



Crude Oil by Rail

API-AAR

Response Safety Course

Introduction

Emergency Preparedness for Crude by Rail





Disclaimer



Neither API, AAR, ACC nor any of their employees, subcontractors, consultants, or other assigns make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or utility of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication, or represent that its use would not infringe upon privately owned rights.

Users of this training should not rely exclusively on the information contained in this training. Sound scientific and safety judgment should be used in employing the information contained herein.

Where applicable, authorities having jurisdiction should be consulted.

Neither API, AAR, nor ACC are undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

Scope and Purpose

This program is designed to give the first responder a basic understanding of crude oil that is being transported by rail tank car. The program will discuss the basics of hazard identification, tank car design, and emergency response considerations.

Hazard
Identification



Tank Car
Design



Emergency
Response



Objectives

At the end of this program, the participant should be able to:

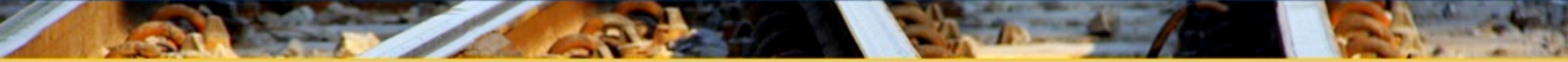
- Understand the growth of crude oil by rail
- Identify shipping papers used
- Identify the information sources available for identification
- Describe the benefit of the information from rail shipping papers
- Recognize the markings used for identification of rail cars transporting crude oil
- Describe the considerations to be taken during an incident involving crude oil by rail including:
 - Basic firefighting
 - Containing and confinement

Course Outline

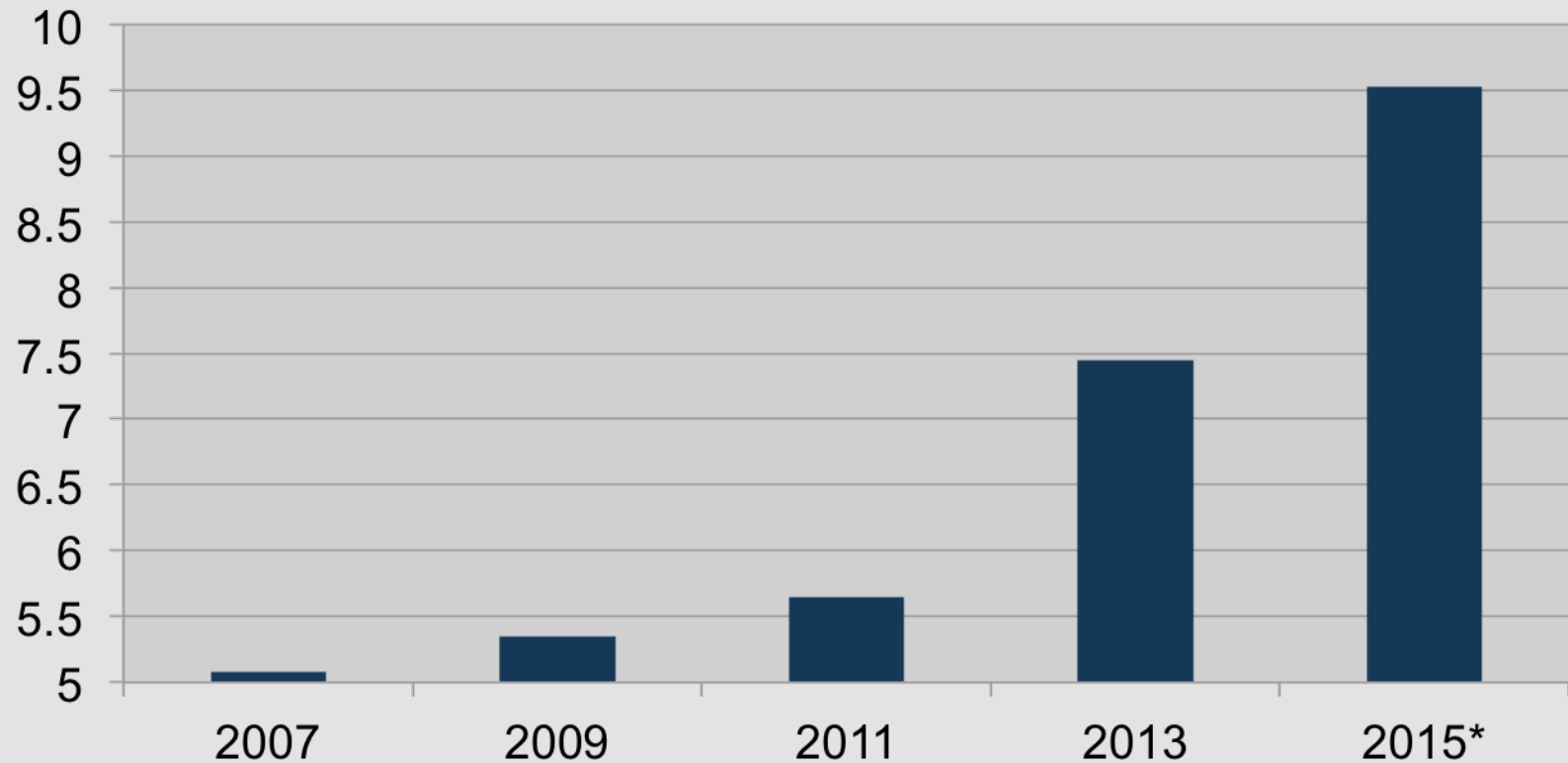
- Why crude oil by rail?
- Recognizing the hazards
- Understanding crude oil
- Rail cars that carry crude oil
- Fire response
- Spill response
- Incident command during a rail incident



U.S. Crude Oil Production



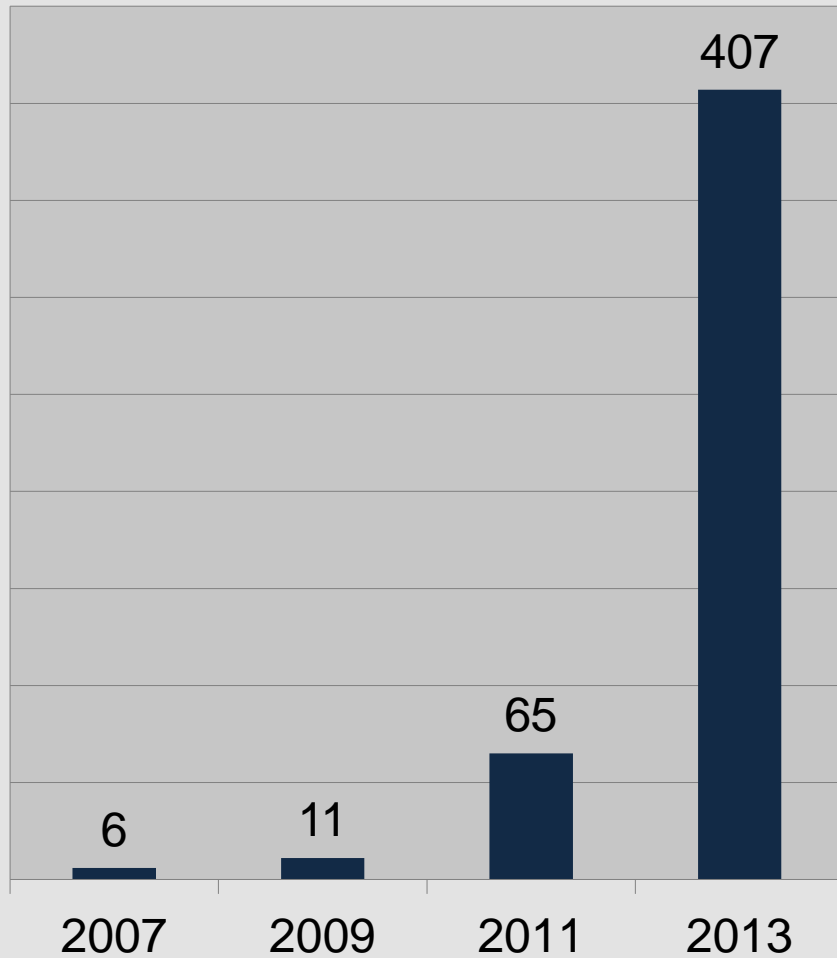
Millions of Barrels Per Day



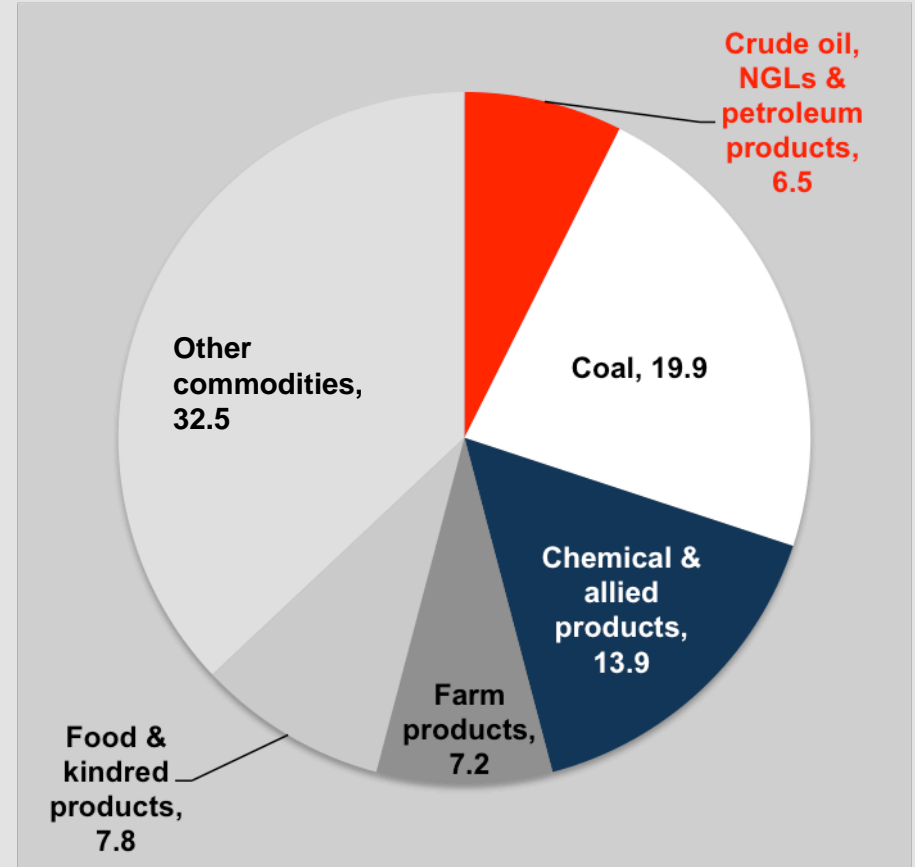
* Energy Information Administration estimate

Source: EIA

U.S. Crude Oil on Class 1 Railroads

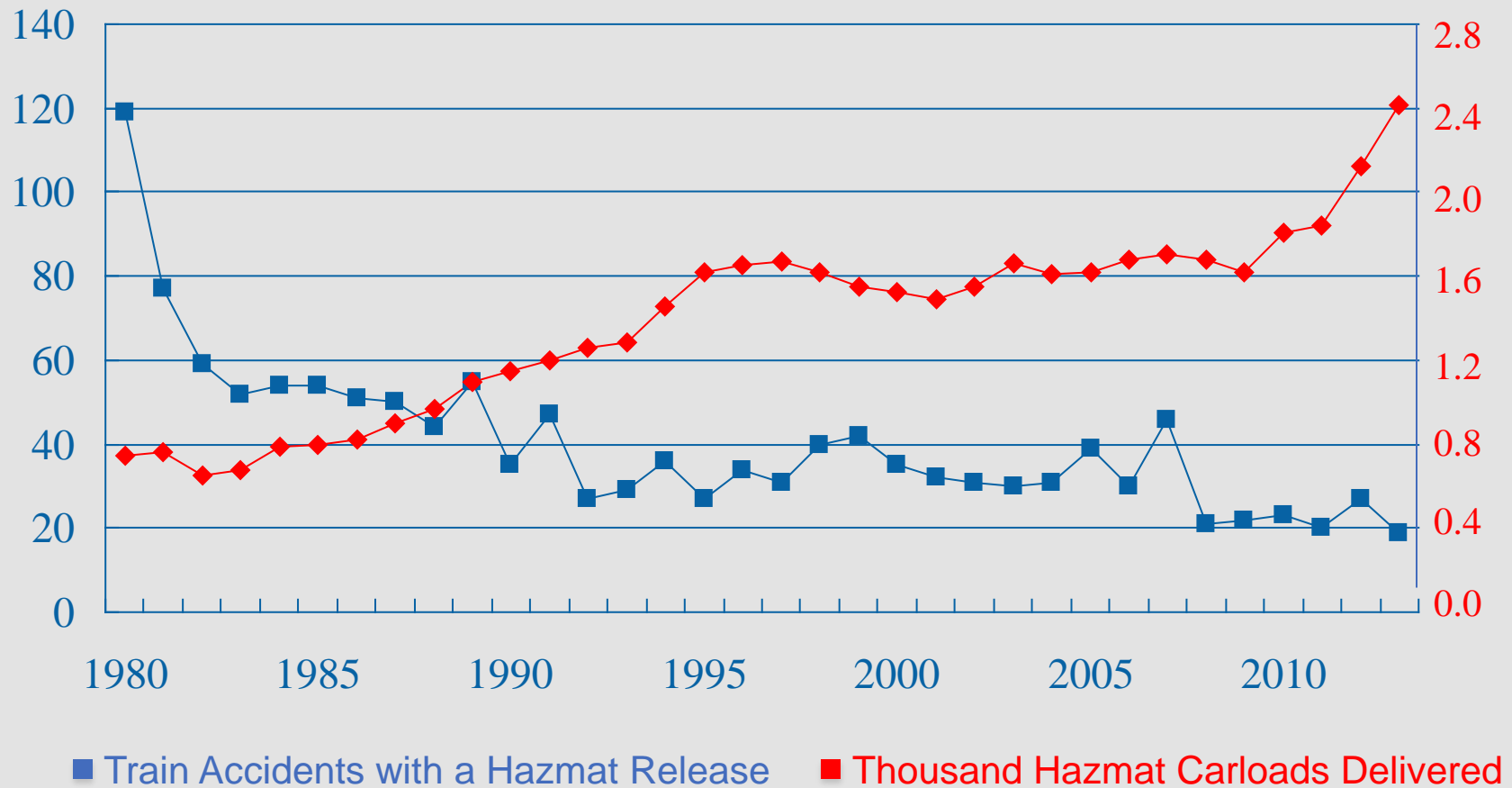


**Car loads of crude oil
(tens of thousands)**



Commodities by %

Rail Safety Record



Sources: AAR Analysis of FRA Train Accident Database as of July 2014.

ICC/STB Waybill Sample. 2013 Carloads from AAR, BOE Annual Report, Ex. 9.

Hazard Recognition

Chapter I



Determine If HAZMAT is Present

- ✓ Call the railroad emergency phone number (found [here](#))
- ✓ Identify specific hazardous materials
- ✓ Find the train crew



Recognizing a HAZMAT Shipment

Placards are on both sides and both ends



Examples of crude oil placards

Emergency Response Information



A Guidebook for First Responders During the Initial Phase of a Dangerous Goods/Hazardous Materials Transportation Incident

GUIDE 128

FLAMMABLE LIQUIDS
(NON-POLAR/WATER-IMMISCIBLE)

ERG2012

POTENTIAL HAZARDS

FIRE OR EXPLOSION

- **HIGHLY FLAMMABLE:** Will be easily ignited by heat, sparks or flames.
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Those substances designated with a (P) may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.
- Substance may be transported hot.
- For UN3166, if Lithium ion batteries are involved, also consult GUIDE 147.
- **If molten aluminum is involved, refer to GUIDE 169.**

HEALTH

- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire may produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY

- **CALL EMERGENCY RESPONSE Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- As an immediate precautionary measure, isolate spill or leak area for at least 50 meters (150 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING

- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill

- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire

- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

FLAMMABLE LIQUIDS
(NON-POLAR/WATER-IMMISCIBLE)

GUIDE 128

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

CAUTION: For mixtures containing alcohol or polar solvent, alcohol-resistant foam may be more effective.

Small Fire

- Dry chemical, CO₂, water spray or regular foam.

Large Fire

- Water spray, fog or regular foam.
- **Do not use straight streams.**
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads

- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- **ALWAYS** stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK

- **ELIMINATE** all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

Large Spill

- Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID

- Move victim to fresh air.
- Call 911 or emergency medical service.
- Give artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin.
- Keep victim warm and quiet.
- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves.

Railroad Shipping Papers

Cars listed in order



```
SEQ EQUIPMT ID  KND COMDTY DESTN  ZTS/CARR  NXBLK CITY/STATE  CONSIGNEE
POWER BLOCK
BNSF004711
BLK--  IND1  TB052  INDU  115
1 BNSF 808331 LC4T INDSND TB052  05-840-55      STJAMES  LA ST JAM RAI
106 FROM HEAD 60-MPH 117-TONS  58-FT  1-P      1.00-BRK  117-ATONS
58-AFT
2 CBTX 743322 LT32 CRDOIL TB052  05-840-55      STJAMES  LA ST JAM RAI
105 FROM HEAD 60-MPH 139-TONS  60-FT  1-P      1.00-BRK  394-ATONS
118-AFT
*****
* DANGEROUS *
*****
EMERGENCY CONTACT:
8004249300
1/TC, 201630/LB
UN1267
PETROLEUM CRUDE OIL
3
PG I
TN=(PETROLEUM CRUDE OIL)
SHIPPER CONTACT
CHEMTREC (CCN 681568)
HAZMAT STCC = 4910165
SI11/12 RESTRICTION 143 TONS
3 CBTX 742845 LT32 CRDOIL TB052  05-840-55      STJAMES  LA ST JAM RAI
104 FROM HEAD 60-MPH 138-TONS  60-FT  1-P      1.00-BRK  394-ATONS
178-AFT
*****
* DANGEROUS *
*****
EMERGENCY CONTACT:
8004249300
1/TC, 200619/LB
UN1267
PETROLEUM CRUDE OIL
3
PG I
TN=(PETROLEUM CRUDE OIL)
SHIPPER CONTACT
CHEMTREC (CCN 681568)
HAZMAT STCC = 4910165
SI11/12 RESTRICTION 143 TONS
4 CBTX 743319 LT32 CRDOIL TB052  05-840-55      STJAMES  LA ST JAM RAI
103 FROM HEAD 60-MPH 138-TONS  60-FT  1-P      1.00-BRK  532-ATONS
238-AFT
*****
* DANGEROUS *
*****
EMERGENCY CONTACT:
8004249300
1/TC, 201018/LB
UN1267
PETROLEUM CRUDE OIL
3
PG I
TN=(PETROLEUM CRUDE OIL)
SHIPPER CONTACT
CHEMTREC (CCN 681568)
HAZMAT STCC = 4910165
```

Box of asterisk identifies HAZMAT car

DOT Proper Shipping Name (PSN) and information

24-Hr emergency contact number for shipper

Verifying Information



020	CBTX 743308	L	T32	CRDOIL	TB052	05-840-05	STJAMES, LA	ST JAM RAI	60	138 T	60 ft
	87 FROM HEAD		Platforms:	1	Brakes:	1.0				2,719 T	1,198 ft
*****		* DANGEROUS *		1/TC, 201071/LB							
*****				UN1267							
EMERGENCY CONTACT:				PETROLEUM CRUDE OIL							
8004249300				3							
				PG I							
				TN=(PETROLEUM CRUDE OIL)							
				SHIPPER CONTACT							
				CHEMTREC (CCN 681568)							
				HAZMAT STCC = 4910165							

Example Emergency Response Information

PETROLEUM CRUDE OIL
CLASS 3 (FLAMMABLE LIQUID)

4910165
UN1267

PETROLEUM CRUDE OIL IS A DARK VISCOUS LIQUID. IT HAS A FLASH POINT OF LESS THAN 141 DEG. F. IT IS LIGHTER THAN WATER AND INSOLUBLE IN WATER. ITS VAPORS ARE HEAVIER THAN AIR.

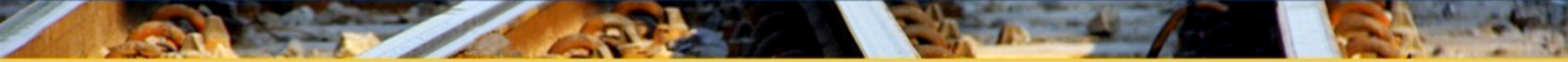
IF MATERIAL ON FIRE OR INVOLVED IN FIRE
DO NOT EXTINGUISH FIRE UNLESS FLOW CAN BE STOPPED
USE WATER IN FLOODING QUANTITIES AS FOG
SOLID STREAMS OF WATER MAY SPREAD FIRE
COOL ALL AFFECTED CONTAINERS WITH FLOODING QUANTITIES OF WATER
APPLY WATER FROM AS FAR A DISTANCE AS POSSIBLE
USE FOAM, DRY CHEMICAL, OR CARBON DIOXIDE

IF MATERIAL NOT ON FIRE OR NOT INVOLVED IN FIRE
KEEP SPARKS, FLAMES, AND OTHER SOURCES OF IGNITION AWAY
KEEP MATERIAL OUT OF WATER SOURCES AND SEWERS
BUILD DIKES TO CONTAIN FLOW AS NECESSARY
ATTEMPT TO STOP LEAK IF WITHOUT UNDUE PERSONNEL HAZARD
USE WATER SPRAY TO KNOCK-DOWN VAPORS

PERSONNEL PROTECTION
AVOID BREATHING VAPORS
KEEP UPWIND
WEAR APPROPRIATE CHEMICAL PROTECTIVE GLOVES, BOOTS AND GOGGLES
DO NOT HANDLE BROKEN PACKAGES UNLESS WEARING
APPROPRIATE PERSONAL PROTECTIVE EQUIPMENT



Types and Properties of Crude Oil



Chapter II



Comparison of Common Flammables

Packing Group (PG) and Key Physical Properties of Common Flammable Materials

	PG I Crude Oil*	PG II Crude Oil*	PG III Crude Oil*	Ethanol (PG II)	Gasoline (PG I or II)	Diesel (PG III)	LPG (Propane)
Boiling Point	<95 °F	>95 °F	>95 °F	174 °F	90 to 110 °F	300 °F	- 43 °F
Flashpoint	<73 °F	<73 °F	>73 to <140 °F	55 °F	-36 to -50 °F	125 °F	- 156 °F

*No two shipments (even from same well head or mine) will have the exact same chemical and physical composition, flashpoints/boiling points and Packing Groups will vary.

Crude Oil Hazards

Crude oil is not a refined product but consists of many constituent products.

Primary concerns

- Flammability
- Volatility – similar to gasoline – confined space hazard
- Hydrogen sulfide – headspace as well as open air
- Benzene

Secondary concerns

- May contain known or suspected carcinogens

Combustion byproducts

- Oxides of carbon, nitrogen, and sulfur
- Various organics – aldehydes, aromatics
- Particulate matter/soot, polycyclic aromatic hydrocarbons

Liquid Viscosity

Viscosity is a measure of how easily a substance flows.

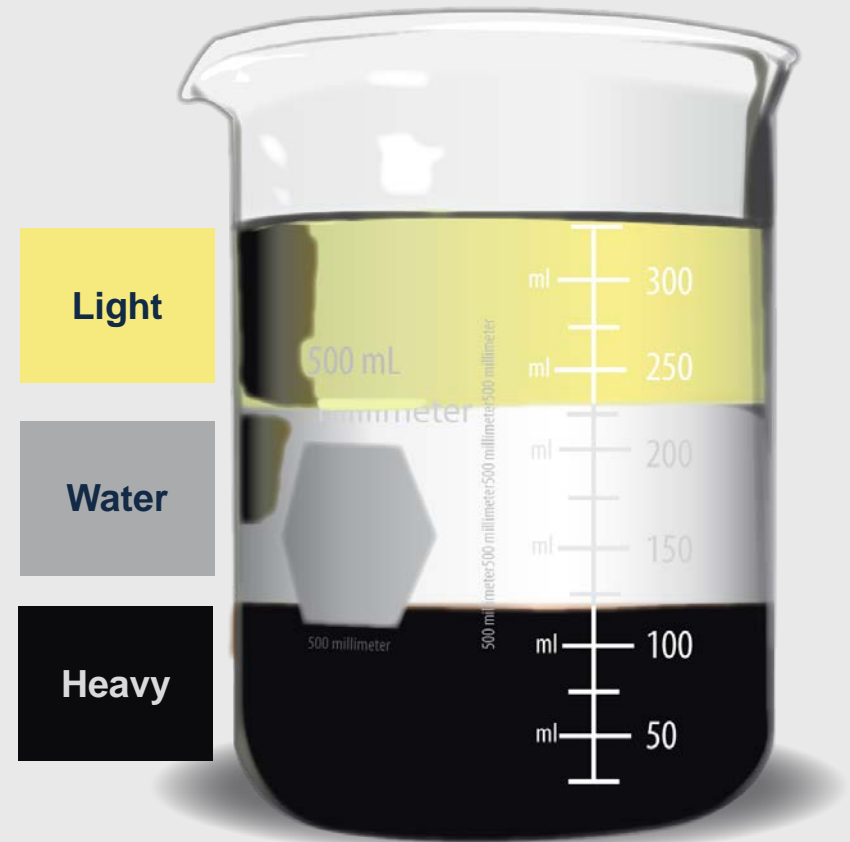
Liquid @ 68° F	Viscosity (cP)
Water	1
Crude Oil (sg=0.855)	7.5
Olive Oil	84
Light Machine Oil	102
Pancake Syrup	2,500
Ketchup	50,000
Peanut Butter	250,000
Tar or Pitch	30,000,000,000

Sources: http://www.eng.fsu.edu/~schreiber/uol/exp120/viscosity/viscosity_of_common_materials.htm,
http://www.roytech.co.uk/Related/Fluids/Fluids_Viscosities.html

Classification by Specific Gravity

“Weight” or Specific Gravity

- Lighter crudes
 - Lower density
 - Low viscosity
- Heavier crudes
 - Higher density
 - Higher viscosity



Crude Oil Tank Cars

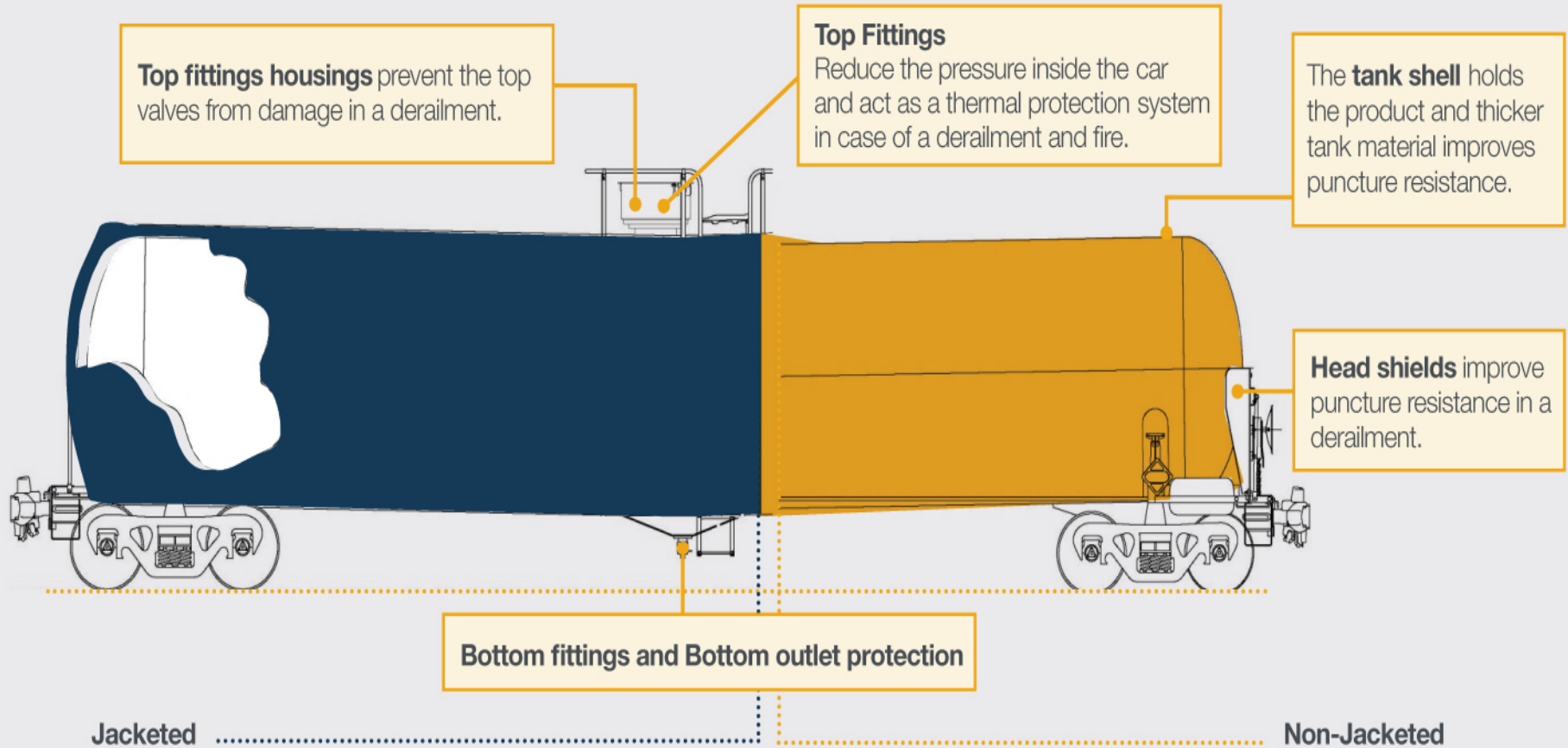
Chapter III



Non-Pressure Tank Cars



Key Components of a Tank Car



Considerations for Fire Response

Chapter IV- Site Assessment



PPE Considerations

Respiratory protection

- **Skin protection**

- Flammability is the major influencer of PPE selection
- If the potential for flammability exists, PPE choices are limited
- No flammability – many more options

- **Eye protection**

- Splash protection
 - ✓ Glasses, goggles, or face shield depending on the job task

- **Guidance for PPE**

- Response to these incidents can be found in the NFPA standards, OSHA regulations, and the AHJ SOP/SOG



Air Monitoring During a Crude Oil Incident



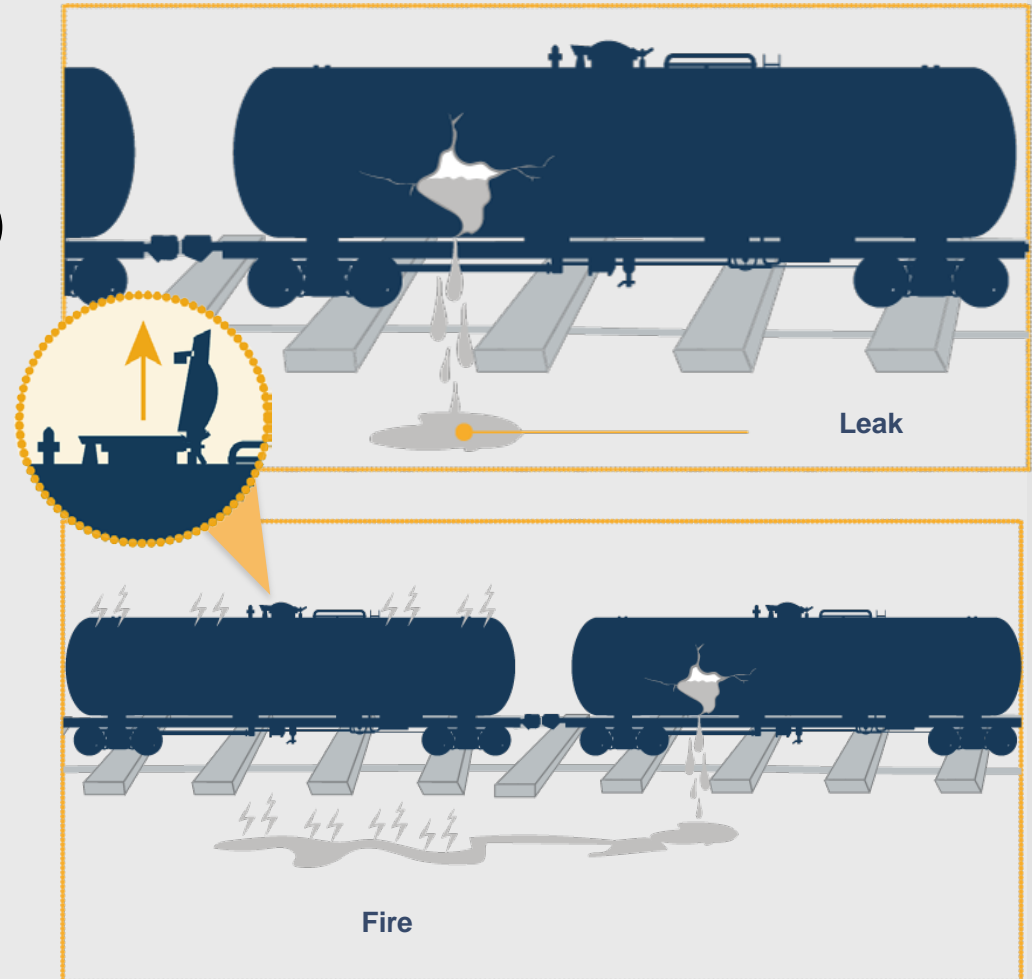
Provide air monitoring in the community and work areas surrounding the crude oil release.

■ **Reasons for air monitoring:**

- Worker safety
- Safety of the community near the incident
- Assessment of potential problems
- PPE selection
- Compliance with regulatory standards and guidelines

Fire Assessment-Crude Rail Cars

- **Spill fires**
running and pooled
- **Fire impinging on car(s)**
- **Pressure fire**
three dimensional fire
- **Fire/product release**
from pressure relief devices
- **Breached car**
with crude inside of car on fire
- **Fire duration**



Potential Rail Car Failure



**Heat
Induced
Tears**

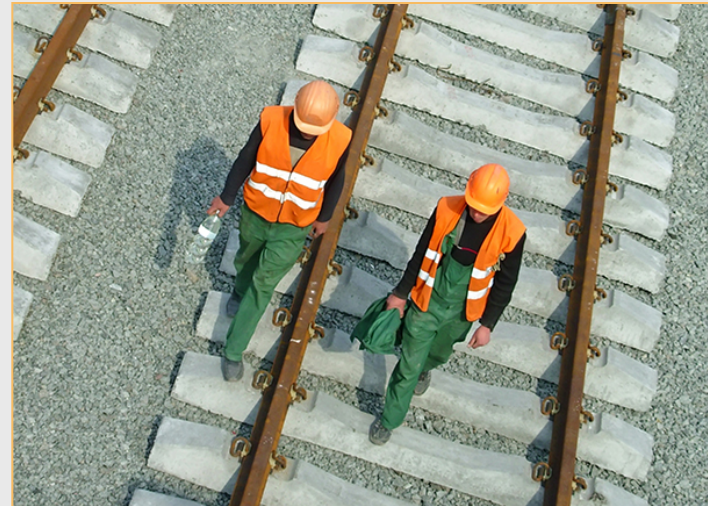
DOT 111 tank cars involved with intense pool fires or torch fires are subject to immediate failure.

Site Assessment

Evaluate the risk vs. benefits and the capability to intercede prior to engagement.

■ **Potential hazards:**

- Rail car failure
- Respiratory hazards
- Physical site hazards
- Potential for boil over
- Slop over/froth over
- Fire type



This information is also detailed in the ERG, see slide 13

Strategic Objectives

■ RECEOS

- Rescue
- Exposures
- Confine/Contain
- Extinguish
- Overhaul
- Salvage

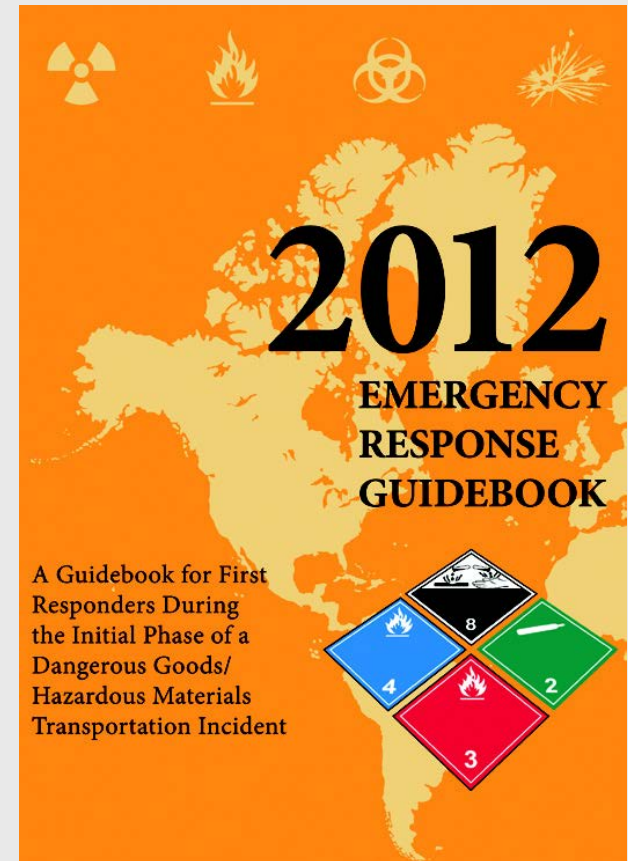


Rescue/Life Safety

Protective Actions:

2012 DOT Emergency Response Guidebook

“If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.”





Considerations for Fire Response



Chapter V – Response Operations

- ◆ Defensive Operations
- ◆ Offensive Operations

- ◆ Non-intervention

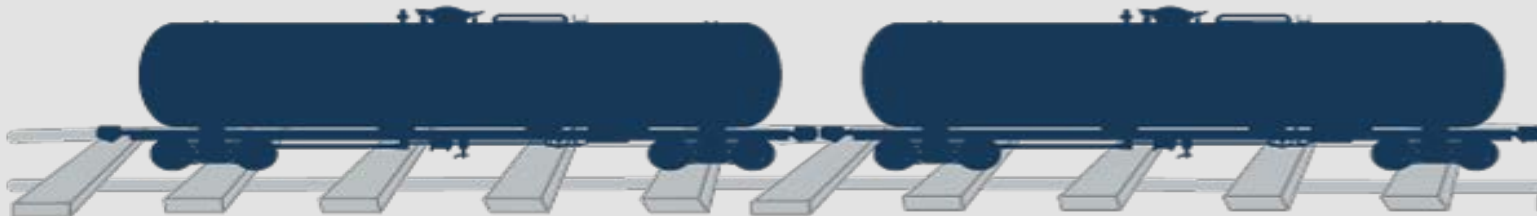


Fire Response – Extinguish

◆ Defensive Operations Considerations

■ Cooling Tank Cars

- Is cooling from a distance beneficial?
- Are all exposures outside the exclusion zone?
- Can an adequate water supply be maintained?
- Can the fire water runoff, if used, be contained or diverted to minimize impact to the environment?





Defensive Operations – Concerns



Cooling crude oil rail cars adjacent to the fire can decrease the possibility of car failure such as a heat induced tear.

- **Cooling water should be directed:**
 - At the point of flame impingement first
 - On the vapor space of tank cars adjacent to the fire exposure from radiant heat

- **For extended operations** (long burn times) or when the ability to reach needed areas of the car(s) is limited, remote unstaffed monitors should be considered

Defensive Operations – Concerns

Cool Adjacent Cars

- **DO NOT** spray cooling water directly into a crude oil tank car if breached. This could lead to a slop over/froth over or long term, potentially, a boil over
- **Continuously evaluate** the effect cooling
 - Effective cooling is when water is flowing down the sides of the car without evaporating
 - Lack of effective cooling may result in rising pressure within the tank (increasing sounds may be noted)

Fire Response— Contain/Confine

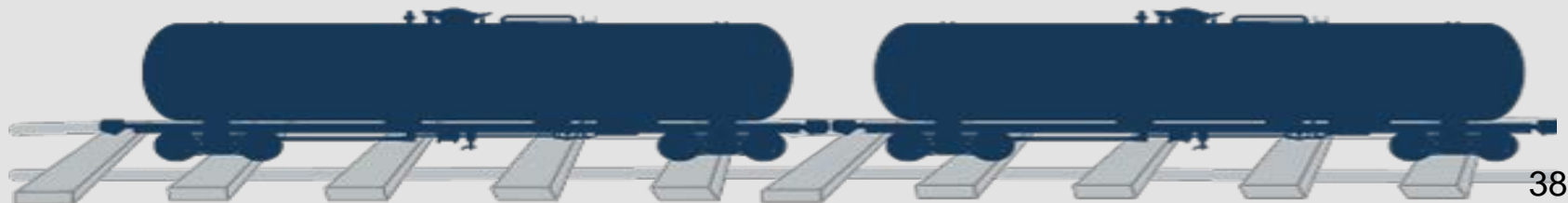
Cool Run-Off

- **Evaluate potential** down stream impacts of crude oil on fresh water intakes, sewers, and water bodies
- If **burning** crude oil enters a storm sewer
 - Consider the use of fire fighting foam to extinguish (ref. **NFPA 11**)
- If **non-burning** crude oil enters a storm sewer
 - Conduct air monitoring to determine the quantity of flammable vapors and **H₂S**
 - Evaluate the use of foam in the sewer to reduce flammability

Fire Response – Extinguish

◆ For Offensive Operations

- **Class B foams** are recommended in NFPA 11 as the extinguishing agent of choice on crude oil spill/pool fires (NFPA 11 is the standard for foam application).
- **Dry chemical** is an effective extinguishing agent for crude oil fires.
- **Railroad track structure**, tank car position, and other obstructions as well as weather conditions can impact foam effectiveness.





Fire Response – Extinguish



Additional Key Considerations for Offensive Operations

- Do you have the necessary amount of adequately trained and protected responders available?
- Do you have clarity on the type of fire – spill/pool vs. three dimensional?
- Do you have enough of the correct extinguishing agent, equipment, and trained personnel?
 - Foam concentrate
 - Dry chemical
- Can you maintain a post suppression foam blanket to prevent re-ignition?
- Do you have a large enough sustainable water supply?

Fire Response – Overhaul

- **Monitoring for Flammable Vapors**
 - Once the fire is extinguished, monitoring for flammable vapors, which can cause re-ignition, and toxic atmospheres should be conducted even with a foam blanket.
- **Reapplication of Foam**
 - Reapplication of foam may be necessary for an extended time during remediation.
- **Foam-blanketed Area**
 - NFPA 11 recommends responders not enter a foam-blanketed area, disturbing the intact blanket, unless absolutely necessary. If this is necessary, foam lines should be actively utilized to maintain a robust foam blanket.

Considerations for Oil Spill Response

Chapter VI



Guiding Principles for Oil Spill Preparedness and Response

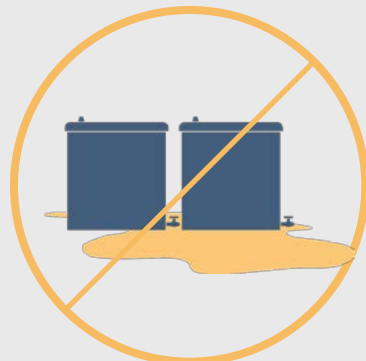
Industry follows a set of guiding principles that allows the response community to achieve a rapid, well-managed, and unified response effort:

Protect the safety & health of people

Stop the source of a spill as quickly as possible

Minimize environmental & community impact

Minimize oil getting into water in onshore scenarios



ONSHORE



Oil Spill – Basic Info

- What type of oil was spilled?
- Where was it spilled?
- Where is it going?
- What will it impact?
- When will it impact?
- What should be done about it?
- How much was spilled?



Tactics and Strategies

Secure the perimeter

- Eliminate ignition sources
- Establish air monitoring

Stop the source of a spill as quickly as possible

- Close valves, plug holes

Minimize environmental and community impact by limiting the amount and the spread of oil that has spilled

- Berms, trenches etc.

Minimize oil getting into the water

- Damming, diking, diverting, or retention

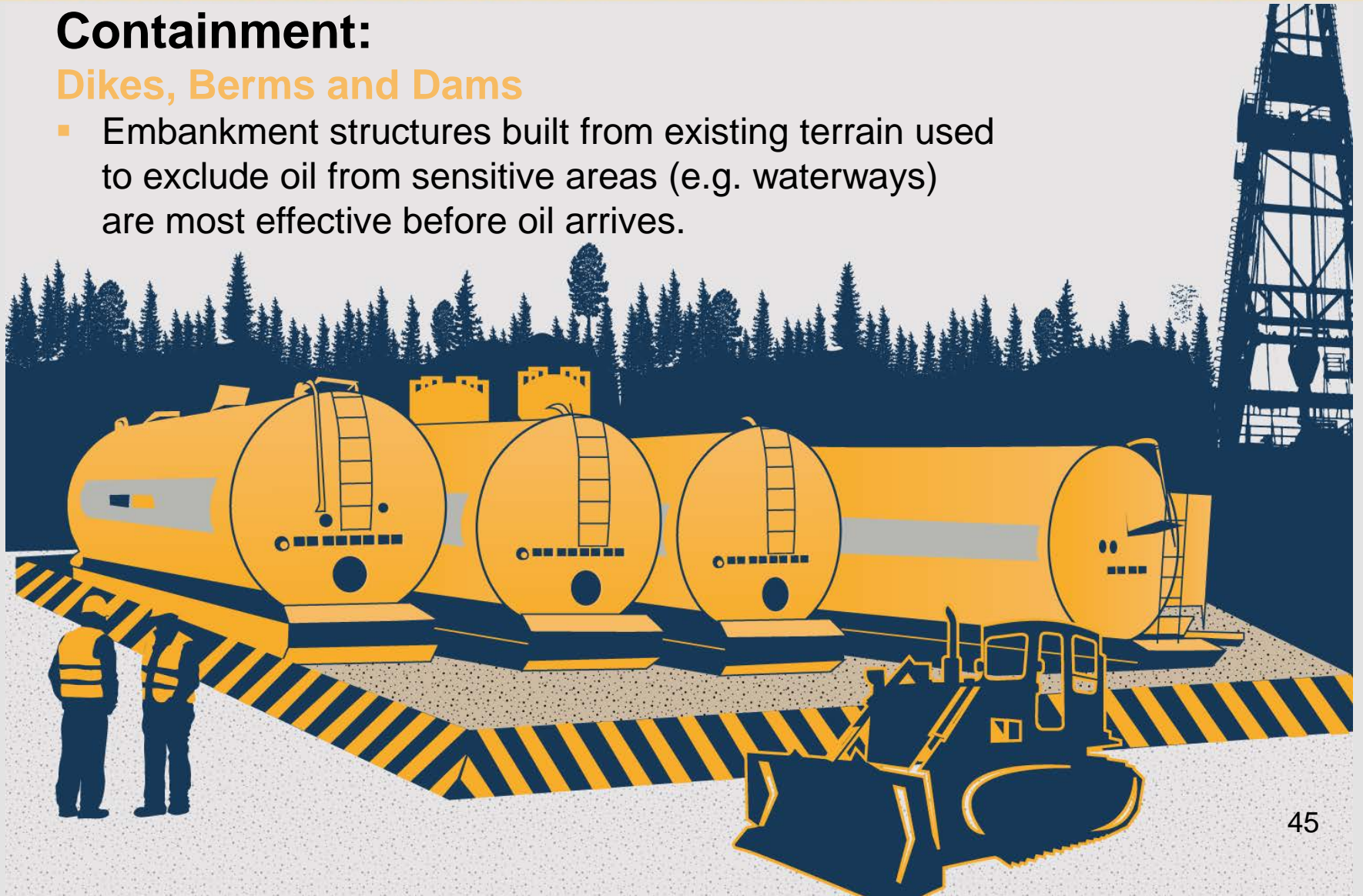
Minimize the spread of oil

Oil Spill on Land

Containment:

Dikes, Berms and Dams

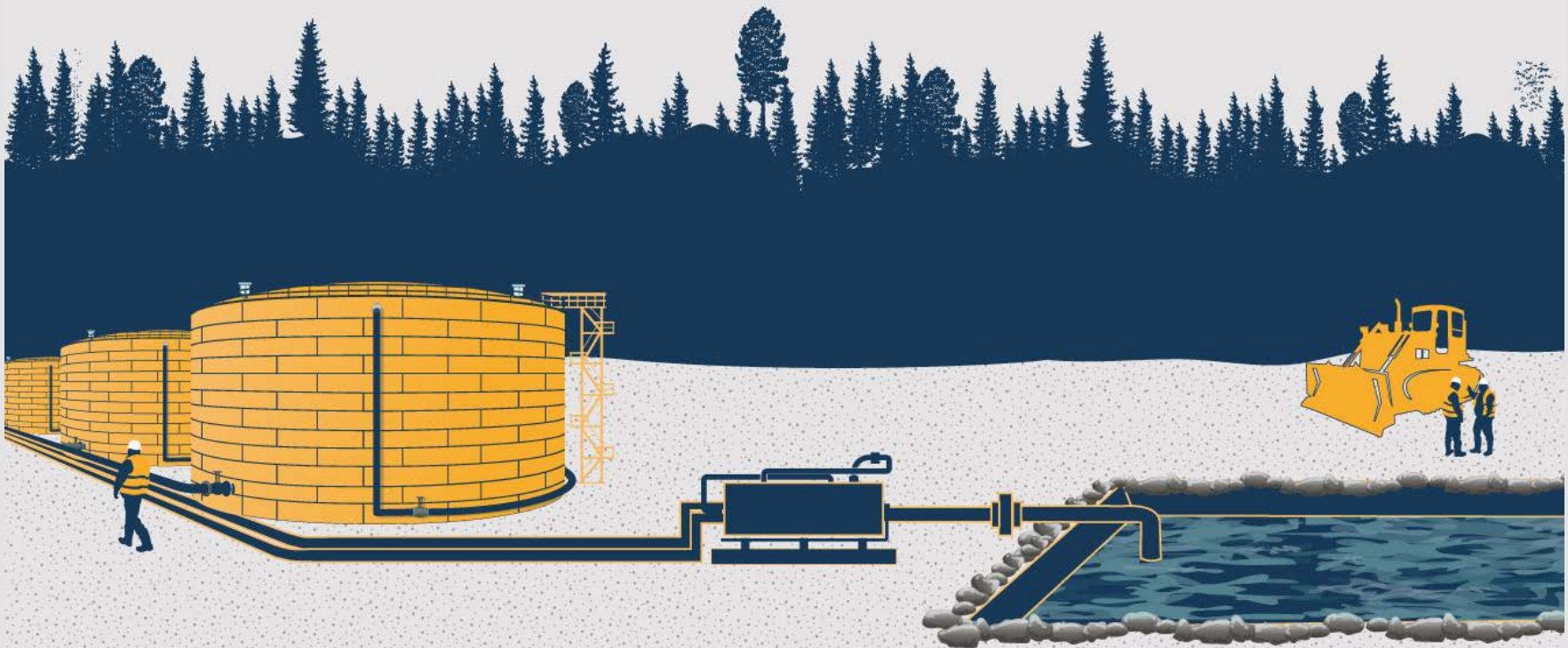
- Embankment structures built from existing terrain used to exclude oil from sensitive areas (e.g. waterways) are most effective before oil arrives.



Oil Spill on Land

Containment: Trenches and Pits

- Constructed with earth moving equipment to collect free flowing product on land



Oil Spill to Water – Booming



Booming is used to contain product or protect sensitive areas, under certain environmental and operational conditions, with four basic strategies:

- ***Containment Booming*** – Booming strategy used in little or no current to isolate a spill, control spreading, concentrate the oil, and to facilitate its recovery.
- ***Exclusion Booming*** – Strategy used to exclude slicks from sensitive shorelines and/or amenities. With the addition of sorbent material, booms can also be used to collect oil.
- ***Diversion Booming*** – One or more boom strings can be positioned to divert a slick to a shoreline area that's suitable for recovery.
- ***Deflection Booming*** – Boom is deployed at an angle to a drifting slick to deflect oil away from sensitive areas or to a collection point.

Incident Command

Chapter VII



Preparing for Response

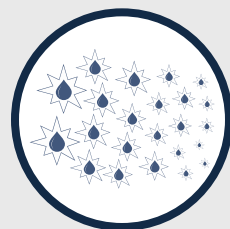
A detailed contingency planning and preparedness process is made up of the following core components:

The preparedness process allows for potential scenarios, enabling a rapid and effective response in the event of an incident.

Preparedness



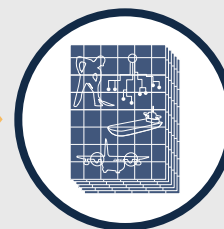
Perform Training and Exercises



Identify Potential Events



Plan Scenarios



Develop Response Strategies



Provision Resources

Stakeholder Engagement with Governments, Communities, and Industry

Working with the Railroads – ICS Integration

Railroad emergency responders are trained in and prepared to operate using NIMS/ICS.

- In the Unified Command, the senior transportation officer or designee will act as the lead railroad official with the lead agency Incident Commander.



ICS and Rail Personnel

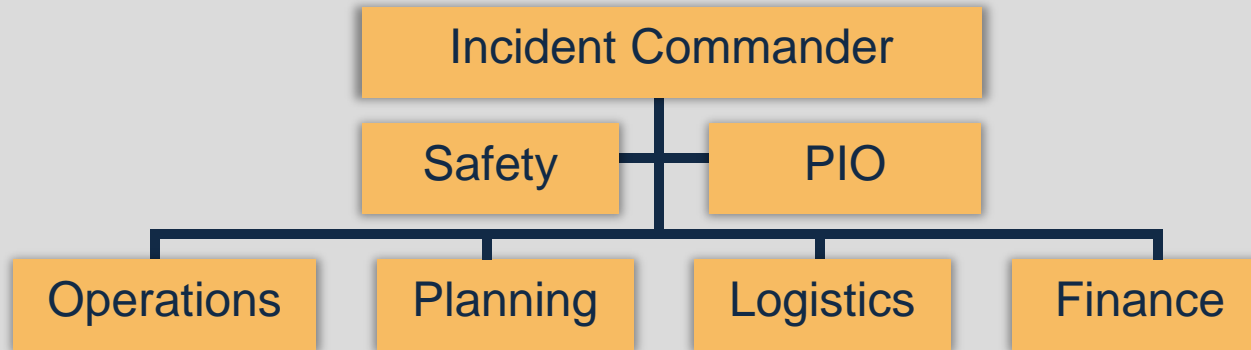
Railroad ICS

The four major organizational components one encounters in a typical railroad ICS structure are:

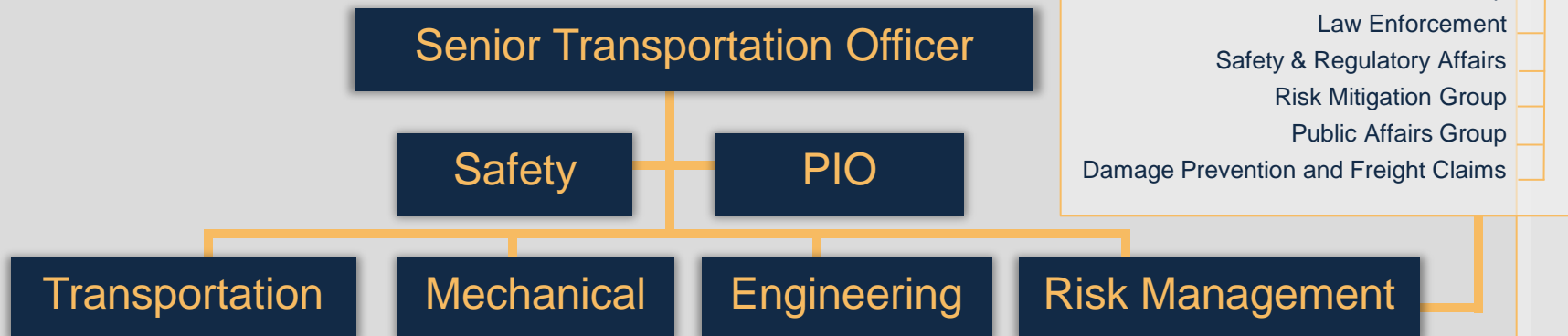
- Transportation – monitors the network, routes traffic and schedules trains and crews
- Mechanical – in charge of all rolling stock (railcars) and locomotives
- Engineering – in charge of all infrastructure including, track, signals, bridges, tunnels, etc.
- Safety or Risk Management – contains emergency response functions such as police, HAZMAT, Environment, Public Affairs, Claims, etc.

Incident Command System

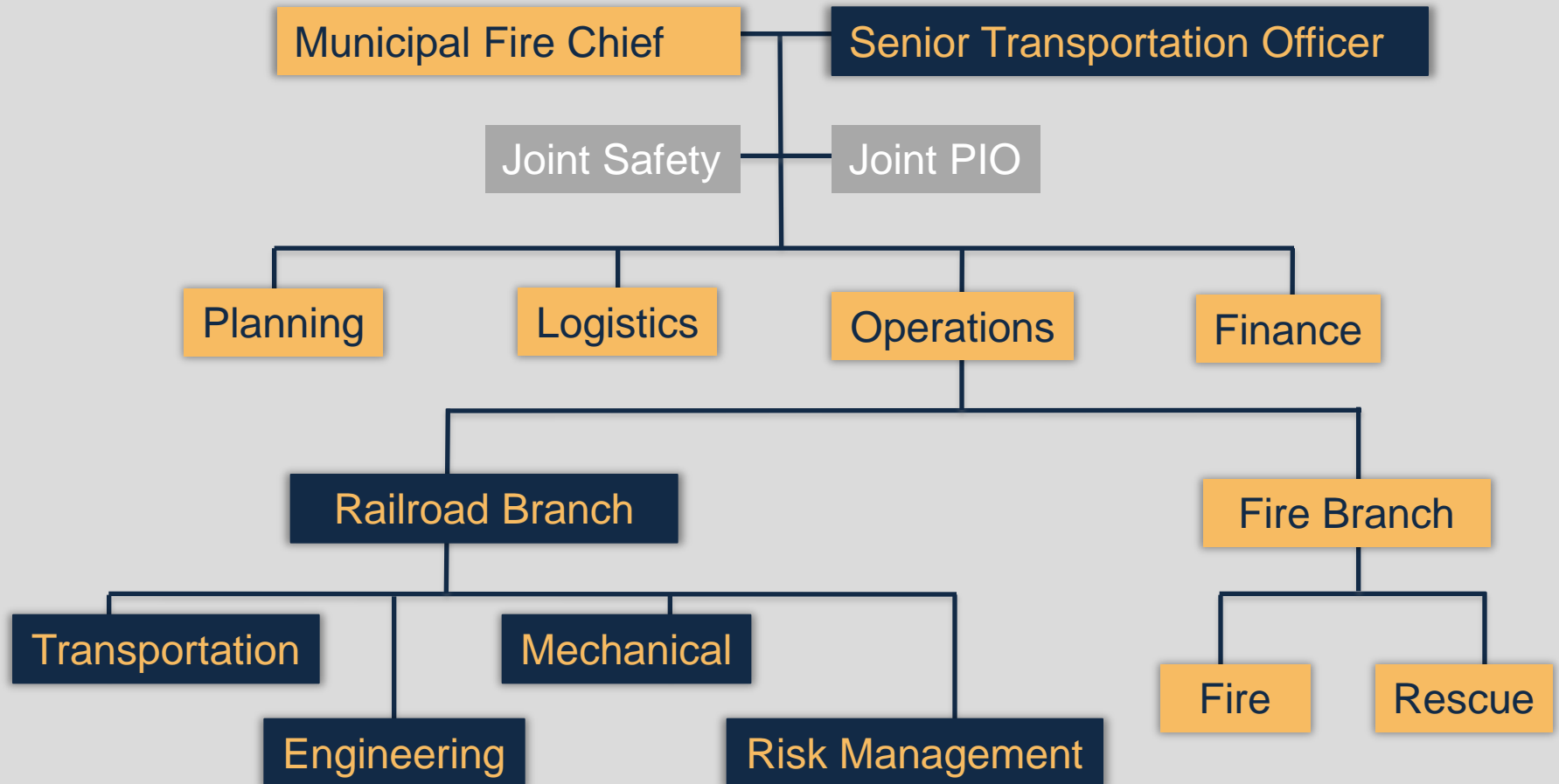
Public Safety ICS



Railroad Incident Management



Unified Command



In Summary

Chapter VIII

- ✓ Protect the public
- ✓ Contact the railroad
- ✓ Secure the scene
- ✓ Assess the hazards
- ✓ Respond accordingly
- ✓ Coordinate response actions with the railroad

Resources

- Emergency Response Guidebook
 - http://phmsa.dot.gov/pv_obj_cache/pv_obj_id_7410989F4294AE44A2EBF6A80ADB640BCA8E4200/filename/ERG2012.pdf
- National Incident Management System (NIMS)
 - <http://www.fema.gov/national-incident-management-system>
- CHEMTREC®
 - <http://www.chemtrec.com/>
- TRANSCAER®
 - <http://www.transcaer.com/>
- NFPA 472 - Standard For Competence Of Responders To Hazardous Materials/Weapons Of Mass Destruction Incidents
 - <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=472>
- NFPA 11 – Standard for low-, medium-, and high-expansion foam
 - <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=11>
- NFPA 1851 - Standard on Selection, Care, and Maintenance of Protective Ensembles for Structural Fire Fighting and Proximity Fire Fighting
 - <http://www.nfpa.org/codes-and-standards/document-information-pages?mode=code&code=1851>
- OSHA 29 CFR 1910.120-Hazardous waste operations and emergency response
 - https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9765