POLA'S ON-DOCK RAIL TERMINAL: THE INTERMODAL CONTAINER TERMINAL OF THE FUTURE

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ABSTRACT

Meeting market demands by delivering products to customers as quickly as possible is a key concern of businesses today. This concern has been complicated because of the industrial globalization of manufacturers and the continuous development of international markets. In this international market, the efficient movement of goods is important to manufacturers as well as to the markets they serve.

What does all this mean to today's seaports? To the Port of Los Angeles (POLA), it means developing efficient intermodal terminals that minimize the time it takes to move a container from ship to rail and into the national rail network. In a quest to deliver efficiencies to its shipping customers, POLA has created an intermodal terminal that effectively combines a ship-to-rail transfer area within their traditional container terminal. This next generation of intermodal terminals will help POLA maintain its preeminence as the largest and busiest container port in the United States.

Introducing a rail terminal into the traditional marine container terminal makes sense because of the common elements in operation as well as in physical site improvements; however, many competing demands must be considered. This paper examines planning and design considerations, both complementing and competing, that have to be addressed when introducing a new mode of transportation into or adjacent to the traditional marine container terminal.

PLANNING

Traditionally, container terminals primarily supported regional markets; therefore, trucking was the primary mode of transportation to and from the container terminal. Sizes of container terminals varied considerably, and at POLA they ranged from 25 to 130 acres supporting grounded operations, wheeled operations, and a combination of both. The throughput of these terminals also varied within the range of 2,000 to 5,000 20-ft equivalent units (TEUs) per acre per year. The terminals were planned and laid out to fit the site using a modular approach to the maximum extent possible and to allow maximum flexibility of operational choices.

Serving local markets is still of primary importance to many shippers; however, the combined globalization of businesses and markets is creating a long haul requirement that is best served by rail. At POLA this was provided by intermodal railyards located 5 to 30 mi from the port. These railyards provide shippers with rail access to the three major railcarriers serving the Los Angeles Basin. The Southern Pacific Railroad realizes an advantage over the Union Pacific and the Atchison, Topeka, and Santa Fe (AT&SF) railroads because of the proximity of its intermodal railyard to the port, which is within 5 mi. Southern Pacific's advantage results from drayage charges being significantly less because of the travel distance and difficulties over the Los Angeles freeways. Also, Southern Pacific's intermodal facility is the most modern of the three railroads and was developed specifically to capitalize on the port's containerized shipping business. The railyards of Union Pacific and AT&SF in East Los Angeles originally were developed in the early 1900s to serve the Los Angeles boxcar trade, not the containerized port/shipping business. Over the years these yards were modified as much as was practical to allow efficient container handling. However, inefficiencies still exist.

Shippers today require fast turnaround for both trucking and rail transportation. This requirement has resulted in POLA designing future container terminals with intermodal railyards within the confines or immediately adjacent to its container yards. Determining the location of an intermodal yard is based on the shippers' preferences and is driven by the land configuration and size of the container terminal's intermodal business. To identify the optimal terminal configuration, POLA undertook an optimization study in 1985, entitled Operations Facility and Infrastructure

(OFI) Study, which became the basis of consideration for future terminal designs.

From the OFI study it was determined that an efficient intermodal container terminal should be configured to support a wheeled and grounded container operation and should be capable of processing an average of 5,000 TEUs per acre per year. This translates into an average of 14 containers per peak day per acre, which is determined through the following equation: 5,000 TEUs/year / 260 weekdays/year / 1.75 TEUs/container X 1.3 peaking factor. It was also determined that the cargo makeup at POLA will grow to 50 percent local market bound and to 50 percent overland common point (OCP) bound. The local market will be served predominately by trucking, with the OCP being served by rail. Therefore, the intermodal terminal must be capable of processing up to seven containers per day per acre with sufficient moves to block a train by destination.

The OFI study also indicated that a two-module container yard covering roughly 220 acres that combines a wheeled and grounded container operation would generate the volumes necessary to support development of a dedicated intermodal yard. This container terminal must be of sufficient length to support reasonable cuts of double-stack railcars, which is also an efficiency determining factor. Given these conditions, the intermodal facility that was considered for the basis of design had to support the processing of 1,540 containers per peak day.

The length of the double-stack car unit trains identified for planning the intermodal terminal is 8,500 ft, which incorporates the next generation of double-stack cars. The double-stack railcars considered are 337 ft long, and the estimated capacity of the train is approximately 250 containers. This length also considers a locomotive set consisting of four 90-ft locomotives, which is an important consideration for planning. With a throughput of 1,540 containers, the train planning volume is more than 6 unit trains per day.

In summary, the challenge is to design an efficient in-terminal intermodal yard capable of accommodating a minimum of six 8,500-ft unit trains while maintaining the integrity of the traditional container terminal. The following summarizes the planning considerations that were the basis of design for POLA's intermodal container terminal of the future.

Terminal Requirements:

- Berthing, 4 berths/ship;
- Container yard throughput (theoretical average), 3,080 containers/day;
- Container yard terminal size, 220 acres;
- 10,000 containers;
- Intermodal terminal;
- 112 double-stack cars (each 337 ft in length);
  - —56 cars at working yard
  - —56 cars at storage yard
- Peak day train movements, 6 trains/day;
- Grounded storage adjacent to working yard, 2.5 trains; and
- 600 containers.

Important Intermodal Yard Layout Considerations:

- Minimal interference between truck and train movements;
- Equal amount of storage and working tracks;
- Flexibility for access from any storage track to any working track;
- Truck flow in the facility;
- Ability to share loading/unloading equipment between container yard and intermodal yard;
- No stopping or switching moves on the rail mainline;
- Maneuverability of double-stack cars;
- Twelve-degree curve minimum with 10-degree curves desired;
- Equal access to the site by the three railroads serving the Port of Los Angeles;
- Railcar maintenance location and car maintenance accessibility while on working tracks; and
- Yard escape track.

THE TERMINAL SITE

POLA created Pier 300, a 450-acre site with dredged spoils from dredging programs at the port, the most recent of which was completed in 1983. The site configuration will serve as a dry-bulk terminal as well as a container terminal (Fig. 1).

The area being considered for development of the two terminals is outlined in white. The dry-bulk facility requires 105 acres in an oval configuration for product storage, and the areas outlined on the aerial view were reserved to meet this requirement. The remainder of the site is available for the intermodal container terminal and actually lends itself very well to terminal requirements.

The dimensions of the intermodal site are 3,500 ft by 3,750 ft, and rail service is available from the north. Diagonally the site is approximately 8,000 ft long. Consolidating the container terminal and ship-to-shore movements as close to the berths as possible is necessary. Therefore, it was important to define a site

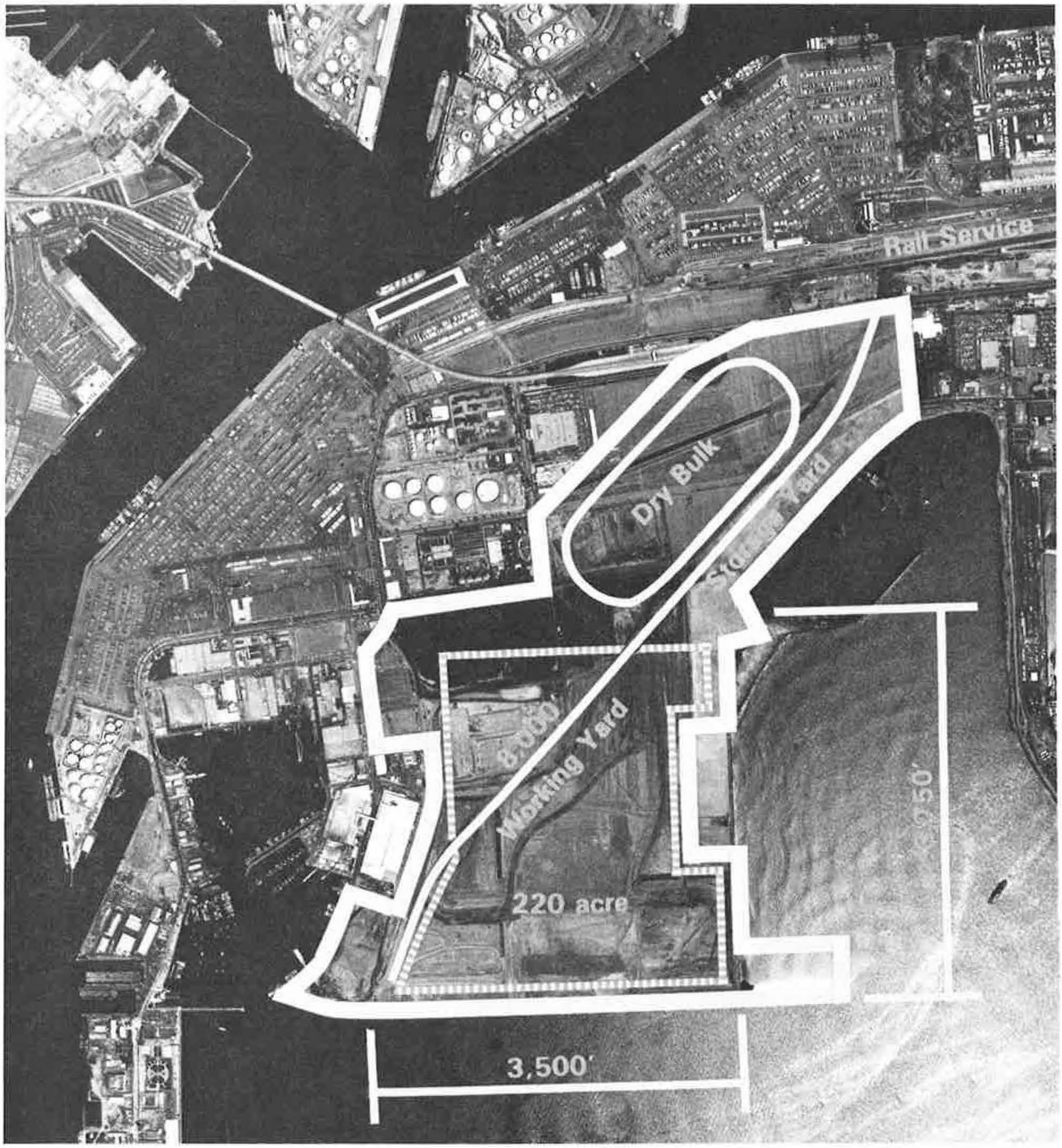

FIGURE 1 Aerial view of site.

of approximately 220 acres immediately behind the wharf without rail disruption. This began to frame the boundaries for the intermodal yard.

The site is not long enough to accommodate 8,000-ft-long working tracks with the required switches and crossovers; and the width of the site adjacent to the dry-bulk storage facility is not wide enough to accommodate two unit trains and working aisles with an equivalent amount of storage tracks. Because efficiencies are better at an intermodal operation that reduces travel distances in the ship-to-rail cycle, it was decided that trains will be broken up for storage at the intermodal

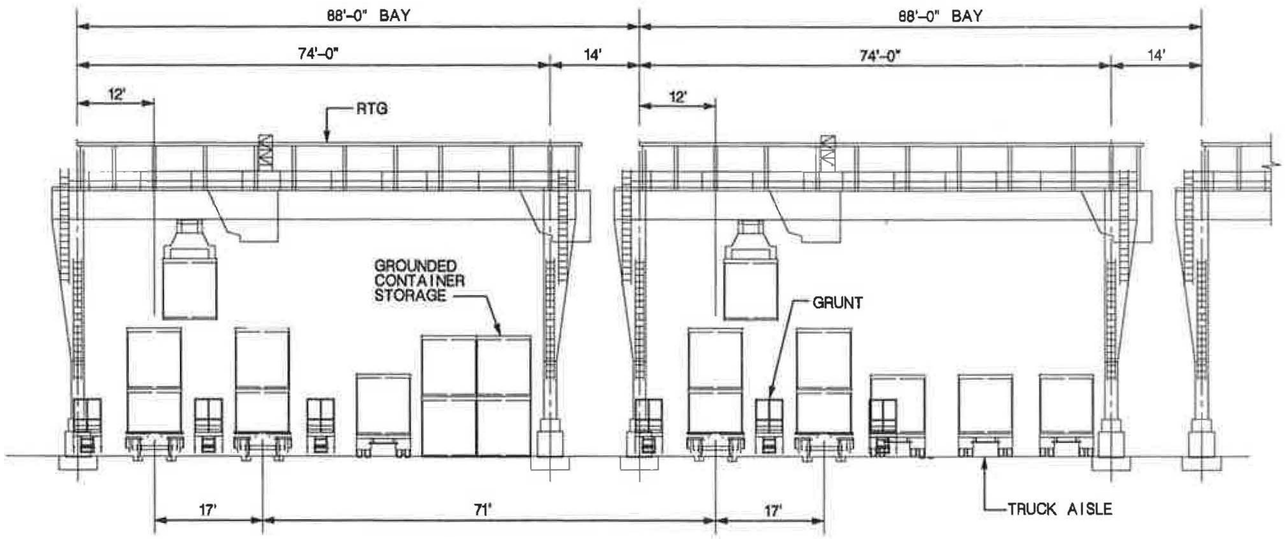

FIGURE 2 Intermodal yard working bay.

yard. Layouts for the intermodal and storage yards began.

THE INTERMODAL YARD

Intermodal Yard Configuration

Planning for the intermodal yard considered common usage of equipment throughout the container and intermodal yards. The rubber-tired gantry (RTG) was determined to be the primary equipment to be used for loading and unloading containers at the intermodal yard. The crane gage had to be consistent with the grounded container operation planned for the container yard. The gage for the RTGs is 74 ft, which results in a working bay of 88 ft to accommodate clearance between RTGs. Figure 2 identifies a typical working bay for the intermodal yard.

Intermodal Yard Working Bay

The 88 ft intermodal yard working bay will accommodate two parallel tracks and three truck lanes (Fig. 3). The bay will have sufficient track spacing for "grunts" or small scissors lifts used to place securing pins between stacked containers. This bay will also accommodate prestaging trains by grounding containers in two of the truck aisles if operations require. Top-pick and reach-stack equipment were evaluated because of the desire for the bay to be flexible enough to accommodate other means of operating the intermodal yard and to address peak loading demands if necessary. The working bay will accommodate a reach-stack as well as a top-pick operation for loading and unloading railcars and trucks. However, aisle spacing will not accommodate a reach-stack or top-pick maneuvering and traversing longitudinally between railcars while transporting a container. Such maneuvers tend to be inefficient in a container transfer operation.

Intermodal Yard Working Bay Operational Options

The width of the intermodal yard is based on the number of bays necessary to accommodate two unit trains, each approximately 8,000 ft in length. Because the Pier 300 intermodal-yard working area is unable to accommodate an uncut 28-car unit train, it was determined that the length of the cuts would be a function of the following:

- The port's requirement for equivalent storage of railcars at the site;
- The requirement that all switching moves between working and storage tracks be internal and not affect mainline trackage; and
- The desire to provide the flexibility to access any track in the storage yard from any working track in the intermodal yard. (This requirement decreased the length for storage areas at both yards because of the development of a common switching point—the "throat" of the intermodal facility.)

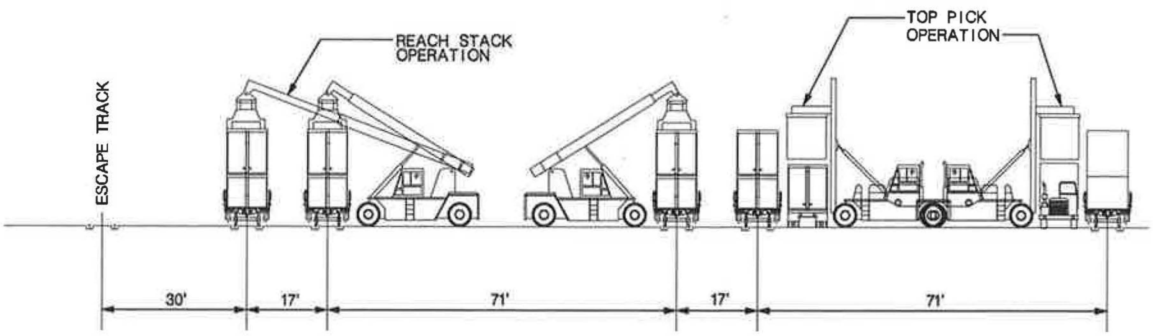

FIGURE 3 Intermodal yard working bay operational options.

Based on these considerations, car cuts were identified as the most appropriate option for accommodating two unit trains.

Taking into consideration a working bay width of 88 ft, 112 double-stack railcar storage, and each track holding an eight-car cut, the width of the working yard was established at approximately 360 ft. Because the intermodal yard requires paired tracks, eight tracks are planned for the working yard to accommodate a total of 64 cars. The storage yard also has to provide equivalent storage along with the flexibility to access any intermodal yard track from any storage track. Given these requirements, the intermodal facility will have eight 8-car tracks at the working yard and the equivalent amount of storage in the storage yard. In addition, at the intermodal yard, an escape track will provide access around the working tracks to accommodate the maneuvering of locomotives when all tracks are occupied. Planning also had to consider expansion capability, including the addition of two more working bays (i.e., two pairs of tracks).

The storage yard, whose width was established to accommodate eight-car cuts to the working yard, will include two additional tracks. One of these tracks will provide the continuation of the escape track for maneuvering locomotives when all storage yard tracks are occupied. The other track is intended to be used as a railcar maintenance track that will provide storage and repair of railcars that are not roadworthy. The separation between these yard tracks, which are driven by California Public Utilities Commission requirements, will be spaced at a minimum of 14 ft. An additional 16 ft of separation between tracks will be provided at the railcar maintenance track to accommodate repair operations and repair vehicle maneuvering.

The minimum length of each of the intermodal yard tracks was established at 2,700 ft to accommodate eight 337-ft future generation double-stack railcars. In addition, within the working yard, an aisle is required for truck/yard hostler flow at midpoint along a railcar cut. This aisle was established at 70 ft; therefore, the resulting minimum length of track in the working yard area is 2,770 ft. Figure 4 shows the configuration of the intermodal yard and identifies the working yard and storage yard.

Intermodal Yard Layouts

The intermodal yard layouts were developed to facilitate train movements between the working yard and storage yard tracks. In addition, simultaneous train movements between the yards to maximize rail activity on the working tracks during downtime of the container transfer operation is required. To accomplish this, the intermodal yard was developed with double-track leads through the throat area. Crossover capability is also necessary to meet the original requirement of providing complete flexibility to access any storage yard track from any working track. As a result, this facility effectively will be two separate intermodal yards in juxtaposition with complete crossover capability.

Rail access to the facility will be provided by a dedicated lead track approximately 3,000 ft in length. The length of the lead was established through the operational condition that trains must not perform switching movements nor stop when entering a terminal while on the rail mainline. All train stoppages and switching moves must be accomplished within dedicated lead tracks and the intermodal yard so that mainline railroad trackage is not blocked. In addition, a second lead branch from the main terminal lead will continue the double-yard concept and provide the maximum length possible for train operations.

Developing the optimal intermodal yard layout was an intensely iterative process in which a balance was achieved; the envelope established by adjacent facilities was not violated; equivalency between working yard and storage yard track capacity was maintained; flexibility in accessing any storage yard track from any working yard

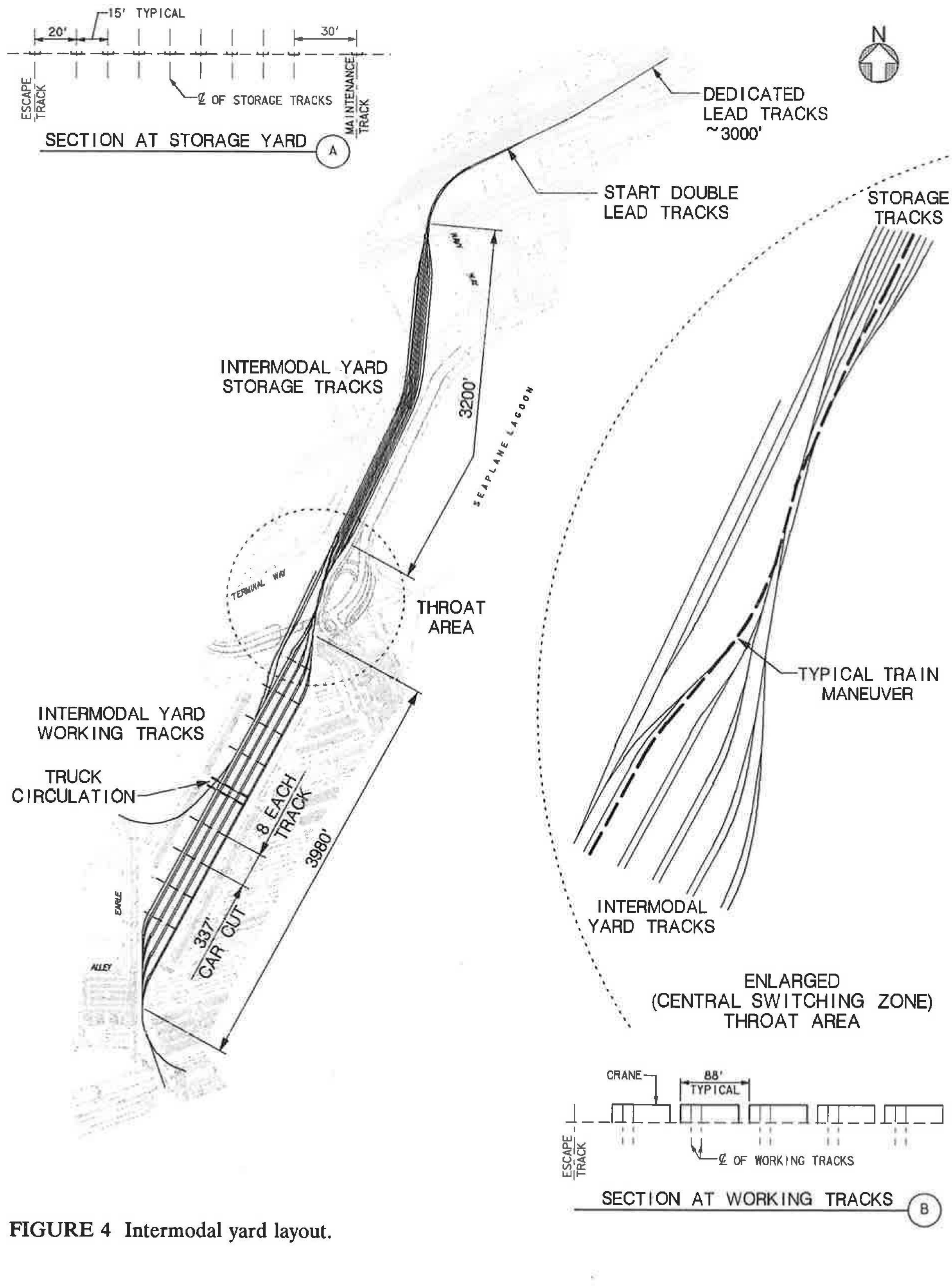

FIGURE 4 Intermodal yard layout.

track and vice versa was provided; simultaneous rail operations through the throat can occur; and standard rail construction (i.e., standard special track work) was incorporated to minimize rail maintenance. In the quest to achieve success, 25 intermodal yard layouts were developed. All stakeholders including POLA, the tenant and terminal operator, and the three railroads that potentially will use the facility were involved in developing the optimal layout. Figure 5 presents the intermodal terminal layout selected for the Pier 300 container facility.

Intermodal Yard Train Operations

Train operations in the intermodal yard will be provided by yard switcher locomotive (yard power) and road power locomotive consist (road power). The yard switcher will be a dedicated locomotive for this facility and will be used to maneuver cuts of cars between the storage and working yards. This yard power will also position cuts of cars into a unit train in preparation for the road power to connect up and depart the terminal. The road power will enter the intermodal yard and perform the maneuvers to store a train in working area, storage yard, or both. The road power will either exit the facility empty or connect to a waiting unit train, perform the final preroad check, and depart the terminal. Road power may also perform the moves to make up a unit train if that operation is included in the carrier's agreement with the tenant.

The time it takes to perform rail moves was considered in laying out the terminal to assess the time the working area might experience disruption for container transfer operations. The times given are ideal times and do not consider unique situations such as locomotive or railcar malfunctions or worker injury. These times were developed to assess the amount of time that trucks will have to be curtailed or prohibited from traversing over the active track:

- Putting a train away in the working yard using road power will take 72 minutes. During this time, truck activity over three tracks will be affected.
- Putting a train away in the storage yard using road power will take 43 minutes. During this time, the road power and an eight-car cut will operate on an empty track at the working area. Truck activity will be affected over this active track.
- Maneuvering an eight-car cut from the working area to the storage yard and replacing a new eight-car cut into the working area will take 49 minutes.
- Making up a unit train with yard power will take 120 minutes.
- Making up a unit train with road power will take 90 minutes.
- Final train makeup by road power, given a unit train readied by yard power, will take 30 minutes.

Given these ideal times, the turnaround time for a road locomotive to put a unit train away and perform final makeup of a readied unit train is 102 minutes. Taking into account the switching times, it will take between 3 to 5 hours to completely turn over the working area, depending on the amount of simultaneous operations.

Intermodal Yard Automation and Safety Features

Switching at the intermodal yard will be accomplished with hand-operated and remote-operated power switches. Power switching will be incorporated at the throat and the entrance of the storage yard because it is anticipated that these areas will experience the most train activity. The remote source for switching will be the intermodal yard tower, which is located at the truck entrance for the container yard and which provides full view of the working yard. Hand-operated switches will be located at the south end of the yard, where the activity is less and where there are trailable switches to facilitate operations for this area. Automated equipment identification will be included in the facility and will provide the capability to identify the containers and railcars on each track in the intermodal and storage yards. Each container and car will be read as it enters and exits the facility, and track sensors along with motion detectors will identify the tracks where the cars are destined.

Blue flag derails will be used for safety on working tracks in the working yard as well as on the maintenance track in the storage yard. Each working track will have additional protection at the intermediate truck access aisle to permit maneuvering of smaller cuts of cars, thereby providing protection for the remaining cars on the track. Power-operated blue flag derails will be provided at each working track in the working yard and will be operated from either the intermodal yard control tower or locally at the derailer through a locking device. The maintenance track in the storage yard and the escape track in the working yard will use hand-operated blue flags because of the less frequent operations at these locations.

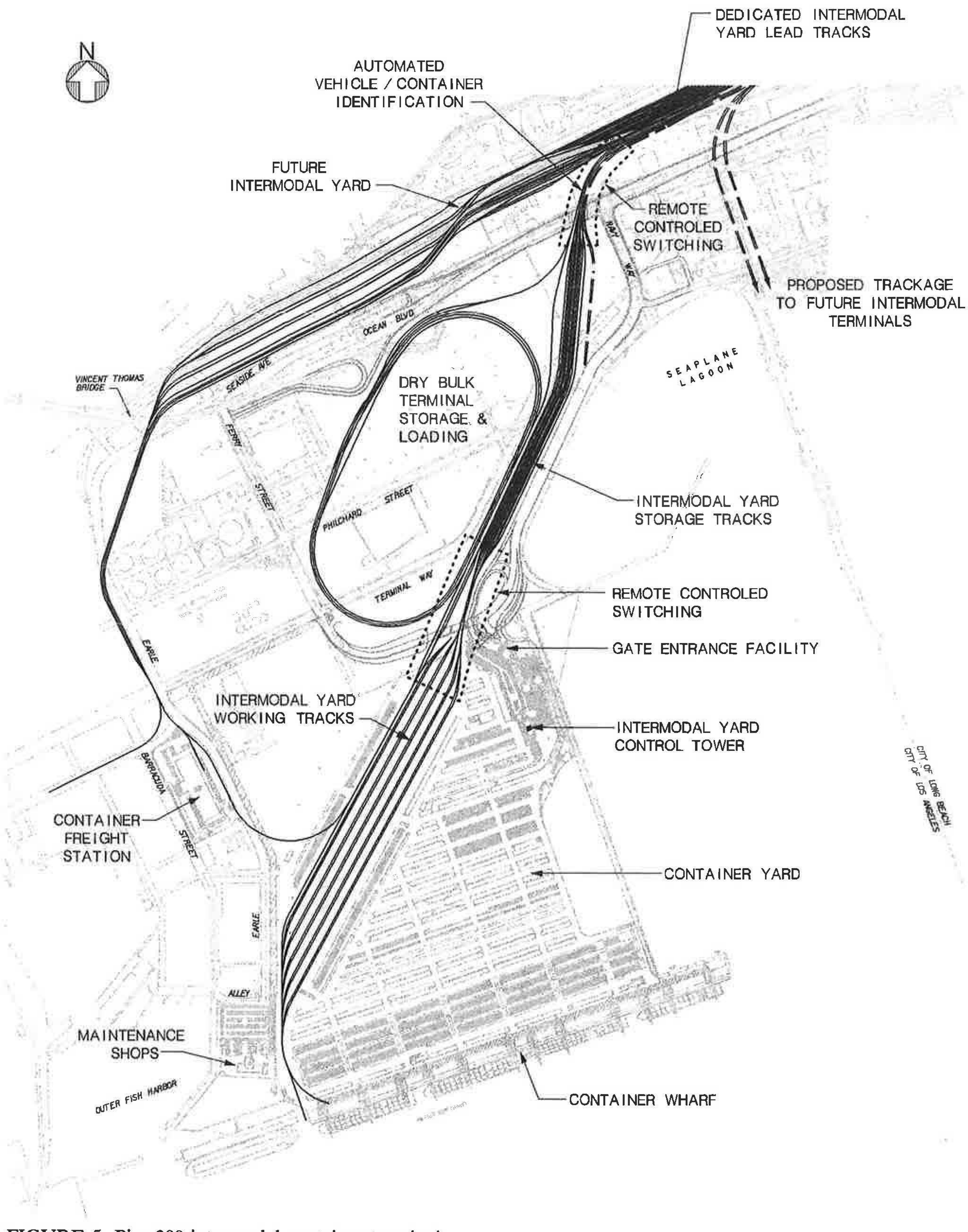

FIGURE 5 Pier 300 intermodal container terminal.

CONCLUSION

Introducing an intermodal yard into a container terminal involves a number of economies attributed to capital improvements and maintenance and creates operational efficiencies. Combine this with the price competition offered through equal access of three major Class 1 railroads for transporting goods and it becomes clear why this terminal is POLA's model container facility for the next decade. Common capital improvements include the following:

- *Yard pavements.* The container and intermodal yards are designed to accommodate 100-kip wheel loads for the planned top-pick and front-end loader operations as well as for the RTGs.
- *Yard lighting and fire suppression systems.* Lighting levels and fire fighting requirements for the container and intermodal yards are similar; therefore, the planned systems will use the same equipment.
- *Compressed air systems.* Railcar air makeup systems have the same supply demands as maintenance shop systems; therefore, common equipment will be used throughout.

The intermodal yard will employ common rail equipment within the working area and storage yards, including a 136-lb, continuously welded rail on concrete ties; standard number 9 turnouts; and all other standard specialty track work necessary to complete the facility.