

CAPP Hydraulic Fracturing Operating Practice: ANOMALOUS INDUCED SEISMICITY: ASSESSMENT, MONITORING, MITIGATION AND RESPONSE

OVERVIEW

To support CAPP's Guiding Principles for Hydraulic Fracturing, seven Operating Practices have been developed in collaboration with CAPP member companies. These Operating Practices strengthen industry's commitment to continuous performance improvement in shale gas, tight gas and tight oil development.

The Anomalous Induced Seismicity: Assessment, Monitoring, Response and Mitigation Operating Practice supports the Guiding Principle:

“We will continue to advance, collaborate on and communicate technologies and best practices that reduce the potential environmental risks of hydraulic fracturing.”

WHAT DOES THIS PRACTICE MEAN?

CAPP and its member companies support and encourage greater transparency in industry development. To reassure Canadians about the safe application of hydraulic fracturing technology, this practice outlines the requirements of companies to assess the potential for anomalous induced seismicity and, where necessary, establish appropriate monitoring procedures, and procedures to mitigate and respond to anomalous induced seismicity in shale gas, tight gas and tight oil development areas.

HOW WILL THIS WORK?

Under this Operating Practice, companies will assess the potential for anomalous induced seismicity for each hydraulic fracturing program. Given the unique geologies where hydraulic fracturing takes place, each hydraulic fracturing program or location requires a tailored approach that draws from this practice. This practice includes:

- Assessing the potential for anomalous induced seismicity using available engineering, geologic and geophysical data.
- Complying with applicable regulatory requirements and employing sound wellbore construction practices.

Where assessment indicates the potential for anomalous induced seismicity exists:

- Evaluating wellbore placement and drilling design to account for geologic conditions.
- Communicating with onsite personnel; establishing procedures and preparedness for the possibility of anomalous induced seismicity.
- Establishing procedures to monitor for induced seismicity during hydraulic fracturing operations.
- Establishing procedures to mitigate and respond to anomalous induced seismicity.

TECHNICAL DESCRIPTION

The purpose of this practice is to describe minimum requirements for assessing, monitoring, responding to and mitigating anomalous induced seismicity in shale gas, tight gas and tight oil development areas.

The objective of this practice is to enable and demonstrate conformance with the following CAPP Guiding Principle for Hydraulic Fracturing:

We will continue to advance, collaborate on, and communicate technologies and best practices that reduce the potential environmental risks of hydraulic fracturing.

BACKGROUND

Hydraulic fracturing is a controlled operation that pumps a fluid and a propping agent through the wellbore to the target geologic formation at high pressure. This is done in multiple intervals, or stages, to create fractures in the formation and facilitate production of hydrocarbons. Hydraulic fracturing is a safe and proven way to develop natural gas and oil. It has been extensively used throughout the oil and gas industry for about 60 years.

It is known that certain oil and gas basins, such as the Horn River Basin of British Columbia, have a distinctive geology, and hydraulic fracturing has caused rare and minor anomalous seismicity. None of the events recorded in the Horn River Basin have caused any injury, property damage or posed any harm to public safety or the environment. Scientific research concludes hydraulic fracturing can safely proceed under current regulations, which ensure activities are carefully monitored and appropriate precautions are taken. After decades of experience with hydraulic fracturing, there has been no demonstrated evidence of harm to the public or workers, damage to local property and structures, or impact on surface and groundwater from induced seismicity.

SCOPE

This practice applies to CAPP member companies engaged in the development of shale gas, tight gas and tight oil resources through the application of hydraulic fracturing processes in Canada. While use of this practice is voluntary (subject to applicable laws and regulations, and where the assessments of geologic conditions are indicative), CAPP strongly encourages its integration into existing management systems by member companies.

Operational Requirements

CAPP member companies meet or exceed the following requirements to have procedures to assess the potential for anomalous induced seismicity. Where this assessment indicates there is a possibility of anomalous induced seismicity, such as in the Horn River Basin, member companies meet or exceed the following requirements: appropriately evaluate wellbore placement and drilling design to account for geologic conditions; communicate and prepare onsite personnel for the possibility of anomalous induced seismicity; have procedures established to monitor for induced seismicity; and have procedures to mitigate and respond to anomalous induced seismicity.

A) Assess the Potential for Anomalous Induced Seismicity

When assessing the potential for anomalous induced seismicity, CAPP member companies will appropriately consider the public interest, well type, local surface conditions and geology, past operating experience, historical seismicity and the anticipated scope of operations. Each hydraulic fracturing program or location requires a tailored approach that draws from these measures.

Operators will assess the potential for anomalous induced seismicity for each hydraulic fracturing program, which may include:

1. The use of available engineering, geologic and geophysical data to describe the geological setting (including pre-existing faults and lineaments) and historical seismicity in the area.
2. Communication with area operators and the regulator to determine if seismicity has been experienced and at what intensities.
3. Understanding the local context by considering:
 - a. Population and communities.
 - b. Buildings and structures.
 - c. Infrastructure.
 - d. Environment.

Where assessment indicates the potential for anomalous induced seismicity exists, CAPP member companies will implement practices as follows:

B) Wellbore Placement and Drilling Design; Personnel Preparedness and Monitoring Procedures for Anomalous Induced Seismicity

For each hydraulic fracturing program or location, CAPP member companies will consider conditions identified by the seismic potential assessment when evaluating wellbore placement and drilling design, and establishing personnel preparedness and monitoring procedures. Companies will:

1. Evaluate wellbore placement and drilling design to account for local surface and geological conditions (including pre-existing faults and lineaments).
2. Communicate with onsite personnel to recognize and be prepared for the possibility of anomalous

induced seismicity detectable to people on the surface.

3. Authorize onsite personnel to suspend operations if unusual conditions are experienced or suspected.
4. Establish an appropriate monitoring procedure based on the assessment of the potential for anomalous induced seismicity. Monitoring procedures may include:
 - a. Review of data from Natural Resources Canada seismic array.
 - b. Observations by onsite personnel.
 - c. Use of existing micro-seismic arrays and surface monitoring.

C) Mitigation and Response Procedures to Anomalous Induced Seismicity

Based on the assessment and monitoring procedures, companies will have procedures in place to mitigate and response to anomalous induced seismicity. As well, onsite personnel are required to suspend operations if they have reason to believe that conditions are unsafe.

1. If anomalous seismicity is monitored at the threshold of general detectability by available detection equipment – including the Natural Resources Canada monitoring system – or by onsite personnel, a company's mitigation procedures will be undertaken. These may include:
 - a. Assess the situation.
 - b. Increase monitoring activities.
 - c. Evaluate operating conditions.
 - d. Pumping proceeds with caution or is temporarily suspended.
 - e. Engage engineers, subsurface geological and geophysical staff and/or third-party experts to review available subsurface data and, if deemed necessary, design and conduct engineered trials to adjust operating procedures as appropriate with respect to injection volumes, rates, locations, etc.
 - f. Report and discuss occurrence with the regulator.
 - g. Share learnings with other area operators.

2.If seismicity, measured using available detection equipment, escalates to an unacceptable level, or if anomalous seismicity is detected at unanticipated levels which could present harm, the onsite personnel will immediately suspend operations and report to the regulator. Specific and appropriate thresholds may be developed in concert with the regulator for a basin or location based on local context, the geologic setting, pre-existing faults and lineaments and historical seismicity. The company will consult with the regulator to establish amended procedures to restart the program.

Performance Measures

Conformance with this practice will be confirmed by demonstrating that:

- Procedures are in place to assess the potential for anomalous induced seismicity.

Where assessment indicates a potential for anomalous induced seismicity exists:

- Procedures are in place to account for geologic conditions when evaluating wellbore placement and drilling design.
- Procedures are in place to communicate and prepare onsite personnel for the possibility of anomalous seismicity.
- Procedures are in place to appropriately monitor for induced seismicity during hydraulic fracturing.
- Procedures are in place to appropriately respond to and mitigate anomalous induced seismicity.

Reporting Expectations

Companies are expected to make their process for assessment, monitoring, mitigation and response to anomalous induced seismicity during hydraulic fracturing available to the public.

DEFINITIONS

Anomalous seismicity:

Seismicity that would not normally occur when performing hydraulic fracture completions (such as seismicity from fault movement).

Induced seismicity:

Seismic events that can be attributed to human activity. Seismicity can be induced by geothermal energy extraction, mining, dam building and hydraulic fracturing.

Seismicity:

The frequency and magnitude of earthquake activity in a given area.

Shale gas, tight gas and tight oil:

For the purposes of this practice, shale gas, tight gas and tight oil refer to unconventional resources from low permeability reservoirs being developed using horizontal wells with multi-stage hydraulic fracturing.