Company Information

The QuakeMonitor™ team is made up of two specialized and highly qualified companies with many years of experience. The team consists of GeoEnergy Monitoring Systems, GeoEMS, Inc. of Los Alamos and Weir-Jones Engineering Ltd. of Vancouver. The Principals and senior employees of both organizations have decades of experience monitoring and interpreting natural and induced seismicity in connection with the oil and gas sector, mining and construction, and the military.

The two companies have combined their professional resources to make QuakeMonitor™ available to operators and other stakeholders in the oil and gas sector. The purpose of QuakeMonitor™ is to provide unambiguous information to the community about low magnitude seismicity, thus eliminating the uncertainties and misunderstandings which may arise in this part of the critically important energy sector.

Weir-Jones Engineering Ltd. was founded in 1971 to provide specialized structural and geomechanical monitoring and testing services. Weir-Jones capabilities subsequently expanded into the areas of data processing and structural integrity monitoring of heavy structural, energy, transportation and offshore systems. Weir-Jones has provided technical services to multinational clients and government agencies in more than fifty-five countries, developing proprietary technologies which are used to meet the specific needs of particular markets. These include ShakeAlarm™ a robust and highly reliable earthquake early warning system which is deployed in locations in Canada and the United States, and RockCheck™ a railroad track hazard detection system used by mainline operators in North America. The Company has its headquarters in Vancouver, British Columbia and has been active in projects in 55 countries worldwide. Weir-Jones has been audited to ISO 9001: 2008 standards since 2003.

Personnel from GeoEnergy Monitoring Systems, Inc. GeoEMS have worked at various US Government National Laboratories, as well as at the Nevada National Security Site (formerly the Nevada Test Site), the EMRTE facility in Socorro, and the West Virginia National Mine Health and Safety Academy. The principals have specific experience in the detection, identification, and interpretation of both local and distant induced seismic events in North America and overseas.

Together the companies offer a unique combination of experience in the field of seismic analysis, operational systems development, and real-time hazard and risk monitoring for multinational clients and oil and gas companies throughout the world.

Figure 3: A picture of QuakeMonitor™ in use at a drilling operation. This unit is communicating via a satellite link.
QuakeMonitor™

Overview

There is now heightened concern from regulators, and the general public, over the real or perceived impact of unconventional oil and gas production operations on local seismicity. Weir-Jones and Associates have developed a technically advanced, cost effective, and easily deployable recording system for collecting information about the induced seismicity associated with wastewater injection, fracking, geothermal, CO2 sequestration, and other applications. The standalone system is QuakeMonitor™ and it has been designed, developed, and implemented by a team of earth scientists and engineers who have worked in the induced seismicity monitoring and regulatory sector in the US, Canada and overseas for more than forty years.

System Details

QuakeMonitor™ is a cost effective SmartSensor® based system that is easy to deploy, and inexpensive to operate. The key to the monitoring system is a unique and proprietary combination of on-board processing linked via satellite (or cellular modem) to a central processing center. QuakeMonitor™ is manufactured to ISO 9001:2008 standards. The system provides a frac operator with unambiguous graphical reports which answers any questions the regulator may ask, see figure 1.

The hardware and software components of the QuakeMonitor™ system consist of:

1. The QuakeMonitor™ field recorder supplied in a NEMA 4 enclosure c/w solar panel, low temperature battery pack and the communications module as shown in the schematic in Figure 2, and deployed at a fluid injection site in Figure 3. It is easily and quickly deployed and has an operating temperature range of -40°C to +65°C.

2. Operational Support: providing installation support and maintaining a seismic network to monitor a site on a 24/7 basis for as long as the operator requires.

3. Processing (collecting and processing the induced seismicity data to provide, at a minimum, graphical and numerical plots of daily events, cumulative number of events, local magnitudes, event distance from sensor location, and event timing. If three or more QuakeMonitor™ units are deployed, the data provided also includes estimates of event location and depth. All the data can be easily manipulated and viewed with a browser based interface, including detected event information and the system’s state-of-health.

The QuakeMonitor™ field recorder digitizes up to 9 analog inputs with 16bit effective resolution, a MEMS accelerometer is included to record large magnitude events. A GPS receiver provides timing synchronization and self-location of the recording station. A cellular or satellite modem transmits detected event waveform data, event time, and state-of-health information to a central server. Three 4.5 Hz geophone sensors and 3-component MEMS sensors are mounted inside the main system enclosure. With the addition of a suitable connector, any available geophone/seismometer can be used with the system.

The simple user interface consists of 3 LEDs (red, green, yellow) that indicate normal system operation or error conditions. No external equipment is needed for system setup or maintenance.

Figure 1: Sample QuakeMonitor™ Report

Figure 2: System Components

QuakeMonitor™ is designed to record and report earthquakes in real time with magnitudes (M) greater than 0.5. Detection levels down to M 1.5 are achievable when the event is 20kms from the installation. Setup time is less than 1 hour, with no need for special equipment, material, or tools. The system is easily installed at any production or disposal site and it provides information about induced seismicity at a fraction of the cost of equipment and services offered by other geophysical companies. The field systems are very cost effective, and the monthly monitoring and interpretation fees are reasonable. Shorter term rentals are also available with a 3 month minimum period.

QuakeMonitor™ provides a documented history of induced seismicity in the vicinity of fracking or waste disposal sites. This provides the operator with near real-time confirmation (less than 3 minutes) that all provincial, or federal regulatory requirements are being met. Based on the local seismic record, the operator can determine if operations should be modified by changing injection rates or zones, if induced events are related to operations at a specific site, or if they are being caused by activities at some other unrelated operation.

QuakeMonitor™ analyses seismic event data either as a single-station, which gives event magnitude, distance and time; or as a network. Network analysis requires a minimum of 3 stations and provides a catalogue of seismic event locations and magnitudes in the region defined by the network. Independent stations are analyzed on a common time base to provide a catalogue of seismic event distances-from-station and magnitudes for each station.

Single-station analysis is a lower cost approach if injection wells are few and widely spaced, and if the operator is confident that the regulator, or other stakeholders, will be satisfied with local magnitude and time information. Each injection well is equipped with one seismic station and that station provides event distance and local magnitude estimates. The distance estimates are based on the time between P-wave and S-wave arrival, which are robust measurements with few sources of error. However, single-station analysis cannot determine an event location - only how far away it was. In some cases this may be sufficient to assign blame to another party, but it is not necessarily conclusive. This approach provides the operator with a degree of protection against a poorly located earthquake being attributed to their activities, and being forced into a costly shutdown.

The establishment of a network configuration and more detailed analysis can be a more cost effective approach if there are many injection sites in a small area, because monitoring costs may be reduced. However, and much more importantly, network analysis provides a more complete picture of seismicity by providing location and magnitude estimates based on three or more stations. This provides definitive documentation in the event of any regulatory or 3rd party claim or investigation.

Irrespective of which deployment or commercial options are chosen, the QuakeMonitor™ operational support service provides not only technical support and analysis, but also 24/7 system health monitoring.

*SmartSensor® is a registered trademark of Weir-Jones Engineering Consultants Ltd.*