Overview

• NIOSH Oil & Gas Sector Program overview
• Field effort to assess chemical exposure risks to Oil and Gas workers
• Future research activities
• Questions
Oil and Gas Exploration and Production

Exploration and production (E&P) operations include a wide variety of activities including seismic and geophysical activities, site preparation, drilling, completions
Occupational Fatality Rate and Industry Activity, Oil and Gas Extraction, 1993-2012

Note: BLS CFOI/QCEW (2010); Baker Hughes Rotary Rig Count. Rate per 100,000 workers per year. Pearson correlation coefficient: r=0.57; p<0.05.; *2011 data are preliminary.
NIOSH OIL & GAS EXTRACTION SAFETY & HEALTH PROGRAM
Research Projects and Publications Timeline

Projects
- NORA Projects
- PHP Projects

Outputs
- Publications
- DVDs

2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015

Seed Money to Support Learning

Chemical Exposures to Oil & Gas Workers (EE, JS, MB)

Contact Injury Prevention Project (PS)

Motor Vehicle Best Practices in Oil & Gas (KR)

PPE Use in O&G: Seat Belts & Fall Protection (NM)

Preventing Fires & Explosions in Oil & Gas (JB)

Chemical Exposures to O&G Workers (MB)

Rig Move Safety for Oil & Gas Workers (EC)

Injuries in the Offshore Oil & Gas Industry (RH)

Preventing Falls in Oil & Gas (PS)

2007
SPE Article: Working Hard to Work Safely

2008
SPE Article: Fatalities by Company Type and Size

MMWR: Fatalities Among O&G Workers

2008
Take Pride in Your Job: Seat Belts & Fall Protection

2009
Fact Sheet: Chemical Exposures to O&G Workers

2010
Move It! Rig Move Safety for Roughnecks

2011
SPE Article: Mortality Statistics for the US Upstream Industry

Well Servicing: Fatal Injuries in the Upstream O&G Industry

ASSE Professional Safety: Effective Training, A Case Study from the O&G Industry

2012
Move It! Rig Move Safety for Truckers

2013
Occupational Exposures to Respirable Crystalline Silica during Hydraulic Fracturing

2013
SPE Article: Review of the Literature: MV Safety Practices
NIOSH Interdisciplinary Team – Unconventional Oil & Gas Operations

• Subject matter experts
• Received orientation-level industry training
• Participate in field studies as appropriate
• Review draft outputs
• Assist with dissemination of research findings
NIOSH FACT SHEET

NIOSH FIELD EFFORT TO ASSESS CHEMICAL EXPOSURE RISKS TO GAS AND OIL WORKERS

BACKGROUND
There is a lack of existing information regarding the variety and magnitude of chemical exposure risks to oil and gas extraction workers. To determine if risks are present, NIOSH wants to develop partnerships with the oil and gas extraction industry to identify, characterize and (if needed) control workplace chemical exposures. This work will occur as part of the NIOSH Oil and Gas Extraction Safety and Health Program, which seeks to prevent injuries and illnesses among oil and gas extraction workers. Strategic objectives include identifying possible exposures, determining risk, and preventing chemical exposures to workers involved in oil and gas extraction industry.

PURPOSE
The goals of this NIOSH field effort include: 1) identifying processes and activities where chemical exposures could occur; 2) characterizing potential exposures to vapors, gases, particulates and fumes (e.g., solvents, diesel particulate, crystalline silica, acids, metals, aldehydes, and possibly other chemicals identified during the study); 3) depending on results of the field effort, recommending safe work practices and/or proposing and evaluating exposure controls (to include engineering controls, substitution, and personal protective equipment).

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

WHO CAN PARTICIPATE
Workers, managers, supervisors, and health and safety professionals involved in oil and gas drilling and servicing operations are encouraged to participate in the field effort.

BENEFITS OF PARTICIPATION
Companies can leverage the industrial hygiene expertise of a NIOSH field research team to help identify if chemical exposure risks are present or absent, and based on results of field studies, prioritize and control potential workplace chemical exposures at their worksites. Data and results collected by NIOSH in the field effort will be communicated to the company in letter format. Become involved with NIOSH and be seen as a leader in occupational safety and health in the gas and oil industry.

NOTE: This Field Research Effort will be fully funded by NIOSH; there is no cost to participate. NIOSH is a part of the Centers for Disease Control and Prevention (CDC). NIOSH is a federal agency responsible for conducting research and providing guidance related to occupational health and safety. NIOSH is not a regulatory agency. Federal regulations provide for trade secret protection for participating companies.

HOW TO BECOME INVOLVED
To learn more about the Field Effort to Characterize Chemical Exposures in Oil and Gas Extraction Workers, contact Eric Esswein, CIH, at (303) 236-5946, or submit inquiries electronically or by mail to: eje1@cdc.gov or Eric Esswein, NIOSH, Denver Federal Center, PO. Box 25226 Denver, CO. 80225

Sand truck operator at hydraulic fracturing operations. Image courtesy of Eric Esswein, NIOSH.
Worker Exposures

Worksite operations, processes, and chemicals used in the industry suggest workers have potential risks for exposures to multiple chemical hazards.
Chemical Exposures Risks

• Silica
• Diesel emissions
• Components of fracturing fluids
• Hydrocarbons and other volatile organic compounds (BTEX)
• Hydrogen sulfide (H$_2$S)
• Acids/bases
• Biocides (aldehydes, others)
• Polycyclic Aromatic Hydrocarbons (PAHs)
• Metals (Pb)

Not an inclusive list
Completions: Hydraulic Fracturing
Silica (Quartz)

- Respirable crystalline silica
- OSHA NPRM
- Silicosis, lung cancer, other diseases
- Occupational hazard of antiquity
- Preventable disease
- Used as a proppant during HF
  - Hundreds of thousands of pounds per stage
- Virtually 100% silica
How much respirable crystalline silica is the NIOSH REL?

500 micrograms (µg’s)

NIOSH REL = 0.05 mg/m³ TWA

0.05 mg/m³ = 50 micrograms (µg) mg/m³

1 m³ of air = 1,000 liters

Normal breathing rate (moderate work, 1 work day) = 10 m³ (10,000 liters of air)

50 micrograms x 10 m³ = 500 µg’s

Photo: Geoff Plumlee, USGS
Initial Field Effort: Respirable Crystalline Silica

Field Work (2010-2011):

• 11 sites, 5 states
• CO (7 sites), AR, PA, TX, ND
• Winter, spring, summer
• Elevation: 300 – 5000 ft.
• Single stage refracs, multi stage, zipper fracs
• Slickwater & gel fracs
• Silica sand, resin coated and ceramic
Hot Loading – Hydraulic Fracturing
Sand transfer operations
Sand transfer operations

Sand mover

Transfer belt

Operator
# Respirable Silica Results by Location

<table>
<thead>
<tr>
<th>Site</th>
<th>&gt; ACGIH TLV 0.025 mg/m³</th>
<th>&gt; NIOSH REL 0.05 mg/m³</th>
<th>&gt; OSHA PEL 0.1 mg/m³ (100% silica)</th>
<th>Total # samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>24 (92.3%)</td>
<td>19 (73.1%)</td>
<td>14 (53.9%)</td>
<td>26</td>
</tr>
<tr>
<td>B</td>
<td>16 (84.2%)</td>
<td>14 (73.7%)</td>
<td>12 (63.2%)</td>
<td>19</td>
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<tr>
<td>C</td>
<td>5 (62.5%)</td>
<td>5 (62.5%)</td>
<td>4 (50.0%)</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>19 (90.5%)</td>
<td>14 (66.7%)</td>
<td>9 (42.9%)</td>
<td>21</td>
</tr>
<tr>
<td>E</td>
<td>25 (92.6%)</td>
<td>23 (85.2%)</td>
<td>18 (66.7%)</td>
<td>27</td>
</tr>
<tr>
<td>F</td>
<td>4 (40%)</td>
<td>1 (10%)</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>93 (83.8%)</td>
<td>76 (68.5%)</td>
<td>57 (51.4%)</td>
<td>111</td>
</tr>
</tbody>
</table>

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8 Primary Points of Dust Generation

1. Release from top hatches, sand movers
2. Transfer belt under sand movers
3. Site traffic
4. Sand dropping in blender hopper
5. Release from T-belt operations
6. Release from dragon tail
7. Dust ejected from fill ports on sand movers
8. Release from work uniforms
Initial Field Effort: Outcomes

• Numerous conference presentations 2012-2013
• OSHA/NIOSH Hazard Alert
• NIOSH Science Blog
• JOEH article
• NIOSH mini baghouse retrofit assembly
• Increased awareness and adoption of controls
Journal Publication

Available online: www.tandfonline.com
Initial Field Effort: Impact

- Respirable crystalline silica focus group
- Nationwide awareness of an emerged hazard
- Development/dissemination of control options
- Patent-pending baghouse control
- Private industry development and production of controls
- ND OSHA O&G “sweep” includes health component and industry participation
- Industry support for NIOSH investigations to evaluate other chemical risks
Current Field Effort: 2013-2016

- Internally funded NIOSH project
- Volatile organic compounds
  - BTEX, alcohols, PAHs, biocides
  - Real time and integrated monitoring
- Biological monitoring and dermal assessments
- Diesel emissions
- NORM
- Numerous sites, geographical locations, seasons
- Includes drilling and servicing
Diesel Emissions

Photo: courtesy of Jeff Swensen, NY Times
Chemicals
Biocides

Chemical additives added to frac fluids: friction reducers, biocides, acids,
Completions: Flowback Operation
Flowback Tank: Gauging

0530 hrs. steam, hydrocarbon vapors visible

1200 hrs.
Flowback Tank – Remote IR
Production Tanks
VOC Monitoring: Production Tank
Monitoring: Flowback Separators
(multiple contaminants)
NIOSH Toxicology Research – Hydraulic Fracturing 2014-2017

• NIOSH Health Effects Laboratory Division (HELD)
• Mixed exposure
  – Diesel exhaust and respirable crystalline silica
• Potential synergistic effect
• Rat animal model
  – 3 exposure doses, 3 post-exposure periods
• Lung and extra-pulmonary organ system endpoints
  – Cardiovascular
  – Immune
  – Brain
  – Blood
Current/Planned Activities

• Silica control evaluation
• Worker exposure to VOC’s, dermal and biological monitoring, other health stressors
• Toxicological research
  – Silica and DPM
• Possible mid-stream initiative
• Collaboration and joint projects with DOE NETL
• Participation on Inter Agency UOG Work Group
• Expand partnerships
• Comprehensive technical document
• Off-shore initiative
NIOSH – BSC Discussion

• Suggestions for communicating new findings of hazards in this rapidly growing industry (given our obligation of company/worker notification first and need to raise awareness in a timely fashion)?
• Suggestions for presenting findings where we have conclusive scientific evidence but have not yet published a peer-reviewed article?
Thank you for your Attention