



Why is API 653 Relevant to AP5A?

Andrew Yearwood, PEMY Consulting, LLC.

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API 653 v STI SP001

- API 653: Any container that is not shop built.
- API 653: Can be used for shop built tanks.
- Any tank that is large (focus today)

Overview

- Some history
- Tank basics
- Managing tank inspections
- Conclusions

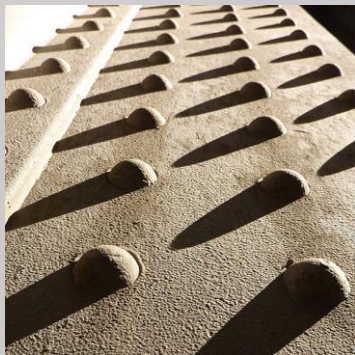
History of oil storage rules

- Rules? What rules?
- 1973 the Oil Pollution regulation set requirements for prevention, preparedness and response to oil spills
- In 1988 EPA formed SPCC Task Force
- 1991 API Publishes API Standard 653
- RAGAGEP/Litigation tend to regulate corporate behavior

Tanks of yore



Rivets of yore

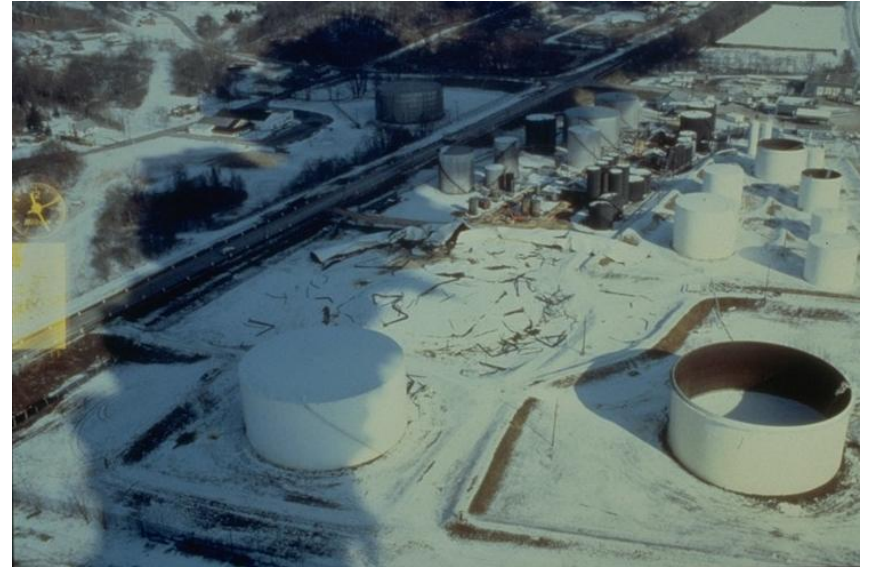


Welded tanks today



A Defining Moment for Tanks

- January 2, 1988
- Recently reconstructed tank was filled completely with diesel. 4M gallons.
- Extreme cold, -12F
- Sudden catastrophic failure of the tank – Brittle Fracture
- All contents released, spilled over dike, and into Monongahela River then to Ohio River.









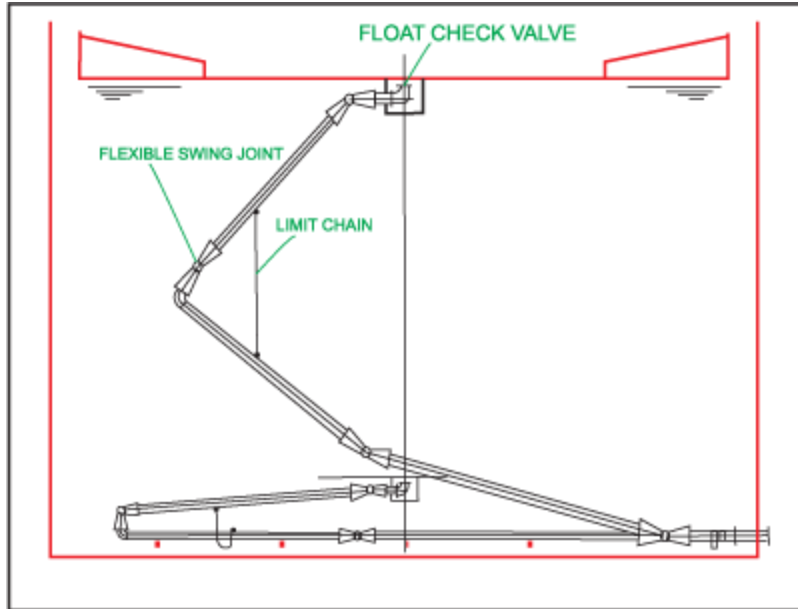
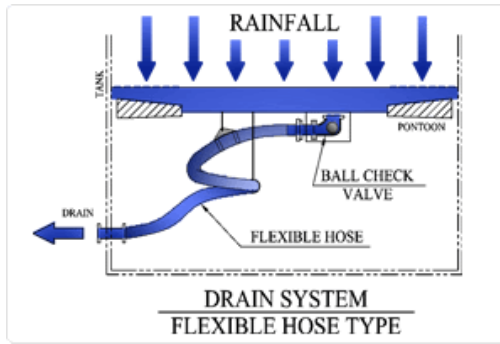
1/2 to 1 million gallons spilled into river. \$2M fine.

A bad day in Martinez

- Martinez Shell Refinery April 23, 1988
- A hose failed
- Tank drain valve opened
- Secondary containment valve opened
- 100-acre marsh covered and oil flowed in and out to the Carquinez Strait downstream into San Pablo Bay.
- 400,000 gallons of heavy crude oil had leaked out into the environment before being noticed from 12.5M gal tank
- This was one important driver for SCPP







The “Molassacre” of 1919



Order your Used Car, Tire, Truck and Accessory advts for next Sunday's Globe today. Make sure of your copy of the Sunday Globe by ordering it regularly from your dealer.

MOLASSES TANK EXPLOSION INJURES 50 AND KILLS 11

SCENE OF RUIN AND DESOLATION IN NORTH END AFTER DESTRUCTION OF PURITY DISTILLING COMPANY TANK AND NEARBY STRUCTURES



GENERAL VIEW OF THE EXPLOSION, LOOKING NORTH ACROSS NORTH END PARK. THE CROSS WITHIN THE CIRCLE MARKS THE LOCATION OF GREAT MOLASSES TANK WHICH EXPLODED.

Death and Devastation In Wake of North End Disaster

Buildings Demolished, Sticky Mass Floods Streets— Loss \$500,000

Red Cross Women, Firemen and Sailors Do Heroic Work In Aiding Victims

A sea of more than 1,500,000 gallons of molasses, freed by the sudden explosion and collapse of a giant iron tank, sent a tidal wave of death and destruction stalking through North End Park and Commercial at shortly after noon yesterday.

LIST OF DEAD

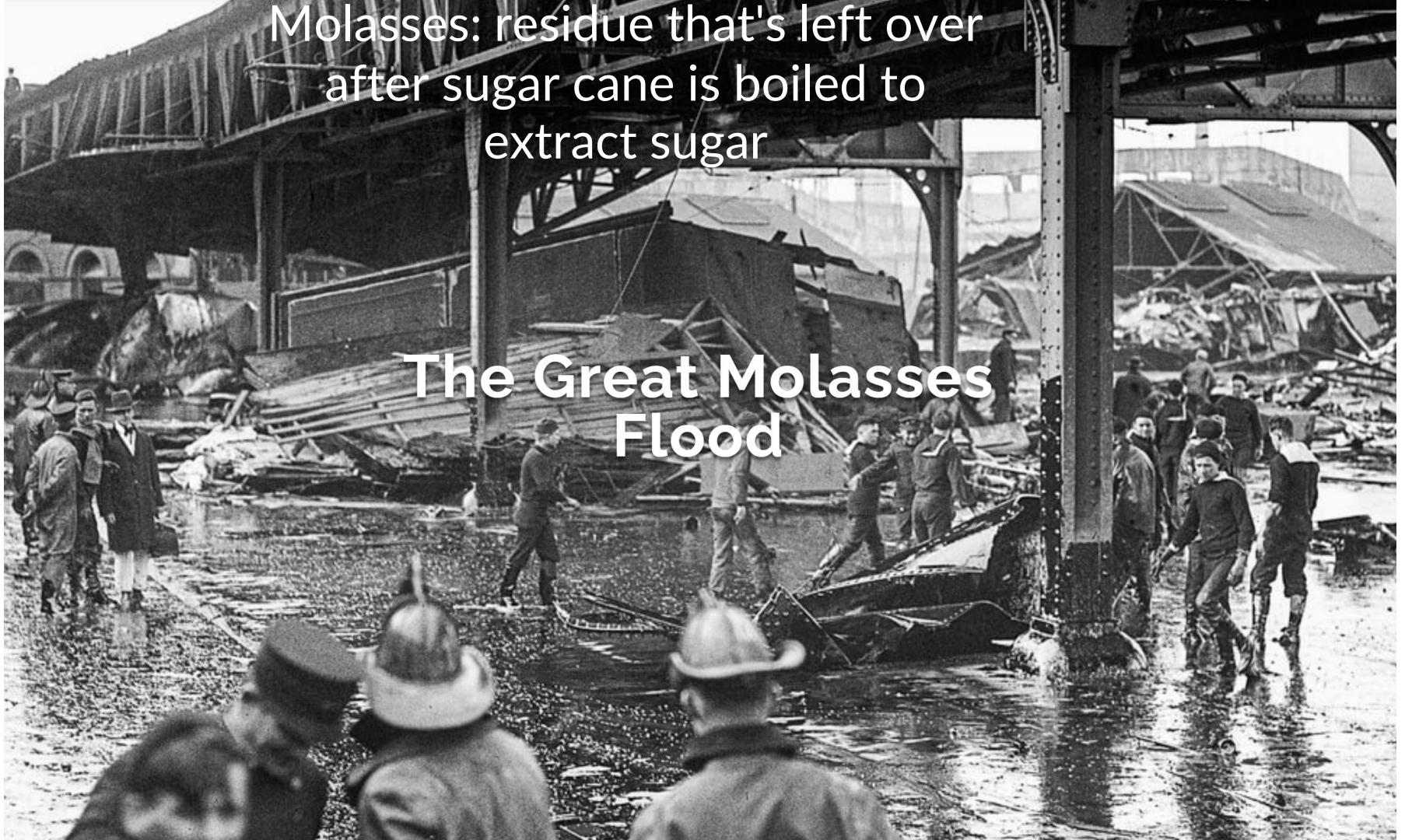
DEAD AT NORTH GROVE STREET MORGUE—

Mrs. Bridget Clougherty, 6 Coppas Hill terrace, identified by her son.

Casualty lists furnished by the

Molasses: residue that's left over
after sugar cane is boiled to
extract sugar

The Great Molasses Flood





15 Jan 1919
2 million gallons
released
40 foot wave
21 fatalities
150 injuries
Significance:
Impacts the
beginnings of
regulations on
industry
activities which
can pose risk to
the public.

Exxon Valdez

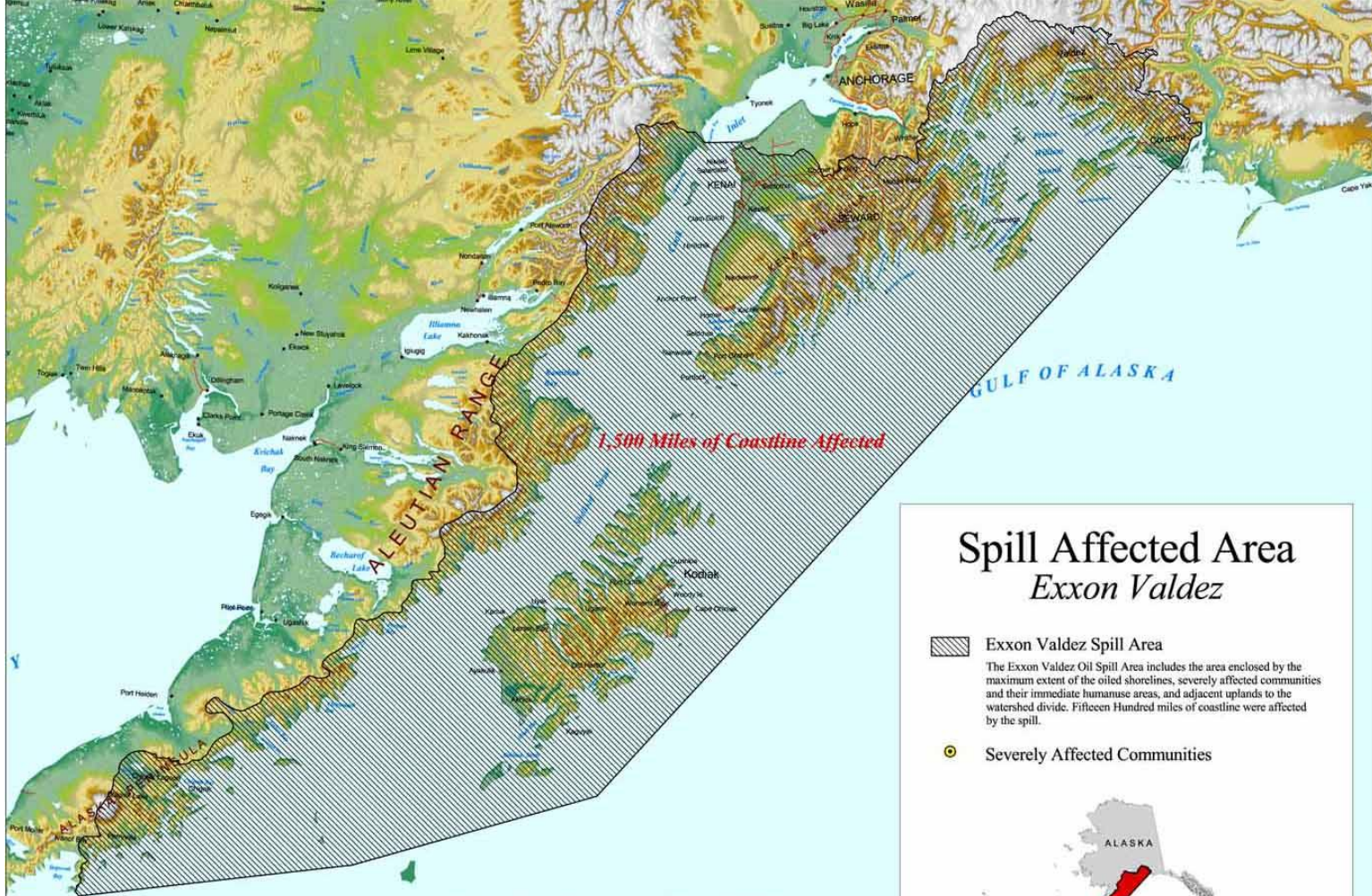
987 ft x 166 ft x 88 ft





1989
11 M gallons






Spill Affected Area *Exxon Valdez*

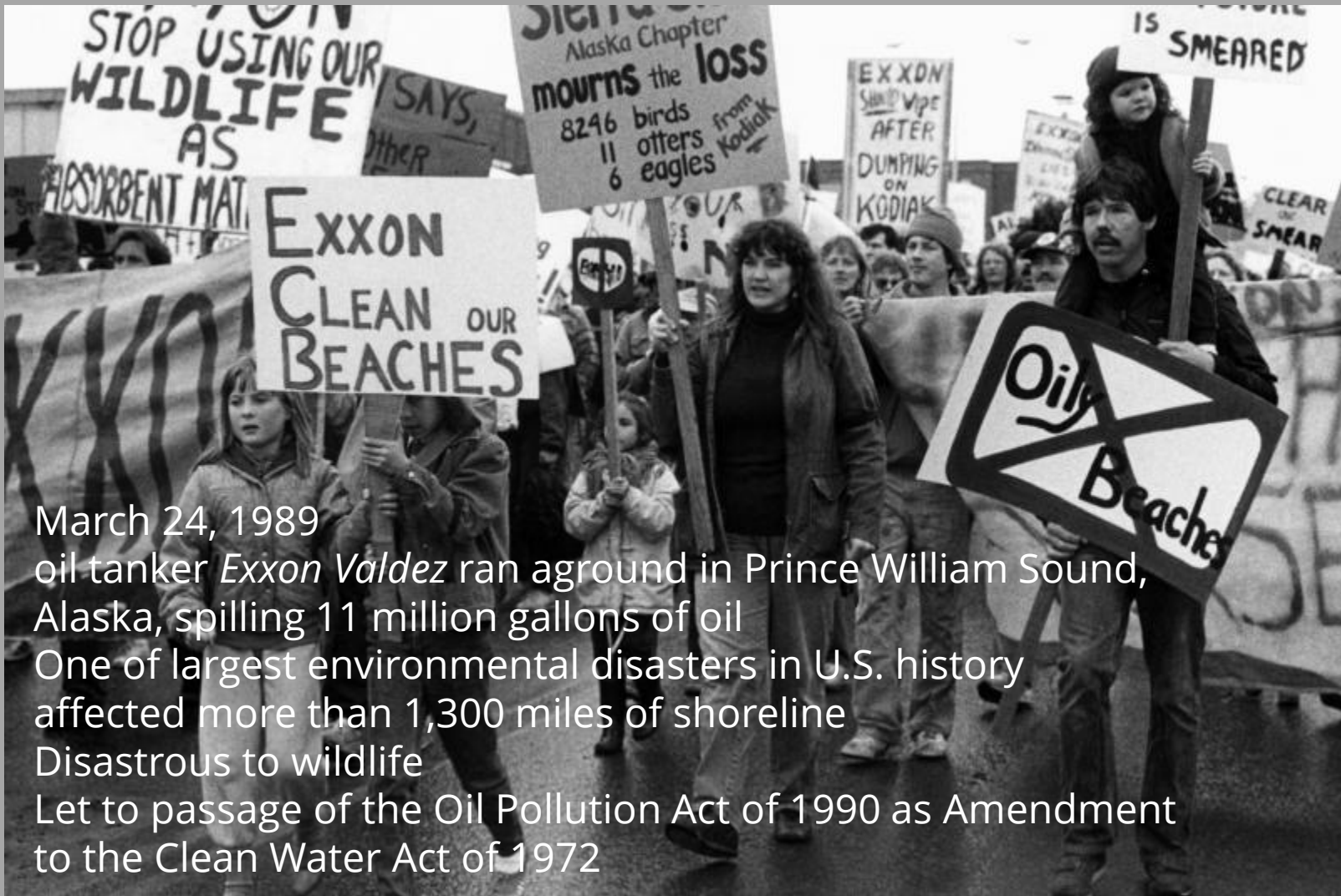
 Exxon Valdez Spill Area

The Exxon Valdez Oil Spill Area includes the area enclosed by the maximum extent of the oiled shorelines, severely affected communities and their immediate humanuse areas, and adjacent uplands to the watershed divide. Fifteen Hundred miles of coastline were affected by the spill.

 Severely Affected Communities



25 0 25 50 75 100 Miles



March 24, 1989
oil tanker *Exxon Valdez* ran aground in Prince William Sound,
Alaska, spilling 11 million gallons of oil
One of largest environmental disasters in U.S. history
affected more than 1,300 miles of shoreline
Disastrous to wildlife
Led to passage of the Oil Pollution Act of 1990 as Amendment
to the Clean Water Act of 1972

Freedom Chemical Incident

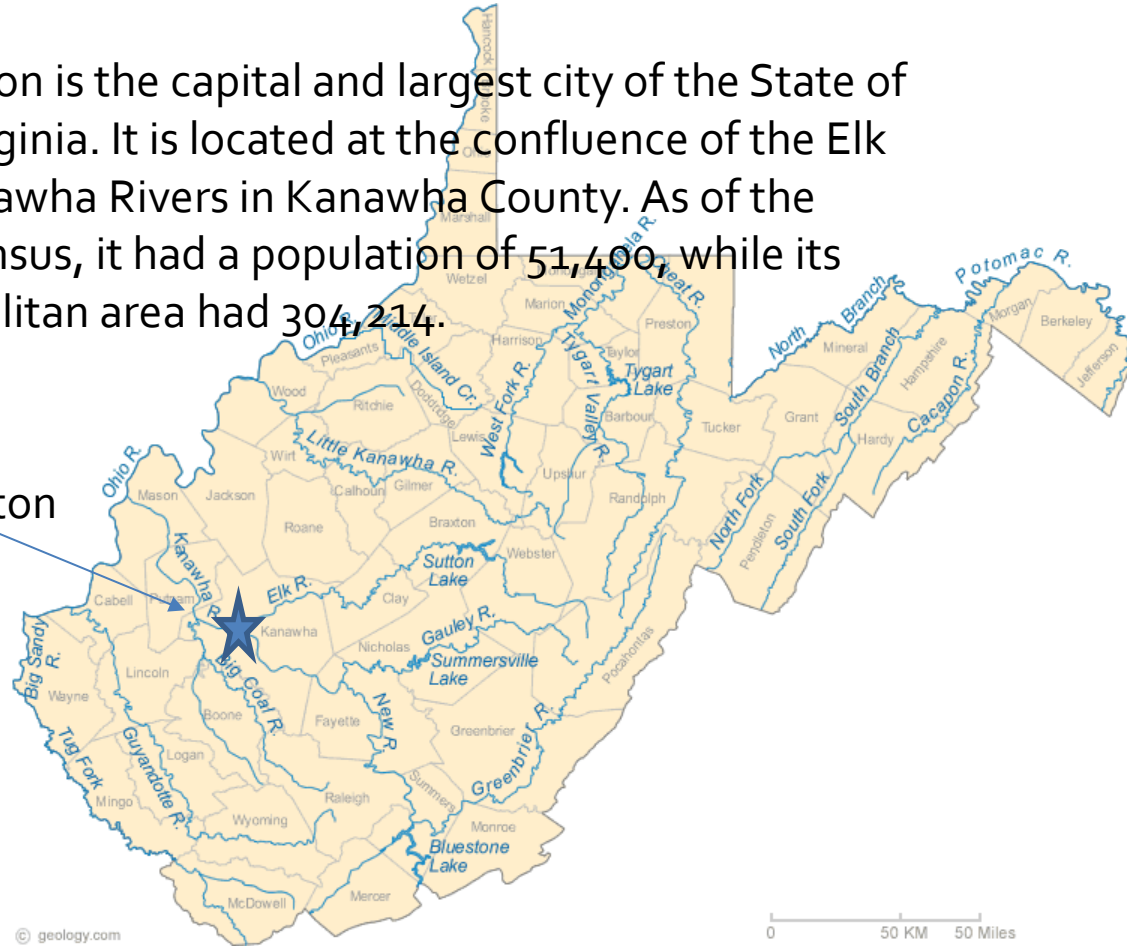


Goals and Concepts Related to this Safety Moment:

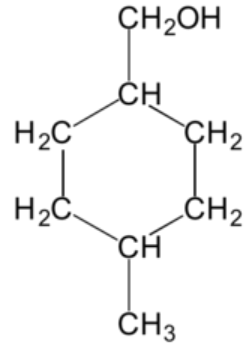
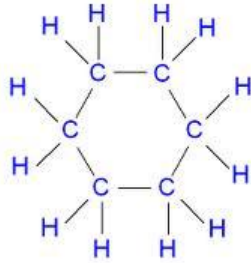
- Illustrate what can happen in a tank incident
- What is API 653
- GIS applicability
- What is secondary containment
- Some terminology: Fixed roof, center column and rafters
- Bottom hole leak rate
- Management systems
- Why you don't always need 20/20 hind sight
- Idea of risk and evolving risk: initiating event, receptors, consequences and impacts

Charleston is the capital and largest city of the State of West Virginia. It is located at the confluence of the Elk and Kanawha Rivers in Kanawha County. As of the 2010 Census, it had a population of 51,400, while its metropolitan area had 304,214.

Charleston



Cyclohexane, Cyclooctane Methylcyclohexanemethanol (mchm)



API 653 Inspections?

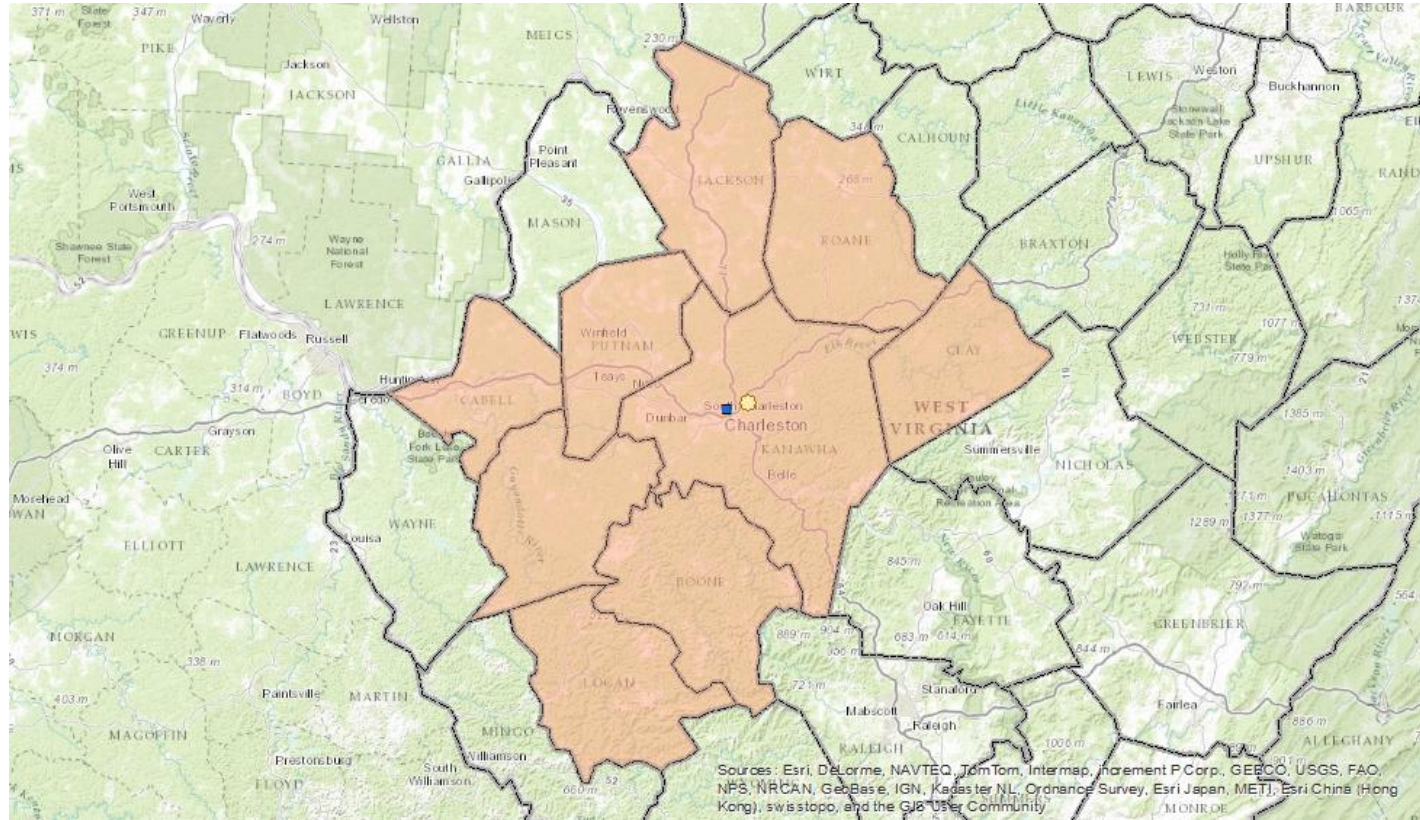






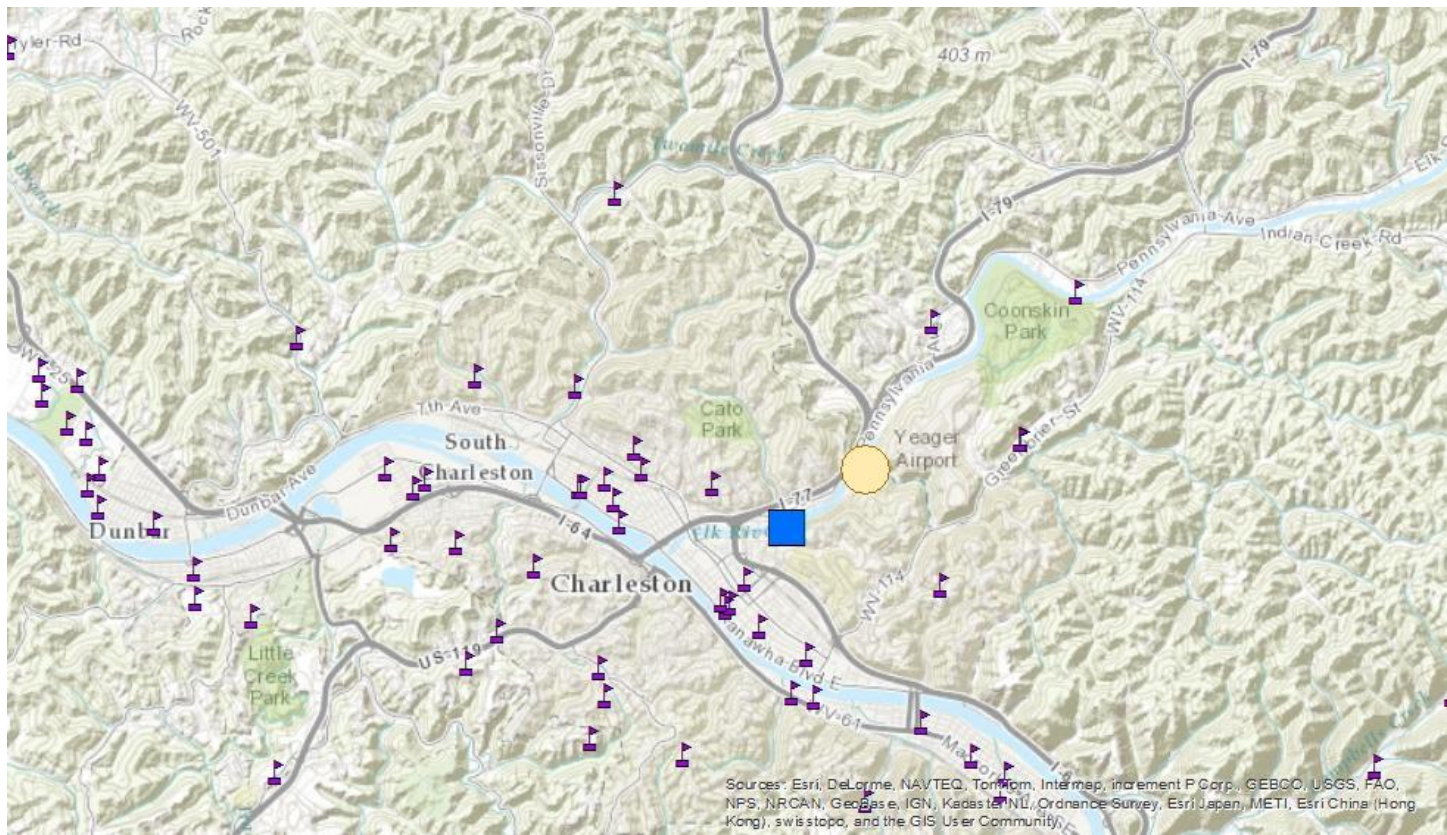
Spill ultimately affected approximately 300,000 people in 9 counties around the original spill.

What is the risk to the company if that happens?



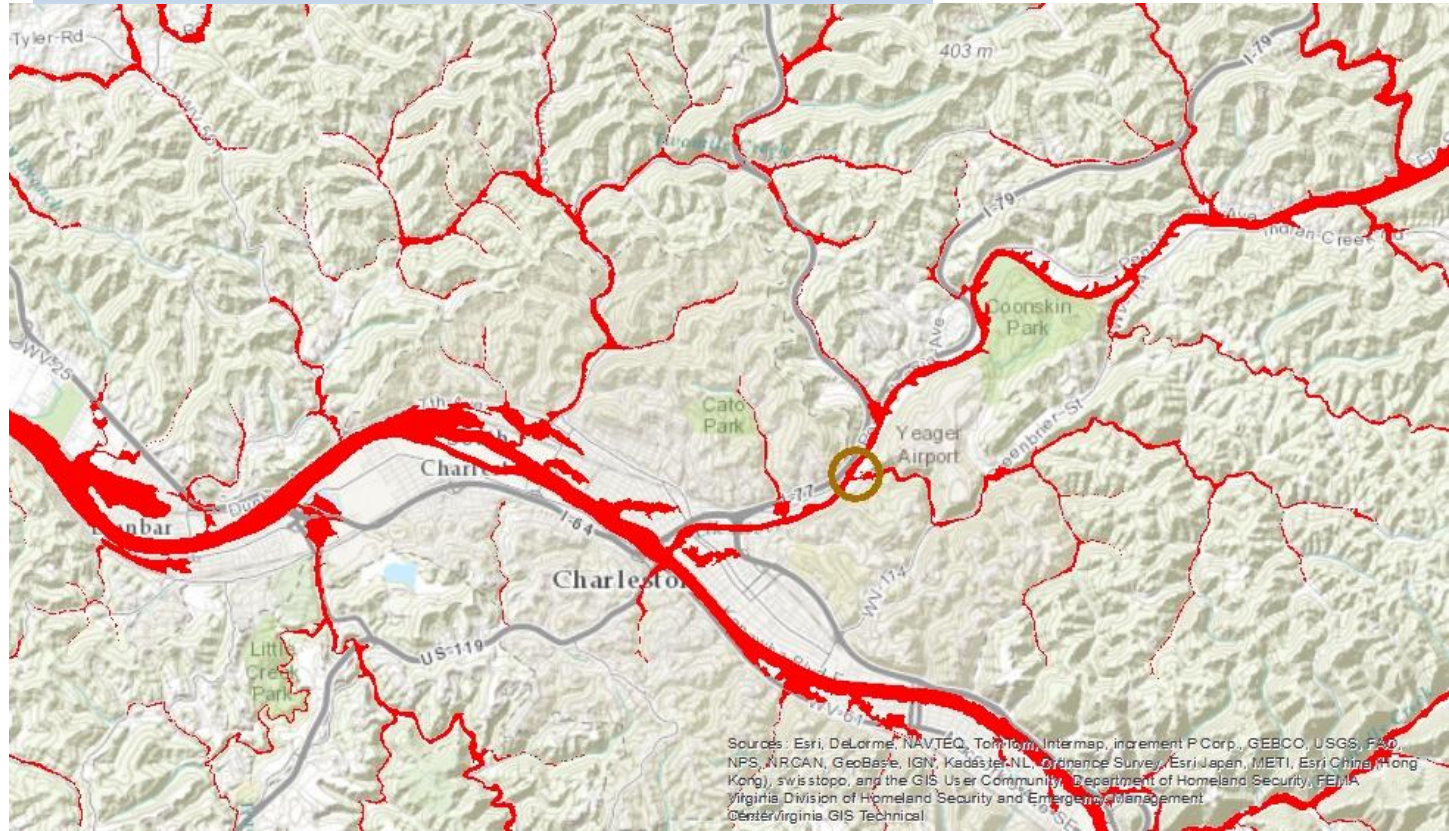
What else is around the facility? What is the risk to them/
the company if a spill occurs?

How far away are schools, hospitals, daycare facilities?



What is the risk of flood, landslide or fault areas around the facility? How close are those risk areas?

Will any of these risks trigger an incident?



Safeguards

- What is the purpose of secondary containment?
- Did Freedom know the purpose?
- As a new employee would you ask your boss why the hole is there? Would you exercise stop work authority if your company allowed it?
- What would you do?





Unfilled, non
reinforced hollow
block wall

A look inside





Bottom
Holes
3/16 to 1/2
inch
diameter

Any credible safety/environmental management system could have prevented this

- The company went out of business and the owners were levied financial and criminal penalties.
- If anyone had asked a few simple questions or done a what-if analysis they could have foreseen the potential problem.
- This incident triggered calls for annual internal inspections and other over-the-top responses.

Buncefield December 2005

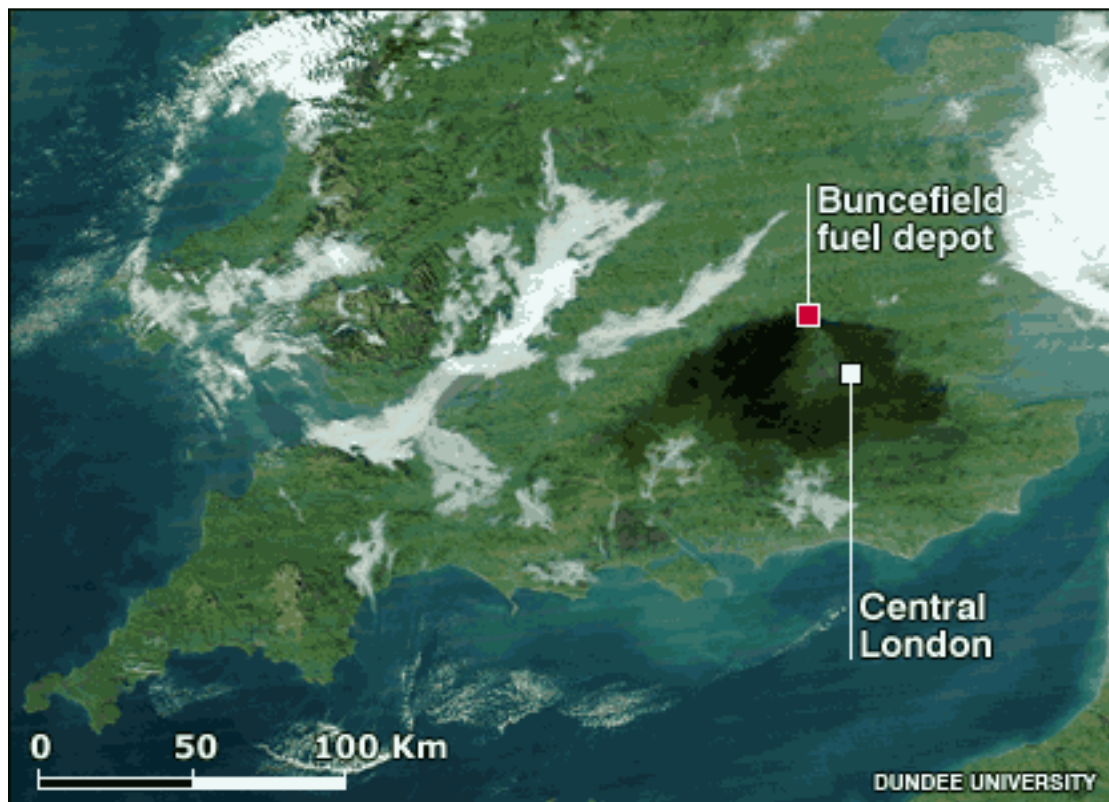












The Buncefield Incident was a Gasoline Tank Overfill

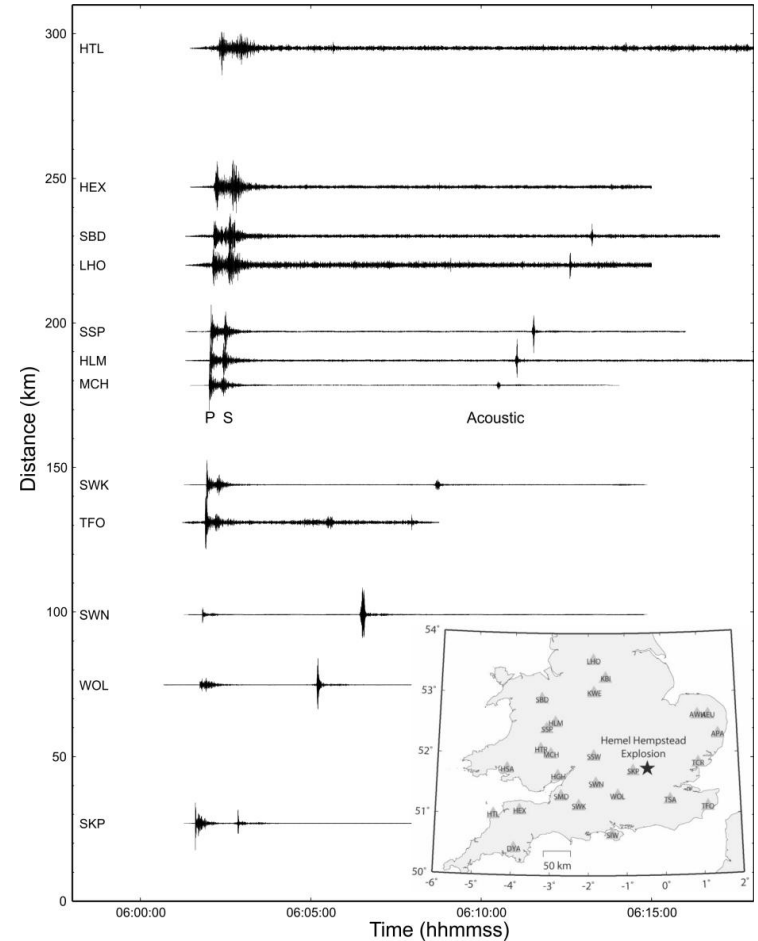
- The terminal was the fifth largest oil-products storage depot in the United Kingdom, with a fuel distribution facility supplied fuel across the region including Heathrow and Luton airports.
- On Saturday the December 10th, 2005 a part of the Buncefield oil storage depot was filling with gasoline.
- About 200,000 gals overflowed during 26 minutes. A vapor cloud formed and was ignited causing a massive explosion and a fire that lasted for five days.

The Incident

- The incident occurred on December 10, 2005
- The final HSE report of the [Major Incident Investigation Board](#) (MIIB) was written in 2008 and released in February 2011.
- The investigation found that Tank 912 at the Buncefield oil storage depot was being filled with petrol (gasoline).
- The tank had a level gauge that employees used to monitor the level manually, and an independent high-level switch which would shut off inflow if the level got above a certain setpoint.
- On the day of the incident Tank 912, the manual gauge was stuck and the independent shut-off switch was inoperative, meaning that the tank was being "filled blind". The petrol overflowed through vents at the top, and formed a vapour cloud near ground level, which ignited and exploded. The fires from the explosion then lasted for five days.

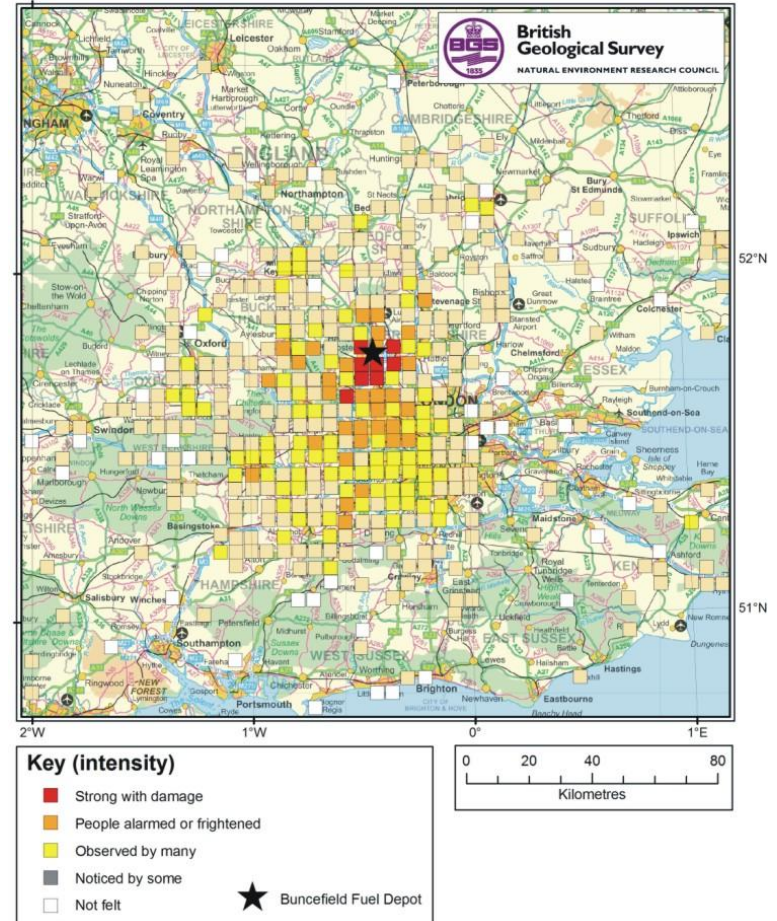
Seismograms

- The explosion was detected on seismograph stations in the UK and the Netherlands
- Largest explosion in peacetime Europe
- Rough estimate 29.5 tons TNT equivalent



Public Impact Survey

- 43 injuries
- Damages ~ \$1 billion USD



Before



After



Key Ideas

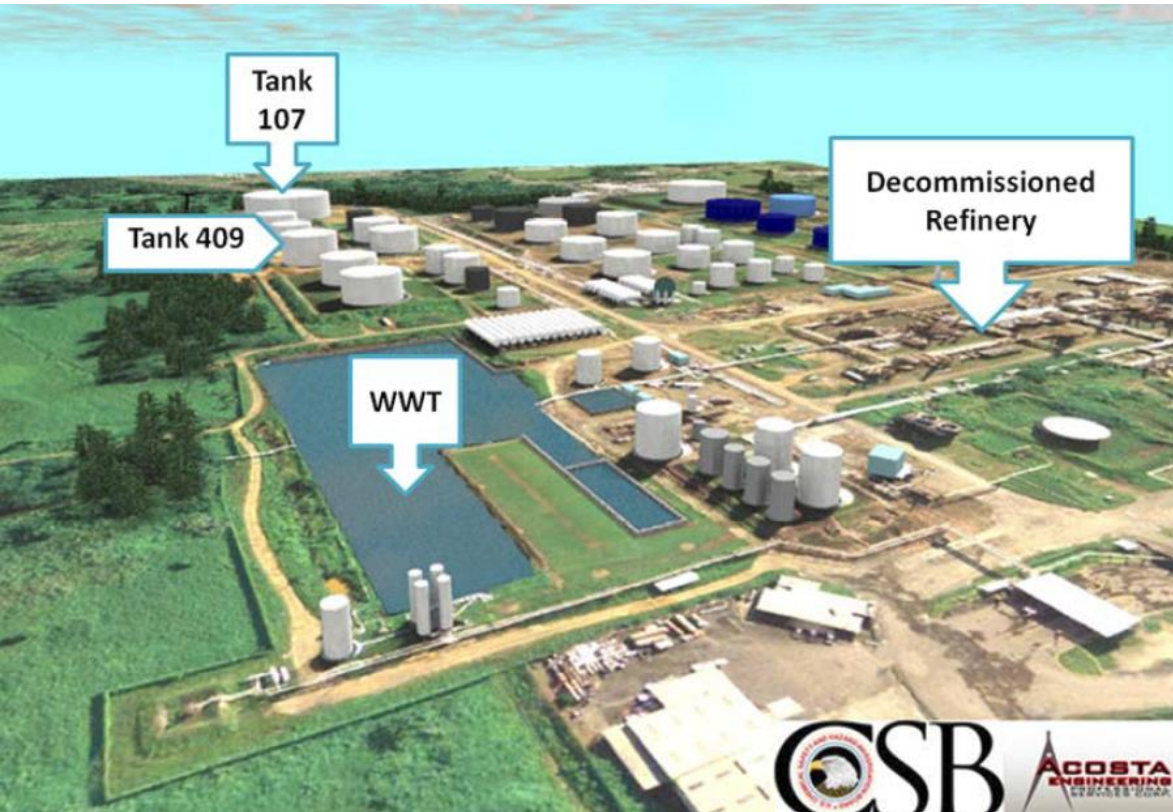
- Buncefield caused by failures in management systems, a failure to understand possibility of VCEs, procedures, human factors, management of change, training, equipment, etc.
- API 2350 4th edition triggered and energized by Buncefield, then again by the CAPECO tank overflow and explosion.
- Today, if you follow the principles of API 2350-4 or –5 then you are assured of not having a Buncefield type event.

CAPECO What Happened

- October 23, 2009
- 5mm gal tank receiving gasoline overflowed
- Vapor cloud explosion (VCE) escalating fire to 17 other tanks
- Burn 60 hours
- Massive community impacts, environmental damage, surrounding areas
- No fatalities
- US CSB investigated
- Full report: <http://www.csb.gov/caribbean-petroleum-refining-tank-explosion-and-fire/>



Refinery operation discontinued and facility used as a gasoline, fuel oil, and diesel terminal with a 90 million gallon capacity.

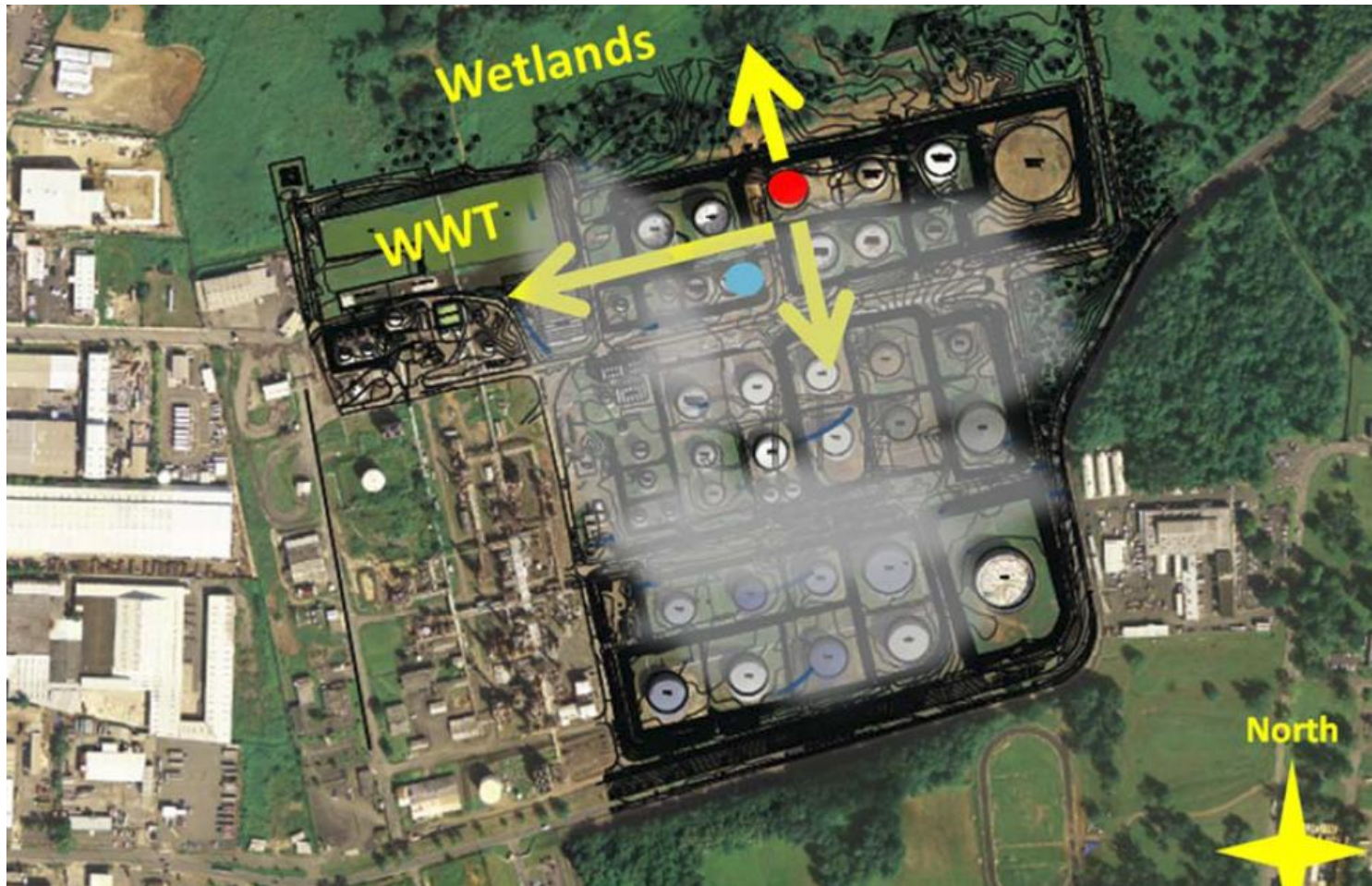


Wed Oct 21, 2009 Cape Bruny ship to deliver 11.5 MM gal unleaded gasoline. Plan to pump into T405, T504, T409, and T411 with balance to T107 over a 24 hour period.

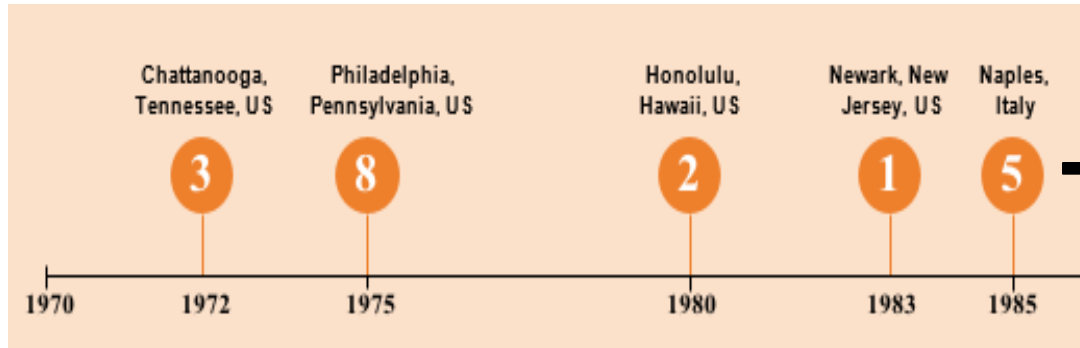
One operator at dock while another monitoring at terminal. At 10 pm T411 reached max level and T409 was opened to the 7000 gpm flow. Operator estimated T409 filled at 1am. At 11 pm operator confirmed from the side gauge that T411 would be filled at 1am. But it started to overflow between 11pm and midnight.



Overflow went on for 26 minutes dumping about 200,000 gallons of gasoline on the ground before the VCE



Past Landmark Overfill Cases and Fatalities



For more information and a sample copy of LPB visit: www.icheme.org/resources/lpb



API 2350 4th Edition (2012) is a major edition that will address future overfills with new technology, management practices and lower tolerance for error.

API 2350 4th ed. is **RAGAGEP**

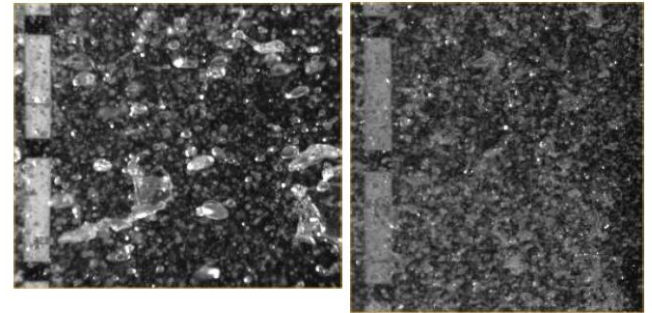
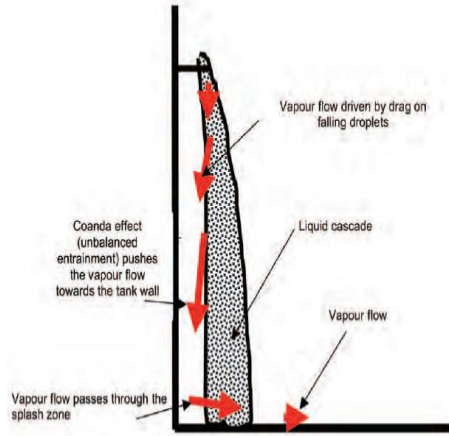
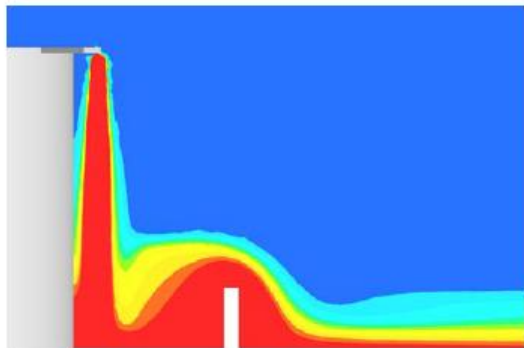
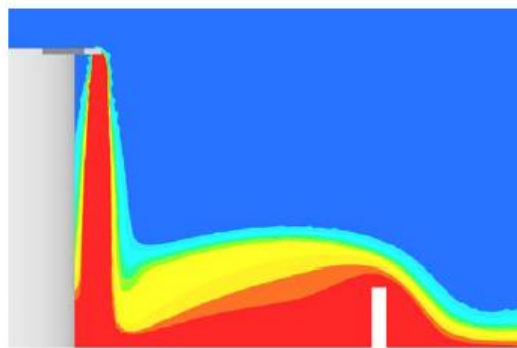


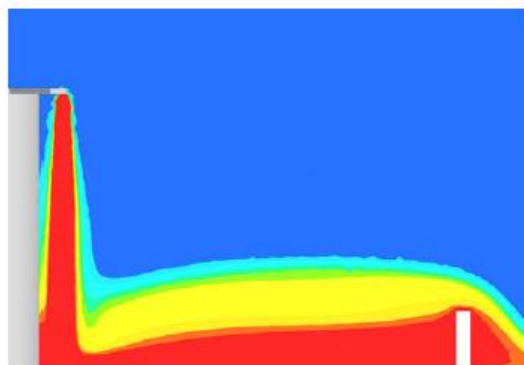
Figure 14b: Comparison between cascade droplet structure in water (left) and decene (right) in similar conditions



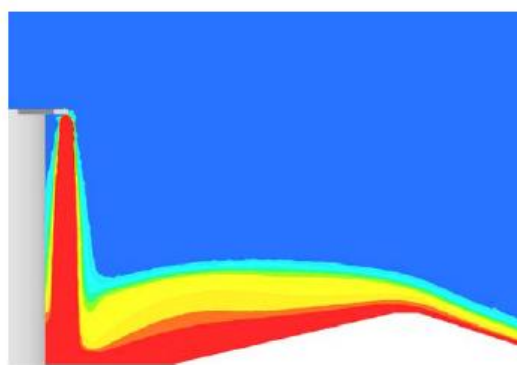
Case D



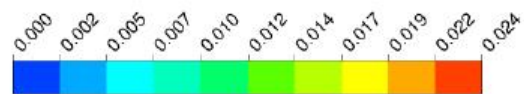
Case E



Case F



Case G



Guidebook for Overfill Prevention & Tank Gauging

ABSTRACT

The public, the regulatory community and industry have expectations that tank overfills should be addressed proactively and in accordance with the current edition of API 2350. We aim to provide you with the knowledge and expertise to address the concern for hazardous liquid overfill unique to your facility, goals, and corporate interests.

Available for download from
<https://www.pemyconsulting.com/>
Or from Endress Hauser website

Intercontinental
Terminals
Company
March 17, 2019
Deer Park, TX

Investigation Report

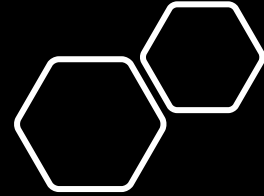
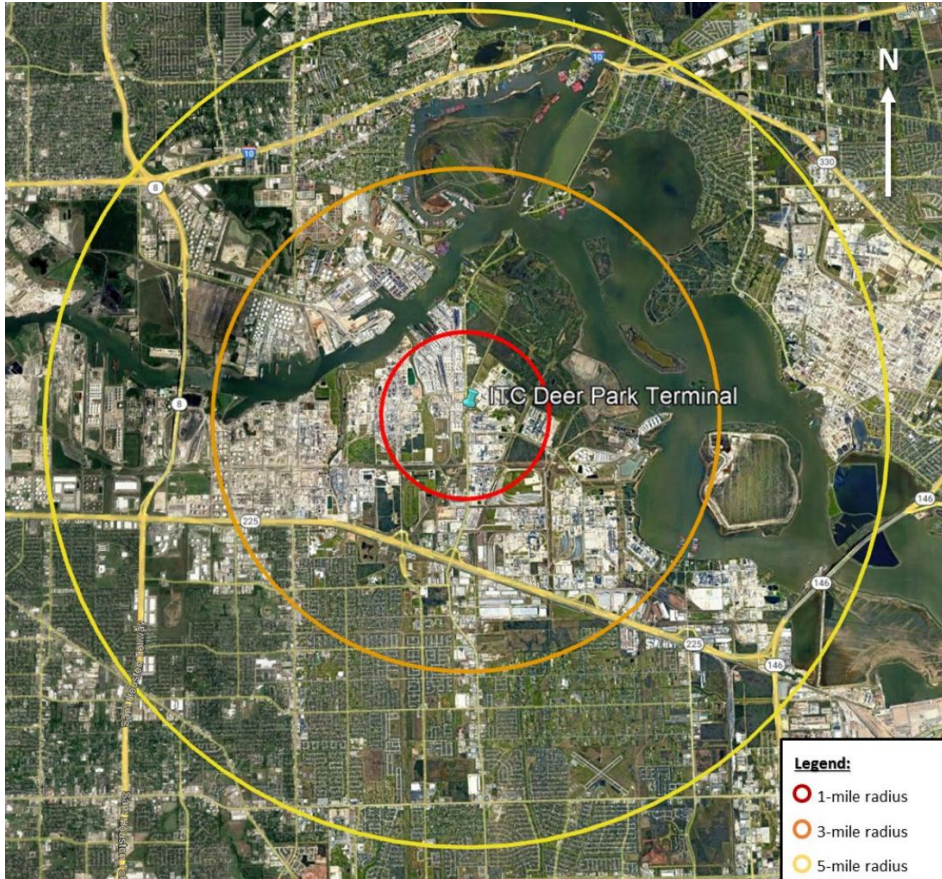
Published: July 6, 2023

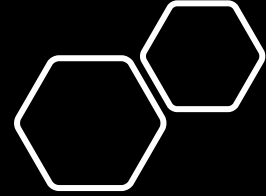


SAFETY ISSUES:

- Pump Mechanical Integrity
- Flammable Gas Detection Systems
- Remotely Operated Emergency Isolation Valves
- Tank Farm Design
- PSM and RMP Applicability







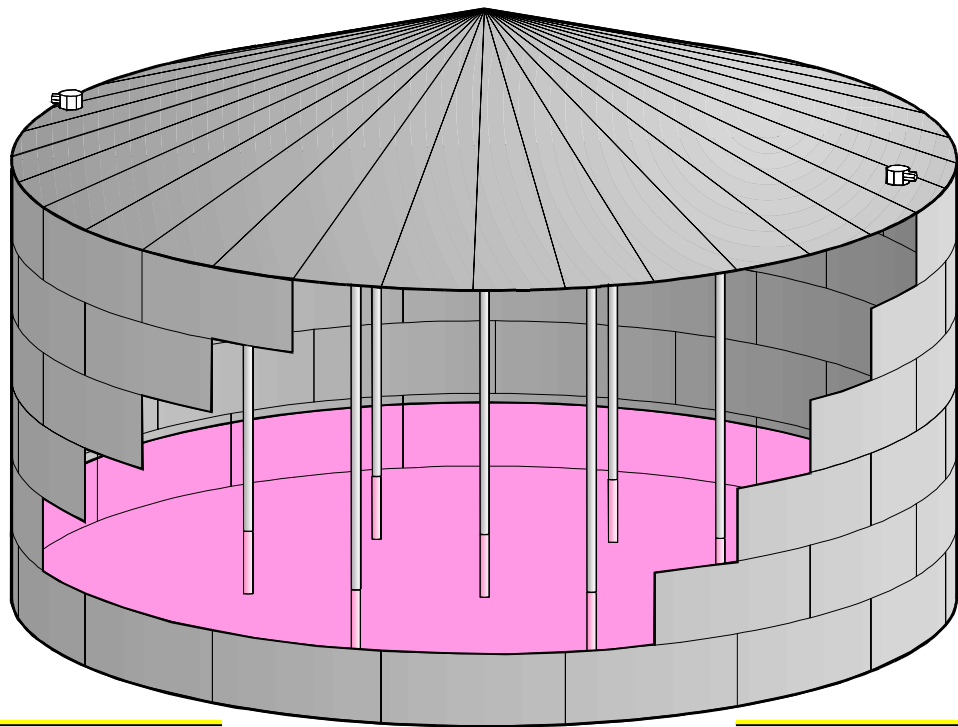
Bottom line

- Butane injection pump seal failure ejects butane cause fire that melts piping
- No flammable gas detectors to alert operators allowing a 30 min headstart
- No emergency shutoff valve on the tank
- No elements of PSM required for this facility

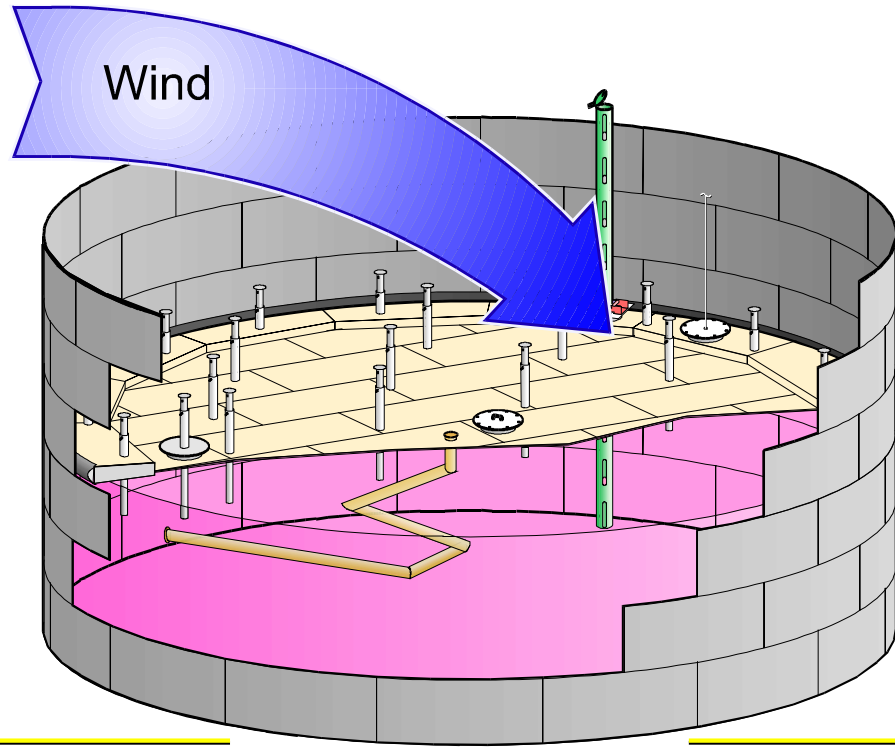
Tank Basics

- Three tank types:
 - Fixed roof tank
 - External floating roof tank
 - Internal floating roof tank



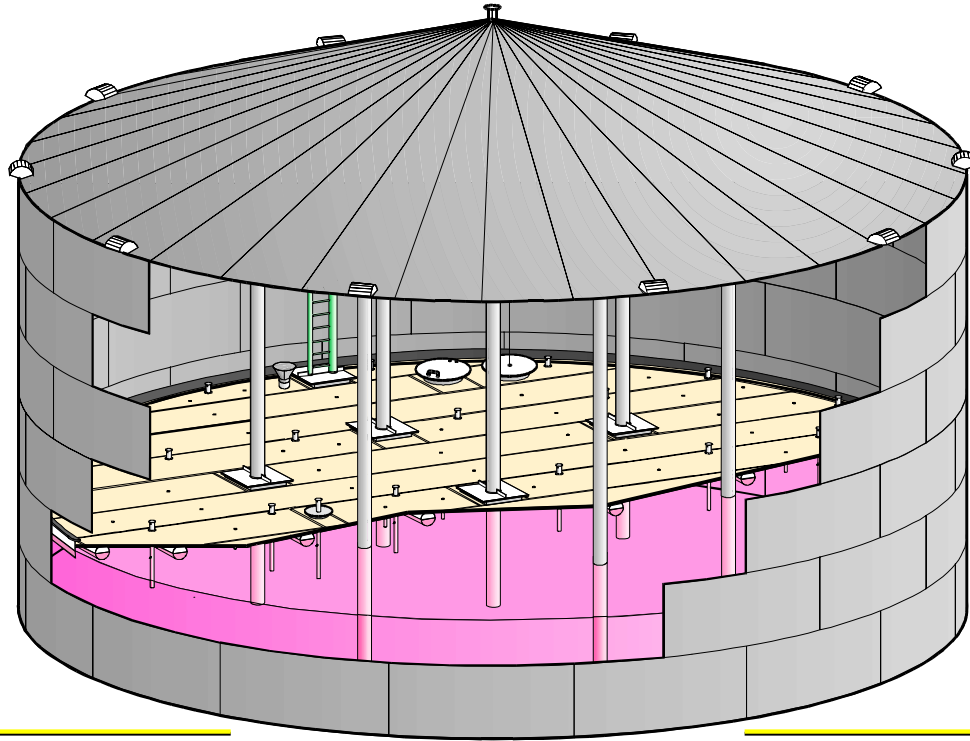


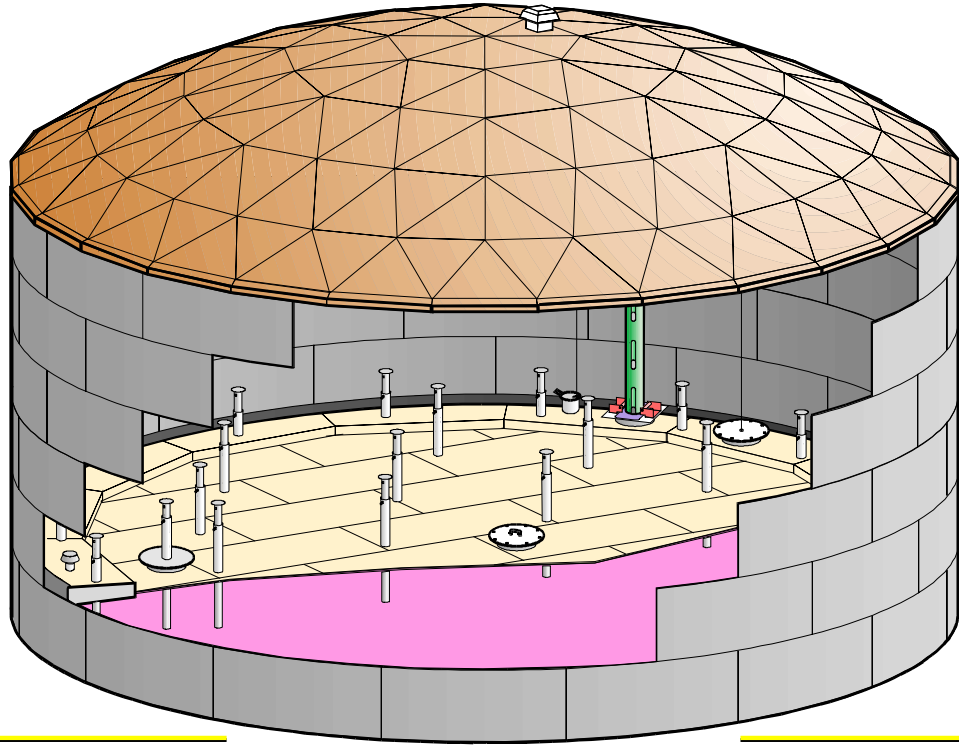
TGB



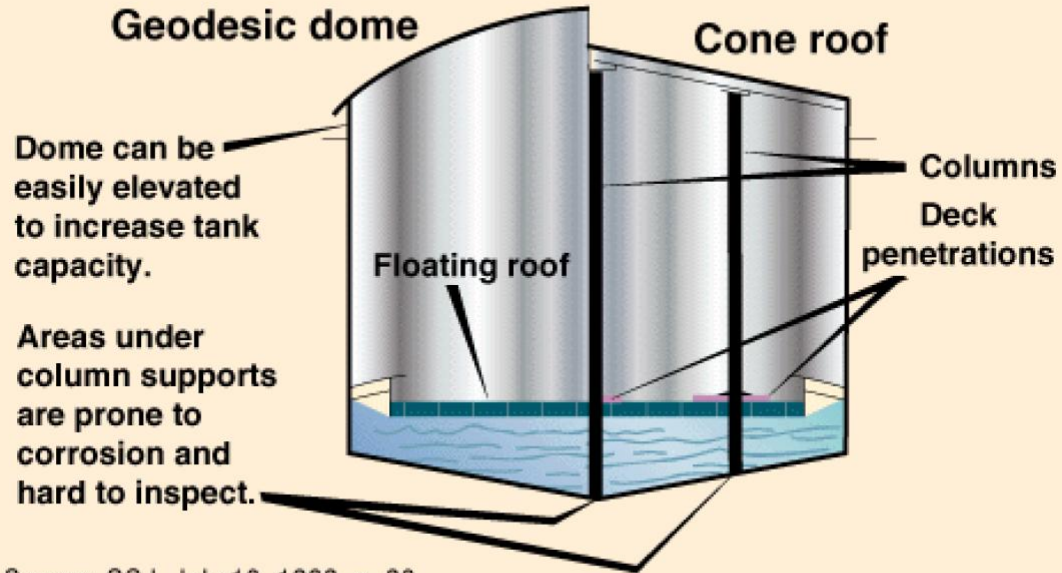
TGB

Internal Floating-Roof Tank





GEODESIC DOME VS. CONE ROOF



Source: OGJ, July 10, 1989, p. 90.

OGJ

Figure 4 Contrast between geodesic and cone roofs

WHITE PAPER



Floating Roof Tanks in Petroleum Storage

An overview of roof types, fault modes, failure causes and technology for incident prevention



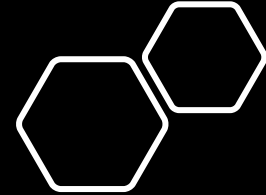
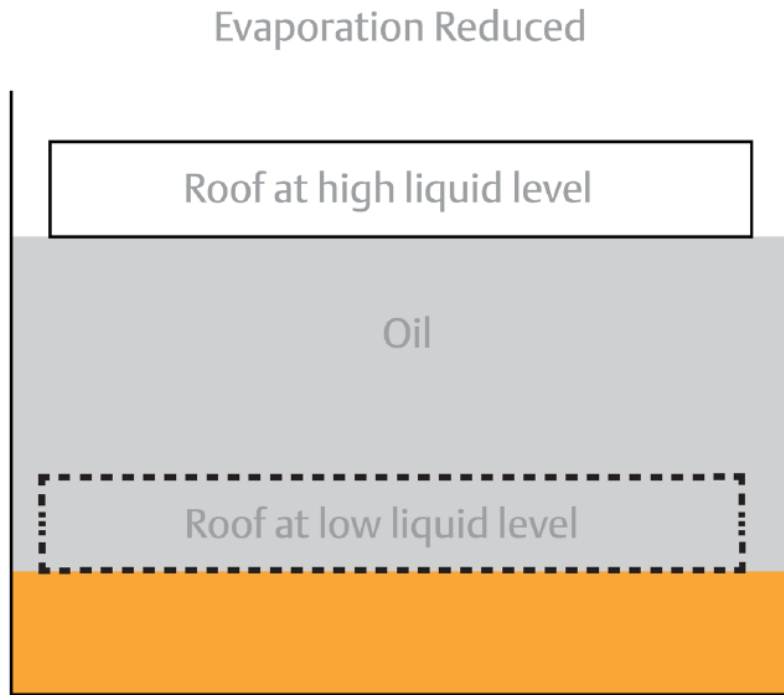


Figure 1 Conceptual diagram of floating roof tank

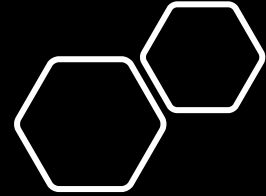
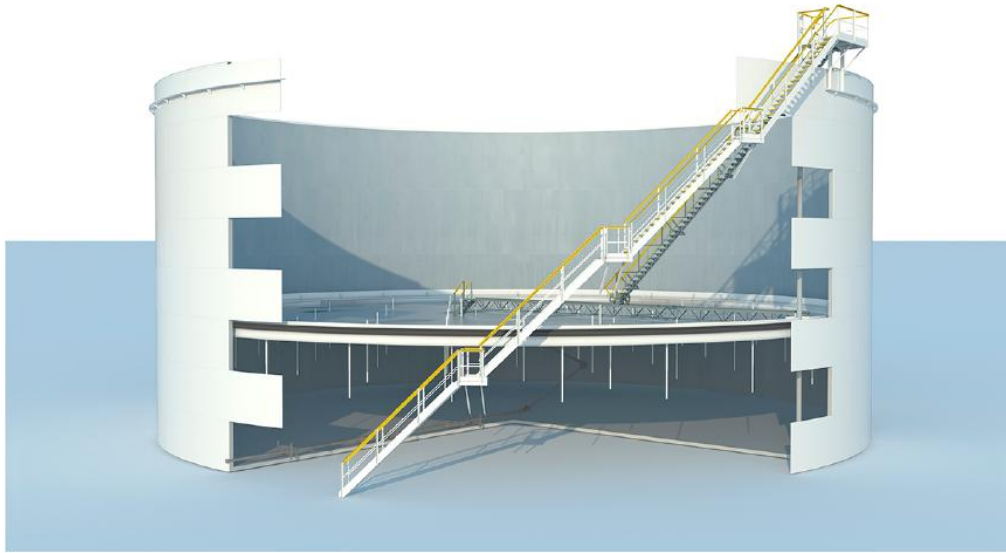


Figure 27 External Floating Roof Tank (EFRT) Cut Away (courtesy Emerson)

Schematic of an APFR

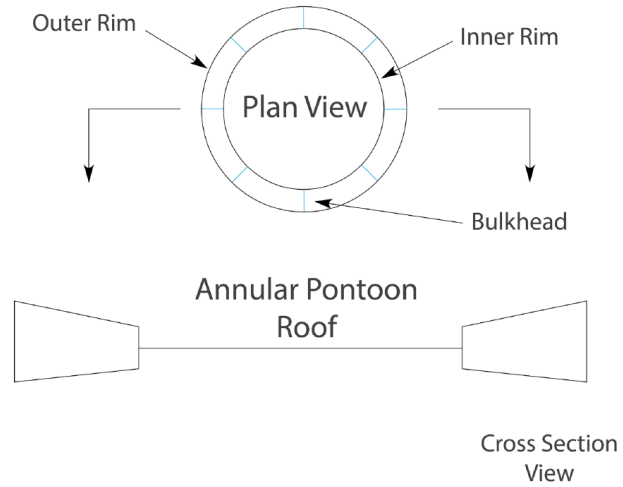
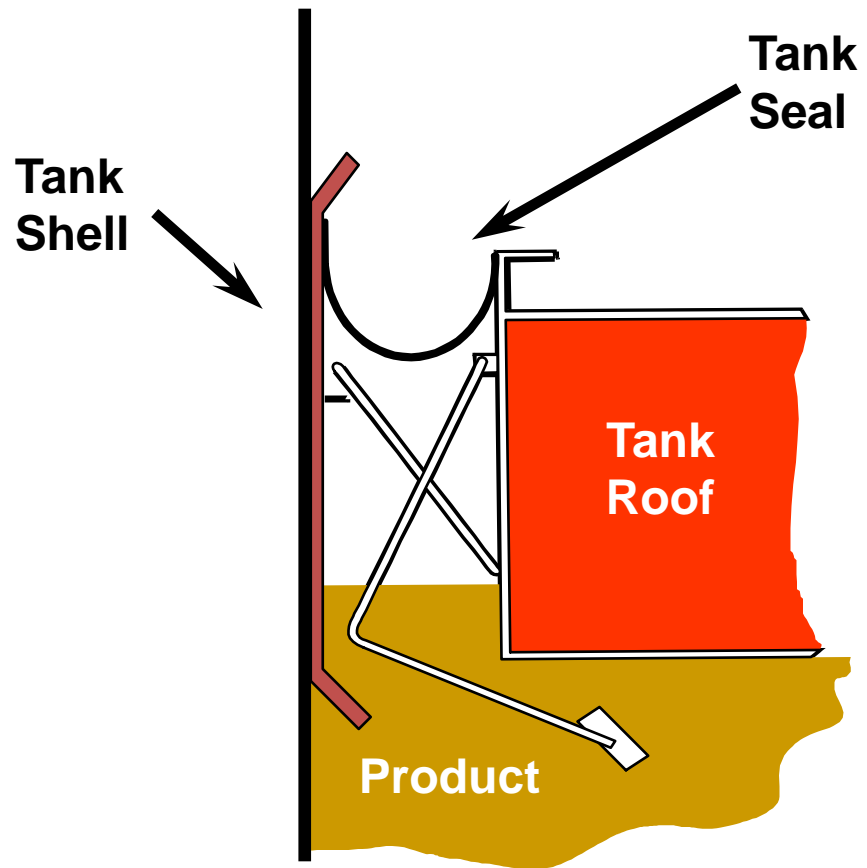


Figure 5 Schematic of an APFR



Differences between large and small tanks

Small Tanks

- Thickness (constructability)
- Welding less critical
- No brittle failure
- Materials not critical
- New: UL,
- Inspection: STI SP001
- Up to 50 thousand gallons

Large Tanks

- Thickness (Stress)
- Welding critical
- Brittle fracture critical
- Materials critical
- New: API 650, API 620
- Inspection: API 653
- Up to 10 million gallons

Fundamentals of API 653

- covers steel storage tanks built to API 650 and its predecessor API 12C
- Minimum requirements for maintaining the integrity of such tanks
- after they have been placed in service and addresses inspection, repair, alteration, relocation, and reconstruction
- scope is limited to the tank foundation, bottom, shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange, first threaded joint, or first welding-end connection.
- conflicts between the requirements of this standard and API 650 or its predecessor API 12C, this standard shall govern for tanks that have been placed in service
- This standard employs the principles of API 650; however, storage tank owner/operators, based on consideration of specific construction and operating details, may apply this standard to any steel tank constructed in accordance with a tank specification
- standard is intended for use by organizations that maintain or have access to engineering and inspection personnel technically trained and experienced in tank design, fabrication, repair, construction, and inspection

- standard does not contain rules or guidelines to cover all the varied conditions...provide a level of integrity equal to the level provided by the current edition of API 650
- This standard recognizes fitness-for-service assessment concepts
- The owner/operator has ultimate responsibility for complying with the provisions of this standard.
- standard is restricted to organizations that employ or have access to an authorized inspection agency
- If any provision of this standard presents a direct or implied conflict with any statutory regulation, the regulation shall govern. However, if the requirements of this standard are more stringent than the requirements of the regulation, then the requirements of this standard shall govern.
- An assessment shall be made of the potential hazards to which personnel may be exposed when conducting internal tank inspections, making repairs, or dismantling tanks. See guidelines given in API 2015 and API 2217A
- Three types of inspections:
 1. Informal
 2. External
 3. Internal

Probably Single Most Important Statement (and assumptions implied by API 653)

- 4.1.1 When the results of a tank inspection show that a **change** has occurred from the original physical condition of that tank, an evaluation shall be made to determine its suitability for continued use.

Suitability for Service

- A change from the original physical condition requires an evaluation
- The change determined by the inspection
- Some explicit changes not allowed:
 - Holes in roof plates or shell
 - Holes in the bottom estimated by corrosion rates
 - Brittle failure
- Change of Service

Tank Inspection Purpose → Tank Integrity

Frequency Considerations

- the nature of the product stored
- corrosion allowances and corrosion rates; corrosion prevention systems;
- conditions at previous inspections; the methods and materials of construction and repair;
- the location of tanks, such as those in isolated or high risk areas;

Change of service (MOC)

- Corrosivity
- Pressure
- Density
- Temperature
- Venting

Revisions for inspection continuity

Existing

Reports shall include at a minimum the following information:

- a) date(s) of inspection;

Establishes continuity between prior and current inspections.

Necessary to calculate corrosion rate of repaired components.

Revised

6.9.2 Report Contents

Unless agreed otherwise with Owner / Operator, reports shall include:

- a) date(s) of **current** inspection;
- b) If required by the owner and the previous inspection reports are provided prior to the inspection, the new inspection report shall include
 1. the date(s) of previous internal inspection.
 2. areas of concern from previous inspections and what condition these areas were found in during the current inspection.
 3. condition of previously repaired areas
- c) date of installation or repair of components that are subject to corrosion rate calculations, if available;

Inspection – Section 6

- Routine In-Service
 - Monthly
- External
 - Typically every 5 years
- External UT Measurements
 - Based on shell corrosion rates
 - Typically 10 to 15 years
 - API 653 Inspector
- Internal
 - Based on bottom corrosion, also other components
 - Typically 10 to 30 years
 - API 653 Inspector

Corrosion is a primary damage mechanism
See API 571



Tank Bottom Inspection



- Types
 - Top/bottomside corrosion
 - Uniform, general/localized, pitting
- Causes
 - Product, water bottoms, sediment
 - Sand pad contaminants
 - Microbes
- Magnetic Flux Leakage Examination
 - Qualification per Annex G
- Critical zone
- Uniqueness of tank bottoms

Initial Inspection Interval

Table 6.1—Tank Safeguard

Tank Safeguard	Add to Initial Interval
i. Fiberglass-reinforced lining of the product-side of the tank bottom installed per API RP 652.	5 yrs
i. Installation of an internal thin-film coating as installed per API RP 652.	2 yrs
iii. Cathodic protection of the soil-side of the tank bottom installed, maintained, and inspected per API RP 651.	5 yrs
iv. Release prevention barrier installed per API Std 650, Annex I.	10 yrs
v. Bottom corrosion allowance greater than 0.150 in.	(Actual corrosion allowance -150 mils)/corrosion rate*
vi. Bottom constructed from stainless steel material that meets requirements of API 650, Annex SC, and either Annex S or Annex X; and internal and external environments have been determined by a qualified corrosion specialist to present very low risk of cracking or corrosion failure.	10 yrs
* Corrosion rate to be 15 mpy, or as determined from Appendix H, Similar Service	

Alternative is Risk Based Inspection

4.4.5 Minimum Thickness for Tank Bottom Plate

- Quantifying the minimum remaining thickness of tank bottoms based on the results of measurement can be done by the method outlined in 4.4.5.1. Other approaches such as the probabilistic method in 4.4.5.2 may be used.

Table 4.4—Bottom Plate Minimum Thickness

Minimum Bottom Plate Thickness at Next Inspection (in.)	Tank Bottom/ Foundation Design
0.10	Tank bottom/foundation design with no means for detection and containment of a bottom leak.
0.05	Tank bottom/foundation design with means to provide detection and containment of a bottom leak.
0.05	Applied tank bottom reinforced lining, > 0.05 in. thick, in accordance with API 652.

$$MRT = \min(RT_{bc}, RT_{ip}) - O_r(StP_r + UP_r)$$

Concept of Joint Efficiency

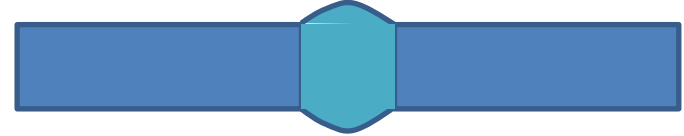
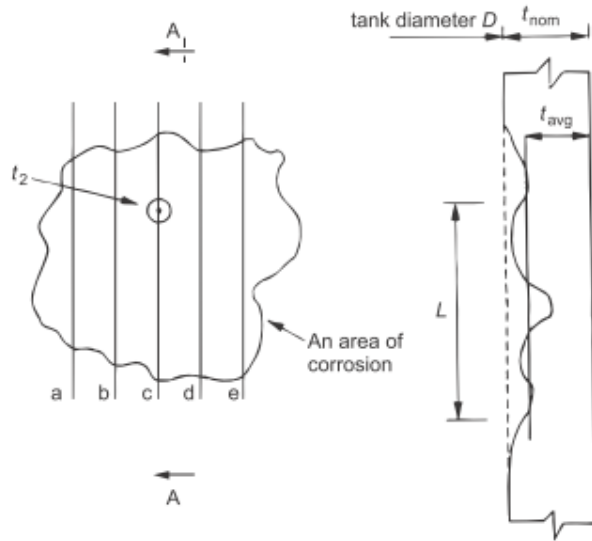


Table 4.2—Joint Efficiencies for Welded Joints

Standard	Edition and Year	Type of Joint	Joint Efficiency E	Applicability or Limits
API 650	Seventh and Later (1980 to Present)	Butt	1.00	Basic Standard
		Butt	0.85	Annex A Spot RT
		Butt	0.70	Annex A No RT
	First to Sixth (1961 to 1978)	Butt	0.85	Basic Standard
		Butt	1.00	Annexes D and G

Lap welded tank shells have $E=0.35$ to $E=0.70$

Locally Thin Area



$$L = 3.7\sqrt{Dt_2} \leq 40$$

$$t_1 \geq t_{min}$$

$$t_2 \geq 0.6t_{min}$$

Locate L to minimize
 $t_{ave} = t_1$

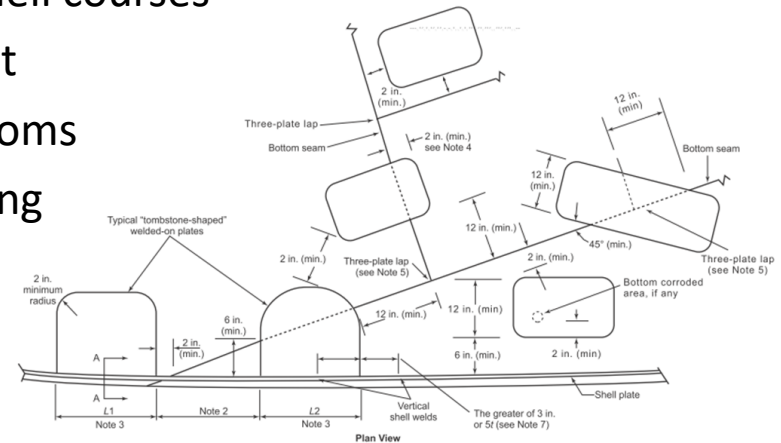
4.3.5 Shell Distortions

- Out of round
- Dent
- Creases
- Buckles
- Bulges
- Flat spots
- Peaking and Banding

Causation?

Repairs and Alteration

- API 650 equivalence
- New materials per API 650
- Repair vs. alteration
- As-built standard
- Reconstruction
 - Design
 - Methods
 - Welding
 - Inspections
 - Tolerances
- Repairs
 - Patches
 - Nozzles
 - Adding shell courses
 - Doorsheet
 - New bottoms
 - Hot tapping



Welding

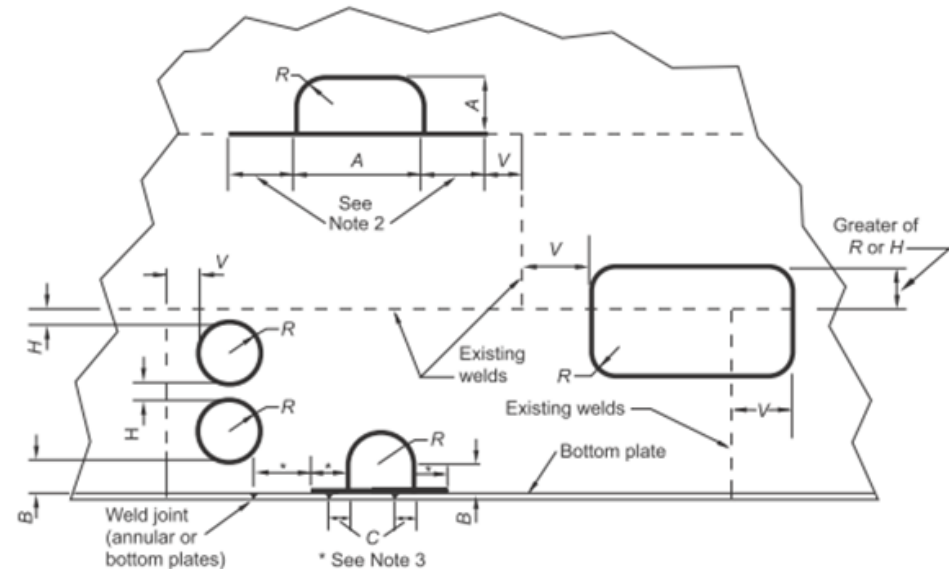
- Qualified in accordance with Section IX of the ASME Code
- Weldability of steel from existing tanks shall be verified.
- Welding shall conform to the permit and safety precautions of Section 1.4 of API 2009. Permits shall consider tank conditions in the hot-work areas which might release flammable vapors (such as perforation resulting from corrosion).

12.3 Hydrostatic Testing

- Hydrostatic testing is of interest to Owners/Operators because
 - Water scarcity
 - Costs of water
 - Delays of projects and business due to time required for testing
- Hydrotesting is required for
 - New Tanks
 - Reconstructed Tanks
 - Major repairs (but these may be exempted)
- Owners and Operators can reduce hydrotests by
 - Not making mistakes (understanding the exemptions) and testing only that which must be tested
 - Use of API 579 Hydrostatic testing exemptions

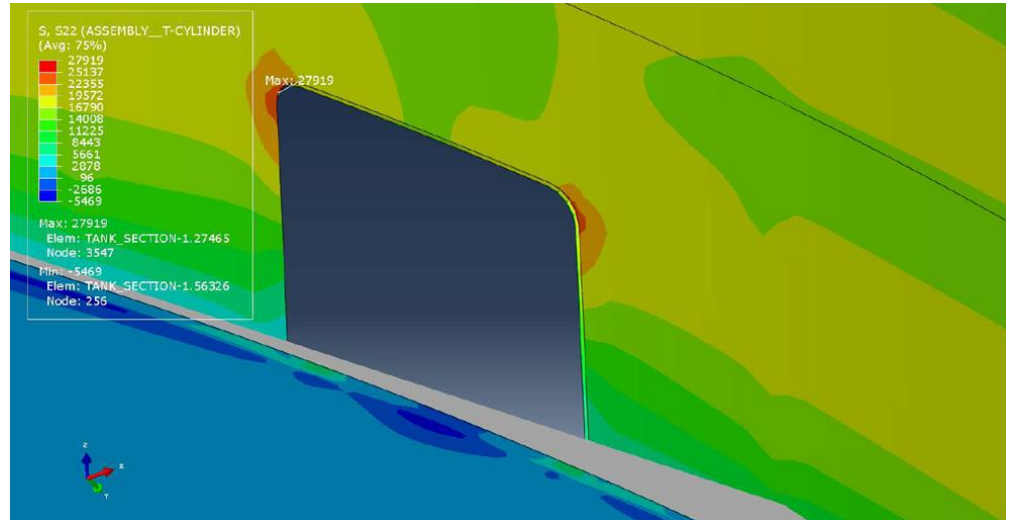
Major Repairs and Hydrostatic Testing

- Installing a shell penetration larger than NPS 12 beneath the design liquid level
- Removing and replacing or adding a shell plate beneath the design liquid level where the longest dimension of the replacement plate exceeds 12 in.
- Installing a bottom penetration within 12 in. of the shell
- Installing a complete new bottom. Installing a portion of a new bottom as described in API 653 12.3.3.3 is not a major repair.
- Removing or replacing annular plate ring material where the longest dimension of the replacement plate exceeds 12 in.;
- Complete or partial (more than one-half of the weld thickness) removal and replacement of more than 12 in. of vertical weld joining shell plates or radial weld joining the annular plate ring;
- Removing and replacing part of the weld attaching the shell to the bottom, or to the annular plate, exceeding 50% of the API 650 section area;
- Jacking a tank shell, except carefully considered minor jacking.
- (API 653 Paragraph 3.19)



Hydrostatic Test Exemption

- Improved materials, welding, and examinations
- Proportionality
- Fitness-for-service API 579



API 579 Fitness-for-Service Standard

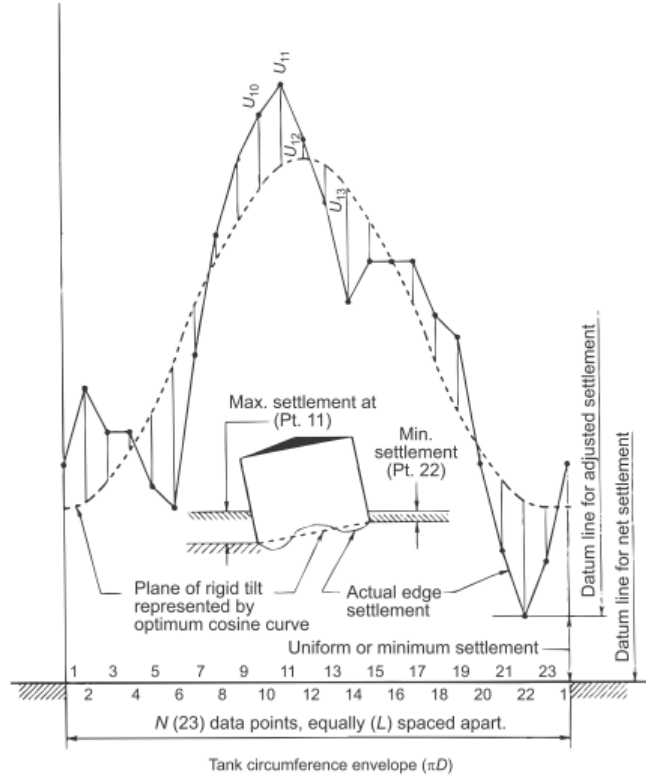
- Given a type of damage, is the tank fit for continued service?
- API 579 explicitly permitted by API 653
- Damage mechanisms:
 - Corrosion (uniform, local, pitting)
 - Cracking
 - Brittle fracture
 - Laminations
 - Blisters
 - Deformations
 - Fire

Annex B Evaluation of Tank Bottom Settlement

Types of Settlement

- Uniform planar
- Tilt planar
- Differential
- Global dishing
- Local bulges or bowls
- Edge
- Ridge

Cosine Curve



Annex C Checklists for Tank Inspection

Tank In-service Inspection Checklist		
Item	Completed √	Comments
C.1.1 Foundation		
Measure foundation levelness and bottom elevations (see Annex B for extent of measurements).		
C.1.1.1 Concrete Ring		
a) Inspect for broken concrete, spalling, and cracks, particularly under backup bars used in welding butt-welded annular rings under the shell.		
b) Inspect drain openings in ring, back of waterdraw basins and top surface of ring for indications of bottom leakage.		
c) Inspect for cavities under foundation and vegetation against bottom of tank.		
d) Check that runoff rainwater from the shell drains away from tank.		
e) Check for settlement around perimeter of tank.		
C.1.1.2 Asphalt		
a) Check for settling of tank into asphalt base which would direct runoff rain water under the tank instead of away from it.		
b) Look for areas where leaching of oil has left rock filler exposed, which indicates hydrocarbon leakage.		

Fundamentals of Managing Tank Inspections

- Does the owner have a policy statement about tanks?
- Is there a tank database
 - Tank service, size, date constructed, when last inspected, etc. for each tank
- Where and how are the Inspection reports filed?
 - Informals, externals, internals
- What is the site history of spills and incidents
- Look at the SPCC plan
- What is the history of repairs, alterations, modifications made
- There should be lots of hi-res photos from past tank inspections
 - Photos should capture all damage or concerns found by inspector
- Verify the inspector qualifications

Is there a
policy?

Global Logistics

GLOBAL MARKETING PROCESS LIBRARY

Terminal Operation Standard: 10.10.2.X.X

10.10.2.X.X – Tank Database Specification

REVISION DATE: 31/May/2005

- X.X.1 Summary**
 - X.X.2 Qualification Requirements**
 - X.X.3 Standard**
 - X.X.4 Management System**
 - X.X.5 Training**
 - X.X.6 Definitions**
 - X.X.7 References**
 - X.X.8 Roles and Responsibilities**
 - X.X.9 Sarbanes-Oxley Compliance**
-

Summary (Purpose, Scope & Objective)

Recordkeeping is critical to efficient process and cost savings. Because of the numerous tanks, it is not possible for one person to collect and verify all the information necessary for the purposes of complying with an API 653 program. This standard sets forth the information to be collected and the format of the data so that the AST Integrity Management Program can be monitored.

The purpose of this standard is to define the amount and type of data to be collected from various facilities on aboveground storage tanks, pressure vessels and containers.

A Decent Internal Inspection Report (snippets)

1. TANK DESCRIPTION

GENERAL:

TANK NUMBER:	116
OWNER:	Kinder Morgan Liquids Terminals, LLC
LOCATION:	Galena Park, Texas
DESIGN STD:	API 650 8 th Edition
MANUFACTURER:	Pasadena Tank Corporation
PRODUCT:	REOFOS 35
SPECIFIC GRAVITY:	1.0 (per nameplate)
MAXIMUM DESIGN TEMP:	200°F
NORMAL OPER. TEMP:	Data Not Available
MINIMUM DESIGN TEMP:	Data Not Available
DESIGN PRESSURE:	Atmospheric
CATHODIC PROTECTION:	Yes
NAMEPLATE PRESENT:	Yes
BREAKOUT TANK (DOT):	No

DIMENSIONS:

DIAMETER:	30.07 ft (as measured)
HEIGHT:	40.00 ft (as measured)
DESIGN LIQUID LEVEL:	40.00 ft (per nameplate)
NOMINAL CAPACITY:	4,900 bbls (per nameplate)

COMPONENT TYPES:

FOUNDATION:	Concrete Ringwall
BOTTOM:	Lap Welded (Shovel Slope)
SHELL:	Butt Welded (A36)
FIXED ROOF:	Lap Welded Cone w/ Framing

DATES:

YEAR BUILT:	1991
PRIOR INSPECTION DATE:	May 2, 2006 (Out-of-Service) April 11, 2016 (Internal Floorscan Only) April 5, 2021 (In-Service External Only)

-
- Maximum fill height
 - Next inspections

2. INTERVALS AND FILL HEIGHT CALCULATIONS

FOUNDATION:

The survey found the tank out of level by 1.272 inches. API 653 calculation for deflection of this tank is 0.189 inch. API maximum deflection permitted for this tank is calculated at 1.137 inches. Differential settlement for this tank does not exceed the API allowable (ref. API 653, Appendix B, Para. B.3).

The Foundation Settlement data in 4.2.3 indicates that the tank has a 13.08-inch single slope from Station 1 to Station 5. The tank was designed with a 12-inch single slope. Edge settlement calculations exceed the requirements of API 653, Annex B, Section B.3.4 likely due to the design slope of the tank and small diameter. Visual (VT) inspection did not identify signs of edge settlement. The tank settlement should be monitored at the next internal inspection.

INTERNAL:

The next Internal inspection should be conducted within 20 years if all areas of corrosion below 1/8 inch on the tank bottom and 0.177 inch in the critical zone are repaired and no later than November 2028 (ref. API 653, Para. 6.4.2.2.1). This calculation is based on the measured tank bottom corrosion rate and the minimum remaining thickness in accordance with API 653, Para. 4.4.5.

If the tank bottom is replaced, the next internal inspection should be performed within 10 years to establish a corrosion rate. Additional years may be added if measures are taken in accordance with API 653, 6.4.2.1.1 and Table 6.1.

EXTERNAL VISUAL AND ULTRASONIC:

The next Visual (VT) external inspection should be conducted within 5 years and no later than November 2028 (ref. API 653, Para. 6.3.2.1). This calculation is based on the formula $RCA/4N$ (where RCA is the difference between the measured shell thickness and the minimum required thickness in mils, and N is the shell corrosion rate in mils per year).

Shell corrosion rate calculations indicate the next Ultrasonic Thickness (UT) inspection should be performed within 15 years and no later than November 2038 (ref. API 653, Para. 6.3.3.2.b). This calculation is based on the formula $RCA/2N$ (where RCA is the difference between the measured shell thickness and the minimum required thickness in mils, and N is the shell corrosion rate in mils per year).

3. FINDINGS AND RECOMMENDATIONS

EXTERNAL COATINGS

The external coatings on the tank have chalking and chipping type failure on 20-30 percent of the tanks surface with isolated areas of visible primer and surface rust. While not required by API 653, coating failure is directly related to active corrosion and other types of metal loss that could result in premature failure of steel components causing hazards to personnel and / or loss of contents. Consideration should be given to properly cleaning and re-coating the external Shell, Nozzles, and Fixed Roof.

FOUNDATION:

There is vegetation growing inside the containment and adjacent to the concrete ringwall. Consideration should be given to removing the vegetation.

The top of the concrete ringwall has been sealed at an unknown date using an unknown material similar to epoxy-based paint. This is provided as information only.

The concrete ringwall has isolated hairline cracks less than 0.0625 inch in width and spalling intermittently around the tank. These areas should be properly sealed.

The tank is equipped with an asphalt type moisture barrier that has dry rotted and failed around the entire circumference of the tank allowing water to penetrate beneath the bottom edge projection. The moisture barrier should be removed, and a new appropriate moisture barrier installed.

The tank is equipped with ten (10) 4-inch X 2.50-inch X 12-inch-tall anchor chairs affixed to 1-inch anchor bolts spaced evenly around the tank. The anchor bolts have active corrosion that has deteriorated up to 60-75 percent of the bolt's material directly above the concrete ringwall. The anchor bolts should be removed and replaced prior to returning the tank to service.

There is active corrosion on the inside of Anchor Chair CC that is beginning to spread to the shell plate. This area should be re-inspected once the bolt is removed.

One (1) leak detection port was visible beneath Manway A. This is provided as information only.

No Cathodic Protection equipment was noted near the tank. This is provided as information only.

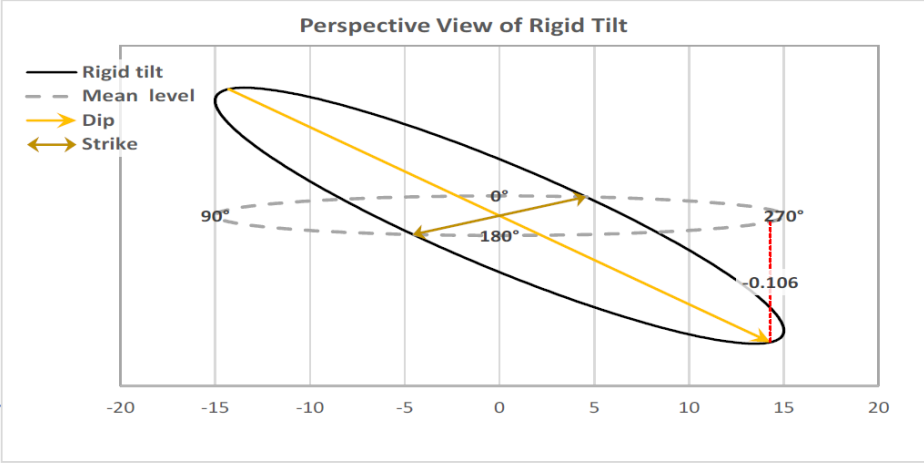
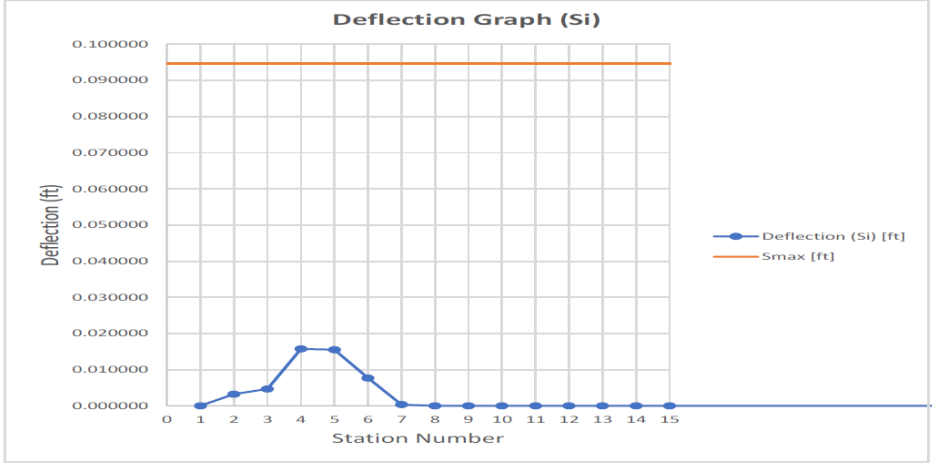
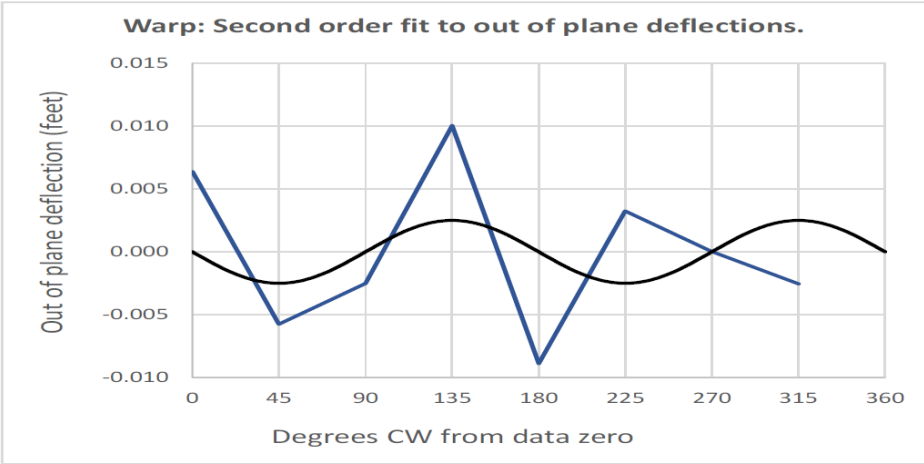
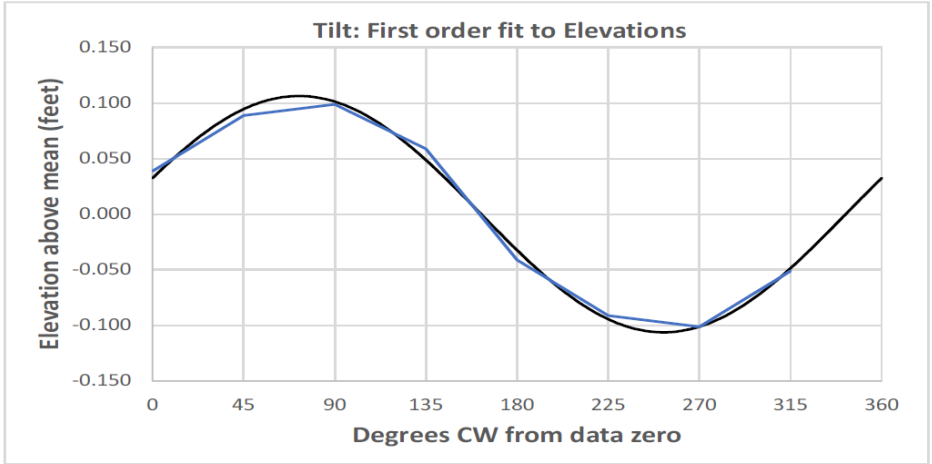
BOTTOM:

The tank bottom requires an inspection blast to properly evaluate the entire condition of the tank bottom for repair. Taking in consideration the additional wall loss found on the MFL indications identified in 2016 at the previous bottom scan and the active corrosion on the external bottom edge projection plate, it would be likely that additional corrosion and possible through thickness corrosion would be found after an inspection blast. Consideration should be given to replacing the tank bottom at this time prior to returning the tank to service.

The external bottom edge projection has leafing type corrosion around 40-50 percent of the tanks circumference due to the asphalt moisture barrier failing. Random Ultrasonic Thickness readings were taken where corrosion was present and found remaining thicknesses between 0.130 to 0.180 inch. Thickness readings in some areas could not be obtained due to the condition of the surface. The bottom edge projection should be sandblasted and re-inspected prior to returning the tank to service.

The tank bottom is a lap welded single slope (shovel bottom). The bottom slope was measured at twelve (12) inches by measuring the first shell course at the high point (Manway A) and Low Point (behind the sump nearest the shell).

4.2.2 SHELL SETTLEMENT EVALUATION GRAPHS



4.2.5 FOUNDATION PHOTOGRAPHS



001 Grade Surrounding Tank Foundation



002 Grade Surrounding Tank Foundation



003 Spalling on Ringwall



004 Spalling on Ringwall





031 Active Corrosion on Anchor Chair X



032 Anchor Chair Z



033 Active Corrosion on Anchor Chair Z

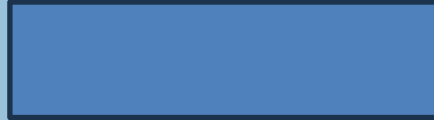


034 Anchor Chair BB

API INDIVIDUAL CERTIFICATION PROGRAMS



verifies that



HAS MET THE ESTABLISHED AND PUBLISHED REQUIREMENTS FOR API CERTIFICATION AS AN
API 653 ABOVEGROUND STORAGE TANK INSPECTOR

IN ACCORDANCE WITH THE KNOWLEDGE DEFINED IN THE **API Standard 653**

CERTIFICATION NUMBER **74686**

ORIGINAL CERTIFICATION DATE	August 31, 2017
CURRENT CERTIFICATION DATE	August 31, 2023
EXPIRATION DATE	August 31, 2026

Director, Individual Certification Programs

CERTIFICATION

Steel Tank Institute



STI Inspector No: **AC 44536**

Expires: **January 3, 2028**

The person whose name appears on this certificate has met all the requirements to attain the STI SP001 Adjunct Certification for API 653 Inspectors.

This certification is dependent on an active API 653 certification.

6 PDHs Awarded

A handwritten signature in black ink, appearing to read "Joseph Mentzer".

Joseph Mentzer, P.E.
Steel Tank Institute



Issue Date:
01/03/2023

The official status of this certificate can be verified at www.steel tank.com.

A few questions

- Describe your safety and environmental management system and show me the documentation and some examples of leadership messaging about it.
- Can I review the tank database and what do you track?
- Do you use RBI or similar service at the facility. Describe when and how. Show the process for its implementation.
- Can we review the tank inspection report?

- Tell me about the corrosion rates, repair recommendations, the basis for the next internal inspection date, the repairs that were done, the service history, etc.
- Does the tank have an RPB (release prevention barrier)?
- Does the tank have a double bottom?
- Does the tank have leak detection? If so, what kind?
- Can review the photos from the inspection report?



Any Questions?

Andrew Yearwood, PEMY Consulting
Andrew@pemyconsulting.com
918-698-2110



27th California Unified Program
Annual Training Conference
March 24-27, 2025