Putting it all together: An analysis of oil and gas extraction worker fatalities, severe injuries, and illnesses

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Sophia Ridl

National Institute for Occupational Safety and Health
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Mention of any company or product does not constitute endorsement by the National Institute for Occupational Safety and Health, Centers for Disease Control and Prevention.
NIOSH Oil and Gas Program

Established in 2007

Four Components

- Epidemiology and surveillance
- Exposure assessment
- Engineering controls
- Communications

Partner-focused

- NORA council
- OSHA Alliance
- National STEPS Network
Outline

Introduction

Fatalities from FOG

Hospitalizations and Amputations from OSHA Severe Injury Reporting

Putting it all together: trends and recommendations
Outline

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Fatalities from FOG

Hospitalizations and Amputations from OSHA Severe Injury Reporting

Putting it all together: trends and recommendations
Oil and gas extraction is...

- Diverse
- Dynamic
- Specialized
- Complicated
- High hazard
Oil and gas extraction is...

an intricate machine
The problem...

Important information was not captured in available databases.
The solution...

The Fatalities in Oil and Gas Extraction (FOG) database

A database specific to the oil and gas extraction industry.
FOG captures what is missing
FOG captures what is missing

FOG ≠ BLS CFOI
Outline

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**Fatalities from FOG**

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

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

- Onshore
- Offshore
- All NAICS (O&G related)
- Motor vehicle incidents
- Non-traditional commuting
- Cardiac events
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**Excludes**

Midstream and downstream

- Motor vehicle incidents
- Non-traditional commuting
- Cardiac events
Fatalities in Oil and Gas Database

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

• Onshore
• Offshore
• All NAICS (O&G related)

Excludes

Midstream and downstream

Data Sources

OSHA case files, media, crash reports, autopsy reports, industry partners, state health departments

Includes

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

• Motor vehicle incidents
• Non-traditional commuting
• Cardiac events

Excludes

Motor vehicle incidents
Non-traditional commuting
Cardiac events
## Fatalities in Oil and Gas Database

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

<table>
<thead>
<tr>
<th>Includes</th>
<th>Excludes</th>
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<th>Limitations</th>
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<td>Fatal events to U.S. oil and gas extraction workers:</td>
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<td>Roadway motor vehicle fatalities, chronic illness</td>
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<td>• Onshore</td>
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<tr>
<td>• Offshore</td>
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<tr>
<td>• <strong>All NAICS (O&amp;G related)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Motor vehicle incidents</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• <strong>Non-traditional commuting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Cardiac events</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Federal
Local
State
Industry
Media

50 Variables per Incident
- Industry operations
- Industry activities
- Incident event type
- Contributing factors (i.e. weather, equipment, etc.)

41 Variables per Worker
- Industry-specific occupations
- Years in Oilfield
- Fatigue
Fatalities in FOG 2015-2016

2015

Fatalities: 63

Incidents: 53
<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>63</td>
<td>29</td>
</tr>
<tr>
<td>Incidents</td>
<td>53</td>
<td>26</td>
</tr>
</tbody>
</table>
### Fatalities in FOG 2015-2016

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>63</td>
<td>29</td>
<td>92</td>
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<tr>
<td>Incidents</td>
<td>53</td>
<td>26</td>
<td>79</td>
</tr>
</tbody>
</table>
Upstream Oil and Gas

- Operators
- Drilling Contractors
- Well Servicing Companies
- Other Support Activities
Fatalities in FOG by Industry Group, 2015-2016

**Industry group**
- NAICS codes
- Primary business
- One per fatality

**Oil and gas extraction NAICS**
- 211- operators
- 213111- drilling
- 213112- support activities
  - 4842- specialized freight

★ FOG includes all fatalities related to oil and gas extraction regardless of NAICS
Fatalities in FOG by Industry Group, 2015-2016

Industry group
• NAICS codes
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Oil and gas extraction NAICS
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  o 4842- specialized freight

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Support activities 54
Drilling 18
Specialized Freight 6
Operator <5*
Other industry <5*
Unknown 10
n=92

*Values <5 are suppressed in this dataset
Fatalities in FOG by Industry Group, 2015-2016

Industry group
- NAICS codes
- Primary business
- One per fatality

Oil and gas extraction NAICS
- 211- operators
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Support activities 59% of FOG identified fatalities
- Drilling 18
- Specialized Freight 6
- Operator <5*
- Other industry <5*
- Unknown 10

n=92

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Fatalities in FOG by Operation, 2015-2016

Operation

• Stages or distinct processes
• One per incident

Operations that Occur throughout Oil and Gas Extraction

- Vehicle repair or maintenance: <5*
- Waste fluid treatment or disposal: <5*
- Unspecified (Off-wellsite): 26
- Unspecified (Wellsite): <5*
- Offshore: 5
### Fatalities in FOG by Operation, 2015-2016

#### Operations by Stages of Well Development

<table>
<thead>
<tr>
<th>Operation</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Drilling operations</td>
<td>10</td>
</tr>
<tr>
<td>Casing Installation</td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Hydraulic Fracturing</td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Flowback</td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Production</td>
<td>15</td>
</tr>
<tr>
<td>Well-servicing, intervention, or workover</td>
<td>21</td>
</tr>
</tbody>
</table>

*Values <5 are suppressed in this dataset

- **Operations that Occur throughout Oil and Gas Extraction**
  - Vehicle repair or maintenance: <5*
  - Waste fluid treatment or disposal: <5*
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n=92
Event type

- How fatality occurred
- FOG has its own event types
- Initial event
- One per fatality

★ 5 cardiac events with no identified work exposure are not included in these data
## Fatalities in FOG by Event Type, 2015-2016

### Event type
- How fatality occurred
- FOG has its own event types
- Initial event
- One per fatality

★ 5 cardiac events with no identified work exposure are not included in these data

### Fatalities

<table>
<thead>
<tr>
<th>Event Type</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Vehicle Incidents</td>
<td>26</td>
</tr>
<tr>
<td>Contact injuries</td>
<td>22</td>
</tr>
<tr>
<td>Explosion (combustion) or fire</td>
<td>13</td>
</tr>
<tr>
<td>Exposure</td>
<td>10</td>
</tr>
<tr>
<td>Falls</td>
<td>6</td>
</tr>
<tr>
<td><strong>Cardiac event: possible work exposure</strong></td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Electrocution</td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Explosion (pressure)</td>
<td>&lt;5*</td>
</tr>
<tr>
<td>Intentional Act</td>
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**Fatalities in FOG by Event Type, 2015-2016**

- **Vehicle Incidents**: 26
- **Contact injuries**: 22
- **Explosion (combustion) or fire**: 13
- **Exposure**: 10
- **Falls**: 6
- **Cardiac event: possible work exposure**: <5*
- **Electrocution**: <5*
- **Explosion (pressure)**: <5*
- **Intentional Act**: <5*

*n=92*

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**Event type**
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</tr>
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</table>

n=92

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Vehicle Incidents

26 total fatalities

- 24 roadway
- <5* on-site
- <5* other location

*Values <5 are suppressed in this dataset
Contact injuries

22 total fatalities

- 8 caught between/crushed
- 8 struck by
- 6 struck by falling object
Exposure

10 total fatalities

7 harmful substance
- H2S
- Hydrocarbons

<5* environmental

<5* alcohol or drug poisoning

*Values <5 are suppressed in this dataset
Fatalities in FOG: Activities, 2015-2016

Activities
- Steps within operations
- Carried out several times
- As many as appropriate per incident

43 total activities

5 Associated with 8+ fatalities
Most common activities associated with worker fatalities

- Motor vehicle travel including non-traditional commutes
  - 21

- Material handling: crane, forklift, winch truck, etc.
  - 10

- Production rig activities
  - 10
Using FOG to Identify Emerging Issues, 2015-2016

- New to task
- Drug Use
- pressure related
- Less than 1 year in oil field

25% Working alone
Introduction

Fatalities from FOG

Hospitalizations and Amputations from OSHA Severe Injury Reporting

Putting it all together: trends and recommendations
Report a Fatality or Severe Injury

- All employers are required to notify OSHA when an employee is killed on the job or suffers a work-related hospitalization, amputation, or loss of an eye.
- A fatality must be reported within 8 hours.
- An in-patient hospitalization, amputation, or eye loss must be reported within 24 hours.

To Make a Report

- Call the nearest OSHA office.
- Call the OSHA 24-hour hotline at 1-800-321-6742 (OSHA).
- Report online

Be prepared to supply: Business name; names of employees affected; location and time of the incident, brief description of the incident; contact person and phone number.
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Data from 2015 through 2017 is available for download...

Severe Injury Reports

OSHA requires employers to report all severe work-related injuries, defined as an amputation, in-patient hospitalization, or loss of an eye. The requirement began on January 1, 2015. This page provides information from those reports, including a description of the incident and the name and address of the establishment where it happened. Injuries are coded using the Occupational Injury and Illness Classification System.

You can download a file of the reports below. The reports will be updated periodically and represent federal OSHA states only. They do not reflect injuries in state plans.

Please be aware the geocodes (latitude/longitude) provided were obtained through third party services based on address information provided with the injury report. The precision varies by case, and accuracy is not guaranteed.

(Data from 1/1/2015 through 12/31/2017)

www.osha.gov/severeinjury
Data from 2015 through 2017 is available for download...

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...But lacks reports from State-Run Programs...

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(Data from 1/1/2015 through 12/31/2017)

www.osha.gov/severeinjury
Data from 2015 through 2017 is available for download...

...But lacks reports from State-Run Programs...

...Through OSHA-NIOSH Partnership, our team obtained OGE injury data from all 50 States!
All Severe Injury information is from OSHA reporting and inspections

- No OSHA jurisdiction on public roadways
- Vehicle incidents are underreported in this dataset
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Data provided from OSHA:
- Company NAICS Code (211(111), 213111, 213112)
- Incident Date and Location
- Counts of Hospitalizations & Amputations
- OSHA Inspection Numbers (if applicable)
- Incident Narratives
Some narratives were brief....

Activity:

Operation:

Event Type:

Equipment:

Hosp. or Amp:

“An employee was injured during a fire at a gas well.”
### Severe Injury Narratives 2015-2016

<table>
<thead>
<tr>
<th>Activity:</th>
<th>???</th>
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</thead>
<tbody>
<tr>
<td>Operation:</td>
<td>???</td>
</tr>
<tr>
<td>Event Type:</td>
<td>Explosion (combustion) or fire</td>
</tr>
<tr>
<td>Equipment:</td>
<td>???</td>
</tr>
<tr>
<td>Hosp. or Amp:</td>
<td>Hospitalization</td>
</tr>
</tbody>
</table>

Some narratives were brief....

“An employee was injured during a **fire** at a gas well.”
...And some were very descriptive!

“Employees were running rods downhole on a servicing rig when the pump hit a tight spot causing slack on the rods. The slack resulted in the rod elevator breaking and allowing the rods to come loose. The rod struck the employee in the middle, right side of his back and knocked him to the ground.”
Activity: Pulling or running rods  
Operation: Well Servicing, Intervention, or Workover  
Event Type: Struck by falling object  
Equipment: Rods, Rod Elevator  
Hosp. or Amp: Hospitalization

...And some were very descriptive!

“Employees were running rods downhole on a servicing rig when the pump hit a tight spot causing slack on the rods. The slack resulted in the rod elevator breaking and allowing the rods to come loose. The rod struck the employee in the middle, right side of his back and knocked him to the ground.”

(Listed as 1 Hospitalization)
Starting point:

649 Oil and Gas Related incidents reported to OSHA

All FOG data are preliminary, unpublished, and subject to change without notice.
Summary of Severe Injuries 2015-2016

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalizations</td>
<td>312</td>
<td>228</td>
</tr>
<tr>
<td>Amputations</td>
<td>101</td>
<td>68</td>
</tr>
</tbody>
</table>

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Summary of Severe Injuries 2015-2016

<table>
<thead>
<tr>
<th></th>
<th>2015</th>
<th>2016</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalizations</td>
<td>312</td>
<td>228</td>
<td>540</td>
</tr>
<tr>
<td>Amputations</td>
<td>101</td>
<td>68</td>
<td>169</td>
</tr>
</tbody>
</table>

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Severe Injuries by Operation 2015-2016

Operations by Stages of Well Development

- Drilling: 110
- Casing Installation: 8
- Hydraulic Fracturing: 13
- Production: 76
- Well Servicing, Intervention, or Workover: 114
- Unspecified or Unknown: 301

Operation
- Stages or distinct processes
- One per incident

Severe Injury data includes all hospitalizations and amputations related to oil and gas extraction NAICS codes.

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Severe Injuries by Operation 2015-2016

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Well Servicing was most common (known) Operation.

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Severe Injuries by Operation 2015-2016

Operations by Stages of Well Development

- Drilling: 110
- Casing Installation: 8
- Hydraulic Fracturing: 13
- Production: 76
- Well Servicing, Intervention, or Workover: 114
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Well Servicing was most common (known) Operation

46% of reported incidents

Operation
- Stages or distinct processes
- One per incident

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All FOG data are preliminary, unpublished, and subject to change without notice.
### Severe Injuries by Most Common Activity Type 2015-2016

<table>
<thead>
<tr>
<th>Activity</th>
<th># of reported incidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rig or equipment repair or maintenance</td>
<td>87</td>
</tr>
<tr>
<td>Material handling: crane, forklift, winch truck, etc.</td>
<td>66</td>
</tr>
<tr>
<td>Make up or break out tubulars</td>
<td>45</td>
</tr>
<tr>
<td>Equipment install or dismantle</td>
<td>31</td>
</tr>
<tr>
<td>Material handling: Manual</td>
<td>31</td>
</tr>
<tr>
<td>Unknown Activity</td>
<td>144</td>
</tr>
</tbody>
</table>

**Activities**

- Steps within operations
- Carried out several times
- As many as appropriate per incident

---

All FOG data are preliminary, unpublished, and subject to change without notice.
Severe Injuries by Most Common Event Type 2015-2016

Event type
- How injury occurred
- Initial event
- One per incident

★ N=649

All FOG data are preliminary, unpublished, and subject to change without notice.
Event type

- How injury occurred
- Initial event
- One per incident

★ N=649

Severe Injuries by Most Common Event Type 2015-2016

Contact Injury: 48% of reported incidents (314)

- Falls (Height and Same level): 106
- Explosion (combustion) or Fire: 54
- Explosion (pressure): 37
- Exposure: Environmental: 33

All FOG data are preliminary, unpublished, and subject to change without notice.
Contact injuries

211 total hospitalizations
- 96 caught between or crushed
- 75 struck by
- 40 struck by falling object

141 total amputations*
- 123 caught between or crushed
- 10 struck by
- 8 struck by falling object

*In some cases, amputations also involved hospitalization.
Severe Injury Amputation Events 2015-2016

128 Finger(s), Fingertip(s) or Partial Finger(s)

N=169

*Hand Icon created by Sasha Willins from Noun Project
Severe Injury Amputation Events 2015-2016

- 21 Thumb or Partial Thumb
- 128 Finger(s), Fingertip(s) or Partial Finger(s)

N=169

*Hand Icon created by Sasha Willins from Noun Project
Severe Injury Amputation Events 2015-2016

- <5 Hand(s)
- <5 Arm(s)
- <5 Leg(s)
- <5 Toe(s)
- 21 Thumb or Partial Thumb
- 128 Finger(s), Fingertip(s) or Partial Finger(s)
- 6 Other or Unknown

N=169

*Hand Icon created by Sasha Willins from Noun Project
Common Equipment causing Severe Injuries 2015-2016

- Forklifts
- Power tongs
- Hoses
- Hand tools (manual and powered)
- Pressure Washers
“Employee was using a 10 lb. sledge hammer to tighten a hammer union. The employee missed and caught his right index finger between the handle of the hammer and a valve handle.”

(Finger was amputated)
OSHA Jurisdiction does not cover:

- Incidents that occur on public streets, highways, or on normal commute \(^1\)

Trucking and Hauling related incidents may be listed on other NAICs codes

Under-reporting and reporting errors

- Estimated to be roughly 50% underreported based on workers compensation data \(^2\)
- Self-reported incidents may lack crucial detail or information

**Sources:**
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Putting it all together: trends and recommendations
Fatalities are the tip of the iceberg

High number of fatalities and severe injuries for:

• Well servicing, workover, intervention operations
• Drilling operations
• Contact injuries
• Material handling: crane, forklift, winch truck
• Pressure related events
<table>
<thead>
<tr>
<th>Differences</th>
<th>Fatalities</th>
<th>Severe Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Falls</td>
<td>6% of fatalities</td>
<td>16% of severe injuries</td>
</tr>
<tr>
<td>Hand tools</td>
<td>Not a major source</td>
<td>Major source</td>
</tr>
<tr>
<td>Manual material handling</td>
<td>None</td>
<td>5th most common activity</td>
</tr>
<tr>
<td>Exposure: environmental</td>
<td>1-3% of fatalities</td>
<td>5% of severe injuries</td>
</tr>
<tr>
<td>Vehicle incidents</td>
<td>Some information</td>
<td>Very little information</td>
</tr>
</tbody>
</table>
# Driving: The most dangerous activity for oil and gas workers

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Tools/Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure 100% of drivers are wearing their seatbelt</td>
<td>- IOGP Buckle UP</td>
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<tr>
<td>Consider the implementation of In-Vehicle Monitoring System (IVMS) with coaching</td>
<td>- IOGP Report 365-12</td>
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<tr>
<td>Utilize journey management concepts</td>
<td>- IOGP Report 365-2</td>
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<tr>
<td>Address driver impairment (fatigue, distraction, substances): including during long-distance commutes</td>
<td>- IVMS&lt;br&gt;- Journey management&lt;br&gt;- Oil and Gas workers: How to prevent fatigued driving at work (NIOSH)</td>
</tr>
</tbody>
</table>
**Contact Injuries:** Use multi-intervention approach

**Struck by falling object**

Strategies:
- DROPS
- Load securement (IOGP 365-18)

**Caught between or crushed**

Strategies:
- Lock out tag out
- Machine guarding
- Reduce pinch points
Material handling: Follow industry practices

**Load securement**
- Properly secure and unsecure loads (IOGP 365-18)
- Ensure cables and other handling equipment is properly used and inspected
- Train workers to stay out of fall zones

**Vehicle Safety**
- Use spotters
- Ensure vehicles have back-up alarms
- Improve communication on multi-employer sites
What's next

- Relaunch of updated FOG website
- FOG data tables available on-line
- 2015-2016 FOG infographics for injuries, hospitalizations, and fatalities
- Reporting of analysis for 2017 severe injuries and fatality FOG fata
- **FOG 5 year report for 2014-2018 fatalities!**
FOG Website
https://www.cdc.gov/niosh/topics/fog/default.html

OSHA Severe Injury
https://www.osha.gov/severeinjury/index.html

IOGP Buckle Up
https://www.osha.gov/severeinjury/index.html

IOGP Report 365-12

IOGP Report 365-2

Oil and Gas workers: How to prevent fatigued driving at work

DROPS
http://www.dropsonline.org/

IOGP 365-18
NIOSH Breakout Sessions

**Industrial Hygiene Strategies for Assessing Exposures during Onshore Drilling Activities**
Bradley King, 11:30-12:15p, 355-A

**A new method for assessing worker exposure to diesel-based drilling fluids**
Michael Breitenstein, 2-2:45p, 355-B

Visit the NIOSH booth

Booth #418

New video
Printed products
NIOSH researchers