PT - 2013: Coastal and Ocean Engineering ENGI.8751 Undergraduate Student Forum
Faculty of Engineering and Applied Science, Memorial University, St. John's, NL, Canada
March, 2013

Long Harbour Wharf – Marine Development

Burton, Bradley
Memorial University of Newfoundland
St. John's, NL CANADA
f65btb@mun.ca

Abstract

Long Harbour, Newfoundland is located on the South-East Coast, which is an ideal location for shipping routes. The location of Long Harbour has been taken advantage of prior to the construction of the Nickel Processing Plant, as Long Harbour was originally used as the main processing site for the Electric Reduction Company of Canada Industries Limited (ERCO) in the late 1960's.[2] The Long Harbour Nickel Processing Plant began construction in April 2009 on the same site as the previous plant, using the existing wharf as a base for the construction of a larger wharf structure. Vale's intentions are to use the production plant for the Voisey's Bay mined ore in Labrador.

The Long Harbour Marine Development project accomplishes the initial stage of what will be a multi-stage process in nickel extraction. The wharf receives the nickel concentrate from the Voisey's Bay mine, which is transported via bulk carriers, thus making it a vital stage in the commissioning of the plant. The wharf construction itself has multiple stages and the following paper will highlight the economic advantages of the marine development, a brief project description, the challenges presented with the construction phases, environmental requirements of the project and the remaining work which needs to be completed.

1 Introduction

On September 17th, 2010, Pennecon McNally Joint Venture (PMJV) was awarded the contract for the wharf section of the Long Harbour Nickel Processing Plant. For proper use of the processing plant the original wharf that was in place had to be re-designed and constructed to receive the nickel concentrate, which is being shipped down from Voisey's Bay mine. This design uses elements of the existing wharf structure to produce a larger and suitable wharf for the processing plant.

The Long Harbour Marine Development project accomplishes the initial stage of what will be a multi-stage process in nickel extraction. The wharf receives the nickel concentrate from the Voisey's Bay mine, which is transported via bulk carriers, thus making it a vital stage in the commissioning of the plant. The wharf construction itself has multiple stages. A proper schedule along with accurate cost estimates allows the completion of the wharf project on time and within budget.

In order to carry out this project as scheduled, it is required to outline the project milestones, and build your schedule accordingly.

Milestones to be achieved for project include:

- Rock Reef Completion – An artificial rock reef is required to be constructed on the North side of Long Harbour. Two reef portions both consisting of twelve 45x45m cells will form the artificial reef. Each cell contains a 15m wide rock in the center which is then bordered by 15m of natural seabed. The artificial reef is being constructed to comply with the Fisheries Act and to account for compensation required by HADD (the harmful alteration, disruption or destruction of fish habitat).

- Pipe Piling on both the North and South sides of the wharf – Pipe piling is required to support the extensions to both North and South sides of the wharf. Twenty five (25) 914-mm diameter piles are required on the North side and Twenty two (22) 610-mm diameter piles on the South side. PMJV will utilize the Symmetrix Drilling System to accomplish installation of all Forty seven (47) rock socketed piles. The pile tip elevations are to be driven to between -22.0m and -33.2m.

- Bay Area Dredging – Dredging of approximately 30,000 cubic meters of sea floor is required to produce a deep enough harbour to allow the entrance of large cargo ships containing Nickel concentrate. A pre-dredge sounding survey was completed prior to construction.

- Scour and Shore Protection – Protective layers of rock are to be placed along the shoreline to avoid erosion along with a layer of stone to be placed over dredged areas to protect the wharf structure from turbulence of shipping vessels.

- Wharf Rehabilitation & New Structure – Upgrading the wharf structure to include North and South deck extensions require the addition of precast and cast-in-place sections which are to be installed as per Drawings and Specifications.

2 Technical Approach

2.1 Design Phase

The design aspect of this project was accomplished by Worley Parsons, hired by the client Fluor, to do the task of engineering a stable wharf structure for production requirements. Many factors had to be considered in the design phase of the wharf, mainly trying to incorporate all the needs and requirements of a Nickel Processing Plant. The existing wharf structure was not large enough to incorporate the updated technology used in the Nickel ore processing. The new design had to incorporate this technology and allow for larger loads and larger, more updated, production.

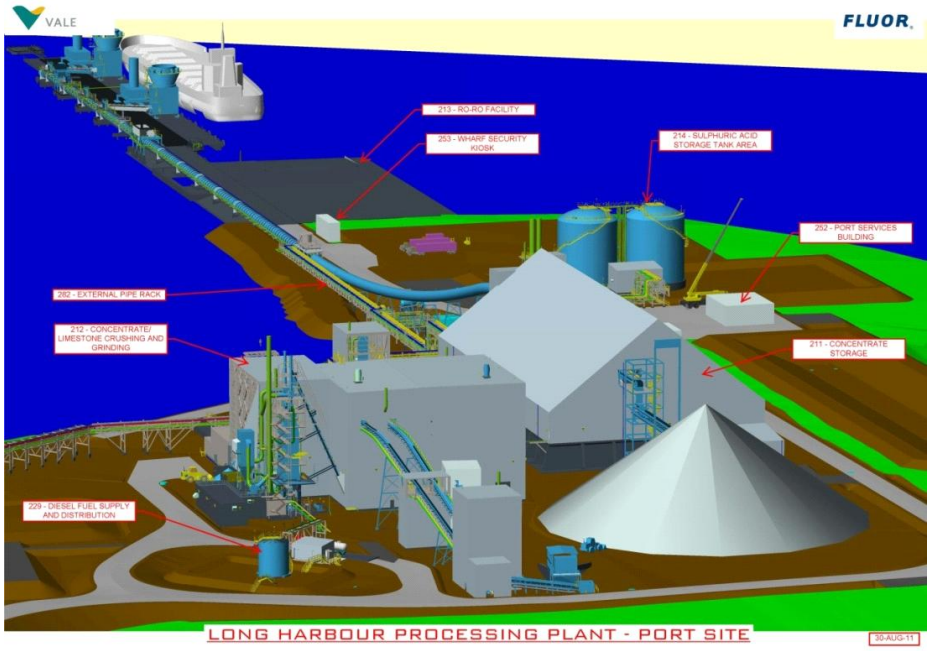

Figure 1: Final design of Long Harbour Nickel Processing Plant Port Site. Photo credited to PMJV.

Some final drawings show the original designs of the existing wharf which are followed up by new designs which clearly depict an extension to both North and South sides of the wharf. Widening the wharf is the main goal of the new design, due to large hoppers which require a much greater area to relay the Nickel concentrate from the ships to the processing plant. The addition of a conveyor system is the reason for the additional width to the South side of the wharf; this extension is a resting area for the conveyor which will transport the Nickel concentrate from the hopper up to the processing plant.

2.2 Scheduling

Scheduling is a way of analyzing tasks within a project which will take the most time to complete and in turn potentially costing more. Knowing what points in a project may or may not possess these potential delays can save a company large amounts of money in the future. Allowing extra time while scheduling for such events may be the deciding factor in a company making profit on any given project.

On a project in which different stages of construction are separated into different contracts it is very important to have a logistic schedule of events to follow with specific milestones labeled. Scheduling can be very difficult, especially on a project with unpredictable circumstances such as tides and weather. The tides and weather are major factors that can cause delays, especially while dealing with water work. With construction being done near the surface of the water PMJV had to wait for low tides to construct the cope wall and pile caps. Tides also affected dredging; while the tides were high the water was too deep to dredge. While scheduling construction such factors need to be considered. The tentative schedule given for the wharf project was set to be approximately one year.

2.3 Data Collection

Data collection is one of the first stages of construction for a contractor. Knowing the required information for permits and/or environmental issues is essential for getting a project started. Before construction can begin a contractor is required to attain permits such as proposed site trailers, excavation and site grading permits. On top of the typical construction permits it was required that PMJV conduct an environmental analysis for all port-site marine works.[1] The potential for environmental damage when operating heavy machinery is very high, making it absolutely essential for an assessment to be conducted and safety procedures put in place.

Without permits, a contractor cannot legally work on a project.[3] There are numerous laws and regulations that relate to construction and permits are only issued for work that is allowed under these regulations. Permits work in conjunction with inspections, which ensure that the work that is planned was actually done, and was done correctly and safely. If a contractor were to disobey these permits they could face serious, potentially costly, consequences.

PMJV also required another set of data; this set was used in designing formwork. The formwork used to pour the fenders, pile cap and cope wall had to withstand the wave forces acting on them. Having sufficient lateral resistance is mandatory to assure the formwork does not come apart while the concrete is setting.

Many factors were considered while solving for the force of waves acting on these forms, such as wave height; water depth; surface area and roughness of surfaces. With the help of Dean's stream function theory a simple calculation was made to determine this horizontal force.

2.4 Construction Phase

One of the initial stages of construction for the wharf was to dredge the sea floor to assure the water level is deep enough for navigation by the supply vessels. A crane and clam bucket were used to remove the dredge material, which were then trucked away to be cleaned and separated into sand and gravel.

The dredging process took approximately two months and removed an estimated 30,000 cubic meters of material from the sea floor. This process now allows the supply vessels to dock and unload on the North side of the wharf.

Figure 2: Dredging. Photo credited to PMJV.

Scour protection is used on the sea floor and protects the wharf from being undermined. The propellers on big shipping boats can create large turbulent forces and while they are near dock, where the water level is much lower, the wharf can be undermined and potentially damaged. Scour can also occur near the vertical piles of the wharf when waves or current changes apply forces. The typical placement method between the piles and wharf structure can be seen in Figure 3.

Figure 3: Placing Scour Protection. Photo Credited to PMJV.

A layer of stone is placed using an excavator and helps protect the piles and the seabed from erosion. Without this form of protection, the wharf would be in danger of collapsing due to erosion near the main piles which hold up the wharf extensions.

While dredging was being performed construction could also commence on the shoreline protection. Shoreline protection is also required near the wharf to protect from shoreline erosion. The waves and tides can erode away land near the port site very easily so it is protected

Figure 4: Shoreline Protection. Photo credited to PMJV.

with a layer of fabric, typically geotextile, and multiple layers of stone on top.

3 Conclusions

The Long Harbour Nickel Processing Plant is a multi-billion dollar project which will turn the small community of Long Harbour into a leading exporter, turning out over 50,000 tonnes of processed nickel per year along with associated cobalt and copper products. The Wharf – Marine Development contract awarded to PMJV is one of many phases in the overall construction of the plant. PMJV was in charge of constructing the new wharf structure and marine development on the port site of the processing plant.

The project is nearing completion and production will soon follow. The new wharf structure will be used to allow Nickel concentrate to be offloaded from shipping vessels and transported directly to processing via conveyor system. The goals of this project were to upgrade the port site to allow more advanced processing of Nickel concentrate, and the Wharf-Marine Development project has allowed this.

4 Recommendations

Although the project is nearing completion, it is recommended that for future construction projects more planning and detailed scheduling be considered. It has been noted throughout the construction of the Wharf- Marine Development project that multiple delays have been encountered. These delays cause a company to lose money on a project which is why careful scheduling and planning has to be followed for such a difficult project.

While delays can sometimes be difficult to predict, a project involving a lot of marine work should consider the large affect that tides and weather will have on construction. A more reasonable time period for water work would avoid any lost time in scheduling.

5 References

The majority of knowledge used in this report was from personal experience, but a few references were used for background knowledge.

[1] World Wildlife Fund Canada, "HADD enough? Keep habitat protection in the Federal Fisheries Act" Linda Nowlan, March 15, 2012.

[2] Heritage Newfoundland, "ERCO and Long Harbour" *Article by Melanie Martin. ©2006, Newfoundland and Labrador Heritage Web Site*

[3] Doing Business, "Dealing with Business Permits" pdf file.