FREQUENTLY ASKED QUESTIONS

HYDROCARBONS (OIL & GAS) EXPLORATION IN NORTHERN IRELAND

1. BACKGROUND

1.1 What are hydrocarbons?
1.2 Is there any oil or gas in Northern Ireland and, if there is, where can they be found?
1.3 What processes are involved in exploring for oil and gas?
1.4 How many hydrocarbon wells have been drilled in Northern Ireland?
1.5 Why is the Department undertaking to consult when there is no Minister/Executive in place to grant a licence?
1.6 What happens after the Consultation Period ends?

2. PETROLEUM LICENSING

2.1 What is a Petroleum Licence?
2.2 What Legislation governs Petroleum Licensing in Northern Ireland?
2.3 How long does a Petroleum Licence last?
2.4 What does a Petroleum Licence permit a company to do?
2.5 Why do Petroleum Licences cover such a large area?
2.6 When may a Petroleum Licensee commence drilling?
2.7 Does the Licensee need the landowner’s permission to drill?
2.8 What is a drill site?
2.9 What happens to the drill site after drilling operations have been completed?
2.10 What are the potential financial benefits to the Northern Ireland economy of oil and gas production?
2.11 What are the potential financial benefits to the local community of oil and gas exploration and production?
2.12 Will Brexit impact on Petroleum Licensing in Northern Ireland?
3 SHALE GAS & HYDRAULIC FRACTURING

3.1 What is shale?
3.2 What is shale gas?
3.3 What are conventional and unconventional reservoirs?
3.4 How does shale gas differ from ‘conventional’ oil and gas?
3.5 What is hydraulic fracturing or ‘fracking’?
3.6 Why is fracking necessary during shale gas exploration?

4 POTENTIAL IMPACTS/ISSUES ASSOCIATED WITH SHALE GAS

4.1 Can shale gas operations pollute water supplies?
4.2 What chemicals and materials are used for fracking?
4.3 How much water will be used for fracking?
4.4 What additional contaminants are present in fracking fluid?
4.5 How will our water resources be protected?
4.6 Is it true that fracking can cause earthquakes?
4.7 What can be done to reduce the earthquake risk?
4.8 Why pursue fossil fuels when we are attempting to reduce carbon emissions?
4.9 Will shale gas production lead to increased greenhouse gas emissions?

5 SHALE GAS IN NORTHERN IRELAND

5.1 Where are the shale gas resources in Northern Ireland?
5.2 How large are these potential resources?
5.3 Has permission for fracking been granted in Northern Ireland?
5.4 Has any fracking taken place in the past in Northern Ireland?
5.5 Why has Northern Ireland not followed other neighbouring jurisdictions by announcing a ban on fracking?
5.6 Why has there been no Strategic Environmental Assessment?
5.7 Who will decide if fracking should be allowed in Northern Ireland?
5.8 How would fracking be regulated in Northern Ireland?
5.9 What chemicals will be allowed in the fracking process in Northern Ireland?
5.10 What is the potential for radioactivity to be released?
5.11 What are the possible effects of fracking on tourism in Northern Ireland?

6 FURTHER INFORMATION

The following provides some links to documents/reports which may be of interest.
6.1 Northern Ireland Government information
6.2 UK Government information
6.3 British Geological Survey
6.4 UK Onshore Operators’ Group (UKOOG)
6.5 Royal Society / Royal Academy of Engineering
6.6 Republic of Ireland
6.7 USA Government information
1. BACKGROUND

1.1 What are hydrocarbons?

Hydrocarbons are organic compounds comprising carbon and hydrogen that are found in geological rock formations below, or rarely at, the Earth’s surface. They include gases like natural gas (methane), liquids like petroleum but also waxes and low melting solids. Hydrocarbons form through the burial and chemical transformation of organic organisms like algae and plankton. The transformation process involves the rocks being subjected to high temperatures and pressures over millions of years. Hydrocarbons are the principal current source of energy for most countries. However, the combustion of fossil fuels in the electricity, heating and transport sectors produces the most significant man-made component of greenhouse gas emissions that contribute to global climate change. Although most nations recognise the need to reduce the concentration of greenhouse gases in the atmosphere and hydrocarbons are gradually being replaced by low-carbon renewable energy sources, they still make up a significant part of the overall energy mix.

Many natural processes, including the decomposition of organic matter at or near the ground surface, can also produce hydrocarbons, such as the methane that may be collected from old landfill sites. Hydrocarbons produced by shallow decomposition of organic matter is termed biogenic whereas the hydrocarbons produced by the conversion of organic matter in rocks is known as thermogenic. The two types can often be differentiated by chemical analysis, with the latter usually containing higher (heavier) types of hydrocarbons.

1.2 Is there any oil or gas in Northern Ireland and, if there is, where can they be found?

No oil or gas has been commercially produced in Northern Ireland and Northern Ireland is currently entirely dependent on imports to meet the oil and gas requirements of its energy sector. However, small quantities of both oil and gas have been recorded in exploration wells. The most prospective areas for hydrocarbon resources lie in thick successions of sedimentary rocks, restricted to areas called basins. Some of these basins contain thicknesses of sedimentary rock in excess of three kilometres. In places these basins contain all the ingredients of a working petroleum system (organic-rich source rocks, porous sandstone reservoir rocks and thick impermeable caprocks to seal hydrocarbon accumulations). The presence of these parameters and traces or small amounts of hydrocarbons found whilst drilling mean that areas of Northern Ireland remain prospective for oil and gas in porous sandstones at depths of 1-3 km, although significant accumulations have not been found yet. Other hydrocarbon energy sources, such shale gas and coalbed methane have an as yet unproven potential within Northern Ireland. Some deeply buried shales and coal seams are known to contain methane gas but these have not been fully evaluated.
1.3 What processes are involved in exploring for oil and gas?

In the search for petroleum, licensees carry out preliminary studies before they can make a decision about whether they wish to drill a deep exploration well. These studies include analysis of existing information and reports, geological mapping and relatively non-invasive geophysical or geochemical surveys. Drilling a hydrocarbon well is a necessary method of confirming the presence of hydrocarbons.

1.4 How many hydrocarbon wells have been drilled in Northern Ireland?

In comparison to the rest of onshore UK, Northern Ireland remains relatively unexplored. Although exploration has taken place since the 1960’s fewer than 20 wells have been drilled. Since the first was granted in 1964, there have been 34 Petroleum Licences in Northern Ireland and a total of 16 exploration wells have been drilled on nine of these licences. Nine of these wells were drilled in County Fermanagh and nearly all had ‘shows’ of gas but none were deemed to be able to produce commercially viable quantities of gas from the poor quality sandstone reservoirs that were targeted. The other seven exploration wells have been drilled in the Lough Neagh (2), Larne (4) and Rathlin (1) sedimentary basins and, although there have been minor traces of hydrocarbons in a number of these wells, only one (Ballinlea No. 1 in the Rathlin Basin) recovered significant amounts of oil to the surface when it was ‘flow tested’.

1.5 Why is the Department undertaking to consult when there is no Minister/Executive in place to grant a licence?

In assessing previous Petroleum Licence Applications, the Department would have consulted on the basis of an ‘intention to award’, having already obtained Ministerial approval. In November 2018 the Secretary of State published new guidance to government Department entitled ‘Guidance on decision-making for Northern Ireland Departments during the period for Northern Ireland Executive formation’. In line with this guidance, the Department undertook a Public Interest Test and concluded that it should continue all necessary preparatory work to ensure that a decision on the Petroleum Licence Application can be taken as soon as possible after a Minister is appointed. The objective of this consultation therefore is to ensure that we have taken account of the range of opinions and relevant evidence submitted in preparation for making a recommendation to a future Minister as to whether or not the Petroleum Licence should be granted. To that end, the Department will follow a revised process in considering the two current Petroleum Licence Applications. The follow outlines both the existing and revised processes.

Had a Minister been in place, the process for considering a Petroleum Licence would have involved the Department:

1. completing due diligence to assess the validity of the application,
2. making a recommendation to the Minister on whether or not to grant the licence,
3. subject to the Minister’s approval, consulting other NI Departments and publicly on the basis of the Department ‘intending to grant’ the licence,
4. considering the responses to the consultation and relevant evidence, and
5. as appropriate, granting a Licence or rejecting the application.
In the absence of a Minister, and in line with the Secretary of State’s Guidance, the Department will follow a process for considering a petroleum licence which will involve the Department:

1. completing due diligence to assess the validity of the application,
2. consulting other NI Departments,
3. consulting publicly on the licence application,
4. considering the responses to the consultation,

Once a Minister has been appointed the Department would continue the process by:

5. making a recommendation to the Minister on whether or not to grant the licence, and
6. as appropriate, granting a Licence or rejecting the application.

As you will see the processes are similar with the exception that in the revised process the public consultation will be undertaken in advance of a recommendation being made to a Minister. This will allow the Department, in line with the Secretary of State’s Guidance, to be fully prepared, having considered the full range of opinions, to make an informed recommendation to a new Minister thereby allowing the Minister to make a more immediate decision. The Department is clear that any final decision to grant a Petroleum Licence in Northern Ireland will have to await Ministerial/Executive approval.

1.6 What happens after the Consultation Period ends?

Following this consultation, the Department will consider use all the responses and relevant evidence to inform a recommendation on whether to grant or reject a Petroleum Licence, and if appropriate, also to inform any restrictions to be imposed on the operation of a Petroleum Licence, to a future Minister. The Department is clear that any final decision on whether or not to grant a Petroleum Licence in Northern Ireland will have to await Ministerial/Executive approval.

2. PETROLEUM LICENSING

2.1 What is a Petroleum Licence?

All petroleum (oil and gas) in Northern Ireland, with some exceptions, is vested in (is owned by) the Department for the Economy (DfE) and the Petroleum Production Act (Northern Ireland) 1964 gives DfE the powers to ‘explore for, bore for and get petroleum’ and to grant these rights to other persons (the Licensee). A Petroleum Licence grants a Licensee ‘exclusive rights’ to explore for oil or gas from an area. It does not grant permission for any specific engineering works, all of which are subject to further consents and permits from DfE and other Departments (see below). The Licence is granted after scrutiny of the Applicant’s financial viability and capacity, technical capacity and agreement of an outline work programme. It includes specific terms and conditions.

---

1 The 1964 Act refers to the Department of Commerce (DOC) – the Department for the Economy is a successor department to the DOC.
2.2 What Legislation governs Petroleum Licensing in Northern Ireland?

The underpinning Petroleum Licensing Legislation for Northern Ireland may be viewed on the Department’s website - [https://www.economy-ni.gov.uk/articles/petroleum-licensing](https://www.economy-ni.gov.uk/articles/petroleum-licensing)

2.3 How long does a Petroleum Licence last?

In Northern Ireland the licensing system covers petroleum exploration, development and production, with different terms of the licence corresponding to each of the different phases in this cycle. The table below provides a summary of each of the stages.

<table>
<thead>
<tr>
<th>Term</th>
<th>Length (years)</th>
<th>Phase</th>
<th>Work Permitted/Carried Out</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial</td>
<td>5</td>
<td>Exploration</td>
<td>Evaluation of acreage, identification of prospects, exploration drilling (subject to permission).</td>
</tr>
<tr>
<td>Second</td>
<td>5</td>
<td>Appraisal &amp; development</td>
<td>Further exploration or appraisal of discovery leading to submission of field development plan.</td>
</tr>
<tr>
<td>Third</td>
<td>20+</td>
<td>Production</td>
<td>Development of field and production period, field decommissioning.</td>
</tr>
</tbody>
</table>

During the Initial Term, the early exploration activities are focussed on identifying a suitable drilling target. Before the end of Year Three the Licensee must decide whether they want to proceed to the drilling of an exploration well or to relinquish the licence. If the Licensee decides that they wish to drill an exploration well then they must enter into a contractual arrangement with the landowner for permission to use a site and obtain all the permits required to carry out the drilling operations. If the Licensee completes their work programme to the satisfaction of the Department then they can opt to continue the Licence into the Second Term which will normally involve the drilling of additional well(s) and the submission of a Field Development Plan if any discovery made is deemed commercially viable. If the Field Development Plan is approved by DfE and the Licensee obtains planning permission and other consents then the Licence may enter the Production Period, which includes the development of the field, the production of oil and/or gas, and the decommissioning of the production facilities at the end of the production phase.

2.4 What does a Petroleum Licence permit a company to do?

In Northern Ireland a Petroleum Licence grants a Licensee the exclusive rights to explore for, drill for or extract oil or gas. It does not, however, grant carte blanche for the Licensee to carry out all petroleum-related activities over the Licence area. Many activities, including drilling, are subject to further individual consents from DfE and further controls by other statutory bodies such as the HSENI, NIEA and the Planning Service. These consents and controls address, amongst other things, the risks to public health and the environment that the exploration activities may pose and therefore may place restrictions on these activities as a result.
2.5 Why do Petroleum Licences cover such a large area?

Any person who wants to explore for, drill for or extract oil or gas in Northern Ireland must hold a Petroleum Licence granted by DfE under the Petroleum (Production) Act (Northern Ireland) 1964. An Applicant may apply for any unlicensed area where it believes petroleum accumulations could be present. An oil or gas field often lies directly below only a small area on the ground surface, and they are relatively rare and difficult to find, so having a large licence area allows the Licensee to understand the local geology more fully and increases their chances of making a discovery. During the application process the Applicant must satisfy DfE that they understand the geology and will have the necessary financial and technical capacity to carry out an exploration work programme to evaluate the area applied for. On award of a licence, the initial work involved in identifying potential accumulations of oil or gas in the subsurface requires desk-based or field-based surveys across a wide area to identify potential structures on which to focus further exploration, leading to the drilling of an exploration well. At the end of the five-year Initial Term they must relinquish at least 50% of the licence area, the rationale being that they will retain the most promising area within that original area. Details on the process and copies of all existing Licences, and a Licence Map, can be found on DfE’s website here.

2.6 When may a Petroleum Licensee commence drilling?

Drilling is, of course, essential in the exploration and development of oil and gas, including shale gas. As with any major engineering activity there are risks involved but with proper management the risks associated with these activities can be substantially reduced although, of course, never completely eliminated. Drilling operations are regulated by legislation and subject to a range of guidelines from Oil and Gas UK, the industry body which oversees best practice. The Northern Ireland Environment Agency (NIEA) is the authority with primary responsibility for environmental protection and will continually assess risks to the environment from drilling operations. Extensive legislation provides effective regulatory control on petroleum exploration activities in Northern Ireland. If and when a Licensee applies to DfE for ‘Consent to Drill’ a well then the risks to health and the environment will be considered fully by all relevant authorities. DfE’s consent to drill is dependent on the Licensee having obtained all the necessary consents including planning permission.

If an application is submitted for permission to drill, frack and test an exploration well for shale gas the risks specific to fracking would be evaluated, based on the methodology proposed and the geological, environmental and other factors relevant to both the wellsite location and the surrounding area. A decision to grant, or withhold, permission to drill would be taken only after this risk assessment of the well operations had been completed. Currently the Strategic Planning Policy Statement (SPPS) includes a presumption against the use of hydraulic fracturing for shale gas in Northern Ireland.

2.7 Does the Licensee need the landowner’s permission to drill?

Yes. The Licensee must obtain the permission of the landowner before drilling a well on or beneath their land. Licence holders are expected to reach a contractual
agreement with individual landowners for access to, and use of, land for the purpose of drilling.

2.8 What is a drill site?

A drill site is the area where drilling activities take place. For a single exploration well it is usually about a hectare in area (equivalent to between one and two football pitches in size) and is designed to produce a safe working area which is isolated from the ground below. This is achieved by laying an impermeable geotextile membrane on the ground and enclosing the area with a perimeter ditch to catch rainwater and intercept any fluid spillages to prevent any leakages from the site. The site is then built up with hardcore to produce a level stable surface on which the equipment can be placed for the drilling operations. The wellsite is securely fenced and operations must be carried out in accordance with the Borehole Sites and Operations Regulations (Northern Ireland) 1995.

2.9 What happens to the drill site after drilling operations have been completed?

When an exploration well is drilled there is a significant amount of activity within an area of around a hectare. Drilling can last for a few months and when complete the machinery is removed from the site. If the well has not discovered any hydrocarbons it is deemed a dry hole and is plugged and abandoned as required by the relevant legislation and industry standards. The abandonment of a well is a process that requires further consents from HSENI and DfE. Thick cement plugs are set into the steel casing to permanently seal off tested reservoir sections and in the top few hundred metres of the hole to prevent any natural contaminants or residual drilling fluids contained within the well bore from entering shallow aquifers and surface waters. The top of the well is securely sealed with a steel cap a few metres below the ground surface before the site is commonly restored back to its original use. Whilst there may be ongoing baseline monitoring around the site, if the well did not find hydrocarbons monitoring will continue until the relevant statutory bodies are satisfied there is little chance of fugitive emissions being present.

If the well makes a discovery of oil or gas the Licensee may wish to carry out further work before submitting an application to develop the oil or gas field and produce oil and/or gas from it. The Licensee may need to drill one or more appraisal wells before submitting their development plan for approval. All further drilling will require new applications and regulatory consents and, depending on the size, nature and location of the proposed development, may require an Environmental Impact Assessment as part of the planning process. The initial exploration well may be temporarily suspended, with mechanical plugs set in place to prevent escape or ingress of fluids out of or into the well, before a decision is made whether to complete it as a producing well or to plug and abandon it permanently.

2.10 What are the potential financial benefits to the Northern Ireland economy of oil and gas production?
The Petroleum (Production) Act (Northern Ireland) 1964, with a few exceptions, vests ownership of petroleum resources in DfE. DfE will receive royalties from any producer of oil or gas in Northern Ireland at the rate of 7.5% of the value of the petroleum produced as set out in the Petroleum Production (Royalties) Regulations (Northern Ireland) 1965. DfE may then pay ‘compensation’ to anyone who, before the passing of the 1964 Act, held the mineral rights including petroleum for the ‘appointed area’ of the petroleum well.

In addition, the following are payable to the State:
- Ring Fence Corporation Tax at a rate of 30% of ring fence profits.
- Supplementary charge at a rate of 10% of ring fence profits.

In 2014 the Government sought to encourage the development of shale gas resources by extending the Ring Fence Expenditure Supplement (a mechanism whereby losses in early stages of development can be used to reduce and defer tax on future profits) to new shale gas projects, and by introducing a new “pad allowance” whereby capital expenditure reduce the profits used to calculate the supplementary charge. Details of these measures are to be found in Section 70 and Schedule 15 of the 2014 Finance Act.

2.11 What are the potential financial benefits to the local community of oil and gas exploration and production?

Oil and gas exploration activities are, by their nature, temporary and seismic surveys or exploration drilling may last a matter of weeks or months. Much of the associated costs are spent on specialised drilling services and the direct input to the local economy may amount to about £1 million per well from the use of local labour and services.

The greater number of wells associated with the appraisal and development of oil or gas resources would provide more long-term jobs and a greater boost to the local economy through the more sustained use of local services and supplies. Conventional oil or gas fields may have a relatively small footprint in an area and production facilities often consist of a single small site of a few acres area.

The development of shale oil or gas resources typically requires a much greater number of wells to be drilled. The industry recognises that the local communities should benefit directly from any development, in part to compensate for the inevitable disturbance caused by drilling operations. UKOOG (the industry operators’ body) has proposed that, during the exploration and appraisal stages, companies should provide benefits to local communities of £100,000 per well site where hydraulic fracturing takes place. If this leads to production UKOOG propose that communities should receive a 1% share of revenue, allocated approximately 2/3 to the local community and 1/3 at the county level. (A similar community fund scheme is operated by the wind energy industry in the UK whereby payments are linked to the installed capacity of the wind farm).

More information is available in the UKOOG Community Engagement Charter which sets out the industry’s approach to community engagement.
2.12 Will Brexit impact on Petroleum Licensing in Northern Ireland?

No. However, Brexit will require legislative changes to ensure that the policies and procedures in place in Northern Ireland have an appropriate statutory basis.

As a consequence of Brexit and with respect to its responsibility for the NI petroleum licensing regime, DfE, with support from counterparts in Great Britain, made corrections to one (1) NI petroleum subordinate legislation that implemented in respect of Northern Ireland the HLD Directive namely, The Hydrocarbon Licensing Directive Regulations (Northern Ireland) 2010 (S.R. 2010 No.170)

In that NI subordinate legislation there were nine (9) deficiencies (legislative references to European obligations, institutions and treaties) identified that required to be corrected to ensure legal certainty in NI law on or after EU exit day. These necessary technical Northern Ireland corrections were made by regulation 6 of United Kingdom subordinate Regulations entitled


3. SHALE GAS AND HYDRAULIC FRACTURING

Below is a list of frequently asked questions concerning exploration and production of shale gas and fracking. Reference is made to both the USA, where shale gas production takes place in over 17 states and accounts for over 60% of total gas production, and to England where Cuadrilla Resources have carried out the only high volume hydraulic fracturing of a shale gas exploration well in the UK to date. In Northern Ireland there has not been any drilling for shale gas and high volume hydraulic fracturing has not been carried out on any wells. At this stage, therefore, the answers to questions about the potential impacts of these activities or any future shale gas developments are qualified by this lack of activity.

3.1 What is shale?

Shale is a common sedimentary rock – approximately 70% of the rocks on the land surface are sedimentary and about half of these are shale. Shale is a fine-grained, finely layered mudrock, which consists mostly of clays and organic fragments. The mud that makes up these rocks settled under quiet conditions in lakes or on the sea-bed and this allowed organic material to accumulate in the rock and not decompose.

3.2 What is shale gas?

Shale gas is natural gas (predominantly methane) held within shale. The organic content of these rocks is normally a few per cent by weight and if the rock has been buried to great depths, the high temperatures help to turn the organic material into oil and gas. Some shales contain gas within minute pores (holes in the rock), but there is very little permeability (connectivity of the pores) and so the rock would not normally
release its gas under present conditions. Gas from shale can either be classed as ‘dry gas’ (pure methane) or ‘wet gas’, a mixture of methane and heavier hydrocarbons such as ethane or propane. Increasingly in some sedimentary basins of the US (notably the Permian Basin of Texas) oil has been extracted from shale.

3.3 What are conventional and unconventional reservoirs?

Conventional and unconventional are terms that are applied to a number of things in the petroleum industry. Much of what has been unconventional is now considered to be conventional. The terms can be applied to the rock that hosts the hydrocarbons, to the hydrocarbons themselves and to the process involved in extracting them. This has caused much confusion.

In conventional reservoirs the oil and gas has migrated from a mature source rock (typically a shale or coal) into a permeable reservoir rock (most often sandstone), where it is trapped beneath a caprock (a very low permeability rock such as a shale or salt) which acts as a seal to prevent oil or gas escaping.

In the case of unconventional resources the oil and gas is present in rocks where people would not normally look for oil and gas. These unconventional reservoirs include shales, coal seams and ‘tight’ or low permeability sandstones. These reservoirs do not necessarily have a conventional seal or caprock because their very low permeability means that the oil or gas does not easily escape from them under normal conditions.

3.4 How does shale gas differ from ‘conventional’ oil and gas?

Gas within shale is often called unconventional gas. It may have the same chemical composition as so-called conventional gas, but is held in what would be considered to be an unconventional reservoir. It is not the gas itself which is unconventional but the geological setting in which it is found, which necessitates the use of a particular combination of drilling and extraction techniques.

Conventional gas comes from a typical reservoir, such as sandstone, and is found trapped beneath a seal, such as shale. Hydrocarbons are extracted by drilling through the seal into the reservoir containing the oil or gas. This can be produced to the surface relatively easily, although different methods (including hydraulic fracturing) may be used to maximize the recovery of oil or gas. The production of conventional oil and gas has been carried out in different areas of the world for over a hundred years and in the North Sea since the 1960’s (gas) and 1970’s (oil). In England oil was first extracted from conventional onshore oilfields during the Second World War.

Although historically small amounts of oil have been produced from shallow oil shales, organic-rich shales were historically considered primarily as potential source rocks. In the case of shale gas, the shale acts as both the source rock and the reservoir, with gas trapped both within the micropores (Figure 1) and adhering to the remnant organic matter within the rock. To release this gas and allow it to flow up the well to the surface the connectivity between the pores within the shale needs to be improved and hydraulic fracturing is used to achieve this. Because the gas is distributed
throughout the shale rock, rather than trapped in the localised large volume accumulations of conventional gasfields, a much greater number of shale gas wells is needed to produce a similar amount of gas.

3.5 What is hydraulic fracturing or ‘fracking’?

“Fracking” or “fraccing” is commonly used as a shortened form for hydraulic fracturing, a process that may be used to increase permeability and thus flow in water wells, geothermal wells and hydrocarbons wells. Water is forced down the borehole under pressure into selected zones of the subsurface rocks to mechanically enhance the pre-existing fractures within the reservoir rocks.

In oil and gas production wells it is used to increase the flow from the reservoir, particularly when this has a low permeability. The fracturing creates tiny cracks in the
rock which connect hydrocarbon-filled pores and this allows the oil or gas to flow into the well and then up to the surface. Fracking may be used on a relatively small-scale to enhance production from conventional or low permeability (tight) sandstone reservoirs.

Fracturing during shale gas production operates on a much larger scale and involves higher volumes of fluid and greater numbers of well bores. Hydraulic fracturing in shale gas production is sometimes referred to as ‘high volume hydraulic fracturing’ (HVHF) to distinguish it from the fracking used in conventional or tight gas sandstones. HVHF may be defined in official documents and regulatory instruments where total volumes of fracking fluid per well, or volumes per fracturing intervals, are exceeded.

Gas held within shale is accessed through fracking and horizontal drilling along the shale beds may be used to increase the volume of shale ‘reservoir’ that is accessed by a single well. As the well is drilled the borehole is lined with a steel casing (Figure 2), cemented into place. Special downhole electronic tools are used to measure the quality of the cement layer and any deficiencies detected can then be repaired. The casing is pressure-tested to ensure that there are no leaks out of the well bore into the surrounding rock formations. A ‘perforating gun’ is lowered into the well and this makes small holes in the casing in a pre-selected zone of the shale (Figure 3). Following this, a mixture of water and sand (‘proppant’) is pumped at high pressure through the perforations to fracture the shale and allow the gas to flow into the well. The sand in the frack fluid lodges in the fractures and helps to keep them open after the pumping is stopped. The fluid contains chemicals to improve the performance of the fracturing process (see below).

Gas held within shale is accessed through fracking and **horizontal drilling** along the shale beds may be used to increase the volume of shale ‘reservoir’ that is accessed by a single well. As the well is drilled the borehole is lined with a steel casing (Figure 2), cemented into place. Special downhole electronic tools are used to measure the quality of the cement layer and any deficiencies detected can then be repaired. The casing is pressure-tested to ensure that there are no leaks out of the well bore into the surrounding rock formations. A ‘perforating gun’ is lowered into the well and this makes small holes in the casing in a pre-selected zone of the shale (Figure 3). Following this, a mixture of water and sand (‘proppant’) is pumped at high pressure through the perforations to fracture the shale and allow the gas to flow into the well. The sand in the frack fluid lodges in the fractures and helps to keep them open after the pumping is stopped. The fluid contains chemicals to improve the performance of the fracturing process (see below).

**Figure 2. The process of drilling and cementing casing**

---

- **A**: Steel casing
- **B**: Cement flows down pipe and up between casing and borehole wall
- **C**: Cement
The fracking process is carried out in stages along the horizontal section of the well, each stage taking some hours. The hydraulic fracturing involves the propagation of fractures on the scale of millimetres, which creates multitudes of tiny earthquakes, too small to be felt at the surface and only measurable by sensitive instruments. The location and the height/length of the fractures produced is measured and monitored by seismic sensors at the surface and in nearby boreholes, to ensure that the fractures do not extend further than intended. However, the fracturing process can also alter the stress regime within neighbouring rocks, causing small movements on local pre-existing faults. This movement can give rise to larger 'induced' earthquakes which can be felt at the surface and, in some areas of North America, earthquakes with magnitude of 4 or more have been associated with HVHF. In Great Britain the induced seismicity is closely monitored to ensure that the allowable levels, which are set below the intensity level of felt earthquakes, are not exceeded.

Some of the fracking fluid remains in the shale and the rest flows back up the well bore as ‘flowback’ water, soon after the fracking process is completed. This flowback water must be treated before it can be used again as part of the fracturing fluid or disposed of at a licensed disposal site. The percentage of the fracking fluid that returns to the surface as flowback is usually between 30% and 70%. Additionally, a mixture of fracking fluid and formation water may be produced at low concentrations along with the gas, and this ‘produced’ water must be treated similarly to the flowback water.

After the fracking operation is completed the gas production from the well is tested. Several wells may be drilled from the same well-pad, with the horizontal sections of the wells extending in different directions (Figure 4). The use of multi-well pads and horizontal drilling reduces the number and surface area of well sites required to abstract gas from an area, compared with single-well pads.

Following completion of the wells, the surface infrastructure is reduced to the well heads and pumps and some low-level buildings, all of which are screened and landscaped appropriately.
3.6 Why is hydraulic fracturing necessary during shale gas exploration?

Sandstones are rocks which generally have high porosity and are permeable. Shales, on the other hand, have low porosity and very low permeability. The porosity in shales is called microporosity because the pores are microscopic. Permeability in shales is normally low and the gas held in pores can only be released through fracturing the rock and increasing the connections between these pores.

4. POTENTIAL IMPACTS/ISSUES ASSOCIATED WITH SHALE GAS

4.1 Can shale gas operations pollute water supplies?

Both surface waters (rivers and lakes) and groundwater (water in underground rocks or aquifers) are at risk of pollution from a wide range of human activities. Shale gas operations usually involve the use of chemicals in drilling operations and in fracking fluids. In addition, hydraulic fracturing brings to the surface saline water or other elements that occur naturally in the shales. These materials, which normally occur at
very low concentrations in the shale but may become more concentrated by the fracking process, are potential pollutants and can pose a risk to water supplies.

For pollution of either the groundwater or surface waters to occur it is necessary to have a route, or pathway, for these chemicals to enter the water bodies. This could occur either at the surface or underground and the possible pathways – both natural and manmade - and the associated risks need to be fully assessed, and eliminated or minimised by the proper use of appropriate mitigation measures.

In the subsurface pollution could occur if the steel casing of the well is inadequately sealed by cement. Pollution arising directly from the hydraulic fracturing of the shales is not perceived to be a high risk because of their great depths, the vertical separation (often 1 – 2 km) between the fracture zones and the overlying shallow aquifers, and the presence of intervening laterally extensive low permeability rock layers.

The risks of pollution can be significantly reduced by the use of appropriate technology according to industry standards and best practice and implementation of appropriate regulation, including effective monitoring and enforcement. In Northern Ireland, the sources of drinking water supplies are protected through a number of regulatory mechanisms. These include, the designation of drinking water protected areas under the Water Framework Directive, and the requirement for NI Water to undertake risk assessments and have in place appropriate mitigation measures to protect drinking water supplies from ‘source to tap’. There is also a monitoring programme in place to verify drinking water quality. Similar controls are also in place in protecting private water supplies.

Companies planning to undertake shale gas operations would be required to obtain appropriate planning permission and Northern Ireland Water, and NIEA Drinking Water Inspectorate, are both statutory consultees within that process to assess the impact any such development could have on drinking water quality.
The fracking fluid used typically consists primarily of a mixture of water and sand (normally 99% or above) and a number of chemical additives. There are hundreds of chemicals on the market but these belong to a small number of types according to the role they play in the fracking process. In a particular shale gas region, a Licensee may use only a few chemicals – for example, in Lancashire, Cuadrilla Resources has obtained permission from the Environment Agency to use four chemicals (polyacrylamide, sodium salt, dilute hydrochloric acid, glutaraldehyde biocide) but used only the polyacrylamide friction reducer and the sodium salt tracer in their first Preese Hall No. 1 shale gas exploration well.

The chemical additives make up a very small percentage of the fluid mixture - i.e. they are very heavily diluted – although this still equates to a large volume of chemicals that must be transported safely and stored securely at the well pad. It should be possible both to reduce the number of chemicals used and replace hazardous chemicals with non-hazardous ones in most instances, albeit at some additional expense and perhaps reduced efficacy.

The chemicals can be grouped into different classes based on their role. As well as providing the force to fracture the shale the water is needed to carry the sand or ceramic beads (used as a proppant). The sand grains act to ‘prop’ the fractures open after the frack fluid has been forced into them. Chemicals added to the fluid can include friction reducers, acids and biocide. The acids and biocides act to keep the equipment clean and to eliminate the growth of sulphide-producing bacteria downhole.

In North America there has been a degree of secrecy surrounding the chemicals used by individual companies who regard their fracking fluid as a ‘trade secret’. However, information about the fracking fluids used in the USA is now available to the public on the FracFocus website, http://fracfocus.org/. In the UK the use of all chemicals will have to comply with EU and national regulations. In their guidelines the UK Onshore Operators’ Group (UKOOG) state that companies will disclose the chemical additives of fracturing fluids on a well-by-well basis on the UKOOG website.

In UK stringent regulations regarding use of chemicals are being developed. The following standard set of rules are available on the Environment Agency: https://www.gov.uk/government/collections/standard-rules-environmental-permitting

High volume hydraulic fracturing is likely to use large quantities of clean water, typically 10,000 m$^3$ to 30,000 m$^3$ per well. Some of this water will remain in the geological formation, while the rest will return up the well to surface for treatment and subsequent reuse or disposal.

This water might be sourced from publicly accessible water supplies in which case Licensees will have to negotiate a commercial contract with public suppliers. Alternatively, water could be obtained from surface water bodies or from an aquifer. In the UK, if a Licensee wishes to draw on surface water sources or groundwater (i.e. an aquifer), they need an abstraction licence from the relevant regulatory body. Water
abstraction licences are only awarded after an assessment of the application in the context of local and regional water demand, natural recharge of surface water bodies and aquifers, and the potential risk to these water bodies. If the Licensee wishes to dispose of any waste fluids after use they must obtain a licence to do so – the relevant authority will ensure that the fluid composition and the method of disposal comply with their regulations before issuing a licence.

4.4 What additional contaminants are present in fracking fluid?

As water returns from the fracking operations it is collected at the top of the well. It is likely to contain other minerals and elements, which were present in the shale, but are now either suspended or dissolved in the fluid. This flow-back fluid can contain dissolved salts, metals or low levels of naturally occurring radioactive materials (NORMs) that are present in the shale rocks.

All waste resulting from any mining or oil exploration/development are subject to EU and UK regulations. All toxic or potentially toxic wastes have to be transferred to a licensed site for treatment, storage or disposal. Current UK regulations are summarised in:


4.5 How will our water resources be protected?

The Licensee of any fracking operation will need to purchase water from public supplies or develop its own supply from a surface water body or from an underground aquifer. In the latter cases an abstraction licence will be needed from NIEA. Abstraction licences are awarded only after the full impact on the water resources and environment have been calculated, in the context of other local needs.

The Licensee will also need an NIEA licence to inject water into the well, which will define the conditions under which this can be done.

Any risks of pollution of water bodies from shale gas operations will be assessed by NIEA when the Licensee submits applications to carry out these operations, whether these are drilling or construction and operation of pipelines etc. The Oil and Gas UK Well Integrity guidelines deal with well design and construction and the assessment and minimisation of well-related risks. The UK Onshore Operators’ Group (UKOOG), an industry body, has published their own UK Onshore Shale Gas Guidelines which include sections on groundwater isolation, fracturing containment and induced seismicity which are not specifically addressed in the current Oil and Gas UK guidelines.

4.6 Is it true that fracking can cause earthquakes?

In some circumstances hydraulic fracturing may cause earthquakes, but these are rarely felt at ground level. The size and number of earthquakes caused is low compared to other human activities, such as mining. Two small tremors registering 2.3
4.7 What can be done to reduce the earthquake risk?

The Oil and Gas Authority (OGA), which is responsible for petroleum licensing in Great Britain, published the recommendations for the monitoring and mitigation (reduction) of seismic risk in April 2012, followed by a period of consultation. On 13 December 2012 the Secretary of State for Energy announced that exploratory hydraulic fracturing for shale gas in GB could resume, within a framework of new regulatory requirements relating to the monitoring and mitigation of seismic risk. The framework contains a precautionary ‘traffic light’ system (TLS) that sets a conservative limit of magnitude 0.5 at which fracking operations are temporarily suspended to monitor seismicity before potentially resuming operations.


In October 2018 Cuadrilla Resources started fracking operations at their Preston New Road well site in Lancashire. Seismic monitoring has been carried out continuously before, during and after fracking has taken place. Fracking was suspended (and then resumed) on two occasions after events of magnitude 0.76 and 1.0 were recorded before being suspended after an event of magnitude 1.5 was recorded on 11th December 2018. Trailing events (i.e. occurring during pauses in fracking after these three events), were recorded with magnitude 0.78, 0.66 and 0.9, respectively. From a regulatory viewpoint the TLS has operated as planned although it has resulted in Cuadrilla being unable to operate their fracking programme as planned (only 2 out of 41 intervals have been fracked). As a consequence the company has reformulated its fracking fluid to carry more sand and submitted an application to the Environment Agency to vary its environmental permit to this effect.

4.8 Why pursue fossil fuels when we are attempting to reduce carbon emissions?

There is a considerable body of scientific data, which indicate that increased concentrations of greenhouse gases (GHG), principally carbon dioxide, in the atmosphere are the main cause of recent global climate change (often referred to as global warming). Having been relatively constant for most of the last millennium, carbon dioxide levels in the atmosphere have increased by 40% over the last 200 years and evidence shows that this extra CO₂ came from burning of fossil fuels (coal, oil and gas), cement production and deforestation. Many governments, including the UK and Ireland, have recognised the need to reduce carbon emissions in order to moderate the effects of global warming. Carbon reduction targets are enshrined in UK law by the
Climate Change Act 2008. Natural gas, whether produced from conventional or unconventional sources, is a fossil fuel.

It is Government policy to reduce the burning of fossil fuels and to progressively replace their use in the energy sector by the use of renewable or low carbon energy resources. However, although significant progress has been made in the electricity sector, with Northern Ireland already close to reaching its 2020 target of 40% renewables\(^2\), both the heat (~90%) and the transport (>98%) sectors in Northern Ireland still rely heavily on fossil fuels. Under current policy scenarios the use of fossil fuels in these sectors is likely to be significant for several years to come, notwithstanding the UK Government’s commitment to reduce total greenhouse gas emission by 80% by 2050, relative to 1990 levels. If this is the case, the exploration for and production of local oil and gas resources may be less carbon-intensive, and more economically beneficial to Northern Ireland, than importing oil and gas from further afield.

4.9 Will shale gas production lead to increased greenhouse gas emissions?

Whilst governments are keen to switch to sources of renewable energy, gas can be beneficial in allowing the switch from more polluting fossil fuels such as coal. In Northern Ireland, where domestic heating has been dominated by oil and coal, the penetration of the heating market by gas is a mechanism for reducing the GHG emissions for this sector, at least initially. Demand from the public for gas is increasing and the UK currently is a net importer of gas, leading to higher energy prices.

DfE is fully committed to sustainable development and, as stated in the Strategic Energy Framework 2010, to increasing the proportion of our energy needs that will be met from renewable energy sources. DfE has set targets of 40% of electricity and 10% of heating from renewable energy sources by 2020. However, we recognise that fossil fuels will still be used to produce the greater part of our electricity for the foreseeable future and that Northern Ireland is entirely dependent on imports for its supplies of oil, gas and coal. The Department will therefore continue to encourage the exploration for indigenous reserves of oil and gas in Northern Ireland, provided that this can be carried out in a safe and environmentally sound manner. To this end, DfE will incorporate lessons learnt from shale gas exploration worldwide to ensure that industry best practice is followed at all times.

There are some concerns about the extra fugitive emissions (losses to the atmosphere) of methane, a gas with a greenhouse warming potential at least 25 times greater than that of carbon dioxide, associated with shale gas extraction. A 2011 paper by Howarth et al in Cornell University concluded that the extraction and use of shale gas could have a higher GHG footprint than that of coal, when viewed across a 20 year time frame. More recent reviews have agreed with earlier papers that the GHG footprint of shale gas should be slightly higher than that of conventional gas but significantly lower than that of coal, and lower than that of LNG imports. Significant reductions in fugitive emissions can be achieved, using current technology, by means of ‘green’ well

\(^2\) For the 12 month period January 2018 to December 2018, 38.2% of total electricity consumption in Northern Ireland was generated from renewable sources located in Northern Ireland.
completions, which are being ‘phased in’ in the USA and would be required in the UK. However, the evidence about the level of greenhouse gas emissions from shale gas extraction is not conclusive and these levels may vary markedly depending on whether they are calculated from testing of individual components of the operational set-up (from inventories – a bottom-up method) or taken from direct measurements of the atmospheric concentrations of greenhouse gases in the vicinity of shale gas extraction sites (a top-down methodology). The latter show levels that may be factors of two to four times than the former, according to a review paper by Mobbs (2017) for pressure group Talk Fracking. More recently, Alvarez et al. (2018) reviewed methane emissions from the US oil and gas supply chain using a facility-scale bottom-up approach and validated the results using top-down data. The authors’ estimates were 60% higher than the US EPA inventory estimate, with most of the discrepancy occurring in the production segment of the supply chain. The authors do suggest that there is considerable scope for emissions reduction during production. However, the claim that gas can be used as a bridging fuel to a low carbon economy should be viewed with caution, therefore, when its whole life cycle is considered.


5. SHALE GAS POTENTIAL IN NORTHERN IRELAND

5.1 Where are the shale gas resources in Northern Ireland?

Prospective shale is present in Co. Fermanagh. This is primarily the Bundoran Shale Formation. It ranges in thickness from 555 to 60 metres across the area. The shale formed during the Carboniferous time period (around 345 Million years ago). These Carboniferous rocks currently represent the best prospect for shale gas in Northern Ireland.
Similar organic-rich shales are also found within the Ballycastle and Dungannon coalfields, although here they are too shallow to be prospective for shale gas. Similar Carboniferous sedimentary rocks are likely to be present in some of the deeper parts of the Rathlin, Lough Neagh and Larne sedimentary basins. However, there are very few deep boreholes that have reached these depths and so the distribution of organic-rich Carboniferous shales in these basins remains speculative.

The Rathlin, Lough Neagh and Larne sedimentary basins do, however, contain high quality sandstone reservoirs in younger Permo-Triassic rocks, which form the primary conventional oil and gas exploration targets here.

5.2 How large are these potential resources?

In Northern Ireland, estimates about the gas present (gas in place) in the Bundoran Shale Formation are based on the extent, thickness and depths of the shale, together with other properties (e.g. Total Organic Carbon, porosity). In Co. Fermanagh the subsurface distribution and thickness of the Bundoran Shale Formation can be mapped with confidence, but some of the other parameters are less well understood. Drilling to obtain fresh rock core samples would enable these parameters to be more accurately quantified.

The volume of gas recoverable from the formation is expected to be less than 15% of the gas in place.

Tamboran Resources Pty Ltd., who previously held a licence looking for shale gas, estimated the gas reserves in place in the Bundoran Shale in both Northern Ireland and the Republic of Ireland at between 10.7 and 21.3Tcf (trillion cubic feet), with recoverable gas volumes of 1.6 to 3.2Tcf. This is a large potential resource but, as outlined above, there are still significant uncertainties around these figures at this early stage of exploration. By comparison, the total volume of gas currently used in UK is approximately 3Tcf per year. Gas use in Northern Ireland for electricity generation and heating is between 2% and 3% of the UK total.

The British Geological Survey has published estimates of the shale gas resource underlying part of northern Britain: https://www.ogauthority.co.uk/onshore/onshore-reports-and-data/reports-bowland-shale-gas-study/
This report and others are available on the Oil and gas Authority’s website at: https://www.ogauthority.co.uk/onshore/onshore-reports-and-data/

5.3 Has permission for fracking been granted in Northern Ireland?

No. There is currently one petroleum licence in Northern Ireland which is concerned with the search for hydrocarbons in porous sandstones. To date, no wells have been drilled for shale gas in Northern Ireland.

5.4 Has any fracking taken place in the past in Northern Ireland?

There has been no high volume hydraulic fracturing for shale gas in Northern Ireland.
However, fracturing of the rocks within a borehole is not only a part of shale gas operations, and this has been carried out in Northern Ireland in the past. For many years fracturing of the rocks (a process known as “stimulation”) has been used in the UK and elsewhere in the world with the aim of enhancing the permeability in conventional oil and gas reservoirs and increasing flow rates of hydrocarbons into the well. The difference between this and fracturing for shale gas is that the volume of fluid used per well and the number of wells (often drilled horizontally) are much greater.

In 1981, the vertical Dowra No. 1 well in Co. Cavan (ROI) was re-entered and the ‘tight-gas’ sandstone reservoir interval ‘fracked’, resulting in a tenfold increase in the gas flow rates from the well. Subsequently, in 2001-02, a US company, Evergreen Resources, drilled four vertical exploration wells in County Fermanagh and hydraulically fractured selected intervals of the tight-gas Mullaghmore Sandstone reservoir in three of these wells. After fracking, the wells were extensively tested but the resulting gas flow rates were non-economic and the wells were plugged with cement and permanently abandoned.

5.5 Why has Northern Ireland not followed other neighbouring jurisdictions by announcing a ban on fracking?

Both Scotland and Wales currently operate a moratorium or outright ban on fracking whereas the UK Government has promoted shale gas exploration in England. In the Republic of Ireland the use of hydraulic fracturing in onshore petroleum exploration or extraction is prohibited (the prohibition does not apply to offshore).

Previously the Minister for the Economy informed the Assembly that any decision on the use of High Volume Hydraulic Fracturing for shale gas would be a matter for a Northern Ireland Executive.

It should be noted that at this stage the public consultation is being used to prepare to make a recommendation to a future Minister.

5.6 Why has there been no Strategic Environmental Assessment?

The EU SEA Directive (2001/42/EC) – https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32001L0042 - applies to plans and programmes whose first formal preparatory act was on or after 21 July 2004. The current petroleum legislation in Northern Ireland permits an applicant to apply for any unlicensed area of Northern Ireland at any time and are not restricted to time-limited Licensing Rounds as is the case for most jurisdictions. Petroleum Licence applications are considered by the Department for the Economy (DfE) on a “first come, first served” basis (https://www.economy-ni.gov.uk/articles/petroleum-licensing). As such the petroleum licensing regime for Northern Ireland has remained essentially the same since the late 1980s and predates the Strategic Environmental Assessment Directive.

Notwithstanding this, the Department for the Economy (DfE), is cognisant of recommendation 3.1 of the non-binding EC Recommendation paper on the minimum
principles for the exploration and production of hydrocarbons (such as shale gas) using high-volume hydraulic fracturing published on 22 January 2014 which provides that:

3.1. Before granting licenses for exploration and/or production of hydrocarbons which may lead to the use of high-volume hydraulic fracturing, Member States should prepare a strategic environmental assessment to prevent, manage and reduce the impacts on, and risks for, human health and the environment. This assessment should be carried out on the basis of the requirements of Directive 2001/42/EC.

5.7 Who will decide if fracking should be allowed in Northern Ireland?

Before an oil well and all the associated engineering works can be drilled, including fracking, the Licensee must make a Planning Application accompanied by an Environmental Impact Statement (EIS). The scope and terms of reference of the EIS will be agreed by Planning Service, NIEA and other regulators. The Planning Application will be assessed by the planning authorities according to the well-established process, which includes wide-ranging public and governmental consultation and assessment of the all the relevant environmental, engineering, economic and social issues.

If hydraulic fracturing is intended, DfE will require the Licensee to submit a fracturing plan to address the risk of induced seismicity, and will review this plan to ensure that they meet the requirements set out in OGA’s recommendations. DfE is ultimately responsible for granting a Licensee the Consent to Drill a well.

5.8 How would fracking be regulated in Northern Ireland?

On the instruction of the then DETI (now DfE) and DfI Ministers, DfE convened a NI Shale Gas Regulators’ Forum, to bring together all relevant regulatory departments, to share information and ensure that the regulatory processes developed in Northern Ireland are coherent. Minutes of the meetings of this group may be seen here.

The regulatory processes will be informed by extensive research and technical guidance that is now underway in UK, Europe, the USA and elsewhere, some of which is described in Section 6 below.

5.9 What chemicals will be allowed in the fracking process in Northern Ireland?

Any planned use of chemicals in the drilling and hydraulic fracturing process would be subject to assessment, regulation and, if permitted, monitoring by the Northern Ireland Environment Agency. The planned use of different types of chemicals would vary according to local geological conditions and drilling and fracturing methodologies.

The engineering protocols and regulations to be applied in shale gas exploration drilling and development are currently being refined by legislators in UK and in the EU so it is premature to say exactly what will be required of drilling operators. However, it
is likely that full disclosure of any chemicals will be required and, if approved, will be monitored by the regulators. In their guidelines UKOOA state that Licensees will disclose the chemical additives of fracturing fluids on a well-by-well basis. The Environment Agency (EA), which the independent public body responsible for environmental protection in England, is the environmental regulator for onshore oil and gas operations in England. The EA updates their website regularly and links to useful documents can be found on their information page. Environmental regulation in Northern Ireland differs from that in England but it might be expected to follow the same general principles.

There are existing EU Directives that apply to the injection or disposal of fluids into the ground, including the Water Framework Directive and the Mining Waste Directive. The Environment Agency is well advanced in considering this matter and it is considered that ‘Only substances that have been assessed as being non-hazardous pollutants under the Groundwater Daughter Directive may be used in hydraulic fracturing fluids. Information on the chemicals used by an operator in hydraulic fracturing fluid will normally be made available to the public’.

In North America there has been some recent development of new hydraulic fracturing fluids using only food-industry ingredients (e.g. CleanStim from Halliburton). It should be noted that some of the food-industry ingredients are still classified as hazardous at the concentrations in which they are transported to and stored at the wellsite. Biodegradable weak hypochlorous acid products, non-hazardous Anolyte solutions and chemical-free oxidation treatments (e.g. Ozonix from Ecosphere) have been developed to replace the use of conventional biocides in fracking fluids.

5.10 What is the potential for radioactivity to be released?

All rocks are slightly radioactive and detailed maps of the radioactivity of Northern Ireland measured by the Tellus airborne radiometrics survey may be viewed in the Geophysics theme of the GSNI GeoIndex. The rocks of Co. Fermanagh, including the Bundoran Shale Formation, are not anomalously radioactive but do contain several grams per tonne of radioactive uranium and thorium, as do most rocks. North American rocks such as the Marcellus Shale show higher concentrations of uranium associated with their higher organic carbon content.

Because a part of the uranium may be adsorbed onto the organic matter in the shale small quantities of uranium and radium (a soluble daughter product of uranium decay) may be flushed out and concentrated by the drilling process. These should be contained at the well-head by engineering facilities established to collect and retain well water returned from underground, and disposed of according to the defined regulatory system. For example, Cuadrilla’s returned waters at their recent Anna’s Road, Becconsall and Grange Road exploration wells in Lancashire required both Mining Waste Directive and Radioactive Substances Activity permits to ensure appropriate treatment and disposal of both solid matter and fluid recovered to the surface from the wells.

Radon is a gaseous daughter product of uranium. Radon has a half-life of 3.8 days so any radon present in the system decays quickly, and would be decaying even as it moves to surface up the well with the produced fluids which are collected in sealed
containers at the surface for further processing. Nevertheless, radon emissions would be measured as part of the production testing process. If radon were significant, it would easily be reduced to acceptable (background) levels naturally by storing the gas for some days.

The issue of Naturally Occurring Radioactive Materials (NORM) has been examined by various environmental authorities in the USA who have concluded that, properly managed, it should not pose any health risk. For example, the Pennsylvania Department of Environmental Protection (DEP) states that ‘Current industry practices are such that data do not indicate the public or workers face any health risk from exposure to radiation from these materials.’ The DEP has embarked on a comprehensive study of NORMs in all aspects of the oil and gas industry and the results will provide further evidence about the potential, or otherwise, for these materials to cause health risks.

Very small radioactive sources are used in some of the down-hole measuring tools, and have been routinely used in the petroleum industry at least since the 1960s. They are routinely conveyed in lead boxes when not in use.

5.11
What are the possible effects of fracking on tourism in Northern Ireland?

Tourism plays a major role in the Northern Ireland economy and forms the livelihood of many people in areas like Co. Fermanagh where there are potential shale gas resources. The possible effects on tourism from any future shale gas development would be assessed as part of the Planning process.

As a comparative example, the Wytch Farm development in Dorset has demonstrated how oil and gas development co-exists happily with tourism, agriculture and other interests. Although this is not a shale gas (or fracking) operation, Wytch Farm is the largest on-shore oil/gas field in Western Europe, and any oil/gas development in Northern Ireland would be regulated to similar standards. The oil wells lie close to Bournemouth in one of the most touristic areas of UK, and the field extends beneath Areas of Outstanding Natural Beauty, the Jurassic Coast World Heritage Site and several other environmentally designated sites. The operation won a Queen’s Award for Environmental Achievement in 1995.

6. FURTHER INFORMATION

The following provides some links to documents/reports which may be of interest.

6.1 Northern Ireland Government information

- Research and Information Service of the Northern Ireland Assembly: ‘Shale gas and hydraulic fracture – an overview of existing research’ (September 2012)
Written and oral evidence presented by GSNI, Tamboran Resources and the Fermanagh Fracking Awareness Network to the Enterprise, Trade and Investment Select Committee in June 2012 may be found here.

The Northern Ireland Environment Agency (NIEA) is the NI government department concerned with environmental regulation.

6.2 UK Government information

The Oil and Gas Authority (OGA) website has a range of documents explaining shale gas and hydrocarbons exploration in the UK. The link to OGA’s webpage on onshore oil and gas exploration and production is given below:

https://www.ogauthority.co.uk/onshore/overview/

The reports and data page contains further links to a number of other reports on shale gas resources and associated topics.

The GOV.UK website has more general information and guidance on shale gas and fracking at the following webpage:


with videos, infographics and links to downloadable reports.

The Environment Agency in GB is the principal regulator on environmental issues surrounding any development. Their role is described in this webpage.

6.3 British Geological Survey

The BGS is a component of the Natural Environment Research Council, with extensive web pages on shale gas resources and regulation with videos, infographics and downloadable reports. Recent publications include:

- Information on Earthquakes [An illustrated section about earthquakes on the British Geological Survey (BGS) website. BGS operate the seismic monitoring network in the UK]
- Earthquakes - frequently asked questions [BGS website – FAQs on earthquakes]
- Estimate of resources in Northwest England [Bowland Shale Gas Study, July 2013]

BGS also carries out monitoring of seismicity, air quality, surface waters and groundwater to establish baseline conditions and identify any impacts associated with shale gas operations in England. Further details are available from the webpage below:

https://www.bgs.ac.uk/research/groundwater/shalegas/monitoring/home.html
6.4 UK Onshore Operators Group (UKOOG)

UKOOG is an industry group that promotes industry best practice. Publications include:

- UK Onshore Shale Gas Well Guidelines (February 2013)
- Community Engagement Charter

6.5 Royal Society / Royal Academy of Engineering

The Royal Society and RAE are the premier independent scientific organizations in UK. They investigated some of the concerns surrounding shale-gas exploration and published their report in June 2012. The report concluded that 'the health, safety and environmental risks can be managed effectively in the UK', while also recommending extensive regulatory processes.

Since 2012 there have been numerous studies into a range of topics to do with shale gas, mostly originating in North America where most shale gas and shale oil development has taken place. There is also active research on shale gas in many UK universities e.g. at the Durham Energy Institute which has a section on its website on shale gas.

6.6 Republic of Ireland

The EPA facilitated various studies to inform regulation of shale gas exploration in Ireland. The scoping study ‘Hydraulic Fracturing or ‘Fracking’: A Short Summary of Current Knowledge and Potential Environmental Impacts’ was completed by Aberdeen University in July 2012. This was followed up by an extensive research programme into the Potential Environmental Impacts of Unconventional Gas Exploration and Extraction (UGEE). The 2016 outputs from this research are available from the EPA website here.

6.7 USA Government information

The US Environmental Protection Agency is undertaking extensive research and development into hydraulic fracturing that will inform the development of regulation in UK and Ireland. Their website is: http://www2.epa.gov/hydraulicfracturing

In 2016 they released a final report entitled ‘Hydraulic Fracturing for Oil and Gas: Impacts from the Hydraulic Fracturing Water Cycle on Drinking Water Resources in the United States (Final Report)’.

The United States Geological Survey (USGS) carries out research into various aspects of oil and gas including hydraulic fracturing and induced seismicity. This page has useful links to USGS FAQs and other relevant websites.