Modules fast-track nickel plant construction

BY MICHAEL A. MOORE

The development of the massive Voisey's Bay open-pit mine in Labrador has been neither cheap nor easy for multinational metals and mining giant Vale. No roads connect the outside world with the site of one of the most substantial mineral finds in Canada in the last 40 years, and no electric power is generated onsite. The only access for project cargo and modular units arriving at Voisey's Bay is by air and by sea; the latter of which is clogged with thick ice at least six months every year.

After acquiring the Voisey's Bay property in 1996, Vale spent nine years building the mine and concentrator 350 kilometres north of Happy Valley-Goose Bay and 35 kilometres southwest of Nain. The first ore concentrate from Voisey's Bay shipped in 2005 and today 30,000 tonnes of concentrate are transported every month to Quebec City aboard Fednav's *Umiak I,* the world's most powerful icebreaking bulk carrier. From Quebec City, the ore moves by rail to a smelter in Sudbury, Ontario.

For the past nine years, Vale has been building the $2.8 billion Long Harbour Nickel Processing Plant. The extraordinary cost of the processing plant does not include the cost to develop a hydrometallurgical process custom-designed for the Voisey's Bay concentrates.

The remote location, severe winters and the plant's sheer size combined to present equally extraordinary logistics challenges to the consortium charged with building the 450,000-square-foot phalanx of facilities. Further complicating logistics planning was the dearth of skilled labor at Long Harbour, and Vale's brief window to complete the facility.

Vale and its construction team found the solution to their problem in transportation practices of the offshore oil-and-gas industry. They designed the plant to be fabricated as giant modules that could be transported by water to the jobsite. "Vale and the builders realized there was no way the plant could be built in Newfoundland due to the lack of a skilled workforce," said Glen Aitken, Senior Vice-President for heavy hauler Mammoet Canada Eastern Ltd.

"We started talking with Vale early in the process, before engineering even started," he said. "While huge modules have been used for offshore oil platforms for years, this was the first time that Mammoet used modules on this scale for a mining project. "More than 20 years ago, we used modules for the Red Dog Mine project in the North Slope off Alaska, but those modules were fewer and smaller," Mr. Aitken said.

Mammoet worked closely with Vale and Vancouver, B.C.-based Fluor Mining and Minerals to coordinate the modules' transportation. As Long Harbour's engineering, procurement, and construction manager (EPCM), Fluor joined the team to design the plant, which was assembled using modules of key structural components. Instead of relocating a larger workforce to Long Harbour, the 14,500-plus tonnes of structural steel were fabricated at several

McKeil Marine organized a fleet of tugs and barges to bring a continuous stream of modules to Vale's Long Harbour nickel processing plant.

Photo: Panprojects

Canadian and U.S. facilities. The steel components were assembled into modules weighing between 100 and 1,100 tonnes at designated assembly yards along the U.S. Gulf Coast, the Great Lakes and St. Lawrence Seaway. The gargantuan modules were then loaded onto barges, which were towed to Long Harbour and offloaded onto self-propelled modular transporters (SPMTs) for the final 3-kilometre leg of the journey.

When begun in 2005, the use of pre-assembled modules at Long Harbour represented a new direction for solving complex problems inherent in designing, fabricating, transporting and assembling the thousands of pieces of steel and other structural and processed components at ever-more-remote sites globally.

"Our scope of work was from factory to foundation," said Mr. Aitken. "One of our engineers worked directly with Fluor's structural group and influenced the design of the tanks and modules so that self-propelled motorized transports (SPMTs) could be easily driven underneath."

Mammoet's SPMT design adaptation added 1.5 metre-high "legs" to the base of many of the modules. The extra height allowed the SPMTs to be driven directly over the building foundation, setting the modules down directly onto the foundation.

For some 30 months, Mammoet worked on the project at various locations across North America. Transport teams picked up and delivered the modules, which were installed by the onsite crew as they arrived. This parallel work schedule resulted in considerable time savings for Vale.

Mammoet brought in a mountain of equipment to complete the job in the relatively short period. The inventory of specialized resources included 10 barges and tugs, 250 axle lines of SPMTs, climbing-jack systems, hydraulic trailers, rough-terrain cranes, and some 180 professional workers to safely operate it all.

A total of 600 modules were delivered in a predetermined order from numerous locations to the secluded site. Mammoet's job included a variety of tasks: shipment coordination, weighing services, load-out services, sea-fastening, marine transportation, load-in services, land transportation and installation services at the mine site.

McKeil Marine came onboard to provide ocean transportation for the modules.

"At the peak of the project, we had nine tug-and-barge units transporting modules and equipment from 14 different ports from Corpus Christi, Texas, to Lake Superior," said Paulo Pessoa, Vice-President of Business Development, Projects for McKeil. "The fleet included five 400-by-100-foot-long barges chartered from U.S. operators," he said. "Those barges sailed between the Gulf of Mexico and Newfoundland. One tug-and-barge delivered modules from fabrication yards in eastern Canada, while three others moved modules from Great Lakes fabrication yards. "We had one barge built especially for this project with a deck strength of 25 tonnes per square metre," Mr. Pessoa said.

Vale and its partners spent nine years moving some 600 modules like this one from fabrication plants over water, then three kilometres on SPMTs to reach its nickel processing plant in Newfoundland.

Photo: Panprojects

One of the greatest challenges facing McKeil and the project involved the timing of the arrival of the tug-and-barge units – nine in total – to avoid congestion and wait times at the Long Harbour delivery port. McKeil had a fulltime assist tug and a fulltime supervisor on site. A total of 56 cargo loads at 14 different ports took place between March 2011 and December 2012.

Panprojects Canada was responsible for all cargo to the nickel processing plant that had nothing to do with the assembly and transport of the structural modules.

"We were responsible for everything that wasn't a module," said Kelly Merath, Project Manager at Panprojects Canada. "We moved 545,000 tonnes of freight for Long Harbour from November 2010 through 2014. "That volume included 19 ocean charters into Newfoundland and 14 to the U.S.," she said. "More than 80 per cent of the project procurement came from North America. We worked quite a bit with oilfield supplier Oceanex as well as Newfoundland companies whenever possible."

Vale's Long Harbour Processing Plant is one of the largest in the world to use a new hydrometallurgy process that uses water to refine 50,000 tonnes annually of nickel ore in a more economical and environmentally-friendly manner. The plant is scheduled to start processing concentrates from Voisey's Bay next year. The port site is comprised of concentrate- and limestone-offloading facilities and storage, a limestone kiln, concentrate and limestone grinding, sulfuric acid storage and distribution, non-process buildings and utilities, a pipe corridor, and an access road to the process plant.

Long Harbour's nickel processing plant may have been one of the first mega projects to make wide use of modularization, but it will certainly not be the last.