Department of Energy & Climate Change

About shale gas and hydraulic fracturing (fracking)

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Department of Energy & Climate Change

Contents

Introduction

This document provides a synopsis of common questions put forward in relation to shale gas and fracking with Government responses to these questions.

Shale gas activity in the UK is still in the exploration stage, where companies are drilling test wells. There is no experience of production operations in UK conditions as yet, although we have a long history of production of oil and gas from 'conventional' onshore fields. The answers to questions about the potential impacts of production operations are therefore tentative or qualified for the time being.

Hydraulic fracturing and shale gas

1. What is shale gas?

Shale gas is mostly composed of methane. Methane is ‘natural gas’ and is the gas used to generate electricity and for domestic heating and cooking. Shale gas is produced using technologies developed since the 1980s that enable gas to be recovered from rocks (mostly shale) which were previously considered to be unsuitable for extracting gas.

Natural gas produced from shale is often referred to as ‘unconventional gas’ by contrast to ‘conventional gas’ produced from other kinds of rock usually sandstones or limestones. Conventional Gas or oil is found in reservoirs in sandstone or limestone, where gas or oil has migrated up from source rocks. The source rocks are normally an underlying shale. In this rock organic matter becomes gas or oil through the action of heat and pressure over time.

In contrast shale gas is produced directly from the source rock. The techniques used to extract gas and oil either from are essentially the same, but shales have to be systematically fractured (“fracked”) to enable the gas to flow. This is because the gas flows much less freely through shales than sandstones or limestones, so the techniques have to be applied in a different way.

2. What is fracking?

Hydraulic fracturing or “fracking” is a technique that uses fluid, usually water, pumped at high pressure into the rock to create narrow fractures to create paths for the gas to flow into the well bore and to surface. The water normally contains small quantities of other substances to improve the efficiency of the process, e.g. to reduce friction. Once the fractures have been created, small particles, usually of sand, are pumped into them to keep the fractures open.

3. How do you break the rock, does it involve explosives?

There are no explosives used in fracking operations.

The process of preparing any oil or gas well for production involve the use of small shaped charges to “perforate” the steel tubing used to control the flow of fluids. The perforations are very precisely designed and do not propagate into the surrounding rock. In a shale gas well, it is the water pressure applied in the subsequent fracking operation which causes the rock to fracture.

4. What is the process for obtaining permission for drilling a shale gas well?

The process of obtaining consent to drill a well is the same whether the well is targeted at conventional or unconventional gas. DECC issues a licence in competitive offerings (licence rounds) which grant exclusivity to operators in the licence area. The licences however do not give consent for drilling or any other operations.

When an operator wishes to drill an exploration well, their first step is to negotiate access with landowners for the drilling pad area and the surface under which any drilling extends. Permission must also be obtained from the Coal Authority if the well encroaches on coal seams. Then the operator needs to seek planning permission from the Minerals Planning Authority (MPA) (In Scotland the local planning authority). The operator must obtain the appropriate environmental authorisation/permit from the Environment Agency (EA) in England, Natural Resources Wales (NRW), or the Scottish Environment Protection Agency (SEPA) in Scotland, who are also statutory consultees to the MPA or Scottish planning system.

The MPA (or local planning authority in Scotland) will determine if an environmental impact assessment (EIA) is required, such assessments are required if the scale of the operations meets certain thresholds, or if, depending on their nature, scale and location, they may have significant environmental impacts. If an EIA is required, it must be completed by the applicant and submitted to the MPA/planning authority before the MPA/planning authority decides on planning permission.

An environmental permit/authorisation from the appropriate environmental regulator may also be required. At least 21 days before drilling is planned, the HSE must be notified of the well design and operation plans to ensure that major accident hazard risks to people from well and well related activities are properly controlled, subject to the same stringent regulation as any industrial activity. HSE regulations also require examination of the well design and construction by an independent and competent person. Notification of an intention to drill has to be served on the Environment Agency under S199 of the Water Resources Act, 1991.

DECC will check that the EA/SEPA/NRW and HSE have no objections before consenting drilling operations. If hydraulic fracturing is intended, DECC will require that a fracturing plan to address the risk of induced seismicity is submitted, and will review this plan before these operations are permitted.

If the operator wished to drill an appraisal well or propose to start production operations, they start again with the process described above; the landowner's permissions and planning consent, which may require an EIA; EA, NRW or SEPA consultation and HSE notification, and finally a decision from DECC.

5. Is Government regulation holding back Shale Gas development?

The UK Government has been extremely active creating the right framework to accelerate shale gas development in a responsible way. The Office of Unconventional Gas and Oil (OUGO) has been set up to co-ordinate the activity of the regulatory bodies and Departments. OUGO is liaising with regulators to create a

streamlined planning and regulation system with a high degree of local scrutiny and prior consultation. We want to ensure that regulation is fit for purpose, encourages growth whilst fully protecting the environment.

6. What are the best estimates at the moment for the amount of shale gas that can be extracted by fracking?

DECC commissioned the British Geological Society to undertake a detailed gas in place analysis for part of central Britain in an area between Wrexham and Blackpool in the west, and Nottingham and Scarborough in the east (the Bowland Shale) and this has now been published. The report shows that shale gas clearly has potential in Britain, but as little drilling or testing has taken place, it is not at this stage possible to make meaningful estimates of how much shale gas may be practically and commercially recoverable. The next area of detailed study is the Weald Basin in Southern England.

7. What about these huge numbers – bigger than the North Sea reserves – mentioned in the Press?

No-one knows at this point what proportion, if any, of the gas in the ground will ever be practically and commercially producible.

8. Will shale gas give us a secure domestic supply of gas?

Production of unconventional gas could offer the UK additional security of supply, but given the uncertainties around when, and the degree to which, unconventional gas will be produced outside North America, DECC continues to take a cautious view of the implications for gas security of supply.

9. Should we halt the production of shale gas?

There was a moratorium on fracking following two seismic tremors in the Blackpool area during 2011, associated with “fracking” for shale gas at Preese Hall, Lancashire.

In the light of the robust controls in place to protect the environment and ensure safe operation, DECC see no need for any moratorium on shale gas.

The Government takes the safety of the public and protection of the environment very seriously. We commissioned the Royal Society to review the scientific and engineering evidence on shale gas extraction conducted by the Royal Academy of Engineering and the Royal Society.

This concluded that “the health, safety and environmental risks associated with hydraulic fracturing (often termed ‘fracking’) as a means to extract shale gas can be managed effectively in the UK as long as operational best practices are implemented

and enforced through regulation." The Government believes that the regulation is robust for exploration, but wants to continue to improve it.

10. Why has a full public consultation of all aspects of shale gas fracking not been undertaken?

There has been extensive Parliamentary discussion of shale gas, including an inquiry into shale gas by the Energy and Climate Change Committee in 2011, which concluded:

"On balance, we feel that there should not be a moratorium on the use of hydraulic fracturing in the exploitation of the UK's hydrocarbon resources, including unconventional resources such as shale gas. However, DECC needs to monitor closely the current exploratory activity in the Bowland Shale in order to both assess the likely impact of large scale shale gas extraction in the UK and also to promote public confidence in the regulation of this activity".

Also, the Royal Academy of Engineering and the Royal Society have conducted a wide ranging review and authoritative of the scientific and technical evidence on the risks associated with hydraulic fracturing for shale gas, and published a report in June 2012. Their overall conclusion is that the risks can be managed effectively in the UK as long as operational best practices are implemented and enforced through regulation.

A: Water pollution, use and disposal (inc. chemicals)

A1. How will the Government ensure that groundwater is not contaminated during shale gas fracking?

The UK regulatory regime ensures that hazardous substances must not be allowed to enter groundwater.

A permit, under the Environmental Permitting Regulations 2010 (EPR), from the Environment Agency is required where fluids containing pollutants are injected into ground, where they may enter groundwater. This may also be needed if the activity poses a risk of mobilising natural substances that could then cause pollution. The permit will specify any necessary limits on the activity, any requirements for monitoring, the chemicals which may be used and any appropriate limits on permissible concentrations. If the activity poses an unacceptable risk to the environment the activity will not be permitted. If the Environment Agency decides that the activity cannot affect groundwater, a permit will not be necessary. However, such activities are still subject to the requirements of the regulations. If a significant risk or an actual impact becomes apparent, the EA may issue a notice under the EPR requiring the operator to obtain a permit, or in extreme situations, a notice to prohibit the activity.

The EA will take a risk-based approach to the regulation of the use of chemicals in shale gas fracking activities and will assess the permitting requirements for each proposal on a site-by-site basis, considering the design of the operations and its proximity to ground and surface waters.

The process in Scotland is similar in outline, but the Regulations and terminology differ.

A2. How will the risk of shale gas fracking fluids migrating into ground water be mitigated and how will the risk of groundwater contamination by methane and other gases be mitigated?

In assessing the risks to determine whether a permit is required for a groundwater activity, the operator needs to provide the Environment Agency, Natural Resources Wales (NRW) or the Scottish Environment Protection Agency (SEPA) with details such as a geological assessment, the casing design and fracking fluid composition. If a permit/authorisation is issued, it may include conditions on aspects such as, casing design and integrity testing, distance between boreholes and groundwater resources and limits on the amounts of substances that may be discharged to the water environment.

The British Geological Survey (BGS) has been undertaking a National Baseline Survey of Methane, covering all prospective areas for shale gas in England and Wales, and initial results were published in June 2013. This will enable

environmental regulators to understand background methane levels prior to assessing permit applications.

A3. How will the Government ensure that 'fractures' caused by hydraulic fracturing for shale gas, do not extend into aquifers and cause contamination of ground water?

Fracking takes place at a depth sufficiently distant from groundwater to ensure that any risk of fractures extending into aquifers is negligible. The Royal Society considered this question and concluded that upward flow of fluids from the zone of shale gas extraction to overlying aquifers via fractures in the intervening strata to be highly unlikely. The thickness and properties of rock surrounding the fractures limit the volume of rock which is effected by fracking.

Experience in North American shale gas fracking also indicates that the laminated nature of rocks in the subsurface contain and restrict fracture height growth by what are termed 'composite layering effects',.

DECC, EA, SEPA and HSE have worked with the UK Onshore Operators Group to codify best practices for onshore shale gas wells. See UK Onshore Operators Group's UK Onshore Shale Gas Well Guidelines [PDF, 674KB, 37 pages] for a description of the Hydraulic Fracturing Programme (HFP), the detailed risk assessment now required as part of DECC frac consent that also describes the control and mitigation measures for fracture containment and for any potential induced seismicity.

A4. How much water is required in Hydraulic Fracturing?

Hydraulic fracturing for shale gas is likely to involve the use of large quantities of clean water, typically 10,000 to 30,000 m3 water per well (10,000 to 30,000 tonnes). The water may be obtained from the local water supply company sources or by abstraction from surface or groundwater (if permitted by the relevant environment agency).

A5. How will the Government regulate the amount of water made available for Hydraulic Fracturing?

To date companies have sourced water for shale fracturing from the local water utility company. We would expect companies to do this wherever possible, at least during the exploratory phase, (see A6 for how utility water supply is managed).

As an alternative, companies may wish to take water direct from groundwater or surface waters. Water abstraction is regulated by the Environment Agency through the abstraction licensing process under the Water Resources Act or by the Scottish Environment Protection Agency (SEPA) under The Water Environment (Controlled Activities)(Scotland) Regulation 2011 (CAR). There is an exemption from the need

for a licence for abstractions that do not exceed 20m3/day but the water requirements for hydraulic fracturing are likely to be much greater than this limit.

Operators wanting to abstract surface or groundwater would need to make an application for a licence to the environmental regulator. For groundwater, there is an additional groundwater investigation process that must be undertaken before a licence application can be made.

An application for a licence from an operator would be assessed in the same way as any other application for an abstraction licence and would only be granted by the environmental regulatory where a sustainable water supply was available.

A6. How will Government ensure that there is sufficient drinking water for the general public, in the face of drought and the already large demands on water use?

The Environment Agency produce a Water Resources Strategy, which sets out how water resources should be managed throughout England and Wales to 2050 and beyond to ensure that there will be enough water for people and the environment.

By law, water companies have to produce water resource management plans every five years to show how demand for water is going to be managed and met over a twenty-five year period. Water companies must assess in detail the pressures on future water supplies, including changes in demand and changes to the availability of water resources. The Environment Agency consults on and produces guidelines for the water companies to follow when writing their plans. Water companies must then consult on their plans for which the Environment Agency is a statutory consultee.

It is also a statutory requirement for water companies to produce a drought plan every three years. The Environment Agency produces guidelines for water companies to follow to make sure their plans contain measures to adequately protect public water supplies and minimise the impact of drought on the environment.

A7. How many different chemicals can be used in shale gas fracturing?

A large number of chemicals have in the past been used for this purpose in the US. A full list of the most commonly used chemicals in shale gas fracking operations in the US can be found at http://fracfocus.org/chemical-use/what-chemicals-are-used.

The EA and SEPA assesses the hazards presented by fracking fluid additives on a case by case basis, and therefore only the substances proposed for use in UK operations have so far been assessed for hazard potential. (See A8 for the chemical approved for use in the UK). The Environment Agency, or SEPA, will use its regulatory powers to protect the environment from shale gas fracturing.

A8. What chemicals are used in shale gas fracking in the UK?

The Environment Agency has powers to require full disclosure of chemicals used in hydraulic fracturing in England and Wales, both under the Water Resources Act 1991 and the Environmental Permitting Regulations 2010 and assesses the hazards presented by fracking fluid additives on a case by case basis. SEPA has similar powers as regards Scotland.

The chemicals being used by Cuadrilla, the only company so far to have carried out fracking for shale gas, are listed on Cuadrilla's website and are as follows:

1. 99.75% of the shale gas fracking fluid is made up of water and sand, beyond that a very limited number of chemicals are used:
2. Polyacrylamide friction reducers (0.075%), commonly used in cosmetics and facial creams, suspended in a hydrocarbon carrier;
3. Hydrochloric acid (0.125%), frequently found in swimming pools and used in developing drinking water wells,
4. Biocide (0.005%), used on rare occasions when the water provided from the local supplier needs to be further purified.

All of these chemicals have been approved for use in Cuadrilla's activities, but only polyacrylamide has been used by the company to date.

For future activities, subject to appropriate protection for commercial sensitivity, the regulators have decided that operators should disclose, either on their own websites or on third-party developed websites, the chemical constituents in fracturing fluids and additives on a well-by-well basis, along with a brief description of their purpose and any hazards they may pose to the environment.

A9. What additional contaminants are present in shale gas fracking fluids when they are returned to the surface via the borehole?

The water that returns from the well is likely to contain small quantities of minerals that have dissolved into the water from the shale. Some of these can be harmful so their storage and disposal needs to be planned and subjected to permits.

Operators must carry out laboratory and batch scale trials to identify the best options for the disposal of the flow-back fluids. All the facilities that operators use must also hold the appropriate permits from the Environmental Regulator, who will be notified in advance of any movement of the waste.

The Environment Agency has sampled and analysed the flow-back fluid from Cuadrilla's activities in Lancashire.

The results show that the flow-back fluid contained significant levels of minerals dissolved from the rocks, such as chloride, sodium, iron and other dissolved metals. It also contained very low levels of naturally occurring radioactive minerals (NORM) at levels similar to those found in granite rock. All of the chemicals found are those which would be expected in shale rock.

A10. How does the Government ensure that chemicals from shale gas fracking, both fracking fluid and flow-back fluids, do not escape into the environment?

The chemicals that are present in shale gas fracking fluid, and the flow-back fluid that returns to the surface after shale gas fracking, are prevented from escaping to the environment through several regulatory mechanisms:

- The borehole is designed and constructed to standards enforced by the Health and Safety Executive, to ensure Well Integrity is maintained (see section B).

- The storage of the fluids on the surface is regulated through the planning process, which places requirements on the design and construction of the site to prevent and contain spills.

- Flow-back fluids are deemed to be a mining waste and require an environmental permit for disposal to a waste water treatment works. Final disposal of the returned flow-back fluid is regulated by the environmental regulator; (the Environment Agency in England, NRW in and Wales, and SEPA in Scotland).

A11. How will operators dispose of shale gas fracking fluids from flow-back?

The disposal method for flow-back fluid will be agreed between the operator, their contractors and the Environmental Regulator. Prior to receiving an environmental permit for disposal to a waste water treatment works, a review of options is undertaken to ascertain the most appropriate method. In general the available options include:

- On-site treatment with re-use of water and disposal of remaining liquids and solids to a suitable licensed waste treatment and disposal facility or effluent discharge.

- Removal off site to a suitable licensed waste treatment and disposal facility.

- Disposal to foul sewer with the permission of the relevant waste water utility company.

So far in England and Wales, only one shale gas well has been hydraulically fractured and the flow back from that has been taken to a waste water treatment works for treatment and disposal.

A12. How will radioactive elements from flow back fluids be disposed of?

A case-specific radiological assessment is required in support of any application for a permit for the disposal of radioactive waste. The environmental regulator will critically review any such assessment, and will only issue a permit if satisfied. The radiological assessment will detail the disposal options and the radiological implications for people and the environment. All facilities that accept the radioactive components of flow back fluids hold the appropriate permits for the materials.

A13. How will the risk of flooding be considered where shale gas fracking is likely to take place (surface water, groundwater, tidal and river etc)?

It is highly unlikely that companies will wish to locate shale gas wells or facilities in areas prone to flooding. The National Planning Policy Framework applies a sequential, risk-based approach to ensure that inappropriate development is located away from areas at risk of flooding whenever possible. Should a company never the less propose such a development, than a properly prepared assessments of flood risk should inform the decision-making process at all stages of development planning. A Strategic Flood Risk Assessment carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources (including rising groundwater and from 'artificial sources') informs local plan-making, including the identification of areas for particular land uses.

A site-specific flood risk assessment is required for all developments in areas where flooding is an issue, and for all development sites of at least one hectare. This assessment is carried out by, or on behalf of a developer to assess the risk to a development site and demonstrate how flood risk from all sources of flooding to the development itself, and flood risk to others, will be managed.

The Environmental regulators is a statutory consultee in the planning process and undertakes assessment of flood risk from all sources where this is believed to be a key risk to a proposed site. This assessment informs the decision of the planning authority. The Environmental regulators can also incorporate conditions into a site's environmental permit to ensure that flood risk is managed appropriately.

B: Safety, including well integrity

B1. How is the safety of shale gas drilling and well integrity regulated?

The operator is responsible for ensuring the safety of the well and the site. The HSE scrutinise the working practices adopted by operators for conformity with the requirements of the Health and Safety at Work etc. Act 1974, and regulations made under the Act. These include:

- The *Borehole Site and Operations Regulations 1995 (BSOR)* apply to all oil and gas operations, including shale gas operations. These regulations are primarily concerned with the health and safety management of the site.

- The *Offshore Installations and Wells (Design and Construction, etc) Regulations 1996 (DCR)* apply to all wells drilled with a view to the extraction of petroleum (whose definition includes shale gas) regardless of whether they are onshore or offshore. These regulations are primarily concerned with well integrity.

- The *Reporting of Injuries Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR)*. These Regulations set out a specific set of Wells Dangerous Occurrences in Schedule 2, Part I, that the Well Operator has to report to HSE. Reporting of well incidents enables the HSE 'Offshore Division' (OSD) to investigate those that would have an effect on well integrity and ensures the Well Operator secures improvements to his operations. These are:

    - A blowout (i.e. an uncontrolled flow of well fluids)
    - The unplanned use of blow out prevention equipment
    - The unexpected detection of H_2S (hydrogen sulphide)
    - Failure to maintain minimum separation distance between wells
    - Mechanical failure of any safety critical element of a well

For the drilling process, the HSE initially scrutinises the well design for safety and then monitors progress on the well to determine if the operator is conducting operations as planned. An oil and gas well is a complex engineered construction and the key to well integrity inspection is to ensure that the operator is managing risks effectively throughout the life cycle of the well. To ensure this, HSE uses an

inspection and assessment process consisting of the following main elements, all of which utilise HSE's experienced specialist wells inspectors:

- Assessment of well notifications submitted to HSE. This assesses well design prior to construction, a key phase of work where the vast majority of issues likely to have an impact on well integrity will be identified and addressed by the well operator;
- Monitoring of well operations during construction based on weekly operations reports submitted to HSE by the well operators. This ensures the construction phase matches the design intent;
- Meetings with well operators prior to, and during, the operational phase will be undertaken (including joint meetings with the EA). This will include site inspections to assess well integrity during the operational phase. A programme of inspections and site visits will be established for each well prior to drilling, this may include ad-hoc inspections as deemed appropriate. The following has been established as a minimum in the HSE/EA joint inspection arrangements;

For new or first time shale gas operators the HSE and Environment Agency will:

- Meet them and advise of their legal duties under the relevant legislation.
- Conduct a joint inspection of the key operations at site including:
  - cementing and verification of cement
  - mini hydraulic fracture
  - bleed back
  - main hydraulic fracture
- Any such meetings and visits could include other interested parties e.g. DECC.
- Any change in the process i.e. hydraulic fracturing at shallow depth or change of media would entail a refresh of this inspection schedule.

For the future activities on the existing Cuadrilla wells in Lancashire, the HSE/EA intend, as a minimum to:

- Jointly inspect the Cuadrilla drilling operations at Anna's Road, paying particularly attention to well integrity and cementing issues.

- Jointly inspect the Cuadrilla fracking operations at both Anna's Road and Becconsall sites.

In addition, HSE will, during the standard scrutiny of weekly drilling reports from the operator, request and review an independent analysis of logging outcomes used to verify cement job/zonal isolation.

B2. Who is responsible for ensuring public safety in the vicinity of fracking sites and how is this managed?

The well (borehole) site operator is responsible for ensuring public safety within, and in the direct vicinity of, the work activities. The HSE is responsible for regulating this requirement.

B3. How will well casing integrity and quality be assured?

The integrity of the wells is ensured through a combination of:

- a well design created by competent personnel in compliance with appropriate health and safety regulations, specifically the *Offshore Installations and Wells (Design and Construction, etc) Regulations 1996 (DCR)* which apply to all wells drilled with a view to the extraction of petroleum regardless of whether they are onshore or offshore. These regulations are primarily concerned with well integrity;

- a well design process that has identified any well bore hazards and mitigated them;

- a review of the well design by an Independent Well Examiner;

- review of the well design by HSE Wells inspector against construction Standards in HSE guidance and in the Well Integrity Guidance;

- construction of the well in compliance with the design by competent personnel with any significant changes subject to the same scrutiny as described above;

- monitoring of the construction phase of the well and subsequent maintenance by the Independent Well Examiner and by the HSE Wells Inspector.

B4. What impact did the seismic events near Preese Hall have on Cuadrilla's well casings?

The casing of the well close to the level of the fracking activity was distorted at the time of the seismic tremors. However, there was no similar effect in those sections of casing, higher up the well, that are critical to pressure integrity and preventing the escape of gas to the ground.

B5. What safety 'features' are integrated into well operations to ensure well integrity is maintained?

Well design and construction operations follow a recognised industry design and construction process (e.g. the API Guidance Document HF1 – 'Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines'). Such processes ensure that wells have 'safety features' incorporated into their design. Specific design and construction requirements include:

- A well design based upon a review of the local geology. This enables the well design and construction plan to mitigate for any prognosed well bore hazards.
- Casing (size and grade) is selected based upon the results of a casing design process. The casing design analyses the burst, collapse, tensile and triaxial loads that it may be subjected to.
- Once the type of casing and its setting depths have been selected, the cementation programme is developed in consultation with the well operator's specialist cementing contractor. This design process analyses the rock strength and isolation requirements of the cement slurry so that it is placed as per the well design requirements.
- The drilling of a well is conducted on a "closed" circulating system for the fluids, so that any losses and gains to/from the well bore can be monitored.
- Drilling of the well is conducted with an overbalanced drilling fluid that keeps any overpressured formation fluids out of the well bore. If flow from an over pressured formation is detected, the blow out preventers at the top of the well will be shut, a denser fluid displaced into the well and the influx removed from the well bore.
- Once a casing has been set in the well it is cemented in place. The cement operation is closely monitored to ensure correct placement of the cement slurry between the outside of the casing and the well bore. Casing strings should be cemented back into the previous casing or back to surface for shallow strings. In the event that the correct cement returns are not obtained then a cement bond log may be run to verify that there is sufficient cement behind the casing. Once cemented the casing is pressure tested to ensure its integrity.
- Once the well is completed it will be monitored at the surface for any annulus pressure (i.e., pressure in the spaces between the different strings of casing) so that its ongoing integrity can be verified. Additional measurements can be made at depth if there is any doubt about the integrity of the well.

B6. Would cement bond logging be an effective way of monitoring the integrity of the cement bonding?

Cement bond logging (CBL) can be a useful means of verifying integrity where there is a single casing. CBL cannot verify the cement integrity through double casing of pipe and cement. Where there is a double casing, the best method and standard industry practice is to monitor the annular pressures. As an additional protection, surface methane and groundwater monitoring are being undertaken by Cuadrilla at those sites where it is the operator and any anomalies will be reported to EA, HSE

and DECC, and compared with data from the National Baseline Methane Survey, being undertaken by the British Geological Survey.

B7. What quality controls are put in place to ensure concrete well casings are of sufficient strength?

The cement specification, testing of the slurry and placement of it in the well follows recognised industry best practice as contained in the following American Petroleum Institute (API) documents:

- API Guidance Document HF1 – Hydraulic Fracturing Operations – Well Construction and Integrity Guidelines.
- API Specification 10A (ISO 10426-1:2009) Specification for Cements and Materials for Well Cementing.
- API Recommended Practice 10B-2 (ISO 10426-2:2003) Testing Well Cements.

B8. How are well casings tested? and how often?

Pressure tests are conducted on the casing strings installed in wells to ensure they have pressure integrity. Leak-off or formation integrity tests are also conducted once the bottom of the casing strings have been drilled out to determine what the strength of the rock is.

A leak-off test is where the rock is subjected to hydraulic pressure until the drilling fluid begins to leak into the rock and it begins to fracture, this determines the “leak off pressure”. A Formation Integrity Test is where the rock is subject to a predetermined pressure below the leak off pressure to monitor well integrity. Both of these tests provide the well operator with information on the strength of the rock about to be drilled through, but also provides confirmation that the casing is properly cemented into the section of rock that has just been drilled.

A cement bond log of casing strings can also be conducted if there is any doubt about the quality of a cementing operation. This determines where the top of cement is in the casing and confirms that the cement is as designed for specific location and of the appropriate quality. The pressures in the spaces between the casings are routinely monitored throughout the life of the well to ensure that integrity is maintained.

All of the above tests represent standard oilfield practice for well construction and are not particular to shale gas operations.

Casing strings in the well are typically pressure tested as follows:

- Once they have been installed and cemented.
- A leak-off test or formation integrity test can be conducted on the rock at the bottom of the casing once it has been drilled out. This is to ensure that the

cement bond at the base of the casing is good and to gain information on the strength of the rock at the bottom of the casing.
- The innermost casing string will be pressure tested prior to any hydraulic fracturing operations and after the running of any completion tubing.

B9. Apart from the regulator, what independent monitoring arrangements are in place?

Regulation 18 of the *Offshore Installations and Wells (Design and Construction, etc) Regulations 1996* requires the Well Operator to set up a Well Examination scheme and appoint a Well Examiner. The Well Examination Scheme and involvement of the Well Examiner is for the complete lifecycle of the well from design through to abandonment. The Well Examiner is an independent competent person who reviews the proposed and actual well operations to confirm they meet the Well Operators policies and procedures, comply with the *Offshore Installations and Wells (Design and Construction, etc) Regulations 1996* and follow good industry practice. During assessment and inspection activities, HSE checks that the operator has these arrangements in place.

The Well Operator's well examination scheme requires the operator to send the following documents to his Well Examiner:

- the well construction programme and any material changes to it;
- reports on how the well is being constructed;
- reports on how the well is being monitored; and
- at the end of the well's life, a plan for how it will be abandoned;

The Well Examiner reviews these documents to ensure the complete lifecycle of the well is designed, constructed and operated in line with the Well Operator's policies and procedures, good industry practice and legal compliance.

Shale gas well operators will ask their well examiners to examine certain well integrity and fracturing operations in real time, especially during the early stages of a development, to provide a further level of independent assurance. Such periodic site visits should be made at the discretion of the examiner, in addition to assessing documentary evidence of well integrity, to observe and verify that such operations have been executed satisfactorily in accordance with the approved programme. The frequency and need for such site visits to shale gas operations would reasonably be expected to reduce with time.

B10. How are radioactive sources, such as well tools, stored and managed on site? and do such sources pose a risk to public health?

Radioactive sources are used in oil and gas exploration, but are also extensively used throughout many other industries, including the NHS, paper and steel manufacturing, food irradiation, medical sterilisation and the construction industry.

Nuclear well logging tools are robustly built with almost no chance of radioactivity release under normal oilfield operations and stringent regulatory requirements are imposed on the transport, storage, handling, abandonment and eventual disposal of chemical radioactive sources.

International Atomic Energy Agency (IAEA) guidelines, European Union protocols, and national regulatory bodies prescribe standards for the handling of all radioactive sources [IAEA, 2003a; IAEA, 2004; IAEA, 2005; EU, 2009; NRC, 1987; NRC, 1991] to ensure their safe use. The use of ionising radioactive sources in the UK is strictly controlled by the UK radiological regulatory framework, which includes the Ionising Radiations Regulations 1999 enforced by HSE, as well as other legislation enforced by the environmental regulators, Department of Health, and the Office of Nuclear Regulation, all of which have programmes of inspection in place to ensure compliance.

Strict security and safety procedures are used for storing these tools and special shielded containers are used for transporting sources. Only authorised personnel following specific rules can access sources of this nature.

In almost all cases nuclear logging tools are owned and operated by oil and gas service companies, who are licensed to use the equipment. Operators, such as Cuadrilla, would commission service companies to undertake well logging as and when their operations require their use.

The use of such sources by appropriately trained personnel in accordance with the prescribed standards will not result in any risk to public health.

C: Seismicity

C1. What are the plans to mitigate the risk of earthquakes caused by shale gas fracking, and who is going to monitor the implementation?

New controls are being introduced to mitigate the seismic risks identified following the events in Lancashire. A precautionary approach will be adopted for the fracking of the next few wells, and these operations will be subject to particularly close scrutiny to ensure that the controls are being applied correctly and that they are effective.

A Hydraulic Fracturing Programme (HFP), the detailed risk assessment now required as part of DECC frac consent that also describes the control and mitigation measures for fracture containment and for any potential induced seismicity.

See UK Onshore Operators Group's UK Onshore Shale Gas Well Guidelines [PDF, 674KB, 37 pages]

As a first step operators will be required to review the available information on faults in the area of the well to confirm that wells are not drilled into, or close to, existing faults which could provide the mechanism for triggering an earthquake. Background seismicity will then be monitored for a period of several weeks before fracking operations commence to provide a baseline against which activity detected during and after fracturing operations can be compared.

Each stage of the fracking process will be carefully designed to use only the amount of fluid to fracture the rock sufficiently to allow the gas to flow. A flow-back period will be routinely incorporated into the design so that after each stage the pressure is quickly reduced to further reduce the risk of a tremor.

Once fracking commences, "real time" seismic monitoring will be used to operate a "traffic-light" warning protocol under which operations will be halted and pressures immediately reduced if a seismic event of magnitude greater than ML 0.5 is detected. This magnitude is well below the energy level that could be felt at the surface, and the protocol would enable a review of the possible causes of the event and allow further steps to be taken to prevent the occurrence of larger events. (for more information on earthquake magnitudes, see the BGS site - http://www.bgs.ac.uk/downloads/start.cfm?id=661)

Once the fracking and flow-back is complete, monitoring will continue for at least 24 hours so that any abnormal induced events amidst the normal background seismicity can be identified.

Until the characteristics of fracking in a particular formation are well established, in addition to the real time monitoring described above, tiltmeters and a permanent buried seismometer system will record the usual microseismic events (of magnitude much less than ML 0.5) that accompany all fracking activity. These can be used to

establish exactly how far the fractures penetrate into the surrounding rock. This will allow the effectiveness of the fracture to be evaluated but also ensure that the size is as predicted and that the fracture has not extended further than planned, e.g, toward any near surface fresh water aquifer.

The operator will be required to submit seismic data promptly to DECC and to publish up-to-date information on their website. For the first few operations in Lancashire, DECC will have an independent expert on site during shale gas fracking to observe that the protocols are followed and that the monitoring is proceeding as planned. The need for further DECC onsite observation will be reviewed after the first few wells.

C2. The next shale gas wells fracked in Lancashire will be under close scrutiny, but will the strict requirements and measurement criteria be the same for fracking all shale gas wells in the future?

This is a developing area of knowledge, and as experience is gained of the influence of local geology and the design, duration and volume of the fracking operation, then the protocols may be tightened or relaxed or new controls introduced, taking account of expert advice. This will ensure that seismic risks from shale gas operations are properly addressed and mitigated by the operators, and do not present any hazard to local communities.

C3. The expert's report suggests that an earthquake magnitude of ML 0.5 should be used as a traffic light threshold, but the ground movement from this magnitude of earthquake is within the range of ground motion that is the normal background caused by vehicles, trains and farming activities and smaller than the maximum ground motion regulated for other industrial and construction activities. Isn't this too severe and likely to cause false alarms?

A magnitude ML0.5 earthquake in itself is not cause for concern and is unlikely to be perceptible, but the analysis of the Lancashire data indicates they may be an indication of, or precursor to, a larger earthquake. Both the 2011 frac-induced earthquakes (magnitude ML 2.3 and ML 1.5) happened about 10 hours after the frac, with only much smaller earthquakes (magnitude ML<1) being recorded during the frac. By using earthquake monitoring algorithms supported by on-site expertise, it is possible to discriminate very small deep earthquakes from background surface-induced vibrations (10-12 such surface events have been detected per day as part of the background monitoring). As operational detection data develops from fracking operations, DECC will consider, with expert advice, the most appropriate criteria to define the threshold.

C4. Will shale gas production (as against exploration) cause subsidence or earthquakes large enough to cause damage at the surface?

There are no documented cases of shale gas operations, whether exploration or production, causing subsidence or earthquakes large enough to cause damage at

the surface (although large scale re-injection of frac disposal fluids poses a recognised earthquake risk and, if proposed in the UK will be closely scrutinised). Shale gas production does not remove large quantities of rock from underground (by comparison with coal mining where subsidence does occur).

The amount that shale rock changes with the extraction of gas is expected to be almost zero, so compaction and resultant subsidence would not be expected. However, prior to commercial production being approved, samples of the rock will be tested and analysis made to confirm this for the geology and production rates of the particular site identified.

When gas is produced there is a change in the internal (hydrostatic) stress in the formation. This causes the rock to be subjected to an increased and variable overburden load, which can result in compaction of the rock structure, due to an increase in the 'effective stress'. In soft or porous unconsolidated formations where subsidence has been observed, this compaction has resulted from a change of grain packing, pore and bulk volume of the reservoir rock, (for example in the soft chalk of offshore Ekofisk field or the porous sandstone of the Groningen Field in the Netherlands).

The compressibility characteristic of a rock is quantified by Biot's constant, the efficiency with which the internal pore pressure offsets the externally applied total vertical stress. Typical Biot's values for most conventional porous reservoir rock types are 0.75 to 0.95. Biot's constant approaches unity for high porosity reservoirs (e.g. conventional high porosity/permeability sandstone reservoirs) but approaches zero for low porosity/permeability reservoirs, such as shale. For US Devonian shales (probably the most analogous to the Bowland shale) Biot's is often taken as zero, as the ratio of matrix to bulk compressibility is nearly one for such low porosity shales (Blanton and Teufel, 1983, Evans & Engelder 1986). Frac operations in North America are routinely monitored by both microseismic and tiltmeter measurements and no compaction issues have been documented.

C5. Are there cumulative effects of shale gas fracking on the risk of induced earthquakes as more wells are fracked?

There is no evidence from more than a decade of very active shale gas operations in the US to suggest any effect of this kind. However, there is long-term monitoring of seismicity in Lancashire, and analysis of the events recorded on the BGS National Earthquake Monitoring System will alert scientists and regulators to changes in the natural background seismicity of the area. An additional BGS National Earthquake Monitoring System station is being installed in Lancashire.

C6. These recommendations are for exploration drilling and testing, but what would happen if these tests prove that a shale gas development would be commercially viable, with many wells and shale gas fracking over a period of years?

For DECC to approve any Field Development Plan, the local authority must first grant planning permission in consultation with the Environment Agency (or SEPA in Scotland or Natural Resources Wales) and their assessment would consider the need for an EIA and environmental permits and address the impacts on the local community.

DECC will require geophysical surveys to identify faulting so that planned wells are placed in low risk locations and well spacing would be evaluated with a view to avoid unplanned interaction between wells. Building on the experience gained during the exploration phase, controls would be in place to mitigate fracture induced earthquake risk and micro seismic monitoring would be used, when necessary, to ensure that fractures do not propagate further than planned. Although it is not expected that the cumulative fracturing or production would give rise to an increase in regional seismic activity or ground subsidence, the background seismicity of any area of development would be monitored by the permanent Earthquake Monitoring System so that any cumulative effect of fracking on seismicity would be identified quickly.

C7. How were the technical experts regarding induced Seismicity selected by DECC?

The three independent experts (Brian Baptie - British Geological Survey, Peter Styles – Keele University and Chris Green – G-frac) were specifically commissioned by DECC because of their knowledge of geology, seismicity, and fracking and their professional independence.

C8. How will the Government ensure that seismic events caused by shale gas fracking will not impact existing critical infrastructure?

The controls being put in place by DECC are designed to prevent any more earthquakes being triggered by fracking. In addition, DECC's experts consider that the magnitude of any earthquake that could be triggered would be limited by the strength of the rocks to ML 3. This magnitude of earthquake occurs 3-4 times a year and only occasionally causes minor superficial damage. Published data for a number of UK earthquakes suggests that most events with magnitudes greater than ML 4.5, which could cause damage, tend to nucleate at depths of at least 10 km or greater, well below depths at which fracking will occur.

Where there are concerns over particularly vulnerable infrastructure, the planning process requires engagement and consultation with stakeholders to ensure any concerns are suitably mitigated prior to consents being granted.

C9. If it was determined that shale operations had caused an earthquake, what would the position in relation to liabilities be?

The controls being put in place by DECC are designed to prevent any more perceptible earthquakes being triggered by fracturing. If despite this an earthquake did occur which caused damage, the operator would be liable in the normal way for any harm caused by their activities. The data available from the permanent BGS National Earthquake Monitoring System would establish whether any observed quake had been caused by shale gas operations, and enable anyone who believed that he had suffered damage to make his case for compensation from the relevant operator.

D: AIR POLLUTION

D1. How will gas escaping into the air from both the well and shale gas fracking fluids be avoided/monitored?

Waste gases, including fugitive emissions, are considered an 'extractive waste' under the Mining Waste Directive. Operators must develop a Waste Management Plan, which is submitted to the Environment Agency (Local planning authority in Scotland) with permit applications. The waste management plan must characterise the waste, set out details of how the operator will employ a waste hierarchy, including waste minimisation and safe disposal, as well as any monitoring.

Techniques for the "completion" of wells to reduce the emissions of gases to air have been developed in the United States, this is known as 'green completions'. The shale gas industry in the UK is in its infancy and green completion techniques are being developed based on industry best practice. The operator in Lancashire has already developed a green completions methodology.

Venting and flaring are regulated by DECC as part of licence conditions. For all oil and gas activities, onshore and offshore, DECC requires that venting should be kept to the minimum that is technically possible. Routine venting is never permitted, but it is not possible to prohibit venting entirely, as in particular operational circumstances it may be necessary for safety reasons. However, the preferred alternative, where gas has to be released because there is no economic use for it, is that the gas should be flared to reduce its contribution to global warming emissions. In respect of future appraisal or production activities, DECC's established policy is that flaring should be reduced to the economic minimum.

D2. How will air pollution due to site operations be monitored locally and who is responsible?

During the construction and drilling of a well the operator will monitor methane emissions at the site and this will be a permanent feature of operations should activity progress to commercial development.

The Environment Agency has published research to understand how the emissions from a well can affect air quality, how they can be monitored and what controls are available.

The local authority has general responsibility for local air quality and developing a strategy to improve it.

D3. Leaks of methane from the well heads will be a major contributing factor in increasing GHG and climate change?

It is essential to develop as clear a picture as we can about the environmental impact of all fossil fuels. Any emissions of methane form shale gas operations, including leakage, should be taken into account in the UK greenhouse gas inventory, and count towards UK carbon budgets and international commitments on emissions reduction.

The carbon footprint of shale gas operations has been the subject of a number of reports and significant controversy. The most recent comprehensive review of the evidence, by consultants to the European Commission, (see http://ec.europa.eu/clima/policies/eccp/docs/120815_final_report_en.pdf) concluded that even on worst case assumptions, the carbon footprint of shale gas is likely to be substantially less than that of coal; and with the application of good industry practice, is likely to be only a few percentage points greater than that of conventional gas. Better data to inform future assessments is expected to emerge from studies presently being conducted by the US Environmental Protection Agency.

Ultimately, emissions from shale gas extraction processes will be determined by the design and conditions of a particular development. No development has yet been proposed for the UK but any application would be required to minimise the release of methane to the atmosphere including through the adoption of green completions and the avoidance of routine venting of gas.

E: Regulatory and monitoring responsibilities

E1. Who will regulate seismic (earthquake) risks associated with shale gas fracking?

DECC will ensure that appropriate monitoring and control arrangements to regulate seismic activity caused by shale gas fracking are agreed, before consent is granted. Operators will be required to have procedures in place to monitor, report and mitigate seismic activity caused by shale gas fracking, and a Hydraulic Fracturing Programme (HFP), the detailed risk assessment now required as part of DECC frack consent that also describes the control and mitigation measures for fracture containment and for any potential induced seismicity.

E2. Who will regulate shale gas fracking operations from an environmental perspective?

Environmental aspects of shale gas fracking operations are monitored by the Environmental Regulator with jurisdiction within a geographical area within the UK (The Environment Agency in England or Natural Resources in Wales, and SEPA in Scotland). The environmental regulators adopt a risk based approach to the monitoring of environmental issues to ensure those operations that potentially pose the greatest risk are more closely scrutinized, combining their own 'direct' monitoring, supplemented by inspections of the operators' reports. This approach is aligned in the same way that the environmental impacts of other industrial sectors are regulated. The conditions attached to any operator's environmental permits will stipulate the minimum requirements for site based monitoring and reporting.

E3. Who will regulate shale gas fracking operations from a safety perspective?

The Health and Safety Executive monitors shale gas operations from a safety perspective. The role of HSE, in relation to shale gas, is to regulate the health and safety risks to people from these operations, as it does for any UK well construction project onshore or offshore. In doing this, HSE works closely with other regulators such as the Environment Agency (EA) and the Department of Energy and Climate Change (DECC) to share relevant information on such activities and to ensure that there are no material gaps between the safety, environmental protection and planning authorisation, and that all material concerns are addressed.

E4. How is the health of local communities from shale gas operations being considered?

The Health Protection Agency (HPA) is currently reviewing the evidence base on the health impacts of shale gas, with a particular focus on the health impacts of emissions to air, land and water. This review will identify any potential health risks, and inform both future regulation and any future health impact assessments that may be carried out.

The HPA will assess the potential impact on health on a case by case basis, when approached by local authorities or industry as part of the Environmental Impact Assessment process. The current work on shale gas will help inform the HPA's position on the potential risk presented by such operations.

The Environment Agency is the main environmental regulator for shale gas operations in England (or Natural Resources in Wales, and SEPA in Scotland). They take a risk based approach to the protection of groundwater and will only allow substances that are not hazardous to groundwater to be used for hydraulic fracturing for shale gas. They will not authorise the use of hazardous substances for shale gas fracking operations. Non-hazardous substances may be used, subject to their appropriate use and it may restrict or prohibit the use of any substances where they would pose a risk to the natural environment.

The Environment Agency has recently published research on how the emissions from a well can affect air quality, how they can be monitored and what controls are available to minimise fugitive emissions.

E5. Who funds the enforcement of the regulatory framework on shale gas?

HSE can recover its costs from operators for assessment and inspection activities associated with an onshore well notification.

Government also funds the Environment Agency's work up to the point at which a company applies for a permit, after which the permit charge is designed to cover the cost of permitting a facility. For standard permits there is a fixed charge depending on the types of activity, for bespoke permits used on complex sites, the Environment Agency charges for time spent on the permit application on a case by case basis.

DECC already recovers costs from industry for offshore environmental regulation, and is currently extending cost recovery to certain licensing activities both offshore and onshore.

E6. Who will monitor the environmental aspects of shale gas operations in the UK?

The Environmental Regulators adopt a risk-based approach: combining their own 'direct' monitoring, supplemented by inspections of the operators' reports. This approach is aligned in the same way that the environmental impacts of other

industrial sectors are regulated. The conditions attached to any operator's environmental permits will stipulate the minimum requirements for site based monitoring and reporting.

Planning authorities also have a responsibility for monitoring and enforcing any planning conditions attached to the planning permission.

E7. Who will monitor traffic movements?

Impacts from traffic movements are a relevant consideration in planning permission. Overall the local authority has general responsibility for assessing local air quality and developing a strategy to improve it. This would include the monitoring of pollution from traffic flow as a result of shale gas fracking operations.

E8. What regulations govern how shale gas fracking operators comply with environmental laws?

The key regulations in England and Wales are the Environmental Permitting Regulations 2010, which incorporate the requirements of a number of different pieces of legislation, such as the Mining Waste Directive, Water Framework Directive, the Groundwater Daughter Directive and the Radioactive Substances Act 1993. The Environment Agency also has the provisions of s30 and s199 of the Water Resources Act 1991 available to it.

In Scotland SEPA will use the Water Environment (Controlled Activities) (Scotland) Regulations 2011 to control borehole drilling, the abstraction of water and the discharge of fracturing (fracking) fluids and other discharges to the water environment. SEPA also have powers under the Pollution Prevention and Control (Scotland) Regulations 2000 for certain activities, such as those involving refining of gas, gasification or other heat treatments, combustion, or disposal of solid or liquid wastes and powers to control any naturally occurring radioactive materials (NORM) via the Radioactive Substances Act (1993).

E9. Who will regulate the disposal of flow back fluids?

Flow back fluids are regarded as extractive waste under the Mining Waste Directive and may be covered by the Radioactive Substances Act 1993 if the amount of naturally occurring radioactive material exceeds specified amounts. As such their disposal will most likely require a permit from the Environmental Regulator.

E10. What are the arrangements for a new round (14th) of onshore licencing?

DECC plans to conduct a new round of onshore licensing (the 14th) next year, and is presently conducting the necessary Strategic Environmental Assessment.

F: Implications for Low carbon generation and climate change

F1. Why is the UK exploring shale gas when we should be investing in low carbon energy?

The UK Government has and continues to strongly support the roll-out of low carbon energy across the UK. We need a diverse energy mix including renewables, CCS, nuclear and gas. Gas generation will continue to play a major role in our electricity mix over the coming decades, alongside low-carbon technologies as we decarbonise our electricity system. Gas fired power stations are relatively cheap and quick to build, and they will also be important for providing flexibility to help balance out increasing amounts of relatively inflexible and intermittent low carbon capacity. The Government is keen to maximise indigenous production where we can - this includes shale gas.

F2. Why is the UK not investing the money being used to explore Shale Gas into renewables?

There are no subsides for shale gas exploration, so the Government is not "investing" in shale gas. Rather its role is to licence acreage so that operators are able to see if commercially recoverable amounts exist; and to ensure that those operations are conducted safely and without harm to the community and environment.

F3. We should be making our existing assets more efficient and integrate low carbon energy into all developments?

The Government's energy and climate change goals are to deliver secure energy on the way to a low carbon energy future and drive ambitious action on climate change. To achieve this, it is critical that we address security of energy supply and climate change challenges while maximising benefits, including economic benefits investment that creates jobs and tax receipts.

F4. Exploiting shale gas will only continue the UKs addiction to fossil fuels?

The Government is committed to a diverse, efficient and low-carbon energy supply, but this cannot be achieved overnight. Oil and gas supply two thirds of our energy today, and will continue to be of substantial importance for many years to come.

We have robust regulatory systems in the UK to protect the environment and ensure safe working. We think it is very much in Britain's interests for as much as possible of our future oil and gas supplies to be produced here, rather than in other countries which may not maintain the same standards.

So we believe it is vital that we do all we can to maximise economic recovery of our indigenous hydrocarbon reserves and we think it is right to encourage industry to continue to invest in exploration, development and production whilst maintaining high standards of management and minimising environmental impacts.

F5. Why would the UK exploit shale gas when it is clearly not aligned to managing global warming?

Shale gas production would in the first place replace declining offshore gas production and reduce reliance on external supplies. Beyond that point, use of gas could displace use of coal in generation, with a positive effect on GHG reduction (provided fugitive emissions are subject to proper controls as outlined above).

The Government is committed to meeting its legally binding target to cut emissions by at least 80% by 2050 and its renewable energy target by 2020. We need a diverse energy mix in the UK, including renewables, CCS, nuclear and gas generation.

F6. Investment in shale gas must be at the expense of investment in low carbon?

It is too early to say whether shale gas will be able to contribute significantly to our sources of gas supplies for the future. But the recently published Gas Generation Strategy confirms that the Government sees a significant role for gas into the future; while continuing development of low carbon supply will be essential to meeting our targets for renewables and wider climate change goals.

G: Planning and local environmental impacts

G1: How will local issues (visual impact, traffic movements, natural environment etc) be taken into account where shale gas fracking is proposed?

Proposals for shale gas fracking in exploration and development wells will require planning permission from the relevant planning authority. The National Planning Policy Framework requires planning authorities to assess applications for all minerals developments, including oil and gas developments, so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural or historical environment or on human health, including from noise, dust, visual intrusion, or migration of contamination from the site. In doing so, they should take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality.

The National Planning Policy Framework makes it clear that the phases of development - exploration, appraisal and production - of on-shore oil and gas extraction (including unconventional sources such as shale gas) should be clearly distinguished. Planning applications for each stage are subject to consultation with the local community and with relevant statutory consultation bodies such as the Environmental Regulator before the mineral planning authority/local planning authority takes a decision. Furthermore the applicant is required to provide sufficient information that is relevant, necessary and material to the proposed development.

Shale gas wells, whether for exploration or production, are subject to the environmental impact assessment regime established by the EIA Directive. The EIA Directive is transposed into English law through the Town and Country Planning (Environmental Impact Assessment) Regulations 2011. Similar regulations apply in the Devolved Administrations. Under the Regulations, all deep drilling operations, including shale gas wells, will be screened by the local planning authority to assess whether they are likely to have any significant effects on the environment. Where significant effects are identified, an environmental statement will need to be submitted to the relevant planning authority before the planning application is consulted on and considered.

Guidance on the role of planning system in handling applications for all phases of development may be found on GOV.UK

G2. What has the Government set as the minimum distance that shale gas fracking can take place from populated areas?

There is no set minimum distance for any industrial activity from populated areas. Planners are asked to assess the environmental effects of each application on a case-by-case basis.

G3. Who is responsible for monitoring and managing any long-term aspects of shale gas fracking. e.g. when shale gas extraction has ceased?

The planning authority will monitor the restoration of the site to its previous use once operations have ceased. The restoration of sites will be the subject of planning conditions imposed as part of any planning consent.

The procedures for abandoning a well are designed to ensure that all fluids will be it is permanently contained sealed. In addition, DECC is in discussion with the industry on how introducing arrangements to ensure that, for a defined period after abandonment of a well, the operator will conduct suitable monitoring monitor the groundwater and the air in the vicinity of the abandoned well.

G4. How will the Government ensure that communities do not suffer 'property blight', or higher insurance, as a result of hydraulic fracturing activities and what mechanisms exist for compensating people who suffer property damage due to seismic events caused by Hydraulic Fracturing?

There is no reason to expect that the current phase of exploration activities will have any adverse effect on property values in the vicinity of the activities. There has been no evidence of any such effect in the UK to date, in over half a century of oil and gas exploration and production, though the impacts on health, local amenity, traffic movements, etc., are expected to be broadly similar; and the activities will be subject to the same robust safety and environmental regime, supplemented by new controls against seismic risks.

The scale and character of any future phase of shale gas production in the UK is at present unknown, and its impacts, including impacts on health, local amenity, etc. will of course be fully considered through the planning process before any such project can proceed.

G5. Who will monitor the impacts of shale gas fracking activity on agriculture?

There is no reason to expect any impacts on agriculture, and no plausible mechanism for such an impact has been proposed. Until some such possible threat has been identified, no monitoring activity would be meaningful or justified.

G6. If agricultural activity is impacted by fracking activity, who will compensate the landowners?

Any farmer who believes his activities have been adversely affected should seek compensation from the relevant operator.

G7. What if fracking has come up on the conveyancy searches completed when buying a house?

Conveyancy services will compile reports that list information of interest for a particular site, and their reports may include the words “licence” and “fracking”. This should not be taken to mean that fracking or any other oil and gas activity is either happening or imminent at that site.

Please note that DECC cannot undertake to enter into correspondence about individual conveyancing cases; furthermore DECC is under no obligation to provide information that is already publicly available or which should be sought elsewhere, or to speculate about licensees’ future plans.

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