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Iron Ore Handling Facilities Conceptual Study

Port of Port Alberni

General

Sacré-Davey Engineering Inc. (SDE) was asked to investigate a general concept for a potential iron ore handling facilities located in Port Alberni. Without specific site, technical requirements or commercial information, various general assumptions were made with respect to cargo movements which were based on SDE's experience with similar handling facilities in other port facilities on the West coast. Those assumptions include:

- The ore handling facility would be co-located with a container terminal transshipment facility. As such, capital efficiencies may be gained from the acquisition of land, sharing of berth faces and any required marine improvements.
- Cargo to be handled is Iron Ore pellets having a bulk density of 2.3 MT/m^3 and angle of repose of 32 degrees.
- General cargo-style apron dock or wharf with vessel access within 2m of bull rail.
- Dock facilities capable of mooring and securing Handymax-sized bulk cargo ships up to 40,000 DWT (approx. 180m in length).
- Vessel is to be loaded using rubber tired mobile ship loading equipment (B&W Samson or equivalent) with capacity of 2000MT/hr.
- Cargo will be delivered to the port facility via highway going end dump truck and trailer units (25MT per unit)
- Storage building of approximately 40m x 180m to permit operational space for trucks and equipment to operate.
- 60,000MT capacity storage building for iron ore pellets (1.5 x largest vessel shipment) located within 100m of dock face.
- Storage building will be equipped with large roll-up doors at each end to provide access for mobile equipment and minimize environmental exposure of cargo.
- Stockpiles will be maintained and transferred from the warehouse to ship loader using rubber tired Front End Loader (FEL).
- Cargo handling using two FEL's (Caterpillar 980K or equivalent) each capable of transferring cargo to the ship loader at a maximum average hourly rate of 500-800MT/hr depending on haul distance.

- Environmental utilities such as wheel wash stations and water collection sumps to collect iron ore contaminated run-off from the dock and warehouse operation areas.

Description of Facilities

Without specific information with respect to commercial aspects being considered for handling iron ore, SDE has developed a conceptual cargo handling solution that should be considered to be the minimum in terms of operational and environmental requirements. That is to say that the facilities described herein are generally the least sophisticated and capital cost intensive however they also are also highest with respect to operational cost and flexibility.

Handling iron ore using mobile equipment is very common due to the material's high density. Required storage space is proportionately less, however equipment must be suitably robust to handle the sizeable impact pellets can create when dropped from height. Although equipment is designed and sized for specifically handling iron ore, one should expect a cost premium for equipment due to the required robustness. Iron ore pellets are very tough, flow readily and can be somewhat of a safety concern to workers as they act like little ball bearings under foot. Pellets rubbing against one another will produce fines that stick to the pellets making them quite dry and dusty.

Transporting iron ore pellets from mine to port is most commonly done using rail cars however we have assumed delivery to the port via highway truck. It is envisioned that trucks arriving to the port would drive to one end of the storage warehouse and position themselves so that they can back into the warehouse. Port staff receiving trucks would exchange paperwork and open a roll-up door to allow access to the warehouse to dump the contents of both truck and trailer. Following transfer of cargo into the warehouse, each truck would navigate through a truck rinsing station where the underside and wheels of the truck would be cleaned before leaving the site and returning to public roadways.

The warehouse shown on the attached drawings is a single linear A-Frame style building of approximately 180m in length and 40m in width. This is typical of concentrate shipping facilities in BC, and provides an efficient operational design. However, should space be of a premium, different designs could be evaluated such as square flat roof storage building with approximate dimensions of 85m by 85m. This style of building typically requires central load bearing columns to support the flat roof which pose an operational hazard and typically see impact from FELs during stock piling and reclaiming operations.

Once cargo is delivered inside the enclosed warehouse, port staff operating rubber tired front end loaders (FEL's) would consolidate cargo within the building by stockpiling the ore. Pile heights would be limited to approximately 4.5m due operational limits of front end loaders. The stockpile on the attached conceptual drawing shows material at its natural angle of repose (32 degrees) in a triangular stock pile with a width of 30m and length of 170m. Higher stock pile heights can be achieved by using an excavator to stack the material or a gallery conveyor system and tripper to discharge product to stock piles however this would require more capital to install a receiving hopper, a network of elevation conveyors and a gallery conveyor with tripper. Also, with a gallery conveyor and tripper, a more robust structure is required to support the elevated mass which will also require more initial capital.

It is envisioned that cargo would be stored along one side or in another manner so as to allow ease of future truck deliveries as well as access to stockpiled cargo for shiploading. Ventilation within the warehouse would be required to permit the escape of diesel emissions. Keeping doorways and other openings to a minimum will serve to reduce dust from escaping the building while cargo is moved using FEL's. It is assumed that general heating or fire protection within the building is not necessary.

Once inventory within the warehouse has accumulated to permit full loading of a ship, it is envisaged that port crews would move a mobile shiploader into position alongside the vessel and hatches to be loaded. It is assumed that a mobile shiploader with receiving hopper would be positioned opposite each hatch to be loaded and would move each time another hatch is to be loaded (alternatively, the vessel can be "warped" along the dock to reduce movement of the shiploader). Cargo from the warehouse would be moved to the hopper of the shiploader via FEL. As one loaded FEL makes its journey from the warehouse to the shiploader another empty FEL would return from the shiploader to the warehouse for another load. It is envisioned that two (2) FEL's working in unison would transfer approximately 7-10MT of cargo on each trip to the shiploader. Depending on distance from stockpile to shiploader, maximum productivity of approximately 500-800 MT/hr per machine can be expected for short hauls and as low as 300 MT/hr for longer haul distances. To a limited degree, overall productivity can be increased by adding an additional FEL however employing more than two (2) machines will increase congestion and potential for delays/interference in tight quarters (doorways, stockpile & hopper).

Once shiploading operations have completed, the mobile shiploader would be cleaned and stored while FEL's would return to the warehouse to be used for stockpiling cargo, etc. The wharf area would be swept of iron ore pellets and dust washed with wash water collected in a central sump for treatment. Both dock wash water and truck rinsing water would be treated in an appropriate water treatment facility prior to being discharged.

Capital Cost Order of Magnitude Estimate

Scaling from previous projects and judgment, SDE would estimate that this project would have an order of magnitude cost of $40 million assuming that it shares infrastructure with the associated container ship terminal such as acquired land and berth face. This would also exclude any marine preparation, such as dredging, to accommodate vessels in the port facility.

Summary

The simple unloading, storage and shiploading system described above in concept is typical of low-capital cost operations that handle high value and low volume commodities. Such a system would be appropriate to handle volumes up to 1,000,000 MT/yr. As throughput volumes of a commodity increase into multiple millions of tonnes per year, operators may look to more sophisticated cargo handling systems that would reduce labour requirements. In such high volume operations, high labour and maintenance costs coupled with low productivity of mobile equipment severely limit operational efficiency and bottom line revenue.

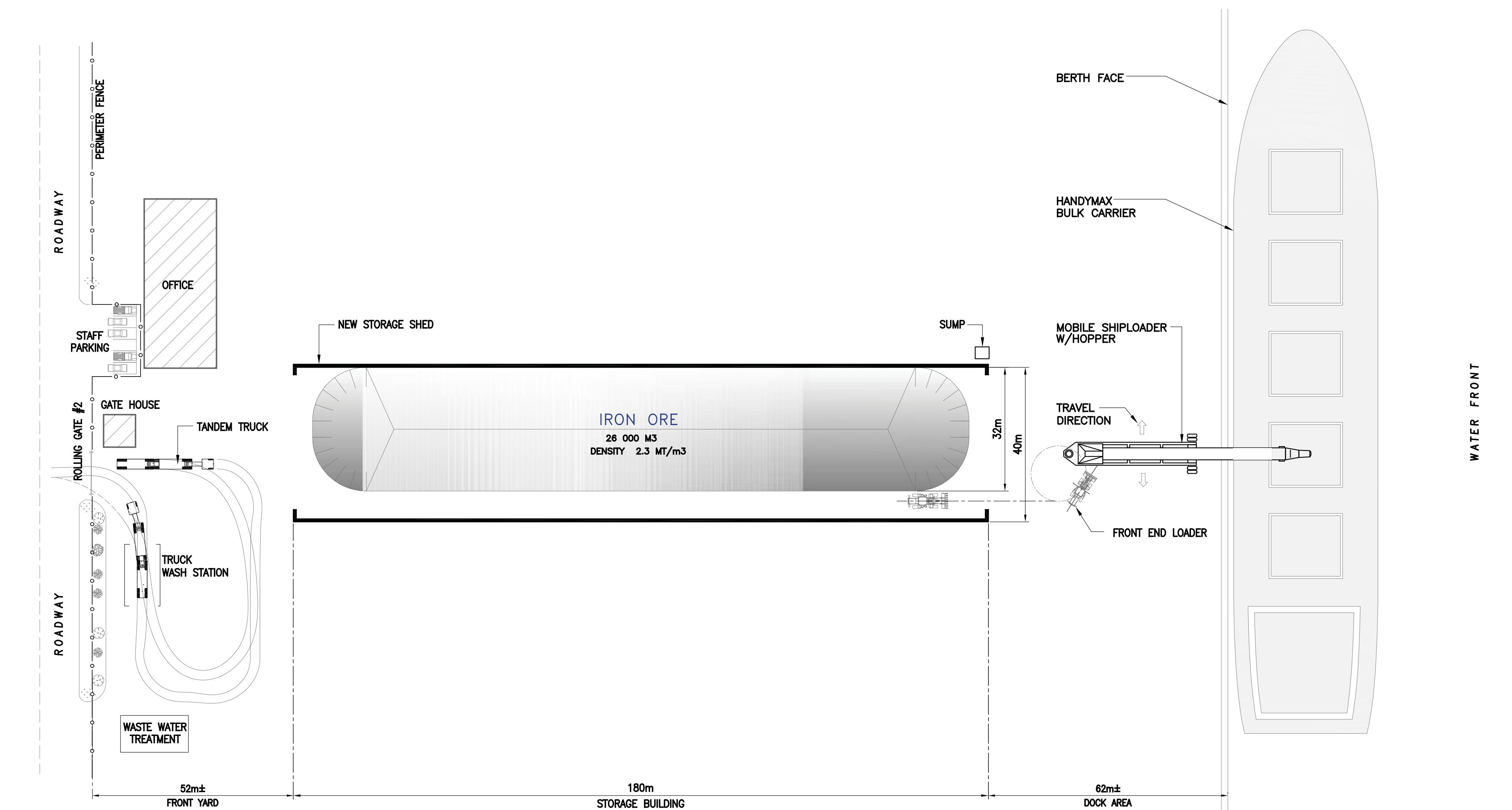
Appendix A – Representational Photos

Figure 1 – A Frame Storage Facility Example

Figure 2 – Flat Roof Storage Example

Figure 3 – Cat 980 Example

Figure 4 – Mobile Shiploader Example



PLAN VIEW

PRELIMINARY
DATE: March 25, 2014

TANDEM TRUCK
25 MT / TRUCK
ORE DELIVERY FROM MINE VIA HIGHWAY TRUCK

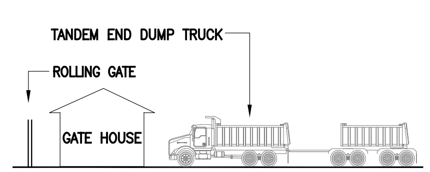
STORAGE WAREHOUSE
40m x180m LONG
SHED INVENTORY EQUAL TO 1.5 x VESSEL CAPACITY

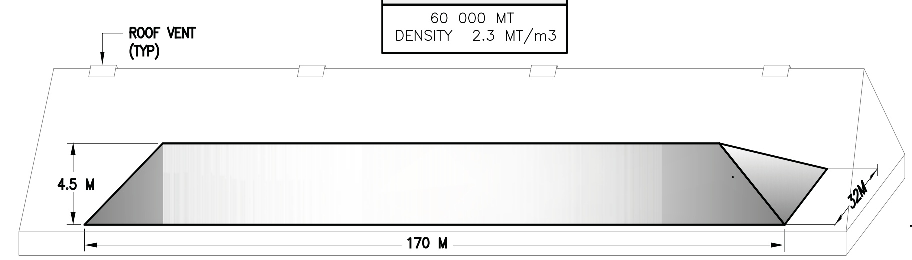
IRON ORE PELLETS
60 000 MT DENSITY 2.3 MT/m3

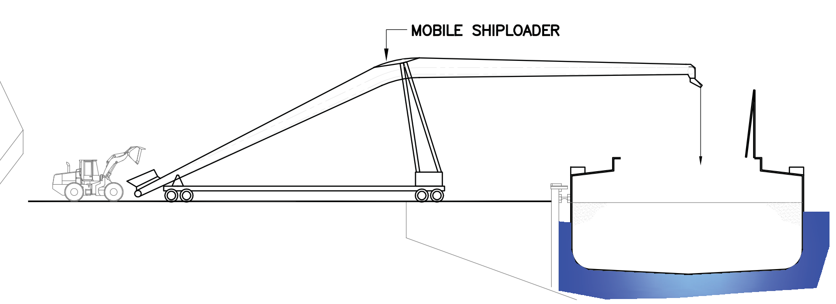
FRONT END LOADER
QTY 2 500-800 MT/hr x2
USED FOR STOCKPILING AND RECLAIMING

MOBILE SHIPLOADER
2,000 MT/hr

HANDYMAX BULK CARRIER
40,000 DWT 180m LONG







FLOW DIAGRAM

NO.	DESCRIPTION	DATE (YYYY/MM/DD)	BY	CHK'D
B	UPDATED RE-ISSUED FOR INFORMATION	2014/03/25	FP	CR
A	ISSUED FOR INFORMATION	2014/03/18	ZS	CR

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SEAL

PROJECT DESCRIPTION:
IRON ORE HANDLING FACILITIES
CONCEPTUAL STUDY
PORT OF PORT ALBERNI

DRAWING TITLE:
PLAN VIEW
FLOW DIAGRAM

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