Mitigating Induced Seismicity Risks of CO_2 Storage: Are Best Practices from Oil and Gas Applicable to CCS?

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Abstract

Objectives
Passive seismic monitoring is an integral part of a robust verification plan for CCS projects. Two key objectives include the monitoring of the storage complex for natural or induced seismicity (IS), which could pose a risk to locally contained CO2, and second; to detect seismic events that can be felt by nearby communities and surface stakeholders and therefore pose a risk to the project's social licensing to operate. While these objectives are complementary, specific monitoring parameters should be considered for each separately. Passive seismic arrays also offer synergies with technologies in support of direct CO2 plume and caprock integrity monitoring.

Induced Seismicity, causally related to human activity, has been documented around the world, including fluid injection for wastewater disposal and gas storage projects. Permanent sequestration of CO2 has geomechanical similarities to these operations and two risks associated with IS need to be managed for CCS projects:

- Risk to Containment (seals/caprock): seismicity might be related to pre-existing faults that could compromise caprock. Demonstrating the absence of seismicity levels of concern supports regulatory requirements to verify that CO2 stays in the geologic storage formation indefinitely.
- Risk to social license to operate: induced seismic events that are felt at the surface can prompt significant opposition from regulators and local stakeholders. Oil & gas projects had to shut down as a result.

Methods, Procedures, Process
Examples from the oil & gas industry and synthetic models demonstrate that proactive IS risk management spans the entire project lifecycle. It can be broken down into:

- Seismicity risk and hazards assessment during project planning as an integral part of the site selection process prior to Final Investment Decision (FID)
- Monitoring of background seismicity prior to startup of injection to establish a baseline and inform risk mitigation plans (traffic light protocols).
- Real-time monitoring for seismicity during sequestration enables a managed response (communication & mitigation).

IS risk management is highly project specific. In this paper, best practice considerations and synergies with other CCS verification objectives are discussed.

Results, Observations, Conclusions
IS risk requires management throughout the lifecycle of CCS projects. Generally, minimum standards are defined by regulators. Regulations for CCS projects are currently immature and rapidly evolving. Consistent application of best practices helps mitigate this uncertainty. The oil &

gas experience provides robust guidance for project- specific strategy and implementation. Synergies with other monitoring objectives such as the extent of CO2 plume also exist.

Significance

This is a concise overview of key aspects of seismicity in the context of CCS projects. Lessons from IS experience in other industries are translated into a practical framework for risk management for CCS. Data examples illustrate options and rationale for choosing robust and fit for purpose solutions.