

CLASS I CONSORTIUM

UNDERSTANDING TRENDS IN SEISMICITY

CLASS I CONSORTIUM

Overview for Upper Management

The **Kansas Geological Survey (KGS)** proposes to manage a **consortium or Industry group of Class 1 deep injection well**

owners, to oversee the operation of and basic data analysis for several seismic networks designed to **record and allow**

accurate location and magnitude estimates of microearthquakes hundreds of times smaller than routinely

IT IS IMPORTANT TO KNOW THE BACKGROUND MICROSEISMICITY OF AN AREA IN ORDER TO HELP CHARACTERIZE NORMAL, LOW-LEVEL SEISMICITY ALREADY TAKING PLACE IN THE AREA.

possible with current regional networks. The **Kansas Department of Health and Environment (KDHE)** will be involved in the consortium

in an advisory capacity. **These networks will be strategically located and comprised of both stations designed for long term occupation and temporary sensor installations designed to**

be moved frequently to address the most current and highest priority needs of the consortium members.

KEY QUESTIONS:

1. What is microseismicity and why should we monitor it?

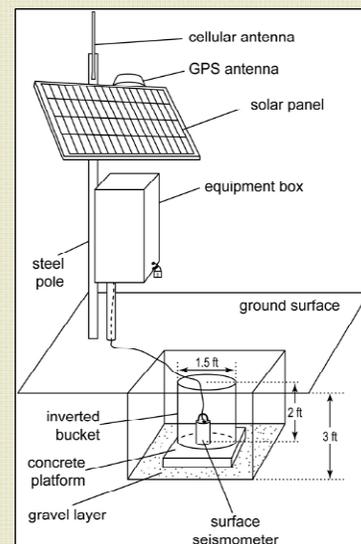
Earthquakes that are orders of magnitude smaller than those generally felt by humans are called **microearthquakes**, and the term for these small earthquakes in general is **microseismicity**.

It is important to understand the **background microseismicity** of an area in order to help characterize normal, low-level seismicity already taking place in the area. In addition, **microearthquakes can help predict the potential for larger earthquakes under certain conditions.**

Since **the deep injection of fluids has been shown to disrupt the stability of faults**, even the slightest felt ground motion can influence

WHAT DOES A SEISMIC STATION LOOK LIKE AND HOW MUCH ROOM WILL IT TAKE UP?

The actual footprint of a seismic station is small and does not require a source of electricity. The KGS will work with Class I operators to determine the best placement of the stations. A typical temporary seismic station is shown below:



the public's perception of the impact and therefore safety of underground injection wells, resulting in questions about damage to property or the environment.

Informed and defensible decisions concerning fluid disposal operations under KDHE review are best supported with actual seismic data and analysis. This information also gives industry partners predictive capabilities necessary to support minimizing the impact of injection operations. These measurements are essential in formulating, defending, and improving injection methods KDHE can meaningfully review, evaluate, and comment on, and can allow regulators to **methodically and proactively plan rather than react rapidly and harshly to a seismic event.**

2. Why join the consortium? What are the goals of the consortium?

As a group, companies can take advantage of spreading costs amongst the participants in a way that a company conducting seismic monitoring on their own could not, such as, the sharing of proximity stations between several companies and the incorporation of existing stations in the State-operated Kansas network.

Additionally, each participant will benefit from an improved understanding of the impacts and effects that prolonged or altered deep fluid disposal practices at and near their facilities have on local seismicity, which in most cases is well below felt levels and therefore current awareness.

The **General Operational Plan** is to operate targeted, customized monitoring networks. Sites will be selected and prioritized based on both the consortium needs to understand the effects, if any, of injection activities that concern KDHE and sites optimized for event location accuracy and operational efficiencies, using analysis to support injection management.

Short-term goals focus on identifying trends, correlating those to geologic structures and historical earthquake databases, and locally projecting/extrapolating those observations where data allows.

Long-term goals will generally target understanding temporal and spatial trends exhibiting increased event magnitudes in proximity to Class 1 disposal well operations and analyzing the potential of various triggering mechanisms.

Quarterly preliminary reports containing pertinent earthquake locations and their characteristics will be provided to **Tier 1 members (discussed below)**; augmented occasionally with supplemental reports focusing on areas the size of a few counties where the current temporary network is deployed.

Discussions in reports will focus on trends, geologic features of interest, and, to a limited degree, patterns or characteristics that help build a knowledge base to aid in distinguishing natural processes and cycles from those that could be influenced by humans.

Annually, KGS will hold a stockholders meeting in Lawrence, Kansas, for **Tier 1 and Tier 2** consortium members (discussed below) and **KDHE** to provide program review evaluation of the previous year's goals and accomplishments. The consortium will review how well strategies and tactics (current and future deployments) are meeting the mission and objectives of the consortium.

3. What is the State's role in the consortium?

KDHE will serve the consortium in **an advisory role**. Key KDHE staff will be invited to the annual meetings to provide input and clarity as to the needs of the state related to seismic monitoring activities. **Annual reports will be made available to KDHE** at the annual meeting; however, **all magnitude 2 or larger earthquakes** recorded at any of the 13 current KGS-operated stations or ~10 Consortium stations will be reported to a designated KDHE representative within 12 hours of the automatic alert received by KGS seismicity staff.

4. How much will this cost my company, and what is included in the cost?

Consortium members will enter into an agreement with the Kansas University Center for Research (KUCR) that defines their benefits and fees. Members can choose between two plans that are tiered to provide distinctly different benefits. This **two-tiered** program provides options for involvement, monitoring levels, and influence, with cost depending on both the tier chosen and proximity of a company's injection wells to a seismic station. **A seismic station must be within 15 miles of an injection well to provide data sensitivity levels necessary to meet the consortium objectives. Active members** are those who have paid annual operating fees. At any time, if a member wishes to leave the Consortium, they would simply stop paying their annual fees. Below is a description of the tiers and what is included in each.

Tier 1 Membership

Tier 1 membership in the consortium includes **full voting rights**, equal influence on strategic goals and tactical approaches as data dictates, and **requires a one-time Membership Fee of \$15,000 (approximately equal to the hardware costs for one station) per company**. All funds collected as membership fees for Tier 1 members go to the purchase of equipment necessary to assemble seismic stations.

Additionally, each active Tier 1 member contributes an **annual operating fee of \$4,000** per earthquake station necessary for the member to achieve full sensitivity monitoring status at the beginning of each calendar year. Full sensitivity monitoring status for an injection well requires a consortium seismograph station **be located within 15 miles**. A company will be assessed a fee of \$4000 for each **unique** seismograph station required to obtain full sensitivity monitoring status for all their wells. So, for a company with several wells, all in close proximity to each other, a single seismograph station might be sufficient to meet the 15-mile full sensitivity monitoring requirements. This kind of well grouping would represent a situation where the company only is assessed a \$4000 fee since a single station could adequately monitor multiple wells. This annual operating fee goes toward network operations, basic data analysis, development and distribution of quarterly reports, and compilation of the annual report to be presented at the annual consortium meeting.

Following is how a company's annual operating fee would be calculated:

- If a company has injection wells (regardless of the number of wells) that are **all less than 15 miles from a single, specific consortium seismograph station, the company's annual fee will be \$4,000**.
- If a company has 2 or more injection wells, each located within 15 miles of a Consortium seismograph station but not within 15 miles of the same Consortium station, then more than one seismograph station is necessary for the company's injections wells to achieve full sensitivity monitoring. **A \$4,000 annual fee for each unique station necessary for full sensitivity compliance would be assessed; therefore, the annual fee would be \$8,000**.
- **No more than one \$4000 annual operating fee** will be assessed for a single injection well regardless of the number of Consortium seismic stations that are less than 15 miles away.

Stations will remain in place and operating **as near 100% as possible** as long as the consortium members agree on a station's placement and operating objectives. Basic analysis will be ongoing and will result in weekly updates to the consortium event catalog and 24 hour status reports to members in proximity to any unusual event activity. At the start of **each quarter** the KGS will provide all **Tier 1 members** with a catalog update and discussions of noteworthy seismic activity. This will include any trend discussions and event clustering that justify tracking. At the **annual meetings** a complete report will be provided at least 2 weeks in advance of the meeting with network statistics and extended discussions related to trends or clusters of

earthquakes that might have an impact on plant operations or asset stability. **Full voting rights** also include the ability to vote on **Tier 2 seismic station locations**.

Tier 2 Membership

Tier 2 members of the consortium will be assessed a **\$5,000/year fee** that will be used to fund the operation of a **roving, temporary network** designed to move across the State, mapping seismic trends in proximity to Tier 2 members' facilities. This network will incorporate KGS state owned and operated permanent network stations with a few Consortium stations that will be installed and then **moved every 6 to 9 months**. This level of coverage would **not provide sufficient data to establish defensible trends**, rather the data from this roving array will only allow a generalized awareness of areas with higher levels of seismic sensitivity. The goal of this roving network is to establish areas where seismicity can be expected but not provide the benefits of long-term monitoring for any specific area or facility. **Tier 2 members** will be invited to the **annual consortium meeting** where the annual report for the previous year will be available and discussions/decisions related to network response and focusing will take place. Tier 2 members will be **allowed to provide input** on issues related to the movements and locations of the temporary network, **but will not have voting privileges**.

If you have questions regarding the Consortium, please contact:
Rick Miller, Kansas Geological Survey, rmiller@kgs.ku.edu, 785-864-2091,
or
Gregg Eichorn, ONEOK, geichorn@oneok.com, 620-960-2207

For an estimate of company-specific costs and to procure copies of the consortium documents, including agreements, please contact Rick Miller.

Since buying in bulk can help keep costs down, we'd like to target a response by the end of the year. After that, it will take a few months to purchase equipment and obtain site clearances.