

Bulk Terminal Expansion: The Need for World-Wide Upgrading of Shiploaders and Related Material Handling Equipment

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ABSTRACT

Due to expanding productivity and environmental regulations on a global scale, port facilities handling bulk materials are now evaluating their existing systems and preparing for future needs and liabilities. This article reviews the design solutions for a proposed shiploader and related equipment upgrades.

Renovations/Upgrades

The need to increase productivity and resolve environmental issues are two major reasons for facility expansion and/or upgrade.

The need to move more material, more quickly, has produced larger ships whose capacities have exceeded many port facilities' loading and storage equipment. This trend will continue as older, smaller Handysize bulk carriers become out-dated and are replaced with larger more efficient Capesize and Panamax vessels. The increased capacities of shiploading equipment necessary to accommodate these larger vessels will require modification of shore-based material handling systems.

If a port facility does not have the physical capacity for larger ships, it may become necessary to handle more vessels at a much faster rate. Upgrades or renovations of existing material handling systems (shiploaders, conveyors and storage) can greatly increase the productivity and efficiency of port facilities in handling the higher volume of traffic.

Many port facilities have inadequate or out-dated control equipment. Current PLC technology can more efficiently monitor product volume and movement within a system. It can also handle safety/emergency situations such as belt misalignment/breakage, plugged chutes and any emergency system shut-downs.

Global awareness of environmental issues has forced dust control to be a serious issue at port facilities. Monetary fines for pollution, as well as lost product can greatly reduce a port's efficiency and ability to compete in a highly competitive global market. Dust control modifications can virtually eliminate dusting and result in significant cost savings

Preliminary Studies/Evaluations

Initial evaluations of a facility will look at the conditions and capacities of the existing equipment as well as the overall system design and storage capabilities. Pier constraints may dictate a fixed shiploader or allow the use of a mobile gantry shiploader to minimise vessel movement during the discharge operation.

Higher loading rates may be developed by simply increasing the speed and efficiency of certain system components. More extensive upgrades with larger capacity systems (i.e. conveyors, silos, shiploaders) may be required. Existing shiploaders can be modified and refurbished as well as replaced to obtain the higher and longer



Example of nuisance dust during discharge as evidenced by dust cloud and errant material build-up on deck and ship's gear.



Example of shiploading with new equipment

reach requirements for Cape-size and Panamax vessels. Dust control reduces infiltration of the product into moving parts and machinery which lowers maintenance costs and down time. Dust control at the shiploader and other transfer points increases system productivity by reducing material losses. Upwards of 5% product loss from the plant facility to ship's hold has been recorded.

Case Study

Upon completion of the terminal analysis and selection of basic equipment, preliminary concepts are formalized. A typical final concept may include a traveling gantry as shown in Figure 3.

This Case Study includes the following major design components:

1. Traveling gantry
2. Slewing and luffing boom
3. Transfer conveyor
4. Dust control
5. Controls and data acquisition.

Traveling Gantry

In our case study, consideration of the existing pier

arrangement and utilization of the existing material handling system resulted in the selection of a new traveling gantry. The existing shiploader consisted of a fixed boom having limited reach, loading tube with no dust control and an overall insufficient capacity to handle Panamax vessels.

The new gantry structure, approximately 37 meters high, has a 14 meter square main frame footprint and weighs approximately 275 metric tons. The outboard legs (fender line) are equipped with three (3) equalized two-wheel truck assemblies designed to limit the load transferred to the existing rails. Each rear leg includes two (2) two-wheel truck assemblies also equalized to limit rail loading. Hydraulic torque hubs drive each of eight (8) wheels. The hydraulic drive system was selected due to its versatility in providing full speed range from 0 to 15 meters per minute.

The gantry structure is designed with stair access to all levels. Each of three main equipment levels is provided with a service hoist for ease of equipment maintenance. The main operating level, approximately 14 meters above the pier, is provided with an enclosed electrical equipment room. The equipment room houses the MCC and main system control panels. Although alternative locations were possible, this level provided access to the existing tripper and close proximity to other major equipment components (i.e. air compressor, hydraulic power units, boom slewing drive, dust collector).

The boom luffing winch, located at the uppermost platform, is mounted on a turntable allowing it to track the boom slewing movement while maintaining proper cable alignment during discharge operations.

Slewing and Luffing Boom

Boom selection is vital to the final success of any new shiploader. A slewing boom providing 180° total travel and 22 meters total reach was selected as it provided complete hold coverage for discharge and trimming. In our case study, a light-weight boom constructed of 6061-T6 structural grade aluminum was selected. The reduction in weight for aluminum verses steel resulted in the least amount of load transferred to pier rails. Existing pier rail load limits will often become the limiting design factor when considering new shiploading equipment.

The boom includes an airslide type conveyor, centrally mounted with walkways provided along both sides for maintenance and inspection. A geared bearing, driven by two (2) hydraulic torque hubs, is provided at the base of the boom. The hydraulic drive was selected as it provides a variable speed range during discharge operations.

Transfer Conveyor

An existing belt conveyor with tripper was used to transport material to the shiploader. In our case study a new larger tripper was recommended to elevate the

material to a greater height suitable for transfer onto the new shiploader. A fluidizing air conveyor transferred the product from the tripper to the boom mounted conveyor. The transfer conveyor design considered material direction changes, dust control at transfer points and re-acceleration of material after leaving the tripper. Re-acceleration of product is often not given sufficient consideration and in that regard the transfer conveyor was oversized to handle capacity surges and provide additional contact area required to ensure product acceleration.

Dust Control

Dust control at transfer points and spout discharge is perhaps one of the most important considerations for new or refitted shiploaders. Our case study provided a 400 M3/minute pulse jet type dust collector designed to remove dust at three (3) transfer points and the spout discharge. The dust collector is located such that collected material can be re-entrained onto the transfer conveyor. This system allows for the capture of potentially lost material and minimizes airborne/wind-swept nuisance dust.

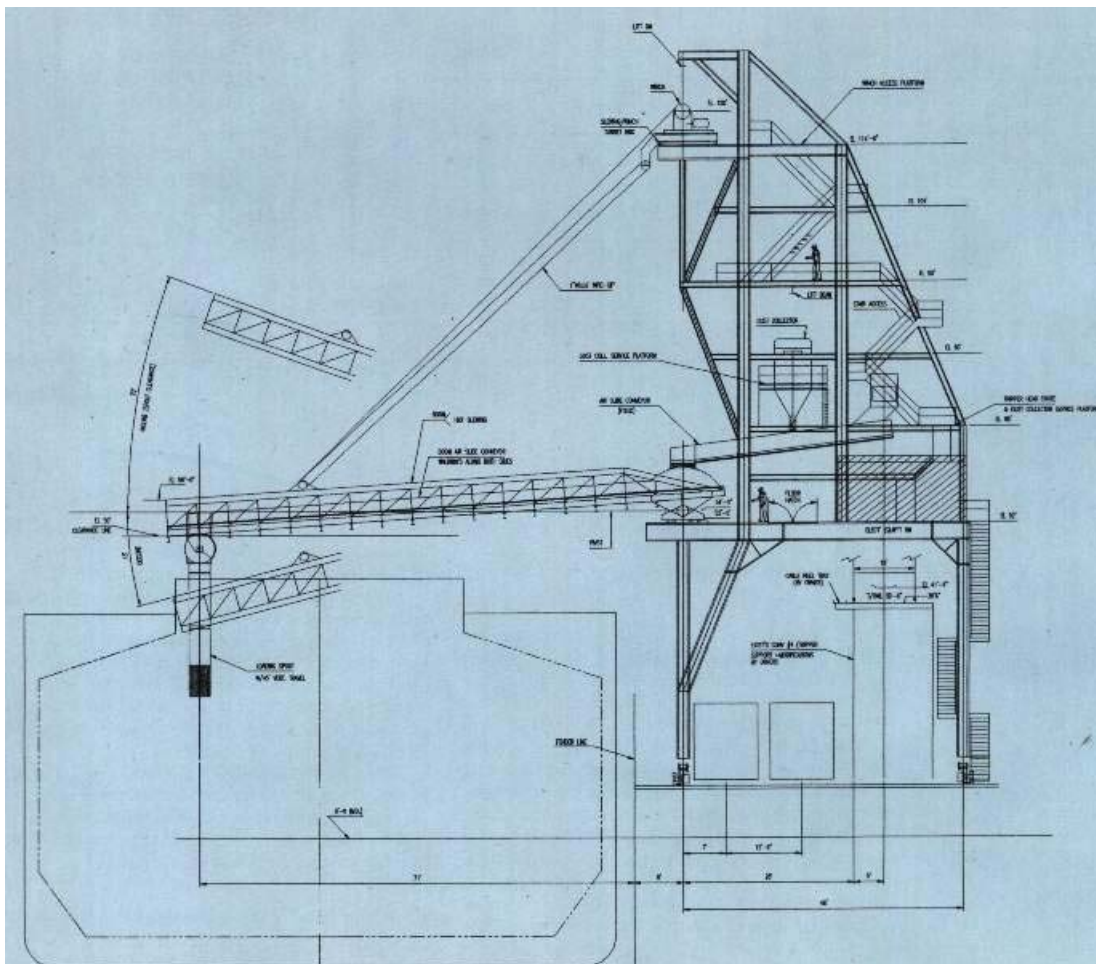


Fig. 3

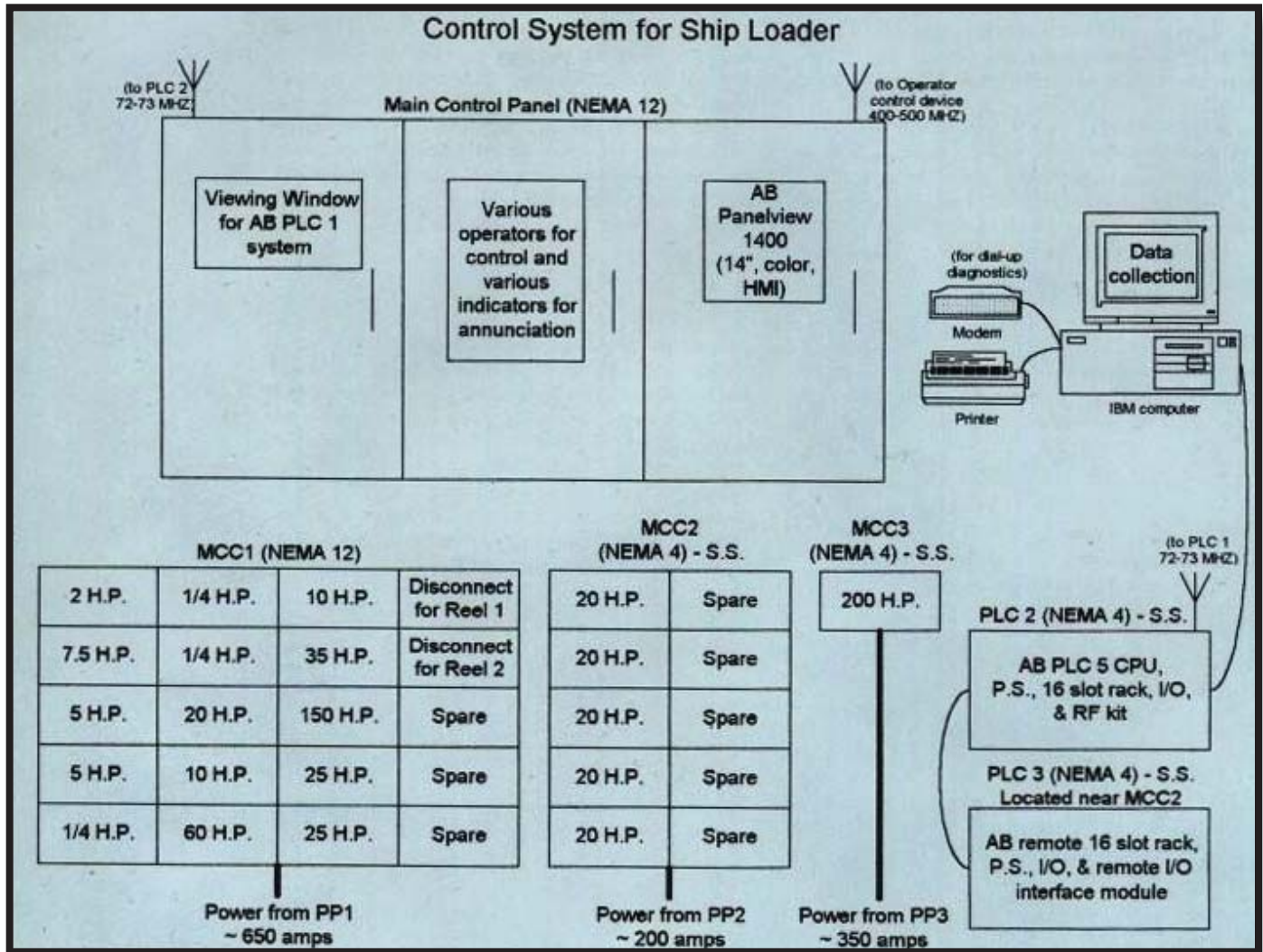


Fig. 4

A telescoping spout is used to place material into the hold with minimal to zero dusting. The reduction of nuisance dust increases visibility and allows for safer loading and better control of material placement during discharge and final trimming.

Controls and Data Acquisition

The main control system components are graphically illustrated in Figure 4. This system includes both PLC and HMI (Human Machine Interface). The HMI (housed in the main system panel, located in the electrical equipment room ~ gantry) is used for monitoring the system, including alarm indication, set-point entry, miscellaneous controls and graphic representation of system indicators (scale readout, total tonnage, etc.). An IBM Pentium industrial computer (located on shore) collects data from main system PLC (PLC-1); this data will be organized and spreadsheet reports generated. The data collection computer is equipped with a modem for on-line, remote diagnostics, thus allowing the engineers the ability to troubleshoot and execute program modifications from off-site locations.

Synopsis

There are a number of reasons bulk terminals around the world are faced with concerns regarding the adequacy of their existing facilities and equipment. Many of these concerns include increased productivity and the need to move more material at a faster rate. Larger ships are used to meet the increased demands. However, a terminal's existing equipment is often found to be inadequate and undersized. In addition, environmental concerns regarding dust and sound emissions are increasingly causing terminal managers to evaluate their facilities and equipment.

Once the decision has been made to upgrade your facility, a preliminary study must be prepared to identify the equipment and upgrades required to meet future needs. A very basic list of items to consider when identifying the scope of necessary upgrades is as follows:

Terminal yearly capacity (throughput) - present/future Vessel size - present/future Environmental - dust control, transfer points System capacity: - Conveyor capacity - Storage capacity - Shiploader loading rate System control and data acquisition Site characteristics - Pier construction/load limits - Facility layout - Material or materials handled - Climate

The solutions presented herein are site specific. Each port facility must be examined on an individual basis to identify its unique characteristics. These characteristics are then evaluated to find the most cost effective and efficient solutions to maximize a port's ability to compete in expanding global markets.

ABOUT THE AUTHORS

Robert D. Lang is the President and C.E.O. of Enco Engineering, Inc., a United States firm specializing in shiploaders and related material handling equipment. He has 25 years of experience with material handling equipment from design through manufacture and supply. He has taken a particular interest in creating technically feasible, cost-effective solutions for bulk terminal expansion and development both domestic and international.

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