# Seismic Acquisition Experiences in Western Siberia

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## Introduction

Over the last few years the Russian oil industry has attracted a high level of investment from western oil companies. This interest has been driven primarily by the belief that profitability can be improved by applying western technology and western working practices to increase the percentage of oil that can be recovered from the sub-surface reservoirs.

The Russian seismic industry is now being challenged to deliver the seismic foundations that are essential for this increase in production efficiency. This paper summarises the authors experiences of several Russian seismic crews during the 2003-4 winter season.

Because of the obvious physical similarities between the Canadian and Siberian operating environments, some Canadian seismic contractors and sub-contractors could find very significant growth opportunities in Russia if they can master the cultural and political aspects of operating there. The purpose of this paper is to provide some basic information on the current state of Russian seismic.

## Russian Oil and Gas Reserves

The industry's interest in Russia stems from the fact that Russia produces more than 18 million barrels per day of hydrocarbon equivalent (42% oil), more than any other country. It has estimated reserves of 60 billion barrels of oil and 1.7 thousand trillion cubic feet of gas. There are also some 70 billion barrels of oil and one thousand trillion cubic feet believed to be awaiting discovery. So the long-term potential is there in Russia.

## The Siberian Landscape

Whilst seismic operations do take place across large parts of European and Siberian Russia, they are currently concentrated in Western Siberia. Northern Siberia is very similar to northern Canada, consisting predominately of flat, marshy terrain that freezes in winter. In southern Siberia the so-called Sosnovie Bory ("pine strip") forests consist of long, narrow parallel bands of pine and aspen forests that extend for hundreds of kilometres across the steppes.

Throughout Western Siberia there are several significant population centers that are located within existing oil and gas production areas. Within these areas there is extensive oil field infrastructure as well as the usual urban infrastructure.

Within Western Siberia all seismic acquisition work is currently done only during the winter months, and there is no suitable equipment available for summer operations. Given the scale of the hydrocarbon reserves, and the extensive need for modern seismic data (3D, 3C and 4D), the lack of summer operations represents a significant inefficiency to the oil companies.

## Russian Seismic Contractors

### Background

Most Russian seismic contractors originated from two Ministries under the Soviet system – the Ministry of Geology and the Ministry of Oil. The sole exception is PetroAlliance, which originated as a Joint Venture with western service contractors in 1989. The Soviet seismic contractors traditionally operated within clearly defined geographical limits, and worked only for their local oil and gas production companies. The resulting lack of competition has lead to a general lack of cost awareness at the crew level, and to a certain amount of complacency regarding the need for new operating efficiencies.

In the Soviet system, the entire seismic process – from initial survey planning through to the delivery of the final interpreted sub-surface maps – was managed by the seismic contractors in what has been described as a “Contractor Dictatorship”. There was absolutely no interaction with the oil company geologists, neither to define the survey objectives, nor to review the final survey outcome. In effect, the seismic process was a classic “Black Box” process. Some Russian seismic contractors still have a tendency to operate in this fashion.

Most Russian seismic operations are severely under-resourced in terms of both the quality, and the quantity, of their equipment. To an outside observer, the contractor's management philosophy appears to be "The less we spend the more profit we will make".

As a result of this heritage almost every aspect of a Russian seismic operation differs from its western counterpart. Below are some of the key differences.

**Topographic Surveying**
The survey coordinates are, by law, a state secret. Only those seismic crew members with the necessary security clearance are allowed to work with the "real" location coordinates. Everybody else, even the client representative, has to work with either "false" coordinates or, in some cases, with no coordinates at all. Maps typically have neither coordinate labels nor grid lines, and often do not even have a scale bar.

Most of the crews that worked for TNK-BP in the 2003-4 season had no significant in-field mapping capability, and instead worked mostly from paper "pre-plot" maps that had been prepared by their Head Office prior to the crew mobilizing to the survey area.

**Crew Personnel**
The Russian seismic crews must be among the most dedicated and hard working in the world. Typically the crew members work through the entire winter season with no home leave at all. For example, the seismic observers often live in the recording cabin, and can spend the entire working season in the recording fly-camp on the line. The recording cabin is usually heated by a wood-burning stove, on which snow is melted in buckets to provide water for all of the recording crews needs.

The quality of the people is essentially no different to the rest of the world. What is different is the lack of a knowledgeable, results-orientated, management team to coordinate and control the work efforts of the field staff.

**Crew Equipment**
Most of the crew transport is provided by second-hand army vehicles. A wide variety of tracked personnel carriers and even tanks (with their weapons removed) are converted into survey vehicles, drilling platforms and recording line vehicles. However, whilst the army is a cheap source of vehicles, it is not a cost efficient solution since typically at least 25% of the vehicles may be broken down at any one time. Since crews usually do not carry extensive spare parts, some vehicles can be inoperative for weeks or even months.

The accommodation trailers double as offices, workshops, data processing units and GPS base-stations. Some trailers are skid mounted, some are on wheels, and all are designed to be entirely self-contained. They have simple cooking and washing facilities, and most have a wood-burning stove for heating. The advantage in this is that the daily routine remains much the same for the crew no matter where the trailer is parked – be it in the base camp, or in the wilderness.

Whilst modern, western-built, recording electronics have almost totally replaced the Soviet equipment, crews frequently have insufficient channels to operate efficiently and often lack the training that is necessary to use this new equipment to the full. Western-built vibroseis units are also becoming a more common sight, but given the low level of investment in preventative maintenance, their long-term reliability is a concern.

Explosive sources dominate in Western Siberian seismic, with auger drilling being the preferred drilling technique. However, there are no modern shot-hole drilling rigs available and drilling production rates are well below Western Canada standards.

Inertial navigation represents another area where western equipment has yet to penetrate the Russian market. These systems would be very beneficial for reducing environmental impact, increasing crew productivity, and improving the overall data reliability.

**Health, Safety and Environment**
Most contractors appear to lack an effective corporate Safety Management System. Whilst the safety procedures are usually in keeping with Russian standards, and meet the minimum guidelines laid down by Russian law, the crews do not operate to contemporary international HSE standards. In addition, HSE appears to be a low priority for management and few resources

are made available to the crews to improve the overall HSE situation. More advanced safety concepts such as "Near Miss Reporting" and "Risk Analysis" are almost entirely absent.

Running water is usually in very short supply on the base camps, so most crews provide a sauna cabin, instead of shower stalls, for personal hygiene. Normally each crew member will have access to the sauna only once a week, and will usually take that opportunity to also do their personal laundry. The latrines are sometimes no more than holes cut in the floor of an unheated wooden trailer.

There is currently no "Low Impact Seismic" (LIS) capability in Russia. Instead, wide lines are either bull-dozed or cut through the forest to create the necessary access for the conventional surveying crews and the wide crew vehicles. In some cases the converted tanks simply drive straight through the trees. It is important to note, however, that the felled trees provide the crew with wood for heating, without which the entire operation would not be viable.

The introduction of the various LIS equipment and techniques (such as inertial navigation, mulchers and narrow drill rigs) into the Siberian market is another example of how Canadian expertise could make a very significant difference.

**Quality Control**

Historically Russian clients have applied very strict quality control standards to the acquired field shot records based on a measurement of recorded signal-to-noise ratios. This approach resulted in some of the best looking shot records that some of TNK-BP's international QC's had ever seen.

Unfortunately, less thought appears to have been given to other aspects of the quality control process, such as positioning accuracy. For example, on one crew the geophone layout crew had deployed some geophones as much as 25 meters off station, but for the seismic observers that error was irrelevant to their quality control process.

**Crew Evaluations**

TNK-BP used both Russian and international Quality Control Representatives (QC's) on several seismic crews during the 2003-4 season. In order to assess the strengths and weaknesses of the contractors, and to identify realistic ways of improving their performance, both groups of QC's were asked to evaluate the crews using the same evaluation system.

The total crew performance was subdivided into several key components: (a) management – crew and corporate, (b) HSE, (c) technical skills of the staff, (d) working practices, and (e) equipment – field camp, drilling rigs, recording equipment, and office equipment.

On a scoring system where a score of 50% qualified a crew as being "Acceptable" (with 100% as "Excellent"), the Russian QC's gave the crews an average score of 46%, whilst the international QC's gave exactly the same crews an average score of only 26%. One observation that was frequently made by the international QC's was that although all of the crews were performing 3D surveys, their operating practices were often no more than extended 2D procedures.

Another telling difference in perception between the two sets of QC's was in their evaluation of the performance of the seismic contractors Head Office. The Russian QC's scored this at 61%, against only 35% for the international QC's, thereby underlining the close relationship that some of the Russian QC's seem to have with the seismic contractor's management.

**Entering the Russian Seismic Market**

Whenever foreign contractors enter a new market they have to learn to deal with many issues related to that new market. Entering the Russian market is no exception. For example, the seismic survey areas are often remote from support facilities and mobilizing a crew can take many months of pre-planning. Also, as mentioned previously, the real coordinates are a state secret. The customs clearance and work permitting procedures can be very complicated, and neither is made any easier by the language and cultural differences. Finally, the Russian client base is extremely diverse and dynamic - some clients welcome new ideas and new technology, whilst others currently do not.

In addition, Russians are rightly proud of their long tradition of geophysical excellence, and it is important for newcomers to the Russian market to recognize that "west" is not necessarily synonymous with "best".

## Future Steps

In order to deliver the seismic foundations that are necessary for its business, TNK-BP has introduced several changes to its seismic operations, such as:

- Separate tendering for the acquisition, processing, and interpretation phases of its seismic projects.
- Improved acquisition parameters, thereby driving the demand for significant increases both in crew channel counts and in source productivity.
- The introduction of Project Management and international QC crew supervision.
- A HSE policy that is specifically designed for its seismic operations.
- Hiring its first non-Russian seismic acquisition contractor.
- Opening a Dedicated Data Processing Center under a long term contract.

Clearly there is more work to be done, and TNK-BP continues to look for ways to improve the overall cost efficiency of its seismic operations, whilst also meeting international HSE standards.


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### References


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**Auger drilling unit mounted on Russian army vehicle**