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The Badddest

Lured by the money, hooked by the life

ENGINEERING MASTERPIECES

By Gordon Jaremko

From the Andes to Siberia,
Canadian talent is in demand

Talk about tall orders. They go with the turf as the hunt for oil and gas reaches out into harder spots to replace dwindling supplies in the old, easy places.

In South America, a natural-gas route across the Andes Mountains set a world pipeline height record by climbing to 5,032 metres, an elevation much closer in scale to the 6,195-metre highest point in North America on top of Mount McKinley than the 1,330-metre summit of Rogers Pass through the Canadian Rockies. Offshore of eastern Siberia in the frigid Sea of Okhotsk, tapping a rich new oilfield took equipment capable of withstanding pack ice, 10-metre waves and earthquakes. In northeastern Alberta, harnessing new "in-situ" underground extraction technology in the oilsands requires fitting in with supersonic military aircraft, abundant wildlife, native sacred trails and rising anxiety about water quality.

Sponsors of the tricky projects knew where to turn for talent to execute them. Tall orders went to professional houses that have matured with western Canadian resource industries into a collective powerhouse in engineering and project management. The mountain pipeline, cold-ocean production platform and touchy oilsands venture were among accomplishments recognized in the 2001 Showcase Awards granted by the Consulting Engineers of Alberta. The annual event highlighted a wide range of capabilities in a professional community with a global clientele.



Molikpaq earns keep in Sea of Okhotsk

WAVES, EARTHQUAKES, ICE AND CHAMPAGNE

In eastern Siberia, the reception was friendly to the point of enthusiastic when Canadian talent and technology was recruited by Sakhalin Energy Investment Co., an international consortium originally led by Marathon Oil Co. that now has Royal Dutch Shell in the driver's seat. Four Russian women – Yana, Julia, Olga and Tatyana – dressed as brides for a christening ceremony where they broke 12 bottles of champagne on four hulls. The floating pieces were towed to another site near Vladivostok for assembly into a rectangular base called the Spacer. It supports an oil production platform stationed 16 kilometres offshore of Sakhalin Island in the frigid Sea of Okhotsk at a site called Piltun-Astrokhoye, a short tanker trip

from Japan, Korea and China. At the shipyard, at Komsomolsk-n-Amure on the Amur River, workers got the job done a month early. They raced to earn salaries that became legendary across the Russian Far East: 18 million rubles per month, or about US\$3,000. The project revived a yard originally built in 1932 on the orders of Joseph Stalin to fabricate ships, then submarines by the hundreds during the Second World War.

The occasion was no less happy on the Canadian side. The project represented vindication for innovations made in the 1980s in the Beaufort Sea. For the production platform, Sakhalin

Energy bought and converted Molikpaq, one of two giant drilling platforms built for Gulf Canada Resources Ltd.'s former Beaudril exploration armada. After finding oil and gas, but not enough to justify production to this day, the ice- and cold-proof fleet was put up for sale.

At the engineering house that crafted the conversion, Kohn Crippen Consultants Ltd., Alberta manager Brian Rogers worked on the Molikpaq for Gulf. He says "it's really good" to see Molikpaq put to use. "I've worked on this since '83." That was soon after the Briton moved to Canada following the start of his engineering career in irrigation dams, including a stint in Iraq.

In the Beaufort, Molikpaq served as a roving, 30,000-tonne drilling rig. It travelled as a floating steel square that was towed to drilling sites by ice-strengthened ships. It parked by filling itself with ▶

water to settle down on berms or sculpted hills made by dredging up the sandy, shallow bottom of the Beaufort. The idea was to be anchored securely enough to stay on station year-round, by shouldering aside massive floating fields of pack ice that stay in constant motion through the Arctic winter.

Molikpaq adapted well to the Sea of Okhotsk, where the ice is less formidable. It melts every year, with no counterpart to the Beaufort pattern of floes thickening and hardening in polar regions over many winters then drifting south. To avoid being swept by 10-metre waves that fierce Siberian winds drive across the open water in the Russian sea, shields were added to the structure. The biggest change resulted from deeper water offshore of Sakhalin Island and a high risk of earthquakes in the region. Enter the Spacer, with help from another veteran of the Beaufort drilling campaigns, icebreaker designer Ben Johansson and his Calgary consulting house, Visions & Polar Innovations.

Welded into a square as much as 110 metres long per side, the four hulls of the Spacer sit under the original Molikpaq. The platform still floats for towing, then settles down at its work site by filling the hulls with water. The added height enables the structure to operate in water 30 metres deep. Kohn Crippen showed Sakhalin Energy how to anchor the platform by filling the new ring-shaped base with 300,000 tonnes of clean sand and gravel dredged from the seabed. To make sure no ice or earthquakes can shake the enlarged



Brian Rogers

Molikpaq loose, the filling is "densified" setting off explosive charges that make it settle into a compact mass.

The technology remains "very applicable to any of the Canadian Beaufort," Rogers says. "The lessons we learned in the Beaufort certainly helped on Sakhalin." Watch for the Canadian know-how demonstrated by the project to spread. In the Sea of Okhotsk, Molikpaq was drafted as an exercise in achieving early production from a true giant among global oilfields. "The lessons we learned here will help with the next phase of full-scale development. A number of companies want to develop the fields," Rogers reports.

EXTREME PIPELINING

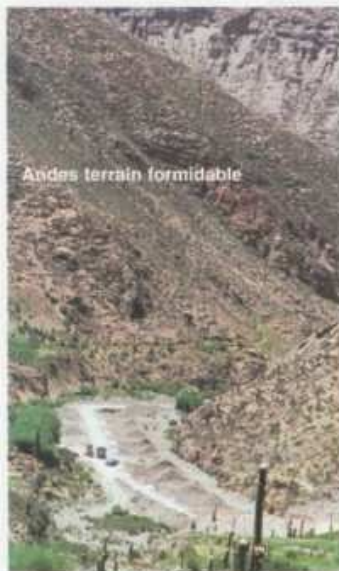
In the Andes, the height of the GasAtacama pipeline between northern Argentina and Chile made an impression on even a fit cyclist accustomed to exercise at Calgary's 1,000-metre elevation and in nearby foothills taller than Rogers Pass. Reports Wil Veldman, president of Hydroconsult EN3 Services Ltd.: "Even at 4,000 metres," or five Calgary Towers-worth of height below the project's summit, "when you're walking around you feel it. I had people get sick their first time up if they went up quickly. I use a tape recorder to keep notes. When I listened later to transcribe them, I could tell I was talking differently. I was speaking more slowly."

While Hydroconsult only has a staff of six, it has earned an international clientele in its specialty of working in, under and beside rivers. The EN3 in the company's name stands for the triple repetition of the two letters in its motto: engineering environmental enhancement. Raised on a

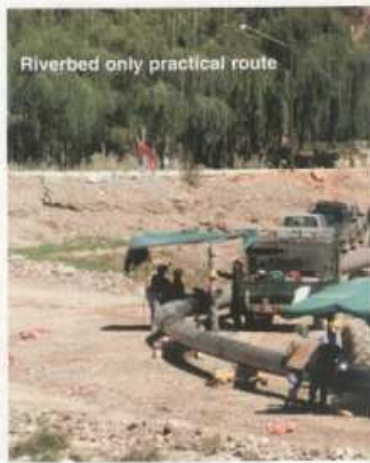
southern Manitoba farm, Veldman cut his professional teeth as a civil engineer with graduate training in water resources on hydroelectric dams. He entered the petroleum industry by working in 1973-76 on construction of TAPS, the Trans Alaska Pipeline System that connected the Prudhoe Bay oil discoveries to markets. Hydroconsult continues to serve in Alaska, on a team doing an Environmental Impact Assessment needed to extend the life of the TAPS right-of-way agreement with state authorities beyond the 30-year term of the original land grant when it expires in 2004. Veldman's outfit is also in a long lineup of professional firms forming in western Canada and Alaska to lay out proposed Arctic gas pipelines.

The Andes assignment arrived courtesy of a contact made in Alaska, at engineering giant Fluor Daniel Williams Bros. in Tulsa, Oklahoma. Hydroconsult entered the picture because the project — a 940-kilometre stretch of 24-inch-diameter pipe between gas fields in northern Argentina and customers on the fringes of Chile's Atacama Desert — had to cope with more than high elevation.

The Andes are so rugged that the only ways through are often along rivers in steep-sided gorges. The channels fill up with violent, bottom-scouring torrents during rainy seasons and dry up to wide beds of big gravel in between. Temperatures range from the stifling +30°C in summer at 100 metres above sea level at the inlet to the line on the northern plains of Argentina to the -20°C on the windy heights of the mountains. The human environment is also challenging. The communities are poor. There is uncontrolled mining of the river beds for



Andes terrain formidable



Riverbed only practical route



Wim Veldman

construction materials. Squatters perch on any even slightly accommodating structures. Every flat spot is intensively cultivated and irrigated for food.

Hydroconsult devised a route that included 23,000 metres of "midstream alignment." The pipeline was laid under the rivers, deep enough to escape the scouring forces of wet-season runoff, and protected by 23 kilometres of gabions or mammoth mats made of heavy rock held together by chicken wire-like steel nets.

During construction, local irrigation systems were kept going with pumps. "If I had it to do again, I'd get the local and provincial people more involved," Veldman says. Although the project had full approval by national authorities, residents along the route did not hesitate to call local police if they had any grievances – and the calls got results.



ADVANCING ENVIRONMENTAL DESIGN

Far from all the action is in the international arena. Canadian oilfields remain breeding grounds of talent, technology and industrial management. At the Calgary office of EBA Engineering Consultants Ltd., project director Ross Huddleston is only a day's drive from the scene of a five-year effort in advancing an art becoming a critical element of large-scale development everywhere – the EIA, or environmental impact assessment.

The firm is a barometer of the rising requirements and complexity of the EIA. Born 35 years ago as a specialist in geotechnical and cold-regions engineering, EBA was drawn into the newer field as a byproduct of work on converting industrial sites such as rail yards and gravel mines into residential neighbourhoods. Since 1990, the number of EBA professional staff dedicated full-time to environmental has multiplied more than five-fold to 110 from 20. About 80% of the personnel in the firm's principal offices in Edmonton, Calgary and Vancouver work on environmental matters.

In the petroleum industry, Huddleston and EBA carried out the environmental work for Alberta Energy Co.'s pioneering oilsands development with a new approach known as SAGD, or steam-assisted gravity drainage. Compared to strip-mining, the method stands out as a green way to exploit the resource. By separating the oil from the sand beneath the ground with pairs of heat-injection and production wells, the system avoids the huge machinery, vast open pits and lake-sized waste-water or "tailings" ponds that result from the older approach of surface mining and processing.

SAGD does not, however, spell easy from an environmental point of view. Nothing does in a province that has come to expect its resource wealth to be exploited with squeaky-clean methods. When AEC launched its Foster Creek Commercial Thermal Recovery Project in 1996, the timing coincided with refinement of EIAs into must-have, thorough surveys and controls covering both the physical and human environments of industrial projects. AEC's location, on the Cold Lake Air Weapons Range near the boundary between northern Alberta and Saskatchewan, also made the project an extreme case in another necessity for industry – getting along with other land users.

While the province owns the property and its resources, it leases out the surface



Ross Huddleston

as an air force training and proving ground. From biologists and pilots of survey aircraft to drilling and road contractors, civilians gain entry by obtaining written military permission. So long as they obey permits to the letter, fighter pilots resist temptation to "light up" their operations with targeting systems or buzz them with heart-stopping sonic booms.

Even in this no-man's land, policies on permanent industrial damage are headed for zero tolerance. To do AEC's Foster Creek EIA, Huddleston and EBA fielded six subcontractors in specialties such as fish, wildlife, air quality, historical and native resources, and hydro-geology. The art included government-relations skills to stay ahead of evolving requirements and keep the attention of official agencies as other companies stepped forward with seven more SAGD projects. There had to be pioneering technical work on the effects of massive heat injections, which cause heavy elements to dissolve in underground water layers or aquifers. The problem at Foster Creek is arsenic. EBA devised computer projections showing that the poison should cool, solidify and precipitate back out of the water before it can do any harm. Next comes monitoring environmental effects to make sure they stay under control for the lifespan of the project.

Like medicare, clean environmental bills of health do not come cheaply. Huddleston gives industrialists blunt advice about EIAs. "These are multimillion-dollar projects," he says. "You seldom realize how much has to be done or how long it will take. This is the earth we're talking about. There are always a tremendous amount of variations." ■