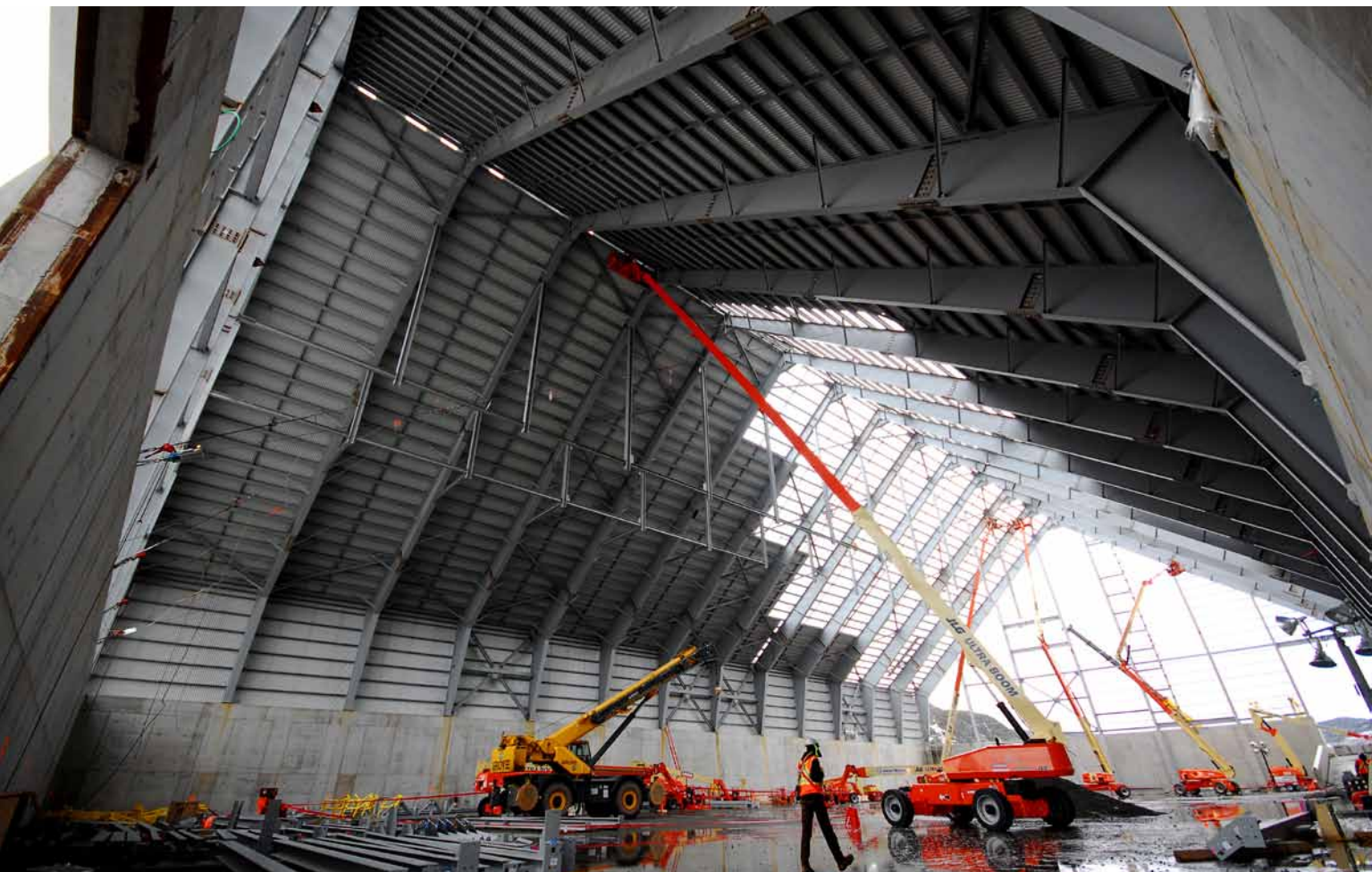


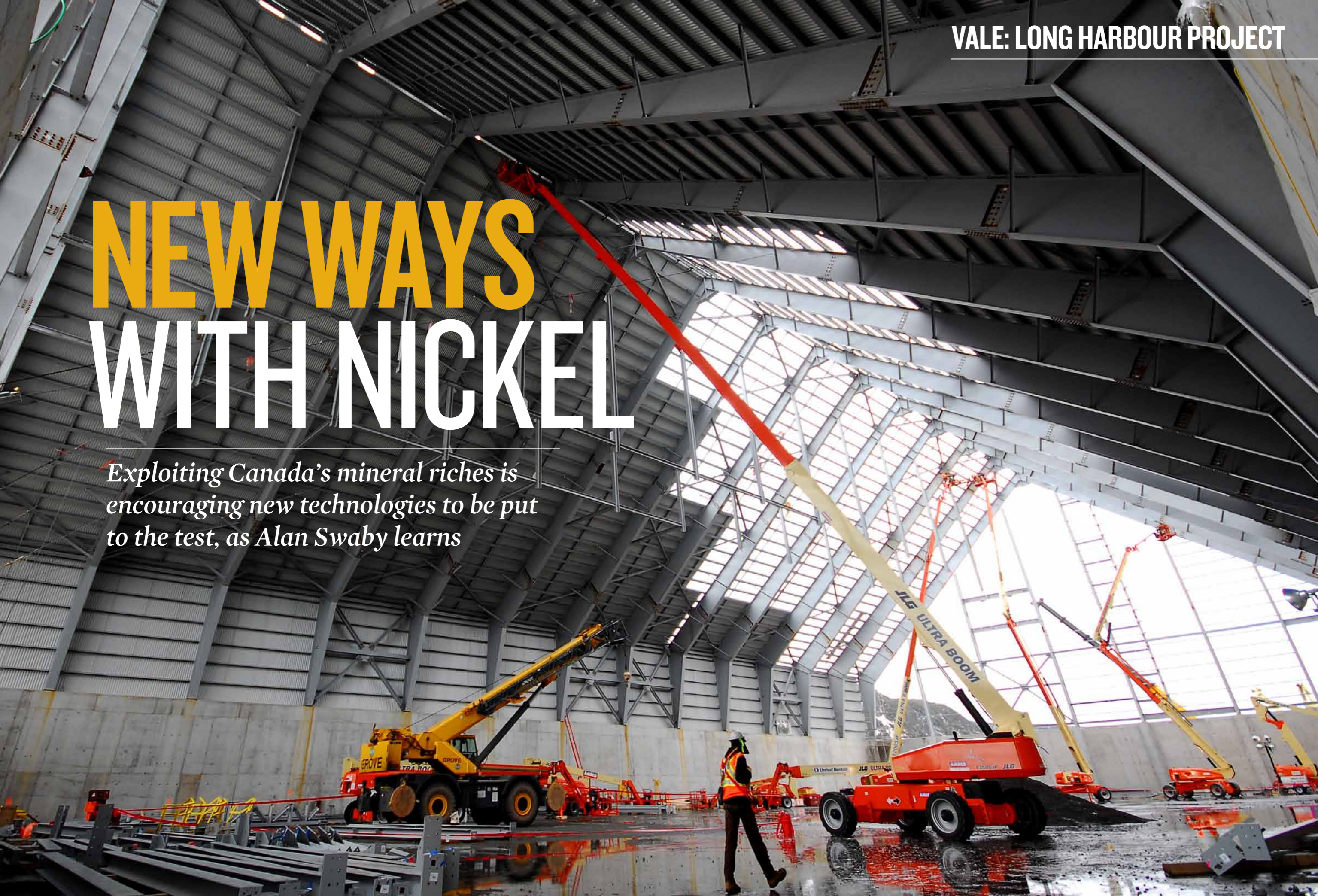
# VALE: LONG HARBOUR PROJECT

## NEW WAYS WITH NICKEL



# NEW WAYS WITH NICKEL

*Exploiting Canada's mineral riches is encouraging new technologies to be put to the test, as Alan Swaby learns*



There are two things an ambitious engineer wants to see on his CV: big projects and ground breaking technology. For those lucky enough to be working for Vale on the Long Harbour project in Newfoundland, they will have both.

Formed in 1942 as a publicly listed but government-owned engineering concern, Vale has played a major part in Brazil's development, primarily – but not exclusively – through iron ore mining.

At the time of privatization in 1997, Vale had a limited global presence. Its 11,000 strong workforce was confined to operations in Brazil and the United States, along with a handful of offices in the Far East and London. Now, however, it's the world's second largest mining company after BHP Billiton. There isn't a corner of the globe where minerals are to be found that doesn't feature Vale, and the workforce has grown over ten times to 120,000 in over 30 different countries.

Vale's interests have diversified and today it holds the distinction of being the second largest nickel producer anywhere; a situation that came about largely through the acquisition of one of Canada's largest mining companies, Inco, in 2006. Canada is particularly rich in nickel. Around 30 percent of the world's needs are met by Sudbury, Ontario, where nickel has been mined for over 100 years. One theory is that the nickel in the ground rose to the



Early construction on the main access road to the Long Harbour Processing Plant site

# Door to door delivery — quicker than you think.



- With more than 200 trips annually, Oceanex meets your JUST IN TIME transportation needs
- Transit time as little as 4 days from Central Canada to Newfoundland
- From Halifax to St. John's in just 30 hours
- Shipments from ANYWHERE in North America
- Marine transport – the most environmentally friendly mode of transportation
- A fixed weekly schedule means no delays; our on-time performance speaks for itself, better than 99% in 2011

St. John's: (709) 722-6280 • Corner Brook: (709) 634-2079 • Halifax: (902) 429-9201  
Montréal: (514) 875-9244 • Toronto: (289) 291-4030 • Bookings: (888) 875-9595  
[www.oceanex.com](http://www.oceanex.com)

## VALE: LONG HARBOUR PROJECT

surface following a meteorite impact in the area, early in the earth's geological history.

Compared with the millions of tons of iron ore that are extracted annually, the production of nickel is on a much more modest scale. Vale, for example, accounts for about 250,000 tons, destined for the metallurgical sector where its properties of resistance to corrosion and ductility are used in the formulation of stainless steel and other alloys.

Whether brought to surface by meteorites or not, nickel occurs most often in combination with sulfur and iron. There are several ways of extracting the nickel depending on the exact composition of the mineral bearing rock but until recently, they all involved smelting and used considerable amounts of energy to reach sufficiently high temperatures to release the nickel.

### OCEANEX

Oceanex offers a complete range of shipping and trucking services to Newfoundland and Labrador from anywhere in North America and sets the pace in safety, service efficiency and reliability. Over the past 100 years, shippers have come to rely upon Oceanex's fixed-day schedules, on-time performance and dependable, quality service. As well as providing transportation services, Oceanex is active in the Newfoundland offshore industry. Adding to its fleet of over 2,500 containers and three vessels, Oceanex recently announced an investment of more than \$100 million for the construction of a custom designed ice-class Ro/Ro vessel – the largest of its kind in Canada. It's full speed ahead at Oceanex!

[www.oceanex.com](http://www.oceanex.com)

# 250,000 TONS

.....  
Vale's annual production of nickel



Workers installing temporary power

# Is your system safe or are you just lucky?



## Oxygen Hazards & Fire Risk Analysis

The OHFRA process is a tool to provide effective fire risk evaluation and mitigation.

OHFRA is consistent with evaluation methods prescribed by CGA, EIGA, ASTM, ISO, NFPA, and NASA.

## Piping Systems Audit

Review of oxygen and hydrogen systems, from construction and commissioning to sustained operations.

Find out more at our website.

## Simplifying Oxygen Safety

### Safety Training

For design engineers, safety managers, and operations and maintenance personnel

### Oxygen Clean Inspection Kits

Tools to assess oxygen system cleanliness



“NICKEL WAS FOUND AT VOISEY’S BAY IN 1993 AND IT IS VIEWED AS ONE OF THE MOST IMPORTANT NICKEL-COPPER-COBALT DISCOVERIES OF RECENT TIMES”



Module being off-loaded at the Long Harbour Port site

Vale’s most recent nickel venture is located at Voisey’s Bay in the Canadian province of Newfoundland and Labrador. Voisey’s Bay is on the north coast of Labrador and 1,200km away from the provincial capital of St John’s on the island of Newfoundland.

“Nickel was found there in 1993,” explains corporate affairs manager Bob Carter, “and it is viewed as one of the most important nickel-copper-cobalt discoveries of recent times. It has been estimated that there may be as much as 60 million tons of resource contained in near surface and underground deposits.

We currently have a mining plan based on the near surface reserves which has a working life of 15 years.”

The mine processes up to 6,800 tons of ore a day from which it produces nickel and copper concentrates. The copper concentrate is sold into the market and the nickel concentrate is shipped to Vale’s operations in Sudbury,

## WENDELL HULL & ASSOCIATES, INC.

WHA supports industrial companies in designing, assessing and mitigating fire risks for oxygen, hydrogen and other gaseous systems and components. Our engineers have extensive forensic and testing experience that informs their hazard assessments. They actively participate in the development of standard methods for oxygen system design, materials selection, oxygen cleaning, and oxygen compatibility testing of materials and components. We also provide oxygen and hydrogen safety training for personnel at our facility, customized on-site training and computerized eTraining. WHA is proud to be a major contributor to the success at Vale.

[www.wendellhull.com](http://www.wendellhull.com)

Wendell Hull & Associates, Inc.

T 575-523-5623 | E [wha@wendellhull.com](mailto:wha@wendellhull.com) | [www.WendellHull.com](http://www.WendellHull.com)

## Sustainable Water & Wastewater Technologies for Every Industrial Project

Veolia Water Solutions & Technologies Canada offers robust, dependable, tailor-made leading edge technologies that meet the strictest discharge limits.

For process water treatment, effluent treatment, resource recovery and water recycling, Veolia Water Solutions & Technologies is the global leader in providing innovative and proprietary solutions to industries.

[salescanada@veoliawater.com](mailto:salescanada@veoliawater.com)  
[www.veoliawaterst.ca](http://www.veoliawaterst.ca)

Proud supplier of both the raw water treatment and the effluent treatment plants at Vale's Long Harbour Nickel Processing Facility



Solutions & Technologies

Ontario and Thompson, Manitoba for further processing. Vale ships the nickel concentrate on a purpose built Arctic-class bulk carrier especially strengthened to break through the sea ice that builds up in the waters around Voisey's Bay.

An integral part of Vale's agreement with the Government of Newfoundland and Labrador requires that processing be done within the province. The question then, is what form of processing?

The answer is to be found at Long Harbour, 100km overland from St John's, on the Avalon Peninsula. "Vale's R&D engineers had been looking for a more efficient processing technique for nickel since the late 1990s," says Don Stevens, general manager of the Long Harbour project. "They decided to take a fresh look at hydrometallurgy – a well-established process that uses water based chemicals to extract metals from

### VEOLIA WATER SOLUTIONS & TECHNOLOGIES CANADA INC.

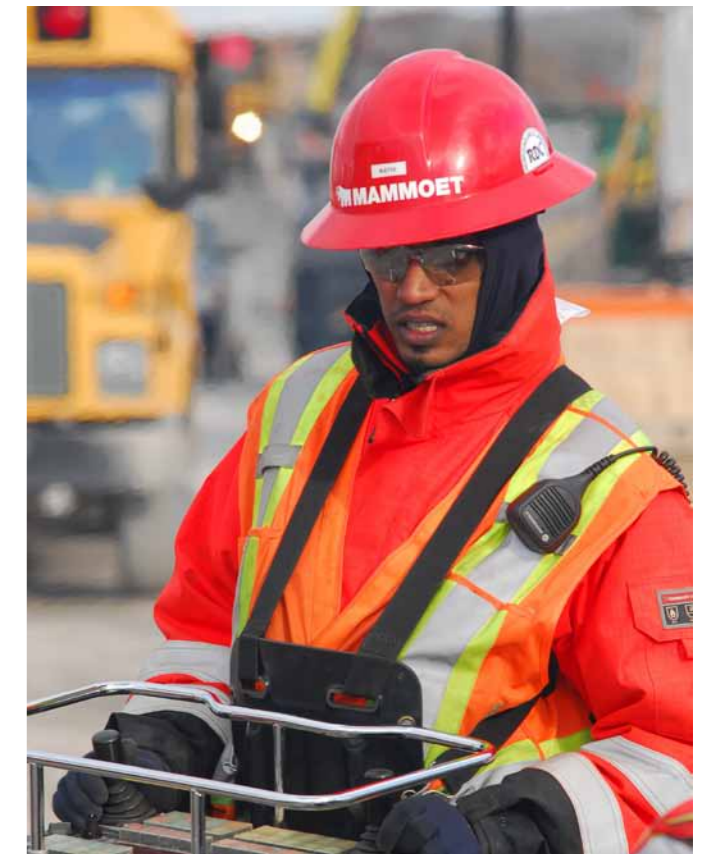
Following performance testing of its ACTIFLO® treatment technology at Vale's 1:100 scale demonstration plant, Veolia Water Solutions & Technologies Canada (Veolia) was contracted by Vale to design, supply, manufacture, test and start-up the complete effluent treatment package for the Long Harbour facility's process effluent prior to discharge into the environment. Veolia also provided a raw water treatment plant that provides clean process and potable water for the Vale complex.

Veolia has served Canadian industries and municipalities since 1948. We offer a wide range of technologies and services, allowing us to create tailor-made solutions for our customers' water, wastewater and biosolids treatment needs.

[www.veoliawaterst.ca](http://www.veoliawaterst.ca)

# 50

.....  
Number of years hydrometallurgy has been used to extract metals from minerals



Mammoet employee operating a self-propelled modular transporter (SPMT)



**Wharf Conveyor Supplied to Antamina Peru**  
(A photo of the Vale Long Harbor conveyor will be placed here after it is erected)



**Industrial Equipment Manufacturing Ltd. (IEM)** was privileged to supply Vale with a wharf conveyor for delivery of concentrate and limestone. We also supplied a tripper conveyor and a large luffing stacker conveyor for outdoor storage of limestone, as well as two belt feeders and seven process conveyors.

Although IEM has a firm bid contract, and is the responsible party, the job is in many ways a co-operative venture with The Vale Co., Fluor Engineers (the overall designers and project managers), Worley Parsons-Westmar (the dock expert engineers), CWA Engineering, (who helped with the conveyor design), Metal World of Newfoundland and IEM in Surrey, BC.

[www.iem.ca](http://www.iem.ca)

## It wouldn't have been possible without a good air quality

We are leaders in environmental engineering, delivering quality and innovating technological solutions to solve air pollution issues of industrial and mining processes.

Our strength is focused on mitigation and control of dust and gas emissions from industrial production processes, also developing a unique technology that helps to improve the air conditions in electrowinning tankhouses, fully complying with the highest standards in health, security and environmental.



📍 **CORPORATE OFFICE:**  
Avda. Holanda 3857, Nuñoa, Santiago, Chile.  
☎ Phone: (56-2) 591 5000 / Fax: (56-2) 591 5090

📍 **INDUSTRIAL DIVISION, SANTIAGO:**  
Hnos. Carrera, Sitio 164, Loteo Industrial Los Libertadores, Carretera San Martín 16.500, Colina, Santiago, Chile.  
☎ Phone: (56-2) 591 5020 / Fax: (56-2) 591 5040

📍 **INDUSTRIAL DIVISION, ANTOFAGASTA:**  
General Borgoño 934, of. 901, Edificio Las Empresas, Antofagasta, Chile.  
☎ Phone: (56-2) 591 5080 / Fax: (56-2) 591 5099



minerals. It's a technique that has been used for 50 years but has never been applied to sulfide bearing rocks."

Rather than look for something entirely different, the approach was to use proven hydrometallurgical methods but link them up in a novel way. As well as requiring less energy input, hydromet has a major environmental advantage over smelting since most of the waste products from the process are not produced as air emissions, but rather as solids, which can easily be contained.

In conventional pyro-metallurgical smelting, sulfides are burnt off, creating SO<sub>2</sub> gas, which is released as air emissions. With hydromet, there are no air emissions. The sulfides are transformed into elemental sulfur, which together with iron oxide form solid tailings. The tailings will also contain gypsum and unleached rock minerals and they

### INDUSTRIAL EQUIPMENT MANUFACTURING LTD. (IEM)

IEM was privileged to supply Vale with a wharf conveyor for delivery of concentrate and limestone. We also supplied a tripper conveyor and a large luffing stacker conveyor for outdoor storage of limestone, as well as two belt feeders and seven process conveyors.

Although IEM has a firm bid contract, and is the responsible party, the job is in many ways a co-operative venture with The Vale Co., Fluor Engineers (the overall designers and project managers), Worley Parsons-Westmar (the dock expert engineers), CWA Engineering, (who helped with the conveyor design), Metal World of Newfoundland and IEM in Surrey, BC.  
[www.iem.ca](http://www.iem.ca)



Main processing plant site

### SAME LTDA

SAME Ltda, a specialized company in mining ventilation projects, will provide its Acid Mist Capture & Abatement System for Long Harbour Processing Plant of Vale Newfoundland & Labrador Limited.

The project is entering its completion stage and our mutual commitment of controlling the contaminants inside the EW Tankhouse will be achieved with the highest standards. SAME is involved in finding the best solutions for air pollutants control and glad to give full support to Vale not only in this project, but on future ones as well.

[www.same.cl](http://www.same.cl)

# 1997

Year of privatization



**Xmetech**

**Excellence in Equipment Supply  
For the Vale Long Harbor Plant Project**

Armed with over thirty five years of industry experience under Korea Zinc Group, and the foremost latest technologies for the nonferrous metals industry, Xmetech Corporation is a reputed international leader that can be trusted to bring out your company's utmost potential, particularly for, but not limited to:

**EPCM SERVICES IN NONFERROUS METALS INDUSTRY**

- Engineering
- Procurement
- Construction Management

**EQUIPMENT SUPPLY (FABRICATION)**

- Storage Tanks  
(Carbon Steel / Rubber Lining / Plaste Coating)
- Flash Vessels
- Pressure Vessels
- Heat Exchangers

3F, Starwood Plaza, 5439-1, Sangdaewon 2-dong, Joongwon-gu, Seongnam, Gyeonggi-do, South Korea, 462-819.  
Contact Number: +82-31-737-0620 Website: [www.xmetech.com](http://www.xmetech.com)



Show the world  
what your company  
has to offer with our  
tailored packages

**BE Seen**

[www.bus-ex.com](http://www.bus-ex.com)

**XMETECH CORPORATION**

Xmetech Corporation, an EPCM services provider in the nonferrous metals industry based in South Korea, has been working together with Fluor Corporation to provide equipment for the Vale Long Harbour Project in Canada. Through years of industry knowhow and experience, Xmetech was tasked with supplying 49 fabricated large tanks, with rubber lining or special coating included. Pressure vessels were also supplied, including flash vessels for autoclave. Despite the size and time constraints, Xmetech showed great flexibility and ability in successfully sourcing the tanks using markedly efficient and professional methods.

[www.xmetech.com](http://www.xmetech.com)



Aerial view

are eventually neutralized to form a stable residue.

After several years of lab work, the R&D team put the concept forward together with estimates for a mini-pilot plant in Ontario that would take the bench research to a 1:10,000 scale. The next step was to build a demonstration plant at Argentia (close to Long Harbour) using actual Voisey's Bay concentrate,

to allow for fine-tuning and optimization of the process. Construction of the 1:100 demonstration plant began in 2004 and the plant ran until 2008.

By then, the \$200 million R&D program had been deemed a success and approval was given to build the Long Harbour installation. This time, though, the price tag would be US\$3.6 billion and require a 700 strong army of engineers just to complete the design details.

“Under the terms of our arrangement with the provincial government,” says Rinaldo Stefan, project director for the construction of Long Harbour,

“WE ARE OBLIGED TO HAVE A PROCESSING PLANT IN OPERATION BY 2013 AND WE ARE ON TRACK TO MEET THAT DEADLINE”





**efficient. reliable.  
environmentally friendly.**



**MULTISAFE Double Hose-Diaphragm Pump**

Innovative pump technology for the mining and metallurgical industries. Highest reliability and availability for flow rates from 0.05 to 1000 m<sup>3</sup>/h and pressures from 6 to 400 bar.

Excellent energy efficiency with overall diagnostics and web-based service option.

 Engineered and Made in Germany

FELUWA Pumpen GmbH | Germany | 54570 Mürtenbach | Phone +49 (0) 6594.10-0 | Fax +49 (0) 6594.10-200 | [www.feluwa.com](http://www.feluwa.com) | [info@feluwa.de](mailto:info@feluwa.de)

“we are obliged to have a processing plant in operation by 2013 and we are on track to meet that deadline. There are just loose ends to be tied up with the engineering and most of the civil work is complete which means construction is about 50 percent complete.”

**FELUWA PUMPEN**

In metallurgical plants, FELUWA MULTISAFE double hose-diaphragm pumps are successfully applied for high and low pressure duties, such as autoclave feeding, sulfuric acid, thickener underflow, choke water, seal water make-up, mine dewatering or tailings disposal.

If mining and processing is done at different sites, the slurry is additionally pumped from the mine site to the processing plant through slurry pipelines.

[www.feluwa.com](http://www.feluwa.com)

The entire site comprises two distinct parts: the port facilities where nickel concentrate from Voisey’s Bay will be received and 3km inland, the processing plant itself which has a footprint of 1km x 750m. “At the height of construction,” says Stefan, “we have a workforce of 3,500 working on the site or preparing material at other locations. Fortunately, as many of our people are coming from or staying in St. John’s – about a 1 to 1.5 hour commute – the site itself ‘only’ has to accommodate 1,000 of them.”

As Newfoundland is an island on the edge of the Atlantic and at the mouth of the Gulf of St Lawrence, everything for the project has to get there by sea. Modules measuring as much as 30m x 20m and weighing up to 350 tons are



Tank being transported to the processing plant site


“AT THE HEIGHT OF CONSTRUCTION WE HAVE A WORKFORCE OF 3,500 WORKING ON THE SITE OR PREPARING MATERIAL AT OTHER LOCATIONS”




North Atlantic employees make and market some of the cleanest fuels in the world, and each year we contribute \$160 million to the provincial economy and give \$400,000 to local charities and direct community support. North Atlantic is your responsible neighbour.




Visit us at: [northatlantic.ca](http://northatlantic.ca)



**YOUR PRODUCTION IS OUR BUSINESS**



Distributor of power and hand tools, compressed air products, test and measurement equipment, wood and metal working machinery, construction and industrial products and more.

St. John's, NL  
T: 877-898-5360  
E: [info@rideouttool.com](mailto:info@rideouttool.com)

Corner Brook, NL  
T: 866-634-3294  
E: [cnbr@rideouttool.com](mailto:cnbr@rideouttool.com)

Dartmouth, NS  
T: 877-577-9943  
E: [nsinfo@rideouttool.com](mailto:nsinfo@rideouttool.com)

[www.rideouttool.com](http://www.rideouttool.com)



**CORNER SYSTEMS**

**G Corner design and manufacture DC Bus Bar systems for electro-refining and electro-winning tank houses recovering metals including Copper, Nickel, Zinc, Cobalt and Manganese.**

**G Corner also supplies the individual elements of DC Bus Bar systems for plant refurbishment programmes, including:**

- Intercell and Endcell Busbars
- Busbar System Flexibles
- Main Trunk Busbars
- Shorting Frames for electrowinning refineries
- High Current DC Switches
- Consultancy, Design, Manufacturing, Installation and Commissioning Services

**Telephone:**  
+44 (0)161 703 2250

**Email:** [enquiries@gcorner.co.uk](mailto:enquiries@gcorner.co.uk)

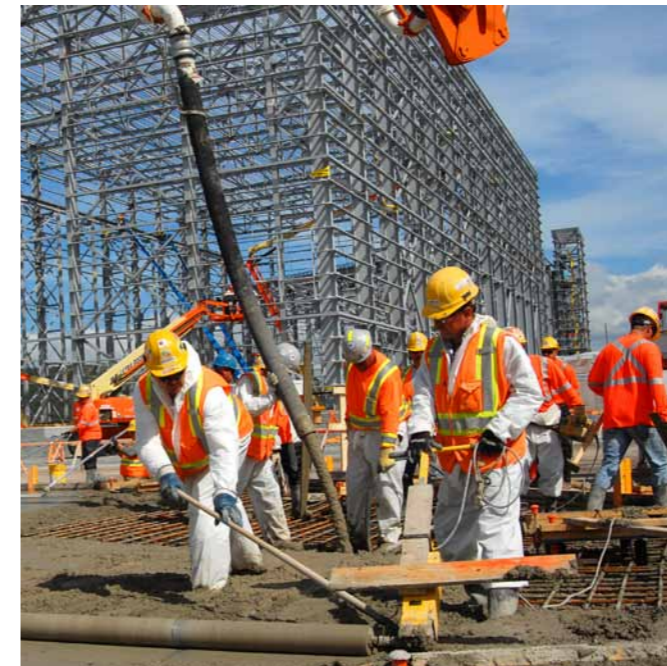
[www.gcorner.co.uk](http://www.gcorner.co.uk)

**G CORNER**

G Corner is proud to have an excellent track record supporting Vale in their projects around the world, and the Long Harbour project has further strengthened this relationship. The busbar equipment supplied to Vale for the Long Harbour project was successfully produced to an extremely high standard within very strict tolerance limits and underwent an extensive inspection regime. Working with Vale on the Long Harbour project has reinforced the production capabilities of G Corner as a leading global supplier of DC busbar systems.

[www.gcorner.co.uk](http://www.gcorner.co.uk)

being pre-assembled at offsite module fabrication yards and shipped to Long Harbour by sea. It's a pretty aggressive schedule that the logistics teams have set. In April, for example, 12 module deliveries are expected but schedules can easily be disrupted by unpredictable weather like gale force winds that can blow for up to a week.



Preparing concrete floor slab for the Long Harbour processing plant

Although the site seems large, it will in fact be completely filled by 16 different buildings and miles of connecting piping, so there is precious little spare space available there for storing material. Fortunately, within a short distance there is a former naval base which is being used as a transshipment and storage center.


“Although the individual processing steps used in the technology are proven,” says Stevens, “the flowsheet on the whole is novel, very complex and involves around 5,000 key components. Therefore, the planning and logistics and the systems employed to control the flow of information and materials

“THERE IS SUCH A LOT OF WORK OUT THERE, THAT CONTRACTORS ARE BEING PICKY ABOUT WHAT THEY BID FOR”

**VERSATILITY THROUGH EXPERIENCE:**

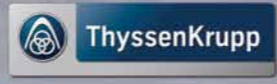
As the world leader in the design and construction of lime kilns, Maerz Ofenbau joined the Polysius Group in 2006. This partnership combines the engineering excellence and longstanding experience of Maerz in the lime industry with the know-how Polysius has earned through the design and supply of equipment and turnkey plants to the cement industry. We are the solutions source for grinding, pyroprocessing, materials handling, automation and services. We put our expertise to work for you whether your needs include a new plant, conversion or optimization.

[www.PolysiusUSA.com](http://www.PolysiusUSA.com)



**POLYSIUS CORP.**  
180 Interstate North, Suite 300  
Atlanta, Georgia 30339-2194, USA  
[www.PolysiusUSA.com](http://www.PolysiusUSA.com)  
Contact: Holger Plath  
Email: [plathh@polysius.com](mailto:plathh@polysius.com)  
Phone: +1.770.980.5047

ThyssenKrupp Polysius



**LIMPACT INTERNATIONAL LIMITED** - Forming a **BOND** with our customers.  
Your partner in the non-ferrous metal industry  
Process Equipment, Manufacture, Supply,  
Site Installation and Commissioning.

**COPPER, ZINC, NICKEL, COBALT**

- Explosion Bonded Permanent Cathodes, Mandrels and Mother Blanks
- Cathode Stripping Machines
- Electrode Refurbishment Programs
- Automatic Overhead Cranes
- Automatic Casting Systems
- Engineering and Design
- Procurement
- Manufacturing
- Site Installation
- Commissioning

**AFTER SALES SERVICE**

- Expertise, follow up, continuous improvement
- Maintenance and Training
- Spare Parts

**SIMULATION**

- Custom simulation of all processes on demand

For any information, please contact us  
LIMPACT INTERNATIONAL LIMITED  
A division of Brochot Hydromet  
Tel : +1-905-373-4100  
www.limpact.com

have to be faultless. Just as critical is the selection and relationship we have with contractors.”

However grand this project is, it’s not the only one being undertaken in Canada where the mining and oil and gas industries are working flat out opening new developments. So demand is running ahead of supply in every conceivable way. “There is such a lot of work out there,” says Stefan, “that contractors are being picky about what they bid for. Rather than breaking the work down into small sections, we are having to bundle large blocks together to grab the attention of contractors.”

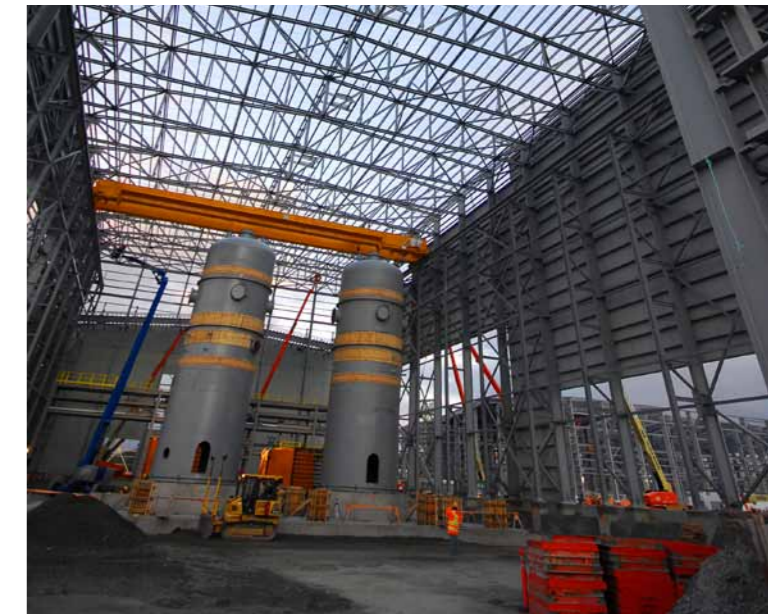
Nor is it easy to find suitably qualified tradesmen or engineers on the doorstep. Newfoundland has at best a population of 500,000 and the province has been without a mega project for some years. Consequently, the skills base has shrunk through retirement and migration. At the same time, Vale is having to compete with many other mega construction projects in less inhospitable parts of Canada (and the world for that matter) for what talent remains.

Nevertheless, as long ago as 2002 Vale identified

## LIMPACT INTERNATIONAL LIMITED

Limpact manufactures permanent cathodes for the non-ferrous metals refining industry utilizing proprietary explosion bonding technology. We are proud to have served the global zinc, copper, cobalt and nickel markets for 40 years. Along with our parent company, Brochot Hydromet, we are able to offer a full range of products including conceptual design, engineering, process equipment as well as commissioning services.

[www.limpact.com](http://www.limpact.com)



Flash vessels inside the leaching plant building

## TRANE CANADA

Trane Canada is a proud partner of the Vale Inco Long Harbour nickel smelter project built in Newfoundland. Trane supplied 72 industrial air handling units that handle the ventilation requirements for the entire plant. The equipment was custom designed to match Vale’s requirements for safety, reliability and durability. Trane Canada has a wealth of experience in the supply and service of custom heating, ventilation, air conditioning and refrigeration equipment to the resource industry.

[www.trane.com](http://www.trane.com)

**IR Ingersoll Rand**

*Efficiency and Reliability from Trane*

Trane Canada is a proud partner of the Vale Inco Long Harbor Nickel Smelter project built in Newfoundland. Trane supplied 72 Industrial Air Handling Units that handle the ventilation requirements for the entire plant. The equipment was custom designed to match Vale’s requirements for safety, reliability and durability. Trane Canada has a wealth of experience in the supply and service of custom heating, ventilation, air conditioning and refrigeration equipment to the resource industry.

*Making buildings better.*

[www.trane.com](http://www.trane.com)

For more information on Industrial HVAC equipment, please contact Cam Lowry at [celowry@trane.com](mailto:celowry@trane.com)

**TRANE**

Concrete pour,  
neutralization building



# 5,000

Number of key components involved in  
the flow of information and materials

a group of key R&D individuals to stay with the project from start to finish. They were involved with the process design, helped run the mini-pilot plant and demonstration plant and later were embedded in the engineering team. As such, all the R&D knowledge has been incorporated into the nuts and bolts design and will continue to stay with the project well into the production proper.

Construction is due to finish in mid-2013 and commissioning will begin towards the end of the year. By summer 2013, the plant is expected to be ramping up but it will be some time before it functions at its optimal level. “Scale up is always a risky process,” says Stevens. “Going from research stage to a functioning plant – however small – is a big step. The challenges of building and operating a 1/100th scale demonstration plant were great. Now we are doing it again, this time a gigantic step into new territory.” **BE**

For more information about  
Vale: Long Harbour Project visit:  
[www.vale.com](http://www.vale.com)



## **VALE: LONG HARBOUR PROJECT**

[www.vale.com](http://www.vale.com)

Produced by:

ACHIEVING BUSINESS EXCELLENCE ONLINE

**BE Business Excellence**

[www.bus-ex.com](http://www.bus-ex.com)