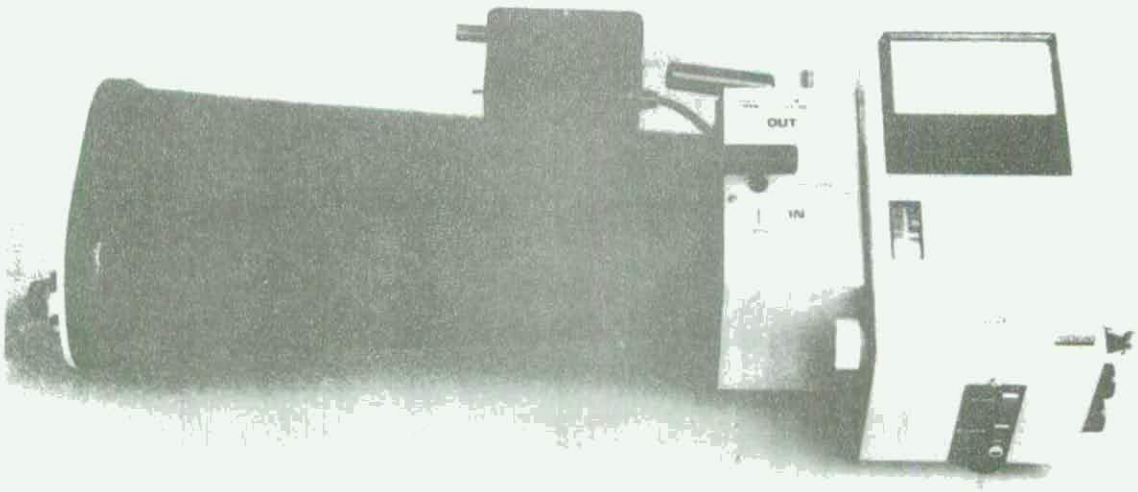


FIGURE 2-6. FOXBORO MIRAN-1A AMBIENT AIR ANALYZER



FIGURE 2-7. MSA MODEL 2A EXPLOSIMETER



FIGURE 2-8. ANALYTICAL INSTRUMENT DEVELOPMENT INC., MODEL 910 ORGANIC VAPOR METER

2.4.3.5 Summary of Field Identification Methods

Fast, accurate in-field sensing methods for detection and identification of hazardous materials involved in a transportation emergency are needed not only to facilitate mitigation and cleanup but also to monitor the environment during post-accident efforts. Present methods utilizing visual (shipping documents, placards, markings) and external communications systems (CHEMTREC) are simply not adequate.

Currently no remote sensing instrumentation exists which is portable and field-ready for detection and identification of hazardous materials.

There is a large number of non-remote instruments commercially available for specific applications during hazardous materials emergencies, but there is no instrument capable of identifying an unknown material. Detector tubes, water analysis kits, portable "sniffers" for flammable and explosive vapor levels and specific vapors are all available and can assist in verification of materials on-scene. Also, a dispersive IR instrument and a portable gas chromatograph-mass spectrometer (GC-MS) system, as shown in Figure 2-9, are being developed for field use in hazardous materials identification.

However, the single instrument to use at hazardous materials transportation emergencies has yet to become a reality, especially in the area of remote sensing capabilities. The emergency responder must be a detective of sorts, assimilating all available information and clues leading to the identity of the HM involved. If conditions on-scene preclude using any techniques to identify the HM involved positively as happened at the derailment in Livingston, LA, the emergency responder needs to pull back, gather and assess his resources and quickly activate the local/State contingency plan to protect lives and to be ready when conditions on-scene change to allow entry and hazard mitigation activities. Proceed to Sequence 3, Activate State/Local Contingency Plan.

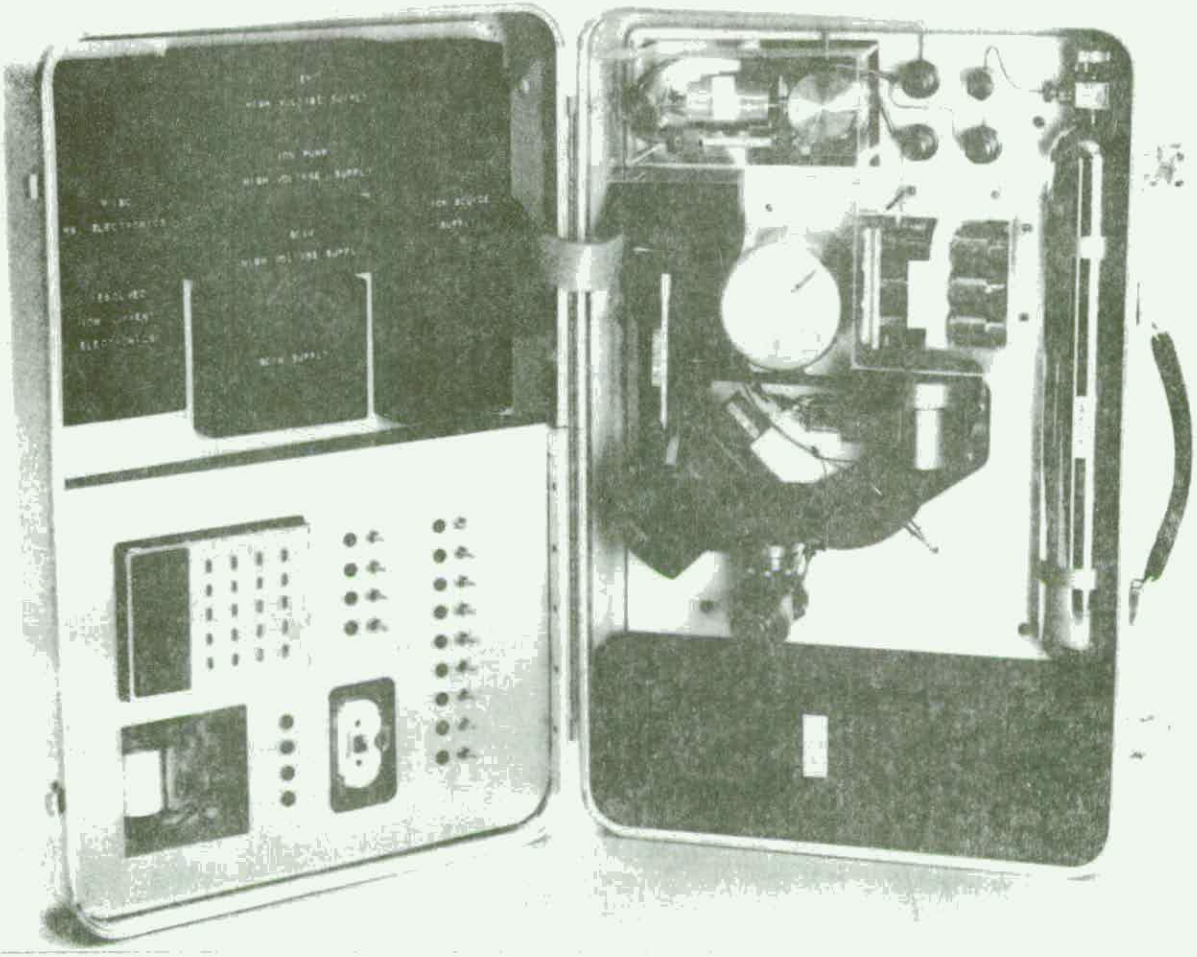


FIGURE 2-9. PORTABLE GAS CHROMATOGRAPH - MASS SPECTROMETER (GC-MS) SYSTEM

3. ACTIVATE STATE/LOCAL CONTINGENCY PLAN

3.1 STATE/LOCAL CONTINGENCY PLAN AVAILABLE

Once the HM have been identified or even if identification of HM are not possible due to on-scene conditions, the OSC should activate the State/local contingency plan for HM transportation accidents. Figure 3-1 shows the next sequence in the flow of events in a HM emergency. The contingency plan designates State/local organizations involved in ER efforts, the designated responsibilities, and a contact and telephone number for each agency. If a HM transportation accident contingency plan has not been developed or is not available, implement the city/county/ State mutual assistance contingency plan. Contact all agencies designated in the contingency plan as well as CHEMTREC at (800) 424-9300 and the National Response Center at (800) 424-8802. Proceed to Section 4, Initial Situation Inspection, Evaluation, and Planning.

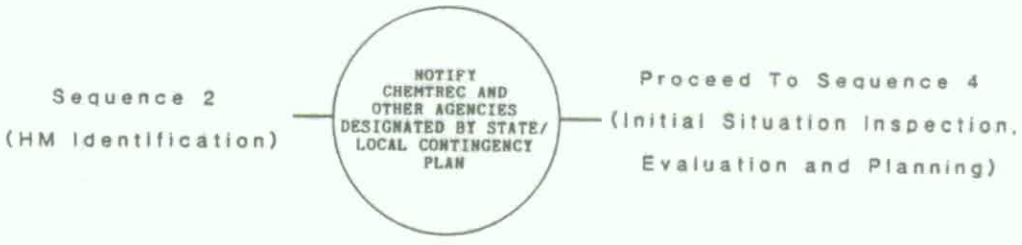


FIGURE 3-1. ACTIVATE STATE/LOCAL CONTINGENCY PLAN - SEQUENCE 3

3.2 NO STATE/LOCAL CONTINGENCY PLAN

If no State/local contingency plan is available do the following:

- Call CHEMTREC at (800) 424-9300 and the National Response Center at (800) 424-8802.
- Take all steps necessary to protect or save human life.
- Take actions to contain and/or prevent the spread of released material.
- Keep the public as far from the scene of the incident as reasonably possible.
- Isolate for further examination those persons who may have come in contact with any material.

- Remove injured persons from the area with as little direct personal contact as possible.
- If incident involves fire or material subject to blowing in the wind, conduct operations from an upwind position.
- Do not eat, drink or smoke in the accident area.
- Take only necessary emergency actions prior to the arrival of qualified HM specialists and a physician.

Proceed to Section 4 (Initial Situation Inspection, Evaluation, and Planning).

4. INITIAL SITUATION INSPECTION, EVALUATION, AND PLANNING

Figure 4-1 shows the decision points from the overall hazardous materials transportation accident scenario related to evaluation of on-site hazards and the development of strategies for mitigating HM hazards.

Sections 4.1.1 through 4.1.10 identify factors which must be considered in conducting the initial on-site inspection, and planning/assessing mitigation strategies based on available resources.

Several factors contribute to the magnitude and severity of a hazardous materials transportation accident. These include the materials involved, accident site location and proximity to population centers, meteorological conditions, site topography and hydrogeology, soil characteristics, presence of fire and firefighting resources available, accident debris, public/observers and the duration of on-scene response activities. The following sections discuss these factors and the significance of their impact on accident response procedures. Many of these factors are further discussed in a book by Al Smith, Jr., Region IV EPA OSC, entitled, Managing Hazardous Substances Accidents.

4.1 INITIAL SITUATION INSPECTION AND EVALUATION

4.1.1 Materials Involved

The hazardous materials involved in a transportation accident determine what containment measures, firefighting techniques and extinguishing media, hazards mitigation, and cleanup/disposal procedures are effective and available to response personnel. Therefore, the identity, amount, condition and properties of involved hazardous materials must be quickly determined as shown in Sequence 2, HM Identification.

4.1.2 Accident Site Location

The proximity of a derailment to large cities, property or vital energy and communications systems can significantly magnify the problems associated with the accident. Densely populated areas may require evacuation, relocation and boarding during an emergency. Evacuation, however, can create as many problems as it solves. On the one hand an adequate evacuation radius is necessary to protect the public in the event of a toxic vapor cloud. On the other hand, the risks associated with evacuation of the elderly or sick can result in extensive liability after the fact. Damage to private

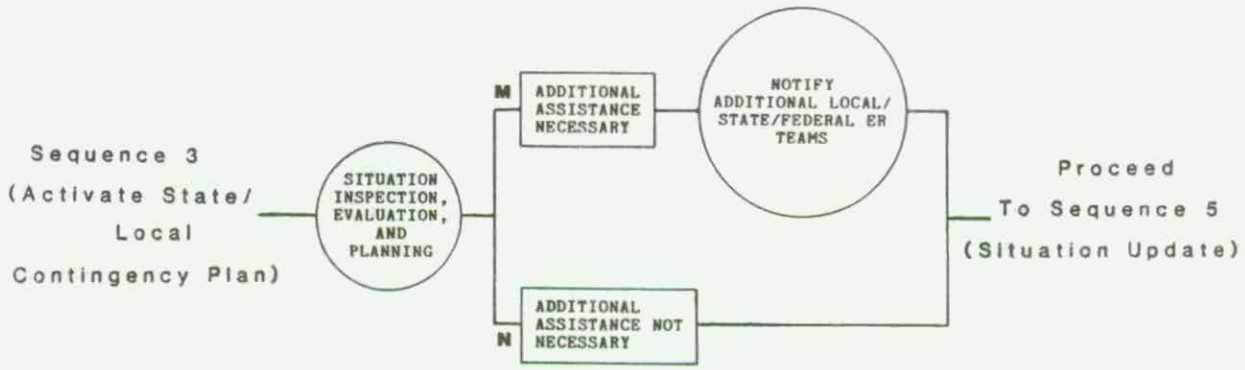


FIGURE 4-1. INITIAL SITUATION INSPECTION, EVALUATION AND PLANNING - SEQUENCE 4

property and businesses as well as energy, communications and other community systems is also a concern.

4.1.3 Meteorological Conditions

Weather is a critical factor in the response phases of an accident involving HM. Reliable precipitation forecasts, local temperatures and surface-wind and high-altitude-wind data is available on-scene from the National Oceanographic and Atmospheric Administration (NOAA) or local weather service. Where available, mobile meteorological monitoring equipment could be used at the site for more accurate assessment of evacuation priorities. Data should be obtained continuously, if possible, during critical operations such as plugging leaks, uprighting cars or transferring loads.

Wind speed and direction are critical when gases or extremely volatile liquids are released. Wind shift could mean that work would have to be stopped and the area evacuated. In the case of such a release, steady winds may help disperse toxic or flammable vapors or a fire column may help carry them away. Of course, this impacts communities downwind and evacuation may be a direct result.

Rain can both help and hamper activities at an accident site and provisions for controlling contaminated runoff, preventing leaching of contaminants through soils into ground water and working under generally more dangerous conditions must be anticipated and dealt with.

The ambient temperature may also be an important safety factor, especially where toxic or flammable materials or fire situations are involved. High temperatures can further cause safety risks such as fatigue and stress for on-scene personnel and perhaps cause judgmental errors.

4.1.4 Site Topography and Hydrogeology

All areas, unless they are swamps or lakes, will eventually drain to some water body. Thus, essentially every hazardous materials transportation accident can be considered a potential spill reaching water. If the material is not directly released into a body of water, it can be introduced as a contaminant by rain or fire control runoff. Steep cliffs or banks at the site can make wreckage handling and cleanup/disposal very difficult and terrain effects can also alter vapor dispersion patterns impacting evacuation considerations and even on-scene approaches.

Soil characteristics at the site also play an important role in on-scene activities. The need to contain liquid releases and prevent them from entering the soil system and eventually reaching subsurface water is largely dependent on the type of soil. For example, sandy or loamy soils or dry, very plastic friable clays allow the rapid penetration and transport of liquids, while dense wet clays, peat moss or humus soils will attenuate and immobilize various contaminants and even change the acidity/alkalinity of certain chemicals. Also certain soil microbia can act to biodegrade some materials once they have been caught in the soil system.

4.1.5 Fire and Firefighting Resources

Conventional fire training is not always adequate for situations involving HM. Water may worsen a fire involving HM and extreme caution must be exercised in using appropriate extinguishing materials. Fire impingement on loaded containers is extremely dangerous and if sufficient water is available and applied early enough, containers may be cooled. Figure 4-2 shows firefighters applying water to a fire impinged tank car. In many cases, fire conditions may provide the best or possibly the only, disposal method for a particular hazardous material. In other instances, it may not be practical to extinguish a fire because there is the danger of flashback, reignition and possible explosion. In all cases involving fires, an adequately trained, equipped and coordinated firefighting unit is a necessity.

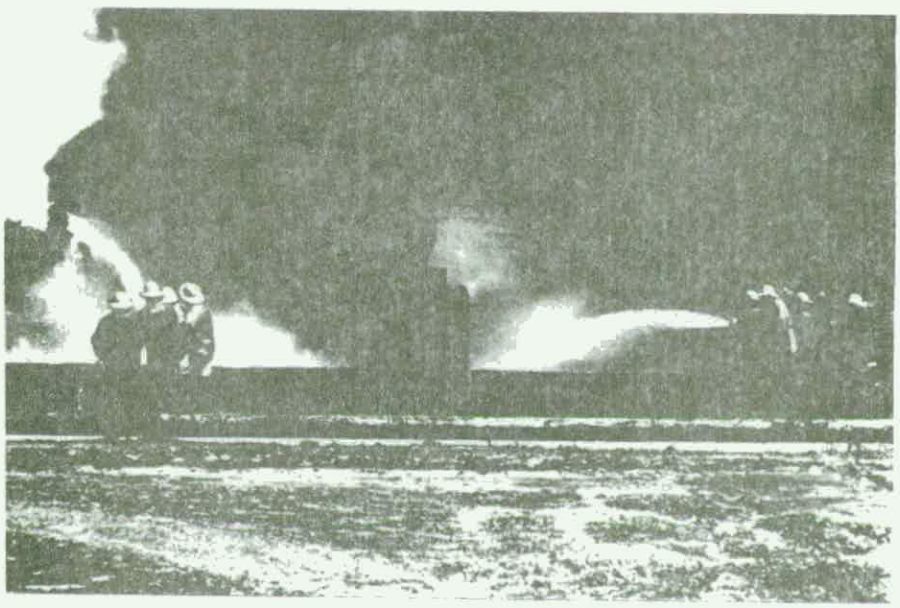


FIGURE 4-2. WATER COOLING A FIRE IMPINGED TANK CAR

4.1.6 Accident Debris

Serious accidents always involve metal, wood, plastic and various other debris as shown in Figure 4-3. This material must at some point be moved and properly disposed of which imposes safety and regulatory requirements. Wreckage removal is an integral step in handling a transportation accident and the presence of hazardous materials may complicate these efforts. The accident site must be stabilized from toxic or flammable vapor levels and care must be taken to monitor the area when moving disoriented or damaged cars.



FIGURE 4-3. ACCIDENT DEBRIS TO BE REMOVED

4.1.7 Public/Onlookers

Onlookers must not be permitted near the scene of a HM accident. An adequate "public safety perimeter" must be established to protect the public and to ensure the safety and efficiency of on-scene response personnel. The news media can do much to alert the public.

4.1.8 Duration of Response Activities

The time and effort spent in the initial phases of accident response can do much to alleviate the need for extensive subsequent cleanup and disposal. The more rapidly the situation is stabilized, the less damage to property and the environment will be done. Also the steps taken early to mitigate hazards will indicate what actions are required in the later stages of wreckage removal and cleanup/disposal.

4.1.9 Assessment of Injuries, Exposures and Fatalities

It needs to be emphasized that, even though the primary on-scene responsibility of emergency medical personnel is to provide medical assistance to those who require it, they should not enter a contaminated area when the concentration of HM vapors exceeds the TLV, unless completely protected and fully qualified in self protection, and never when the minimum vapor/air volume percent exceeds the LEL.

Information is needed about the injuries and exposures to the crew or any civilians in the immediate vicinity of the accident. The crew should be accounted for and rescued if possible without jeopardizing the safety of the would-be rescuer. Rescue personnel need to be adequately clothed and equipped to perform search and rescue operations, or there could be further injuries/fatalities.

Data on hazardous vapor clouds and meteorological conditions are also vital to rescue personnel.

4.1.10 Determining Who and What Are at Risk

When a HM transportation accident occurs, the on-scene coordinator must determine who and what are at risk. Under these conditions, risk includes such factors as personal exposures or injuries, pollution threat and property damage. Once the risk is determined, it should be the on-scene coordinator's responsibility to take actions to mitigate these and any other risks.

The risk associated with personal exposures and injuries should be determined for on-scene response personnel as well as members of the local community.

Risk to on-scene response personnel may be assessed by continuously monitoring the accident site for toxic, flammable and explosive vapors, the weather, the structural integrity of containers and personnel behavior. When the TLV or LEL are exceeded, the on-scene coordinator should immediately pull response personnel back from the scene until the vapor concentrations are acceptable or other precautions are taken. An exception are those personnel specially protected, qualified and who of necessity must work in a toxic atmosphere (not flammable).

The risk to members of the local community can be assessed by looking at the movement of toxic vapor clouds. By using some basic information about the accident the on-scene coordinator can estimate a downwind vapor cloud at specific times and places. Then the on-scene coordinator can establish an evacuation radii based on the specific materials released.

The pollution threat (i.e., ground, water and air) associated with an accident will be a function of the hydrogeology, topography, meteorology at the accident site, and the chemical/physical properties and quantities of the materials released.

The threat of property damage is based upon the location of an accident with respect to populated/industrialized areas. In populated areas, residents are in potential danger as well as their homes, other property, and pets. Industrial areas may be even more threatened, when public systems such as utilities (power, water supplies), communications (telephone, TV, radio, special satellite), and services (hospitals, schools, retirement homes) are endangered. Decisions are needed as to whether sufficient resources are available for handling these situations, and if not, what alternative actions can be taken to minimize the danger.

In all these cases a local/community emergency action plan to address hazardous materials transportation emergencies that has been developed, implemented and tested is the best mitigation option available.

Once these items have been considered the OSC must decide if available resources are adequate to handle the hazards posed by the accident. If available resources are adequate proceed to Section 4.2, if they are inadequate proceed to section 4.3.

4.2 ADDITIONAL ASSISTANCE NOT NECESSARY

If the initial situation evaluation has indicated that available resources are adequate to handle the hazards posed by the accident proceed to Section 5 (Situation Update).

4.3 ADDITIONAL ASSISTANCE NECESSARY

If the initial situation inspection, evaluation, and planning phase of the coordination effort has indicated that available resources are inadequate to handle the hazards posed by the accident proceed to Section 4.4.

4.4 NOTIFY ADDITIONAL LOCAL/STATE/FEDERAL EMERGENCY RESPONSE TEAMS

When available resources are inadequate to handle the hazards posed by the accident do the following:

- Pull back all emergency response personnel to a safe perimeter.

- Contact all local/State agencies designated in contingency plan.
- Contact USCG National Response Center, EPA RRT and CHEMTREC.
- Identify and request additional resources which may be required such as:
  - Emergency medical aid/facilities
  - Firefighting
  - Spill containment equipment
  - Spill treatment materials
  - Heavy equipment
  - Transfer containers
  - Cleanup/disposal contractors
  - Potential disposal sites

Please remember that in any accident situation there may be insufficient information, materials, or equipment to mount the "best" response. The local/State contingency plan should give some guidance so that rational decisions can be made under a variety of emergency conditions. An accident is a dynamic situation and it is important that the responder be able to receive and input changed conditions into the decision-making process and arrive at the "best" solutions for his situation, time, place, and resources at hand.

Proceed to Section 5 (Situation Update).

5. OVERALL SITUATION UPDATE

Figure 5-1 shows the position of the situation update sequence in the overall accident management decision scenario. After requesting additional local/State/Federal ER teams and resources, the following areas need to be considered and actions developed and implemented:

- Hazards/risks mitigation priorities based on HM involved;
- Continuous monitoring of the area for toxic and flammable vapor hazards;
- Tank car cooling, vapor suppression, and tracking of vapor cloud dispersion patterns;
- A mechanism for familiarizing ER personnel arriving on-scene with current accident conditions;
- Identification and contact of wreckage removal and cleanup/disposal contractor;
- Re-evaluation of hazards perimeter; and
- Moving undamaged cars from both ends of train.

These activities are discussed in Sections 5.1 through 5.7.



FIGURE 5-1. SITUATION UPDATE - SEQUENCE 5

5.1 HAZARDS/RISKS MITIGATION PRIORITIES

To identify which specific on-scene hazards must be addressed immediately you must consider the specific hazards of each HM involved in the accident, the amount of damage to the tank cars involved and whether they are on fire, fire impinged, or leaking. The OSC in consultation with technical experts should decide upon the priorities in handling on-scene hazards.

5.2 CONTINUOUS MONITORING OF TOXIC AND FLAMMABLE VAPOR HAZARDS

Toxic and flammable vapor concentrations need to be continuously monitored throughout the accident response. The health hazards posed by a material are expressed as parts per million Threshold Limit Value (TLV). The TLVs for specific HM are identified in the CHRIS, EPA and many other response manuals. When the on-site vapor concentration exceeds the designated TLV then ER personnel should be allowed to work on-scene only if they are protected by adequate personal protective clothing and appropriate specified breathing apparatus.

The flammable vapor concentration of a material can be determined by using the sensing methods described in Section 2. Figure 5-2 shows a member of the team at the outer limits of the hazards perimeter monitoring for vapor concentrations. Work only in an accident area when the flammable vapors are below the Lower Explosive Limit (LEL). Do not work in an accident area when the vapor concentration is within the flammable limits. Extend the hazards perimeter if necessary.



FIGURE 5-2. MONITORING FOR VAPOR CONCENTRATIONS

5.3 INCOMING PERSONNEL

Incoming personnel should report to the command post or designated staging area to be briefed on the accident by the OSC as shown in Figures 5-3 and 5-4. Any press or news media personnel should also report to the command post to find out where and when periodic news briefings on the situation will be held.



FIGURE 5-3. BRIEFING OF RESPONSE PERSONNEL



FIGURE 5-4. BRIEFING IN THE COMMAND POST

5.4 TANK CAR COOLING, VAPOR SUPPRESSION AND TRACKING OF VAPOR CLOUD DISPERSION PATTERNS

Cool tank cars using unmanned monitors. NFPA recommends a water source capable of supplying at least 500 gpm for adequate tank car cooling. Figure 5-5 shows an unmanned monitor. Figure 5-6 illustrates a makeshift unmanned monitor.

Vapors can be suppressed by either fog water spray or various foams. Refer to FIRE in the 1982 DOT Emergency Response Guidebook and other response manuals for appropriate firefighting and vapor suppression agents.

Vapor cloud dispersion patterns can be tracked by contacting a local airport or a nearby military installation, or the vapor cloud dispersion can be simulated using the USCG HACS. Contact the USCG oil and hazardous materials coordinator in your area to access this system.

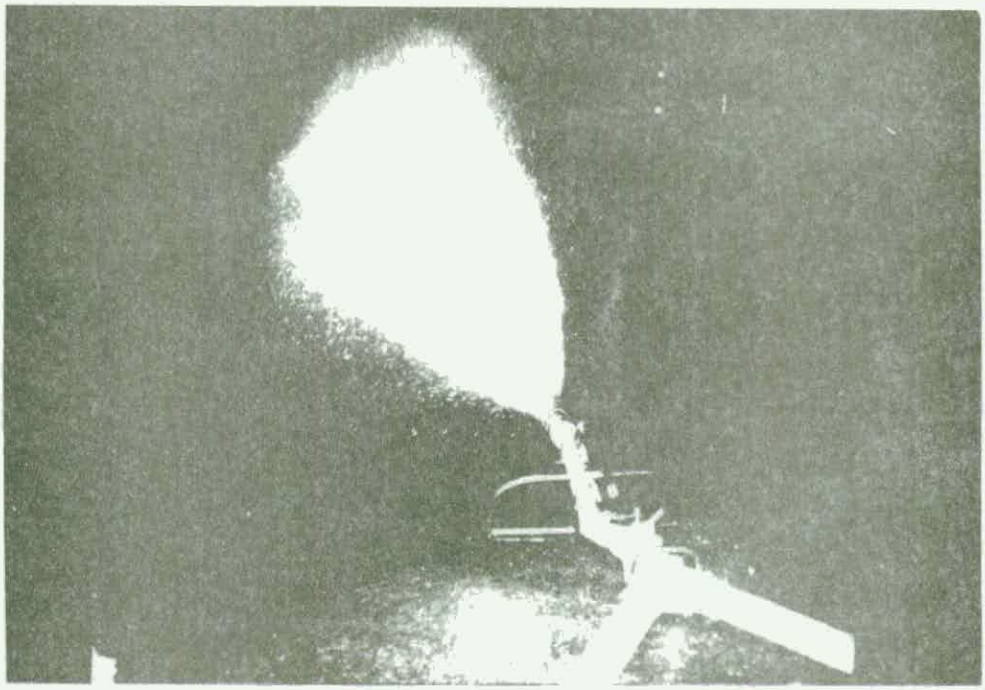


FIGURE 5-5. UNMANNED MONITOR

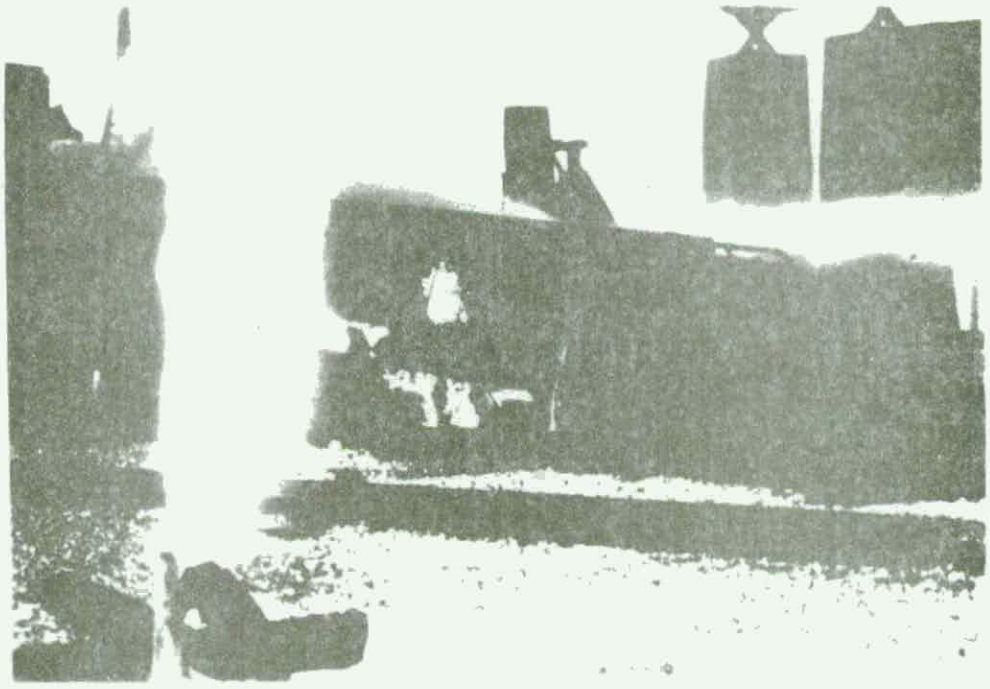


FIGURE 5-6. MAKESHIFT UNMANNED MONITOR

5.5 IDENTIFICATION OF WRECKAGE REMOVAL AND CLEANUP/DISPOSAL CONTRACTORS

When a derailment involving HM occurs and the services of a wreckage removal contractor with special heavy equipment are required on-scene, the choice of a contractor will depend upon the accident severity, proximity of accident site to contractor's facility, and contractor's available resources. Most often, and it is sound safety practice, these contractors will not respond on-scene until all toxic, flammable and explosive vapors have dissipated from the accident site, and the area is considered relatively safe.

Accident severity influences the level of sophistication required for equipment to be brought on-scene. Proximity of the accident site to the contractor's location influences response time and availability of personnel, equipment and materials. State and local emergency response plans should have identified wreckage removal firms which are capable of responding to transportation accidents that occur in their areas.

The personnel, equipment and material resources available to the wreckage removal contractor at the time of the accident may influence the choice of a firm to perform the wreckage removal. If a contractor's facility is located very close to a railroad accident but cannot provide the required heavy lifting equipment to the scene, another firm will probably be needed. This could increase response time but should not create a big problem because wreckage removal does not usually begin until the situation is stabilized. The on-scene coordinator should not automatically discount the value of a wreckage removal contractor who does not have the heavy equipment, for this firm may be able to assist in the short-term response efforts until a contractor from further away can arrive on-scene.

At most hazardous materials transportation accidents, the services of product transfer, cleanup and disposal personnel are also required. In many cases, the shipper or association to which the shipper belongs, may provide such specialized service. The carrier should involve the shipper in the selection of a product transfer, cleanup and disposal contractor.

5.6 RE-EVALUATE HAZARDS PERIMETER

The hazards perimeter needs to be continuously re-evaluated based on changing meteorological and other on-scene conditions. Utilize all available information (e.g., a detailed map in the command post, as shown in Figure 5-7) to identify population areas at risk which may need to be evacuated.

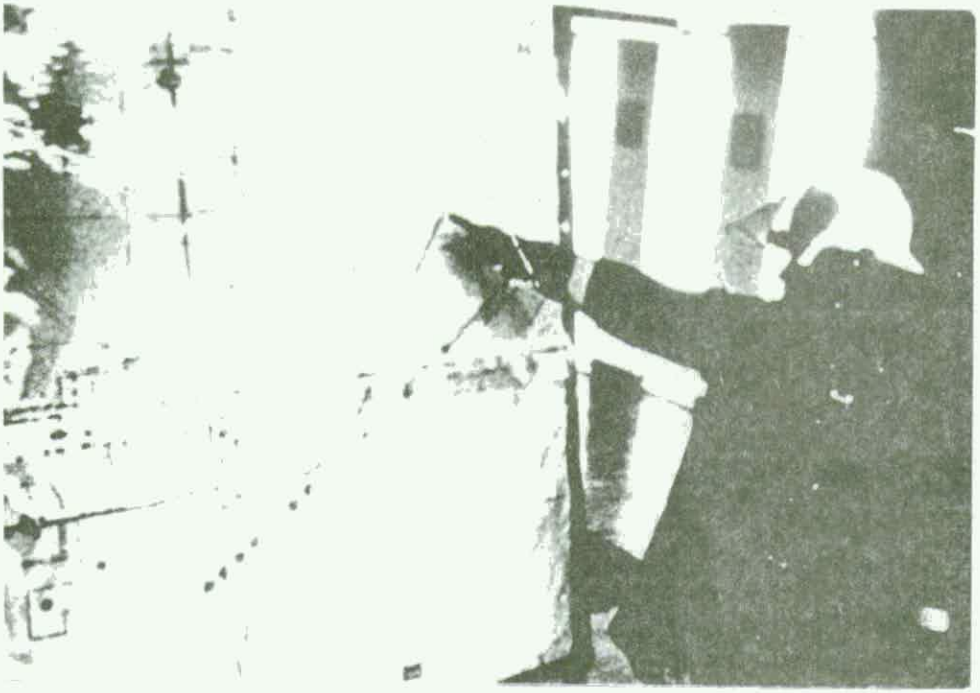


FIGURE 5-7. MAP IN COMMAND POST

5.7 MOVE UNDAMAGED CARS FROM BOTH ENDS OF TRAINS

Railroad personnel need to determine whether undamaged cars can be removed from the accident area. The undamaged cars may then be pulled from both ends of the train so that there is access to the fire/leak/damage area.

Proceed to Section 6 (Fire/No Fire).

6. FIRE/NO FIRE

Figure 6-1 shows the Fire/No Fire decision sequence in its relationship to the overall hazardous materials transportation accident scenario. This sequence is concerned with the presence of fire/explosions on-scene, HM involved in fire, fire impingement on HM tank cars, and fires in the areas nearby the accident.

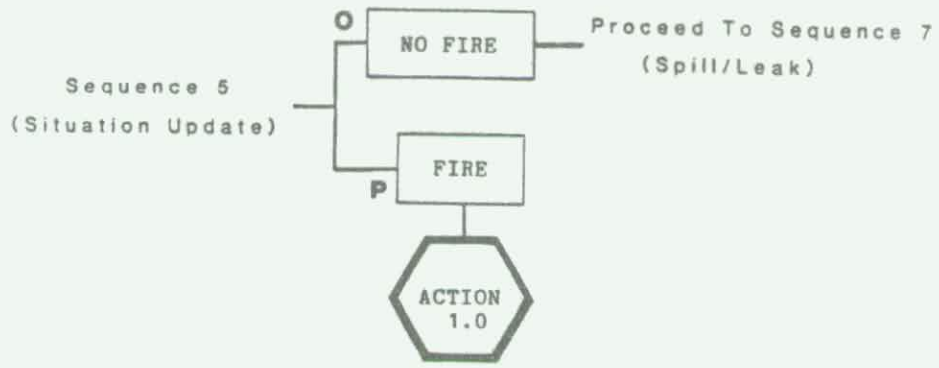


FIGURE 6-1. FIRE/NO FIRE - SEQUENCE 6

The NFPA and other professional firefighting organizations, nationwide, provide excellent training courses and manuals on firefighting techniques related to the involvement of HM. This guide will not presume or attempt to add anything to those efforts. However, it would be helpful to point out some of the special problems and considerations facing firefighters confronted with transportation accidents involving hazardous materials as well as some of the options available for vapor suppression agents and fire extinguishants.

Fires involving hazardous materials present not only the expected thermal hazards but can also involve toxic or corrosive combustion products and present large scale explosive hazards. If a container is mechanically damaged or structurally weakened in a fire, the combination of fire impingement causing an increase in the internal pressure and the resultant lessening of the container's structural strength could cause a rupture.

Structural failure of a container may cause a massive explosion with an accompanying fireball and tank fragments propelled at high velocities in every direction. One such explosion and fireball is shown in Figure 6-2.



FIGURE 6-2. EXPLOSION AND FIREBALL AT CRESCENT CITY, IL

The tank can be destroyed and fragments can be hurled great distances. See Figures 6-3 and 6-4. In such cases the principal firefighting tactic is to cool the tank shell by localizing streams of water at the vapor area of the tank and the point of flame contact. According to the NFPA, the application of 500 gpm of water is recommended if cooling of the container is to have any effect. This is extremely risky and the use of unmanned monitors to apply water is recommended providing they may be safely set up. Refer to Figures 5-5 and 5-6 in Section 5 which show unmanned monitors. Water has been used as the main extinguishant for many years and, when applied as a stream or a fog or in several intermediate forms, sees greater use than any other single material.

Water is most useful against fires involving solid fuels like wood, paper, other cellulosic materials and some liquid fuel fires. However, it may not be effective for hydrocarbon liquids such as oil, benzene, toluene or other petroleum by-products because these liquids float on top of water. In fact, application of water can worsen a situation by causing overflow of contained liquids or frothing, boiling and spattering of pooled liquids. Water is ineffective against gases and cryogenic liquids and cannot be used for

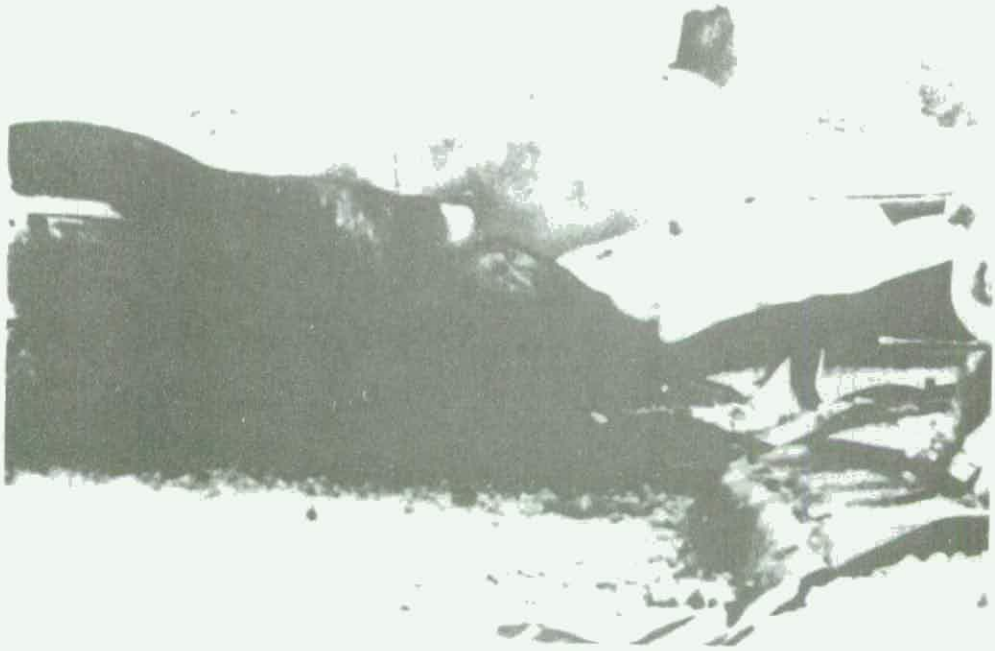


FIGURE 6-3. FLATTENED TANK CAR FRAGMENT



FIGURE 6-4. TANK CAR FRAGMENT HURLED INTO A HOUSE

fires involving live electrical equipment because of hazards to personnel and damage to electrical circuitry.

Water can be more efficient as an extinguishant by adding surface active agents (surfactants) or sealing it into the structure of a gel or foam. To expand the types of fires where water could be applied, the water-surfactant combination was further developed by mechanically inducing dispersion of air in water to form a continuum of bubbles known as foam. Foam offers several advantages, for a range of fire scenarios:

- Can be floated on the surface of liquids;
- Mechanism to deliver water slowly but continuously;
- Cuts down smoke, fumes;
- Easier conversion of water to steam;
- Method to build a 3-dimensional water barrier; and
- Provides a lessened shock hazard or damage potential to electrical circuitry.

The main disadvantage of foam is the possibility of saturation by the burning liquid, usually a result of improper application of the foam blanket. Foam is divided initially into high expansion (a volume expansion of water to foam greater than 100 to 1) and low expansion (a volume expansion less than 20 to 1).

Low expansion foams in addition to fire control can provide vapor suppression from spilled chemicals and smoke and fumes from deep seated fires. High expansion foams complement the low expansion type and are utilized in enclosed areas. High expansion foam provides the fastest extinguishment of contained pool fires.

Carbon dioxide also functions as an extinguishant by blanketing the fire and is available in liquid form in extinguishers or in mechanical foams.

Several dry chemical extinguishers are also available and potentially applicable. Sodium chloride, sodium bicarbonate and/or potassium bicarbonate can be used to reduce the intensity of fires.

6.1 NO FIRE (SCENARIO SEGMENT O)

When there is no longer fire impingement on any tank cars and the area has stabilized (i.e., no material on fire and all fires in the adjacent accident area extinguished) proceed to Sequence 7 to address the problem of spills or leaks (see Section 7.0).

6.2 FIRE (SCENARIO SEGMENT P)

If there are fires/explosions in the accident area, fire impingement on tank cars, material fires, or any other fire situation proceed to Action 1 (Tank Car Burning or Fire Impinged) given in Table 6-1.

TABLE 6-1. ACTION 1.0 - TANK CAR BURNING OR FIRE IMPINGED

1. If a tank car containing compressed flammable gas, flammable liquid or solid is on fire or is fire impinged, pull back response personnel 0.5 miles upwind from tank car until adequate water supplies and firefighting resources become available to control situation.

2. Secure and remove any sources of ignition (e.g., lighted cigarettes, running engines, sparks).

3. Locate water source:

   a. Local hydrant
   b. River/stream
   c. Lake/pond
   d. Farm holding tanks
   e. Wells
   f. Swimming pools
   g. Water tanks

4. Identify and obtain additional equipment needed to utilize water sources, such as pumps, hoses, and fog nozzles.

5. Approach fire from upwind with fog water spray to suppress vapors, heat and fire. Apply water to general area of fire to control it.

6. Fire and contaminated water must be contained. Dike all potentially affected sewers and water sources.

7. Apply water to any fire impinged tank car with unmanned monitors to provide cooling and reduce the effects of fire impingement.

   NOTE: According to the National Fire Protection Association (NFPA) a water source of 500 gpm is recommended for effective container cooling.

WARNING

Fire impingement on an intact tank car presents a potentially hazardous condition. The most critical region for fire impingement is in the vapor space (ullage area) of the tank. The liquid inside the tank car acts as a heat sink; therefore, as the liquid inside the tank car vaporizes, internal pressure increases and the fire impingement in the vapor space can cause hot spots in the tank wall which weaken the metal. If the tank car has suffered sufficient structural damage or the tank metal has been sufficiently weakened, as the internal tank pressure increases, tank car rupture is more likely to occur.

8. Observe any tank car continually that is or has been involved in a fire situation because the danger increases rapidly with the length of time the tank car is on fire or is impinged by fire.

   a. Listen for audible tank noises.
   b. Watch tank car for evidence of bulging or appearance of hot spots in metal.
   c. Observe tank vent stack for venting vapors indicating opening of tank car pressure relief valve.
   d. Tank integrity can be reduced by heating as well as from potential mechanical damage suffered in the accident.

9. If there is a sudden rise in tank car noises or evidence of hot spots, pull back response personnel 0.5 mile upwind immediately because tank car may rupture and rocket.

10. If conditions with the tank car do not stabilize, pull back response personnel to at least 0.5 mile upwind.

11. Observe fire and note any changes in intensity. When situation subsides re-enter area.

12. Keep applying water to tank car to suppress vapors and provide cooling.

13. If fire is extinguished continuously monitor area with a portable explosimeter. Only re-enter when explosive limits are below those specified in air for the material involved.

14. Go back to Section 5, Overall Situation Update, and enter any new data concerning on-scene conditions into decision matrix. As long as fires continue one must address the fire situation and continually update and re-evaluate the overall situation until fires are extinguished or have consumed themselves. Then the responder may continue to Sequence 7, Spill/Leak.

7. SPILL/LEAK

Figure 7-1 addresses Sequence 7, Spill/Leak. Depending upon the accident circumstances there may or may not be a leak of HM from the tank cars involved. If no leak/spill has occurred proceed to Section 7.1. However, if a spill or leak has occurred proceed to Section 7.2.

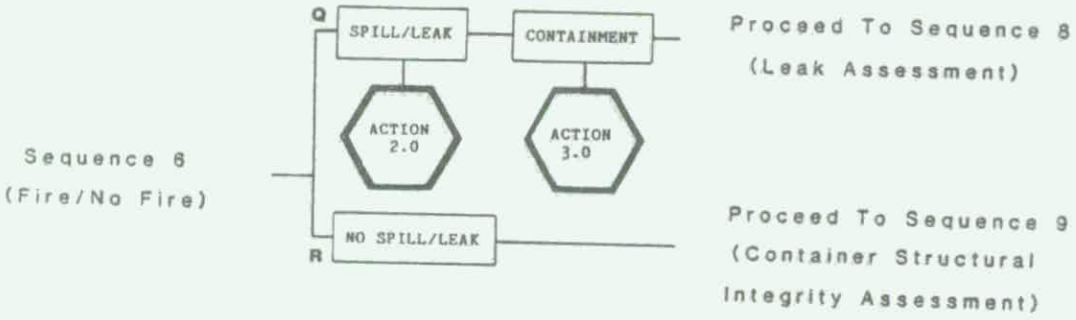


FIGURE 7-1. SPILL/LEAK - SEQUENCE 7

7.1 NO SPILL/LEAK (SCENARIO SEGMENT R)

When the accident does not result in a spill or leak, immediately begin container structural integrity assessment (Section 9).

7.2 SPILL/LEAK (SCENARIO SEGMENT Q)

When a spill or leak has occurred there are several general actions that should be taken. These actions are outlined in Table 7-1, Action 2.0 - Spill or Leak from Tank Car. If there has been a spill/leak of HM it is important that it be contained to avoid widespread environmental contamination and population exposure. Go to Section 7.3 for containment guidelines.

TABLE 7-1. ACTION 2.0 - SPILL OR LEAK FROM TANK CAR

1. Wear self-contained breathing apparatus and adequate protective clothing.
2. Keep sparks, flames, and other sources of ignition away which could react with any material.
3. Do not approach a leaking tank car until adequate water and other resources become available.
4. Monitor vapors continuously with a portable explosimeter or other appropriate device. If vapors are above LEL in air, pull back response personnel.
5. Monitor leak area continuously for indications of fire. If fire starts, go back to Action 1.0.
6. Approach tank car from upwind if explosive limit is below LEL in air and apply fog water spray to suppress vapors and improve visibility.
7. Contaminated water must be contained. Dike (block off) all potentially affected sewers and water sources. See more specific procedures in Action 3.0.
8. If wind conditions change, pull back response personnel and change direction of approach.
9. Even when vapor concentrations are below LEL, keep applying fog water spray to supress vapors.
10. Proceed to Containment, Section 7.3 and Action 3.0.

7.3 CONTAINMENT

Containment methods for spilled hazardous materials will vary based upon the specific nature of the chemical and the physical location of the spill. The EPA's Manual for the Control of Hazardous Materials Spills, Volume I: Spill Assessment and Water Treatment Techniques has identified guidelines for the containment of spilled hazardous materials on land, in water, or in air. Refer to this manual or the USCG CHRIS manual, available from the EPA and the USCG RRT for appropriate containment methods for a particular HM.

General guidelines to be followed during containment are given in Table 7-2, Action 3.0 - Containment of Spill/Leak from Tank Car. Guidelines are also given for the

TABLE 7-2. ACTION 3.0 - CONTAINMENT OF SPILL/LEAK FROM TANK CAR

1. Adequate protective clothing and respirator equipment is required.
2. Keep all internal combustion engines out of the flammable vapors area. Use bulldozers or earth-moving equipment to excavate containment pits. See Figure 7-2. Earthen berms, foamed polyurethane or concrete dikes may also be constructed if equipment and materials are available.

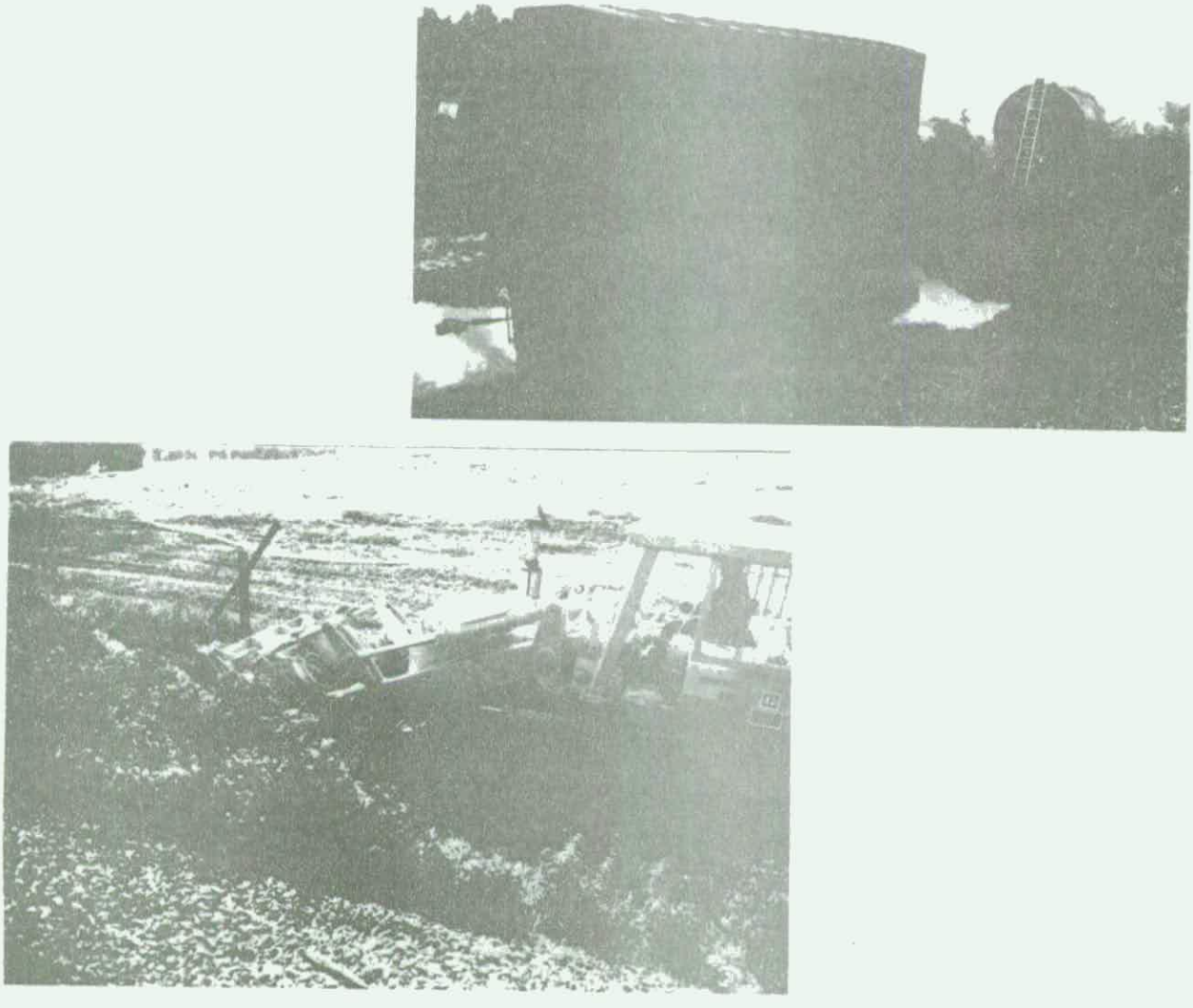


FIGURE 7-2. BULLDOZER EXCAVATING CONTAINMENT PIT

3. Monitor area with a portable explosimeter. Only enter area if reading is below LEL in air.

4. Contaminated firefighting, vapor suppression and tank cooling runoff water must be contained. Dike all potentially affected sewers and water sources. Figures 7-3 and 7-4 show the use of sorbent sheets and pillows, respectively, to stop the movement of released liquid HM. Dig a pit or build earthen dikes in the path of liquid to limit the potential spread of liquid.

5. Approach from upwind to disperse and knock down vapors with fog water spray.

6. Cover any spilled liquid with sand, dirt or appropriate foam to blanket the surface and reduce the rate of evaporation.

7. Go to Section 8 (Leak Assessment).



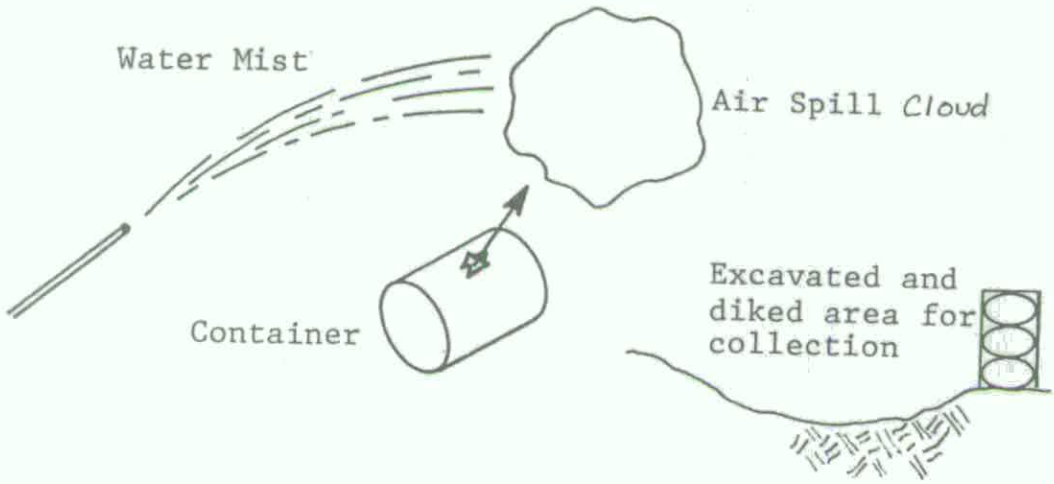
FIGURE 7-3. CONTAINMENT WITH SORBENT PILLOWS



FIGURE 7-4. CONTAINMENT WITH SORBENT SHEETS

suppression of air spills and containment of spills on land in Figures 7-5 and Figure 7-6, respectively. These and other guidelines for spills to water bodies were developed by the EPA and portions are reproduced from the above mentioned manual.

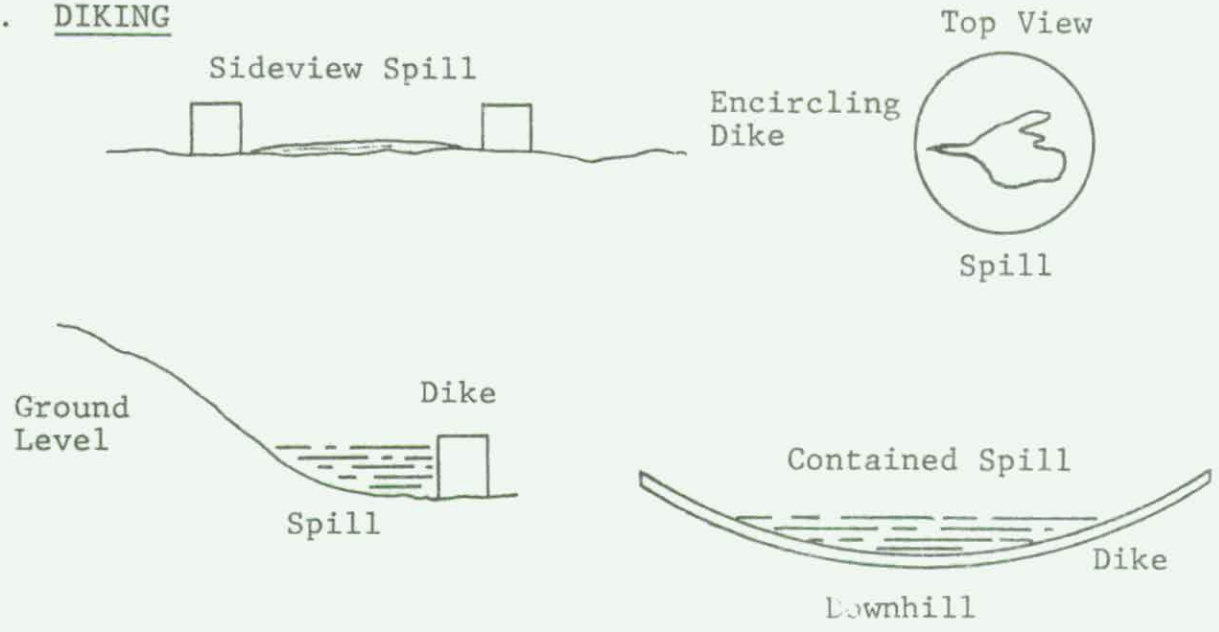
I. MISTING TO REMOVE CONTAMINANTS



1. Not all materials will be removed in this manner.
2. Water source must be available.
3. Require large area for containment of resulting water.

FIGURE 7-5. SUPPRESSION OF AIR SPILLS

I. DIKING



1. Suitable dike materials must be available, either natural soil, sand bags or foam.
2. Proper earth moving equipment or specialized foam dike equipment must be obtainable.
3. An advantageous site must be available.
4. This procedure may not eliminate percolation of the spill through the soil.

II. EXCAVATIONS



1. Equipment and land must be available to accommodate the excavation.
2. In certain areas, soil or subsoil nature may render excavation impossible or ineffective.

FIGURE 7-6. CONTAINMENT OF SPILLS ON LAND

8. LEAK ASSESSMENT

Figure 8-1 shows Sequence 8, Leak Assessment and its decision points as part of the HM transportation accident management scenario.

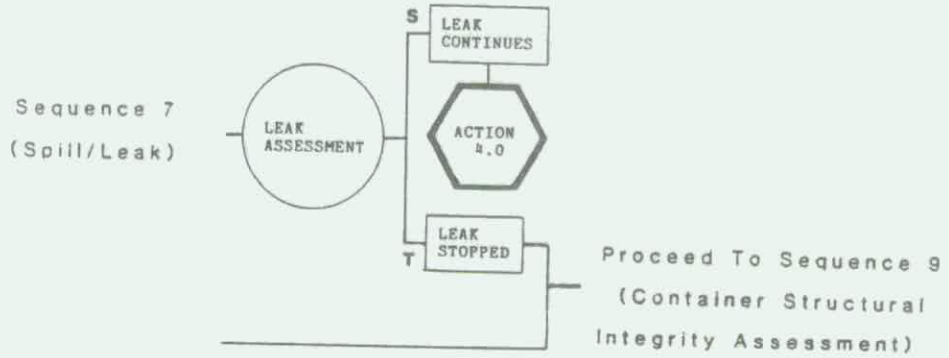


FIGURE 8-1. LEAK ASSESSMENT - SEQUENCE 8

Once fires have been extinguished and there are no further spills/leaks involved, container structural integrity assessment can be conducted (Section 9). The following section provides a general discussion of leak handling alternatives and an assessment of leak conditions.

You can approach the problem of leaks or product releases from containers punctured or otherwise damaged in transportation accidents with three options:

1. Stopping the leak;
2. Leaving the leak "as is;" or
3. Further opening up the car or tank (venting) and disposing of the lading (burning).

Certain companies alone, or as part of a trade association, have made available technical experts (specially trained and equipped teams) to assist with advice and handling of HM on-scene. The CHLOREP teams illustrate a cooperative industry effort to assist in handling chlorine incidents. Figure 8-2 shows two members of the CHLOREP Team and Figure 8-3 shows Patch Kit C that is used by CHLOREP teams to patch tank cars.

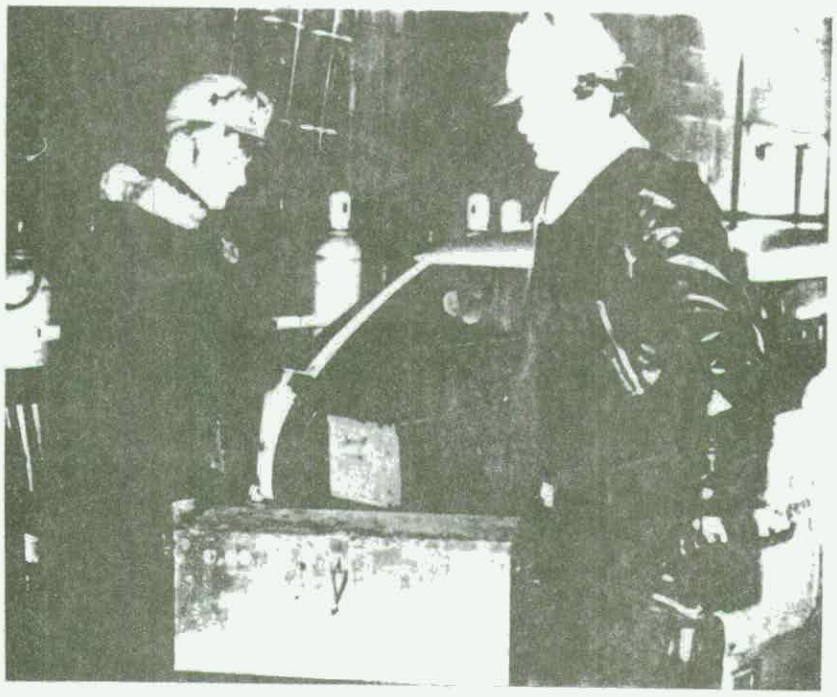


FIGURE 8-2. MEMBERS OF CHLOREP TEAM



FIGURE 8-3. PATCH KIT C

Depending on the size, shape, and orientation of a hole in a container, a leak may be patched or plugged. Figure 8-4 is an example of a patched tank car. If the leak is from damaged or loosened car fittings (gaging devices, valves, safety vents, thermometer well cap, etc.), they may be tightened or repaired. Often, leakage from fittings can be stopped by tightening mounting nuts and closure plugs. However, if the mounting gaskets or valves have deteriorated, tightening nuts will not stop the leak. Replacement may be possible by specially trained personnel with special equipment.



FIGURE 8-4. PATCHED TANK CAR

Leaks can occur in fittings that have not been broken off. Figure 8-5 illustrates the loading and unloading arrangement for DOT105A600W tank cars. When the tank is upright, vapor will be released if the following fittings are loose or defective:

a. The gasketed joint between the manway cover plate and the manway nozzle.

b. The gasketed joint between the base of the safety valve and the manway cover plate.

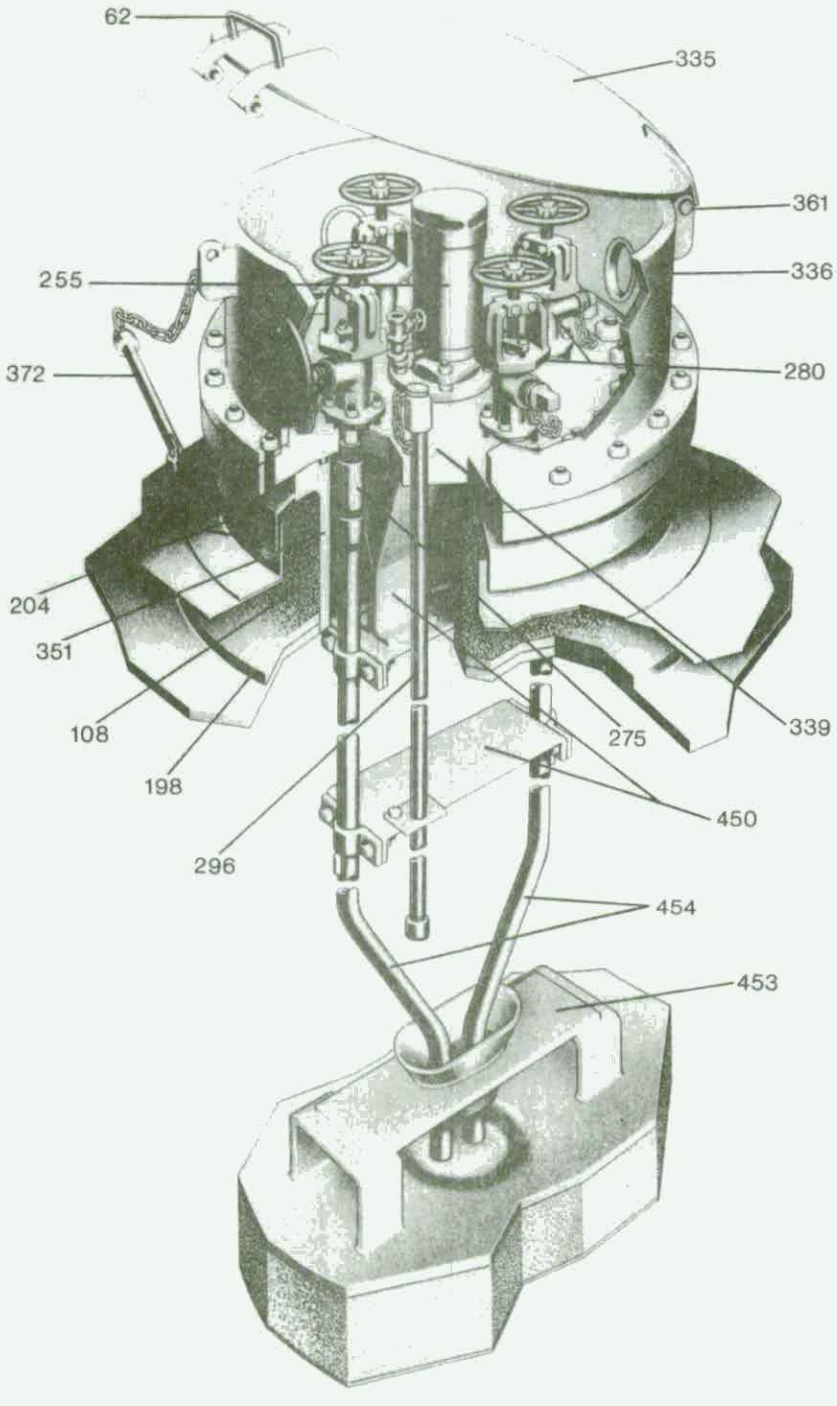
c. The gasketed joint between the base of the safety valve and the manway cover plate.

d. The gasketed joint between the base of gauging device and the manway cover plate.

e. The closure plugs of the safety valve.

f. The thermometer well closure cap.

g. The packing gland of the gauging device.



PART NO.	DESCRIPTION
62	BONNET COVER HANDLE
108	INSULATION
198	MANWAY NOZZLE REINFORCEMENT
204	MANWAY FLASHING
255	SAFETY VALVE ASSEMBLY WTH FRANGIBLE DISC ADAPTER AND TELL TALE VALVE
275	1¼" CHECK VALVE
280	1" ANGLE VALVE
296	THERMOMETER WELL
335	MANWAY BONNET COVER
336	MANWAY BONNET
339	MANWAY COVER PLATE
351	MANWAY NOZZLE
361	HINGE
372	SEAL PIN
450	PIPE BRACKET
453	PIPE GUIDE
454	1¼" DISCHARGE PIPE

FIGURE 8-5. LOADING/UNLOADING ARRANGEMENT FOR DOT 105A600W CAR

Liquid will be released if the following fittings are loose or defective:

a. The gasketed joints between the liquid valves and the manway cover plate.

b. The sampling valve.

c. The gauging device at the valve handle.

d. The closure plugs of the liquid valves sampling line and gauging device.

All openings in a tank car containing flammable compressed gas except the safety valve are equipped with gravity-activated excess flow check valves which are designed to close automatically when their external closure is fully open or broken off. Because of these devices, contents of the tank can be transferred only with the tank in an upright position.

The following must be carefully followed in approaching a leaking container:

1. A leaking container is approached only after monitoring for and assuring safe toxic or flammable vapor levels;

2. Some efforts have been made to assess the overall structural integrity of the container (this is performed in detail in Sequence 9, after leaks have been stopped and containers relatively secured);

3. Response personnel use appropriate protective gear and equipment when approaching a leaking container;

4. All sources of ignition such as mechanical refrigeration units, lamps, stoves, markers, etc. must be extinguished;

5. Only "non-sparking" tools must be used when making emergency repairs;

6. Patching or plugging materials must be compatible with the hazardous material;

7. Trains are not permitted to pass on adjacent tracks or motor vehicles on the highway or street;

8. Moving of leaking tank cars or cargo tanks should not be attempted; and

9. If the container has a fire at the safety relief valve or from a tank puncture, no attempt should be made to extinguish the fire unless the leak can be secured because of the problem of vapor travel, reignition and flashback.

When a tank car containing compressed flammable gases is involved in a transportation accident, leakage is likely to develop, especially if structural damage has occurred. These gases are heavier than air and can travel and accumulate in low-lying areas, posing fire, explosion and flashback hazards. If a leaking tank car is on fire it may rupture. A more severe rupture situation, however, is fire impingement on an adjacent car which is not on fire.

In cases where a container is inaccessible, the damage too severe, where fire impingement has reached dangerous proportions, or the container is punctured and its contents burning; trying to stop a leak may not be feasible or desirable. Figures 8-6 through 8-9 show tank cars in these situations. There may, in fact, be times when a tank car or other container needs to be emptied of its contents because of potential critical damage precluding moving, rerailing or even off-loading. In the past few years there have been a few successful attempts (e.g., Muldraugh, Kentucky; Claxton, Kentucky; Molino, Florida) at "venting" tank cars and "burning" contents using explosives. These procedures are still at very preliminary stages and thus must be used with extreme caution and only when conditions indicate no other solutions. The following issues must be addressed in using this technique:

1. Assessment of critical damage to container precluding moving or a in-field transfer;
2. The decision to utilize explosives for "vent and burn" must be one mutually arrived at and agreed upon by the experts who have critically assessed the situation;
3. The area must be sufficiently remote to reduce public and property exposure;
4. Experts must be located to perform the operation;
5. Explosive materials such as shaped charges, thermite grenades, etc. must be available;
6. The accident scene must be sufficiently stabilized to permit access to place charges and other equipment as required;
7. There must be adequate prior assessment of the potential impacts and expected results;
8. The public and all non-essential response personnel must be removed to a safety perimeter beyond the site;
9. If any liquid release is expected, dikes, dams or containment pits must be constructed; and
10. After fire has subsided the container must be checked for presence of flammable or other vapors and be flushed clear, if any remains, to allow safe resumption of wreck clearing operations.

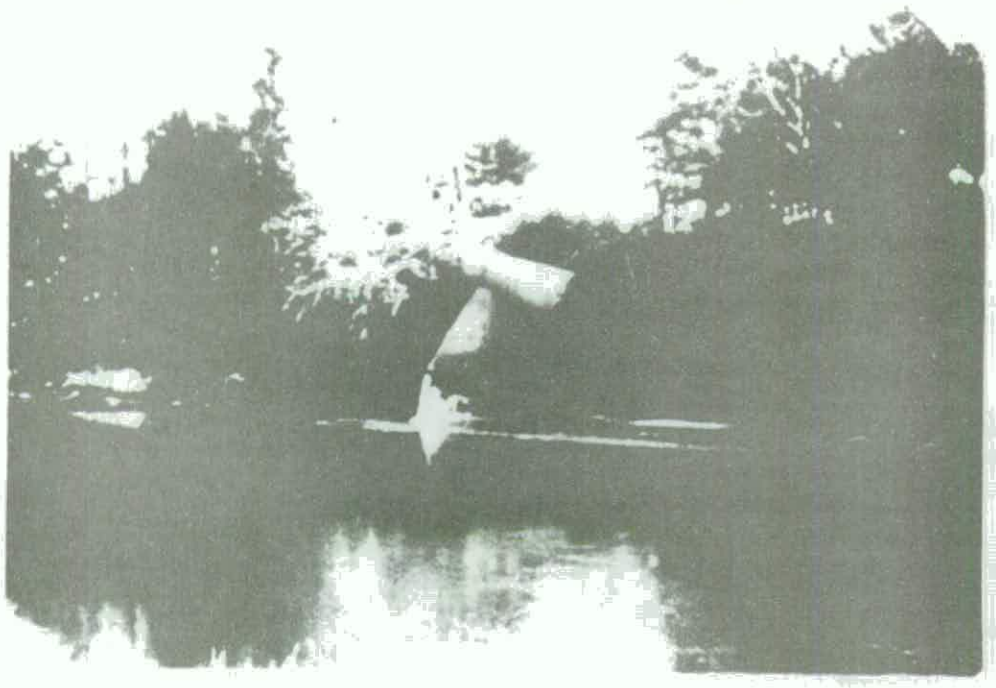


FIGURE 8-6. INACCESSIBLE CONTAINER



FIGURE 8-7. FIRE IMPINGEMENT ON SEVERAL TANK CARS



FIGURE 8-8. TANK CAR PUNCTURED AND BURNING

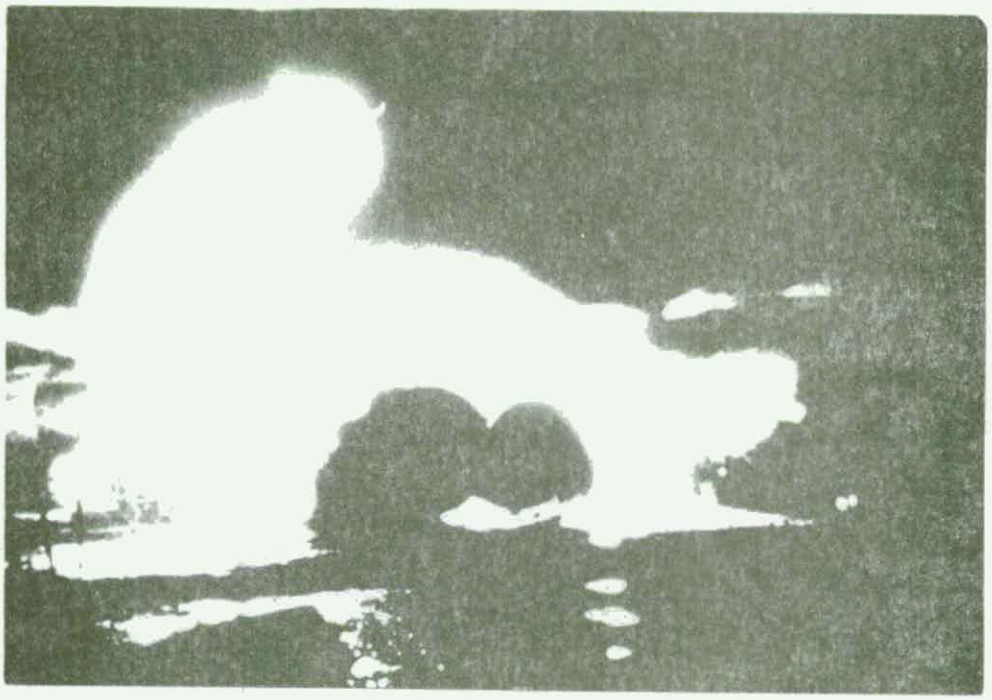


FIGURE 8-9. TANK CARS VENTING AND ON FIRE

If the leak stops proceed to Section 8.1, but if the leak continues proceed to Section 8.2, Action 4.0 - Leak Continues.

8.1 LEAK STOPPED (SCENARIO SEGMENT T)

Proceed to Section 9 (Container Structural Integrity Assessment).

8.2 LEAK CONTINUES (SCENARIO SEGMENT S)

Go to Table 8-1, Action 4.0 - Leak Continues.

TABLE 8-1. ACTION 4.0 - LEAK CONTINUES

1. Remove all ignition sources; use non-sparking tools and explosion-proof equipment; be sure equipment is properly grounded.
2. Approach leaking container from upwind, using fog water spray to suppress vapors. Do not force a stream of water directly into a tank or container.
3. Attempt to patch or plug leaking container using compatible materials or otherwise secure tank.
4. Monitor vapors continuously with a portable explosimeter. If leak is inaccessible or unstoppable, pull back response personnel and evacuate civilians within a 0.5 mile radius. Do not re-enter area until explosive limit is below the LEL.
5. If leak is accessible and it is possible to off-load, go to Off-load/Transfer Required, Section 10.1.
6. If leak is completely inaccessible, allow leak to go to depletion, maintaining application of fog water spray to minimize vapors and containment of the leak and any contaminated runoff.
7. Monitor vapors and approach from upwind when possible.
8. When leak has been stopped or has gone to depletion go to Sequence 9, Container Structural Integrity Assessment.

9. CONTAINER STRUCTURAL INTEGRITY ASSESSMENT

Figure 9-1 shows where Sequence 9, Container Structural Integrity Assessment, fits into the decision-making process in managing a hazardous materials transportation accident.

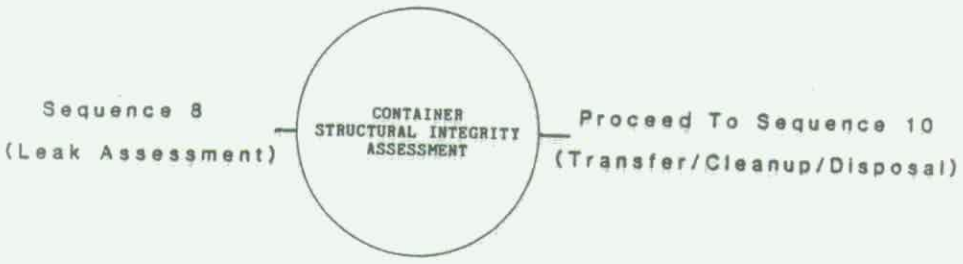


FIGURE 9-1. CONTAINER STRUCTURAL INTEGRITY ASSESSMENT - SEQUENCE 9

Damage assessment is required on tank cars or containers that show signs of the following damage modes:

- Cracks of any size or in any location justify off-load/transfer of the HM being transported;
- Dents having a critical radius of curvature not exceeding 4.0 inches on tank cars constructed before 1966 and a critical radius of curvature not exceeding 2.0 inches on tank cars constructed in 1966 or later;
- Scores and gouges are generally considered to be noncritical unless they cross a weld seam and then are considered potentially critical only if they remove more weld material than the amount extending above the base material; and
- Wheel and rail burns can be treated similarly to scoring and gouging. The depth of the burn is used to recommend immediate unloading (minimum depth greater than 1/8 inch).

Figure 9-2 shows some examples of various types of tank car damage following a derailment.

In every instance where visual inspection of the tank car does not indicate that there has been no damage to the tank cars involved, a detailed inspection of each rail vehicle must still be carried out by trained and experienced railroad personnel in conjunction with the tank car manufacturer and wreckage removal contractor. If the structural integrity of the tank car appears to be weakened to the point necessitating transfer/cleanup/ disposal, proceed to Section 10 of this management orientation guide.



Dents, Torn Jacket



General Damage



General D mage



Gouges, Scrapes

FIGURE 9-2. EXAMPLES OF TANK CAR DAMAGE

If the detailed inspection of the damaged tank cars indicate any signs of the damage modes and critical measurements mentioned above, then the tank car may require transfer/off-loading or other action.

During visual inspection, response personnel should listen for audible tank noises or popping/hissing of a safety relief valve indicating possible tank condition problems. Also any bulges or discolorations should be noted as indicating possible structural problems. If any of these things occur response personnel should be pulled back immediately to a 0.5 mile radius and the tank observed from a distance.

There are problems associated with visual inspection because the damage may be in a location which is inaccessible or difficult to see. Also in the case of insulated, jacketed tank cars damage observed on the outer shell may be immaterial to the integrity of the inner tank. Figure 9-3 shows extensive damage to the outer shell of tank cars carrying HCN; however, the inner tanks were not damaged and no release occurred.

It is also very important to consider ambient conditions when assessing container damage. A steadily increasing temperature can create temperature or pressure problems in a container already mechanically damaged in an accident. A container which has been damaged and weakened may pose severe rupture potential if the temperature of the lading rises increasing the internal container pressure.

The assessment of damage to containers is a critical step especially where HM are involved. It is very important that a trained person be involved in this determination. Tragedies can occur even during off-load and transfer operations under stable post-accident conditions as happened in Waverly, TN.

If it has been determined that the container can not be moved or off-loaded in place, the option to empty the container and dispose of its contents by burning in-place exists. This "vent and burn" technique was discussed in Sequence 8, Leak Assessment. The same criteria and considerations apply in this situation for handling a critically damaged loaded container.

If it has been determined that the car can be moved or rerailed proceed to Section 11, Wreckage Removal; if the car should be off-loaded without moving it, proceed to Sequence 10, Transfer/Cleanup/Disposal. If there is any doubt as to the roadworthiness or structural integrity of the car, proceed with extreme caution and take the most safe and conservative actions.

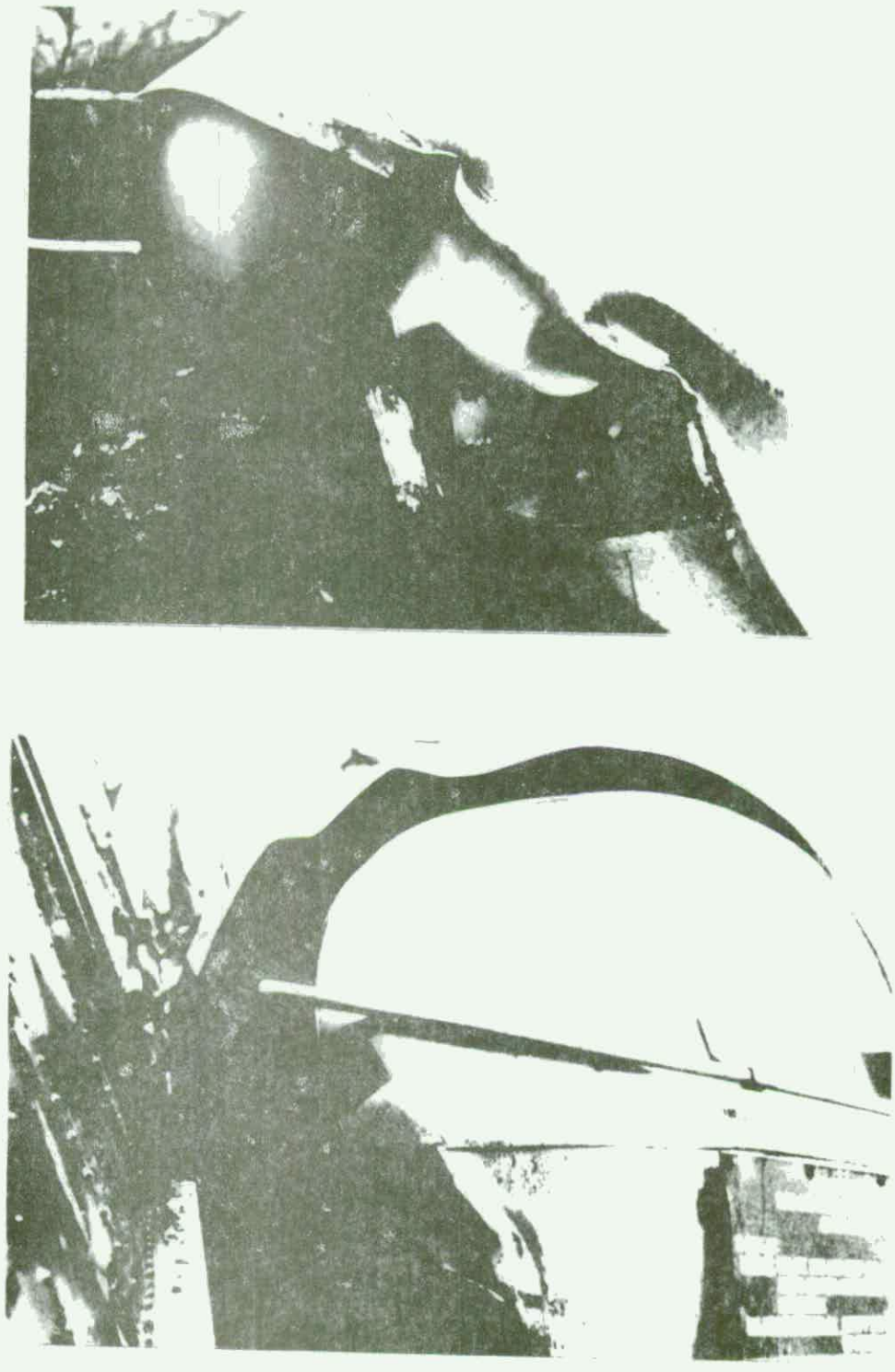


FIGURE 9-3. HCN CARS WITH OUTER SHELL DAMAGE

10. TRANSFER/CLEANUP/DISPOSAL

Subsequent to assessing the structural integrity of the cars damaged in the accident a decision needs to be made as to whether the loaded tank cars require off-load/transfer or whether they can be rerailed/moved. Figure 10-1 shows the decision points in Sequence 10, Transfer/Cleanup/ Disposal.

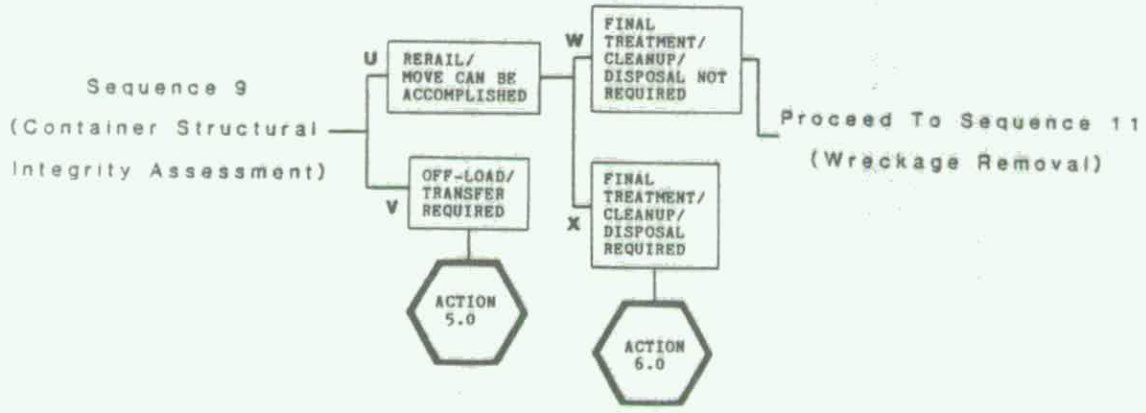


FIGURE 10-1. TRANSFER/CLEANUP/DISPOSAL - SEQUENCE 10

Section 10.1 discusses off-load/transfer considerations such as the cargo transfer team, container status assessment, container accessibility, reaching the liquid level, minimizing internal pressure, transfer system design/layout, transfer operations and controlling transfer. Action 5.0 (Table 10-1) summarizes these considerations for conducting off-load/transfer operations.

Section 10.2 discusses final treatment/cleanup/disposal requirements following an accident with releases of HM. This section discusses considerations for the cleanup/disposal team; communications; cleanup and disposal regulations; monitoring; personal protection; selection of tools, equipment, materials and receiving containers; treatment options; disposal options; handling spilled and unspilled material; recovery versus disposal options; waste collection and waste removal. Action 6.0 (Table 10-2) summarizes these considerations for final treatment/cleanup/disposal.

TABLE 10-1. ACTION 5.0 - TRANSFER/CLEANUP/DISPOSAL

1. Select a cargo transfer team that has expertise in handling the particular HM; this usually involves the advice of the shipper.

WARNING

No cargo transfer should be attempted without supervision of qualified experts and prior approval of the carrier and shipper.

2. Considerations to determine equipment needs and cargo transfer organization and operations include:

   - HM involved,
   - Quantities involved,
   - Container structural integrity,
   - Structural designs,
   - Car orientation, and
   - Container accessibility

3. Obtain all needed personnel, equipment, materials, etc. required to perform the cargo transfer operations.

4. Continually observe container's structural integrity as explained in Section 9.

5. Always assume some structural damage to a tank car even if it is not visible or apparent. All actions should be approached with this assumption in mind.

6. Examine detailed drawings to determine how a connection can be made to the transfer system and whether or not there is an access point.

7. Before transfer is initiated, internal pressure should be minimized.

8. When designing the layout of the transfer system, it is critical that:

   - Fittings and connectors are matched between the tank and the transfer system,
   - Suitable materials are used to ensure construction compatibility,
   - Receiving containers and transport meet 49 CFR specifications, and
   - The damaged container and the receiving container be properly grounded.

9. The three basic ways to move a liquid include:

   - Gas/vapor pressure,
   - Gravity flow, and
   - Pumps.

TABLE 10-1 (cont'd)

10. Gravity flow is the slowest but safest since it does not involve pressurizing or use of mechanical equipment.

11. The transfer flow rate needs to be controlled to prevent static charge build up and so negative pressure is not created in the tank car or cargo tank.

TABLE 10-2. ACTION 6.0 - FINAL TREATMENT/CLEANUP/DISPOSAL

1. Proper protective clothing, gear and equipment are required.

2. Continuous monitoring of the accident site is essential to assure:

   - Response personnel are not experiencing toxic exposure,
   - Response personnel do not become fatigued from extended work and the confined, cumbersome conditions,
   - Sufficient oxygen is available,
   - Flammable limits are within a safe range, and
   - No release of liquid or vapor occurs.

3. Continually monitor the structural integrity of a loaded tank car.

4. The final cleanup/disposal of HM should only be handled by trained and fully qualified personnel.

5. The cleanup/disposal team should establish good communication lines with the OSC and other ER team members.

6. Transport of any HM or contaminated materials should meet Title 49 CFR, EPA regulations and any other State and local requirements.

7. Do not proceed with cleanup and disposal operations until accident scene has been stabilized.

8. Treatment options include:

   - Dilution with water
   - Adding a chemical neutralization agent

9. Disposal options include:

   - Controlled burning
   - Venting/flaring system
   - Dilute sufficiently so that it can run into a stream or sewer
   - Burying

10. When practical, recovery of spilled HM is usually preferable to disposal. Considerations include:

    - Safety of the personnel who will perform recovery or cleanup/disposal operations (e.g. potential for exposure).
    - Complexity of the recovery versus disposal process,
    - Time to set-up and perform operations,
    - Preference (and opinions) of the carrier and shipper,
    - Relative hazards to the other emergency personnel, the public and the environment,

- The HM involved and quantities,
- Environmental conditions (present and forecasted),
- Comparative economics,
- Environmental protection and transportation regulations,
- Availability of an appropriate disposal site,
- Distance to disposal sites,
- Availability of equipment and materials,
- The physical orientation and condition of the containers, and
- Potential liability.

11. The method of waste collection depends upon the particular HM involved, the quality, the quantity, the terrain, and what disposal method is contemplated.

12. All waste transported off-site must be packaged and have a proper manifest as per DOT/EPA regulations.

When off-load/transfer is not required, tank cars can be rerailed or placed on flat cars or gondolas and moved. When final treatment/cleanup/disposal is not required you can proceed with wreckage removal operations which are discussed in Section 11.

10.1 OFF-LOAD/TRANSFER REQUIRED (SCENARIO SEGMENT V)

If the detailed visual damage assessment of tank cars indicates that they are not roadworthy and that they should not be rerailed or placed on a flat car or gondola, off-load/transfer operations may be performed in the field. One other option which is available is the "vent and burn" disposal of lading in-place using a controlled burn. This is discussed in Section 8, Leak Assessment.

10.1.1 Cargo Transfer Team

When a tank car containing HM is to be transferred on-scene, the carrier has the authority to select the group to perform the transfer operations. Because of the value of the cargo, the shipper's knowledge of the cargo's physical/chemical characteristics and expertise in handling the particular HM, and the fact that the carrier is performing a service for the shipper, the carrier usually seeks the advice and assistance of the shipper before cargo transfer. Some shippers have qualified in-house teams available to transfer commodities and provide on-scene assistance. No cargo transfer should be attempted without supervision by fully-qualified experts and the prior approval of the carrier and shipper, both of whom should coordinate the plans and actions with the OSC. They must then decide what personnel and equipment are needed to accomplish the job and determine what resources (equipment, materials, etc.) must be acquired and arrange for their delivery to the site, if necessary. In some cases, the carrier may decide to hire a contractor to perform the transfer. In the best interests of everyone concerned, the shipper and carrier should be knowledgeable about the capabilities and qualifications of a potential cargo transfer contractor.

10.1.2 Transfer Preparations

Before any decision or attempt is made to transfer cargo, the transfer team must know what HM are present, quantities involved, container structural integrity, structural designs (detailed drawings are useful) and orientation. Depending upon the situation, empty specification tank trucks/rail tank cars or other containers have to be obtained. Appropriate hazardous materials monitoring instruments and personal protective clothing, breathing apparatus and other gear must be obtained and checked out. After

careful study of container designs a sketch should be made of the proposed transfer scheme. A list of all necessary pipes, fittings, adapters, valves, gages, pumps, containers and other items required to perform the transfer should be made. One important reason for having detailed container design drawings is the need to be certain that all connections from the transfer system to the tank will be properly sized and threaded; a misfit could create a very serious accident. Then, an overall plan should be developed for every aspect of constructing the transfer system and its operation. The SOP should include an appropriate check off list to assure all steps are followed, leaving nothing to chance.

Upon arriving at the scene, the transfer team should make personal contact with the OSC and other appropriate officials, e.g., railroad, shipper (if the team is not from the shipper's organization), environmental monitoring groups and any other necessary support groups such as earth movers or wreckage handlers to discuss the transfer plan; make necessary modifications if the situation has changed; arrange for any needed support; and establish communications.

10.1.3 Container Status

Presently, there is no accurate way to assess container structural integrity at the accident scene. The technology has yet to be developed and applied to the assessment of a hazardous materials tank car or cargo tank. The propane tank car explosion three days after the derailment occurred at Waverly, TN, is clear evidence of this deficiency. Figure 10-2 shows the magnitude of one such explosion that occurred at Crescent City, IL. However, certain observations can be made to give some indication.

These observations are presented in detail in Section 9, Container Structural Integrity Assessment. Briefly one should look for discoloration, bulging, any sign of external damage such as cracks, dents, gouges, scores, wheel and rail burns, missing external valves or fittings. One should listen for popping or hissing sounds, tank groaning or other noises. All these "sights" and "sounds" may be indications of structural problems or weakening of the structural capabilities of the container.

Even if there is no apparent damage, it should be assumed that there has been some damage and all transfer actions should be conducted with this in mind.

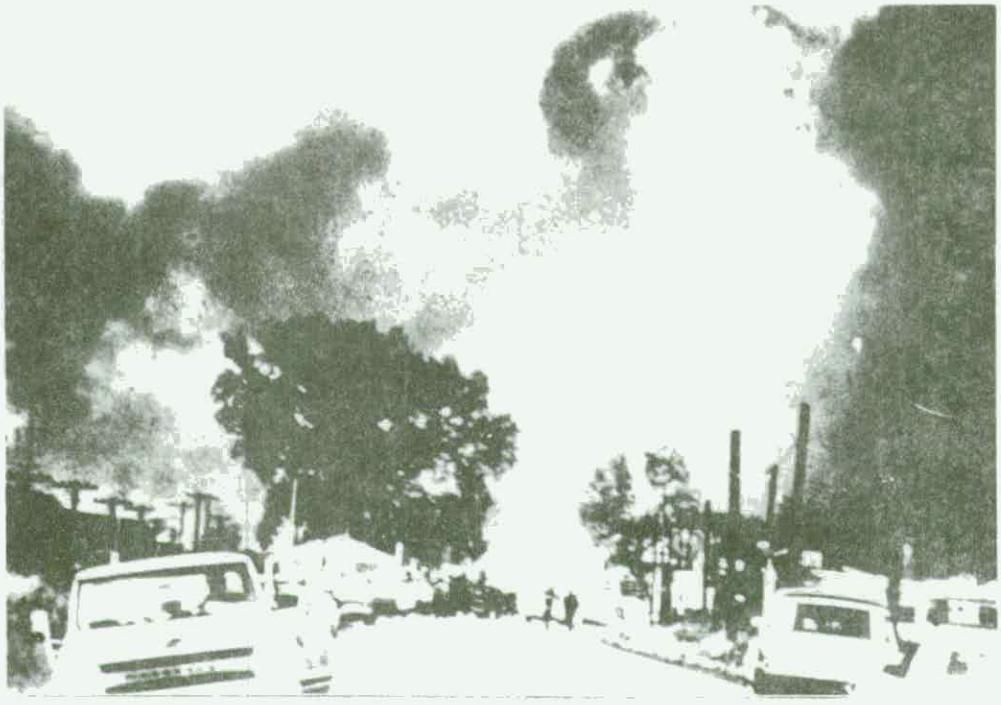


FIGURE 10-2. TANK CAR RUPTURE

In addition to determining the container's integrity, it is very important to shore up, anchor with cables and adequately secure the container before attempting any transfer activity.

10.1.4 Container Accessibility

It is necessary to examine the detailed design drawings for the particular tank car or cargo tank involved to determine internal piping arrangements, valving and other access points, and their position relative to the orientation of the container, the quantity of hazardous materials and liquid level. Knowing these things permits a decision as to how a connection can be made to the transfer system and whether or not the access point can be opened. Also it indicates how much the container needs to be reorientated to provide a suitable access point; or if the container would have to be breached to insert an adapter, and if so, where the best location to breach the container would be. It should be kept in mind that liquid can be transferred. It is not practical to transfer the vapor phase.

The Chlorine Institute has sophisticated CHLOREP teams, experts knowing container designs, and equipment to seal leaks and repair certain items like valves and seals on chlorine containers. Other associations are attempting to develop comparable equipment and programs for other specialized hazardous materials.

The ideal situation is to have the normal unloading valves and piping intact and in a usable position. This does not happen often, so it may not be feasible to transfer any remaining cargo.

Continuous monitoring of the containers, meteorological conditions and personnel is necessary. Only persons essential to the operations should be allowed in the area during product transfer.

10.1.5 Reaching the Liquid Product

Bulk containers are designed for top/bottom unloading depending upon the particular hazardous material being transported in them. As mentioned earlier, liquid transfer is a practical approach. Figure 10-3 shows a product transfer team trying to reach the liquid level. When in the normal position, this is not a problem. However, the usual accident scene finds the containers in anything but normal orientation. The wheels or undercarriage may be sheared off and the container could be resting on, or partially buried in, the ground. Obviously this makes transfer from the bottom impractical unless it is possible to dig an access through the ground to a fitting underneath. If an access is partially below the liquid level, it may be possible to remove some of the liquid.

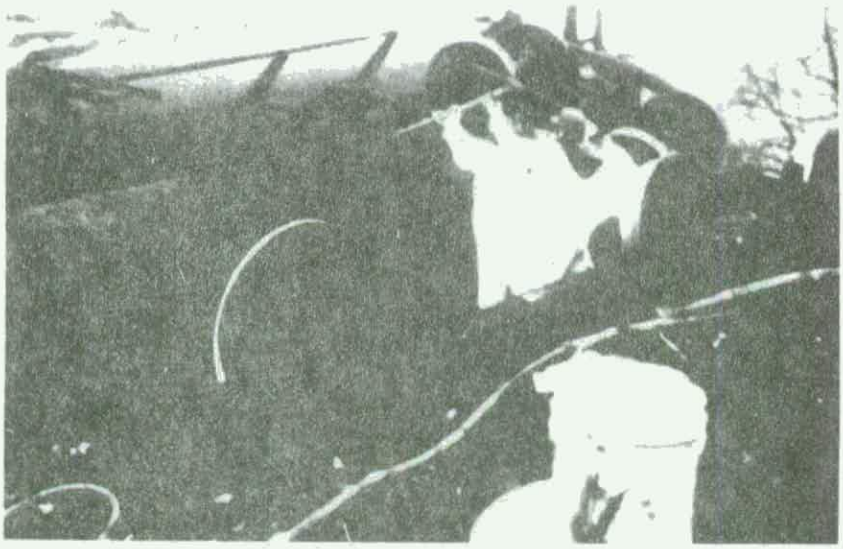


FIGURE 10-3. TRANSFER TEAM ATTEMPTING TO REACH LIQUID LEVEL

10.1.6 Minimizing Internal Pressure

The chances of increased leakage or rupture of the container can be reduced if the excess internal pressure can be safely reduced prior to beginning transfer operations. If the container has an adjustable safety relief device which is free and located in the ullage space it may be possible to use this method. If the vapors are flammable or toxic the release must be done in such a manner that released vapors do not create flammable or toxic hazards. Any person engaged in this operation must have full protective clothing and gear.

Depending upon the particular hazardous material, it may be possible to reduce the tank pressure by water-cooling the container (not to be done with cryogens or refrigerated products). Enough water must be applied to actually cool the tank car. According to the NFPA, a minimum of 500 gpm of water must be applied to cool a tank car effectively. With certain chemicals it might not be possible to reduce the internal pressure significantly unless essentially all the product is released. Water-cooling the container might have to be done if conditions indicate that transfer can not be accomplished or moving the loaded container risky.

As a last resort when cargo transfer is considered too dangerous, it may be necessary to rupture the container and burn its contents. This requires the services of qualified explosive experts working in coordination with persons knowledgeable in the construction of the particular container and the characteristics of the hazardous materials in an explosive environment. Figure 10-4 shows an Army Explosives Ordinance Division (EOD) team getting ready to rupture a container. All effects (fire, toxicity, fragments and blast overpressure) must be carefully estimated and the necessary prior evacuation and other precautions taken beforehand. Provisions must be made to assure immediate ignition of the vapors to reduce vapor-phase explosion intensity.

All pressure-reducing venting/flaring systems must be equipped with flow control valves, check valves, flame arrestors and other necessary safety features to prevent air/flashback into the container.

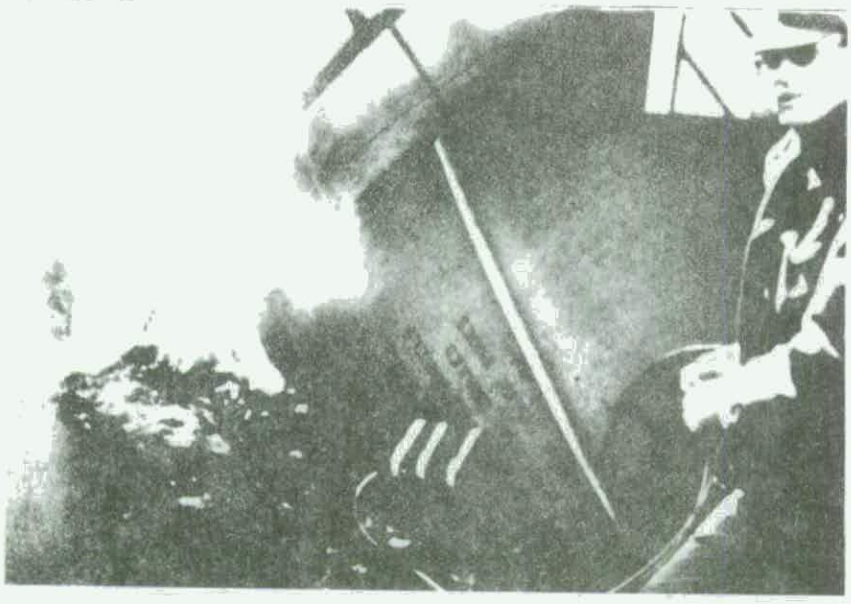


FIGURE 10-4. EOD TEAM SETTING UP TO RUPTURE A CAR

10.1.7 Transfer System Design/Layout

Because of the differing hazards associated with hazardous materials and their incompatibility with other materials, threading and other aspects of valves, connectors, etc. are deliberately designed to prevent interchange. For that reason, and to make certain no leaks occur, it is critical that fittings and connectors are matched between the tank and the transfer system. Certainly, the precaution must be observed throughout the transfer system.

10.1.7.1 Materials of Construction Compatibility

The shippers can provide information about the materials of construction and equipment suitable for handling their respective commodities and should be consulted when designing a particular transfer system. Equipment manufacturers (e.g., for pumps) should be able to recommend equipment suitable for service with particular hazardous materials. In most instances the manufacturer or shipper will be represented at the scene and can provide technical expertise for transfer operations.

10.1.7.2 Capacity and Specifications

All hazardous materials which are transferred will also be transported. Unless the hazardous materials are to be delivered, recovered or disposed in the local jurisdiction where the accident occurred, its transport will be subject to State and Federal

regulations. Receiving containers for the particular hazardous material involved must meet 49 CFR specifications. In addition to avoiding penalities for violating regulations, their use avoids unnecessary additional transfers to specification containers and the hazards, risks and expenses that such operations entail.

It is absolutely critical that any receiving containers be thoroughly cleaned and purged, so that there is no residue that could react with the HM to be placed in them. Furthermore, their integrity needs to be verified so they will not leak.

The receiving containers must be positioned so they will be stable when loaded and be able to be moved out without any problem. Also, the receiving container must have adequate capacity to hold all the product to be transferred.

10.1.7.3 Grounding

Many HM are flammable. Sound safety procedures require that all sources of ignition be removed from any place where flammables are present. Static or electrical sparks can easily ignite flammable vapors so it is important that the entire transfer system, including the damaged container and the receiving container be properly grounded as shown in Figure 10-5, so that the possibility of sparking and igniting any inadvertent vapor release is minimized. Fluid flow and pumps can easily generate static electricity.

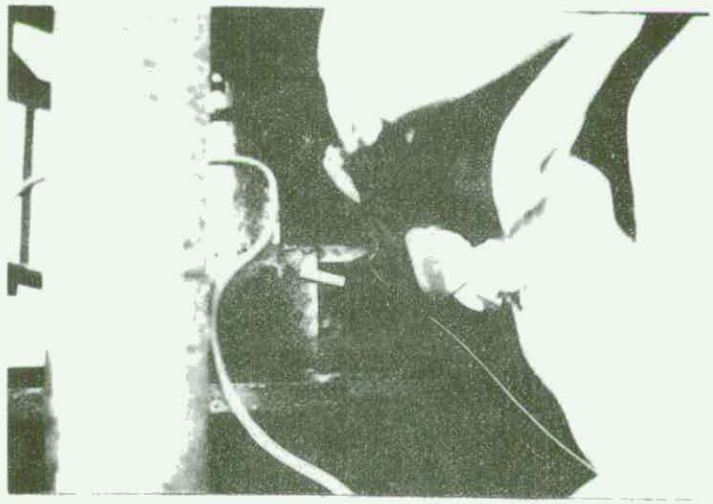


FIGURE 10-5. GROUNDING THE TRANSFER SYSTEM

If it is necessary to reorient the container before transfer, heavy equipment is usually involved. Such equipment can also develop high static charges. Grounding of such equipment along with the container is absolutely essential.

10.1.8 Transfer Operations

Continuous monitoring of operations and personnel is necessary so that corrective actions may be taken immediately if needed.

Leaking vapors could be flammable or toxic. People working in close proximity are particularly susceptible to such hazards and must be alerted immediately. Weather predictions and meteorological data are needed on a continuing basis for downwind vapor dispersion calculations used for evacuation of civilians, deployment of personnel and management of operations.

Changes in tank pressure or temperature may be indicative of a potential problem and are particularly significant if the container has sustained damage.

10.1.9 Controlling Transfer

Transfer operations should be completed as quickly as is practical and safe. Most hazardous materials are moved as liquids because of ease of loading/unloading and the volume per container which can be transported. Three basic options for moving the liquid include gas/vapor pressure, gravity flow or pumps. If the conditions are such that the top of the receiving container is lower than the bottom of the tank car or cargo tank, gravity flow can be used. This is much slower than the other two methods but is the safest because it does not involve a pressurizing or the use of mechanical equipment. Depending upon the orientation and design of the container and the condition of internal piping, gravity flow might involve direct flow from the lower portion of the container. Siphoning may be required and extra precautions and special techniques (e.g., applying some inert gas pressurized or some equipment) may be required to establish the liquid siphon head.

With those HM under pressure, the liquid driving force is already present and can be utilized to accomplish transfer. Unless there is no access to the liquid this method is faster than gravity flow and does not require any auxiliary help.

There is a good likelihood that pumping may be necessary, particularly if those HM are flammable liquids. Introducing a pressurizing gas could stress a container. Pumping offers an alternative. It is important to remember that the pump must be compatible to operate in the presence of the vapors of the particular HM involved and that it be compatible with the hazardous material itself. Figure 10-6 shows product being pumped from one tank car to another container in the field.



FIGURE 10-6. IN-FIELD TRANSFER

Regardless of the method used, the transfer flow rate needs to be controlled so that the grounding system can prevent any static charge buildups and so that negative pressure is not created in the tank car or cargo tank. It is important that a closed transfer system be used to maintain an open line between the vapor (ullage) spaces of the container being emptied and the receiver, so that the pressure in each will be at equilibrium. See Figure 10-7. This is necessary to prevent a negative pressure from developing in the tank car due to rapid drawing which could collapse the container and cause a rupture or leak. The flow rate must be controlled so the ability of the connecting line between the two vapor spaces to maintain an equilibrium pressure is not exceeded.

There may be a lot of pressure to get everything cleaned up so that rail service may be resumed. Safety must override expediency, so that transfer is done efficiently and safely.

10.2 FINAL TREATMENT/CLEANUP/DISPOSAL

10.2.1 Cleanup and Disposal Team

The cleanup and disposal team may or may not be the same one that handles product transfer. This depends primarily upon the particular HM involved and the wishes of the carrier.

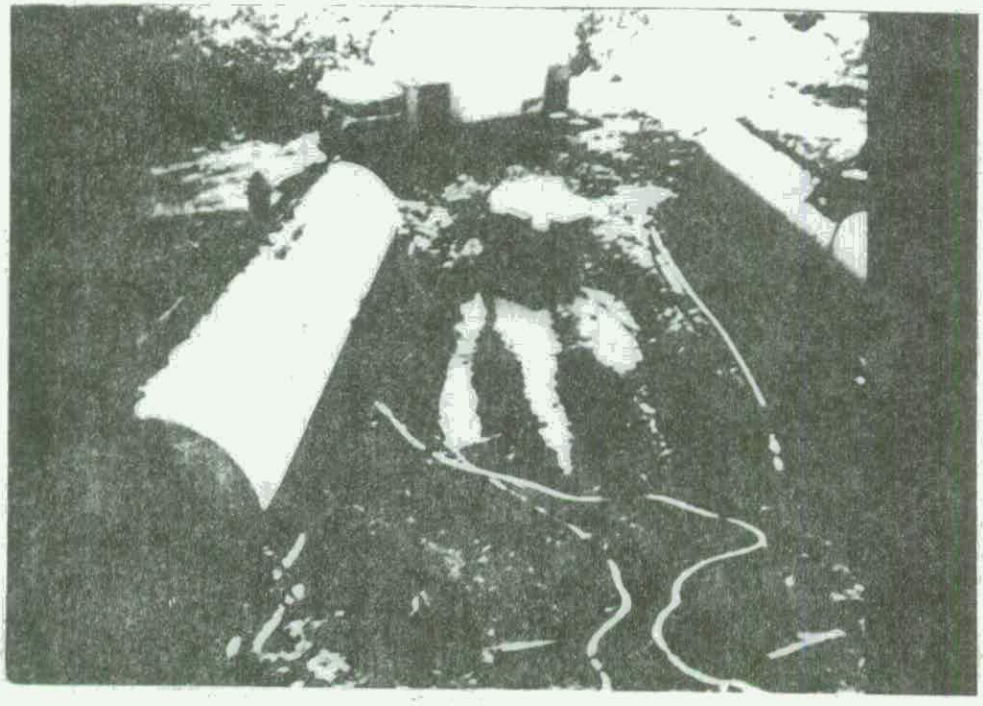


FIGURE 10-7. CLOSED TRANSFER SYSTEM

It is absolutely necessary that the handling and cleanup/disposal of HM be done only by persons who have been specially trained and are fully qualified to deal with them. They must know such things as: the inherent hazards and physical/chemical characteristics of the materials to be handled; the reactions they undergo; safe neutralizing techniques; the neutralizing alternative which will result in the least disposal burden; whether or not recovery should be attempted; whether the hazardous materials should be disposed of on-site or at an EPA-approved waste disposal site; proper protective clothing and equipment; and applicable DOT and EPA regulations. Thus, the team must possess a broad range of knowledge and capabilities.

10.2.2 Communications

As soon as the cleanup/disposal team is alerted that their services will be required, communications must be established with the OSC, the carrier and shipper's representatives. The purpose is to obtain as many details about the accident scene and situation as possible, so that preliminary operating plans can be drawn up and actions taken with regard to ordering, arranging and packaging. Communications should be two-way and provide for periodic updating of the on-scene situations to the team as well as the status of the team preparation to the OSC. Figure 10-8 shows an on-scene response person radioing information back to the command post. Figure 10-9 shows a member of a cleanup/disposal team talking with other on-scene emergency response team members. The OSC should be made aware of the time when the team is expected to arrive.

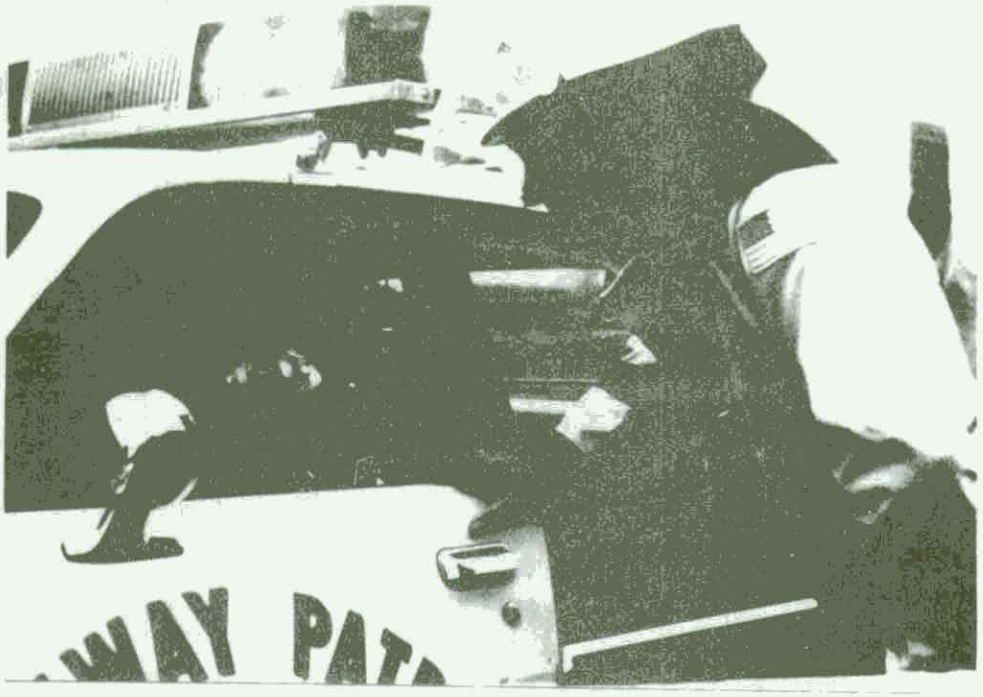


FIGURE 10-8. RADIO COMMUNICATION WITH THE COMMAND POST

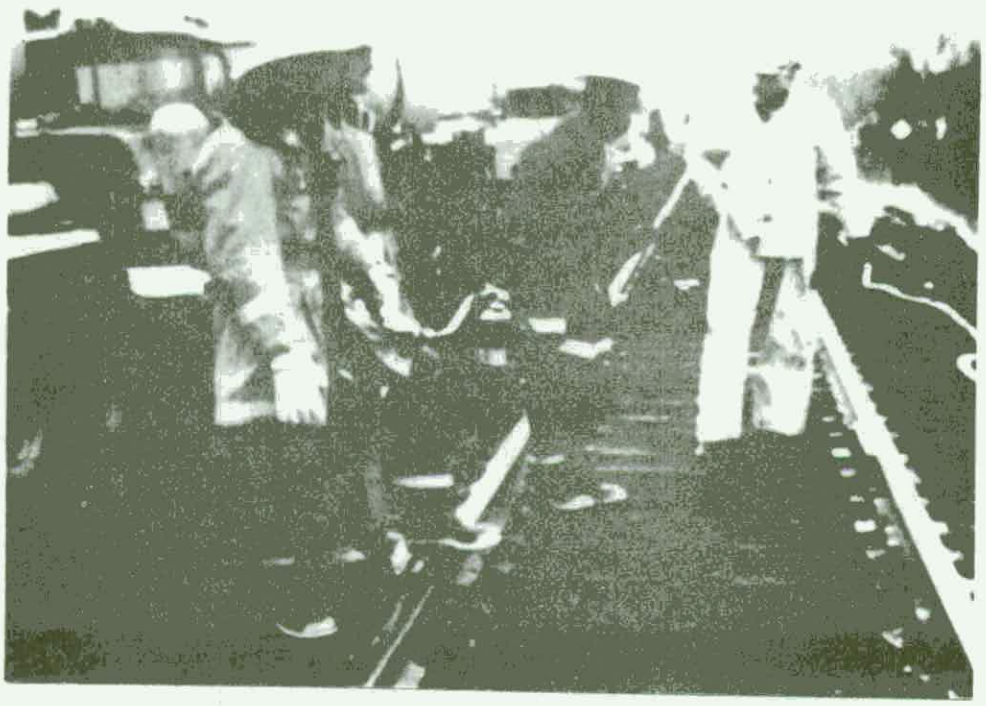


FIGURE 10-9. FIREMEN AND CLEANUP/DISPOSAL CONTRACTOR

The cleanup/disposal team can often provide the OSC with advice on handling or treating the spilled/leaking HM, managing effective control of them while minimizing the quantitiy of HM that has to be cleaned up and disposed of. Good communications can assist in accomplishing these objectives.

10.2.3 Cleanup and Disposal Regulations

If there are any HM or contaminated materials which will have to be transported from the site, such chemicals or waste should be placed directly in DOT-approved shipping containers. This avoids the hazards of additional transfer and handling operations. An early estimate of what containers will be needed and having them on hand before starting transfer and cleanup will do much to speed up these operations and disposal.

Although HM are usually liquids and gases, soil which becomes contaminated as a result of a HM release is considered hazardous waste. Although EPA's intention is to have as much uniformity as possible, there may be some specific variations from state to state, so one must be fully aware of the EPA requirements as well as those of the state where the spill occurs and where the hazardous waste is to be disposed.

If hazardous materials are proposed to be disposed of on-site, Federal, State and local environmental protection laws, regulations and ordinances must be obeyed. A full understanding of all applicable regulations is necessary. The OSC should have this information or be able to obtain it. When the cleanup/disposal team makes their initial contact with the OSC, he should be reminded that the team will require this regulatory information, unless the team already has it. The Regional EPA office should also be contacted for a listing of approved disposal sites and persons to contact at these locations.

10.2.4 Personnel Protection

All persons engaged in HM cleanup/disposal work must be provided and required at all times to use protective clothing, gear and equipment (e.g., breathing apparatus) which are adequate for the particular hazardous materials involved and the concentrations that could be encountered. Figures 10-10 through 10-12 show examples of personal protective clothing being used at HM transportation accident scenes. Note in Figure 10-12 that all openings to the suit are taped to prevent seepage of HM vapors. Only fully qualified people should be engaged in cleanup/disposal. Even though they are fully protected, such persons should avoid walking in, touching or any other direct contact with the hazardous materials. Working upwind of the spill is also recommended.



FIGURE 10-10. FIRE RESISTANT SELF-CONTAINED PROTECTIVE GEAR



FIGURE 10-11. TAPING PROTECTIVE SUIT SLEEVES



FIGURE 10-12. PROTECTIVE CLOTHING WITH OPENING TAPED TO PREVENT EXPOSURE

Cartridge or cannister-type breathing equipment, which filters outside air is good only for extremely limited materials, concentrations and exposure times. Self-contained positive pressure demand breathing equipment is the only kind recommended for clean-up/disposal work and this equipment also has operating limitations. Figures 10-13 and 10-14 show members of an emergency response team using positive pressure demand breathing equipment. There is no universal protective clothing or gear which will keep out all hazardous materials. Manufacturers of such items and the hazardous materials manufacturers can provide the best advice on what should be worn when working with particular hazardous materials.

10.2.5 Monitoring

Cleanup and disposal operations normally begin after the scene has been stabilized (no fires, explosions, leaks, etc.). Examples of stabilized accident scenes are shown in Figure 10-15. However, remaining materials (e.g., pools of spilled hazardous materials or HM mixed with suppressants, gels, foams, water, etc.; or HM in containers which have been patched or temporarily sealed) may be releasing flammable or toxic vapors. Also if the materials are being deliberately burned or otherwise reacted, it is important to know the combustion products and their concentrations where crews are working or civilians could be exposed. Persons engaged in cleanup/disposal work must wear full protective clothing, breathing apparatus and other gear suitable for the HM involved. Continuous



FIGURE 10-13. ER PERSONNEL SUITING UP



FIGURE 10-14. ER TEAM MEMBER IN FULL PROTECTIVE GEAR







FIGURE 10-15. STABILIZED ACCIDENT SCENES

monitoring of the site is necessary to assure that these persons do not receive toxic exposures beyond the capability of this protection. Continual observations of these persons for unusual behavior augments vapor monitoring and also provides an alert that the person might be getting exhausted from extended work under the confined, cumbersome conditions. Insufficient oxygen in the air is another problem which must be spotted immediately. Monitoring is also important to provide warning that a flammable concentration is being approached or has been reached. Trapped pockets of liquid or vapor can exist and be released as earth is moved during cleanup. Monitoring is necessary to detect such occurrences.

In the event damaged tank cars or cargo tanks still contain HM and it is necessary to perform any cleanup or disposal, it is vital that these containers be continually monitored for structural integrity. Cleanup/disposal operations should be confined to those which are absolutely necessary to prevent further problems. Examples might be venting (might include flaring) vapor to reduce internal pressure or to divert a pool or stream of liquid into a catchment to provide working access to the container.

10.2.6 Selection of Tools, Equipment, Materials and Receiving Containers

The primary consideration in selecting any of these items is that they must be compatible with the particular HM released. Only non-sparking tools should be used whenever flammable HM are involved. Also because of the fire/explosion hazard, all equipment (e.g., pumps and machinery) that will be operating at the scene must be of an explosion proof design. Separate lists of equipment, pipes, fittings, valves, containers, personal protective clothing, breathing apparatus, sorbent materials, neutralizing chemicals and sources should be prepared for each HM that the cleanup/disposal team will be handling. Some spare parts and extra amounts of materials should be included in the lists as should auxiliary equipment for really critical items.

The EPA spills manual gives details on equipment sources, the design, construction and operation of an on-site treatment system for the spilled HM. The manual also provides examples of how to calculate the amount of chemicals needed for treatment processing.

10.2.7 Treatment Options

The purpose of treating spilled material and that remaining in a damaged container is to control the hazards and render the HM harmless. Once it has been decided that the HM must be treated, the decision must be made as to what treatment method

and materials should be used. Acids may be neutralized with alkalis and vice versa. When selecting neutralizing agents one should choose those whose reaction products will be non-hazardous or less hazardous. When performed in a suitable open pit at a remote location, it may be possible to react essentially concentrated chemicals directly. For example, liquid chlorine may be added directly to caustic soda at a controlled rate. Reactions can be violent, generating much heat and even boiling and splattering of liquid, so this has to be done carefully.

Dilution of reactants and HM with water may be done, but this approach can create additional problems. There must be an ample supply of water. With the volumes of HM involved, this may be difficult. There must be enough storage capacity to handle the HM until they can be treated and released to a sewer or body of water at an allowable rate. If dilution is used and removal for disposal is required, costs could be prohibitive.

10.2.8 Disposal Options

If the bulk of the spilled/leaking HM can be recovered, the disposal problem can be greatly reduced. The same is true if the contents of damaged containers can be transferred. If the HM has been contaminated and is not suitable for economic/safe recovery, it may need to be disposed of on-site. If it is flammable and the combustion products are not harmful, controlled burning is a possible method.

In some instances it may be possible to dilute the HM sufficiently so that it can be run into a stream or into a sewer. Flow rates and concentrations must be carefully monitored and controlled.

Burying is a possible disposal method, if it can be proven that no unsafe concentrations of the HM would reach the atmosphere or leach through the earth to contaminate underground acquifers or other water sources. There will be a reaction with the soil microbes or bacteria or other oxidation reactions to help render the HM harmless. This would normally have to be in an area which could be maintained and monitored.

Some HM may have to be disposed off-site. This requires arrangements, authorization and transportation. It is essential that the disposal operations are done by fully qualified, reputable organizations.

10.2.9 Recovery Versus Disposal

When practical, recovery of spilled HM is usually preferable to disposal. Among the factors which must be considered in making this decision are stated in Table 10-2, Action 6.0. The OSC, shipper and carrier representatives need to discuss these items with the cleanup/disposal team (in-house or contractor) as early as possible so they can begin working up the preliminary plans and analysis, which can be updated as new facts become available. This approach utilizes team members' time efficiently and should result in the OSC and other officials having the information necessary when a choice has to be made.

10.2.10 Waste Collection

Waste collection should be considered from the beginning of emergency response actions at the scene. The spilled/leaking HM must be contained to limit spread and pollution (water, air and ground) as much as possible. Damming, diking, ditching and entrapment are some of the techniques employed. The surfaces upon which the HM spills may vary considerably in porosity (e.g., sand, clay, concrete, railroad ballast, asphalt or water), so penetration and ease of collection will also vary. Vigorous reactions might occur with certain HM. If it is possible to construct or find a material with less porosity, or even better to line it with a compatible material, leaks and possibly certain spills (e.g., a pool) could be diverted into such containment and easier collection for clean-up/disposal.

If the porous soil is not deep and is underlayed with rather non-porous earth, it might be possible to put a catch pit lower than the interface and drain the HM into it. Depending upon what HM is involved and the purity, the product may be pumped into containers for shipment, treated or disposed. Of course, if the product is spilled on a non-porous surface and can be contained, it can be pumped directly into containers.

Contaminated soil at varying depths and points around the spill needs to be analyzed. If the concentration is within acceptable limits, it can be left to undergo natural degradation and no further effort will be necessary to collect the HM. If it exceeds the allowable limit, the contaminated soil must be treated or excavated and disposed. Cleanup/disposal teams frequently use vacuum trucks for sucking up liquids. Small amounts of contaminated soil usually are handled by shovel. Large amounts may have to be excavated using a bulldozer, front-end loader or backhoe. If the spilled HM has soaked into the soil but the settling rate is slow enough it may be possible to move the contaminated soil onto a covered surface or prepared pit with an outlet which will allow controlled drainage and collection of HM.

The collection method will ultimately depend upon the particular HM involved, the quantity, the terrain and the disposal method. Waste collection operations should be conducted only by a fully qualified cleanup/disposal team properly protected and monitored. If transport is contemplated, collection must be made so that the amount to be shipped is kept as small as practical. The Coast Guard and EPA have detailed instructions on waste collection as related to water spills. These generally would apply to land spills to the extent these involve the HM getting into waterways.

10.2.11 Waste Removal

If it is not possible to dispose of the spilled or otherwise contaminated HM on-site, it must be moved off-site to an authorized treatment facility/disposal site. Usually cleanup contractors obtain the necessary approvals and handle the transport of the waste. Such transport must be in accordance with DOT regulations for interstate shipments and State regulations for intrastate shipments. In addition to removing any of the HM, all the remaining contaminated soil, sorbents, debris and reaction products must be removed, so that the concentration of any residual contaminant is within acceptable limits and the area is safe for normal use.

Tank trucks and drums are the most frequently used containers for shipping hazardous wastes. However, if large quantities of contaminated earth have to be moved, suitably covered lined dump trucks/rail cars might be usable. It should be recognized that vibration from transportation could possibly cause the liquid to migrate and concentrate (e.g., in the bottom of the container), so the lining of the container is important to prevent leakage.

Once the treatment/cleanup/disposal phase is well under way, proceed to Sequence 11, Wreckage Removal.

11. WRECKAGE REMOVAL

Figure 11-1 shows the decision points for Sequence 11, Wreckage Removal.

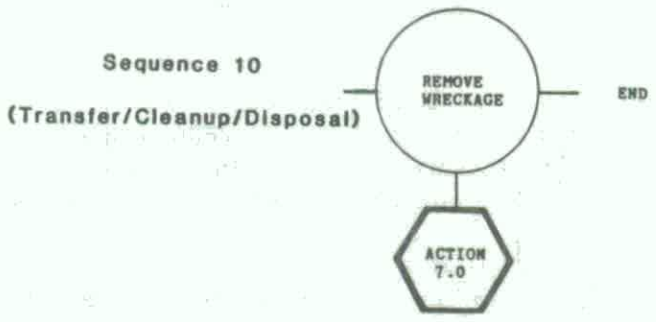


FIGURE 11-1. WRECKAGE REMOVAL - SEQUENCE 11

General considerations for wreckage removal are given in Section 11.1 through 11.8. Action 7.0 (Table 11-1) summarizes these considerations.

11.1 INITIAL PRECAUTIONS

Although wreckage removal is one of the last major operations in restoring a rail line following a HM train accident, wreckage removal operations must be considered early in the response. Response personnel must consider this task just as important and as potentially dangerous as any of the earlier operations if HM tank cars are still in the accident area. Continuously monitoring the accident area for possible vapor releases is absolutely necessary to avoid exposing personnel to dangerous situations. Before wreck clearing is initiated, the accident scene must be stabilized. This includes:

- Reduction of hazards from toxic, explosive, and flammable vapors (Section 6);
- Assessment of the structural integrity of derailed or overturned tank cars containing HM (Section 9); and
- HM transfer where advisable (Section 10).

In a derailment, it is also advisable to pull to safety those cars that are still intact on the track at the front and rear of the train. This should be performed only by experienced railroad personnel.

TABLE 11-1. ACTION 7.0 - WRECKAGE REMOVAL

1. Stabilize accident area before wreck clearing is initiated. This includes reducing flammable, toxic, or explosive vapor hazards; completing HM transfers, if applicable; and assessing the structural integrity of derailed or overturned HM tank cars.

2. Separate and remove intact derailed tank cars at the front and rear end of the train.

3. Decide sequence of removal of tank cars. Extreme caution must be exercised to avoid sudden shocks or jars that might produce sparks or friction. Derailed cars that have not suffered appreciable damage to underframe, including the car body bolster, can be retrucked and transported by rail in the normal manner.

   a. Generally removal of non-hazardous materials cars are first as long as they are readily accessible and their removal does not endanger the integrity of HM tank cars.

   b. Remove damaged, overturned HM tank cars last.

   c. Structural integrity assessment of the tank must be done to a HM tank car before retrucking and transporting by rail.

4. Derailed rail cars that cannot be safely retrucked must be transported by flat car or gondola. The contents of a HM tank car should be transferred before car is transported in this manner.

5. All equipment used in rigging operations should be inspected to insure safe operation including:

6. To ensure safe operations, wreck clearing operators must be familiar with car body construction, the relative strengths of various structural members, and the likely forces and directions of force that would be applied to these members during wreck clearing.

7. Lifting of a rail car should be done by the car body bolster.

8. In rigging operations:

   - No persons should be allowed below a suspended load.
   - No persons should be allowed between portions of wreckage that are being moved.
   - During car movement, no persons should be allowed between crane and point of attachment to car.

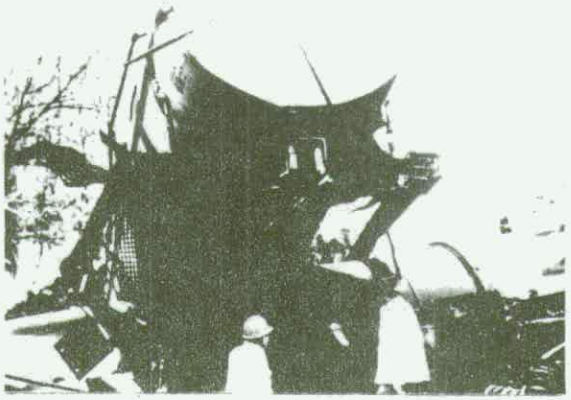
11.2 SEPARATING DERAILED RAIL CARS

The wreckage from a derailment is frequently in a jumbled, partially interlocked condition, as shown in Figure 11-2. Some rail cars may still be coupled together with the couplers inoperative. Damaged trucks may be intertwined with other parts of the wreckage and some wreckage may be difficult to reach with wreckage removal equipment. Even after vapor hazards have been minimized and hazardous materials transferred, removal of damaged rail cars should not be started until these cars have been detached or mechanically separated. Otherwise movement of the rail cars would be subjected to unexpected jolts and banging which could damage the car with possibly disastrous results.

If possible, mechanical separation of the rail cars should be accomplished by gently moving and lifting juxtaposed portions of the wreckage. If portions are inextricably tied together, as for example in coupled rail cars where the couplers are inoperative, then cutting torches may be required. Extreme caution must be used, particularly in the case of tank cars that contain flammable liquids or gas. Cutting torches must not be used on tank cars either empty or loaded carrying flammables. Some applicable guidelines from the Association of American Railroads Bureau of Explosives include:

- Do not attempt wreckage operations on flammable tank cars until flammable vapors have dispersed.
- Do not use cutting torches on flammable tank cars.
- An empty tank car should not be entered before it has been cleaned by steaming and checked for residual vapors.
- When using cutting torches, exercise care to avoid contact with leakage or ground saturated with even such materials as lubricating oils, asphalts, or other petroleum products, vegetable oils and animal fats.

It may not be necessary or desirable to use a cutting torch for an inoperative coupler. Often, the knuckle can be disengaged by knocking out the knuckle pin with a driving pin and sledge hammer. This would then free the two coupled rail cars. When feasible, this is preferred over the use of cutting torches.





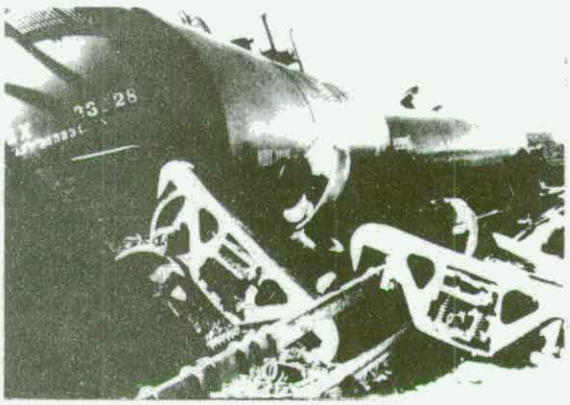




FIGURE 11-2. WRECKAGE FROM DERAILMENTS

11.3 SEQUENCE OF WRECKAGE REMOVAL

After the accident scene has been stabilized, it is necessary to establish a sequence for wreckage removal that minimizes hazards to personnel. The wreckage may contain a mixture of hazardous and non-hazardous materials laden cars with various degrees of damage. It is not possible to state fixed rules for the sequence of wreckage removal because it depends on the particular accident configuration. In general, non-hazardous materials cars should be removed first if they are readily accessible and their removal does not endanger the integrity of hazardous materials tank cars. (Note: HM containers in box cars must be removed to a place of safety, and the contents of broken containers disposed of safely, after which these cars can be treated as non-hazardous).

Next comes the removal of hazardous materials tank cars. This must be done with extreme caution, avoiding sudden shocks or jars that might produce sparks or friction. If any leaks are likely during movement of these cars, their contents should be transferred first. Upright intact tank cars should probably be removed first to reduce the number of HM laden cars at the accident scene as quickly and safely as possible. Damaged, overturned tank cars containing hazardous materials are probably the last to be removed. Their structural integrity should be continually monitored, both before and during wreckage removal. After uprighting these cars, their contents would normally be transferred before proceeding in their removal.

The final decision on the safest sequence of wreckage removal, as well as on all other aspects of wreckage removal, depends on the expertise of the wreck supervisor at the accident scene.

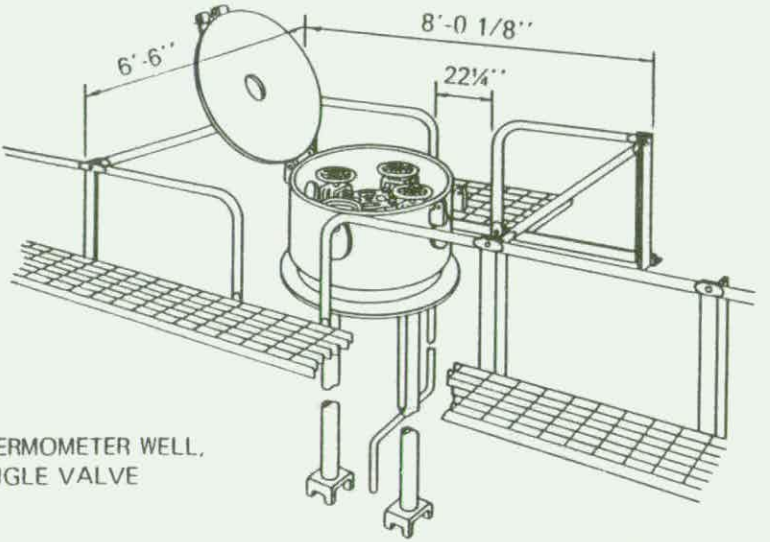
11.4 TRANSPORTING DERAILED CARS

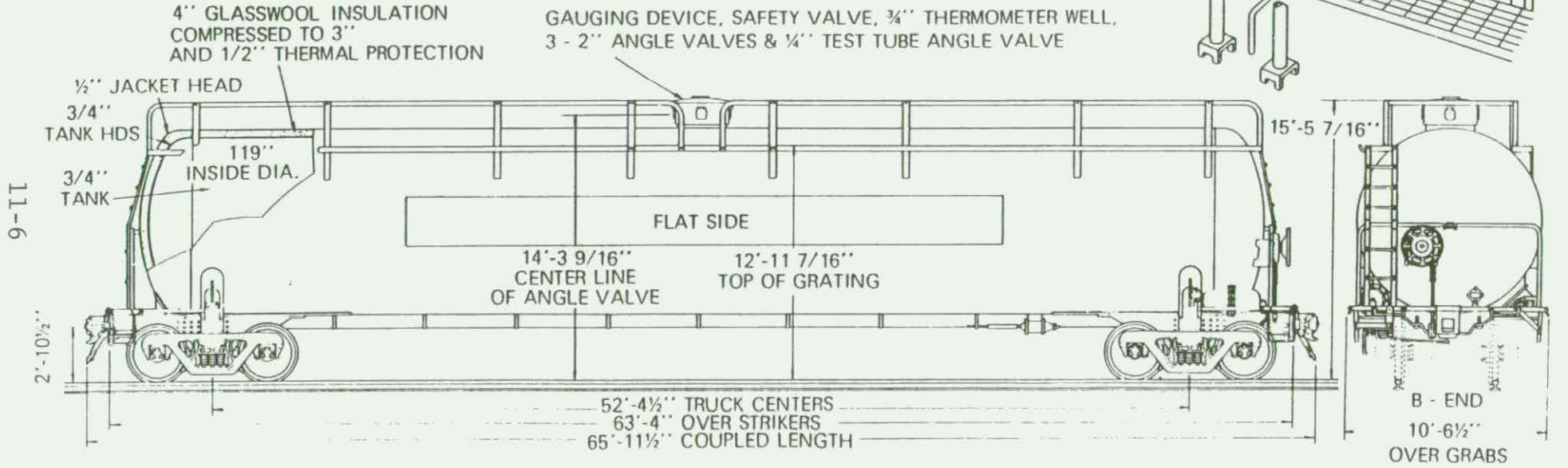
If a derailed car has not suffered appreciable damage to its underframe, including the car body bolster, then the car can be retrucked and transported by rail in the normal manner. A series of schematics showing the typical configuration of tank car components are given in Figures 11-3 through 11-7. Its own trucks can be used if these are available and in operable condition. Otherwise spare trucks should be brought to the accident scene for this purpose. In the case of a derailed tank car carrying a hazardous material, it is also necessary to assess the structural integrity of the tank before retrucking and transport. If a leak is considered likely during transport, the car's contents should be transferred.

33,500 GALLON CAPACITY - INSULATED

DOT - 105A400W

FOR LIQUEFIED PETROLEUM GAS & ANHYDROUS AMMONIA SERVICE





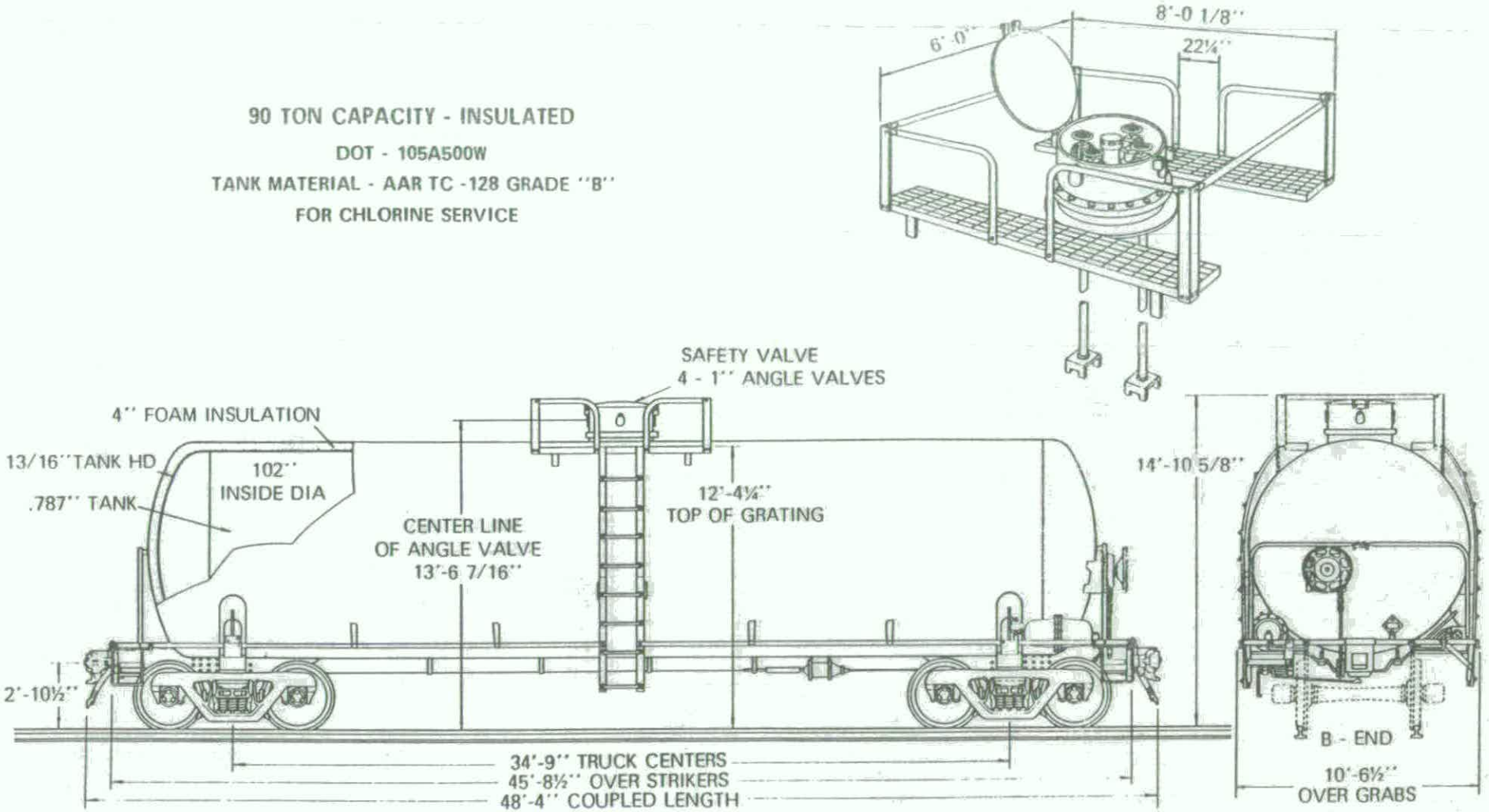
11-6

CAPACITY & WEIGHTS

NOMINAL CAPACITY @ 53.94% FILLING DENSITY - 33,500 GALS.
ESTIMATED LIGHT WEIGHT - 112,500 LBS.
RAIL LOAD LIMIT (100 TON TRUCKS) - (5'-10" WHEEL BASE) - 263,000 LBS.

Drawing reproduced from the GATX Tank Car Manual.

FIGURE 11-3. TYPICAL TANK CAR CONFIGURATION
FOR LPG AND ANHYDROUS AMMONIA SERVICE



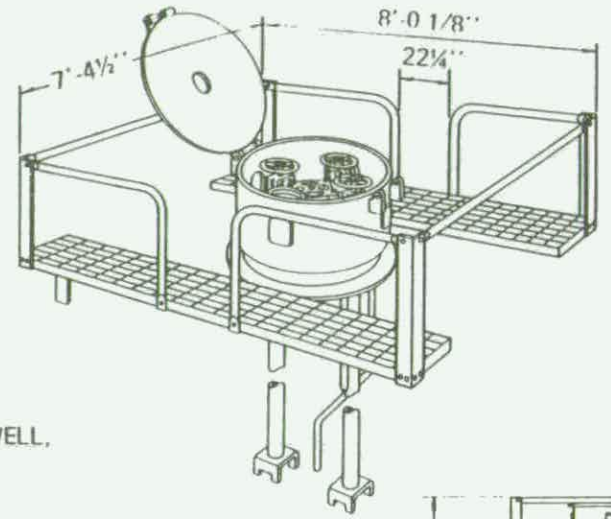
CAPACITY & WEIGHTS

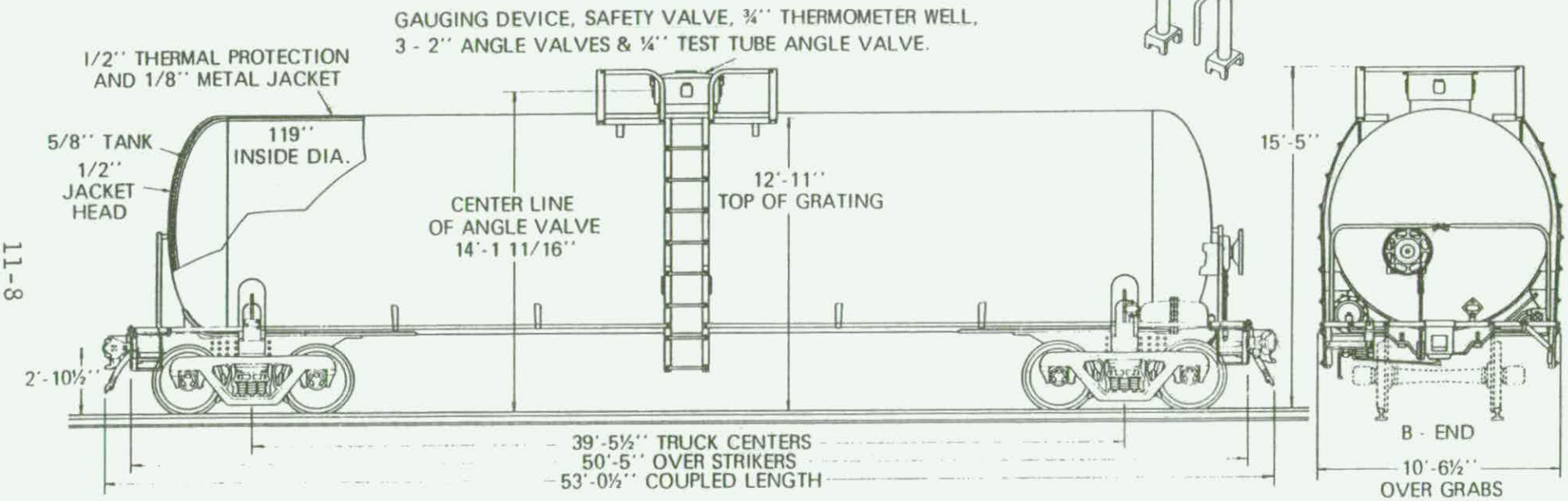
NOMINAL CAPACITY @ 125% FILLING DENSITY - 90 TONS
ESTIMATED LIGHT WEIGHT - 82,500 LBS.
RAIL LOAD LIMIT (100 TON TRUCKS) - (5'-10" WHEEL BASE) - 263,000 LBS.

Drawing reproduced from the GATX Tank Car Manual.

FIGURE 11-4. TYPICAL TANK CAR CONFIGURATION FOR CHLORINE SERVICE

26,100 GALLON CAPACITY - NON INSULATED
DOT - 112J340W
FOR VINYL CHLORIDE SERVICE





CAPACITY & WEIGHTS

NOMINAL CAPACITY @ 81.43% FILLING DENSITY -26,100 GALS.
ESTIMATED LIGHT WEIGHT - 86,000 LBS.
RAIL LOAD LIMIT (100 TON TRUCKS) - (5'-10" WHEEL BASE) - 263,000 LBS.

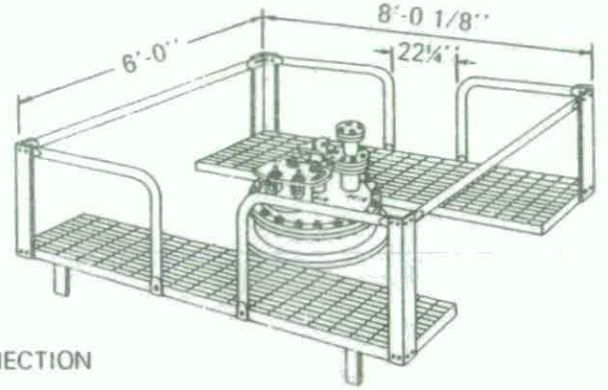
Drawing reproduced from the GATX Tank Car Manual.

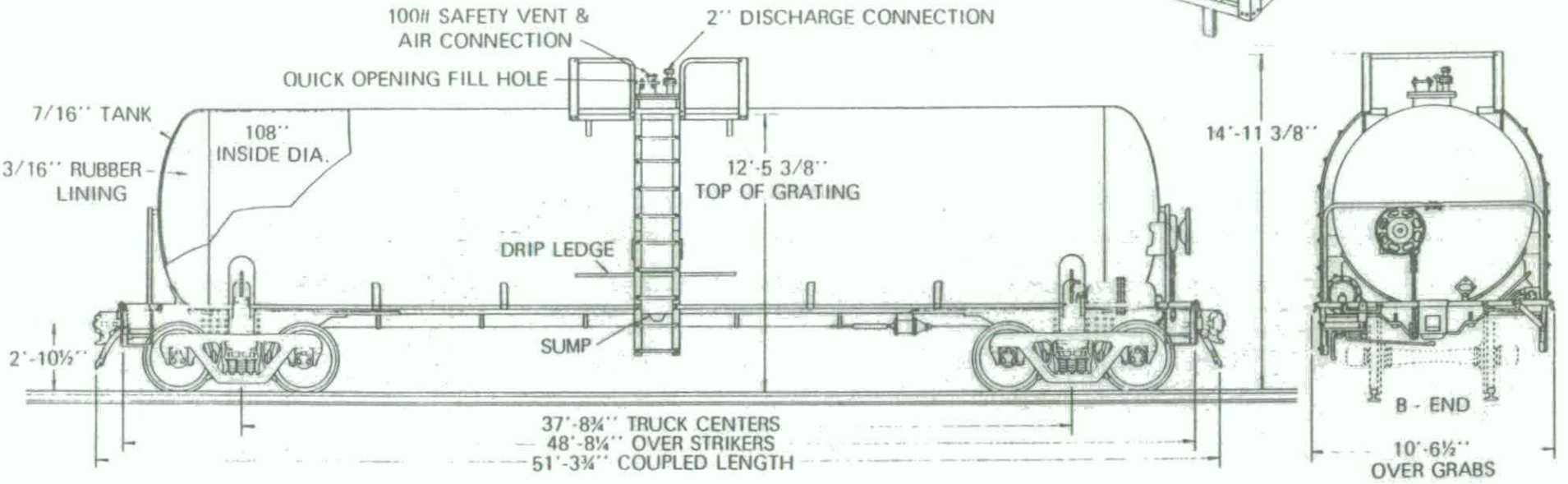
FIGURE 11-5. TYPICAL TANK CAR CONFIGURATION
FOR VINYL CHLORIDE SERVICE

20,000 GALLON CAPACITY - NON INSULATED

DOT - 111A100W5

FOR HYDROCHLORIC ACID SERVICE





CAPACITY & WEIGHTS

NOMINAL CAPACITY @ 2% OUTAGE - 20,000 GALS.
ESTIMATED LT. WT. 60,900 LBS.
RAIL LOAD LIMIT (100 TON TRUCKS) - 263,000 LBS.

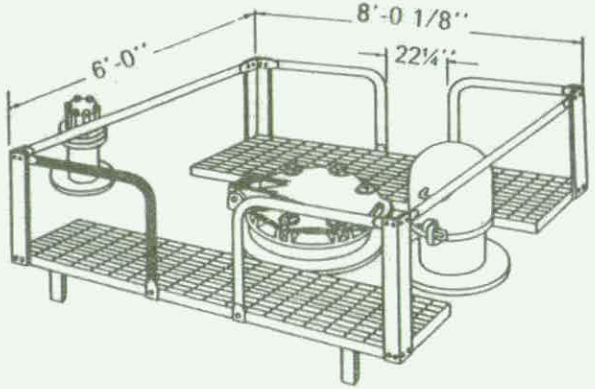
Drawing reproduced from the GATX Tank Car Manual.

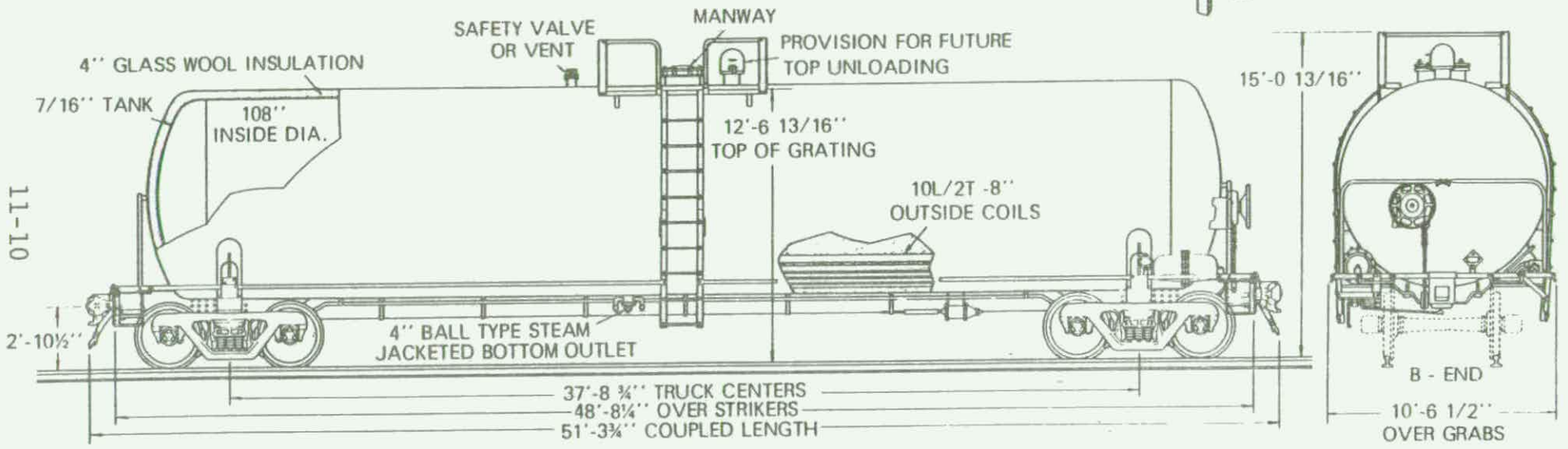
COMMODITY MAXIMUM DENSITY

TRUCK CAPY.	WHEEL BASE	NON - COILED COMM. WT./GAL.
100 TON	5'-10"	9.8#

FIGURE 11-6. TYPICAL TANK CAR CONFIGURATION FOR HYDROCHLORIC ACID SERVICE

20,000 GALLON CAPACITY - INSULATED
DOT - 111A100W1
FOR GENERAL SERVICE COMMODITIES
4" SLOPE TO CENTER RING





11-10

CAPACITY & WEIGHTS

NOMINAL CAPACITY @ 2% OUTAGE -20,000 GALS.
ESTIMATED LIGHT WEIGHT 70,300 LBS.
RAIL LOAD LIMIT (100 TON TRUCKS) - 263,000 LBS.

Drawing reproduced from the GATX Tank Car Manual.

COMMODITY MAXIMUM DENSITY

TRUCK CAPY.	WHEEL BASE	NO. OF COILS	COMM. WT./ GAL.
100 TON	5'-10"	10L/2T-8"	9.43#

FIGURE 11-7. TYPICAL TANK CAR CONFIGURATION FOR GENERAL SERVICE COMMODITIES

If the derailed rail car cannot be safely retrucked, then transport on a flat car or gondola is usually the only alternative. The car body should be blocked and securely tied down to avoid further damage in transport. The contents of a HM tank car should be transferred before the car is transported in this manner.

11.5 RIGGING EQUIPMENT USED IN WRECK CLEARING

Wreck clearing requires the use of mobile cranes. Some types suitable for use in railroad wreck clearing operations are the locomotive crane and the crawler crane, shown in Figures 11-8. Also used frequently in railroad wreck clearing is the side boom tractor, shown in Figures 11-9 through 11-11. Side boom tractors are commonly used in pairs, on opposite sides or opposite ends of a rail car, for lifting and moving the car. Prior to their use at an accident site, these mobile cranes should be inspected to insure their safe operation.

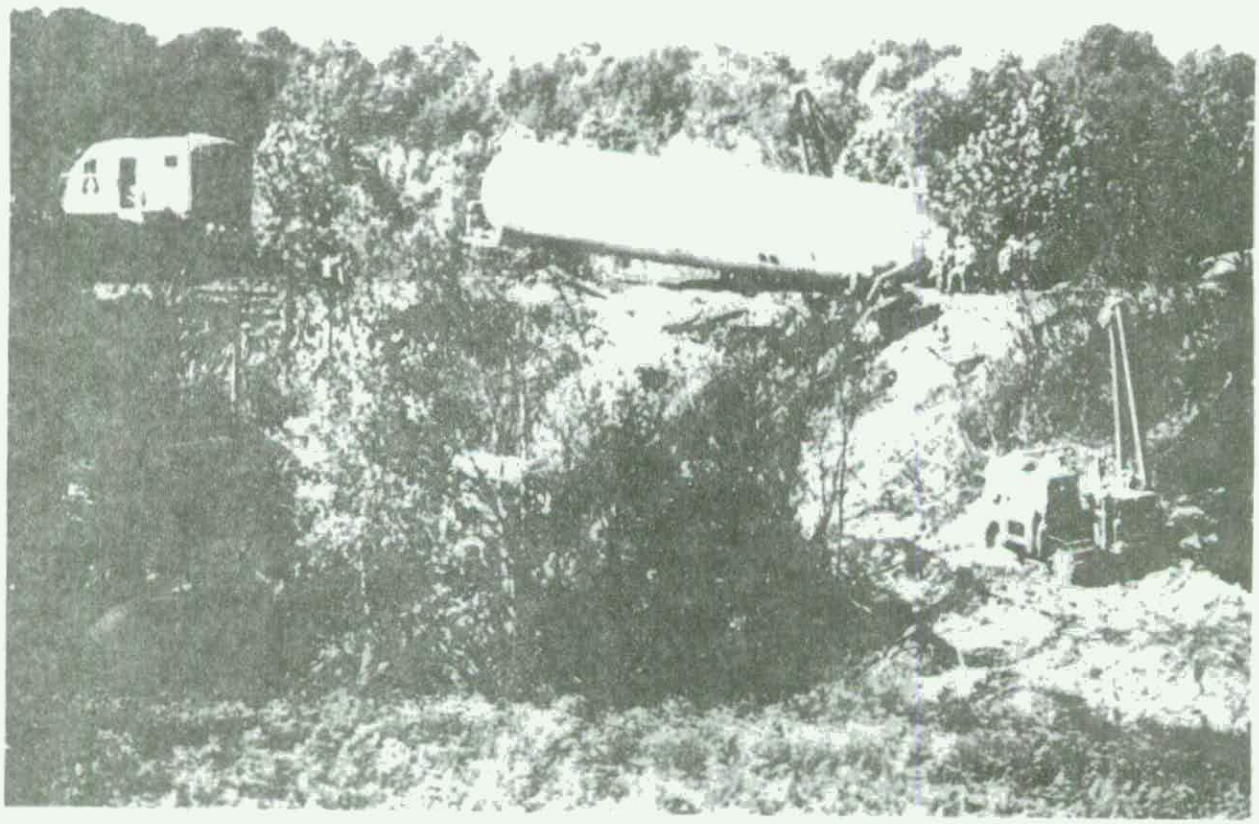


FIGURE 11-8. LOCOMOTIVE AND CRAWLER CRANE

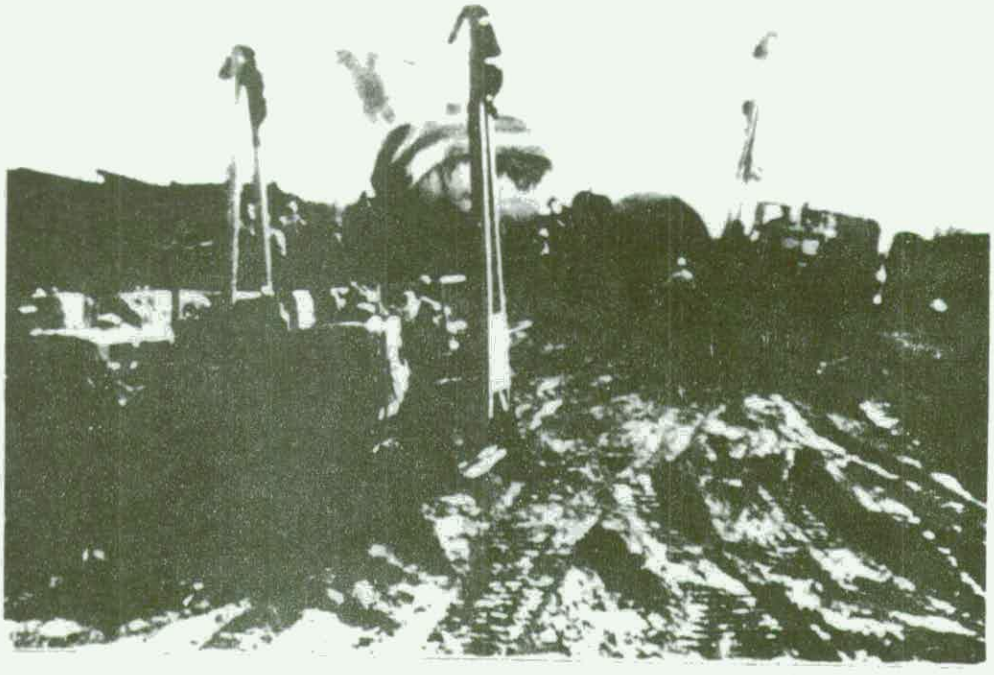


FIGURE 11-9. SIDE BOOM TRACTORS CLEARING WRECKAGE

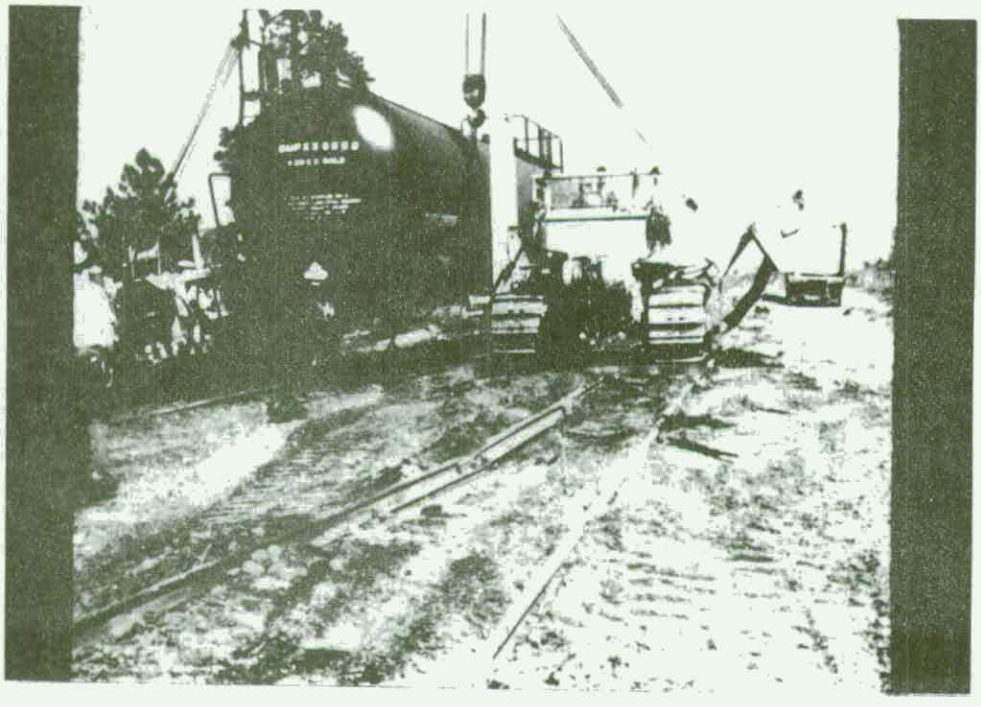


FIGURE 11-10. SIDE BOOM TRACTOR WITH COUNTERWEIGHT EXTENDED

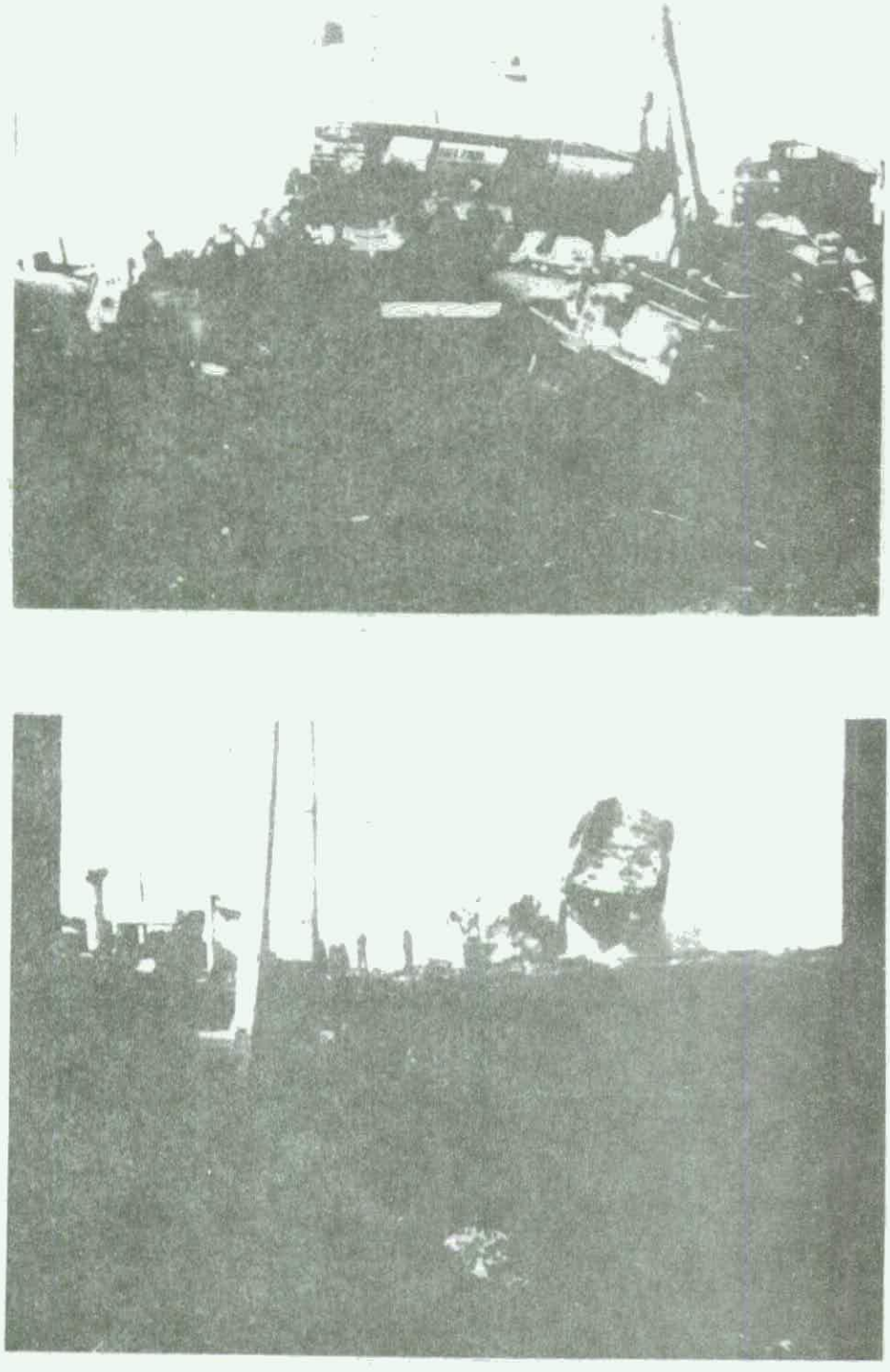


FIGURE 11-11. SIDE BOOM TRACTORS RERAILING TANK CARS

Vehicle mounted winches are also used in wreck clearing for exerting large pulling forces. Of course, the vehicle must be sufficiently braced to remain stationary while the winch is exerting these forces on the wreckage; this is particularly true in railroad wreck clearing where the required pulling force may reach 100,000 pounds or more. Dragging of a hazardous materials tank car, whether by winch or crane, should be attempted only as a last resort and then only after following all safety precautions. This includes laying down a bed of foam along the path to be traversed and keeping all personnel at a safe distance. If leaks are expected, the contents should be transferred first.

Trackmobiles (small tractors) are often used for pulling derailed, but upright, freight cars with intact trucks. Up to 50,000 pounds of car weight can be transferred onto the trackmobile at the pulling face of the coupler (15 inches inside of striker). This provides sufficient traction to the trackmobile to enable it to pull derailed cars longitudinally.

Wire rope, or steel cable as it is frequently called, is used in all aspects of rigging including slings, hoisting cables, winch cables, and crane cables. Figure 11-12 shows typical sling configurations used in wreckage removal.

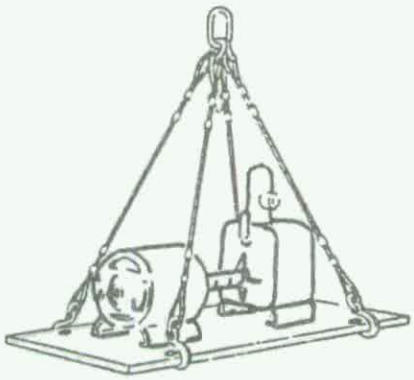
Another sling with a flat cross section is the chain mesh sling, shown in Figure 11-13. This type of sling would also be effective in reducing the stress on tank cars during lifting. It could also be used to advantage in minimizing the damage to the jacket of insulated tank cars.

Finally, wreck clearing involves the use of hoisting chains, hooks, shackles, etc. Although largely superseded by wire rope, chains are still used in many aspects of rigging, particularly where abrasion resistance is important. When a wire rope sling passes over sharp edges, lifting operations will often cause breaking of wire strands, with a resulting deterioration in the overall strength of the wire rope sling. A chain sling can resist this abrasion much better.

On the other hand, chains are not as resistant to sudden loads or shocks as wire rope. Moreover, chains can fail with little warning. Wire rope failure usually occurs over a period of time, with progressive breaking of wire strands, which allow detection during periodic inspection of the wire rope. Thus, chains require very careful inspection prior to their use in wreck clearing.

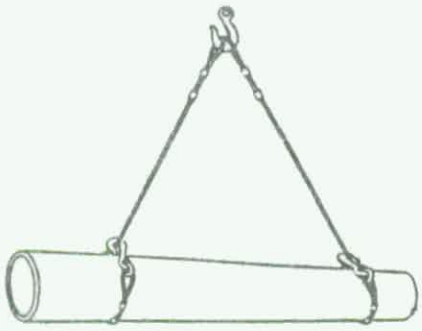


Bridle Sling

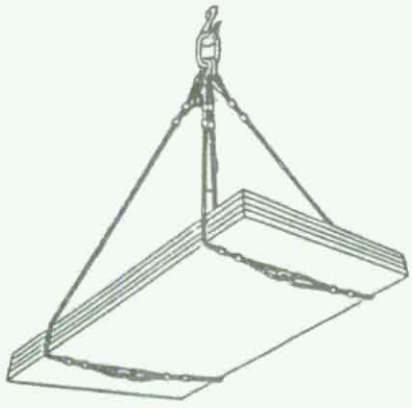


Four-leg sling with hooks for use when lifting holes or eyebolts are provided

Double Basket Sling



Double choker sling with hooks attached for more readily attaching and detaching



NOTE: In using the double basket sling, watch that one part does not tend to slip along the load and allow it to tilt and drop

FIGURE 11-12. TYPICAL SLING CONFIGURATION

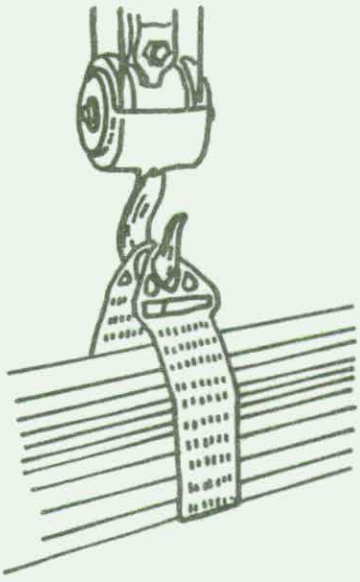


FIGURE 11-13. CHAIN MESH SLING

The hook should be the weakest part of any rigging assembly, since it can provide visible evidence of overloading prior to failure. It seldom breaks, but may fail by straightening out and releasing the load. Hook distortion due to overloading is shown in Figure 11-14.

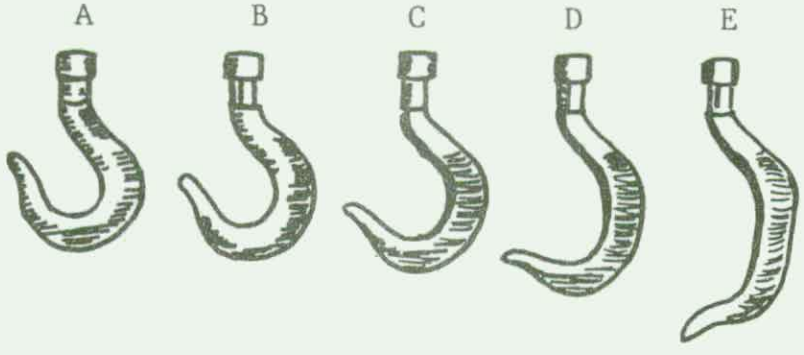


FIGURE 11-14. HOOK DISTORTION DUE TO OVERLOADING

11.6 MOVING DERAILED RAIL CARS WITHOUT LIFTING PROVISIONS

Removal of a derailed rail car may involve uprighting and pulling of the car, in addition to lifting, depending on the condition, orientation and location of the derailed car. The aim is to move the derailed car along side the track where it can be retrucked and retracked if feasible or else loaded onto a flatcar or gondola.

Uprighting and lifting operations require the use of one or two mobile cranes as was previously shown. These operations also require sling configurations.

It is important to recognize that the forces exerted on slings may be much higher than the lifting force exerted by the crane, depending on the sling configuration and the sling angle. This is illustrated in Figure 11-15. As shown in this figure, an angle of 5^{o} for the sling, would result in sling tensions over five times the lifting force involved. Very shallow sling angles are to be avoided in lifting operations in order to reduce stressing of the sling cables.

Basket slings, either single or double, are sometimes used for lifting one end or all of a derailed car. These types of slings can slip during lifting if the direction of force exerted by each sling deviates too much from vertical. The car can drop as a result, endangering personnel as well as causing further damage.

Another danger during lifting is the instability of some higher center of gravity cars. This type of car can roll during lifting and cause the crane to topple. Where there is a possibility of car rolling a steadying line should be attached to the car during lifting.

The corners of freight cars are strongest in the vertical direction. Lifting forces at these locations should therefore, be in a vertical or near vertical direction. Appreciable lateral forces at these locations are to be avoided. Movement of an upright car laterally can be done by lifting and moving the entire car or else by lifting and moving one end of the car while the other end serves as a pivot. In the latter mode, care must be exercised to avoid additional stresses on an already damaged car, particularly in the case of HM tank cars. It may be useful to lay down a bed of foam under the pivot end prior to such movement.

Uprighting of a derailed freight car involves rigging procedures similar to turning a load over on its side. Some correct and incorrect hitches for accomplishing this are shown in Figure 11-16. The objective naturally is to upright the car without banging or jolting it, particularly when the car contains (or contained) hazardous materials.

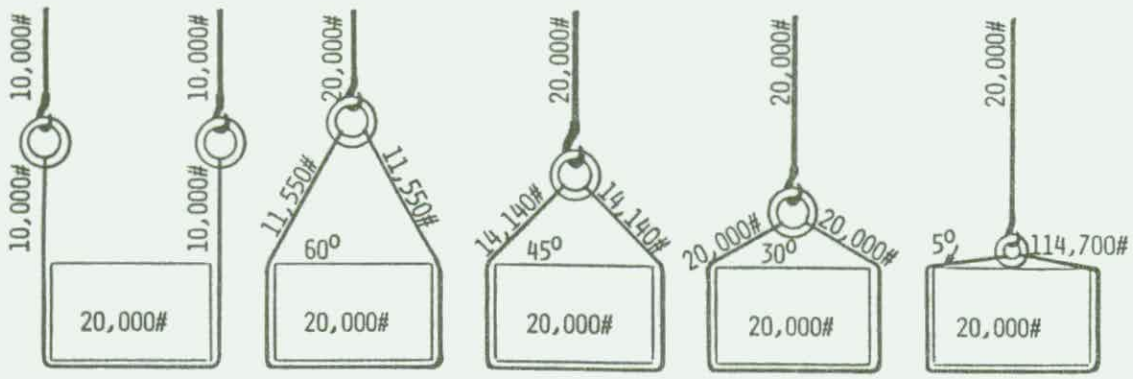


FIGURE 11-15. VARIOUS ANGLES AND TENSIONS ON SLINGS

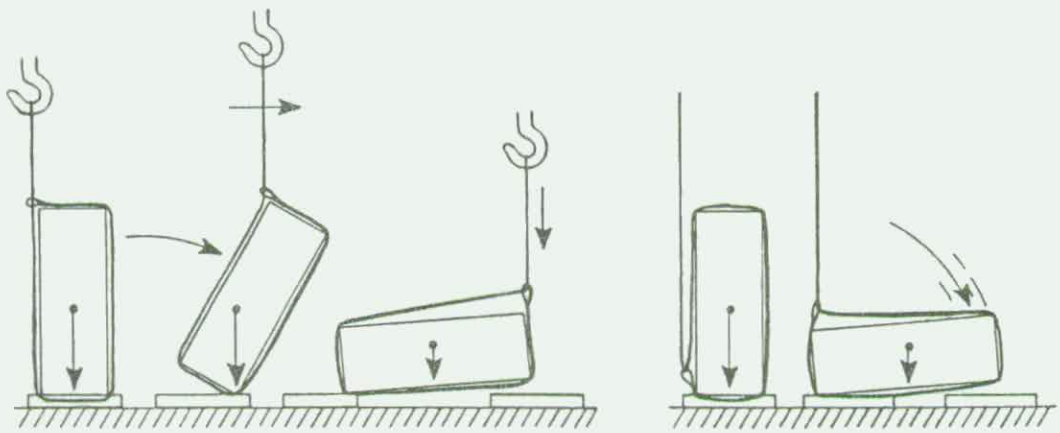


FIGURE 11-16. SOME PROPER AND IMPROPER HITCHES

In all movement and lifting of rail cars during wreck clearing, care must be exercised to avoid forces on structural members that are not designed to withstand it. Tearing away of the structural member can occur with potentially disastrous results but even if the structural member holds, it can be badly damaged. Thus, the wreck clearing supervisor must be familiar with car body construction, the relative strengths of various structural members, and the likely forces and directions of force that would be applied to these members during wreck clearing.

11.7 MOVING DERAILED RAIL CARS WITH LIFTING PROVISIONS

AAR Standard S-234-78, shown in Figure 11-17, gives the specifications for the provision for lifting a freight car. Figure 11-18 shows a tank car configuration with a lifting provision. Freight car manufacturers are now required to meet this standard in new car design and construction.

Although not mandatory, the preferred location of the lifting provision is in the car body bolster which is designed to withstand the lifting forces. This location is particularly desirable in the case of tank cars. Attachment of lifting provisions to the tank itself should be avoided, since damage to the lifting provisions could then affect the integrity of the tank. Tank car manufacturers are generally using the recommended location for lifting provisions in their car designs.

When lifting provisions are available on a derailed freight car, their use in lifting operations may reduce some of the hazards of wreck clearing. Some advantages of lifting provisions in wreck clearing are as follows:

- Lifting provisions attached to car body bolster can withstand lifting forces.
- Use of lifting provisions can reduce most hazards and equipment damage associated with conventional hook and sling attachments.
- Reduces exposure of wreck clearing personnel in handling derailed car.
- Avoids danger of hook slipping or tearing of car body structural member not designed for lifting.
- Avoids damage produced by slings on jacket of insulated tank car.
- Avoids stress produced by slings on tank shell during lifting.
- AAR provision for lifting not restricted to car type, or hazardous versus non-hazardous service.
- Speeds up wreck clearing, return of track to normal and return of derailed cars for repair.

PROVISION FOR LIFTING FREIGHT CAR

Standard

S-234-78

Adopted 1977

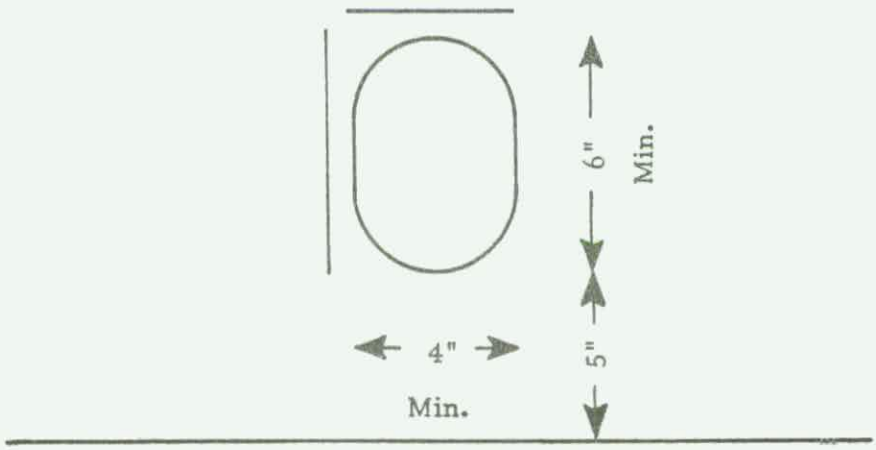
Effective: Cars Ordered New After July 1, 1978

1. The purpose of this provision is to provide a means to vertically lift a loaded upright car. This provision is for new cars to facilitate rerailing operations and to improve the method of handling derailed cars.

2. The provision shall be made available at four places, preferably in or near the body bolster at the side sill.

3. The design force at each provision for the upright car must be 40% of the gross rail load applied within 15 degrees of the vertical axis of the upright car. Each connection zone must be designed to support the above load without exceeding the yield strength of the material except that local deformation is permitted to achieve hook bearing area.

4. The provision may be similar to that shown below and should have rounded ends and provide sufficient opening to accommodate lifting means.



Typical Arrangement When Opening is Utilized in Horizontal Structure

FIGURE 11-17. PROVISION FOR LIFTING FREIGHT CAR

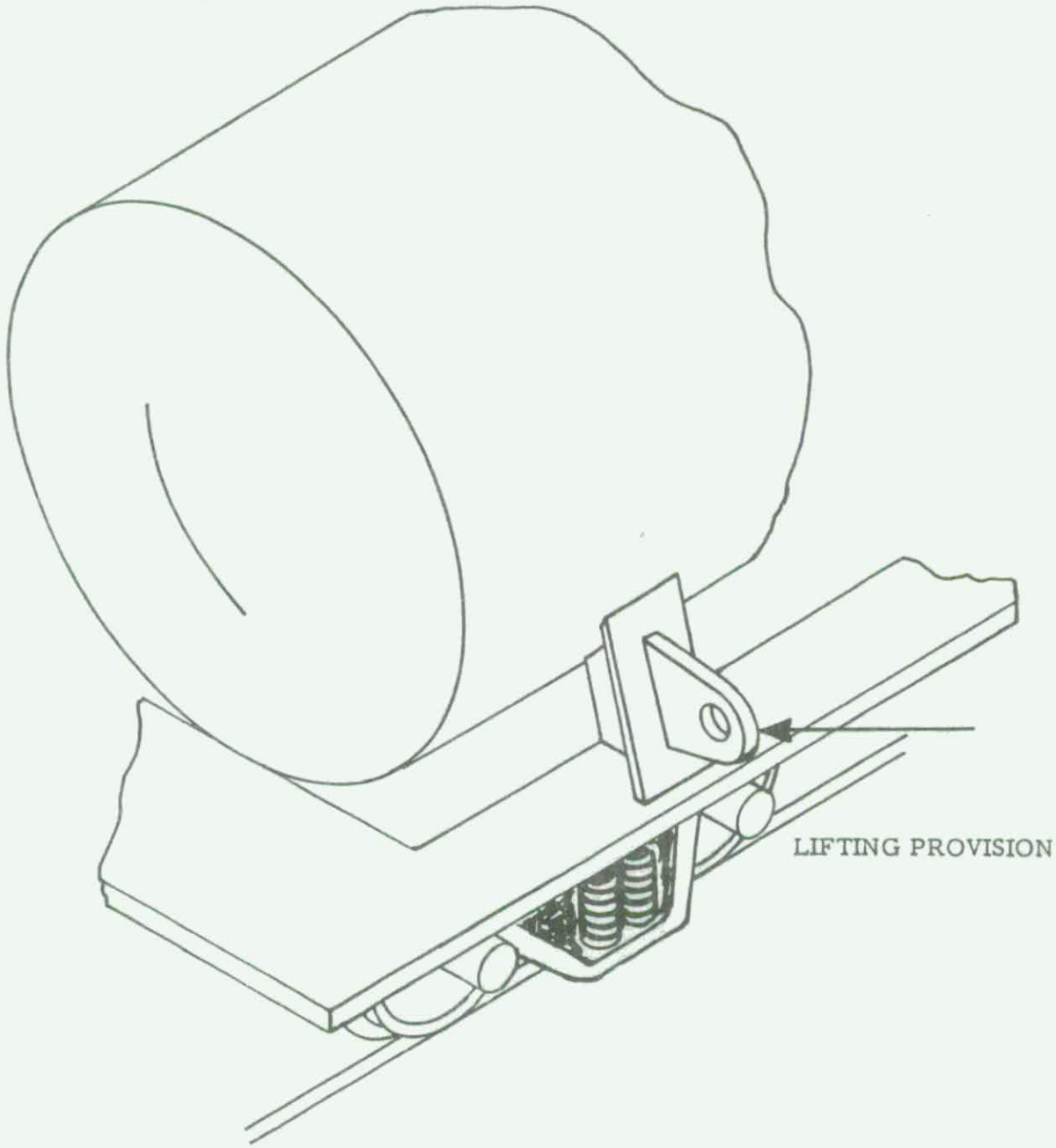


FIGURE 11-18. LIFTING PROVISION ON A TANK CAR

- Increases safety and reduces cost of wreck clearing.

In the case of a tank car, a relatively large horizontal force is allowed which can simplify uprighting operations. Instead of makeshift hook and sling attachments, hooks can be securely attached to the lifting provisions and the car uprighted in a controlled, safe manner, via standard rigging procedures, without exceeding the allowable force levels. This can be of particular value in the case of hazardous materials tank cars.

Lifting provisions on a freight car are not suitable for car pulling operations where large longitudinal forces can be applied. The coupler, which can withstand these forces, should be used for pulling operations.

11.8 ACCIDENT PREVENTION DURING RIGGING OPERATIONS

In addition to the dangers of working around hazardous materials, wreck clearing workers are subject to the considerable hazards associated with rigging operations in general. Wreck clearing workers have been crushed by a rail car after a rigging cable snapped. This type of accident is preventable by following a basic safety maximum in rigging, namely, no persons should be allowed below a suspended load. There have been other fatalities in wreck clearing operations resulting from improper safety practices, which are associated with the improper attachment of hooks and/or application of lifting forces.

The following are general safety guidelines for rigging operations in wreck clearing to minimize danger to personnel:

1. Prior to their use at an accident site, **mobile cranes must be inspected** using standard procedures to insure their safe operation.
2. All **wire ropes must be inspected** periodically for wear and broken wires to determine when a wire rope has reached the limit of its safe usage and must be discarded.
3. **Hooks, chains, and eyebolts should be inspected** periodically for cracks or other flaws and any faulty equipment removed from service. Hooks should be checked for signs of spreading (caused by overloading).
4. **Boom cranes should not be slewed rapidly while carrying a load.** During operation of these cranes, the chassis should be on an even keel and properly stabilized.
5. **Avoid a very wide angle in a basket or bridle sling,** even when strong enough to carry the load, since one sling may readily slip off the crane hook.

6. All **wreck clearing personnel should wear safety shoes and hard fiber safety helmets and appropriate protective clothing.**

7. **No persons should be allowed below a suspended load.**

8. **No persons should be allowed between portions of wreckage that are being moved.**

9. **During car movement, no persons should be allowed between crane and point of attachment to car** (to avoid injury in event of failure of cable, hook or car attachment point).

10. **Extreme caution must be used during crane operations near overhead electrical lines,** to avoid contact between electric lines and any part of the crane or load (particularly applicable to wreck clearing on highways).

In addition, extreme caution should be exercised in the attachment of hooks to car body structural members, in order to avoid hook slippage or tearing away of the structural member with potentially disastrous results. Even when slippage or tearing away does not occur, considerable damage to the structural member can result. It is essential that the wreck clearing supervisor be familiar with the car body construction, the relative strengths of various structural members, and the likely forces and directions of force that would be applied to these members during rigging operations.

12. SAMPLE DERAILMENT ACCIDENT SCENARIO

At 7:03 a.m. on June 23, a train derailment occurred near the town of Simple, GA. Thirty-six of the train's 86 cars derailed. Three minutes after the accident occurred (7:06 a.m.) a tank car ruptured forming a mushroom-like yellow-orange fireball about 300 feet in height. Winds were northeasterly at 5 mph and the temperature 72 degrees. There were no casualties to the train crew. Cars 35 through 61 derailed. The accident and hazardous materials released were the result of a broken wheel on tank car number 39. An additional 35 cars derailed when the high rail tipped as a result of lateral forces. The following outline shows the sequence of events as they occurred and provides you, the emergency responder, with the most up to the minute information as it becomes available so you can make appropriate decisions regarding the mitigation of the accident hazards. Now to the accident scene.

1. Tank car ruptures forming mushroom-like yellow-orange fireball about 300 feet in height.

2. Conductor calls engineer on two-way radio to tell him that there is a problem and it appears that something is on fire. Conductor asks engineer if any of the crew members in the locomotive sustained any injuries. His response is negative. Conductor indicates to the engineer that several of the cars in the train contain hazardous materials (HM) and says that he will contact the railroad dispatcher and inform him of the situation.

3. Conductor notifies railroad dispatcher of accident by two-way radio and provides the following information:

   A. Location: Entering the town of Simple, Georgia

   B. HM involved are: Anhydrous Ammonia and LPG

   C. No known injuries or fatalities.

4. Conductor and train crew wait at accident scene for fire department.

5. Railroad dispatcher receives transmission from conductor and then notifies railroad supervisor and local fire and police departments of accident and that the hazardous materials potentially involved are anhydrous ammonia and propane. The dispatcher also notifies the National Response Center (NRC) at (800) 424-8802 and American Association of Railroads (AAR) Bureau of Explosives at (202) 835-9500. Railroad supervisor states that he will proceed to the accident scene.

6. Police department arrives on-scene and performs the following activities:

   A. Determine alternate traffic routes around hazards area.

   B. Determine hazards radius using DOT Emergency Response Guide or other appropriate response manual.

   C. If no data are available, isolate and evacuate 0.5 mile in all directions.

   D. Assess and implement measures needed to secure the area allowing only authorized response individuals into the area and keeping unauthorized personnel out.

   E. Establish and monitor roadblocks and other barriers.

7. Fire department team arrives on-scene and the fire officer in charge (designated on-scene coordinator (OSC)) finds the train crew. OSC obtains waybills and train consist information from conductor and any other pertinent accident information from the train crew (e.g., rupture and fire (probably propane) and vapor clouds) and relays this information to fire dispatcher verifying the involvement of anhydrous ammonia and propane. OSC establishes command post at a safe distance upwind of accident site.

   A. On-Scene Coordinator: _____

   B. Command Post Location: _____

   C. Call Back Number: _____

8. Fire department calls CHEMTREC at (800) 424-9300.

9. Identify agencies to be contacted in State/local contingency plan and contact these agencies now!

10. OSC sends a two-man team to do an extensive situation assessment. The team starts at the head end of the derailment walking the length of the accident in a clockwise pattern ending at the opposite end of the train. This assessment reveals the following:

Consist No.	Car Contents	Ruptured	Spill/ Leak	Fire	Fire Impinged	Disoriented
35	NH3					x
36	NH3		x			
37	NH3					
38	NH3					
39	NH3					x
40	NH3					
41	NH3		x			
42	news print					
43	news print					
44	news print					
45	news print					x
46	news print					

Consist No.	Car Contents	Ruptured	Spill/ Leak	Fire	Fire Impinged	Disoriented
47	news print					
48	news print					
49	LPG				x	
50	LPG	x		x		
51	LPG				x	x
52	LPG				x	
53	news print					
54	news print					
55	news print					x
56	LPG					
57	LPG					
58	LPG					
59	news print					x
60	news print					
61	news print					

11. Are your community resources (i.e., specialized emergency response equipment, gear and personal protective clothing) adequate to handle the hazards posed by this accident?

    - o Yes, perform a situation update.
    - o No, notify additional local/State/Federal ER teams.
    - o Don't know, notify additional local/State/Federal ER teams.

12. State personnel begin arriving on-scene in the early evening of day one; EPA RRT arrives late in the evening of day one; and AAR Bureau of Explosives personnel arrive early morning of day two.

13. EPA Region IV - Federal On-Scene Coordinator (OSC) arrives and is briefed on the situation and, at the request of the local response team, assumes command as OSC from local fire chief.

14. OSC holds the first of a series of meetings with the local fire and police chief, officials from the Water Quality Board, Health and Safety Department, State Highway Department, Air Pollution Control Commission, National Guard, AAR Bureau of Explosives, Governor's Representative, and the news media to provide updated accident conditions.

15. OSC informs news media that periodic press conferences (every two hours) will be held at the command post. At these conferences, accident status and decisions will be detailed. News media personnel are requested to respect hazards perimeter to prevent unnecessary exposure.

16. Cleanup/disposal and wreckage removal contractors arrive on-scene and are briefed by railroad personnel and OSC.

17. Early on day two after most of ER groups have arrived, OSC convenes strategy planning and command meeting at command post with members of the local emergency services, Department of Disaster Preparedness, State Highway Department, Public Health and Safety Department, Air Pollution Control Commission, Air and Water Quality Board, railroad personnel, AAR Bureau of Explosives, cleanup/disposal contractor and wreckage removal contractor in attendance.

General Overview of Accident Handling

1. Monitor vapor dispersion patterns of anhydrous ammonia for potentially increasing evacuation radius. Vapor clouds are forming from continuous leaks in cars 36 and 41. Municipal airport tracks vapor clouds keeping OSC abreast of potentially affected populated areas.

2. All emergency response personnel working in the accident area should be equipped with rubber suits, air packs, helmets with face shields and other personal protective clothing.

Strategy for Specific HM Handling

1. Anhydrous Ammonia

   a. Vapor Hazards

      Ammonia vapors are toxic and corrosive and releases should be monitored. According to the DOT P5800.2 initial isolation of leaking tank is 200 feet in all directions with initial downwind evacuation distances of 0.4 miles wide by 0.7 mile.

   b. Fire Hazards

      Although ammonia is not flammable it can support combustion in the presence of oil or other combustible materials.

   c. Pollution Hazards

      Ammonia in water forms a corrosive liquid toxic to aquatic life in low concentrations.

2. Propane

   a. Vapor Hazards

      Propane vapors may cause dizziness or suffocation. Vapors are extremely flammable and may travel some distance, ignite and flashback to source.

   b. Fire Hazards

      Propane vapors pose a severe flammable and explosive threat. Fire impingement on containers may cause violent rupture.

   c. Pollution Hazards

      Propane is very volatile and leaves little or no residue in the environment.

18. Does the incident have fires?

- Yes: follow the guidelines for anhydrous ammonia and propane outlined in ACTION 1.0 on pages 12-6 and 12-21, respectively. Proceed to Step 19.
- No: proceed to Step 19.

19. Does the incident involve a spill/leak?

- Yes: follow the guidelines for anhydrous ammonia and propane outlined in ACTION 2.0 on pages 12-10 and 12-25, respectively. Proceed to Step 20.
- No: proceed to Step 21.

20. Attempt to contain anhydrous ammonia and propane in accordance with guidelines outlined in ACTION 3.0 on pages 12-12 and 12-27, respectively.

21. Assess and implement appropriate leak handling options.

- Leak stops: proceed to Step 22.
- Leak continues: perform ACTION 4.0 for anhydrous ammonia and propane on pages 12-14 and 12-29, respectively.

22. Assess the container's structural integrity in accordance with guidelines outlined in Section 9 of the Accident Management Orientation Guide.

- Off-load/transfer required: conduct ACTION 5.0 for anhydrous ammonia and propane on pages 12-16 and 12-31, respectively. Proceed to Step 23.
- Rerail/move can be accomplished: proceed to Step 23.

23. Assess if final treatment/cleanup/disposal is required.

- No: proceed to Step 24.
- Yes: conduct ACTION 6.0 for anhydrous ammonia and propane on pages 12-18 and 12-33, respectively. Proceed to Step 24.

24. Perform removal of tank cars containing anhydrous ammonia and propane in accordance with ACTION 7.0 on pages 12-20 and 12-34, respectively.

All Actions and their general associated risk assessments are given in sequence for each HM involved. ACTIONS 1.0 through 7.0 for handling anhydrous ammonia are presented on pages 12-6 through 12-20, followed by the same Actions for propane on pages 12-21 through 12-34.

Fire (Decision Point P)

WARNING

Anhydrous ammonia is toxic and corrosive. Inhalation and skin contact should be avoided. The vapor is particularly irritating to the eyes, ears, and throat and contact may cause frostbite.

WARNING

Ammonia may burn in the presence of oil or other combustible materials but does not ignite easily. Toxic vapors are the immediate concern.

WARNING

Ammonia is soluble in water forming a corrosive liquid.

1. Wear appropriate protective clothing including a self-contained breathing apparatus, goggles, and rubber overclothing (including gloves).

2. Remove all ignition sources and combustible materials.

3. Initially isolate the tank 200 feet in all directions. Then evacuate in a downwind direction 0.4 mile wide by 0.7 mile long.

4. If there is an indication of a leak with the fire, monitor ammonia vapor cloud and evacuate all residents in direction and vicinity of cloud.

5. If no water sources are available, pull back response personnel upwind to a distance of 0.5 mile and wait for adequate water sources to become available.

6. Locate water source:

    a. Local hydrant
    b. River/stream

c. Lake/pond
d. Farm holding tanks
e. Wells
f. Swimming pools
g. Water tanks

7. Identify and obtain additional equipment needed to utilize water source: pumps, hoses, fog nozzles.

8. Monitor the area with an explosimeter. Restrict area and evacuate if above 15.5% in air. Do not re-enter area until explosive limit is below 15.5% in air.

9. All contaminated water (tank cooling, firefighting, vapor suppression) must be contained. Dike all potentially affected sewers and water sources. See ACTION 3.0 for more specific details.

10. Approach accident site from the upwind direction and extinguish fire using agent suitable for type of surrounding fire. If ammonia vapors are present, use water fog spray to suppress and knock-down vapors and cool tank cars. Set up unmanned monitors if possible.

NOTE: According to the NFPA, a water source of 500 gpm is recommended for adequate container cooling.

WARNING

Fire impingement on an intact tank car presents a potentially hazardous condition. The most critical region for fire impingement is the vapor space. The liquid inside the tank car acts as a heat sink; therefore, if the liquid inside the tank car evaporates hot spots can develop from direct flame impingement on tank metal. A rupture may occur if the internal pressure of the tank car has increased to a point exceeding the capability of the weakened tank shell. If the tank car has also suffered structural damage, rupture is more likely to occur.

11. Observe tank car continually that is or has been involved in a fire situation.

a. Listen for audible tank noises.
b. Watch tank car for evidence of bulging or appearance of hot spots or discolorations in the metal.
c. Observe tank for venting ammonia vapors indicating opening of tank car pressure relief valve.

12. If there is a sudden increase in tank car noises or evidence of hot spots, pull back response personnel 0.5 mile upwind immediately because tank car may explode and rocket.

13. Observe fire and/or leak and note any changes in intensity. When situation subsides, re-enter area.

14. Proceed to Sequence 7, Spill/Leak.

ACTION 1.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. Ammonia vapors pose extreme hazards to response personnel: vapors are toxic upon inhalation; cause irritation to eyes, nose, and throat; and impair visibility. Skin contact with liquid ammonia may cause frostbite.

2. Adequate water supplies and backup are essential for vapor suppression which is of primary concern where response personnel are engaged in an ammonia spill and fire situations.

3. The situation and conditions of the accident must be carefully and continuously monitored through the emergency:

   a. Tank integrity is reduced by heating as well as from potential mechanical damage suffered in the accident.
   b. Fire impingement on the vapor space of the tank car, especially on damaged surfaces, is critical.
   c. The effectiveness of firefighting and tank cooling techniques is important. Visual and audible senses may be limited by the personal protective gear being worn and by other background noises at the accident site.

4. Risk is dependent on:

   a. Sufficient water (500 gpm) to cool tank car.
   b. Tank car temperature and pressure (sudden rise is critical).
   c. Duration of fire (the longer the fire, the greater the hazard).
   d. Location of fire impingement on tank (impingement on vapor space is critical).
   e. Amount and location of tank damage (critical when in vapor space with fire impingement).

ACTION 2.0
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive

Spill/Leak (Decision Point Q)

WARNING

Anhydrous Ammonia is toxic and corrosive. Inhalation and skin contact should be avoided. The vapor is particularly irritating to the eyes, ears, and throat and contact may cause frostbite.

WARNING

Ammonia may burn but does not ignite easily. Poisonous vapors are the immediate concern. Ammonia is soluble in water forming a corrosive liquid.

1. Wear self-contained breathing apparatus and adequate protective clothing.

2. Remove all combustible material from the accident site as ammonia will support combustion producing a fire hazard.

3. Approach ammonia tank car from upwind and apply water fog spray for vapor suppression and to improve visibility.

4. Liquid ammonia and contaminated vapor control and firefighting runoff water must be contained. Dike (block off) all potentially affected sewers and water sources. See more specific procedures in Action 3.0.

5. If wind conditions change, pull back response personnel and change direction of approach.

6. Proceed to CONTAINMENT (Sequence 7).

ACTION 2.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. Anhydrous ammonia vapors are toxic and response personnel need adequate protective clothing and equipment.

2. Ammonia vapors are lighter than air, the vapors from a leak will initially hug the ground.

3. Containment of contaminated cooling, firefighting and vapor suppression waters is necessary because ammonia is toxic to aquatic life.

ACTION 3.0
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive

Containment

WARNING

Anhydrous ammonia is toxic and corrosive. Inhalation and skin contact should be avoided.

1. Adequate protective clothing and self-contained breathing apparatus is required.

2. Monitor area with a portable explosimeter. Restrict area and evacuate if limit is above 15.5% in air. Do not re-enter area until exposive limit is below 15.5%.

3. Containment of liquid ammonia, any contaminated vapor suppression, tank cooling or firefighting water is necessary. Dike all potentially affected sewers and water sources.

4. If ammonia is pooling, use available equipment to construct containment structures: dikes, dams, berms, excavated pits, and/or basins.

5. Bulldozers or earth-moving equipment can be used to compact soil for earthen dams, dikes, or berms.

   NOTE: Foamed polyurethane or concrete dikes may be constructed if equipment is available in the local area.

WARNING

It may not be easy to operate heavy equipment in full protective gear.

6. Cover pool with appropriate foam to suppress toxic vapors.

7. Proceed to LEAK ASSESSMENT (Sequence 8).

ACTION 3.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. Necessary protective clothing may make earth moving equipment operation difficult.

2. Containment of contaminated vapor suppression, tank cooling and firefighting water is necessary because ammonia is corrosive and toxic to aquatic life.

3. Vapor suppression of pooled ammonia is needed to reduce toxic vapors.

Leak Continues (Decision Point S)

1. Monitor continuously with a portable explosimeter. Pull back response personnel and evacuate civilians if explosive limit is above 15.5% in air. Do not re-enter area until explosive limit is below 15.5%. Response personnel require full protective clothing and self-contained breathing apparatus.

2. Remove all combustible materials.

3. Approach leaking container from upwind with fog water spray for vapor suppression. Do not direct water stream into container.

4. Monitor vapors and approach when safe.

5. Attempt to patch or plug leak using available materials compatible with ammonia.

6. If container is inaccessible or conditions indicate a problem, pull back response personnel at least 200 feet from leaking vehicle and evacuate 0.4 mile wide by 0.7 mile long downwind (DOT P5800.2), allow leak to go to depletion maintaining application of fog water spray and containment of contaminated waters.

7. If leak is small and it is possible to off-load, go to Container Structural Integrity Assessment (Sequence 9).

8. When leak has stopped go to Sequence 9, Container Structural Integrity Assessment.

ACTION 4.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. If no approach can be made and the leak is allowed to proceed to depletion, a toxic environment exists creating a potential cleanup/disposal problem.

2. Visibility of response personnel may be limited due to the ammonia vapors.

3. All ignition sources and combustible materials must be removed otherwise a potential fire hazard exists to response personnel.

4. Vapor suppression using fog water spray is essential for safety of response personnel.

Off-Load/Transfer Required (Decision Point V)

1. Continue monitoring area with portable explosimeter. Pull back response personnel if explosive limit is above 15.5% in air. Do not re-enter area until explosive limit is below 15.5%.

2. Compatible materials for off-loading are required. Ammonia is corrosive to copper and galvanized surfaces.

3. Identify equipment or techniques to accomplish off-load. Be sure equipment is properly cleaned, assembled and grounded. (See Section 10 of Accident Management Orientation Guide.)

4. During off-load, some spillage may occur. Be sure to contain liquid and suppress vapors.

5. Any small spills during off-loading should be contained, absorbed with dry chemicals and then treated/disposed.

6. After off-load transfer is accomplished, proceed to (Decision Point U) in Sequence 10, Transfer/Cleanup/Disposal.

ACTION 5.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. Transfer operations expose response personnel to toxic ammonia vapors. Contact with liquid ammonia may cause frostbite.

Final Treatment/Cleanup/Disposal Required (Decision Point X)

NOTE: A reputable hazardous materials cleanup/disposal contractor is often hired under these circumstances to preclude any handling problems or future environmental problems.

1. Small spills of ammonia can be flushed completely with water.

2. Large spills of ammonia must be treated with an acid material (i.e., hydrochloric acid) and then flushed completely with water.

ACTION 6.0A
Anhydrous Ammonia - Nonflammable Compressed Gas, Corrosive
Risk Assessment

1. Anhydrous ammonia is extremely toxic on inhalation or on contact. It is also very toxic to aquatic life. Response personnel must be very careful to thoroughly treat a spill to ensure safety to the people and the environment.

Remove Wreckage (Sequence 10)

NOTE: Removal of wreckage will usually be done by a contractor known and hired for his expertise in this area. In general, he will not approach the scene until toxic flammable hazards have been mitigated.

1. This is the general priority for removal of tank cars:

   a. Remove all undamaged non-HM tank cars
   b. Retruck and rerail all non-HM tank cars
   c. Off-load all non-HM tank cars
   d. Remove severely damaged HM tank cars
   e. Remove all undamaged HM tank cars
   f. Off-load all damaged HM tank cars
   g. Retruck and rerail all damaged HM tank cars
   h. Remove severely damaged HM tank cars by flatcars

2. Follow through the Decision Matrix for a last time to recheck all major areas. A final update should be done to make sure all HM have been treated and removed so that no existing hazards still remain.

Fire (Decision Point P)

1. If a propane tank car is on fire or is fire impinged, pull back response personnel 0.5 mile from tank car until adequate water source and supplies become available to control situation.

WARNING

Propane and propane vapors are extremely flammable. Container may explode in heat of fire. Vapors may cause dizziness or suffocation; contact with liquid propane may cause severe frostbite. Flammable vapors may spread away from spill and flashback. Fire may produce irritating or poisonous combustion products, such as carbon monoxide.

2. Keep sparks, flames, and other sources of ignition away which could react explosively with propane.

3. If no water sources are available, pull back response personnel to a distance of 0.5 mile upwind and wait for adequate water supply.

4. Locate water source:

   a. Local hydrant
   b. River/stream
   c. Lake/pond
   d. Farm holding tanks
   e. Wells
   f. Swimming pools
   g. Water tanks

5. Identify and obtain additional equipment needed to utilize water sources, such as pumps, hoses, and fog nozzles.

WARNING

The potential risk to response personnel is extremely high when a propane tank car is or has been involved in a fire. Therefore, such conditions demand that personnel safety be considered carefully before any action or reaction is attempted regarding a burning or fire impinged propane tank car.

WARNING

All firefighting must be accomplished with adequate fire protective clothing.

6. Approach fire and/or leak from upwind with water fog spray to suppress vapors, heat and fire. Apply water to general area of leak and fire to control fire.

7. Apply water to any fire impinged tank car with unmanned monitors to provide cooling and reduce the effects of fire impingement.

   NOTE: According to the National Fire Protection Association (NFPA) a water source of 500 gpm is recommended for adequate container cooling.

WARNING

Fire impingement on an intact tank car presents a potentially hazardous condition. The most critical region for fire impingement is the vapor space (ullage area). The liquid inside the tank car acts as a heat sink; therefore, as the liquid inside the tank car evaporates, fire impinges on the metal and can cause hot spots. These hot spots can weaken the car which may then rupture as the internal pressure increases. If the tank car has suffered structural damage, rupture is more likely to occur.

8. Observe any tank car continually that is or has been involved in a fire situation.

   a. Listen for audible tank noises.
   b. Watch tank car for evidence of bulging or appearance of hot spots (discoloration) in metal.
   c. Observe tank for venting propane vapors indicating opening of tank car pressure relief valve.

9. If there is a sudden increase in tank car noises or evidence of hot spots, pull back response personnel 0.5 mile upwind immediately because tank car may rupture and rocket resulting in an explosion and flying fragments.

WARNING

A fire situation involving a propane tank car is critical. Tank conditions must be continuously monitored to insure safety of response personnel.

10. If tank car conditions do not stabilize, pull back response personnel 0.5 mile upwind.

11. Observe leak and/or fire and note any changes in intensity. When situation subsides re-enter area.

12. Keep applying water to tank car to suppress vapors and provide cooling.

13. If fire is extinguished and conditions are safe, monitor area with a portable explosimeter. Only re-enter area when explosive limits are below 2.1% in air.

14. Return to Overall Situation Update (Sequence 5).

15. If situation does not subside, consider vent and burn options. (See Section 5 of Guide for a discussion of considerations for vent and burn.)

16. Proceed to Sequence 7, Spill/Leak.

ACTION 1.0A
Propane - Flammable Compressed Gas
Risk Assessment

1. Propane fires generate carbon monoxide, a toxic combustion product.

2. Under fire conditions propane tank cars or cylinders may violently rupture and rocket.

3. Propane vapor concentrations may cause dizziness and suffocation; contact with liquid propane may cause severe frostbite.

4. Dangerous situations can develop so rapidly that response personnel may not have adequate warning time to evacuate.

5. Adequate water supplies and backup are essential for tank cooling and firefighting.

6. The situation and conditions of the accident must be carefully and continuously monitored throughout the emergency:

   a. Danger increases rapidly with length of time propane tank car is impinged by fire.
   b. Tank car integrity is reduced by heating as well as from potential mechanical damage suffered in the accident.
   c. Fire impingement on the vapor space of the tank car, especially on damaged surfaces, is critical.
   d. The effectiveness of firefighting and tank cooling techniques is important. Visual and audible senses may be limited by the personal protective gear being worn and by other background noise at the accident site.

7. Risk is dependent on:

   a. Sufficient water (500 gpm) to cool tank.
   b. Tank temperature and pressure (sudden rise is critical).
   c. Duration of fire (the longer the fire, the greater the hazard).
   d. Location of fire impingement on tank (impingement on vapor space is critical).
   e. Amount and location of tank damage (critical when in vapor space with fire impingement).

ACTION 2.0
Propane - Compressed Flammable Gas

Spill/Leak (Decision Point Q)

WARNING

Propane vapors may cause dizziness or suffocation. Vapors may spread away from spill and flashback.

WARNING

A leaking propane tank car is extremely hazardous. Vapors are highly flammable; contact with liquid propane can cause frostbite.

1. Wear self-contained breathing apparatus and adequate protective clothing.

2. Keep sparks, flames and other sources of ignition away which could react explosively with propane.

3. Do not approach a leaking tank car until adequate water and other resources become available.

4. Contaminated tank cooling, firefighting and vapor suppression water should be contained. Dike all potentially affected sewers and water sources. See more specific procedures in ACTION 4.0.

5. Monitor leak area continuously for indications of fire. If fire starts, go back to ACTION 1.0.

6. Approach tank car from upwind only if explosive limit is below 2.1% in air and apply fog water spray to suppress vapors and improve visibility.

7. If wind conditions change, pull back response personnel and change direction of approach.

8. Avoid contact with propane liquid or contaminated water spray; contact with liquid propane may cause frostbite.

9. Even when vapor concentrations are below 2.1%, keep applying fog water spray to suppress vapors.

10. Proceed to Containment (Sequence 7).

ACTION 2.0A
Propane - Flammable Compressed Gas
Risk Assessment

1. Personnel exposed to propane are in an extremely dangerous environment.

2. Propane vapors can cause dizziness or suffocation; contact with liquid propane can cause frostbite.

3. Propane vapors are heavier than air and can easily ignite and flashback to the leak source.

ACTION 3.0
Propane - Flammable Compressed Gas

Containment

WARNING

Vapors may cause dizziness or suffocation; contact with liquid may cause frostbite. Flammable vapors may spread away from spill, ignite and flashback.

WARNING

Since propane is extremely flammable, a liquid release will vaporize very rapidly and probably catch fire. Treat a pool or leak of propane not on fire with extreme caution. This situation creates extreme flammable vapor hazards.

1. Adequate protective clothing and respirator equipment is required.

2. Keep all internal combustion engines out of the flammable vapor area. Use appropriate bulldozers or earth-moving equipment to construct containment barriers because sources of ignition may ignite propane vapors or liquid.

3. Monitor area with a portable explosimeter. Only enter area if explosive limit is below 2.1% in air.

4. Dike all potentially affected sewers and water sources. Dig holes or build earthen dikes in the path of liquid to limit the potential fire area.

5. Approach from upwind to disperse and knock down vapors with fog water spray.

6. Cover any spilled liquid with sand, dirt or appropriate foam to blanket the surface and reduce the rate of evaporation.

7. Proceed to Sequence 8, Leak Assessment.

ACTION 3.0A
Propane - Flammable Compressed Gas
Risk Assessment

1. Propane vapors are highly flammable and can be ignited easily by such sources as cigarettes or internal combustion engines.

2. Response personnel treating a pool or leaking tank car of propane that is not on fire face severe fire, flashback and explosion hazards.

3. Flammable vapors may travel some distance with wind currents and ignite to flashback to leak source. Ignition may happen so rapidly that response personnel will not have time to evacuate the area.

Leak Continues (Decision Point S)

1. Wear self-contained breathing apparatus and adequate protective clothing. Approach from upwind using fog water spray to suppress flammable vapors.

2. Continue monitoring vapor concentrations with a portable explosimeter.

3. Be sure all ignition sources are removed as contact with propane vapors can react explosively. All equipment must be properly grounded.

4. Keep applying fog water spray for vapor suppression. However, do not direct water stream directly into the leak to avoid forcing water into the tank.

5. Pull back all response personnel at least 0.5 mile radius from the leaking vehicle and evacuate all civilians from this hazards perimeter if explosive limit is 2.1% in air.

6. If the leak cannot be stopped by tightening, patching or plugging with compatible materials, containment of the propane is necessary (see containment procedures in ACTION 3.0).

7. Two solutions are possible if leak continues:

   a. Allow the leak to go to depletion at the present rate using a controlled burn of any remaining propane.
   b. "Vent and burn" operations. These operations must be considered separately for each accident situation; thus, experts should be called in who can fully handle the situation. See Section 5 of the Guide for a discussion of "vent and burn" considerations.

8. Monitor vapor concentration and approach only when judged safe.

9. When leak has stopped proceed to Sequence 9, Container Structural Integrity Assessment.

ACTION 4.0A
Propane - Flammable Compressed Gas
Risk Assessment

1. An extreme fire hazard exists for response personnel if a tank car of propane is leaking and continues to leak. Vapors may ignite and flashback to the leaking tank car.

2. Vapor suppression using fog water spray is necessary for the safety of approaching response personnel.

3. If leak can not be stopped, other options must be considered because of extreme fire hazards.

Off-Load/Transfer Required (Decision Point V)

1. If a propane tank car is damaged so as to preclude moving but is determined structurally sound to withstand transfer, identify equipment and techniques to accomplish transfer/off-load.

2. Monitor continuously with a portable explosimeter for possible leaks.

3. Be sure equipment and materials to transfer/off-load are compatible with propane, properly clean, assembled and grounded. (See Section 10 of Accident Management Orientation Guide.)

4. If a leak starts, evacuate area and return to ACTION 2.0.

5. After completion of off-load/transfer proceed to (Decision Point U), Sequence 10, Transfer/Cleanup/Disposal.

ACTION 5.0A
Propane - Flammable Compressed Gas
Risk Assessment

1. Propane vapors are extremely flammable and are invisible. Extreme caution is necessary.

2. Propane can be easily ignited and flashback to leak source can occur giving response personnel little warning or chance to escape.

3. It is important that all transfer/off-load equipment be securely connected, adequately grounded and explosion-proof.

ACTION 6.0
Propane - Flammable Compressed Gas

Final Treatment/Cleanup/Disposal Required (Decision Point X)

1. Propane is not a water reactive material.

2. Spilled liquid propane will boil away (evaporate) rapidly, leaving little or no residue.

NOTE: Since propane does not require final treatment/disposal, a risk assessment is not appropriate.

Remove Wreckage (Sequence 10)

NOTE: Wreckage removal will usually be done by a contractor known and hired for his expertise in this area. In general, he will not approach the scene until toxic and flammable hazards have been mitigated.

1. This is the general priority for removal of tank cars:

   a. Remove all undamaged non-HM tank cars
   b. Retruck and rerail all non-HM tank cars
   c. Off-load all non-HM tank cars
   d. Remove severely damaged non-HM tank cars
   e. Remove all undamaged HM tank cars
   f. Off-load all damaged HM tank cars
   g. Retruck and rerail all damaged HM tank cars
   h. Remove severely damaged HM tank cars by flatcars.

2. Follow through the Decision Matrix for a last time to recheck all major areas. A final update should be done to make sure all HM have been treated and removed properly and that no existing hazards still remain.

13. SAMPLE YARD ACCIDENT SCENARIO

At 5:54 p.m. on October 22 there was an accident at the Omhar, IL railroad yard. The accident occurred during a humping operation in which the yard retarder became inoperative. A tank car containing acrylonitrile impacted a stationary tank car containing vinyl chloride monomer. As a result of the impact both tank cars were punctured and an unspecified quantity of material was released. Now to the accident scene.

1. Within four or five minutes of the impact, one of the cars ruptures forming mushroom-like yellow-orange fireball about 300 feet in height.

2. Yard master notifies railroad dispatcher of accident by two-way radio and provides the following information:

   A. HM involved are: Acrylonitrile and Vinyl Chloride.

   B. No known injuries or fatalities.

3. Railroad dispatcher notifies railroad supervisor and local fire and police departments of accident and that the hazardous materials involved are acrylonitrile and vinyl chloride. The dispatcher also notifies National Response Center (NRC) at (800) 424-8802 and American Association of Railroads (AAR) Bureau of Explosives at (202) 835-9500.

4. Police arrive on-scene and perform the following activites:

   A. Determine hazards area using DOT 5800.2 Emergency Response Guide or other appropriate manual.

   B. Determine alternate traffic routes around hazards area.

   C. If evacuation radii are not specified for materials involved in DOT P5800.2 or other response manuals, isolate and evacuate 0.5 mile in all directions.

   D. Assess and implement measures needed to secure the area allowing only authorized response individuals into the area and keeping unauthorized personnel out.

5. Fire department team arrives on-scene and the fire officer in charge (designated on-scene coordinator (OSC)) finds the yard master. OSC obtains information on cars and materials involved and any other pertinent accident information (i.e., rupture, fire, vapor clouds, etc.). He relays this information to fire dispatcher verifying the involvement of acrylonitrile and vinyl chloride.

Car Contents	Ruptured	Spill/ Leak	Fire	Fire Impinged	Disoriented
Acrylonitrile		x			
Vinyl Chloride	x	x	x		

6. Fire department calls CHEMTREC at (800) 424-9300.

7. Determine the agencies to be contacted in State/local contingency plan. Contact these agencies now!

8. Are your communities resources of specialized emergency response equipment, gear and personal protective clothing adequate to handle the hazards posed by this accident?

   - Yes, perform a situation update.
   - No, notify additional local/State/Federal ER teams.
   - Don't know, notify additional local/State/Federal ER teams.

9. OSC informs news media of situation and states that the media will be contacted with any updates detailing accident status and decisions. News media personnel are requested to respect hazards perimeter to prevent unnecessary exposure.

10. Cleanup/disposal and wreckage removal contractors arrive on-scene and are briefed by railroad personnel and OSC.

    A. General Overview of Accident Handling

       1. Monitor vapor dispersion of any acrylonitrile and vinyl chloride vapors to reassess evacuation radius.

       2. All emergency response personnel working in the accident area should be equipped with rubber suits, air packs, helmets with face shields and other personal protective clothing.

    B. Strategy for Specific HM Handling

       1. Acrylonitrile

          a. Toxic Vapor Hazards

             i. Acrylonitrile vapors are poisonous and extremely flammable. According to DOT P5800.2 the leaking tank should be isolated 60 feet in all directions, then residents should be evacuated 0.1 mile wide by 0.2 mile long downwind.

             ii. Vapors are heavier than air and hug ground.

          b. Flammable/Polymerizable Hazards

             i. Acrylonitrile may polymerize in absence of oxygen if exposed to excessive heat or in presence of alkalies, causing tank car rupture.

ii. Vapors are extremely flammable and can ignite and flashback to leak source.

iii. Burning acrylonitrile will evolve toxic hydrogen cyanide gas and oxides of nitrogen.

iv. Water and foam are not good fire extinguishing agents — may cause frothing.

c. Pollution Hazards

i. Contain the acrylonitrile because it is harmful to aquatic life in very low concentrations.

2. Vinyl Chloride

a. Toxic Vapor Hazards

i. Vinyl chloride vapors are irritating to eyes, nose and throat and are extremely flammable. According to DOT P5800.2 if a tank car of vinyl chloride is involved in a fire, the area should be isolated 0.5 mile in all directions.

ii. In a fire, toxic combustion products such as hydrogen chloride, phosgene and carbon monoxide may result.

b. Flammable/Polymerizable Hazards

i. Polymerizes in presence of air, sunlight or heat unless stabilized by inhibitors.

ii. Vapors are heavier than air. Ignition of vapors and flashback along vapor trail may occur.

11. Does the incident have fires?

- Yes: follow the guidelines for acrylonitrile and vinyl chloride outlined in ACTION 1.0 on pages 13-5 and 13-20, respectively. Proceed to Step 12.
- No: proceed to Step 12.

12. Does the incident involve a spill/leak?

- Yes: follow the guidelines for acrylonitrile and vinyl chloride outlined in ACTION 2.0 on pages 13-9 and 13-24, respectively. Proceed to Step 13.
- No: proceed to Step 14.

13. Attempt to contain acrylonitrile and vinyl chloride in accordance with guidelines outlined in ACTION 3.0 on pages 13-11 and 13-26, respectively. Proceed to Step 14.

14. Assess and implement appropriate leak handling options.

- Leak stops: proceed to Step 15.
- Leak continues: perform ACTION 4.0 for acrylonitrile and vinyl chloride on pages 13-13 and 13-28, respectively. Proceed to Step 15.

15. Assess container structural integrity in accordance with guidelines outlined in Section 9 of the Management Orientation Guide.

- Off-load/transfer required: conduct ACTION 5.0 for acrylonitrile and vinyl chloride on pages 13-15 and 13-30, respectively. Proceed to Step 16.
- Rerail/move can be accomplished: proceed to Step 16.

16. Assess if final treatment/cleanup/disposal is required.

- No: proceed to Step 17.
- Yes: conduct ACTION 6.0 for acrylonitrile and vinyl chloride on pages 13-17 and 13-32, respectively. Proceed to Step 17.

17. Perform removal of tank cars containing acrylonitrile and vinyl chloride in accordance with ACTION 7.0 on pages 13-19 and 13-34, respectively.

Actions 1.0 through 7.0 with their associated general risks for acrylonitrile are presented on pages 13-5 through 13-19 and for vinyl chloride are on pages 13-20 through 13-34.

ACTION 1.0
Acrylonitrile - Flammable Liquid, Poison

Fire (Decision Point P)

WARNING

When heated or burned, acrylonitrile may evolve toxic hydrogen cyanide gas and oxides of nitrogen. Acrylonitrile may also polymerize under fire conditions causing container rupture.

WARNING

Vapors are heavier than air and can travel some distance to an ignition source and flashback along vapor trail to leak source.

1. Wear appropriate protective clothing including self-contained breathing apparatus, goggles or face mask, rubber overclothing (including gloves) and safety helmet.

2. Remove all ignition sources.

3. Initially isolate tank by 60 feet in all directions. Then evacuate in a downwind direction 0.1 mile wide by 0.2 mile long.

4. If there is an indication of a leak with the fire, monitor acrylonitrile vapor cloud and evacuate all residents in direction and vicinity of cloud.

5. If no water resources are available, pull back response personnel upwind to a distance of 0.5 mile and wait for adequate water resources to become available.

6. Locate water source:

    a. Local hydrant
    b. River/stream
    c. Lake/pond
    d. Farm holding tanks
    e. Wells

f. Swimming pools
g. Water tanks

7. Identify and obtain additional equipment needed to utilize water source: pumps, hoses, fog nozzles.

WARNING

The potential risk to response personnel is extremely high when an acrylonitrile tank car is or has been involved in a fire. Therefore, such conditions demand that personnel safety be considered carefully before any action or reaction is attempted regarding a burning or fire impinged acrylonitrile tank car.

8. All contaminated water must be contained. Dike all potentially affected sewers and water sources. See ACTION 3.0 for more specific details.

9. Approach accident site from the upwind direction and extinguish fire using suitable agent (i.e., dry chemical, carbon dioxide). Use of water or foam may cause frothing. If acrylonitrile vapors are present, use fog water spray to suppress and knock down vapors and cool tank cars. Set up unmanned monitors if possible.

NOTE: According to the NFPA, a water source of 500 gpm is recommended for adequate container cooling.

WARNING

Fire impingement on an intact tank car presents a potentially hazardous condition. The most critical region for fire impingement is the vapor space. The liquid inside the tank car acts as a heat sink; therefore, if the liquid inside the tank car evaporates hot spots can develop from direct flame impingement on tank metal. A rupture may occur if the internal tank pressure has increased to a point exceeding the design capability of the weakened tank shell. If the tank car has also suffered structural damage, rupture is more likely to occur.

10. Observe tank car continually that is or has been involved in a fire situation.

    a. Listen for audible tank noises.
    b. Watch tank car for evidence of bulging or appearance of hot spots or discolorations in the metal.
    c. Observe tank for venting acrylonitrile vapors indicating opening of tank car pressure relief valve.

11. If there is an increase in tank car noises or evidence of hot spots, pull back response personnel 0.5 mile upwind immediately because tank car may rupture and rocket resulting in an explosion and flying fragments.

WARNING

A fire situation involving an acrylonitrile tank car is critical. Tank conditions must be continuously monitored to insure safety of response personnel.

12. If tank conditions do not stabilize, pull back response personnel 0.5 mile upwind.

13. Observe fire and/or leak and note any changes in intensity. When situation subsides, re-enter area.

14. Keep applying water to tank car to suppress vapors and provide cooling.

15. If fire is extinguished and conditions are safe, monitor area with a portable explosimeter. Only re-enter area when explosive limits are below 2.1% in air.

16. Proceed back to Overall Situation Update (Sequence 5).

17. If situation does not subside, consider "vent and burn" options.

18. Proceed to Sequence 7, Spill/Leak.

ACTION 1.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. Acrylonitrile vapors pose extreme hazards to response personnel: Toxic combustion products may be produced in fire.

2. Adequate water supplies and backup are essential for tank cooling and vapor suppression.

3. Dangerous situations can develop so rapidly that response personnel may not have adequate warning time to evacuate.

4. The situation and conditions of the accident must be carefully and continuously monitored through the emergency:

   a. Tank integrity is reduced by heating as well as from potential mechanical damage suffered in the accident.
   b. Fire impingement on the vapor space of the tank car, especially on damaged surfaces, is critical.
   c. The effectiveness of firefighting and tank cooling techniques is important. Visual and audible senses may be limited by the personal protective gear being worn and by other background noises at the accident site.

5. Risk is dependent on:

   a. Sufficient water (500 gpm) to cool tank car.
   b. Tank car temperature and pressure (sudden rise is critical).
   c. Duration of fire (the longer the fire, the greater the hazard).
   d. Location of fire impingement on tank (impingement on vapor space is critical).
   e. Amount and location of tank damage (critical when in vapor space with fire impingement).

ACTION 2.0
Acrylonitrile - Flammable Liquid, Poison

Spill/Leak (Decision Point Q)

WARNING

Acrylonitrile vapors are extremely flammable and toxic if inhaled and are extremely irritating to the skin and eyes. Liquid is toxic if ingested and can be absorbed through the skin.

1. Wear self-contained breathing apparatus and adequate protective clothing.

2. Remove all ignition sources.

3. Do not approach a leaking tank car until adequate water and other resources become available.

4. Monitor leak area continuously for indications of fire. If fire starts, go back to ACTION 1.0.

5. Approach tank car from upwind only if explosive limit is below 3.05% in air and apply water fog spray to suppress vapors and improve visibility.

6. If wind conditions change, pull back response personnel and change direction of approach.

7. Acrylonitrile liquid and contaminated firefighting, tank cooling and vapor suppression waters must be contained. Dike all potentially affected sewers and water sources. See more specific procedures in ACTION 3.0.

WARNING

Acrylonitrile is harmful to aquatic life in very low concentrations.

8. Proceed to CONTAINMENT (Sequence 7).

ACTION 2.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. Acrylonitrile vapors are extremely flammable; in a fire the vapors yield toxic combustion products.

2. Acrylonitrile vapors and liquid are toxic and response personnel must use adequate protective clothing and breathing equipment.

3. Containment of liquid acrylonitrile and contaminated firefighting runoff, tank cooling and vapor suppression waters is necessary because of severe pollution threat to aquatic life and water supplies.

ACTION 3.0
Acrylonitrile - Flammable Liquid, Poison

Containment

WARNING

Vapors are toxic and flammable; contact with liquid is irritating to skin and eyes. Flammable vapors may spread away from spill, ignite and flashback.

WARNING

Since acrylonitrile is flammable, a pool of liquid will present a fire hazard as well as a health hazard. Contact with the liquid should be avoided.

1. Adequate protective clothing and a self-contained breathing apparatus is required.

2. Monitor area with a portable explosimeter. Restrict area and evacuate if limit is above 3.05% in air. Do not re-enter area until exposive limit is below 3.05%.

3. Containment of liquid acrylonitrile, contaminated firefighting runoff, tank cooling and vapor suppression waters is necessary. Dike all potentially affected sewers and water sources. Acrylonitrile poses a severe pollution threat.

4. If acrylonitrile is pooling, use available appropriate equipment to construct containment structures: dikes, dams, berms, excavated pits, and/or basins.

5. Use appropriate (non-sparking, explosion-proof) bulldozers or earth-moving equipment to compact soil for earthen dams, dikes, or berms.

NOTE: Foamed polyurethane or concrete dikes may be constructed if equipment is available in the local area.

6. Cover pool with alcohol foam to contain toxic vapors. NOTE: Foam may cause pool of acrylonitrile to froth.

7. Proceed to Sequence 8, Leak Assessment.

ACTION 3.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. Acrylonitrile vapors pose both toxic and flammable hazards to response personnel.

2. Containment of acrylonitrile and all contaminated tank cooling, firefighting runoff and vapor suppression waters is necessary because acrylonitrile is harmful to aquatic life in very low concentrations.

Leak Continues (Decision Point S)

1. Monitor continuously with a portable explosimeter. Pull back response personnel and evacuate civilians if explosive limit is above 3.05% in air. Do not re-enter area until explosive limit is below 3.05%. Response personnel need to wear self-contained breathing apparatus and adequate protective clothing.

2. Remove all ignition sources.

3. Approach leaking container from upwind with water fog spray for vapor suppression. Do not direct water stream into the container.

4. Attempt to patch or plug leak using available materials compatible with acrylonitrile.

NOTE: Acrylonitrile attacks aluminum, copper and copper alloys; penetrates leather.

5. If container is inaccessible or conditions indicate a problem, pull back response personnel to at least 60 feet from leaking vehicle and evacuate 0.1 mile wide by 0.2 mile long downwind (DOT P5800.2), allow leak to go to depletion maintaining application of fog water spray and containment of leaking acrylonitrile and any other contaminated waters.

6. If leak is small and it is possible to off-load, go to Sequence 9, Container Structural Integrity Assessment.

7. When leak has stopped proceed to Sequence 9, Container Structural Integrity Assessment.

ACTION 4.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. If no approach can be made and the leak is allowed to go to depletion, a large amount of toxic material has been released into the environment and a potentially large cleanup/disposal problem must be addressed.

2. Acrylonitrile vapors are extremely flammable and heavier than air. They may travel a considerable distance to a source of ignition and flashback causing fire/explosion hazards.

3. Acrylonitrile may polymerize spontaneously in absence of oxygen or on exposure to visible light or excessive heat.

4. Vapor suppression using fog water spray is needed for safety of response personnel.

ACTION 5.0
Acrylonitrile - Flammable Liquid, Poison

Off-Load/Transfer Required (Decision Point V)

1. Continue monitoring area with a portable explosimeter. Pull back response personnel if explosive limit is above 3.05% in air. Do not re-enter area until explosive limit is below 3.05%.

2. Compatible materials for off-loading are required. Acrylonitrile is not compatible with copper, copper alloys and aluminum.

3. Identify equipment or techniques to accomplish off-load. Be sure equipment is properly cleaned, assembled and grounded. (See Section 10 of Accident Management Orientation Guide.)

4. During off-load, some spillage may occur. Be sure to contain liquid and suppress vapors.

5. Any small spills during off-loading should be contained, absorbed with dry chemicals, flushed with water, and then treated/disposed.

6. If a major leak starts, evacuate area and return to ACTION 2.0.

7. After off-load/transfer is accomplished, proceed to scenario segment (Decision Point U) in Sequence 10, Transfer/Cleanup/Disposal.

ACTION 5.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. Response personnel must be aware that adding water to acrylonitrile may cause frothing.

2. Transfer operations expose response personnel to toxic flammable acrylonitrile vapors. Contact with liquid acrylonitrile is irritating to skin and eyes.

3. Any release of liquid acrylonitrile must be contained because it poses environmental hazards (i.e., toxic to aquatic life, contamination of water supplies).

4. Care must be taken to properly ground transfer equipment as static could ignite any acrylonitrile vapors.

ACTION 6.0
Acrylonitrile - Flammable Liquid, Poison

Final Treatment/Cleanup/Disposal Required (Decision Point X)

NOTE: A reputable hazardous materials cleanup/disposal contractor is often hired under these circumstances to preclude any handling problems or future environmental problems.

1. Small spills of acrylonitrile can be flushed completely with flooding quantities of water.

2. Large spills of acrylonitrile must be diked for later disposal.

ACTION 6.0A
Acrylonitrile - Flammable Liquid, Poison
Risk Assessment

1. Acrylonitrile is extremely poisonous on inhalation or on contact. It is also very toxic to aquatic life and can contaminate water supplies. Response personnel must be very careful to thoroughly treat a spill to ensure safety to the people and the environment.

Remove Wreckage (Sequence 10)

NOTE: Wreckage removal will usually be performed by a contractor known and hired for his expertise in this area. In general he will not approach the scene until toxic, flammable hazards have been mitigated.

1. This is the general priority for removal of tank cars:

   a. Remove all undamaged non-HM tank cars
   b. Retruck and rerail all non-HM tank cars
   c. Off-load all non-HM tank cars
   d. Remove severely damaged HM tank cars
   e. Remove all undamaged HM tank cars
   f. Off-load all damaged HM tank cars
   g. Retruck and rerail all damaged HM tank cars
   h. Remove severely damaged HM tank cars by flatcars

2. Follow through the Decision Matrix for a last time to recheck all major areas. A final update should be done to make sure all HM have been treated and removed so that no existing hazards still remain.

ACTION 1.0
Vinyl Chloride - Compressed Flammable Gas

Fire (Decision Point P)

WARNING

Vinyl chloride vapors are extremely flammable and irritating. Inhalation and skin contact should be avoided. The vapor may cause dizziness, anesthesia, lung irritation and contact may cause frostbite.

WARNING

Vinyl chloride vapors yield highly toxic combustion products such as hydrogen chloride, phosgene and carbon monoxide.

1. Wear appropriate protective clothing including a self-contained breathing apparatus, goggles, and rubber overclothing (including gloves).

2. Remove all ignition sources.

3. If no water is available, pull back response personnel upwind to a distance of 0.5 mile and wait for adequate water and resources to become available.

4. Locate water sources:

   a. Local hydrant
   b. River/stream
   c. Lake/pond
   d. Farm holding tanks
   e. Wells
   f. Swimming pools
   g. Water tanks

5. Identify and obtain additional equipment needed to utilize water source: pumps, hoses, fog nozzles.

6. Monitor the area with an explosimeter. Restrict area and evacuate if above 4% in air. Do not re-enter area until explosive limit is below 26% in air.

WARNING

The potential risk to response personnel is extremely high when a vinyl chloride tank car is or has been involved in a fire. Therefore, such conditions demand that personnel safety be considered carefully before any action or reaction is attempted regarding a burning or fire impinged vinyl chloride tank car.

7. Approach accident site from the upwind direction and extinguish fire using dry chemicals or carbon dioxide. If vinyl chloride vapors are present, use fog water spray to suppress and knock down vapors and cool tank cars. Set up unmanned monitors if possible.

NOTE: According to the NFPA, a water source of 500 gpm is recommended for adequate container cooling.

WARNING

Fire impingement on an intact tank car presents a potentially hazardous condition. The most critical region for fire impingement is the vapor space. The liquid inside the tank car acts as a heat sink; therefore, if the liquid inside the tank car evaporates hot spots can develop from direct flame impingement on tank metal. A rupture may occur if the internal tank pressure has increased to a point exceeding the design capability of the weakened tank shell. If the tank car has suffered structural damage, rupture is more likely to occur.

8. Observe a tank car continually that is or has been involved in a fire situation.

   a. Listen for audible tank noises.
   b. Watch tank car for evidence of bulging or appearance of hot spots in the metal.
   c. Observe tank vent stack for venting vinyl chloride vapors indicating opening of tank car pressure relief valve.

9. If there is a sudden rise in tank car noises or evidence of hot spots, pull back response personnel 0.5 mile upwind immediately because tank car may explode and rocket.

ACTION 1.0
Vinyl Chloride - Compressed Flammable Gas

WARNING

A fire situation involving a vinyl chloride tank car is critical. Tank conditions must be continuously monitored to insure safety of response personnel.

10. If tank car conditions do not stablize, pull back response personnel 0.5 mile upwind.

11. Observe fire and/or leak and note any changes in intensity. When situation subsides, re-enter area.

12. Keep applying water to tank car to suppress vapors and provide cooling.

13. If fire is extinguished and conditions are safe, monitor area with a portable explosimeter. Only re-enter area when explosive limits are below 2.1% in air.

14. Proceed back to Overall Situation Update (Sequence 5).

15. If situation does not subside, consider vent and burn options.

16. Proceed to Sequence 7, Spill/Leak.

ACTION 1.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. Vinyl chloride vapors pose extreme fire hazards to response personnel; they are irritating if inhaled; under fire conditions the vapors can yield toxic combustion products (i.e., hydrochloric acid, carbon monoxide and phosgene).

2. Under fire conditions a vinyl chloride tank car may violently rupture and rocket.

3. Adequate water supplies and backup are essential for tank cooling and vapor suppression.

4. Dangerous situations can develop so quickly that response personnel may not have adequate time to evacuate.

5. The situation and conditions of the accident must be carefully and continuously monitored through the emergency:

   a. Tank integrity is reduced by heating as well as from potential mechanical damage suffered in the accident.
   b. Fire impingement on the vapor space of the tank car, especially on damaged surfaces, is critical.
   c. The effectiveness of firefighting and tank cooling techniques is important. Visual and audible senses may be limited by the personal protective gear being worn and by other background noises at the accident site.

6. Risk is dependent on:

   a. Sufficient water (500 gpm) to cool tank car.
   b. Tank car temperature and pressure (sudden rise is critical).
   c. Duration of fire (the longer the fire, the greater the hazards).
   d. Location of fire impingement on tank (impingement on vapor space is critical).
   e. Amount and location of tank damage (critical when in vapor space with fire impingement).

ACTION 2.0
Vinyl Chloride - Compressed Flammable Gas

Spill/Leak (Decision Point Q)

WARNING

Vinyl chloride vapors are irritating; contact with liquid vinyl chloride may cause frostbite.

WARNING

Vinyl chloride vapors are extremely flammable and yield toxic combustion products in a fire.

1. Wear self-contained breathing apparatus and adequate protective clothing.
2. Remove all ignition sources.
3. Do not approach a leaking tank car until adequate water and resources become available.
4. Contaminated tank cooling, firefighting and vapor suppression waters should be contained. Dike all potentially affected sewers and water sources. See more specific procedures in ACTION 4.0.
5. Monitor leak area continuously for indications of fire. If fire starts, go back to ACTION 1.0.
6. Approach tank car from upwind only if explosive limit is below 4% in air and apply fog water spray to suppress vapors and improve visibility.
7. If wind conditions change, pull back response personnel and change direction of approach.
8. Contact with vinyl chloride liquid may cause frostbite.
9. Even when vapor concentrations are below 4%, keep applying fog water spray to suppress vapors.
10. Proceed to Containment (Sequence 7).

ACTION 2.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. Vinyl chloride vapors are heavier than air and may travel considerable distance to a source of ignition and flashback to the leak source.

2. Vinyl chloride vapors can cause dizziness and irritation; contact with liquid vinyl chloride can cause frostbite.

ACTION 3.0
Vinyl Chloride - Compressed Flammable Gas

Containment

WARNING

Vinyl chloride vapors are extremely flammable and are irritating to the eyes and skin; contact with liquid vinyl chloride can cause frostbite.

WARNING

Since vinyl chloride is extremely flammable, a liquid release will vaporize very rapidly and probably catch fire. Treat pool or leak of vinyl chloride not on fire with extreme caution. This situation creates extreme flammable vapor hazards.

1. Adequate protective clothing and a self-contained breathing apparatus is required.

2. Keep all internal combustion engines out of the flammable vapors area. Use appropriate bulldozers or earth moving equipment to construct containment barriers because sources of ignition may ignite vinyl chloride vapors or liquid.

3. Monitor area with a portable explosimeter. Restrict area and evacuate if limit is above 4% in air. Do not re-enter area until exposive limit is below 4%.

4. Dike all potentially affected sewers and water sources. Dig holes or build earthen dikes in the path of liquid to limit the potential fire area.

5. Approach from upwind to disperse and knock down vapors with fog water spray.

6. Cover any spilled liquid with sand, dirt or appropriate foam to blanket the surface and reduce the rate of evaporation.

7. Proceed to Sequence 8, Leak Assessment.

ACTION 3.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. Vinyl chloride vapors are highly flammable and can easily be ignited by cigarettes or car engines.

2. Response personnel treating a pool or leaking tank car of vinyl chloride that is not on fire face severe fire, flashback and explosion hazard.

3. Vinyl chloride vapors may travel some distance, ignite and flashback to leak source. This may happen so rapidly that response personnel will not have time to evacuate the area.

Leak Continues (Decision Point S)

1. Wear self-contained breathing apparatus and adequate protective clothing. Approach from upwind using fog water spray to suppress flammable vapors.

2. Continue monitoring vapor concentrations with a portable explosimeter.

3. Be sure all ignition sources are removed as contact with vinyl chloride vapors can react explosively. All equipment must be properly grounded.

4. Keep applying fog water spray for vapor suppression. However, do not direct water stream directly into the leak to avoid forcing water into the tank.

5. Pull back all response personnel at least 0.5 mile radius from the leaking vehicle and evacuate all civilians from this hazards perimeter if explosive limit is 4% in air.

6. If the leak cannot be stopped by tightening, patching or plugging with compatible materials, containment of the vinyl chloride is necessary (see containment procedures in ACTION 3.0).

7. Two solutions are possible if leak continues:

   a. Allow the leak to go to depletion at the present rate using controlled burn of any remaining vinyl chloride.
   b. "Vent and burn" operations. These operations must be considered separately for each accident situation; thus, experts should be called in who can fully handle the situation. See Section 5 on this Guide for a discussion of "vent and burn" considerations.

8. Monitor vapor concentration and approach only when judged safe.

9. When leak has stopped proceed to Sequence 9, Container Structural Integrity Assessment.

ACTION 4.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. An extreme fire hazard exists for response personnel if a tank car of vinyl chloride is leaking and continues to leak. Vapors may ignite and flashback to the leaking tank car.

2. Vapor suppression using fog water spray is necessary for the safety of approaching response personnel.

3. If leak can be stopped, other options must be considered because of extreme fire hazard and toxic combustion products.

Off-Load/Transfer Required (Decision Point V)

1. If a vinyl chloride tank car is damaged so as to preclude moving, but is determined to be structurally sound enough to withstand transfer, identify equipment and techniques to accomplish the off-load/transfer.

2. Monitor continuously with portable explosimeter for leaks.

3. Be sure equipment is compatible, clean and adequately grounded. (See Section 10 of Accident Management Orientation Guide.)

4. If a leak starts, evacuate area and return to ACTION 2.0.

5. After completion of off-load/transfer proceed to scenario segment (Decision Point U), Sequence 10, Transfer/Cleanup/Disposal.

ACTION 5.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. Vinyl chloride vapors are extremely flammable and irritating. Extreme caution is necessary.

2. Vinyl chloride can be easily ignited and flashback to leak source giving response personnel little warning or chance to escape.

3. It is important that all transfer/off-load equipment be securely connected, adequately grounded and explosion-proof.

Final Treatment/Cleanup/Disposal Required (Decision Point X)

1. Vinyl chloride is not a water reactive material.

2. Spilled liquid vinyl chloride will boil away (evaporate) rapidly, leaving no residue.

3. If vinyl chloride enters a water body there is contamination potential because vinyl chloride is toxic to aquatic life.

ACTION 6.0A
Vinyl Chloride - Compressed Flammable Gas
Risk Assessment

1. Vinyl chloride is extremely toxic. It is also very toxic to aquatic life. Response personnel must be very careful to thoroughly treat a spill to ensure safety to the people.

Remove Wreckage (Sequence 10)

NOTE: Wreckage removal will usually be performed by a contractor known and hired for his expertise in this area. In general, he will not approach the scene until toxic, flammable hazards have been mitigated.

1. This is the general priority for removal of tank cars:

   a. Remove all undamaged non-HM tank cars
   b. Retruck and rerail all non-HM tank cars
   c. Off-load all non-HM tank cars
   d. Remove severely damaged HM tank cars
   e. Remove all undamaged HM tank cars
   f. Off-load all damaged HM tank cars
   g. Retruck and rerail all damaged HM tank cars
   h. Remove severely damaged HM tank cars by flatcars

2. Follow through the Decision Matrix for a last time to recheck all major areas. A final update should be done to make sure all HM have been treated and removed so that no existing hazards still remain.

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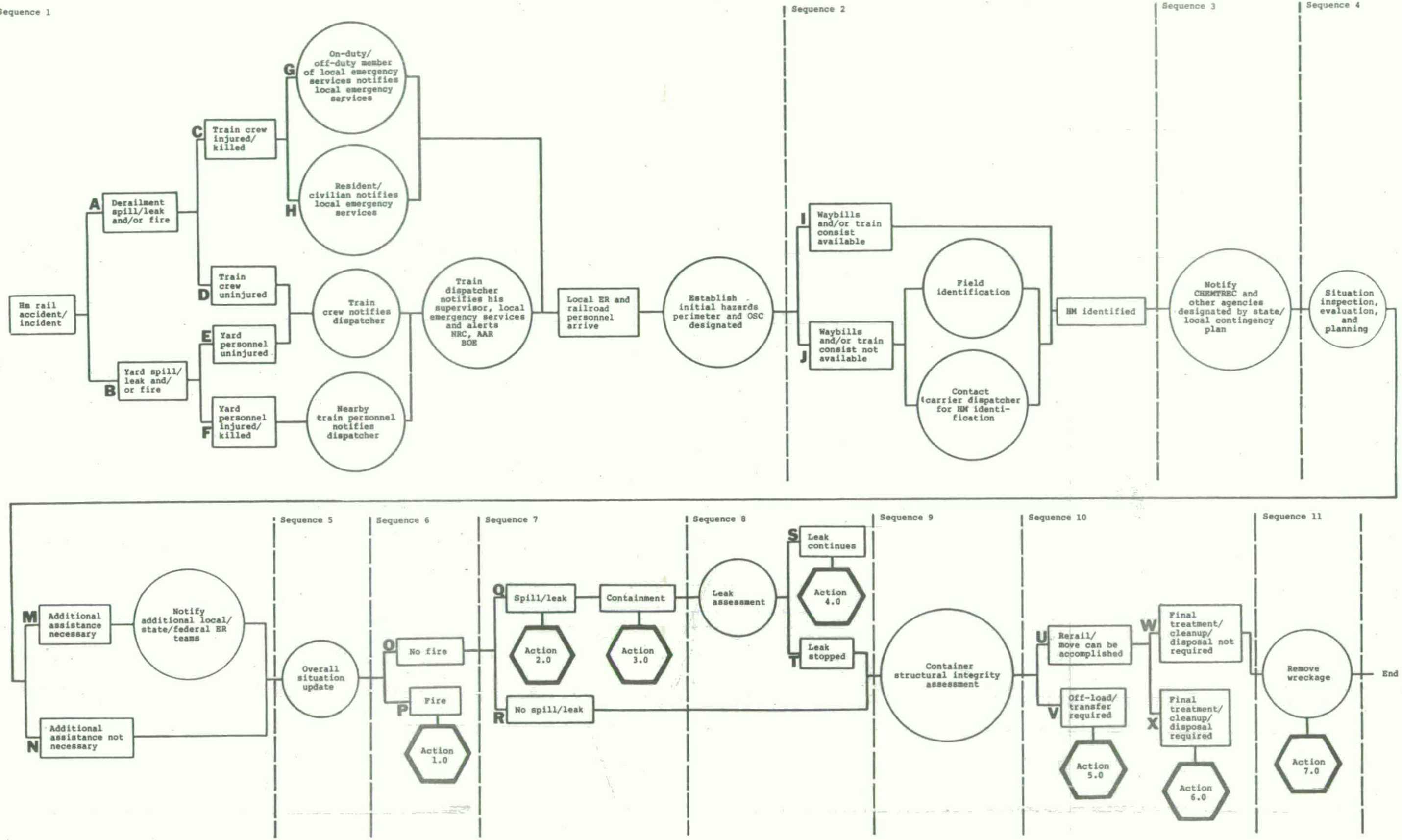


FIGURE I. DECISION SCENARIO FOR HAZARDOUS MATERIALS ACCIDENT MANAGEMENT

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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accident management
emergency response
hazards assessment
hazards mitigation
contingency planning
training
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structural integrity assessment
off-load/transfer
cleanup/disposal
wreckage removal

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The Accident Management Orientation Guide identifies the guidelines needed for mitigating the hazards associated with a hazardous materials (HM) in-service railroad derailment and a HM yard accident. The guide addresses all phases of on-scene emergency response operations from initial notification of emergency response personnel through departure from the accident scene of the cleanup/disposal teams, and resumption of normal operations. Examples of

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programmed decision-scenarios for handling HM rail derailments and yard accidents are included.