

INDUCED SEISMIC ACTIVITY IN CANADA



INDUCED SEISMICITY

Induced seismicity refers to seismicity caused by human activity. It is associated with several industrial processes, including geothermal energy extraction, wastewater disposal, mining, hydroelectric dams and hydraulic fracturing operations.

Induced seismicity caused by hydraulic fracturing are small earthquakes that typically happen deep underground where the rock is being fractured. In rare instances, seismic events create anomalous vibrations that are felt on the surface. These are called anomalous induced seismicity or felt events. The vast majority of induced seismicity caused by hydraulic fracturing result in magnitudes of less than 1 M_L as measured on the Richter scale and are not felt.

HYDRAULIC FRACTURING AND INDUCED SEISMICITY

Hydraulic fracturing is a proven and highly regulated technique that has been used for more than 60 years to recover oil and natural gas from tight rock formations. It involves injecting fluids into deep rock formations at high enough pressures to create fractures in the rock. This opens pathways in the rock to allow oil and natural gas to flow.

In rare instances, this process can trigger movement of an existing fault, leading to anomalous vibrations, some of which have been felt by residents in British Columbia and Alberta. Most induced seismicity related to oil and natural gas operations in Western Canada occurs where the rock is being fractured at depths of 2 km to 4 km.

PUBLIC SAFETY AND ENVIRONMENTAL IMPACTS

Industry takes the issue of induced seismicity seriously and has taken action to address the public's concerns.

Scientific evidence, industry experience and regulator data indicate that impacts to structures, shallow aquifers or the environment from induced seismicity caused by hydraulic fracturing are very unlikely. Citing academic research, the *Scientific Review of Hydraulic Fracturing in British Columbia* states that in Western Canada, 0.3 per cent of hydraulic fracturing operations were linked to felt events with magnitudes greater than 3 M_L. Induced seismic events in Western Canada generally occur at depths in the 2 km to 4 km range. This is the approximate equivalent of at least 10 times the height of the Calgary Tower or Shangri-La Hotel in Vancouver.

Hydraulic fracturing takes place deep underground.



REGULATIONS AND MONITORING

Hydraulic fracturing and induced seismicity are strictly regulated in B.C. and Alberta. Regulations are designed to protect people, structures and the environment, while allowing responsible development of oil and natural gas resources to continue.

- Operators are required to assess and monitor for seismic activity on their operating sites in areas that have experienced induced seismicity and complete detailed risk assessments before starting hydraulic fracturing activities.
- Regulatory tools called traffic light protocols are used in both provinces. If a hydraulic fracturing operation causes a seismic event that exceeds a traffic light protocol's red-light magnitude threshold, the operator must suspend operations immediately and may only resume after the regulator provides permission. If a hydraulic fracturing operation causes a seismic event that exceeds the yellow-light threshold, the operator must inform the regulator and initiate a response plan to eliminate or reduce the magnitude of seismic events.
- Both provinces have exclusion zones around select critical infrastructure, such as hydro dams, where hydraulic fracturing is prohibited.
- Seismic activity in B.C.'s and Alberta's oil and natural gas development regions is closely monitored to detect seismic events that may require regulatory actions and for research.

INDUSTRY APPROACH

Collaboration between industry, academics and regulators, and collaboration among operators, is extensive.

- Industry is guided by *Industry Shared Practices: Anomalous Induced Seismicity Due to Hydraulic Fracturing*. It informs monitoring, mitigation and response procedures to avoid or minimize any adverse effects of induced seismicity associated with hydraulic fracturing.
- Industry contributes financially to public regional monitoring networks in B.C. and Alberta, and to the Canadian National Seismograph Network operated by Natural Resources Canada.
- Oil and natural gas operators deploy local monitoring arrays for monitoring, proactive seismicity management and research, or at the request of regulators. They use real-time data from local and regional arrays, combined with detailed mitigation plans, to minimize the risk of felt events.
- Industry supports independent scientific research and shares data with academia. Industry regularly contributes to Canadian academic research on induced seismicity associated with hydraulic fracturing.
- Operators regularly meet to discuss current and planned operations, characteristics of recent induced seismicity and mitigation practices to ensure operators are fully informed.

SCIENTIFIC RESEARCH

Canadian research on the link between oil and natural gas activity and induced seismicity is growing. This includes academic studies and studies by regulators. Research is conducted by several consortia, including Geoscience BC, and the Microseismic Industry Consortium led by the universities of Calgary and Alberta. Industry is contributing to several of these initiatives.

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WITH ACADEMIA.
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