

## Geothermal, Hydraulic Fracturing & Earthquakes: How contrasting industries have shaped our approach to induced seismicity

Paige E Mamer  
TGS Canada

### Summary

This talk presents a narrative about how the oil and gas industry built comprehensive guidelines for responding to induced seismicity based on practices used by enhanced geothermal systems (EGS) projects. Work to build upon these practices over the last decade has produced a methodology and regulatory framework for addressing induced seismicity that can be adopted by new geothermal developments in North America.

### Learning from Analogous Fields

In 2010, the possible link between modern hydraulic fracturing for hydrocarbon resources and earthquakes was explored for the first time in North America. In response, the oil and gas industry looked to other industries for relevant experience and methods to ameliorate the problem on a social and technical level.

Geothermal, specifically EGS, seemed to be a fitting analogue since EGS projects involve fracturing and fluid injection and had also triggered earthquakes. In both geothermal and hydraulic fracturing, injected fluid modifies underground stress through changes in pore pressure, which has the potential to trigger motion along nearby faults, which is experienced as an earthquake.

One particular tool used by EGS projects is the traffic light protocol (TLP). The premise of the traffic light protocol is that projects are monitored for seismicity using specialized ground measurement tools, such as seismometers and/or accelerometers. Predetermined thresholds dictate whether no action is required (green light), if adjustments are needed to operations to reduce the potential for seismicity (yellow light), or if operations should be stopped (red light).

The EGS TLP template fit nicely within the context of hydraulic fracturing since injection parameters could be adjusted at the yellow light phase. Oil and gas exploration/production companies began using TLPs in their operations to respond to potential seismicity. Their implementation by regulatory bodies quickly followed in jurisdictions that had experienced induced seismicity. The oil and gas industry has since expanded their approach to induced seismicity to include industry best practices, improved hazard assessment, clear response procedures, and public outreach strategies.

As geothermal and oil and gas increasingly cross paths through drilling technology, repurposing of oil and gas wells, etc., the two industries can continue to benefit from each other. Methodologies originally developed for ESG projects, and which have been extensively developed to shape approaches seismicity risk management and regulation, can now be applied to future geothermal projects.



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