Sources and Causes of UST Releases

ASTSWMO Tanks Subcommittee
April 23, 2020
• All attendees are muted throughout the webinar.

• **Questions:** Use the Questions Pane in the control panel to send questions to the speakers throughout the webinar.

  • Note who the question is directed to in your submittal.

• The webinar is being recorded and will be made available on the ASTSWMO website.
Presentations & Speakers

- National Trends in Underground Storage Tank Infrastructure: Alex Hall (EPA ORD)

- Source and Cause of Utah Petroleum Storage Tank Fund Releases: Therron Blatter (UT DEQ)

- Internal Corrosion and UST Releases – Lessons Learned in Arizona: Chris Marks (AZ DEQ)

- Florida’s Process for Determining Source and Cause: Zach Barrett (FL DEP)
National Trends in Underground Storage Tank Infrastructure

Alex Hall, US EPA Office of Research and Development—Cincinnati, OH
hall.alexander@epa.gov

The views expressed in this presentation are those of the author and do not necessarily represent the views of policies of the U.S. Environmental Protection Agency
Underground Storage Tank Releases, by Year

- Count
- Year

- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015

The graph indicates a peak in releases around 1990, with a significant decrease in later years.
Historical UST Lifespan | Removal Date – Installation Date (n=736,757)
Installation Date of Currently Open USTs (n=415k)

- n=415K out of a universe of 552k
- 40% of open USTs are over 30 years old
- Average: 25 yrs.
Single Wall and Double Wall Installations, by Year
Average Underground Storage Tank Age at Removal (n=725,259) & Release Date (n=9,817)

- Single Walled USTs
- Double Walled USTs
- UST Age at Year of Removal
- UST age at Year of Release
Fuel Type: Diesel and non-Diesel Gasoline

UST Release Rates for Twelve States

• Is the rate of diesel releases in diesel tank infrastructure higher than the rate of non-diesel releases in non-diesel gasoline tank infrastructure?

• For every 1 diesel UST installed what is the probability it will be associated with a reported release?

• For every 1 non-Diesel gasoline UST installed what is the probability it will be associated with a reported release?

UST Universe: All USTs installed after 1970
LUST Universe: All LUSTs after 1988

\[ \text{Rate} = \frac{\text{LUST Universe}^{\text{substance}}}{\text{UST Universe}^{\text{substance}}} \]
## Fuel Type: Diesel and non-Diesel Gasoline UST Release Rates

<table>
<thead>
<tr>
<th>State</th>
<th>Substance</th>
<th>UST Count</th>
<th>LUST Count</th>
<th>( \text{of Gas USTs to Diesel USTs} )</th>
<th>( \text{of Gas LUSTs to Diesel LUSTs} )</th>
<th>( \text{of Diesel USTs to Diesel LUSTs} )</th>
<th>( \text{of Gas USTs to Gas LUSTs} )</th>
<th>% LUST Rate</th>
<th>% Likelihood a Diesel UST will become a Diesel LUST over a Gas UST becoming a Gas LUST</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Diesel</td>
<td>5360</td>
<td>169</td>
<td>3:1</td>
<td>3:1</td>
<td>32:1</td>
<td>33:1</td>
<td>3.2%</td>
<td>0.10%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>15964</td>
<td>487</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.1%</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Diesel</td>
<td>3223</td>
<td>396</td>
<td>5:1</td>
<td>3:1</td>
<td>8:1</td>
<td>11:1</td>
<td>12.3%</td>
<td>-21.94%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>15486</td>
<td>1323</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.5%</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Diesel</td>
<td>539</td>
<td>120</td>
<td>2:1</td>
<td>3:1</td>
<td>4:1</td>
<td>2:1</td>
<td>22.3%</td>
<td>-25.19%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>941</td>
<td>416</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>44.2%</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>Diesel</td>
<td>10015</td>
<td>3223</td>
<td>2:1</td>
<td>4:1</td>
<td>3:1</td>
<td>7:1</td>
<td>32.2%</td>
<td>57.4%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>21308</td>
<td>12224</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.74%</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>Diesel</td>
<td>5142</td>
<td>969</td>
<td>2:1</td>
<td>3:1</td>
<td>5:1</td>
<td>3:1</td>
<td>18.8%</td>
<td>-9.82%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>10744</td>
<td>3080</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>28.7%</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Diesel</td>
<td>3243</td>
<td>456</td>
<td>3:1</td>
<td>4:1</td>
<td>7:1</td>
<td>5:1</td>
<td>14.1%</td>
<td>-7.53%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>8383</td>
<td>1810</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>21.6%</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>Diesel</td>
<td>11878</td>
<td>1698</td>
<td>3:1</td>
<td>3:1</td>
<td>7:1</td>
<td>7:1</td>
<td>14.3%</td>
<td>-3.32%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>30368</td>
<td>5348</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.6%</td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>Diesel</td>
<td>2504</td>
<td>282</td>
<td>2:1</td>
<td>2:1</td>
<td>9:1</td>
<td>8:1</td>
<td>11.3%</td>
<td>-0.66%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>5746</td>
<td>685</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11.9%</td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>Diesel</td>
<td>7445</td>
<td>604</td>
<td>3:1</td>
<td>5:1</td>
<td>12:1</td>
<td>7:1</td>
<td>8.1%</td>
<td>-6.15%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>20431</td>
<td>2914</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>14.3%</td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>Diesel</td>
<td>16940</td>
<td>1455</td>
<td>2:1</td>
<td>2:1</td>
<td>12:1</td>
<td>13:1</td>
<td>11.64%</td>
<td>-1.25%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>40237</td>
<td>3122</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>12.89%</td>
<td></td>
</tr>
<tr>
<td>K</td>
<td>Diesel</td>
<td>2016</td>
<td>312</td>
<td>2:1</td>
<td>3:1</td>
<td>6:1</td>
<td>4:1</td>
<td>15.5%</td>
<td>-7.10%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>4358</td>
<td>984</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>22.6%</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Diesel</td>
<td>2179</td>
<td>432</td>
<td>3:1</td>
<td>3:1</td>
<td>6:1</td>
<td>7:1</td>
<td>19.8%</td>
<td>2.27%</td>
</tr>
<tr>
<td></td>
<td>Gasoline</td>
<td>7110</td>
<td>1248</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>17.6%</td>
<td></td>
</tr>
</tbody>
</table>
Looking to the Future

• Framing the complex relationship between UST infrastructure and the cause of a release should be data driven

• Linking individual USTs IDs (and associated piping and stored substances) with a release is fundamental to understanding the source and cause of a release. Without this information we are feeling around in the dark.

• A large database of USTs characteristics and their associated releases will allow analysis on current vulnerabilities in the UST infrastructure and provide predictive insights to prevent leaks.
Source and Cause of Utah Petroleum Storage Tank Fund Releases

Therron Blatter, UST Branch Manager
Division of Environmental Response and Remediation
Why Do I Care About “Source” and “Cause” of UST Releases
Selected Data Set

- Releases reported after January 1, 2000
- Releases for which Utah’s Petroleum Storage Tank Fund has made payment.
- Source and Cause data have been reviewed and verified
- Source and Cause data were matched with the options set forth in the Grant Guidelines for Implementing the Public Record Provision Of The Energy Policy Act Of 2005
- 244 releases: Average cleanup cost $175K
Source of Release

- Unknown: 31%
- Piping: 22%
- Dispenser: 17%
- Delivery Problem: 14%
- Tank: 11%
- Submersible Turbine Pump: 4%
- Other: 1%
Cause of Release

- Unknown: 51%
- Phys/Mech Damage: 19%
- Corrosion: 11%
- Overfill: 10%
- Spill: 6%
- Install Problem: 2%
- Other: 1%
Method the Release was Discovered

- Permanent Closure Samples: 28%
- Environmental Assessment: 7%
- Failed Monitoring/Test: 11%
- Dripping or Streaming Product: 7%
- Vapors/odors: 8%
- Visual Evidence: 4%
- Soil Staining: 4%
- Other: 2%

Division of Environmental Response and Remediation
What We Know About “Unknown”

- 76 sites had an “Unknown” source of release: 74% of these unknown sources were discovered by either a site assessment or permanent closure samples.
- 123 sites had an “Unknown” cause of release: 72% of these unknown causes were discovered by either a site assessment or permanent closure samples.
- Assumptions typically must be made when classifying Source and particularly Cause for releases discovered via site assessments or permanent closure samples.
- I consider source and cause data for releases discovered via closure and site assessment significantly less reliable than for other methods of determination.
Average Cost of Cleanup By Source

- Other
- Unknown
- Delivery Problem
- Dispenser
- Piping
- Tank
- Submersible Turbine Pump

Average Cleanup Cost
Average Cleanup Cost Without Closure and Site Assessment

$0 $100,000 $200,000 $300,000 $400,000 $500,000 $600,000
Average Cost of Cleanup By Cause

- Other
- Spill
- Unknown
- Overfill
- Phys/Mech Damage
- Corrosion
- Install Problem

Average Cleanup Cost
Average Cleanup Cost Without Closure and Site Assessment
Lessons Learned and What is Next

- Determining the Source and Cause of a release is difficult for existing contamination.

- Releases from tanks and submersible turbine pump are significantly more expensive to clean up. Anything that encourages removal of old UST systems, especially impressed current CP steel tanks, is worthwhile.

- What would this look like with multiple states data sets?

- Have trends gotten better with newer releases?
Contact Information:
Therron Blatter
UST Branch Manager
Utah Department of Environmental Quality
tblatter@utah.gov
801-536-4141
Internal Corrosion and UST Releases – Lessons Learned in Arizona

Chris Marks Ph.D.
Arizona Dept. of Environmental Quality
ASTSWMO Tanks Subcommittee – Sources and Causes of UST Releases
April 23, 2020
ADEQ Study:
- Evaluate the existence and extent of internal corrosion (and degradation) on UST surfaces for representative systems, including:
  - UST storing diesel and gasoline
  - USTs constructed of steel and fiberglass reinforced plastic (FRP)

Data Collected
- Internal video (visual) inspection
- Ullage temperature and % relative humidity
- Water presence testing
- Laboratory analyses of water bottoms and fuel samples
- Visual inspection of sumps and spill buckets for signs of corrosion

Can this information be used to identify USTs more likely to have a release?
AZ Results:
- Moderate – Severe issues found in ~30% of surveyed tanks (n = 78)
  - Including both diesel and gasoline storing systems
  - Including both steel tanks and FRP
- Tank age is not predictive of corrosion rating
Rating Results

School Tank Ratings Breakdown

- **B**: 71%
- **C**: 19%
- **D**: 9%
- **A**: 1%

Corrosion Rating: B

Corrosion Rating: D
Facilities with USTs removed after internal visual inspection study.
All USTs removed less than 3 years after visual inspection.
Example: Release Confirmed from USTs Rated C and D

Tank 4 - Diesel: C Rating

Tank 5 - Gasoline: D Rating

Tank Inspection Details:
• Cracks noted in Tank 4 (yellow arrows) and generalized oxidation of STP shaft
• Tank 5 had extensive wall degradation/flaking and STP shaft oxidation, sediment/debris buildup in tank bottom
Release Confirmed from UST with B Rating

Tank Inspection Details:
- Oxidation on tank seams and sediment/debris buildup

Release Details:
- A split weld near tank bottom discovered during removal
D Rated USTs – No Documented Release

Tank Inspection Details:
- Widespread wall deterioration/flaking
- Buildup of sediment on tank bottom

Tank Inspection Details:
- Complete failure of tank lining
- Extensive generalized oxidation of STP shaft
Lessons Learned: the call for nation-wide data

We need to know more about our UST systems, the fuel products stored, and how releases occur.

We need to analyze available data at a local and national level to search for trends and to identify where we have data gaps.

Sometimes, evidence of internal corrosion and degradation issues can help identify potential leaks.

- Current ADEQ & EPA rating scheme limitation:
  - Provides useful info to customers/stakeholders related to fuel quality and system operations; however, the limited data reviewed so far does not suggest that internal corrosion ratings may be used to predict a release to the environment.
Lessons Learned: the need for new paradigms

In addition to the need for improved understanding of the source and cause for releases from UST systems, the following observations suggest that we need to improve our understanding of the existing UST infrastructure:

- Corrosion of UST internal infrastructure is widespread and common
- Microbiologically-influenced Corrosion (MIC) is a complex process
- Assessments of potential infrastructure deterioration need go beyond the native fuel chemistries to account for conditions to be expected from fuel storage (e.g. acidification, biofouling)
- A new UST infrastructure deterioration paradigm is needed to encompass them as dynamic ecosystems and to include non-metallic components
Lessons Learned: the need for new paradigms

Susceptible Material

Electrolyte

Electrochemical Potential

CORROSION

Polymer resin

Water

Labile fuel components

Requisite Microbial Community

DETERIORATION
Contact Info and References

Christopher Marks, Ph.D.
Marks.Christopher@azdeq.gov
(602) 771-0561
https://azdeq.gov/USTProgram

References:
Florida’s Process for Determining Source and Cause
Determining Source and Cause

**Discharge Reporting Form (DRF)**
- Many options
- Simple terminology
- Comments field

**Discharge Inspections**
- Required inspection by DEP
- Training on identification
- Proper data entry
# Our Discharge Reporting Form

**Discharge originated from:** (Check all that apply)
- [ ] Tank
- [ ] Piping
- [ ] Spill bucket
- [ ] Dispenser
- [ ] Piping sump
- [ ] Dispenser sump
- [ ] Other secondary containment
- [ ] Fitting or pipe connection
- [ ] Valve
- [ ] Tank truck
- [ ] Vehicle or customer vehicle
- [ ] Aircraft
- [ ] Railroad tankcar
- [ ] Barge, tanker ship or other vessel
- [ ] Pipeline
- [ ] Drum
- [ ] Unknown
- [ ] Other (specify)

**Cause of the discharge:** (Check all that apply)
- [ ] Spill
- [ ] Overfill
- [ ] Corrosion
- [ ] Puncture
- [ ] Material failure (crack, split, etc.)
- [ ] Material Incompatibility
- [ ] Improper installation
- [ ] Loose connection
- [ ] Collision
- [ ] Vehicle accident
- [ ] Fire/explosion
- [ ] Vandalism
- [ ] Weather
- [ ] Human error
- [ ] Unknown
- [ ] Other (specify)

**Actions taken in response to the discharge:**

**Comments:**

**Agencies notified (as applicable):**
- [ ] Fire Department
- [ ] County Program
- [ ] District Office
- [ ] State Watch Office 800-320-0519
- [ ] National Response Center 800-424-8802
Entering the Data

Data from discharge inspection conducted by inspectors
Types of Inspector Training

- Routine Inspector Webinar Trainings
- Monthly teleconference with Districts
- Quarterly teleconferences with contracted counties
- Annual conference for District and County Inspectors
Closures & Other Unclear Discharges

- Use evidence for identification
- Look at location of contamination
- Look for visible damage
- Review system monitoring data
- Review incident reports
- Some are just unknown
THANK YOU!

- National Trends in Underground Storage Tank Infrastructure: Alex Hall (EPA ORD)
  - Hall.Alexander@epa.gov

- Source and Cause of Utah Petroleum Storage Tank Fund Releases: Therron Blatter (UT DEQ)
  - TBlatter@utah.gov

- Internal Corrosion and UST Releases – Lessons Learned in Arizona: Chris Marks (AZ DEQ)
  - Marks.Christopher@azdeq.gov

- Florida’s Process for Determining Source and Cause: Zach Barrett (FL DEP)
  - Zachary.Barrett@floridadep.gov

- ASTSWMO Contact:
  - Charles Reyes charlesr@astswmo.org