

# Government response to Royal Academy of Engineering and Royal Society report on “Shale Gas Extraction in the UK: a review of hydraulic fracturing”.

Version: Final A04 - 10th Dec 2012

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**Recommendation 1 - To detect groundwater contamination:**

- A) The UK's environmental regulators should work with the British Geological Survey (BGS) to carry out comprehensive national baseline surveys of methane and other contaminants in groundwater.**

The British Geological Survey (BGS) are working with the Environment Agency to establish a national baseline. DECC will work with the Environment Agency and SEPA to agree the scope of "other contaminants" that should be included.

- B) Operators should carry out site-specific monitoring of methane and other contaminants in groundwater before, during and after shale gas operations.**

DECC considers this to be "good oilfield practice" and as such operators will be required to undertake site-specific monitoring and publish the results on their web sites.

Where there is a groundwater risk, the environmental regulator will ensure the operator undertakes monitoring of methane and other contaminants in groundwater before, during shale gas operations and through to well abandonment.

- C) Arrangements for monitoring abandoned wells need to be developed. Funding of this monitoring and any remediation work needs further consideration.**

Arrangements and financing for the monitoring and if necessary remediation of abandoned wells is the responsibility of the industry. DECC will work with UKOOG to put in place a robust scheme to ensure that abandoned wells remain safe and which satisfies, and is incorporated within site restoration and remediation agreements under the planning process.

For the Cuadrilla wells in Lancashire, the company has agreed to put in place specific measures, in advance of agreement on a wider scheme, to ensure effective monitoring and management of abandoned wells.

- D) The data collected by operators should be submitted to the appropriate regulator.**

DECC will require operators to publish data on their websites.

## **Recommendation 2 - To ensure well integrity:**

### **A) Guidelines should be clarified to ensure the independence of the well examiner from the operator.**

Regulation 18 of the *Offshore Installations and Wells (Design and Construction etc) Regulations 1996 (DCR)* requires the well operator to set up a well examination scheme and appoint an independent competent person – the well examiner - to review the proposed and actual well operations to confirm they meet the well operator's policies and procedures, comply with DCR and follow good industry practice. Schemes of well examination must comply with the "*Guidelines for well operators on well examination*" and "*Guidelines for well operators on competence of well examiners*", published by Oil & Gas UK.

The requirement for the independence of the well examiner is crucial, and "independent" is further defined in DCR. This independence is usually achieved by well examiners being from a separate company from the well operator. However, there are a few well operators who wish to use in-house examiners, and that option is legally open to them if they can fulfil the DCR requirements of an appropriate level of impartiality and independence from any aspects of the well design/construction/operation. HSE provides guidance on this aspect, both in the Guidance on DCR (Booklet L84) and in SPC/TECH/OSD/43.

### **B) Well designs should be reviewed by the well examiner from both a health and safety perspective and an environmental perspective.**

Scrutiny by the well examiner to ensure well integrity from a safety perspective should in practice already serve to prevent the release of harmful material into the environment, as the goal setting requirements are to ensure there can be no unplanned escape of fluids from the well, so far as is reasonably practicable. However, there may be some aspects, such as a review of the appropriateness of fracking chemicals from an environmental perspective, which would be outside the strict legal scope of the well examination scheme, but which the well operator, (as the client of the well examiner) can nevertheless specify for the well examiner to cover. UKOOG is currently preparing guidance on good practice for shale gas operations, which recommends that the operator should ensure that the environmental implications should be assessed, either by the well examiner if he has appropriate skills, or by a separate contractor liaising with the well examiner.

**C) The well examiner should carry out onsite inspections as appropriate to ensure that wells are constructed according to the agreed design.**

Well operators should have their own quality assurance processes to ensure wells are constructed to the agreed design. The separate work undertaken by well examiners depends on the scope of the well examination scheme devised by the well operator.

Well examiners use documentary evidence of well integrity as the primary means of examination (as per the published DCR Regulation 18 Guidance) to obtain assurance that wells are designed and constructed properly and maintained adequately. It is not the practice that examination schemes need provide for physical examination of wells, unless reliance cannot be placed on the veracity of the documentary evidence.

However, for the purpose of increasing public confidence in the UK shale gas industry whilst it is in its infancy, UKOOG consider it appropriate for shale gas well operators to 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.

**D) Operators should ensure that well integrity tests are carried out as appropriate, such as pressure tests and cement bond logs.**

In order for well operators to ensure compliance with the goal setting requirements of DCR (which requires that wells should be “...so constructed.....that so far as is reasonably practicable there can be no unplanned escape of fluids from the well...” ) a range of appropriate well integrity tests will be required during the construction phase, as detailed in standards and guidance such as the Oil & Gas UK “Well integrity guidelines”, which were drafted in consultation with HSE and DECC. The guidance being prepared by UKOOG will include reference to best practice specifically for shale gas wells.

**E) The results of well tests and the reports of well examinations should be submitted to the Department of Energy and Climate Change (DECC).**

DECC already requires copies of digital logs to be lodged with the BGS, together with an ‘End of Well Report’. Cement bond logs and well examination reports will be added to the list of data specified. These data

are available through DECC's data release agents, and operators will be additionally required to make this data available upon request.

([http://og.decc.gov.uk/en/olgs/cms/data\\_maps/data\\_release/data\\_release.aspx](http://og.decc.gov.uk/en/olgs/cms/data_maps/data_release/data_release.aspx)).

### **Recommendation 3 - To mitigate induced seismicity**

**A) BGS or other appropriate bodies should carry out national surveys to characterise stresses and identify faults in UK shales. Operators should carry out site-specific surveys to characterise and identify local stresses and faults.**

BGS has already published regional memoirs which describe the tectonic history and faulting in many of the areas which are prospective for shale gas (<http://www.bgs.ac.uk/research/ukgeology/subsurface.html>). Structure contour and isopach maps, associated palaeogeographical maps, sections and correlation diagrams, are based on an analysis and interpretation of seismic, borehole and surface geological data, together with gravity and magnetic data, as well as other sources. These data are held at 10K & 50K scale in BGS' DigMap data set.

DECC has commissioned the BGS to complete a Bowland Shale regional mapping project, which will be published by DECC in early 2013. A further study is planned to map the Jurassic shale gas potential, and studies of the prospectivity of other shales will be considered after that report is published in late 2013.

DECC will require operators to understand the risks of hydraulic fracturing and to use these regional analyses, along with their own site-specific surveys, to characterise in-situ stress and identify faults that a well bore may penetrate.

**B) Seismicity should be monitored before, during and after hydraulic fracturing.**

Before granting consent for shale gas operations which include hydraulic fracturing, DECC will require that a fracturing plan be submitted, for consideration with the well consent application. DECC will expect operators to demonstrate a full understanding of the risks of hydraulic fracturing. The detail should be proportionate to the risks, but in general, operators will need to evaluate the historical and background seismicity and the *in situ* stress regime; and delineate faults in the area of the proposed well to identify the risk of activating any fault by fracking. The fracturing plan should also include appropriate plans to monitor seismicity before, during and after the well operations conclude.

**C) Traffic light monitoring systems should be implemented and data fed back to well injection operations so that action can be taken to mitigate any induced seismicity.**

DECC consent for shale gas hydraulic fracturing will only be granted when a “traffic-light” regime is in place so that operations can be quickly paused and data reviewed if unusual levels of seismic activity are observed. Operations will be halted, and immediate action taken to initiate flow-back to reduce pressure if seismic activity above a predefined level is observed. The predefined action levels will be chosen so as to minimise disturbance to local residents and so far as possible eliminate any risk of damage.

**D) DECC should consider how induced seismicity is to be regulated. Operators should share data with DECC and BGS to establish a national database of shale stress and fault properties so that suitable well locations can be identified.**

DECC is working closely with the other regulators, BGS, industry experts and operators to establish controls for mitigating induced seismicity, with the development of robust traffic light arrangements forming an important component of this.

BGS has compiled orientation and relative magnitudes of the contemporary in situ stress regime in the UK into a BGS stress GIS and database. BGS and operators will contribute to this national stress database (and the World Stress Map.

([http://dc-app3-14.gfz-potsdam.de/pub/introduction/introduction\\_frame.html](http://dc-app3-14.gfz-potsdam.de/pub/introduction/introduction_frame.html)).

However, the risk of induced seismicity cannot be fully eliminated through an understanding of regional/sub-regional stress, as this may not always reflect the true in-situ stress conditions at the wellbore and surrounding strata, but in using this public domain stress and fault data, operators can conduct site specific studies to evaluate the risk of induced seismicity.

#### **Recommendation 4 - To detect potential leakages of gas**

**A) Operators should monitor potential leakages of methane or other emissions to the atmosphere before, during and after shale gas operations.**

The emphasis of this recommendation is on air quality issues, and the Environment Agency is undertaking a review of the environmental impacts of the industry, the regulations that apply and the controls that may be used to limit methane emissions to ensure that should the industry develop there will be a clear regulatory framework for these emissions.

Techniques for use in the completion stage of well construction, to reduce the emissions of gases to air ("green completions") have been developed in the United States. The shale gas industry in the UK is in its infancy and green completion techniques are being developed based on industry best practice.

DECC will ensure that UKOOG's guidance covers monitoring of potential leakages of gas and draws on the findings on the environmental regulators' review.

**B) The data collected by operators should be submitted to the appropriate regulator. These data could inform wider assessments, such as the carbon footprint of shale gas extraction.**

Operators will post all carbon release data on their websites and summary data will be included in end of well reports.

UKOOG's guidance will be amended to reflect the need for monitoring data to be collected by the operator and reported to the environmental regulator and DECC.

## **Recommendation 5 - Water should be managed in an integrated way**

### **A) Techniques and operational practices should be implemented to minimise water use and avoid abstracting water from supplies that may be under stress.**

Water used for hydraulic fracturing may be sourced either by the operator directly, or indirectly through a licensed supplier. In either case, the licensing of water abstraction must take account of stresses caused by water demand, and this must be undertaken in consultation with the environmental regulator.

Operators will be required to follow good oil field practice and adopt techniques that minimise water use - this will be reflected in UKOOG's guidance.

### **B) Wastewater should be recycled and reused where possible.**

This recommendation is supported by the regulators where it is acceptable within the current legislative framework. The Mining Waste Directive and the Environmental Permitting Regulations (EPR) require a review of options, prior to an environmental permit for disposal being granted by the regulator. This ascertains the most appropriate method for managing wastewater at each location.

### **C) Options for treating and disposing of wastes should be planned from the outset. The construction, regulation and siting of any future onshore disposal wells need further investigation.**

This is already required as part of the EPR and is a requirement of the Mining Waste Directive.

The use of disposal wells is not regarded as good practice by the environmental regulators or DECC.

## **Recommendation 6 - To manage environmental risks**

- A) An Environmental Risk Assessment (ERA) should be mandatory for all shale gas operations, involving the participation of local communities at the earliest possible opportunity.**
- B) The ERA should assess risks across the entire lifecycle of shale gas extraction, including the disposal of wastes and well abandonment. Seismic risks should also feature as part of the ERA.**

ERAs are already required by legislation in certain contexts, although these may not address all aspects of the operations in question. For example, when applying for environmental permits, operators are required to submit mandatory environmental risk assessments to support their applications, which then form part of the public consultation process.

The regulators concur that an overall ERA addressing all risks in appropriate detail would be desirable even where not specified by legislation, and DECC will expect all operators to carry out such an assessment as a matter of good practice. This assessment can then be mapped onto the assessments required by legislation, such as the Environmental Impact Assessment, where this is required following screening by the relevant planning authority.

DECC are consulting experts from Cranfield University to assist in the development of ERA guidance for shale gas activities as proposed by the academics, and to further address the scope requirements of the exploration and production phases.

The regulators support the engagement and participation of stakeholders, including local communities, at the earliest opportunity.

## **Recommendation 7 - Best practice for risk management should be implemented**

- A) Operators should carry out goal based risk assessments according to the principle of reducing risks to As Low As Reasonably Practicable (ALARP). The UK's health and safety regulators and environmental regulators should work together to develop guidelines specific to shale gas extraction to help operators do so.**

Risk assessment is central to a goal based regime and is required by UK health and safety legislation. Guidance on best practice for well integrity has been prepared by the Well Life Cycle Forum and published by Oil and Gas UK. This is being integrated into the guidance being prepared on behalf of UKOOG; this will bring together various standards, guidance and best practice. HSE/EA are both involved in this and do not intend to develop separate guidelines at this stage..

- B) Operators should ensure mechanisms are put in place to audit their risk management processes.**

This is supported by HSE, as auditing of health and safety management systems is required by UK health and safety legislation.

- C) Risk assessments should be submitted to the regulators for scrutiny and then enforced through monitoring activities and inspections.**

The intention of this recommendation is already achieved with respect to well integrity via the notification requirements of the Borehole Sites and Operations Regulations 1995 (BSOR). These require the well operator to submit details of well operations to HSE prior to their commencement, including the basis of the well design with respect to the geological strata and any hazards. These notifications are assessed by HSE's wells specialists, and issues likely to have an impact on well integrity can be identified and addressed by the operator. In addition, a variety of safety risk assessment information is included in the Health and Safety Document for the site, required by BSOR. These documents are a crucial part of an operator's approach to well integrity and health & safety on the site, and are valuable tools for HSE inspectors to use to devise intervention work and to assess well operator compliance. HSE will keep the potential implications of any extended surface operations (e.g. gas gathering stations, pipelines etc) under review should shale gas operations be scaled up following the early exploration phase.

When applying for environmental permits, operators are required to submit mandatory environmental risk assessments to support their applications. If an environmental permit is granted, the environmental regulator will develop a compliance assessment plan for each site to measure the operator's compliance and ensure that environmental risks are properly managed. This may include methods such as audits, site inspections, check monitoring and sampling and reviewing operator records and procedures.

**D) Mechanisms should be put in place to allow the reporting of well failures, as well as other accidents and incidents, between operators. The information collected should then be shared to improve risk assessments and promote best practices across the industry.**

There is already a range of mechanisms for well operators to share lessons from wells incidents, ranging from the global OGP Wells Expert Group to the UK Well Life Cycle Practises Forum and Oil & Gas UK and UKOOG. However, these fora have a much wider remit than just shale gas wells, so DECC will discuss this with the shale gas industry and ascertain the most appropriate routes to share best practice across shale gas operators.

**Recommendation 8 - The UK's regulators should determine their requirements to regulate a shale gas industry should it develop nationwide in the future. Skills gaps and relevant training should be identified. Additional resources may be necessary.**

As noted in the report, there are greater uncertainties about the scale of production activities should a shale gas industry develop in future, and attention has to be paid to the way in which risks scale up. The regulators are already considering how to ensure the continued effectiveness in any such scenario of the current regulatory framework. The Environment Agency is conducting a review of the regulation relevant to its responsibilities, and the HSE likewise will keep under review the adequacy of its legislative framework.

The Shale Gas Strategy Group, chaired by DECC and attended by the regulators, considers that the regulatory skills already available are likely to meet the needs, but the issue of future regulatory resource has to be kept under review in the light of the evolving prospects for a future shale gas industry.

**Recommendation 9 - Co-ordination of the numerous bodies with regulatory responsibilities for shale gas extraction should be maintained. A single body should take the lead. Consideration should be given to:**

- **Clarity on roles and responsibilities.**
- **Mechanisms to support integrated ways of working.**
- **More formal mechanisms to share information.**
- **Joined-up engagement of local communities.**
- **Mechanisms to learn from operational and regulatory best practice internationally.**

The Shale Gas Strategy Group, which includes the regulators, Defra and DCLG under DECC chairmanship, will continue to provide coordination on the development of shale gas policy and regulation across government departments, including these issues.

**Recommendation 10 - The Research Councils, especially the Natural Environment Research Council, the Engineering and Physical Sciences Research Council and the Economic and Social Research Council, should consider including shale gas extraction in their research programmes, and possibly a cross-Research Council programme. Priorities should include research into the public acceptability of the extraction and use of shale gas in the context of UK policies on climate change, energy and the wider economy.**

The Research Councils are planning a workshop to consider the implications for UK research of the potential exploitation of unconventional hydrocarbon resources, including shale gas.