

# Bulk materials lightering barge

Lessing Dibben Consulting Engineers Ltd. — Trenton, Ont.

The difficulties of loading ore onto ships in arctic conditions presented a complex set of problems for Cominco and the State of Alaska when they started up the Red Dog Mine in 1989. The richest deposits of zinc and lead ore in North America are located 75 km inland on Alaska's north-west coast above the Arctic Circle. There are no natural harbors nearby, and the closest shore has a very shallow shelving bottom and is open to southwest ocean storms and waves. Construction of a causeway was considered to be impractical because of astronomical costs and the threat of icebergs.

The alternative was to build lightering barges that could be loaded near the shore and towed out to load waiting ships, but even this alternative presented immense problems. There are only 100 days a year when this option is viable, so the mine's annual production of 700,000 tons of concentrated ore would have to be handled within this time frame.

If the barges could not transport the full year's production, there would not be sufficient onshore storage for the next year's production, and the mine would have to reduce its output. There would be

times when barges would have to operate round-the-clock in poor weather conditions, potentially resulting in wind-blown and spilled lead ore, which are a concern because the area is environmentally sensitive. In addition, all components have to be capable of withstanding storm and wave action encountered on the trip to and from Seattle once a year.

Lessing Dibben Consulting Engineers Ltd. was responsible for designing lightering barge materials-handling gear (mechanical, structural and electrical engineering), including sidewall belt housing, boom and machinery and its supports. The project resulted in two unique, continuous self-unloading bulk-materials lightering barges capable of loading ships at 1500 tons per hour, which completed their first season in October 1990.

Each of the two barges used by Red Dog Mine can carry 6000 tons of ore on its deck. While lightering barges usually use clam-shell cranes, which have high spillage, low capacity and do not work well in rough waters, this design incorporated two Cat 988 front-end loaders to scoop up ore and place it in hoppers. The use of an automatic reclaimer was

rejected: instead two deck-mounted conveyors with variable-speed AC motors carry the ore to the stern of the barge, where two cross conveyors carry it to the central sidewall belt. This elevates the material some 65 ft to load a slewing, luffing and shuttling boom that extends up to 120 ft to load the material into the hold of a large ship.

All chutes and hoppers have a minimum slope of 70 degrees and are lined with Tivar 88 (a slippery plastic) because the concentrate is sticky. A beater pulley installed on the sidewall belt vibrates the material out of the pockets.

To keep wind-borne dust to a minimum a partial tent covers the hold area, all belts are covered to below the return belt, including on the shuttling boom, and a 40-ft-long spout on the end of the boom reaches well inside the hold before the ore is exposed to the elements. A 40-ft-long bomb-bay-type door under the boom catches any spillage from the portion of the belt that is over the water. After each loading operation the boom is brought back over the barge and these doors are opened to allow the spillage to fall into the barge.

Tank tests were undertaken to ensure that the boom and its machinery could withstand dynamic loads of plus/minus .25g sideways and 1.0 plus/minus .3g vertically, together with ice, snow, wind, list, dead, live, acceleration/deceleration and impact loads.

Counterweights are not used because they would reduce the carrying capacity of the barge. This resulted in the specification of machinery such as a 350-ton-capacity luffing cylinder. The slewing drives are equally affected.

Height became a major consideration at all stages of the materials-handling gear design. An acceptable hopper width and height for the front-end loaders, combined with the need for 70-degree side slopes meant there was no room for feeders under the hoppers, so the deck conveyors were used to act as feeders. To avoid making the barge top-heavy, the lift height for the sidewall belt had to be kept as low as possible. The elevation of the boom is set to enable it, on a loaded barge, to reach over the deck of an empty panamax-size ship.



Lightering barge (background) loading ore onto a ship.