



International
Association
of Oil & Gas
Producers

Chemical Exposure Scenarios for the Use and Handling of Drilling Fluids in the Oil and Gas Industry

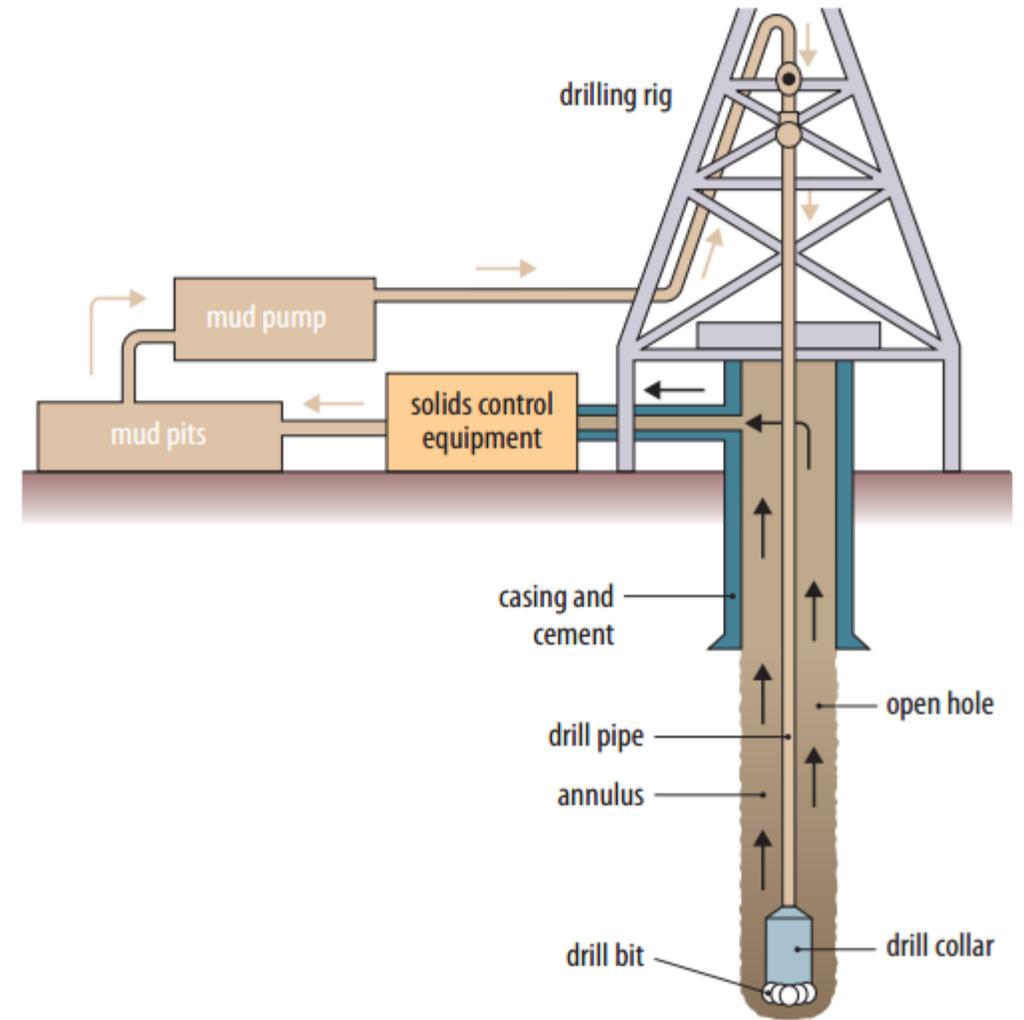
Kirsty Walker
Schlumberger



Drilling Process

What is drilling fluid?

What does drilling fluid do?



Fluids Circulating System of a Well

Drilling fluid types:

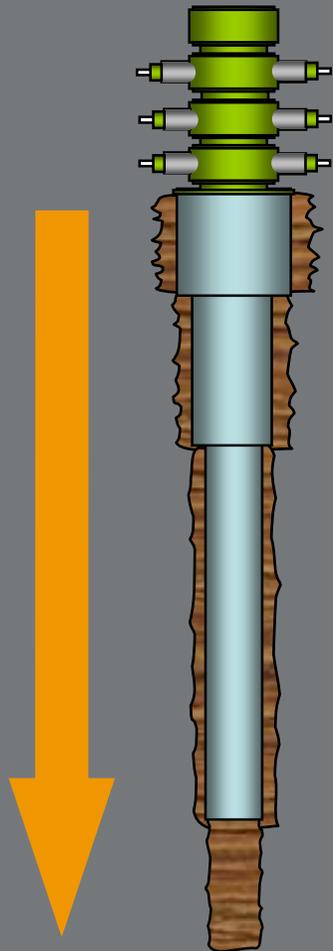
- Water Based
- Non-Aqueous

Properties:

- Density
- Viscosity
- Fluid Loss Control
- Shale Inhibition



Fluid system becoming increasingly complex



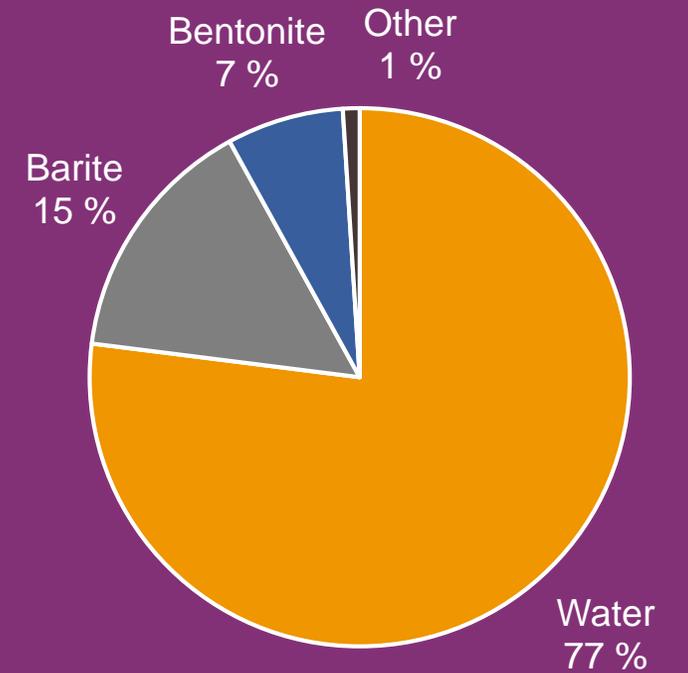
Spud Mud

Dispersed Systems

Inhibitive Polymer Muds

High Temperature Polymer Muds

Non-Damaging Drill in Fluids



Water-based Fluid Components (by weight%)

Classification of Non-Aqueous Fluids

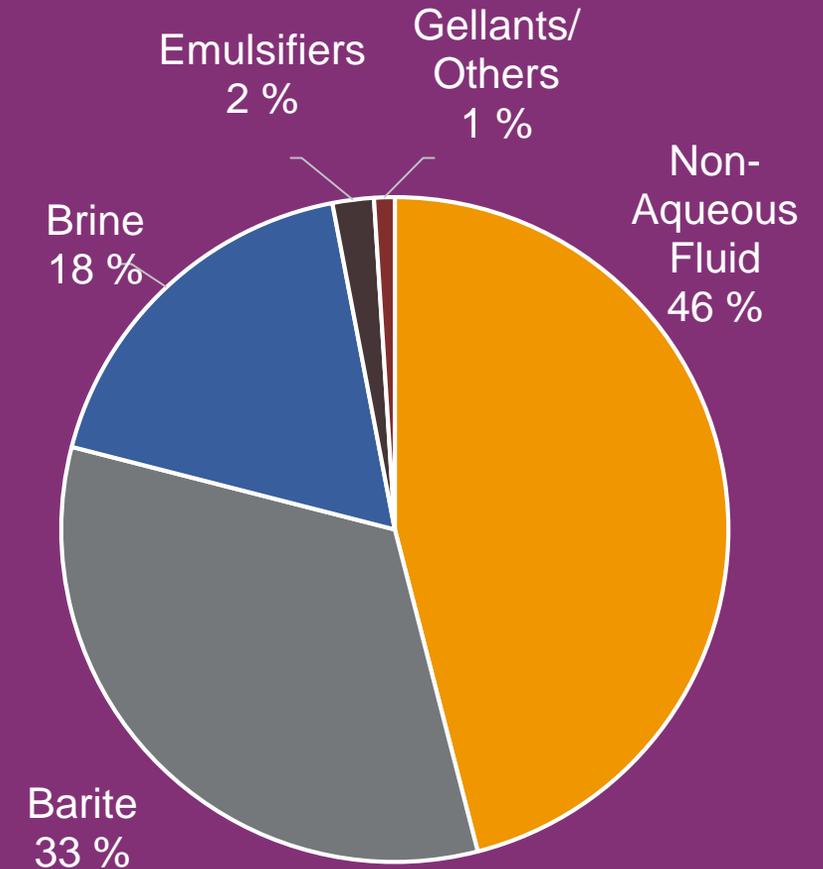
Non-Aqueous Category	Components	Aromatic Content
Group I High Aromatic Content	Crude oil, diesel oil and conventional mineral oils	5 - 35%
Group II Medium Aromatic Content	Low toxicity mineral oil	0.5 - 5%
Group III Low/ Negligible Aromatic Content	Ester, Linear Alpha Olefin, Internal Olefin and highly processed mineral oils	< 0.5% and PAH < 0.001%

Non-Aqueous Fluid Additives

- Base fluid
- Brine
- Emulsifiers
- Viscosifiers
- Weighting agents
- Lime
- Calcium chloride
- Speciality products

Contaminants

- Hydrocarbons
- Non-hydrocarbon gases
- LSA scale



Non-Aqueous Fluid Components
(by weight%)

Health Hazard, Exposure and Risk

Hazard

- for drilling fluid composition and the physical form of components



Exposure

- use conditions, use of personal protection



Worker/ Individual

- variable susceptibility

Risk → Effects

- dependent mainly on hazard and exposure conditions and to a lesser extent on the individual susceptibility



Contact dermatitis after repeated dermal exposure to mineral oil

Exposure:

- Identify routes and type of exposure
- Quantify
- Minimise



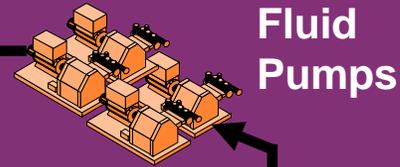
Fluids Circulating System



Well Head

Drilling rig location over well and well head equipment

Drilling fluid flow direction through the well and primary rig equipment

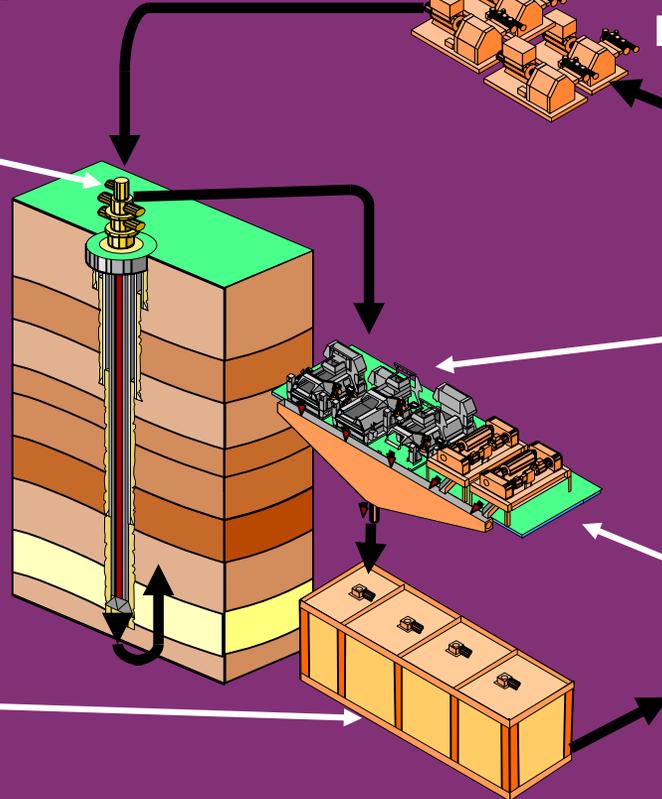


Fluid Pumps



Shakers

Well showing formations and cemented casing strings



Solids Control Equipment



Centrifuges



Drilling Fluid Process and Storage Tanks

Examples of exposure:

Sampling in shaker house

- Routine operation, high frequency (guide >15 minutes per hour)
- Exposure – inhalation of mist
- Skin contact with fluid
- Influencing factors
 - Flowline temperature
 - Fluid characteristics
 - Fluid composition



Examples of exposure:

Changing shaker screens

- Intermittent but routine operation (guide 5 minutes per hour)
- Exposure – inhalation
- Skin contact with fluid contaminated surfaces
- Influencing factors
 - Shaker design
 - Ergonomics



Examples of exposure:

Manual pit cleaning

- Continuous during cleaning operations
- Exposure – splashes, contact with contaminated surfaces, inhalation of vapour/mist
- Influencing factors
 - Temperature
 - Ergonomics and available space
 - Confined spaces
 - Cleaning equipment design and operating methods
 - Lighting



Examples of exposure:

Drill floor operations – pipe handling and cleaning

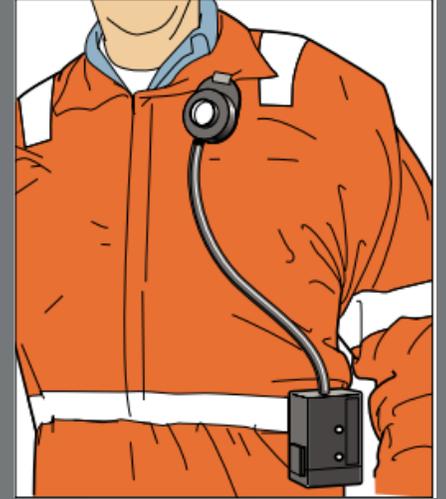
- Continuous during tripping operations
- Exposure – skin contact with contaminated surfaces, splashes, inhalation and skin contact from vapour/ mist
- Influencing factors
 - Degree of automation of drill floor activities
 - Fluid temperature
 - Ergonomics



Exposure Monitoring

Skin

- Passive monitoring
- Visual examination
- Skin moisture level measurement

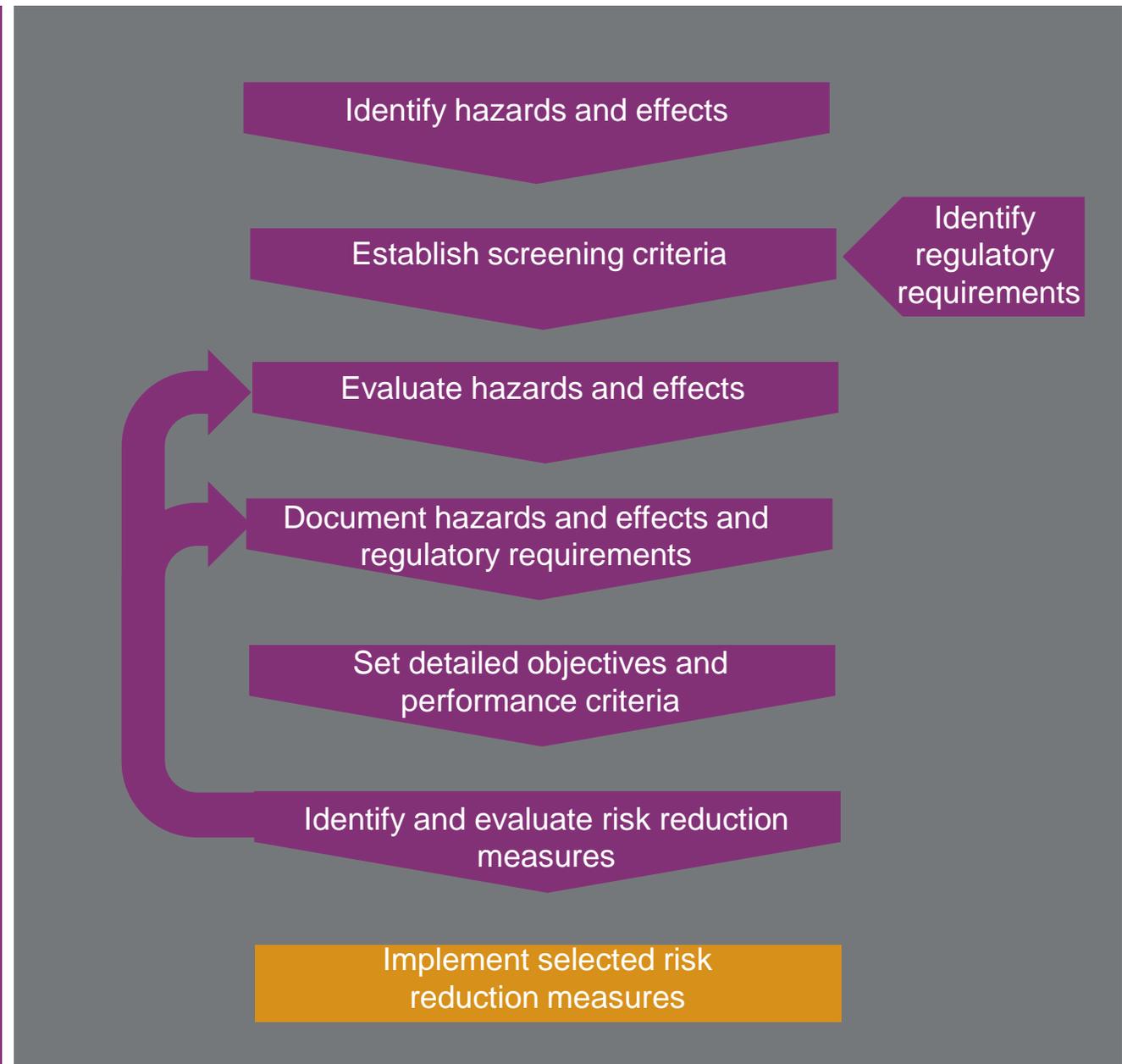


Air

- Dust, aerosol or vapour
- Passive or active sampling
- Adsorption, filters, direct reading meters, colorimetric tubes

Control Measures

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal Protective Equipment



Engineering Controls



Open pits



Enclosed pits



Inadequate ventilation

Administrative Controls



- Training and awareness
- Safe handling guidance
- SDS/ labels
- Correct selection/ use of PPE
- Reporting and diagnosis of skin irritation



Use of barrier creams, appropriate cleansers and reconditioning creams



Laundry practices

UK HSE Offshore COSHH Essentials

 Health and Safety Executive

OCE8 Mixing of drilling muds (sack room)

Offshore COSHH essentials

 This information will help offshore dutyholders (owners, operators and contractors) to comply with the Control of Substances Hazardous to Health Regulations 2002 (COSHH), as amended, to protect workers' health.

This guidance consolidates good control practice and reinforces existing knowledge with additional information.

It will help you carry out COSHH assessments, review existing assessments, deliver training and in supervising activities involving substances hazardous to health.

It is aimed at staff whose responsibilities include the management of substances hazardous to health on offshore installations (eg occupational health specialists, COSHH assessors, supervisors etc). It is also useful for trade union and employee safety representatives.

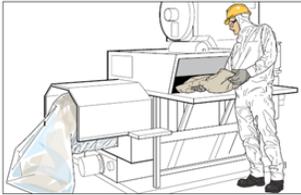
Following this guidance is not compulsory and you are free to take other action. But if you do follow this guidance, you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance as illustrating good practice.

Also see essential information on the back of the sheet.

Control approach 2 Engineering control

What this sheet covers

This sheet describes good practice for control of exposure to chemicals when mixing drilling mud. It covers the key points you need to follow to help reduce exposure to an acceptable level, as part of your COSHH assessment.



Hazard

- Water based drilling & completion fluids contain a wide range of substances including: brines, weighting agents, polymers, oxygen scavengers and biocides.
- Non-aqueous contain base fluids such as mineral oils, calcium chloride, lime, surfactants, viscosifiers and weighting agents such as barite.
- Health effects most commonly include dermatitis, skin & respiratory irritation.
- Individual substances should comply with their workplace exposure limits (if available) or other relevant exposure standard, see MSDS.



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 Health and Safety Executive

OCE9 Use of drilling muds (shale shaker and mud pit areas)

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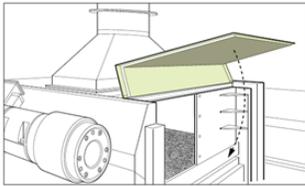
Also see essential information on the back of the sheet.

Control approach 2 Engineering control

What this sheet covers

This sheet describes good practice for control of exposure to drilling muds (liquids, mists and vapours) in shale shaker and mud pit areas. It includes mud handling, sampling and cleaning activities. It covers the key points you need to follow to help reduce exposure to an acceptable level, as part of your COSHH assessment.

This sheet does not cover mixing activities, refer to OCE8 for mixing of drilling muds.



Hazard

- Water based drilling & completion fluids contain a wide range of substances including: brines, weighting agents, polymers, oxygen scavengers and biocides.
- Non-aqueous contain base fluids such as mineral oils, calcium chloride, lime, surfactants, viscosifiers and weighting agents such as barite.
- Hot mud will generate mists and vapours.
- The most common health effects include dermatitis and/or respiratory irritation.
- Mud returned from the well can also contain contaminants from formations (eg crude oil, condensate and Hydrogen sulphide).
- Hydrogen sulphide (H₂S) is a very toxic gas, it can irritate the eyes and throat and can cause unconsciousness and death (see OCE6).
- Good practice benchmark values for total oil vapour is 50 mg/m³ and oil mist is 1 mg/m³ (Norwegian limits).
- Individual substances should comply with their workplace exposure limits (WELs) if available, or other relevant exposure standard.

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OCE26 Drilling waste treatment

Offshore COSHH essentials

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Control approach 3 Containment

What this sheet covers

This sheet describes good practice for control of exposure to drill cuttings and associated waste handling and treatment systems. It covers the key points you need to follow to help reduce exposure to an acceptable level, as part of your COSHH assessment.

Hazards

- Prolonged or repeated skin exposure from handling drilling muds and cuttings, may lead to skin irritation and/or dermatitis.
- Drilling muds at high temperature produce mists and vapour that may cause respiratory and skin irritation.
- Mud on cuttings returned from the well can also contain contaminants from formations (eg crude oil, condensate and Hydrogen sulphide).
- Individual substances should meet workplace exposure limits (WELs), if available, or other relevant exposure standard, see MSDS.

Access

- Restrict access to authorised personnel.
- Improve confined space entry procedures for entry to enclosed cuttings treatment equipment.
- Keep access doors closed.

Equipment and procedures

Substitution

- Use low toxicity base fluids with high flash point and low vapour pressure.

Control equipment

- Where practical, enclose transfer and storage equipment.
- Provide enough fresh air to dilute and remove air contaminants to a safe area eg above 15 air changes per hour with a through draught.
- Provide fixed alarms to detect the presence of contaminants from the well such as flammable and/or hazardous gases eg H₂S.

Cuttings transfer from solids control equipment

- Enclose the transfer equipment, eg closed augers or pneumatic conveying systems.
- Regulate flow to reduce potential for system overload and/or spillage.

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<http://www.hse.gov.uk/coshh/industry/offshore.htm>

Recommendations

- Use less hazardous chemicals where possible
- Design engineering controls to minimise exposure
- Use control measures proportional to the health risk
- Identify potential routes of exposure
- Monitor exposure in the work environment
- Inform and train personnel of the hazards and risks
- Apply relevant health surveillance programs
- Review the effectiveness of control measures

Thank you!

Questions?

IOGP Report 396

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