Good practice guidelines for the development of shale oil and gas

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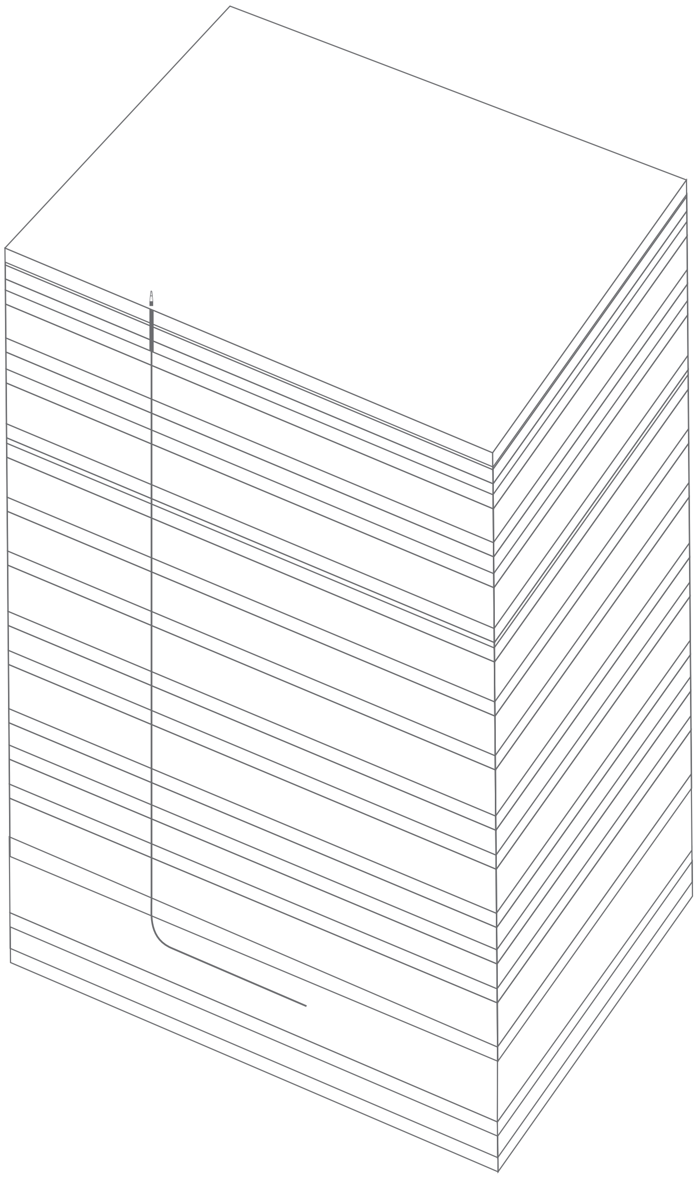

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Revision history

Version	Date	Amendments
1	December 2013	First issued

Contents

Introduction

Many members of both the International Association of Oil and Gas Producers (OGP) and IPIECA have their own guidelines for oil and gas developments. These O*GP-IPIECA Good practice guidelines for the development of shale oil and gas* are intended to complement these established practices. This document also provides a general, global framework of principles for operations under which more detailed standards and/or practices may be developed to meet regional and local circumstances. For the majority of issues, good practices for shale oil and gas will be identical to those for 'conventional' operations.

These guidelines provide stakeholders with an overview of how the oil and gas industry manages the risks associated with its operations. Given the high level of public interest in shale oil and gas operations, these insights into how safety, environmental, health and community aspects are addressed are particularly relevant. Such information may be used to structure discussions between stakeholders and operators at local level.

In addition to the identified good practices, which include local sourcing, operators may consider community investment as a complementary way to bring benefits to the local communities. Social investment projects are best designed in consultation with communities, to understand their views on the most beneficial community investments, as well as long-term versus short-term benefits.

The specific scope of application for these OGP-IPIECA good practices relate to hydraulic fracturing operations performed in either or both the exploration and production phases from shale resources. In some instances, the guidelines may describe practices that reflect the obligations companies have under existing regulation.

As these good practices are carried out and evolve, a periodic review process will encourage continual improvement and further consistency across the industry.

Note: Where examples are given in this document, they are meant to provide context and are not intended to be exhaustive. The application of these guidelines may not be appropriate in every instance, due to regional, local or technical, site-specific circumstances.

Managing potential issues and impacts

1. Worker safety, health and emergency response

Protecting the safety and health of employees, contractors and the general public, as well as the environment[1], is critical throughout every stage of shale oil and gas exploration and production. OGP and IPIECA members are striving to achieve zero incidents at their workplaces and work-related incidents in their neighbouring communities by applying these good practices:

Safety, health and emergency response

- Conduct appropriate risk assessments using qualified personnel
- Ensure personnel are trained and certified to use the appropriate equipment for a job
- Implement safety management systems to mitigate work site risks
- Use recognised engineering controls to reduce work site hazards (silica dust, noise and handling of chemicals)
- Require all personnel in work zones to wear appropriate personal protective equipment and follow approved site procedures
- Ensure there is a safety meeting (sometimes known as a 'tailgate meeting') prior to the execution of operational activities
- Coordinate emergency response plans with local responders and facilities
- Use recognised industry practice for working in challenging weather conditions (hot, cold, high winds)
- Strive for continual improvement in safety, health and environmental performance

Hiring and Training

- Ensure all workers are trained and understand location-specific responsibilities, site conditions and hazards and emergency response plans
- Provide a system to ensure all workers are competent to perform safely the tasks for which they are responsible

[1] Protection of the environment is of utmost importance to OGP/IPIECA members and practices addressing this topic can be found throughout this document, particularly in Chapters 4-9

2. Stakeholder engagement and community impacts

To understand local concerns, answer questions and seek collaborative solutions, open and transparent communication is important early in the planning process. OGP and IPIECA members are encouraged to work with appropriate stakeholders[2] to build an understanding of operations, create trust, seek to reduce potential negative impacts and enhance positive impacts by applying these good practices:

Open communication and collaboration[3]

- Proactively engage in a meaningful dialogue with stakeholders before and throughout activities as appropriate
- Provide opportunities for communities to voice their concerns and consider feedback as plans are developed
- Collaborate with local emergency response officials whenever possible to optimise efficiency and effectiveness of emergency response and emergency response planning
- Recognise and respect traditional values, heritage, culture and legal rights of indigenous people[4] consistent with applicable regulatory frameworks, international and industry standards

Noise and visual impacts

- Maintain appropriate distance from homes, businesses, or other occupied structures and take into consideration community preferences and operational requirements to reduce the potential impacts
- During the drilling and completion phase, evaluate appropriate methods to reduce visual and noise impacts

Traffic and road use

- Consider tracking and recording road use and traffic statistics in order to demonstrate efficiencies
- Use management practices designed to reduce transport of materials from well pad sites or other facilities onto public roads
- Manage transport operations to reduce excessive dust whenever possible
- Encourage use of centralised water storage, distribution, and treatment facilities where possible to reduce transport movements
- Work with local officials to mitigate traffic impact on communities (for example by requiring employee and contractor vehicles to remain on pre-authorised roads, closing gates when entering private land, practicing safe driving techniques, limiting driving time)

Community health

- Implement health, safety and environmental standards to reduce the potential for negative impacts to communities

Local sourcing[5] and economic development

- Pursue opportunities for local training, employment and business collaboration
- Consider sourcing supplier services locally and encourage contractors to use local workers, goods and services where practicable
- Consider the post-project use of infrastructure when planning the project

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2 Definition from IPIECA, 2004: *A guide to social impact assessment in the oil and gas industry,* "Relevant stakeholders are people likely to be affected by the project or who can impact the project, representatives of local communities, interest groups, NGOs, government agencies, funding institutions, employees, and contractors". See glossary for more details.

3 See also Chapter 9 on Biodiversity and Ecosystems

4 IPIECA, 2012. *Indigenous Peoples and the oil and gas industry: Context, issues and emerging good practices*

5 IPIECA, 2011. *Local content strategy: A guidance document for the oil and gas industry*

3. Water sourcing and efficient use

The appraisal, selection and use of water resources need to consider sustainability factors (environmental, social and economic) and respect the rights and needs of other local water users and the overall ecosystem requirements. Within operations, water efficiency can be maximised through the use of technology and other management practices that are appropriate to local conditions. OGP and IPIECA members are encouraged to collaboratively manage water use and act as stewards of this valuable resource by applying these good practices:

Planning process

- Work collaboratively with authorities and appropriate stakeholders to identify and permit suitable water sources, taking into account current and future water needs, quantity and quality of available water resources and the potential to use suitable lower quality water sources
- Design water management systems (storage, distribution, treatment, disposal) with a goal of cost-effectively reducing potential environmental and social impacts

Operations

- Design operations to reduce the single-cycle use of potable water where practical and environmentally beneficial
- Monitor operational water consumption and regularly evaluate options to improve the water efficiency of the project and apply new technology
- Optimise fracture fluid chemistry to maximise water efficiency

Reuse and recycle

- Substitute potable water with non-potable or brackish water where practical
- Seek opportunities to reuse and recycle flowback water
- Treat or responsibly dispose of any non-recycled water and wastes
- Support research aimed at reducing potable water consumption

4. Groundwater and surface water protection

Regulating authorities' definitions of the term 'groundwater' differs across the world. These guidelines consider the expression to mean "water contained in geologic media which has been designated by a state as usable for domestic, industrial or municipal purposes"[6].

Groundwater protection is important throughout every stage of shale oil and gas exploration and production. This includes initial site selection and extends through to well design and construction (see section 5), chemical and flowback water management during operations (see section 6) and the design of abandonment so as to continually protect groundwater.

OGP and IPIECA members are encouraged to apply these good practices for responsible stewardship of groundwater:

Detailed site assessment

- Conduct an investigation into existing groundwater sources near potential well sites
- Seek close cooperation and collaboration with local authorities and other existing water users
- Test existing groundwater sources near potential well sites, as permitted, before commencing construction activities. Where baseline data exists for a site, sampling may not be needed. The type and frequency of sampling depends on site-specific circumstances
- Conduct baseline water sampling, including surface water bodies as appropriate, and analysis using established sampling and analytical methods
- Consider subsequent groundwater sampling for constituents related to oil and gas operations to determine whether substantial changes to groundwater have occurred
- Provide all relevant final testing results to local authorities, other existing water users and applicable landowners to the extent required by contract and regulatory disclosure provisions
- Seek sound sourcing for water procurement, including appropriate due diligence of the supply chain

Fracturing fluids and disclosure

- Maintain current Material Safety Data Sheets at an accessible site location for all hazardous chemicals, materials and additives used onsite in accordance with law or applicable requirements
- Disclose chemical additives used in hydraulic fracturing fluids to the public (*e.g.* http://fracfocus.org/ in the US and Canada, OGP's http://www.ngsfacts.org/ and member company websites) either by operators or by service providers, while respecting the intellectual property and commercial rights of the providers of those additives

[6] Definition from Groundwater Protection Council, May 2009. *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, "water contained in geologic media which has been designated by a state as usable for domestic, industrial or municipal purposes".

5. Cementing and well integrity

Maintaining well integrity over the lifetime of an oil and gas well begins with proper well design and construction. Casing and cement selection, coupled with proper installation, is a key component to providing long-term integrity of the well. OGP and IPIECA members are encouraged to apply the following good practices:

Overall well integrity

- Identify components to address the expected chemical and physical environments of each well during the well design and construction process

Cementing

- Adhere to recognised cement standards for sound well design, construction and well integrity (*e.g.* OGP 485)
- Customise good practices for each individual well and field and adapt for each application, taking into consideration: potential gas migration, cement bonding, lost circulation, proper cement displacement, mud conditioning and displacement, zonal isolation, adequate cement height, representative pilot testing and annular pressure build-up in terms of cement design

Well integrity

- Adhere to recognised well integrity standards (*e.g.* OGP 485, ISO, American Petroleum Institute 65-2)
- Design and construct wells with properly engineered barriers to isolate and protect groundwater
- Design pressure relief and control systems for anticipated flow rates, safe management and proper containment of fluids
- Monitor system pressures during drilling and completion activities, and take appropriate corrective actions, including shutting down, if necessary
- Test emergency well shutdown procedures and blowout preventers and conduct pressure tests on well components according to good industry practices including prior to the start of the first fracture stage
- Follow recognised standard well abandonment procedures at the end of a well's productive life, including setting cement plugs and/or mechanical barriers in the wellbore to isolate oil and gas from groundwater

6. Operational water management

Safe water management practices and the proper disposal of drilling fluids and produced water, including flowback fluid, are vital to protecting surface and ground water (creeks, rivers, lakes, reservoirs, aquifers). OGP and IPIECA members are encouraged to protect surface water by applying these good practices:

Well site design and construction

- Review construction sequencing and staging before breaking ground and reduce erosion using proven sedimentation control structures and methods
- Consider using impermeable natural or manmade material in critical well pad areas to prevent accidental spills and releases from coming into contact with the ground
- Consider employing diversionary structures/storm-water management practices to handle storm water flow at a well pad
- Consider using secondary containment, including berms, for tanks containing fluids (excluding groundwater and other harmless fluids)

Spill prevention and emergency response

- Prepare a spill prevention and emergency response plan that includes access to key equipment and material, as well as internal and external reporting processes and contacts
- Communicate emergency and spill response notification procedures to employees and contractors on site, clarifying individual responsibilities and providing necessary training
- Inform local first responders of drilling operations and emergency and spill response procedures
- Have appropriate amounts of spill response equipment (personal protective equipment, sorbent material) readily available at the well site

Operations

- Consistent with requirements for all oil and gas operations, store chemicals (fluids and liquid additives) in tanks or containers with secondary containment and protect dry additives from the weather
- Consider the use of closed-loop drilling fluids management systems, where practicable, to reduce: the risk of pit liner leakage, the risk of surface spills, waste volumes and pad sizes
- Organise the waste area with tanks or basins for temporary storage of each type of waste
- Implement an onsite management system to monitor tank liquid levels
- Design equipment and associated procedures for fuelling operations to reduce the risk of accidental fuel spillage
- Test the integrity of high pressure surface equipment (wellhead, flowlines, manifolds, piping and pumping equipment)

Produced water disposal

- Test and measure produced water from production zones to assess disposal options
- Capture produced water from well operations in tanks/ impoundments and manage these fluids according to government-approved methods (reinjection, re-use/ recycling, treatment and disposal)

7. Air emissions

Oil and gas exploration, production, processing and pipeline transport activities have the potential to emit pollutants into the air. These can include greenhouse gases (GHG), volatile organic compounds (VOC), nitrogen oxide (NO_x), sulphur dioxide (SO_2), particulate matter and hydrogen sulphide (H_2S). OGP and IPIECA members are encouraged to operate in a manner that protects air quality and reduces GHG and other emissions by applying these good practices:

Planning process

- Design plans to reduce air emissions in line with applicable regulations/standards in order to control potential impacts on environment and human health

Monitor and reduce

- Install, test, maintain and repair equipment as appropriate to reduce the potential for emissions due to equipment leaks or failures
- Report emissions and leaks in compliance with applicable regulations
- Consider the use of Reduced Emission Completion (REC) well technologies ("green completions") when practicable to separate and capture methane emitted during well completions
- Avoid routine venting and long-term flaring, except in cases where required for safety, environmental or other conditions (such as flow testing during the exploration phase)
- Install barriers or control-and-recovery equipment to reduce emissions from storage tanks and tank batteries at production sites to the extent practicable
- Use pipelines instead of trucks or rail to the extent practicable to reduce emissions from transporting oil and gas
- Perform air emission and air quality monitoring in line with applicable regulations/standards in order to control potential impacts on environment and human health

8. Land use

Applying technology and designing facilities in an environmentally and socially responsible manner are important to managing the operational footprint of oil and gas activities. Minimising operational footprints also assists with a biodiversity and ecosystem services approach, (also see section 9), particularly in terms of managing the potential fragmentation of habitats. OGP and IPIECA members are encouraged to reduce the potential impact and amount of land used during the exploration and production phases by applying these good practices:

Site selection and planning

- Consult with appropriate stakeholders when selecting and evaluating sites
- Evaluate multiple options for siting well pads/facilities when potential alternatives are available and avoid sensitive habitats
- Design infrastructure in coordination and cooperation with other oil and gas activities to reduce surface disturbance (flow lines following lease/private roads, use of flow line/pipeline corridors, shared rights-of-way)
- Reduce habitat fragmentation and/or surface disturbance as much as practicable
- Consider the cumulative impacts of shale oil and gas development on local land use during planning

Drilling and operations

- Seek to avoid the construction of new roads by using existing roads and infrastructure that meet regulatory standards, safety and environmental objectives
- Improve roads and infrastructure within existing rights-of-way to meet such standards
- Where new construction (roads, water wells) is necessary, consider potential post-project use of the infrastructure by the community
- Drill multiple wells from a single pad (including horizontal and directional drilling when compatible with reservoir characteristics), where feasible, to reduce the number of well pads and the amount of surface use (roads and other infrastructure)

Reclamation and restoration

- Use good practices to reclaim land and restore its contours as close as practicable to the original condition, in compliance with all regulations, contractual obligations and considering ecological issues
- Re-vegetate disturbed areas, with a preference for native plant species, taking into account pre-existing ecological conditions

9. Biodiversity and ecosystems

Protecting biodiversity[7] and ecosystems and the resources they provide ('ecosystem services')[8] are essential to conserving the natural environment. This, in turn, is a vital factor in human well-being. Guidelines and tools from OGP and IPIECA help operators identify all potential impacts of oil and gas operations on biodiversity and ecosystem services[9] (BES) across the project life-cycle and how to mitigate these. OGP and IPIECA members are encouraged to implement, as early as possible in the project life-cycle, BES assessments at both landscape and site level and to exercise other good practices including:

Open communication and collaboration

- Engage in open dialogue with appropriate stakeholders to gain local ecological knowledge and understand how communities value and use natural resources

Opportunity-screening, site selection, project development, operations and decommissioning

- Conduct scoping surveys, baseline data collection and BES assessments (including the significance of nearby protected areas, the presence of threatened species, critical habitats and key ecosystem services) as early as possible in collaboration with appropriate stakeholders
- Use established impact assessment processes, including BES assessment, and effective planning tools (such as those developed by OGP, IPIECA and the Energy and Biodiversity Initiative (EBI)), to recognise and manage potential operational impacts on BES and potential competition with other resource users
- Address potential impacts to BES in all stages of the project; apply the well-established 'mitigation hierarchy'[10] (avoidance, minimisation, restoration and, if necessary, offset) to address potential operational impacts on BES at all stages of the project and to capture long-term conservation opportunities

Prevention and rehabilitation

- Reduce the potential intrusion of alien invasive species (AIS)[11] based on a thorough understanding of the pre-existing ecological conditions and potential operational threats
- Monitor and report on the implementation and effectiveness of BES action plans

Integrate, adapt and improve

- Integrate BES assessments and action plans in the environmental management system and adapt operational practices on the basis of the monitoring data for continuous improvement in the management of BES issues

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7 Definition from IPIECA/OGP, 2011. *Ecosystem Services Guidance*, "Biodiversity is defined as the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part... "(United Nations Convention on Biological Diversity (1992).

8 Definition from IPIECA/OGP, 2011. *Ecosystem Services Guidance*, "Ecosystem services are the benefits people derive from the environment (Millennium Ecosystem Assessment, 2005).

9 Definition from IPIECA/API/OGP, 2010. *Oil and gas industry guidance on voluntary sustainability reporting*, " Ecosystem services are the benefits (direct or indirect) that people obtain from ecosystems".

10 Definition from BBOP: *Standard on Biodiversity Offsets*. "Mitigation hierarchy views the role of biodiversity offsets as a "last resort", after all reasonable measures have been taken first to avoid and minimize the impact of a development project and then to restore biodiversity on-site. Conformance to the mitigation hierarchy is the first of the ten best practice Principles established by BBOP. See Glossary for the definition of "biodiversity offsets"

11 See IPIECA/OGP, 2010. *Alien invasive species and the oil and gas industry: Guidance for prevention and management*. See Glossary for details.

10. Induced seismicity

Induced or triggered seismicity happens when human activity alters the frequency of occurrence and/or the magnitude of seismic events from natural levels.

According to a US National Academy of Sciences study[12] on induced seismicity, such seismicity related to energy technology operations can be detected on the surface only under rare circumstances.

Many industrial activities (reservoir impoundment, mining, construction, waste disposal, and oil and gas operations) have dealt with induced seismicity for decades using proven engineering and controls. The assessment and management of induced seismicity risk are encouraged.

OGP and IPIECA members are encouraged to apply these good practices in the execution of their operations:

Assessing potential for induced seismicity

- Perform a risk-screening considering the local operating environment and the subsurface site characterisation
- In areas of possible elevated risk of induced seismicity, perform sub-surface site characterisation using engineering, geological and geophysical data, to identify and avoid faults that might be prone to activation. Consider well type and geology, past operating experience, historical seismicity and anticipated scope of operations (rates, volumes, pressures)
- Evaluate wellbore placement and drilling design to account for the specifics of the subsurface site characterisation
- Listen to stakeholder concerns about the potential for induced seismicity and provide credible information. Explain any planned actions aimed at reducing potential induced seismicity

Monitoring

- Consider seismicity monitoring in specific areas, if studies of local geology and local surface conditions indicate the potential for significant seismicity[13]
- Report and discuss occurrence of induced seismicity with appropriate regulators and stakeholders

[12] National Research Council of National Academies, USA, 2012. *Report on Induced Seismicity Potential in Energy Technologies*, National Research Council of National Academies, USA.

[13] Ibid.

Glossary

Alien species: Alien (also known as non-native, non-indigenous, foreign or exotic) species means a species, subspecies or lower taxon occurring outside its natural range (past or present) and dispersal potential, in other words, outside the range it occupies naturally or could occupy without direct or indirect introduction or care by humans; it includes any part, gamete or propagule of such species that might survive and subsequently reproduce.

Alien Invasive Species(AIS): is defined as an 'alien species' (see above) that becomes established in natural or semi-natural ecosystems or habitat, is an agent of change, and threatens native biological diversity'. It is important to note that not all alien species necessarily become invasive; for example, conditions such as effective predation by native species may not allow successful survival or reproduction. Alien species may also successfully establish themselves alongside native species without causing apparent ecological harm or environmental change.

Baseline: Dated information or data that establishes a reference point against which performance trends can be consistently assessed.

Barrier: A reliable and verifiable pressure-control method used to prevent undesirable fluid flow in a well. A barrier, depending on the specific well situation, can be a mechanical barrier (*e.g.* a valve), fluid/mud/cement if of sufficient density to stop fluid flow in the well, or tubing/casing that has been mechanically isolated from open perforations and tested for pressure integrity.

Biodiversity: The United Nations Convention on Biological Diversity defines biodiversity as, "the variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are part…"

Casing: Thick walled steel pipe placed in wells to isolate formation fluids (such as ground water) and to prevent borehole collapse.

Closed-loop drilling: A technique that involves a series of tanks used to store liquids and solids after the drilling process. Solids control equipment separates out the solids from the liquids and minimises the amount of waste drilling muds and cuttings that require disposal and maximises the amount of drilling fluid recycled and reused in the drilling process.

Completion: The process of making a well ready to produce gas or oil. Completion involves installing permanent equipment such as a wellhead. In shale oil and gas operations, completion often includes hydraulic fracturing.

Ecosystems: A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit (taken from Millennium Ecosystem Assessment, 2005).

Ecosystem services: The benefits that ecosystems contribute towards human well-being (taken from Millennium Ecosystem Assessment, 2005).

Flaring: The controlled burning of gas. This can occur for safety reasons, because there is not yet no infrastructure in place to transport gas to market, when gas is being used for other beneficial purposes (such as enhanced oil recovery or reservoir pressure maintenance), or during a reservoir test.

Groundwater: Given there is no universal definition, OGP and IPIEA are using the definition of the U.S. Groundwater Protection Council: "water contained in geologic media which has been designated by a state as usable for domestic, industrial or municipal purposes". National, regional and local definitions may vary.

Hydraulic fracturing: Hydraulic fracturing is a reservoir stimulation technique used since the late 1940s. It facilitates production of oil and gas trapped in low-permeability reservoir rocks. The process involves pumping fluid (comprised of approximately 99% water and sand and 1% household chemical additives) at high pressure into the target formation, thereby creating small fractures in the rock that enable hydrocarbons to flow to the wellbore.

Induced seismicity: Seismic waves are generated when sudden slips occur along a fault. This sudden slip can be due to release of strain accumulation from tectonic loading, stress changes and/or pore pressure changes. It has been previously reported that induced or triggered seismicity has occurred due to many industrial activities, including reservoir impoundment, mining, construction, waste disposal, and oil and gas operations. These occurrences can be detected with very sensitive special seismic instruments and are not normally noticeable at the surface.

Material safety data sheets (MDS): Sometimes called 'safety data sheets' (SDS). A document that contains information on the potential hazards (health, fire, reactivity and environmental) and how to work safely with a chemical product. It contains information on the use, storage, handling and emergency procedures all related to the hazards of the material. MSDs/SDSs are prepared by the supplier or manufacturer of the material.

Mitigation hierarchy: Used to establish an order for mitigation measures in order to achieve 'no net loss' (NNL) or a 'net positive impact' (NPI) of biodiversity. This begins with avoidance and works through other stages as necessary: avoid, minimise, restore, offset and additional conservation actions (ACAs).

Non-governmental organisation (NGO): According to a UN definition, a non-governmental organisation is a not-for-profit group, principally independent from government, which is organised on a local, national or international level to address issues in support of the public good.

Personal protective equipment: Any device or appliance designed to be held or worn by an individual for protection against one or more health and safety hazards.

Produced water: Water produced in connection with activities associated with the exploration, development and production of oil or gas or geothermal operations. Produced water is also referred to as 'brine', 'saltwater', 'hydraulic fracturing flowback fluid' or 'formation fluid'.

Reduced emission completion (REC): Sometimes referred to as 'green completions'. Systems to reduce methane losses by capturing them at the well head immediately after well completion. After a new well completion, the well bore and rock formation must be cleaned of debris and fracture fluid. Conventional methods for doing this include producing the well into a tank to collect sand, cuttings and reservoir fluids before treatment and disposal according to permit conditions. With REC, gas and hydrocarbon liquids are physically separated from other fluids and sent for productive use.

Relevant stakeholder: People likely to be affected by a project or who can impact a project; representatives of local communities, interest groups, NGOs, government agencies, funding institutions, employees, and contractors. Identified stakeholders should be assessed for their ability to influence the project or operation or their vulnerability to negative impacts arising from it. This evaluation can help prioritise and develop appropriate and feasible engagement strategies with each stakeholder. Time scales for effective engagement can be lengthy particularly in areas new to oil and gas activities, therefore early engagement is encouraged.

Silica: Silica or silicon dioxide (SiO_2), also called quartz, is one of the most common minerals found on the earth's surface. It is generally included in hydraulic fracturing fluid to prop open the tiny fissures in the shale rock. 'Sand' refers to a particle size. Silica sand is mined from sandstone formations that have undergone geologic processes to produce well-rounded, well-sorted sand and gravel that consists of almost pure quartz (silicon dioxide).

Shale: A very fine-grained sedimentary rock with a finely stratified or laminated structure and fissile nature that is formed by the consolidation of clay, mud, or silt. Certain shale formations contain large amounts of both oil and gas.

Stakeholder: People that affect, or are affected by company activities or operations (*e.g.* customers, shareholders, management, employees, suppliers, local communities, advocacy groups and government).

Surface water: Water naturally open to the atmosphere, such as lakes, reservoirs, creeks and rivers.

Venting: The controlled release of unburned gas into the atmosphere. Used instead of flaring when necessary for safety, environmental or other concerns.

Wellbore: The hole drilled by a drilling rig to explore or produce oil and/or gas. Also referred to as a well or borehole.

Reference

In identifying these good practices, OGP and IPIECA reviewed various standards and practices from operators and industry organisations as a reference, including:

American Petroleum Institute, 2009. *Recommended Practice 51R: Environmental Protection for Onshore Oil and Gas Production Operations and Leases*, available from www.api.org/oil-and-natural-gas-overview/exploration-and-production/hydraulic-fracturing/rp-51r-environmental-protection.aspx

American Petroleum Institute, 2009. *HF 1: Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines*, available from www.api.org/policy-and-issues/policy-items/hf/api_hf1_hydraulic_fracturing_operations.aspx

American Petroleum Institute, 2010. *HF 2: Water Management Associated with Hydraulic Fracturing*, available from http://www.api.org/policy-and-issues/policy-items/hf/api_hf2_water_management.aspx

American Petroleum Institute, 2010. Standard 65-2, *Isolating Potential Flow Zones During Well Construction*

American Petroleum Institute, 2011. *HF 3: Practices for Mitigating Surface Impacts Associated with Hydraulic Fracturing*, available from www.api.org/oil-and-natural-gas-overview/explorati__on-and-production/hydraulic-fracturing/api_hf3_practices_for_mitigating_surface

American Petroleum Institute, 2012. *Standard 53, Blowout Prevention Equipment System for Drilling Wells*, 4th Edition, BSEE BOP Forum

Appalachian Shale Recommended Practices Group, 2012. *Recommended Standards and Practices*, available from www.eqt.com/docs/pdf/ASRPG_Standards_and_Practices.pdf

Australian Petroleum Production & Exploration Ltd, 2011. *Western Australian Onshore Gas: Code of Practice for Hydraulic Fracturing*, available from http://www.newstandard.com.au.php5-22.dfw1-1.websitetestlink.com/wp-content/uploads/2011/11/APPEA_Code_of_Practice.pdf

BBOP (Business and Biodiversity Offsets Programme), 2012. *Standards on Biodiversity Offsets*, available from www.forest-trends.org/documents/files/doc_3078.pdf

Canadian Association of Petroleum Producers, 2012. *Hydraulic Fracturing Operating Practice: Anomalous Induced Seismicty: Assessment, Monitoring, Mitigation and Response*, available from www.capp.ca/canadaIndustry/naturalGas/seismicity/Pages/default.aspx

Center for Disease Control and Prevention, 2012. *Worker Exposure to Crystalline Silica during Hydraulic Fracturing*, available from http://blogs.cdc.gov/niosh-science-blog/2012/05/23/silica-fracking/

ConocoPhillips, 2013. *Global Onshore Well Management Principles*, available from www.conocophillips.com/Documents/ConocoPhillips/SMID_005_Global%20Onshore%20Well%20MGMT%20Principles.pdf

Groundwater Protection Council *et al.*, 2009. *State Oil and Natural Gas Regulations Designed to Protect Water Resources*, available from www.gwpc.org/sites/default/files/state_oil_and_gas_regulations_designed_to_protect_water_resources_0.pdf

International Energy Agency, 2012. *World Energy Outlook 2012*, available from www.worldenergyoutlook.org/

IPIECA, 2004. *A Guide to Social Impact Assessment in the Oil and Gas Industry*, available from http://www.ipieca.org/publication/ipieca-guide-social-impact-assessment-oil-and-gas-industry

IPIECA, 2011. *Indigenous Peoples and the Oil and Gas Industry: Context, Issues and Emerging Good Practice*, available from www.ipieca.org/publication/indigenous-peoples-and-oil-and-gas-industry-context-issues-and-emerging-good-practice

IPIECA, 2012. *Operational Grievance Mechanisms: Good practice Survey*, available from http://www.ipieca.org/publication/operational-level-grievance-mechanisms-good-practice-survey

IPIECA, 2012. *Human Rights Due Diligence Process: A Practical Guide to Implementation for Oil and Gas Companies*, available from http://www.ipieca.org/publication/human-rights-due-diligence-process-practical-guide-implementation-oil-and-gas-companies

IPIECA, 2011. *Local Content Strategy: A Guidance Document for the Oil and Gas Industry*, available from www.ipieca.org/publication/local-content-strategy-guidance-document-oil-and-gas-industry

IPIECA, 2013. *Water Management Framework For Onshore Oil and Gas Activities*, available from www.ipieca.org/publication/ipieca-water-management-framework

IPIECA/API/OGP, 2010. *Oil and Gas Industry Guidance on Voluntary Sustainability Reporting*, available from http://www.ipieca.org/publication/oil-and-gas-industry-guidance-voluntary-sustainability-reporting-2010-update

IPIECA/OGP, 2010. *Alien Invasive Species and the Oil and Gas Industry: Guidance for Prevention and Management*, available from http://www.ipieca.org/library?x=-515&y=-262&date_filter[value][year]=&keys=Alien+invasive+species+and+the+oil+and+gas+industry

IPIECA/OGP, 2011. *Ecosystem Services Guidance*, available from www.ipieca.org/system/files/publications/ecosystem_services_guidance_8.pdf

IPIECA/ICMM & Equator Principles Banks, 2013 (ongoing). *Cross-sector Biodiversity Initiative*, available from www.equator-principles.com/index.php/ep3/52-best-practice-resources-and-links

Minnesota Environmental Quality Board, 2013. *Report on Silica Sand, Final Report*, available from www.eqb.state.mn.us/resource.html?Id=33133

OGP Report 485, 2012. *Standards and Guidelines Relevant for Drilling, Well Construction and Well Operations*, available from http://www.ogp.org.uk/publications/wells-committee/wecstandards/

Polish Exploration and Production Industry Organisation (OPPPW), *Oil and Gas Operating Recommended Practices*, available from www.opppw.com/organization/downloads

Shell, 2013. *Onshore Tight Sand or Shale Oil & Gas Operating Principles* available from www.shell.com/global/future-energy/natural-gas/gas/shell-operating-principles.html

Statoil, 2013. *Shale Operator Commitments: Developing Global Shale Resources Responsibly*, available from www.statoil.com/en/OurOperations/ExplorationProd/ShaleGas/Downloads/Statoil%20Shale%20Operator%20Commitments-2013.pdf

Talisman Energy, 2013. *Shale Operating Principles*, available from www.talisman-energy.com/operations/the-americas/shale-operating-principles.html

UK Onshore Operators Group, 2013. *Shale Gas Well Guidelines*

US Department of Labor, 2012. *Worker Exposure to Silica During Hydraulic Fracturing,* available from https://www.osha.gov/dts/hazardalerts/hydraulic_frac_hazard_alert.pdf

Each operator should apply the most appropriate standards and practices according to local conditions/national regulations for each site. This may include guidelines, standards and best practices not listed here.

Please note that while every care has been taken to provide accurate hyperlinks, these standards and guidelines are regularly updated.

About us:

***OGP** is a global organisation that has been active for nearly 40 years, facilitating continual improvement in upstream (meaning exploration and production) health safety and environmental issues as well as improvements in engineering and operations. OGP, with offices in London and Brussels, represents publically-traded private and state-owned oil and gas companies, field service companies and industry associations. Its members produce more than half of the world's oil and over one-third of its gas. More information about OGP and the production of gas from shale can be found at: http://www.ogp.org.uk/fracturing and http://ngsfacts.org*

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***IPIECA** is the global oil and gas industry association for environmental and social issues. It develops, shares and promotes good practices and knowledge to help the industry improve its environmental and social performance, and is the industry's principal channel of communication with the United Nations. Through its member-led working groups and executive leadership, IPIECA brings together the collective expertise of oil and gas companies and associations. Its unique position within the industry enables its members to respond effectively to key environmental and social issues.*

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