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Evidence-based online courses on a variety of children's environmental health topics.
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Resource Catalog
Fact sheets, journal publications, reports, and other resources for parents, community members, patients and healthcare professionals
Topics included: Air Quality, Pesticides, Natural Disasters, BPA, Mold, Lead, Mercury
The Aliso Canyon Gas Leak

Public Health Roles and Responses
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Objectives

• Learn the health impacts of the Aliso Canyon gas leak on the adjacent communities

• Understand how local and state agencies interact to evaluate air contaminants and other environmental hazards

• Learn the role of a local Public Health department in mitigating during and after an environmental threat
Aliso Canyon Gas Leak

Background
Operated by Southern California Gas Company since 1972

In the Santa Susana Mountains – 3k ft from homes of Porter Ranch, CA.

Petroleum drilled from this site, until field was “spent”, resulting in empty natural underground caverns

Geologists determined caverns could be used for natural gas storage.
Natural gas trucked into the facility, peaking in Summer when demand is relatively low.

100+ injection/withdrawal wells allow gas storage in caverns under pressure

Gas extracted and distributed to a network of customers (e.g. residences and electric gas generators)

Wells are long pipes with metal and, in some cases, cement casings, depending on size.

No mining, fracking, or drilling
October 23, 2015:

- Personnel (engineers, safety officials, and agency representatives, including County Fire and HazMat) discovered a leak associated with one of the wells (“SS-25”). This is one of the smaller wells on the field.
What is the most significant risk associated with a natural gas leak at a gas storage field?

- Asphyxiation
- Ignition/combustion
- No significant risk
Answer

- Asphyxiation
- Ignition/combustion
- No significant risk
Aliso Canyon Gas Leak

Characterizing the Exposure
Primary component of natural gas is methane.

Sulfur compounds are added before storage and distribution. These compounds give natural gas its characteristic odor.

This facility adds Scentinel® T-50, a mixture of 2 compounds: tert-butyl mercaptan and tetrahydrothiophene (THT).
Characterizing the leak and the exposure

Methane

- Asphyxiant gas, may cause the displacement of oxygen in closed spaces.
- Absorption of methane does not lead to systemic toxicity.
- Safety risk secondary to flammability (lower explosive limit 50,000ppm)
Sulfur odorants:

- Short term: “headache, dizziness, staggered gait, nausea, vomiting, pulmonary mucous membrane irritation, wheezing, tachycardia, limb rigidity, cyanosis” (CDC, 1988)
- Long-term: “dermatitis”… “no long-term studies have been performed…” (CDC, 1988)
Characterizing the leak and the exposure

“…We do not know whether long-term exposure to low levels of mercaptan can result in harmful health effects. There is no information available about whether mercaptan causes cancer in people or animals. The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have not classified mercaptan for carcinogenicity.”

(CDC/ATSDR)
Characterizing the leak and the exposure

- Difficulty with messaging, reconciling with overly generalized statements
- Public confusion regarding context and circumstances of exposure
- Lack of studies construed as positive confirmation of unknown, permanent effects
The gas leak was coming from below the surface of the field, but the depth of the breach was not initially known.

Personnel at the facility detected an odor and notified the Los Angeles County Fire Department on October 26.

Public Health was notified around October 29.

SoCalGas informed the Fire Dept that the leak would likely be fixed in about 3-7 days via after a “well kill”
SoCalGas attempted to drive down well pressure, initiated well kill
Well kill was unsuccessful, resulted in emission of an oily mist, manifested in a dried oily residue on some outdoor surfaces in the community.
Residue was found to be composed of crude oil.
Geological engineers determined well could not be killed from above, would require a 3-4 month solution to kill the well at depth
Public Health determined it would be appropriate to establish a daily air monitoring program to monitor for all chemical constituents that may be associated with the gas leak.

- Methane, sulfur odorants, BTEX gases, PAH’s, metals, hydrogen sulfide
Community complaints and evolution of the leak

- The Public Health department began receiving complaints of odors from the community.
- Most complaints were mild in nature, and involved the homes closest to the facility.
- A few days later, reports of symptoms began to emerge, and increased daily.
Community complaints and evolution of the leak

- Symptoms included nausea, abdominal discomfort, headaches, dizziness, sino-pulmonary irritation

- Public Health issued a directive, enabling any household to relocate temporarily secondary to symptoms

- Directive was extended to 2 areas public schools
Summary of Symptoms/Actions Reported by Household (N=600)

- 61% Headache / Migraine
- 40% Nausea/Vomiting/Stomach ache/GI/Diarrhea
- 32% Bloody Nose
- 27% Respiratory / Breathing Symptoms
- 24% Chest Tightness / Coughing / Palpitations
- 22% Dizzy / Lightheaded
- 18% Eye Irritation / Vision Complaints
- 17% Smell / Odor
- 16% Sore Throat
- 13% Went to MD / ER
- 9% Pet Affected
- 10% Relocated or Requested Relocation
Aliso Canyon Symptom Reports
Respondent’s Address: Distance to Leak

Distance (mi.)  n
1.1 - 2 mi  119
2.1 - 3 mi  166
3.1 - 4 mi  66
4.1 - 5 mi  74
5.1 - 10 mi  81
10 mi +  5
Total  511

Sources: Esri, HERE, DeLorme, USGS, Intermap, Increment P Corp., NRCAN, Esri Japan, METI, Esri, China (Hong Kong), Esri (Thailand), Mappinetic, © OpenStreetMap contributors, and the GIS User Community.

Aliso Canyon Symptom Survey Respondent's Address*
*Created by: Office of Health Assessment and Epidemiology, Epidemiology Unit, 02/3/16. Map shows the density of Symptom Survey respondent’s addresses. 511 of 687 addresses were located (the rest were excluded due to incorrect or missing addresses). *Euclidean Distance from SS-25.
Aliso Canyon Symptom Survey
Complaint Density

Aliso Canyon Symptom Survey Respondent's Address

Created by: Office of Health Assessment and Epidemiology, Epidemiology Unit. 02/3/16. Map shows the density of Symptom Survey respondent's addresses. 511 of 687 addresses were located (the rest were excluded due to incorrect or missing addresses).
Aliso Canyon Gas Leak

Air Monitoring
Air Sampling Locations

Air Sampling Collection Sites

The yellow squares indicate where 12-hour air samples are being collected twice daily at key places within the facility, upwind of the community.

The green points below indicate where “grab” air samples are being collected twice daily in the neighboring community.

In addition, real-time air monitoring is being conducted near the leak site.
SCAQMD and CARB Real-time Methane Monitoring
# Community Cumulative “Grab” Sample Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>Southern California Gas Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>“Grab” (10-minute) Samples</td>
</tr>
<tr>
<td>Dates</td>
<td>October 30 - January 28</td>
</tr>
<tr>
<td>Chemicals Tested</td>
<td>Methane, Other Hydrocarbons, BTEX, Sulfur Compounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Number Detected / Total Samples</th>
<th>% Detects</th>
<th>Range (Min-Max)</th>
<th>Average*</th>
<th>Health Protective Level</th>
<th>Background Levels</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>1702 / 1702</td>
<td>100%</td>
<td>1.2 - 231</td>
<td>8.0</td>
<td>50,000**</td>
<td>NA</td>
<td>ppm</td>
</tr>
<tr>
<td>Benzene</td>
<td>766 / 1699</td>
<td>45%</td>
<td>0.1 - 5.6</td>
<td>0.38</td>
<td>8.0***</td>
<td>NA</td>
<td>ppb</td>
</tr>
<tr>
<td>tert-Butyl Mercaptan</td>
<td>0 / 1623</td>
<td>0%</td>
<td>ND -</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>ppb</td>
</tr>
<tr>
<td>Tetrahydrothiophene</td>
<td>0 / 1623</td>
<td>0%</td>
<td>ND -</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>ppb</td>
</tr>
</tbody>
</table>

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available

*Average of detected concentrations.
**Lower explosive limit.
***Acute reference exposure limit.
Boundary Cumulative Summary

<table>
<thead>
<tr>
<th>Source</th>
<th>Southern California Gas Company</th>
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<tbody>
<tr>
<td>Type</td>
<td>12-Hour Samples</td>
</tr>
<tr>
<td>Dates</td>
<td>January 12 - January 27</td>
</tr>
<tr>
<td>Chemicals Tested</td>
<td>Methane, BTEX, Sulfur Compounds</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Number Detected / Total Samples</th>
<th>% Detects</th>
<th>Range (Min-Max)</th>
<th>Average*</th>
<th>Health Protective Levels</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane</td>
<td>196 / 196</td>
<td>100%</td>
<td>1.9 - 24</td>
<td>5.3</td>
<td>50,000**</td>
<td>ppm</td>
</tr>
<tr>
<td>Benzene</td>
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<td>100%</td>
<td>0.08 - 0.42</td>
<td>0.18</td>
<td>1.0***</td>
<td>ppb</td>
</tr>
<tr>
<td>tert-Butyl Mercaptan</td>
<td>0 / 197</td>
<td>0%</td>
<td>ND</td>
<td>NA</td>
<td>NA</td>
<td>ppb</td>
</tr>
<tr>
<td>Tetrahydrothiophene</td>
<td>0 / 197</td>
<td>0%</td>
<td>ND</td>
<td>NA</td>
<td>NA</td>
<td>ppb</td>
</tr>
</tbody>
</table>

ppm = parts per million; ppb = parts per billion; ND = non-detectable; NA = not available

*Average of detected concentrations.

**Lower explosive limit.

*** Chronic reference exposure limit.
Average Weekly Methane Concentrations in the Community
(10/30/2015 - 1/27/2016); Source: SoCalGas Grab Samples

I indicates highest and lowest test results

* SCAQMD samples taken 10/26/15 - 1/13/16

Indicates break in y-axis scale
Average Weekly Benzene Concentrations in the Community
(10/30/2015 - 1/27/2016); Source: SoCalGas Grab Samples

I Indicates the lowest and highest test
* SCAQMD samples taken 10/26/15 - 1/23/16
“The modeled additional cancer risks attributed to the gas leak are estimated to be less than 2-in-one million for a six-month exposure, almost exclusively due to benzene.” (AQMD)

“Based on the limited available SoCal Gas monitoring data (January 12, 2016 to February 22, 2016), preliminary estimates of the long-term health risks from a six-month exposure to benzene and air toxics from all sources (including the gas leak) is less than one-third of the REL, and the estimated cancer risk from benzene is less than 4-in-one million.” (AQMD)
Activities to Assess Health Effects in Residents, Pets, and Other Animals

Assessing Effects on Human Health
• Department of Public Health Complaint Line
• Community Resource Center
• Outreach to Medical Providers

Assessing Effects on Animal Health
• Veterinary Clinic Outreach
• Outreach to Large Animal Veterinarians
• Outreach to Animal Shelters and CDFW
• Reports from Pet Owners
Case #1

- Newborn male with no symptoms, feeding and sleeping normally
- Family reports no odors associated with the gas leak
- No symptoms reported in any family members
Question from parents:
Our baby was just born. Are the chemicals from the gas leak more harmful to our baby? Should we relocate even though we are not smelling the gas and have no symptoms?
Case #2

- 6-year-old female with history of asthma and allergies, hospitalized in the PICU with pneumonia and respiratory failure

- Past medical history of moderate asthma, controlled with inhaled beta-agonists and corticosteroids

- Symptoms occurred in early November the gas leak. Odors detected by the family. Other family members reported nausea.
Question from parents:
Will our child have permanent health problems associated with the gas leak?
Case #3

- 12-year-old male was diagnosed with anemia and undergoing a workup for possible leukemia

- WBC 2.0, neutrophils “low”, Hgb 7, plt 90

- Bone marrow biopsy pending
Question from parents:
Did benzene cause leukemia in our son?
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