



# **WESTERN STATES DIVISION**

## **OVERVIEW OF NIOSH'S OIL AND GAS RESEARCH PROGRAM**

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***Rocky Mountain EHS Peer Group***

***Q2 Meeting***

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The findings and conclusions in this presentation are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention and the National Institute for Occupational Safety and Health.



# NIOSH Western States Division: Our Mission



Conduct research in the prevention of work-related illness, injury, and death

Focus predominantly on Western occupational safety and health (OSH) issues

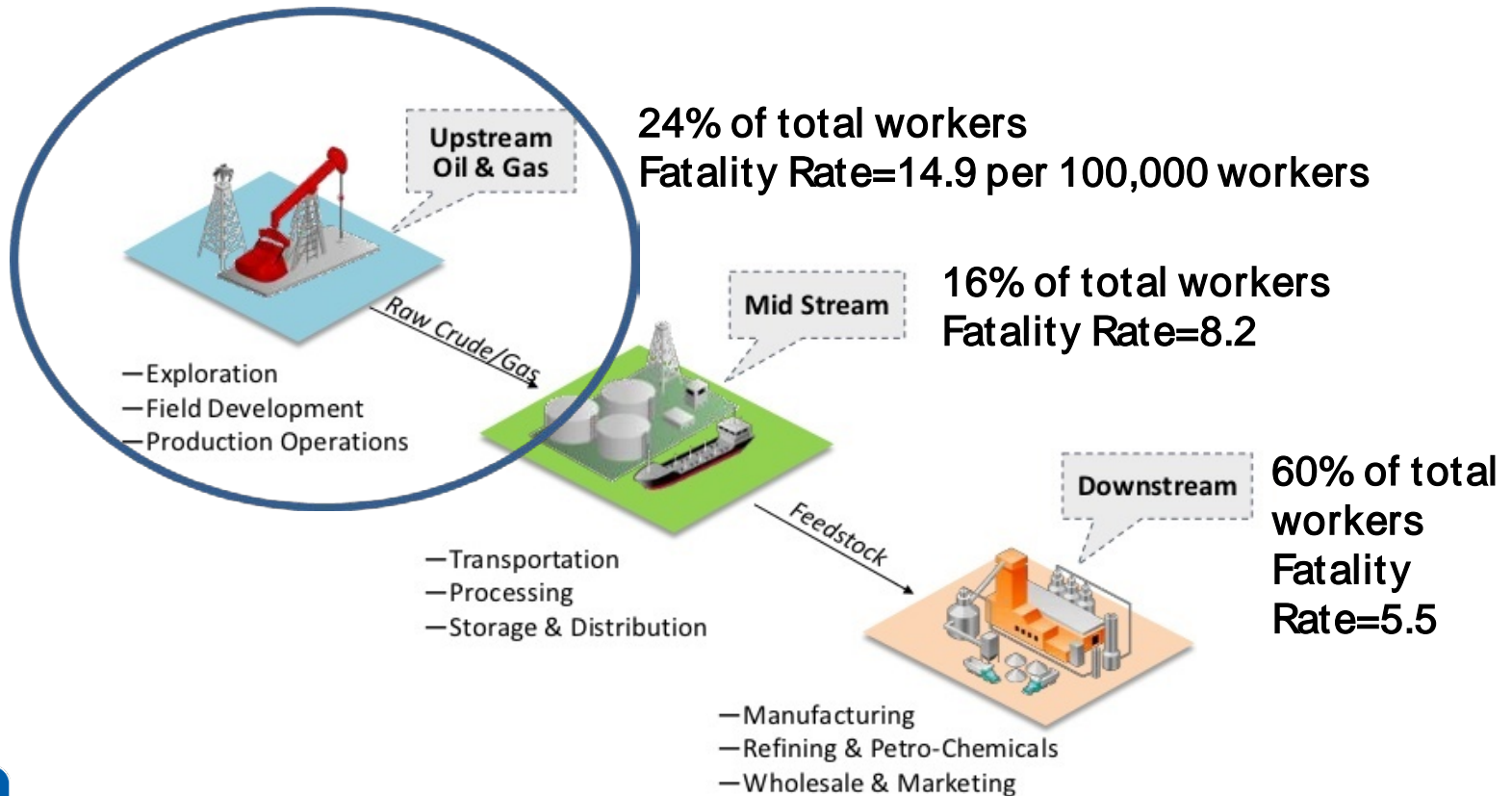
Facilitate and support NIOSH programs, initiatives, and activities in the West

## Oil and Gas Extraction Health and Safety Research

- Data-driven research program
- Integrates:
  - Epidemiology
  - Industrial hygiene
  - Engineering
  - Health Communications
- Partnerships with stakeholders are key

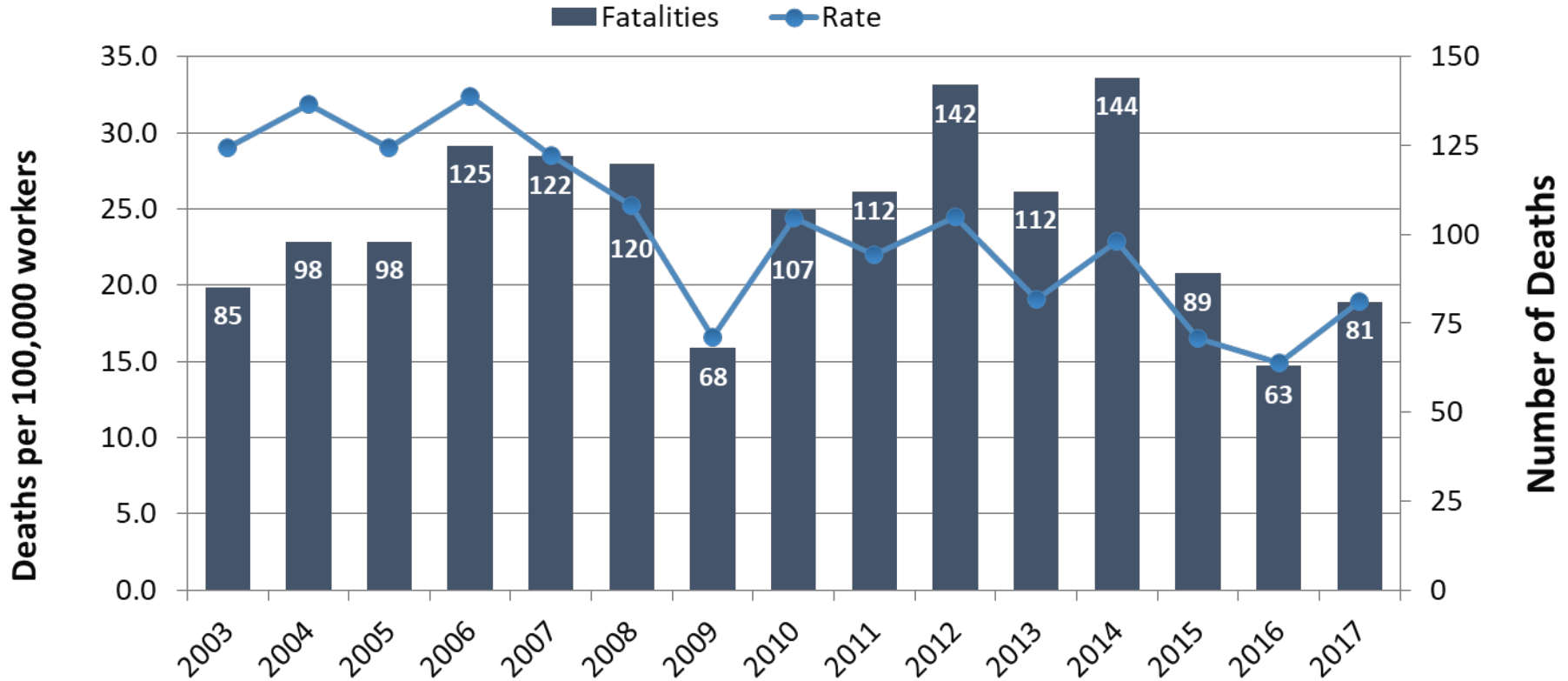


# Oil and Gas Research: Epidemiology

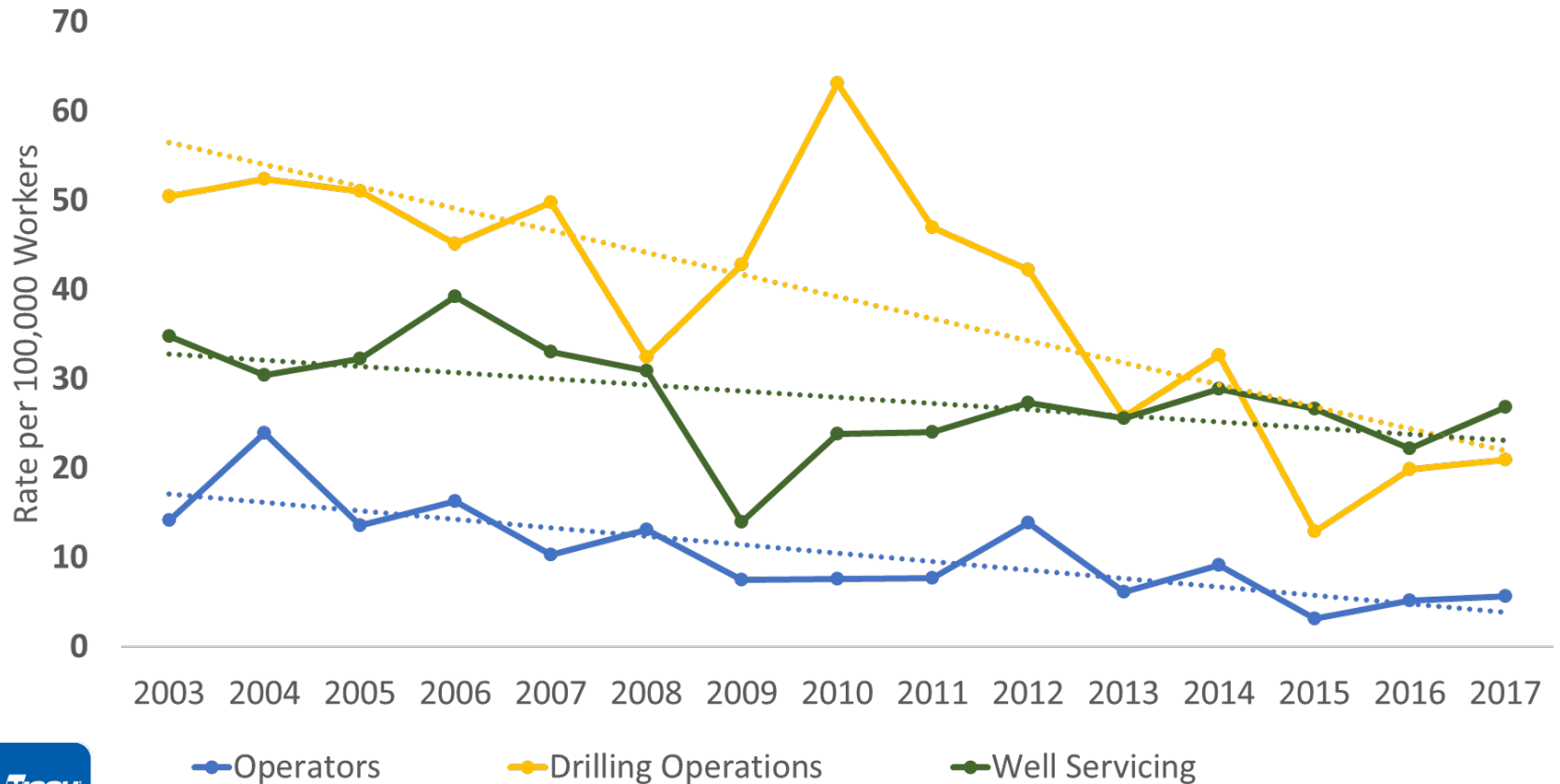


Source: BLS/CFOI and BLS/QCEW. All rates calculated per 100,000 workers.

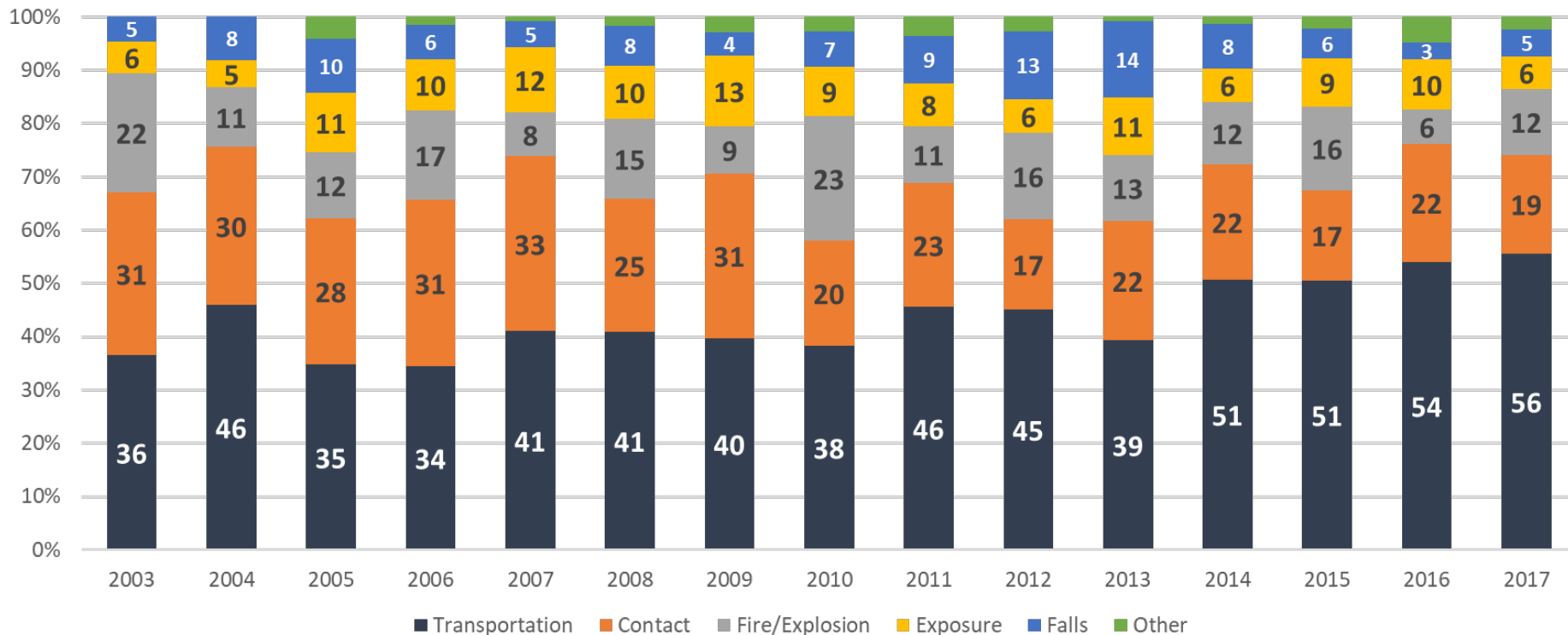
# Number and Rate of Fatal Work Injuries U.S. Oil & Gas Extraction Industry, 2003–2017



# Occupational Fatality Rate by Company Type, Oil and Gas Extraction Industry, 2003–2017



# Leading Causes of Occupational Fatalities (%) by Year, Oil and Extraction Industry, 2003–2017



Note: Fatality counts from BLS Census of Fatal Occupational Injuries



# Fatalities in Oil and Gas Extraction (FOG) database

NIOSH database that collects detailed information about oil and gas worker fatalities in the U.S.

## Includes

Fatal events to U.S. oil and gas extraction workers:

- Onshore
- Offshore
- **All North American Industry Classification System (NAICS) O&G related**
- Motor vehicle incidents
- **Non-traditional commuting**
- Cardiac events

## Excludes

Midstream, downstream, non-fatal injuries

## Data Sources

OSHA case files, media, crash reports, autopsy reports, industry partners

## Limitations

Roadway motor vehicle fatalities, chronic illness



# Oil and Gas Research: Industrial Hygiene (IH)

## IH Field Studies: identify and characterize workplace exposures and evaluate their significance

- Become familiar with process operations
- Perform the preliminary, qualitative survey
- Perform workplace monitoring (quantitative evaluation)
- Interpret the sampling results and communicate with stakeholders
- Develop controls if needed
- Re-evaluate to determine effectiveness of controls

# Hazard: Respirable Crystalline Silica (RCS) during Hydraulic Fracturing



## RCS Exposures

- Systematically evaluated occupational exposures at hydraulic fracturing sites <sup>1</sup>
  - 11 sites in 2010–2011
  - Sand mover operators/T-belt operators
    - Exposures can be 10–50 times greater than occupational exposure limits



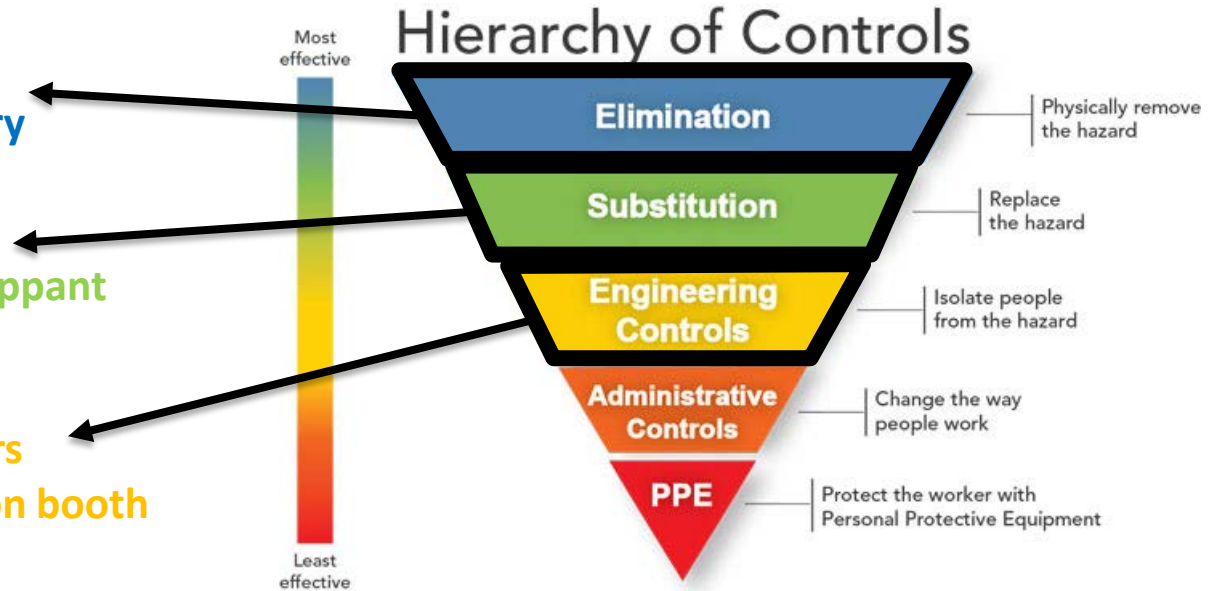
<sup>1</sup> Esswein, Breitenstein, Shawder, et al. *Occupational Exposures to Respirable Crystalline Silica in Hydraulic Fracturing*. *J Occup Environ Hyg*. 2013;10(7):347-56.

# Incorporate Controls Where Possible

## Focus on the Source!

- Thief hatches on sand movers are a large contributor of dust emissions
- Controls needed to limit worker exposure

- **Changes in proppant storage/handling/delivery**
- **Ceramic proppant**
- **Coated/treated sand proppant**
- **Portable baghouse**
- **Dust collectors with filters**
- **Personal decontamination booth**



## NORA-funded Project: “Controls and Interventions for Hazardous Exposures in Oil and Gas Extraction”

- Evaluate controls and other interventions to limit exposure to:
  - respirable crystalline silica aerosols
  - hydrogen sulfide and hydrocarbon gas and vapors
  - respirable diesel particulate matter from diesel engines
- Disseminate information to stakeholders, with an emphasis on small companies, so that appropriate engineering controls, best practices, and personal protective equipment can be implemented

## NORA-funded Project: “Protecting Oil Workers through Enhanced Surveillance, Exposure Assessments, and Control Evaluations”

- Increase knowledge of factors associated with oil and gas extraction worker fatalities and severe injuries
- Identify and advance knowledge of risks of hazardous exposures for workers in the on-shore oil and gas extraction industry, particularly those performing drilling processes

# Hazard: Exposures During Drilling Activities

- **Exposure Assessments during Drilling:**
  - Characterize exposures to:
    - Drilling fluid constituents
    - Oil-based aerosols and mists
    - Dry powdered drilling mud additives
    - Naturally occurring radioactive material
    - Diesel particulate matter





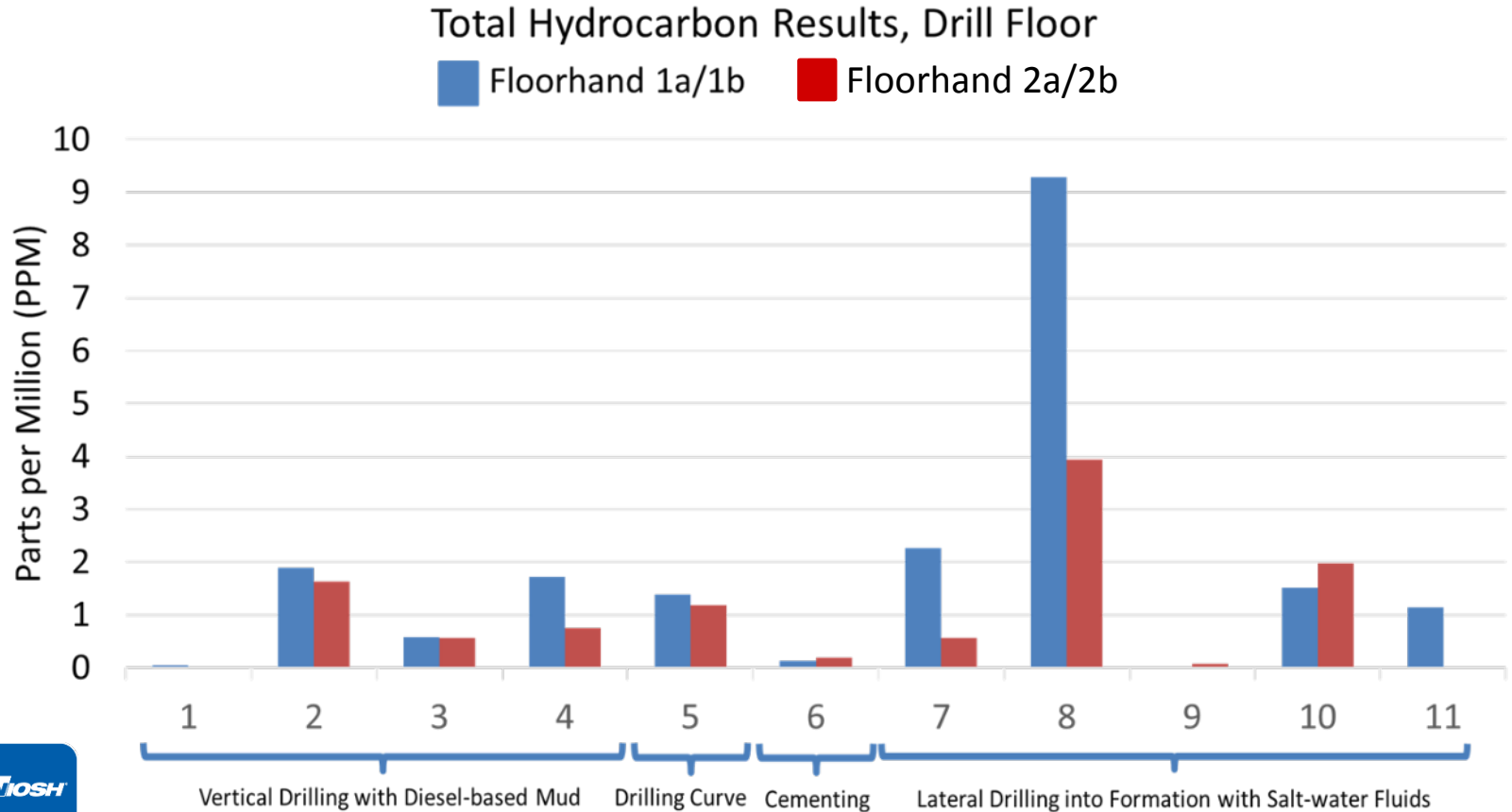
# Hazard: Exposures During Drilling Activities

## Drill Floor: PBZ results

|                                     | Benzene<br>ppm     |
|-------------------------------------|--------------------|
| Assistant Driller                   | 0.01               |
| Derrickhand (n=4)                   | ND-0.08            |
| N over 50% OEL                      | 2                  |
| N over 100% OEL                     | 0                  |
| Floorhand (n=19)                    | ND-0.13            |
| N over 50% OEL                      | 2                  |
| N over 100% OEL                     | 1                  |
| Motorman (n=10)                     | ND-0.05            |
| N over 50% OEL                      | 1                  |
| N over 100% OEL                     | 0                  |
|                                     |                    |
| <b>Occupational Exposure Limit:</b> | <b>0.1 (NIOSH)</b> |

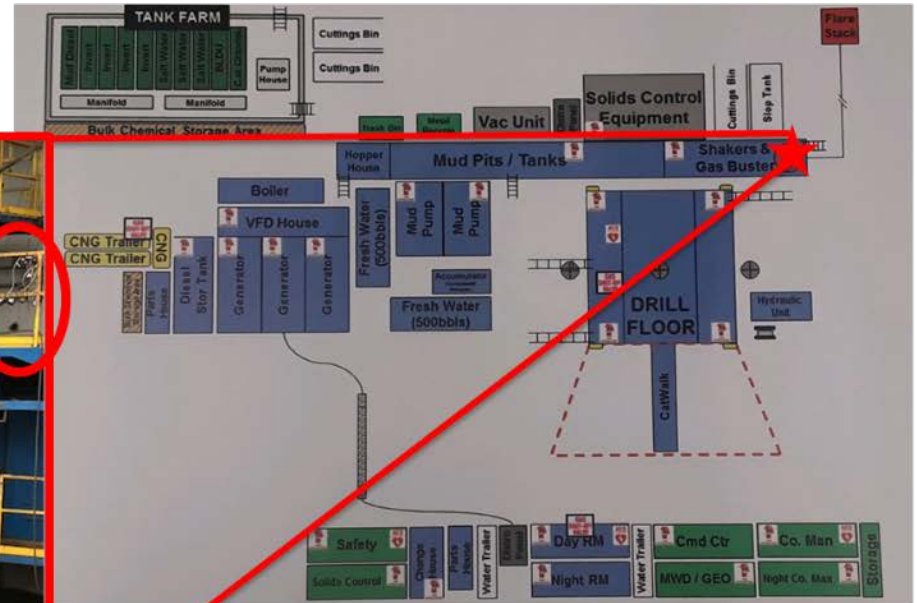


# Hazard: Exposures During Drilling Activities



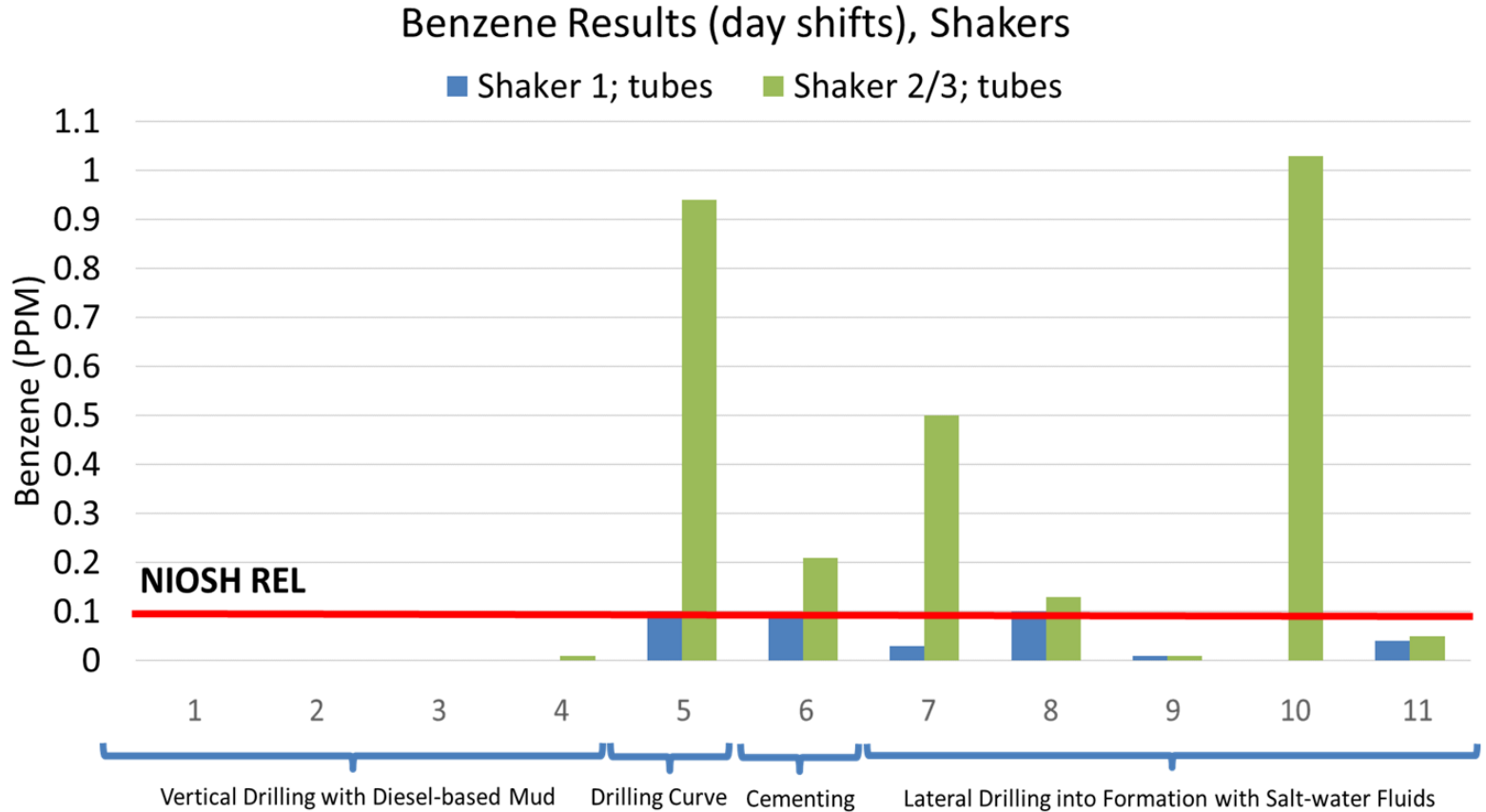
# Hazard: Exposures During Drilling Activities

## SHALE SHAKERS



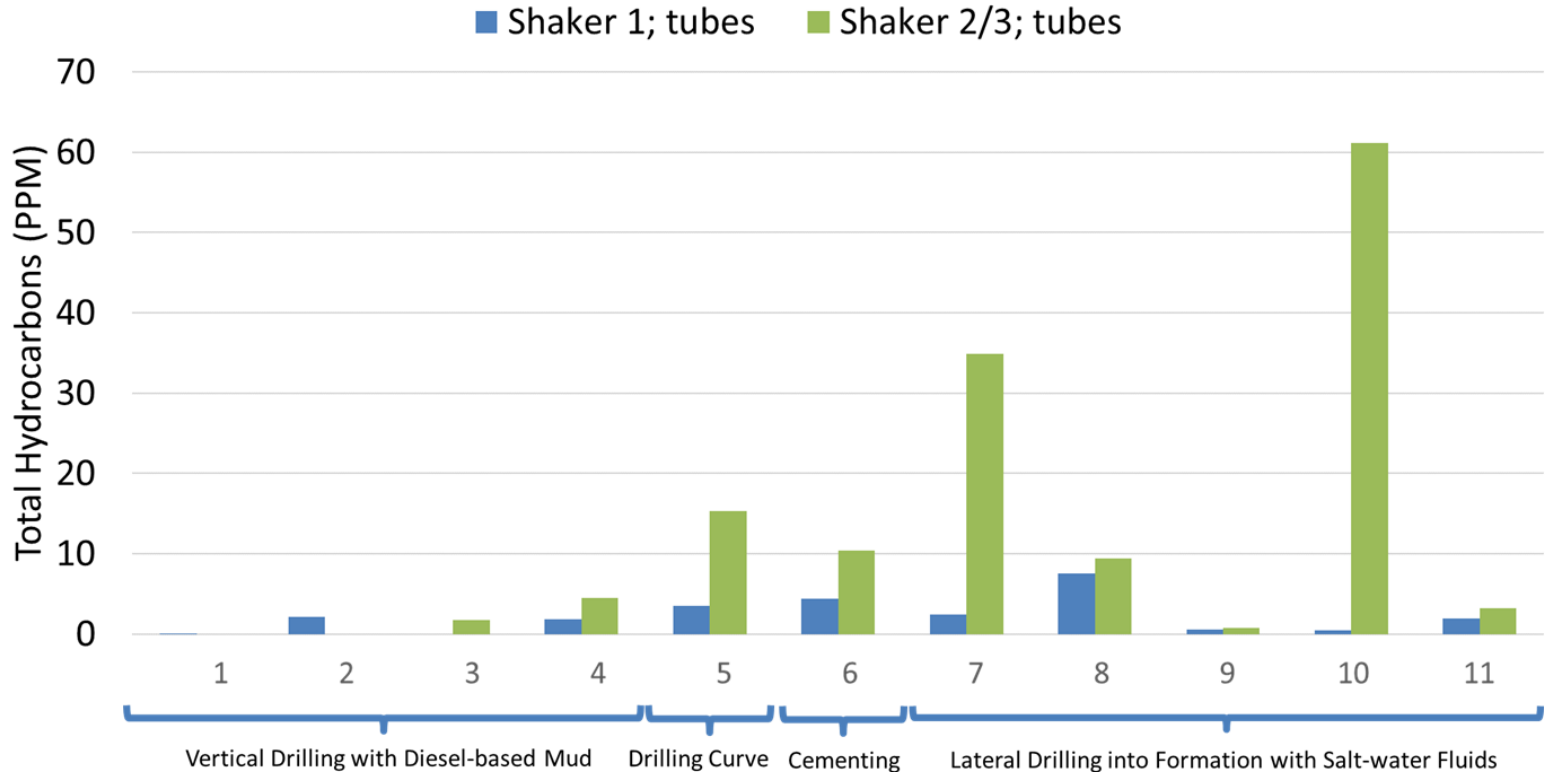
- Hydrocarbon gases and vapors
- Drilling mud mist/gases/vapors
- PAHs

# Hazard: Exposures During Drilling Activities



# Hazard: Exposures During Drilling Activities

## Total Hydrocarbon Results (day shifts), Shakers

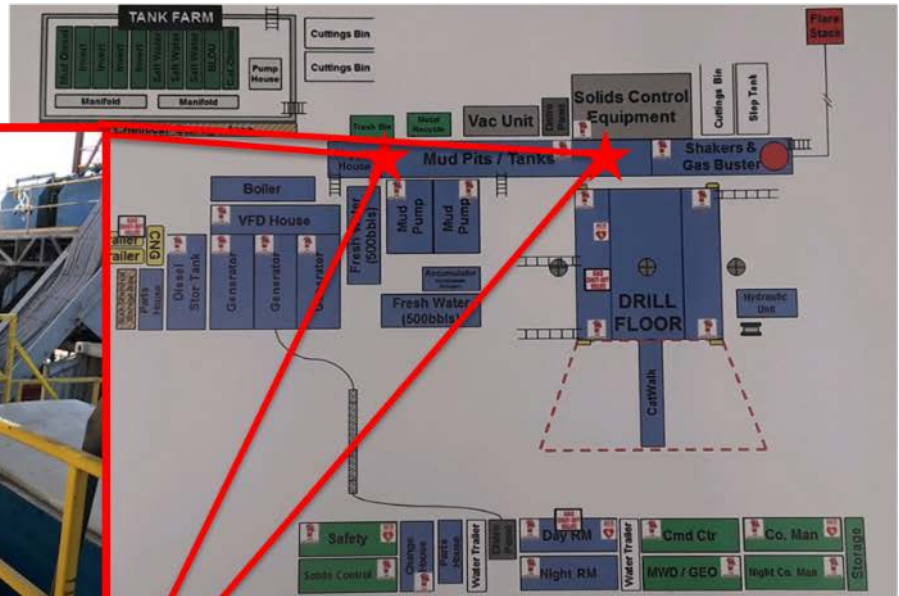


# Hazard: Exposures During Drilling Activities

- Napthalene (PEL/REL: 50 mg/m<sup>3</sup> or 10 ppm)
  - Range: 0.000–0.097 mg/m<sup>3</sup>
- Total PAHs (OEL: none)
  - Range: 0.001–0.378 mg/m<sup>3</sup>
- Drilling mud mist (REL for MWF: 0.50 mg/m<sup>3</sup>):
  - Range: 0.00–0.3 mg/m<sup>3</sup>

# Hazard: Exposures During Drilling Activities

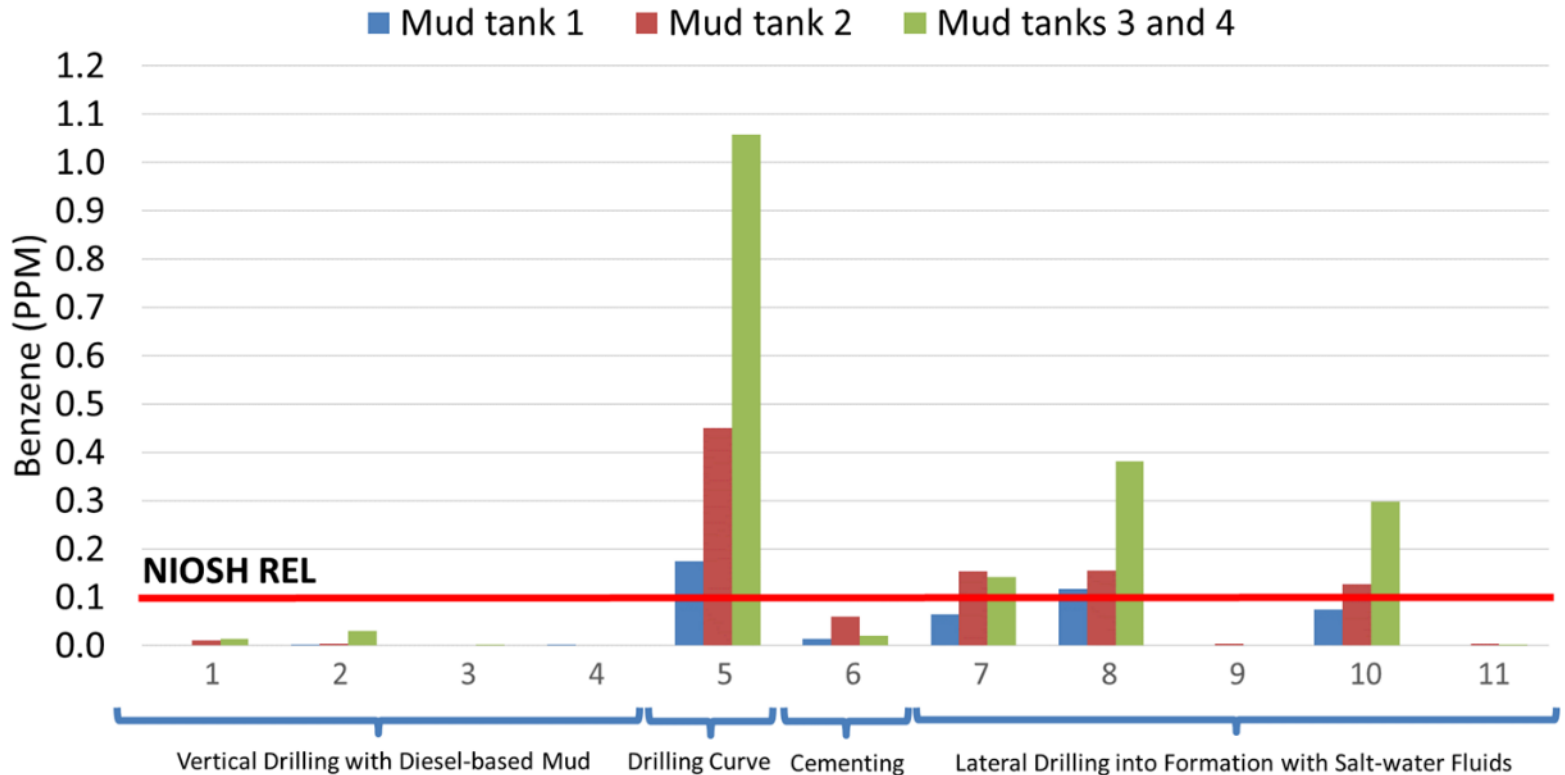
## MUD TANKS



- Hydrocarbon gases and vapors

# Hazard: Exposures During Drilling Activities

Benzene Results (day shift), Mud tank locations



# Hazard: Exposures During Drilling Activities

## HOPPER HOUSE



- Total and respirable particles
- Respirable crystalline silica
- Bulk samples (silica content and particle sizing)

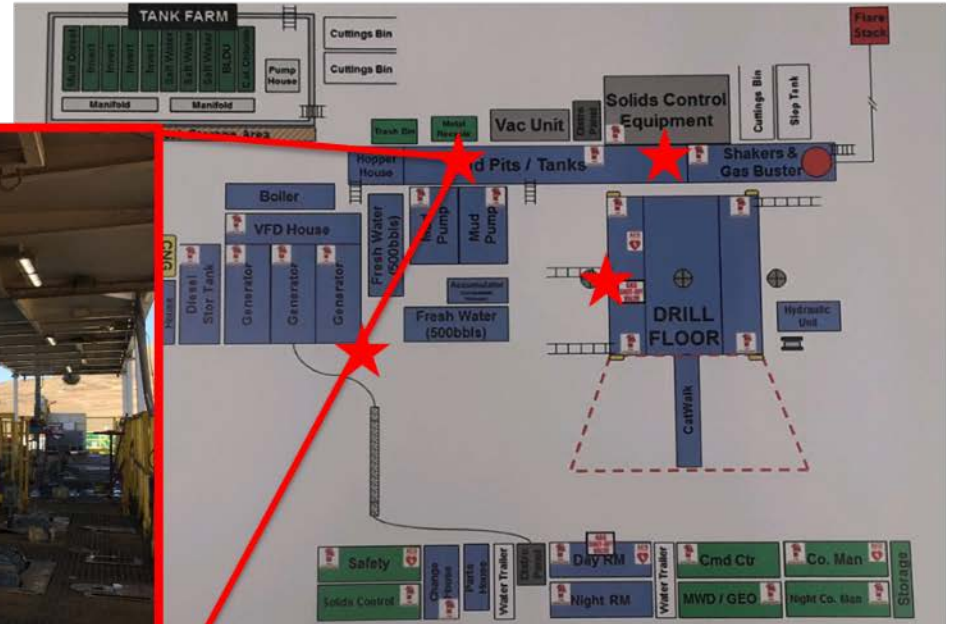


# Hazard: Exposures During Drilling Activities

- Total particles (OEL: 15 mg/m<sup>3</sup>)
  - PBZ: 13.2 mg/m<sup>3</sup> (derrickhand)
  - Area: range 0.69-2.18 mg/m<sup>3</sup>
- Respirable particles (OEL: 5 mg/m<sup>3</sup>)
  - PBZ: range 0.10–1.47 mg/m<sup>3</sup>
  - Area: 0.02 mg/m<sup>3</sup>
- Respirable crystalline silica (OEL: 0.050 mg/m<sup>3</sup>):
  - PBZ: range 0.00–0.12 mg/m<sup>3</sup>
  - Area: 0.003 mg/m<sup>3</sup>

# Hazard: Exposures During Drilling Activities

## DIESEL ENGINES/PUMPS



- Diesel particulate matter

# Hazard: Exposures During Drilling Activities

- Area Samples for Elemental Carbon collected at various locations on the site:

| ELEMENTAL CARBON            | OEL<br>( $\mu\text{g}/\text{m}^3$ ) | N  | Range<br>( $\mu\text{g}/\text{m}^3$ ) |
|-----------------------------|-------------------------------------|----|---------------------------------------|
| In front of sign-in trailer | 20                                  | 1  | 9.3                                   |
| Doghouse                    | 20                                  | 12 | 0.2 – 1.5                             |
| Mud Tanks                   | 20                                  | 12 | 1.0 – 25.4                            |
| Rig fuel tank corner        | 20                                  | 11 | 0.0 – 14.0                            |
| Handrail by Shaker 1        | 20                                  | 12 | 0.5 – 5.7                             |

# Hazard: Exposures During Drilling Activities

## UPCOMING PLANS

- Finalizing report
- New site visit expected in FY2019 to investigate dermal exposures during drilling activities
- Interested in new partners for further drilling activities
  - Consider partnering with NIOSH!

# Thank you! Questions?

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For more information, contact CDC  
1-800-CDC-INFO (232-4636)  
TTY: 1-888-232-6348 [www.cdc.gov](http://www.cdc.gov)

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

