CASE STUDY - ENERGY

Oilfield Life-of-field Microseismic Monitoring

Güralp borehole instruments monitor seismicity in one of the world's largest oil fields

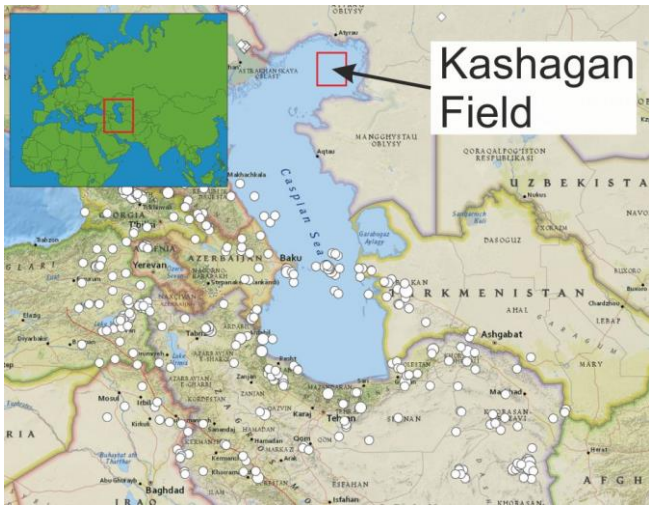
Summary

Güralp was asked by the main operating company of one of the world's largest oil fields to monitor natural seismicity in the region, as well as possible seismic events induced by the production process. Güralp's solution involved the installation of six 3T borehole instruments located on artificial islands, and surface stations along the Caspian coast.

The borehole sensors allow the detection of smaller earthquakes and better determination of hypocentres beneath the Caspian Sea. Güralp monitors the data in real-time and sends regular updates and reports to the operator detailing detected local and regional seismic events.

The network has proved successful in detecting small seismic events in the region of Kashagan Field.

Earthquake monitoring in the Caspian Sea



Map showing the location of Kashagan Field and recorded seismicity (M>4.5; from the USGS catalogue)

Kashagan Field is considered to be the one of world's largest oil discoveries in the last 30 years. It has been estimated that the field will receive a total investment of $136 billion over the life cycle of the field.

The field's operator is the North Caspian Operating Company (NCOC), who are partnered in this project with a number of large multinational companies, including Royal Dutch Shell and Total.

The Caspian Sea is a seismically active region, so NCOC wanted to monitor naturally occurring seismic events and small earthquakes induced by production activities, both of which could impact oil production processes and infrastructure. One of the operator's aims was to validate the resistance of production infrastructure to earthquake shaking by measuring typical ground displacements and accelerations during seismic events.

The client's objective was to implement a seismic monitoring system with a minimum detection threshold of magnitude 0.5—2.5. It was also required that all earthquakes with a magnitude of greater than 2.5 were detected within a 250 km radius of Kashagan Field. However, a network of seismic instruments solely comprising instruments located around the edge of the Caspian Sea is not sufficient to measure small earthquakes occurring beneath the inland sea.

CASE STUDY - ENERGY

Oilfield Life-of-field Microseismic Monitoring

Güralp Solution

In 2013, Güralp was asked by NCOC to supply, install and maintain a borehole seismic network in Kashagan Field. Eleven 3T triaxial borehole digital sensors were installed in dedicated. Six of these station were installed in boreholes along the coastline; the other five were installed in boreholes on manmade islands constructed for producing from Kashagan Field. All instruments were located approximately 100 m below the surface. Each sensor was fixed in place using a dedicated hole lock system.

A completed borehole station on one of the manmade islands in the Caspian Sea

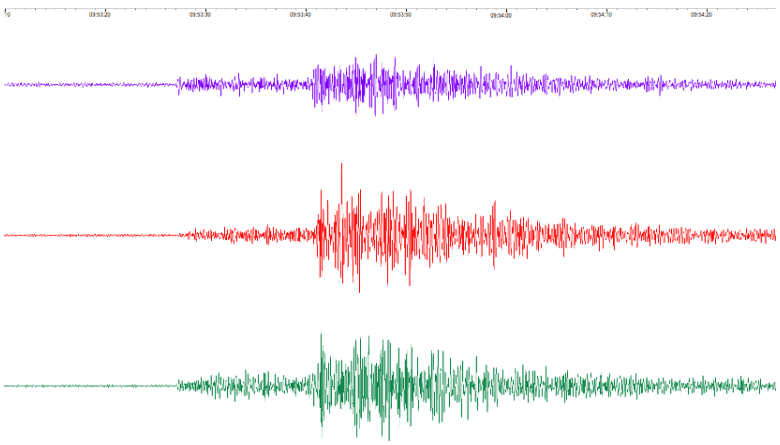
Güralp broadband passive instrumentation delivers information that cannot be obtained using standard seismic equipment. The response of the 3T sensors was set to detect low frequency seismic events down to 0.03 Hz. The instruments were installed in cased boreholes because the coastal zone often floods, potentially leading to damaged equipment. Compared to surface instruments, borehole sensors produce data with very high signal to noise ratio, leading to better quality waveforms.

Güralp provided a full turnkey solution to NCOC, which involved monitoring of seismic activity detected by the network. Recorded data is streamed back to Güralp headquarters in the UK, where the waveforms are processed to determine seismic event locations and magnitudes. Since 2015, Güralp has provided NCOC with regular detailed reports about network's operational status and a description of detected events. Automated daily email alerts are also sent to the client.

Outcome

The installed network has proved vital in the detection and accurate location determination of small earthquakes beneath the Caspian Sea, which would not have been detected by surface stations alone. For example, the network was able to detect a magnitude 2.1 event located some 350 km away from Kashagan Field.

The monitoring network continues to send real time data and Güralp is constantly detecting seismic events.



Recorded 3-component waveforms from a borehole instrument of a local M2.3 earthquake located 80 km away from Kashagan Field.

Güralp Systems Ltd
Midas House, Calleva Park
Aldermaston
Reading RG7 8EA
United Kingdom

T +44 118 981 9056
F +44 118 981 9943
E sales@güralp.com

www.guralp.com