Department of Energy & Climate Change

Fracking UK shale: understanding earthquake risk

February 2014

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Hydraulic fracturing, known as fracking, is a technique used in the extraction of gas and oil from 'shale' rock formations by injecting water at high pressure. This guide explains the risks of tremors and what government is doing.

Links between fracking and tremors

In 2011 there were small tremors at Preese Hall near Blackpool, where hydraulic fracturing operations were taking place. The Department of Energy and Climate Change (DECC) suspended all hydraulic fracturing operations while investigating the cause.

The tremors measured magnitude 2.3 and 1.5 on the Richter scale. Earthquakes of this size are normally not felt at the surface.

Detailed technical investigations and independent review[1] showed that the tremors were probably caused when frack fluids flowed into a geological fault, a crack running through one or more layers of the underground rocks.

US operations have been associated with larger earthquakes, registering up to magnitude 4 or 5 on the Richter Scale, but only where large quantities of waste water has been re-injected into the rock[2]. This practice is not likely in the UK and any application would be closely scrutinised.

[1] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/15745/5075-preese-hall-shale-gas-fracturing-review.pdf

[2] http://www.ldeo.columbia.edu/news-events/seismologists-link-ohio-earthquakes-waste-disposal-wells

Reducing the risk of fracking-related tremors

Following the tremors in Lancashire, DECC introduced new controls and checks for operators using hydraulic fracturing. They are required to:

- use all available geological information to assess the location of faults before wells are drilled to avoid hydraulically fracturing near faults
- use British Geological Survey records to assess baseline levels for seismic activity (vibrations of the earth's crust)
- inject as little fluid as necessary into the rock during fracturing
- monitor seismic activity during and after fracturing
- adopt a 'traffic light' system that controls whether injection can proceed or not, based on that seismic activity

The traffic light monitoring system

During fracturing operations, seismic activity at the site will be monitored. A traffic light system, determines whether the injection of water is safe to proceed:

Green	Less than magnitude 0 on the Richter scale	Injection proceeds as planned.
Amber	Magnitude 0 to 0.5	Injection proceeds with caution, possibly at reduced rates. Monitoring is intensified.
Red	Magnitude 0.5 or higher	Injection is suspended immediately.

Operations stop if a tremor of magnitude 0.5 or greater is detected. The pressure of fluid in the well is reduced immediately.

The magnitude 0.5 threshold was set on the basis of a report by a group of independent experts.

This level is well below what could be felt at the surface. For comparison, it is within the range of normal background noise caused by vehicles, trains and farming activities. However, it is above the level expected from normal fracking operations and so serves as early warning of the possibility of larger tremors

As more data becomes available, DECC and its advisers will keep the effectiveness of these rules, including the trigger level, under review.

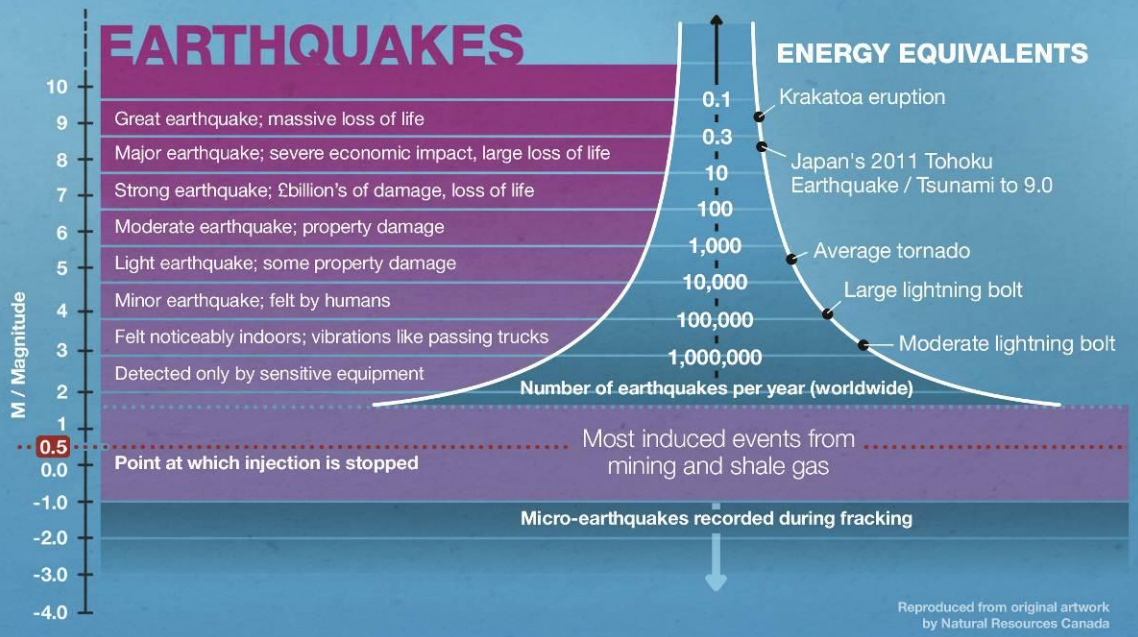
The operator will be required to submit its monitoring to DECC promptly and to publish up-to-date information on its website.

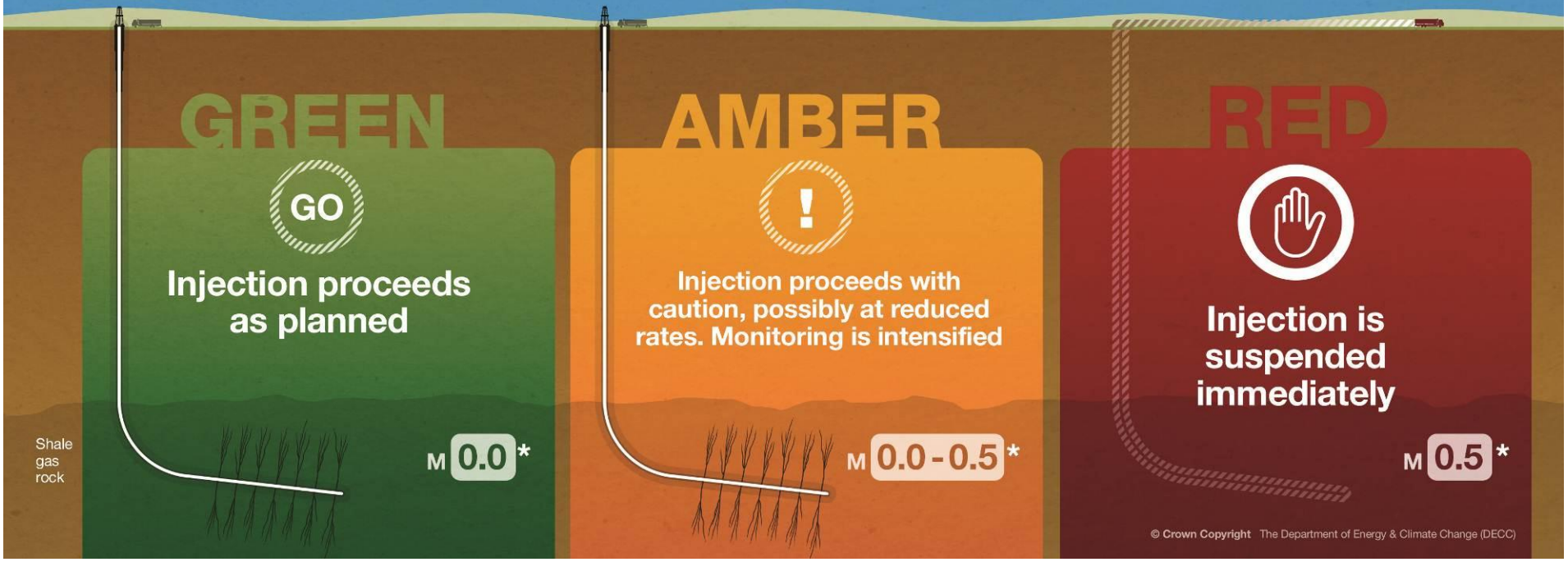
Traffic light monitoring system

Controls are in place so that operators will have to assess the location of faults before fracking, monitor seismic activity in real time and stop if even minor earth tremors occur.

If a magnitude greater than M 0.5* (0.5 on the Richter scale) is detected operations will stop and the pressure of the fluid will be reduced. This level should limit further earthquakes, known as 'induced seismicity', which may happen after the pumping is completed.

**subject to review and may change.*





Risk of subsidence, landslides or surface damage as a result of fracking

There are no documented cases of fracturing operations causing subsidence or tremors large enough to cause damage at the surface.[3]

Unlike coal mining, shale gas production does not remove large quantities of rock from underground, which can cause subsidence.

Subsidence can happen when rock is compressed and collapses in on itself. But shale rock is not easily compressed, so subsidence is unlikely. Rock samples will be tested at each site before commercial production is approved.

Cumulative effects on seismic activity

After a decade of extensive fracturing activity in the US, there is no evidence to suggest that ongoing fracturing increases the likelihood of earthquakes.[4]

In the UK, the British Geological Survey National Earthquake Monitoring System provides continuous seismic monitoring. It would alert scientists to any changes in the level of natural background seismic activity. An additional monitoring station is being installed near Blackpool.

Assessing the risk to infrastructure

Our independent experts consider that any earthquake that could be triggered by fracturing could be no more than magnitude 3 because of the strength of our rocks. This magnitude of earthquake occurs 3 to 4 times a year in the UK.

Where there is particularly vulnerable infrastructure, the planning process requires that operators engage stakeholders and address any of those concerns before planning permission is granted.

More information

A Royal Society and Royal Academy of Engineering report considered the earthquake risk.

DECC commissioned 3 independent experts to write a report on the causes of the Lancashire earthquakes: Brian Baptie from the British Geological Survey, Peter Styles from Keele University and Chris Green from G-frac. They were selected because of their knowledge of geology, seismicity, and fracking. A range of other materials on the earthquakes in Lancashire is available on the gov.uk website, including reports submitted by Cuadrilla at the time.

A note by Professor Peter Styles and Brian Baptie on earthquakes and seismicity in the UK.

For more information on earthquake magnitudes, visit the British Geological Society site.

[3] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48330/5055-preese-hall-shale-gas-fracturing-review-and-recomm.pdf

[4] For example, http://earthquake.usgs.gov/research/external/reports/G12AP20001.pdf

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