

Evidence

Minimising risks from fluid reinjection to deep geological formations

Project summary SC150027

This report provides a greater understanding of the issues related to re-injecting water back into the oil reservoir when extracting oil or gas from the ground. It provides recommendations on how to manage risks from commonly used reinjection practices and describes alternatives such as offsite treatment and disposal. The report will help the Environment Agency to make decisions about the regulation of the onshore oil and gas industry in England.

Oil and gas is held at great depth in reservoir rocks and normally sits on top of very saline water. It is not possible to keep this water separate from the oil and gas when it is extracted. Reinjection is often used to manage this “produced water” and for “secondary recovery” by flushing hydrocarbons towards the extraction well helping to maintain production of oil and gas. If too much pressure is used to force the water back into the ground it could cause earth tremors and potentially damage rock structures. These “geomechanical impacts” could lead to risks to groundwater.

Demand for produced water reinjection (PWRI) may increase in the future for both conventional and unconventional sources (e.g. shale) of onshore oil and gas. At present there is no standard industry guidance relating to the management of geomechanical risks from reinjection activities. As a result, there are no specific requirements for industry to collect or present data for this purpose.

What did the research involve?

The study based its recommendations on a literature review and 8 case studies, which looked primarily at conventional onshore oil and gas activities. PWRI in England takes place at relatively low rates and pressures and no related earth tremors have been recorded, unlike in other countries, such as the USA, where differences in industry practices, regulatory frameworks, and geological conditions exist.

An overview is provided of factors that should be considered as part of a PWRI programme which, if implemented appropriately, will minimise any geomechanical risks.

Risk factors

Reinjection pressures should be low enough to avoid causing movement along faults or creating new fractures. Balancing extensive extraction of oil or gas by reinjection of produced water will help to avoid earth tremors caused by subsidence.

Reinjection should be avoided in areas of increased risk, for example where there are geological faults that are known to link to aquifers.

Soils that could become unstable if earth tremors occur should be identified, particularly where buildings or storage tanks and pipelines could be affected. Structures should be capable of withstanding these stresses, though the risks are not considered to be significant in England.

Large differences in temperature between the reinjected produced water and the receiving formation could lead to unwanted fracturing of the rock. Produced water could cause corrosion of the well casing and scaling. Compatibility of the produced water with the well should be assessed.

Assessment of geomechanical risks

The report makes recommendations on the types of information that will help in assessing the potential geomechanical risks.

A detailed understanding of the subsurface is needed, with a focus on rock structures and existing stresses, the characteristics of the oil and gas reservoir geology and the adjacent confining rock layers.

Construction details of the reinjection well are needed and the well should be subject to regular mechanical monitoring.

An estimation of the expected rates of water production and temperatures should be made along with the expected rate and pressure for reinjection. Appropriate modelling will be needed and monitoring of reinjection rates and pressures should be carried out during operations. Operators should prepare a response plan to manage any unexpected variations from the modelled case.

Recommendations for further work

Development of onshore oil and gas activities may lead to demand for reinjection of other fluids from hydraulic fracturing. The report recommends that work to understand any risks should be continued, including the potential cumulative impacts from PWRI. Improved mapping of the sub-surface is recommended, including the use of detailed seismic monitoring. The potential for impacts on geomechanical stability caused by the temperature difference between reinjected water and the well should also be considered further.

How will this work help the Environment Agency?

The report will help the Environment Agency to make decisions about the regulation of the onshore oil and gas industry in England. It will also be a valuable reference for industry for managing potential risks from reinjection of produced waters.

This summary relates to information from project SC150027, reported in detail in the following output(s):

Report: SC150027/R

Title: ReInjection of fluids to deep geological formations

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