DEVELOPMENT AND EXPANSION OF PSA's PANAMA HUB PORT AT THE FORMER RODMAN NAVAL BASE

By

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ABSTRACT

The opening of the new, third lane of the Panama Canal, and the projected increase in shipping traffic in the region, presented PSA with the opportunity to expand their single berth facility at the former Rodman Naval Base. Two new, deep-draft berths (-18.5 meters mean low water spring [MLWS]) were built to accommodate the largest future container vessels. However, the planning did not stop there. A new high-capacity/high-volume container yard for transshipment was developed using rail-mounted gantry (RMG) cranes. There are 12 container blocks (4,200-TEU [twenty-foot unit] ground slots) fitted with 20 semi-automatic RMG cranes. The RMG cranes can later be converted to fully automatic, self-stacking cranes (ASCs), as cargo throughput increases. There are also six container blocks (990-TEU ground slots) fitted with rubber-tyred gantry (RTG) cranes to service refrigerated containers (reefer) and import/export container cargo. Other improvements included advanced information technology (IT) services and multiple redundancies to allow the facility to operate seamlessly and continuously.

The benefits of the former Rodman Naval Base are that it is 'across the bridge' from Panama City and hence does not present the same restrictions and traffic conflicts experienced at the other port facilities and also provides easy access to the hinterlands in the rapidly growing western provinces of Panama.

The terminal was developed rapidly on a site with difficult and diverse geology. This terminal sets new standards for modern container terminals in Panama and the region.

1.0 PROJECT DEVELOPMENT OBJECTIVES AND TIME LINE

A decision was taken in 2013 to expand the current terminal to accommodate New Panamax (or Neopanamax) vessels. When completed, the PSA Rodman Terminal will be one of the most modern terminals in Latin America and will include semi-automatic RMGs and an extensive data collection system (fiber optics and Wi-Fi) to provide information for the terminal operating system.

2.0 DESCRIPTION OF THE TERMINAL

2.1 Overview

PSA Panama International Terminal (PPIT) is located at the Pacific entrance to the Panama Canal on the west bank (the opposite side to Panama City). Figure 1 shows the location. The terminal operates under a concession with the Panamanian government, via the Maritime Authority (AMP). The initial concession was granted in 2008.

Planning, design, and construction of the terminal took place over a three-year period with the first cargo handled in 2011. The design was based on a single Panamax berth of 330-meter length, three quay cranes, and an operating area of 14 hectares, including container yard, gate, maintenance workshop, and administrative and customs buildings.

Figure 2 shows the operating Phase 1 terminal, with a large container vessel on the berth and well-utilized container storage yard. The administration building, gate complex, and equipment workshop are in the right-hand corner and clearance has started for the Phase 2 construction area.

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Figure 1: Location of PSA Panama

Figure 2: Completed PPIT Phase 1 Terminal

2.2 Phase 1 Construction

Construction of the quay deck was carried out partially in the dry, with the rock slope at the rear of the quay wall being constructed in a bunded area. Figure 3 shows the initial excavation of the slope at the rear of the quay deck, together with a later photo showing the ongoing quay deck construction, including piling operations, placing of the grillage of concrete beams to tie the piles together. Figure 4 shows further construction photos during the piling and quay deck construction.

Figure 3: Phase 1 Quay Deck Construction

Figure 4: Phase 1 Quay Deck Construction

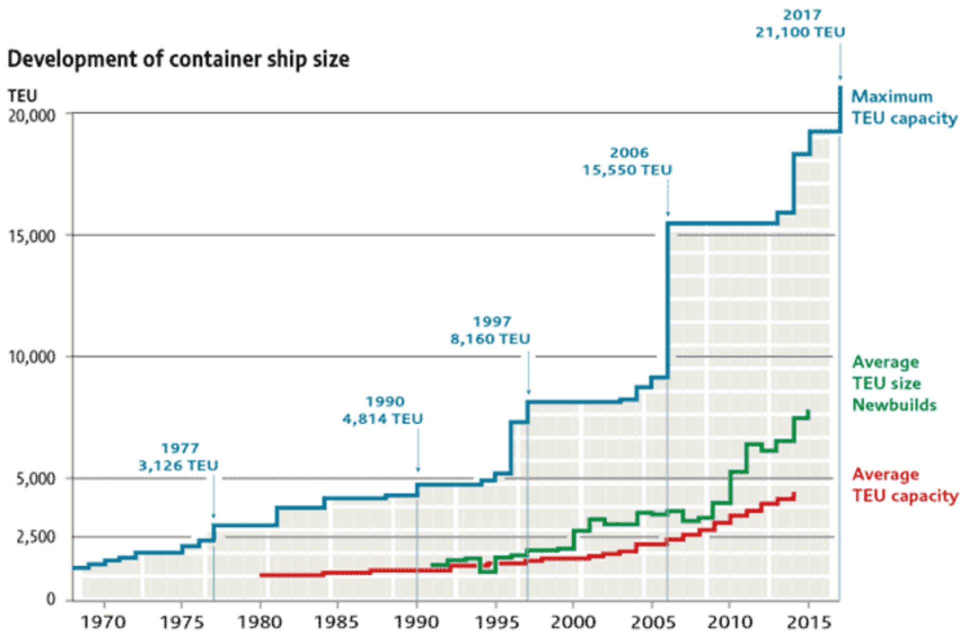
3.0 EXPANSION OF THE TERMINAL

3.1 Shipping Line and Container Vessel Dynamics

In the period from the planning and negotiation of the concession in the mid-2000s, there have been many significant changes in the shipping world. There has been a dramatic increase in the size of container vessels (see Figure 5), the opening of the expanded Panama Canal, and major consolidation of container shipping lines and alliances (see Figure 6).

The dimensions of the locks in the original Panama Canal restricted vessel dimensions such that the maximum capacity of container vessels was approximately 3,500 TEUs (twenty-foot equivalent units – the standard measure of container volumes and capacities, with 1 TEU being a single ISO 20-foot-long container).

The enlargement of the canal, which was completed in 2016, now enables vessels of up to 13,500 TEUs to transit the canal, greatly changing the economics of container vessel operations. In combination with this, there has been a huge increase in ship sizes, and the quantity of these large ships, as shipping lines have sought to reduce the shipping costs per container. The injection of capital needed for these new build campaigns and the need for revenues and capacity has resulted in dramatic consolidation of individual shipping lines and shipping line alliances to the point where there are now only three global alliances. Figure 6 illustrates this rapid consolidation starting from the mid 1990’s to the present day.



Source: The International Transport Forum

Figure 5: Evolution of Container Vessels Sizes

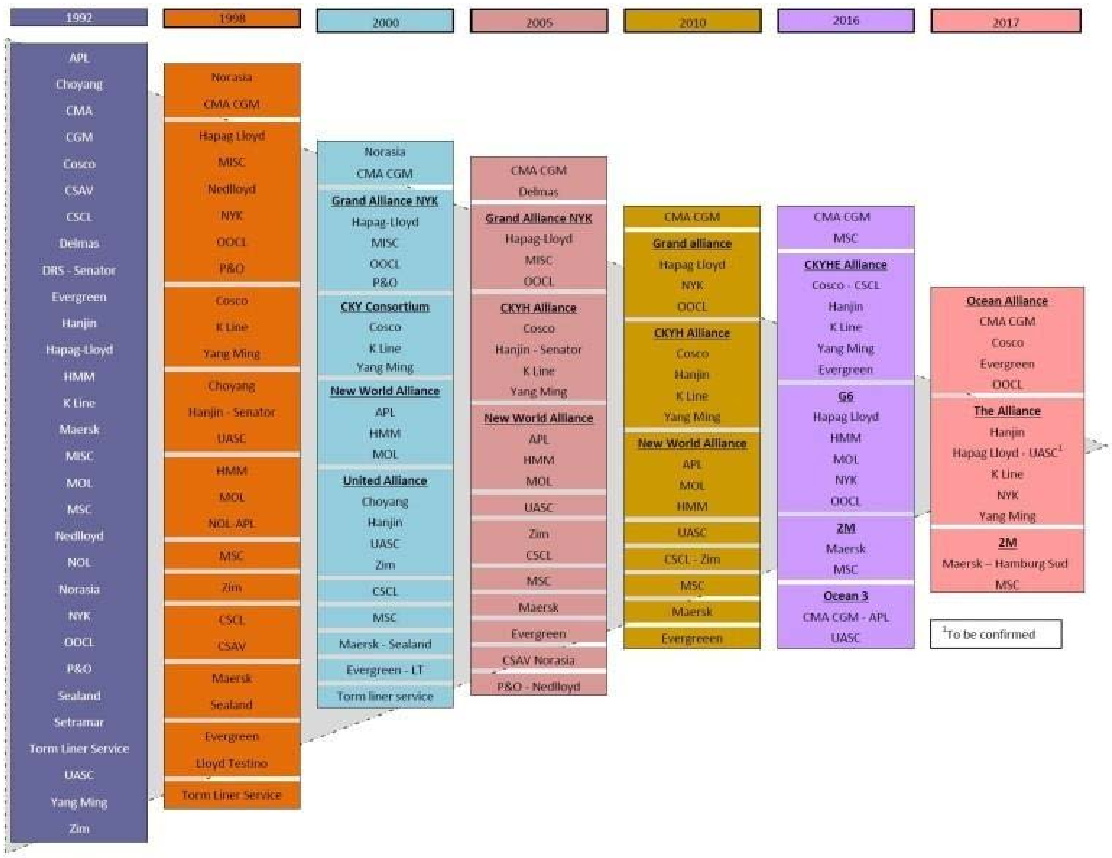


Figure 6: Consolidation of Container Shipping Lines and Alliances

Source – Ricardo J. Sanchez (UN-ECLAC)

3.2 Expanding PSA Panama

Taking account of the dynamics of the shipping industry, it was clear that Phase 1 was not sufficient for future needs and thus planning for an expansion of the terminal was commenced. The main criteria adopted were 800 meters of additional berthing for large vessels, plus sufficient yard to support an annual throughput of 2 million TEUs, based on knowledge of the market and estimated demand in the region.

Options were identified for expansion and discussions held with adjacent concession holders/land owners, with an option to lease a parcel of land between the Canal and the Phase 1 yard from ACP being the preferred option.

The next stage in the process was to carry out vessel navigation studies to determine the optimum alignment of the new berth with respect to the Panama Canal. This was carried out locally using the SIDMAR navigation simulation centre in Panama and with Panama Canal pilots.

Once the berth alignment was established, then it was possible to design the terminal layout to suit the operational goals, including vessel sizes, terminal capacity, etc.; thus enabling preliminary engineering design and site investigation works to be carried out.

4.0 CONTAINER YARD PROJECT SCOPE

The new terminal will have three berths; two Neopanamax and one Panamax, and 5,190-TEU grounded slots and 1,350 refrigerated container plugs. See Figure 7 below.

Figure 7. Reconfigured Rodman Terminal (Phase 2)

Construction of the new Phase 2 terminal includes reconfiguration of the existing Phase 1 container yard and utilities; however, the existing Phase 1 terminal continued to operate during the reconfiguration process.

The design and construction of the civil works for the Phase 2 expansion project was divided into three major packages; the new quays and basin dredging, the new container yard, and electrical and IT services. Yard and quay equipment was procured separately by PSA. The new quays, basin dredging, electrical, and IT services were procured through FIDIC Yellow Book contracts; the new container yard was procured through the FIDIC Red Book process. The equipment order was placed in 2015 in conjunction with the award of the contracts for the quay and dredging, but well in advance of container yard civil works construction. This necessitated a fast-track process to complete the civil works in time. This goal was generally achieved; however, the overlap in equipment deliveries, commissioning, and operator training did produce some conflicts with the civil works.

5.0 DESIGN CHALLENGES – PAVEMENT SECTION

The project was developed on the site of the former Rodman Naval Base (Rodman). The northerly portion of the Rodman site includes the PSA concession. The southerly portion is a separate concession to receive refined petroleum products and provide berthing for the Panamanian naval forces, visiting warships, and product tankers.

The terminal is a greenfield project; however, the site was previously used for dredge disposal and military support activities. The site also hosts navigation towers for the Panama Canal, which have been adjusted to suit the new land use of the site.

The site geology provided challenges to the design team. The underlying soils consisted of imported fill (the “American fill”) and dredge spoils of various depths overlying Pacific Muck (organic materials) and finally the La Boca rock formation. The rock formation was very irregular; in some places, it was located very close to the existing surface of the site, particularly in the future berth area. Over the course of the design program, multiple geotechnical investigations were undertaken, including a geophysical survey in the quay/berth area. The goal of the investigation programs was to refine the ground improvement program and develop the most cost-effective pavement section that could be rapidly built.

Design long-term settlements, after completion of the ground improvement program, were estimated to be on the order of 300 millimeters (mm); and differential settlements were estimated to be 20 mm within the container stacking areas. The containers are stored on discrete reinforced concrete pads (sleepers) in order to mitigate the impact of differential settlements on operations, and the other travel surfaces are portland cement concrete (PCC) pavements. Relatively shallow excavations and a soil replacement program with crushed rock were employed throughout the new container yard area. The Phase 1 container yard used similar methods and no further measures were required in this area,

In consideration of the fast-track schedule and construction cost, the engineer investigated various strategies to minimize the pavement sections across the site. The general pavement section consisted of geotextile, crushed rock subbase, and base topped with concrete. The final solution was to implement three different pavement sections according to the intended use. This resulted in deeper subbase levels in the container stacking areas and reduced subbase levels elsewhere. General details are shown in Figure 8 below.

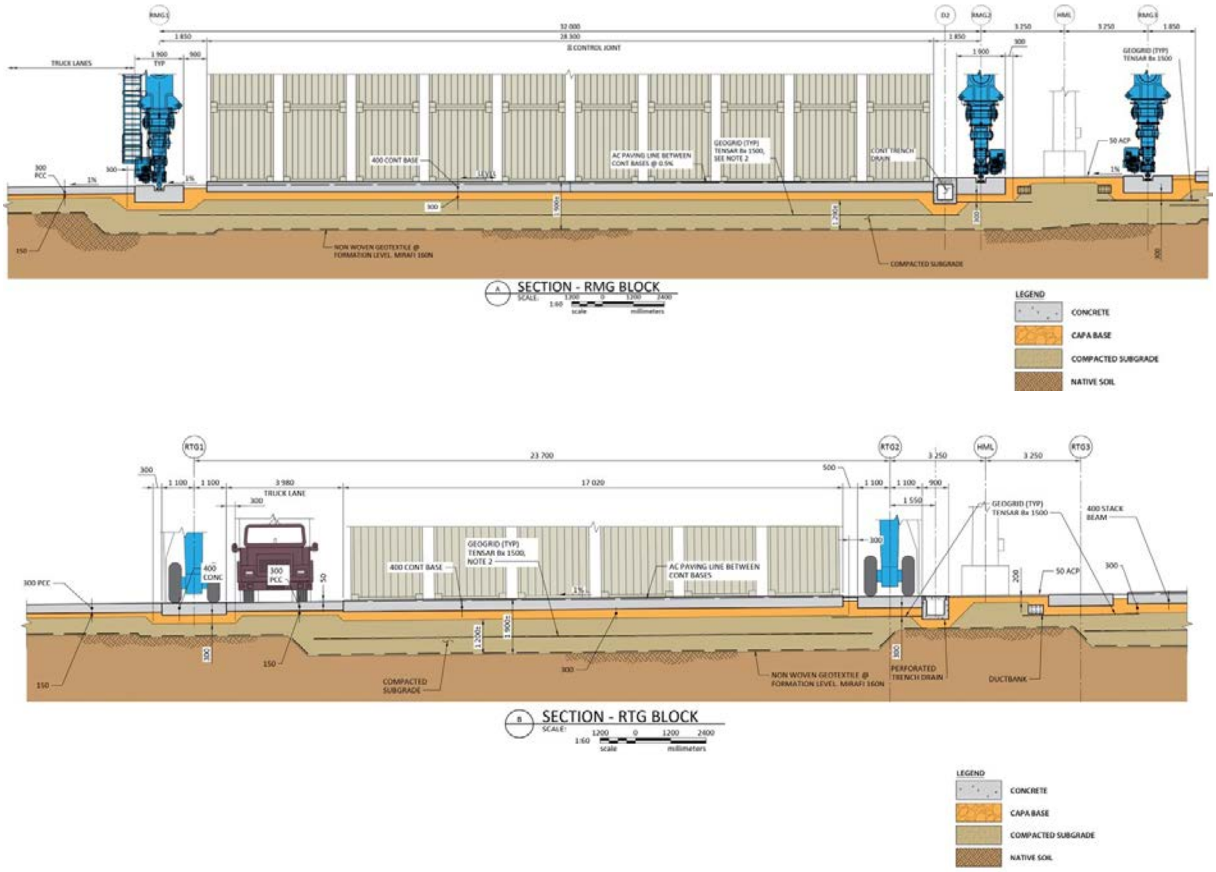


Figure 8. General Pavement Section

6.0 DESIGN CHALLENGES – ELECTRICAL SYSTEMS

The reconfiguration of the terminal had to take into account the existing electrical power distribution system, switchgear, Phase 1 quay cranes, Phase 1 refrigerated container facilities, and the terminal administration buildings. The eventual goal was to develop a new main power center and use the Phase 1 substation to support only legacy equipment from Phase 1. The Phase 1 substation is rated at 5 megavolt amperes (MVA). Feeder line voltage is 12 kilovolts (kV) in from the power company and 6.6 kV out to the terminal. The new Phase 2 main substation (power center) is rated at 16 MVA. Feeder line voltage is 12 kV in from the power company and 12 kV out to the terminal. The local power company, GNF, is constructing a new substation rated at 16 MVA, with future expansion to 32 MVA. The feeder line voltage will be 44 kV in and 12 kV out to the PSA Phase 2 substation. Emergency power on the new terminal is provided by two 2.5-MVA diesel gensets.

The Phase 1 substation provided power for the entire site/terminal until the new power center was completed. Because the Phase 2 main substation could not be built early in the project, a temporary power feed was required from the Phase 1 substation to the new quay substations powering the new quay cranes and RMG cranes. This temporary system required new duct banks and manholes, which were not envisaged in the original container yard civil works contract.

The new terminal also includes a latest state-of-the-art terminal operating system with extensive fiber-optic cabling and Wi-Fi transmission facilities. The terminal has multiple redundant systems for electrical power, IT services, CCTV, and sensors. The systems design and equipment specifications were not fully developed until after the award of the new container yard civil works contract. This fact required extensive design engineering and close coordination with the contractor throughout the construction period to relocate duct banks and add new duct banks and electrical manholes.

7.0 CONSTRUCTION CHALLENGES

The overall Phase 2 development plan included an early works program to clear the site, install wick drains, and surcharge the future Phase 2 container yard area. Surcharge was removed prior to start of the Phase 2 civil works, and the sand drain blanket material was stockpiled on site for future use.

Construction commenced with rough grading and excavation of near surface weak soils and Pacific Muck to the design contours for the subbase formation level, and then was followed by installation of the stormwater drainage system, which was generally located below the subbase formation level. Following the rough grading operations, the prepared site was proof rolled and tested. Soft spots and areas that did not achieve a minimum CBR=2 (California Bearing Ratio) were over excavated for an additional depth of 600 mm and backfilled with crushed rock; or if the area was very small, crushed rock was spread and rolled into the soft spot. After inspection and acceptance, geotextile fabric was spread over the area and backfilling with crushed rock commenced. The crushed rock was placed in layers and compacted to achieve a relative density of at least 95 percent. The above-described operations were straightforward; however, the site was handed over to the container yard contractor in smaller segments as the quay contractor finished his work that led to inefficiencies and eventually resulted in double shifting of some of the works. Water utilities, electrical duct banks, RMG and RTG runways, container sleepers, and PCC pavement construction followed.

Resident engineering services were provided in two phases; the first phase was for the new quay construction and basin dredging, the second phase was for the new container yard and electrical and IT services. The start of new quay and basin construction preceded the container yard construction by about 15 months; however, there were still conflicts due to site, schedule, and logistic issues. Therefore, the resident engineer for the second phase had the responsibility to coordinate the new container yard construction with all of the remaining contracts, which included completion of the new quay, equipment deliveries, electrical and IT services, and staged handover of the completed Phase 2 construction.

The coordination process was challenging; requiring continuous oversight of different major contracts, contractors, and subcontractors. A coordination meeting was held every morning between all contractors working on the site; the day's work area priorities were then established for each contractor. The process worked smoothly except for delays in completion of tasks within the first phase works and the electrical contract; and finally the delivery of new quay and yard equipment to the site. The new container yard civil works contractor was impacted several times during the construction process, as he had to give way to the quay contractor, and then the equipment deliveries and commissioning. At numerous occasions, civil works for the container yard were performed out of sequence until the quay contractor completed his work and demobilized. In order to meet schedule, the engineer had to develop numerous temporary solutions for the civil works and electrical connections, as the civil facilities housing the electrical components could not be built. This posed both design and safety issues that were handled admirably by the entire project team.

8.0 CLOSING STATEMENT

The extremely short construction schedule for the new container yard, including reconfiguration of the existing Phase 1 terminal, compounded by coordination with other contracts and major design changes during construction, presented some interesting challenges to the design and construction team. The close collaboration between the PSA engineering teams and the designer, together with the cooperative spirit of the civil works contractor, resulted in the successful delivery of a high-quality and very complex terminal project.

Figure 10 shows the current progress of the Phase 2 development being readied for the first trial vessels in anticipation of the start of full commercial operations.

Figure 9. Overview of the Phase 2 Development Nearing Completion