



# SHELL ONSHORE OPERATING PRINCIPLES

## FOR TIGHT SAND OR SHALE OIL AND GAS



In 2011, Shell publicly shared five aspirational operating principles that govern the activities where we operate and where hydraulic fracturing is used for the development of onshore tight sand or shale oil and gas.

We believe these operating principles provide a framework for protecting water, air, wildlife and members of the communities in which we operate. Our principles are reviewed and updated periodically as new technologies, challenges and regulatory requirements emerge. This document reflects the 2016 update.

*We continue to share our operating principles to address concerns around the development of onshore oil and gas using the practice of hydraulic fracturing. Shell believes it can explore, develop and produce these resources safely and responsibly.*

Our principles are underpinned by a deliberate focus on safety, environment, continuous improvement, collaboration with regulators, and engagement with local residents where we strive to be open and transparent about how we operate and the impacts of our activities. We support regulations consistent with these principles, which are designed to reduce risks to the environment and keep those living near our operations safe.



We aim to have all Shell-operated projects where hydraulic fracturing is used for the development of onshore tight sand or shale oil and gas to adhere to the five principles, but we will also consider each project independently – from the geology to the surrounding environment and communities – and design our activities using state-of-the-art technology and innovative approaches that make the most sense for local conditions.

Shell participates in a number of joint venture operations across the globe where it does not maintain operational control. When participating in a joint venture not under Shell control, we will encourage the operator of the joint venture to adopt similar operating principles. For assets we acquire from third parties where we are the operator, we will assess the compliance of such assets and operations against these principles. We aim to apply these principles to such assets as is feasible and reasonably practicable.

**SHALES**  
UNCONVENTIONAL  
ENERGY

## Our five onshore tight sand or shale oil and gas operating principles:



**SAFETY** – Shell designs, constructs and operates wells and facilities in a safe and responsible way.



**WATER** – Shell conducts its operations in a manner that protects groundwater and reduces potable water use as reasonably practicable.



**AIR** – Shell conducts its operations in a manner that protects air quality and controls fugitive emissions as reasonably practicable.



**FOOTPRINT** – Shell works to reduce its operational footprint.



**COMMUNITY** – Shell engages with local communities regarding socio-economic impacts that may arise from its operations.

## Principles in detail

Following are the five operating principles with examples from our own operations that describe our principles in action.

## FIVE OPERATING PRINCIPLES



### SAFETY

Shell designs, constructs and operates wells and facilities in a safe and responsible way.

For example:

1. We have mandatory “Life Saving Rules” designed to protect the safety of Shell employees and contractors and promote the safe operations of the facilities in which they work.
2. We have strict company standards for our well and facility designs and operating procedures.
3. We apply the Shell Global Wells Standards covering drilling, completion and well intervention activities. These include comprehensive well planning, execution and maintenance requirements.
4. In accordance with applicable local regulatory requirements, we share our well and completion designs, operations reports, as well as our plans to protect aquifers.
5. Before we drill, conduct exploratory field work or develop a field, we conduct a hazard assessment, covering Health, Safety, Security and the Environment (HSSE), to identify and implement controls and recovery measures to reduce risks. The results of the hazard assessment are documented, and reviewed and updated regularly.
6. We use robust well design and construction, employing at least two physical barriers in the section of the well passing through the potable groundwater aquifer, in order to isolate the hydrocarbon production stream from communicating with potable groundwater. Additionally, we isolate the potable groundwater aquifer from hydraulic fracturing fluid.
7. Shell designs wells based on our understanding of the local geology and environment in which we operate. In new exploration areas, we gather and evaluate existing and publicly available geologic and geophysical data relevant to the area before we drill.
8. When we drill a well, we examine available data (such as pore pressure data, geological hazards, shallow gas, faults or other geological information) to promote safe operations.
9. We assess the seismicity hazard and risk profile of our hydraulic fracturing and related water disposal well operations, taking subsurface and surface exposure factors into consideration. With respect to induced seismicity hazards, we put in place monitoring, mitigation and response plans according to the risk profile of each asset and according to local regulatory requirements.

- 10.** Underground injection wells are designed and operated in accordance with local regulatory requirements. As such, before we begin to drill an underground injection well for disposal of wastewater, we select and review the location based on available data from the surrounding area, available subsurface and geophysical information, as well as the locations of producing oil and gas wells in the area.
- 11.** We test for asset integrity (casing shoes, casing, cement, and well-head equipment) by employing site-specific pressure testing and/or detection equipment during the well construction phase and by monitoring during production.
- 12.** We do not hydraulically fracture wells unless we have pressure tested for wellbore integrity.
- 13.** In accordance with local regulatory requirements, we release information about chemicals used in our hydraulic fracturing fluids (to the extent allowed by our suppliers) and support regulation to require suppliers to release such information.
- 14.** Shell does not use diesel in its hydraulic fracturing completions fluids.
- 15.** We design for primary containment of produced hydrocarbons and oil-based drilling fluids through the use of tanks with secondary containment in the form of liners, berms, double walls, or active monitoring.
- 16.** We eliminate the use of unlined earthen pit systems at well sites for primary containment of produced hydrocarbons and oil-based mud cuttings.
- 17.** We use dual barriers for earthen pits that store produced water after separation. In rare instances, where pit liners are prohibited by local regulation, we will adhere to such regulation.
- 18.** We run and maintain our operations with trained personnel and conduct regular process safety reviews of our operations and management systems.
- 19.** We are implementing appropriate comprehensive technical training certification and competency assurance programs for our technical professionals.
- 20.** We conduct structured, systematic reviews of our asset integrity to identify and address potential hazards, review response plans and manage risk through our HSSE Management System.
- 21.** For all new assets and significant modifications to existing assets, we perform process safety reviews that are designed to prevent incidents involving unintentional release of energy or hazardous substances. We perform new process safety reviews for existing assets at least every five years. We manage any risks identified by the process safety reviews and review such risks at least annually.
- 22.** Among our operating groups, we have a process to share our findings from reported process safety incidents to identify potentially hazardous conditions and improvement opportunities.
- 23.** We utilize an annual business assurance process as a tool to review our management of risk for existing assets, including safety, environmental, operational and technical risks.
- 24.** We have emergency response plans that take into account the local surroundings and enable us to respond quickly and effectively if unplanned events should occur. These plans address, among other things, spill prevention and containment at well pads.
- 25.** We have a coordinated program to invest in state-of-the-art technology to improve our drilling, completion and well intervention operations, including hydraulic fracturing. We invest in new technologies in order to make operations safer, more economically viable and/or to reduce the amount of water we use in our fracturing operations.

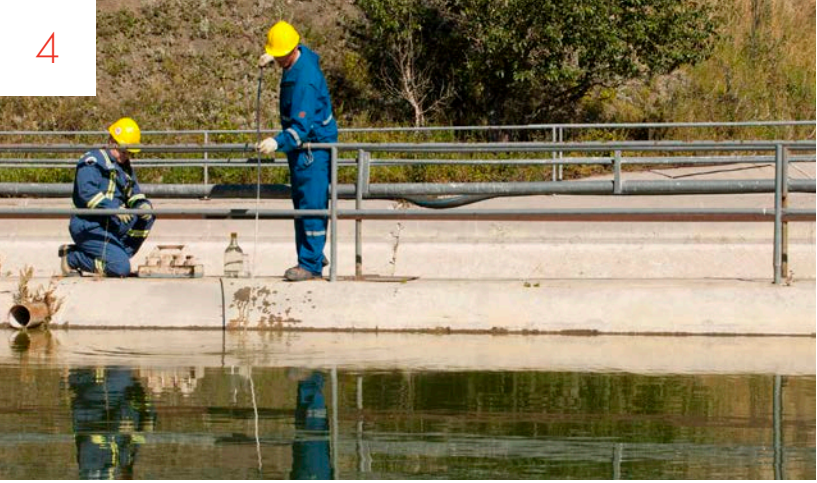
## COLLABORATING WITH STAKEHOLDERS

### PRINCIPLE IN PRACTICE:

Shell works closely with industry, regulators and academics in Western Canada to address emerging risks of induced seismicity associated with hydraulic fracturing.

Shell is working with industry, through the Canadian Association of Petroleum Producers (CAPP) to develop best practices that include monitoring, mitigation and response procedures to avoid or minimize seismicity potentially associated with hydraulic fracturing.





## WATER

Shell conducts its operations in a manner that protects groundwater and reduces potable water use as reasonably practicable.

For example:

1. We design drilling, completion, well intervention and production activities in order to isolate them from potable groundwater aquifers.
2. We will not operate wells where isolation of our completion, well intervention and production activities from potable groundwater cannot be achieved.
3. As part of the initial construction of the top segment of the well and before the well is completed and hydraulically fractured, we use only air, water or water-based drilling fluids through and below the base of potable groundwater aquifers. We case and cement those zones before drilling farther or hydraulically fracturing the well.
4. We keep well pad construction and production activities at least as far away from protected surface water bodies as required by applicable law or regulation.
5. We test potable groundwater near our fracturing operations, as permitted, to help determine whether changes have occurred as a result of our activity. The type and frequency of monitoring will depend on site-specific circumstances.
6. We design our wells and hydraulic fracture treatments using available data to minimize risk of affecting potable groundwater aquifers. We execute our well completion activities against that design.
7. In order to help assess the geologic stresses, fracture lengths and fracture orientations in a given basin, we periodically employ micro-seismic monitoring tools and/or other measurement techniques during our appraisal operations prior to development. We use this data to confirm our models.
8. Unless local conditions call for alternatives, we design our operations to reduce the use of potable water and to use non-potable water as reasonably practicable.
9. We work with local water boards and/or other appropriate regulatory agencies to identify suitable water sources for our operations.
10. We recycle hydraulic fracturing fluids and produced water in our operations to the extent reasonably practicable.
11. We store, treat and dispose of hydraulic fracturing fluids and produced water that is not recycled in an environmentally responsible manner, in accordance with applicable regulatory requirements.

## REUSING WATER

### PRINCIPLE IN PRACTICE:

Near our Fox Creek operations in Canada, we have an agreement with the town of Fox Creek to use their treated waste water in our asset operations.

In 2015, we used approximately 60% alternative or waste water sources. Shell also funded a design study to upgrade the town's natural water facilities.



## AIR

Shell conducts its operations in a manner that protects air quality and controls fugitive emissions as reasonably practicable.

For example:

1. We develop plans for development and production asset areas to reduce adverse emissions as much as reasonably practicable.
2. We measure, catalog and report emissions as required by applicable regulation.
3. We monitor production facilities and gathering lines for fugitive emissions and take corrective action as required by applicable regulation. Monitoring may be done by pressure testing, visual observation, infrared testing or other technologies.
4. We design our wells to eliminate or mitigate routine surface casing annulus venting. Where such venting is required by regulation, we reduce or eliminate emissions with appropriate control equipment, as reasonably practicable.
5. We reduce VOC emissions from hydrocarbon storage tanks at production sites by installing barriers or control equipment as reasonably practicable.
6. We establish and maintain a Greenhouse Gas (GHG) and Energy Management Plan to reduce GHG emissions and we develop options for improving our operations on an ongoing basis.



## REDUCING EMISSIONS

### PRINCIPLE IN PRACTICE:

At our Appalachia operations in Pennsylvania, USA, we introduced a number of voluntary measures at our sites to reduce emissions.

These exceed local, state and federal air quality regulations. Around 90% of our Appalachia surface facilities have low-emission devices to reduce fugitive emissions.

7. We employ emission-mitigating equipment and/or use cleaner burning fuels, such as natural-gas-driven engines, for rig operations in order to reduce the total Nitrogen Oxides (NOx), Sulfur Oxides (SOx) and various GHG emissions from our drill site operations as reasonably practicable and as available in local markets.
8. We operate our assets to minimize continuous flaring and venting of hydrocarbons as a means of disposal except where necessary for safety, emergency or assessment purposes.



## FOOTPRINT

Shell works to reduce its operational footprint.

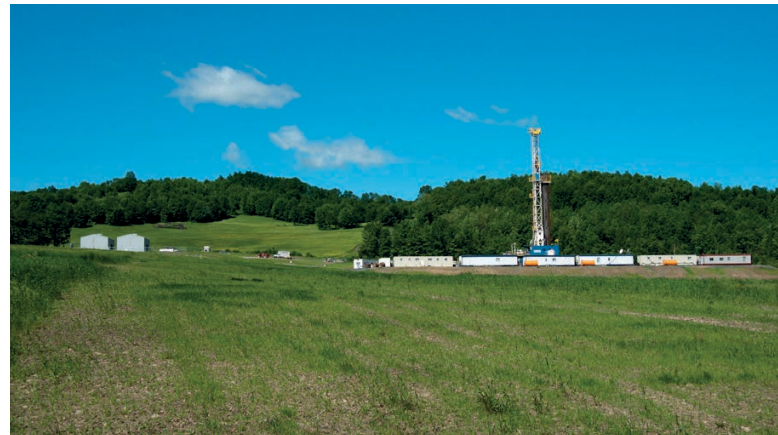
For example:

1. We design facilities and use technology to limit disturbance and reduce the overall footprint, including road location, well site location, and noise and light mitigation, as reasonably practicable.
2. We work to understand and reduce the impact from our operations on wildlife and livestock. This includes limiting activities during specific time periods.
3. We evaluate the installation of gathering systems and pipelines to reduce trucking of produced fluids based on economic, environmental, social and safety considerations.
4. We maintain worksite access roads that we own and control to provide for the safe movement of materials and to minimize dust and noise as reasonably practicable.
5. We identify and consider alternate transportation routes in order to reduce traffic impact on communities where reasonably practicable.
6. We keep our operating sites organized to reflect the quality of the operations and to help protect against accidents.
7. We design seismic operations to increase efficiency and productivity and to minimize habitat disturbance.
8. At the end of the well or field life, we use best practices (such as using native plants and monitoring) for site restoration.

## MINIMIZING LOCAL IMPACT

### PRINCIPLE IN PRACTICE:

At our Permian asset in Texas, USA, we invested in pipelines and water recycling facilities, which have significantly reduced the number of our truck transports and have resulted in a reduction in the amount of our traffic within the community.



## RESTORING LAND

### PRINCIPLE IN PRACTICE:

When reclaiming our sites in Canada, Shell not only invests in native plant species, but we pass along our learnings. For example, we hold training courses in native plant reclamation for First Nations groups.





## COMMUNITY

Shell engages with local communities regarding socio-economic impacts that may arise from its operations.

For example:

1. We work with communities to help develop local economies and improve how we operate.
2. As reasonably practicable, we build relationships and engage with communities, non-government organizations (NGOs), governments, aboriginal groups, academia, industry and other stakeholders to answer questions and understand local conditions. Listening to and engaging with our neighbors helps us identify and respond to concerns.
3. We assess the impacts of our operations on the social and economic aspects of the community and look for ways to reduce the consequences and strengthen the opportunities.
4. We assess and pursue opportunities to train and hire staff locally where reasonably practicable.
5. We identify local opportunities for strategic social investment contributions and partnerships.
6. We pursue opportunities to maintain a local business presence for our development and production operations where reasonably practicable.
7. We work to understand local contracting capabilities and provide opportunities to qualified, competitive local suppliers.
8. We share local socio-economic data where helpful and reasonably practicable to provide information about the social and economic impacts of our development operations.

## PARTNERING WITH COMMUNITIES

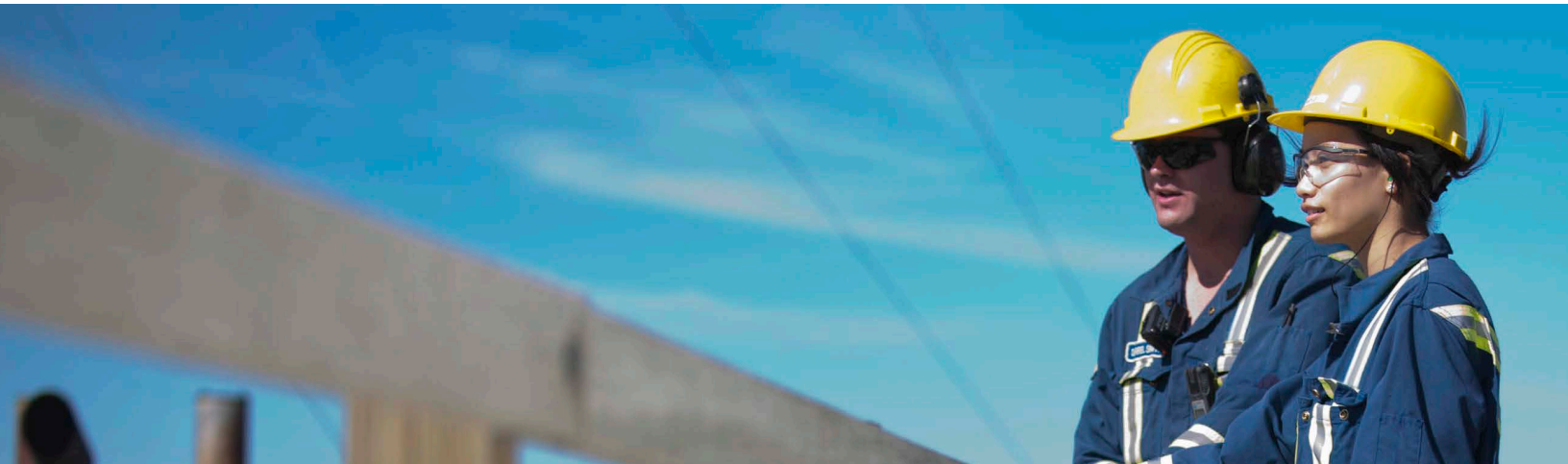
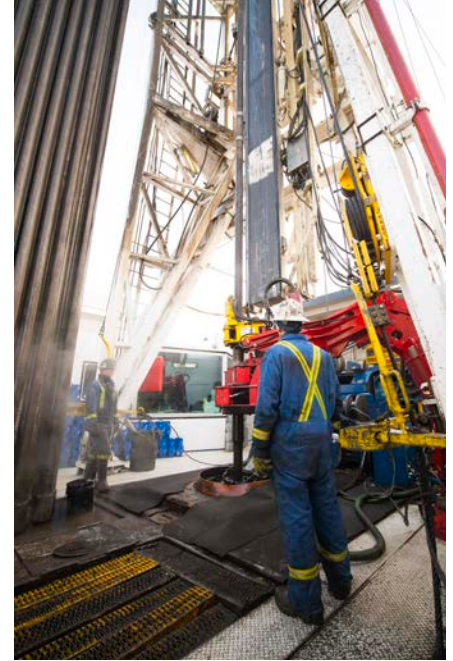
### PRINCIPLE IN PRACTICE:

As part of our exploration project in Argentina, Shell designed a comprehensive, six-month program to provide oil and gas operations training for local workers in the nearby municipality of San Patricio del Chañar.

Since 2013, Shell has coordinated and sponsored three of these training programs with more than 250 graduates in total. After completing the training program, 40% of the graduates found employment – 25% in the energy industry.

These operating principles support Shell's overriding safety philosophy, "Goal Zero". Goal Zero captures Shell's worldwide aim to operate with no harm to people and no significant incidents.

Goal Zero is enabled by strict company standards, multiple required safety barriers, rigorous training and competency assurance, adherence to proven operating methods and a culture that requires workers, contractors and visitors to stop any unsafe activity.



This version of the Shell Onshore Tight Sand or Shale Oil and Gas Operating Principles dated 31 December 2016 supersedes all earlier versions.

[www.shell.com/operatingprinciples](http://www.shell.com/operatingprinciples)

## OUR FIVE OPERATING PRINCIPLES

SAFETY



AIR



WATER



FOOTPRINT



COMMUNITY



SHALES  
UNCONVENTIONAL  
ENERGY

