



## NERC Centre for Doctoral Training in Oil & Gas (2017 start)

<b>Project Title:</b> How likely is high-amplitude earthquake shaking for UK oil and gas installations?
<b>Host institution:</b> University of Strathclyde
<b>Supervisor 1:</b> John Douglas
<b>Supervisor 2:</b> Zoe Shipton

### Project description:

This project seeks to improve our understanding of the physical processes that lead to extreme earthquake ground motions from induced seismicity related to oil and gas extraction. Generally induced seismicity from such human activities is comprised of very-low-magnitude earthquakes and consequently the motions at the surface that are caused by these events are weak. Occasionally, however, larger events are triggered (e.g. Ekofisk 2001,  $M_w$  4.3). Why this is so is still poorly understood. Investigating using geological and seismological analysis the reasons for large ( $M_w > 3$ ) induced events would be the first theme covered by this project. Given a large event, does not necessarily lead to significant shaking at the surface, however, because it may have a low stress drop, for example. Therefore, the second theme covered in this project would be to assess the likelihood of a particularly energetic large event being trigger that could lead to shaking beyond the levels considered in the design of oil and gas facilities. This second theme will involve analysis of recorded seismograms to assess the characteristics of the earthquake source in seismicity related to oil and gas activities. Subsequently the potential surface shaking from such events would be assessed. Finally, the project will compare this potential shaking with the seismic design basis of UK oil and gas infrastructure. This is a multi-disciplinary project that would train the researcher in many topics of geology and geophysics. It would also place this experience and the research within a clear real-world context of environmental safety and regulation. The data required for this project has not yet been requested. These data will be combination of freely-accessible public information but also data from industry, which will require agreements to be signed.

### CDT Research theme(s):

The topics of this proposal lap three themes: (a) Effective production of unconventional hydrocarbons, (b) Extending the life of mature basins and (d) Environmental Impact and Regulation. This is because recent experience of a mature gas basin in the Netherlands (Groningen), for example, shows that induced seismicity can be an increasing problem for such reservoirs; a recent project for unconventional hydrocarbons in the UK led to induced earthquakes; and effective regulation and a reduction in potential environmental impacts of oil and gas extraction should account for potential beyond-design-basis events.

**Research context:** The student will join a team of ~30 postgraduate students working on environmental and geotechnical engineering, geomechanics & structural geology and Oil & Gas. The student will work in the state-of-the-art labs in the Dept of Civil & Environmental Engineering, recently rebuilt at a cost of £6M. Expertise includes structural geology, seismology, geology of the earthquake source, earthquake engineering, and conventional & unconventional oil & gas engineering.

### Research costs:

Computer equipment and software £9K; travel & subsistence - meetings with companies & collaborators £5K; Conferences - £6K. The Department of Civil and Environmental Engineering will guarantee provision of the RTSG budget over 4 years.

### Career routes:

This project would equip the researcher with experience that would be useful for careers in: engineering consultancies concerned with hazard and risk assessments; environmental and regulatory agencies; companies designing oil and gas facilities; and oil and gas companies.