RESPONSE TO DECC CONSULTATION ON PREESE HALL SHALE GAS FRACTURING: REVIEW & RECOMMENDATIONS FOR INDUCED SEISMIC MITIGATION

The DECC independent expert report focused on the occurrence of the unusually high magnitude induced seismicity due to shale gas hydraulic fracturing in Lancashire (Preese Hall well). Here we restrict ourselves to commenting only on this aspect of the report. The DECC report makes other recommendations that go beyond this focus (e.g. DECC report Appendix B) and there should be separate consultations on these other aspects.

Data from the USA published by Warpinski et al. (2012) (SPE 151597) on the moment magnitudes for all Halliburton hydraulic fracturing operations in the USA up until mid-2011 show that the 2.3M event in Lancashire was unusually large. The Eola Field in Oklahoma is the only other example (not reported by Warpinski et al. (2012)) where similar magnitude earthquakes caused by shale gas fracturing are thought to have occurred. The Lancashire event released approximately 1000 times more energy than the largest event reported by Warpinski et al. (2012). It is not clear from the DECC report why this was the case. We cannot even now, after two reports, 2D seismic coverage and a well penetration, be confident which fault was reactivated. This reflects the degree of uncertainty there is around subsurface geology. Therefore we need to be cautious at all stages in future shale gas hydraulic fracturing operations. Although there are several sensible recommendations in the DECC report such as ‘Characterisation of any possible active faults in the region using all available geological and geophysical data,’ we propose DECC should go much further than this. Here we propose a simple workflow, using well established analyses and techniques that could be modified and adopted, some elements of which are already included in the report’s recommendations (marked *).

**STEP 1: Pre-Drill Analysis**
- a. Fault characterisation study *
- b. Installation of seismic network and monitoring of local seismicity
- c. Consideration of current in-situ stress regime
- d. Historical analysis of data on seismicity *
- e. Slip-tendency analysis – fault orientations prone to move in stress regime

**STEP 2: Post drill, Pre-Frack Analysis**
- a. Borehole imaging (e.g. FMI log) before injection to check for presence of faults not identified in STEP 1

**STEP 3: Syn-Fracking Analysis**
- a. Real time measurement of fracture growth using microseismicity *
- b. Traffic light system outlined in the report *. The threshold in the report is an earthquake which has a magnitude of 0.5M. It’s not clear why this threshold is chosen. 0.75M is more justifiable as it is the largest event documented in the USA after thousands of fracturing operations (Warpinski et al 2012) – Fig. 1.

**STEP 4: During Production Analysis**
- a. Continued monitoring of seismicity
Fig 1. Graph of Moment Magnitude for the Barnett Shale from Warpinski et al (2012). Warpinski et al (2012) present graphs from several shale gas reservoirs in the USA. Note of thousands of records of microseismicity the maximum magnitude which was recorded in the Barnett Shale is c. 0.75M. Anything above 0.75M is anomalous and therefore should be the threshold for the traffic light system rather than 0.5M.

Most important in the above work flow and missing in the DECC report is borehole imaging before injection, and sufficient local, detailed and medium-term seismic monitoring. Fracking and monitoring its environmental effects is in its infancy, and it is not possible to state categorically in what way decisions made on the Lancashire project would have differed in the light of the above-described process. However, the potential seriousness of induced nuisance earthquakes warrants better monitoring of the sort described above if decision-making is to be informed by all possible useful information, and if we are get the public acceptability required for this to be part of the energy mix in the future.

References:

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