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Port Kembla Coal Terminal

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Der Kohlenhafen von Port Kembla
Terminal charbonnier de Port Kembla
Terminal de carbón de Port Kembla

ポート・ケンブラ石炭ターミナル

肯伯拉港的煤炭集散站

محطة الفحم في بورت كمبلا

Summary

The new coal loading facilities at Port Kembla, presently under construction and to be commissioned in August 1982, are being described. The system consists of unit train and bottom-dump truck unloading, open stockyard, shiploading and extensive conveyor belting.

One of the major criteria in developing the facility design was its environmental impact on the neighbouring towns. A coal dust suppression system was incorporated to suppress coal dust at the transfer as well as to maintain stockpile surface moisture which is essential for the local summer temperature and high wind conditions.

The main system items such as railroad receiving, truck inloading, conveyor system, coal yard with stackers and reclaimers and the spray, storm water and drainage system, and shiploading are outlined.

1. Introduction

The Port Kembla Coal Loader is being constructed south of Sydney in New South Wales, Australia. The terminal is a development by the N.S.W. Government, with the Public Works Department as the construction authority, while the Maritime Services Board will own and operate the terminal.

The system master planning and detailed design and contract packages have been prepared by Soros-Longworth & McKenzie and Soros Associates. The terminal is planned for an ultimate capacity of $25 \cdot 10^6$ t/year with Phase 1 currently under construction, possessing an annual capacity of $15 \cdot 10^6$ t/year, a stockpile capacity of $0.8 \cdot 10^6$ tonnes in 16 grades and the ability to load 110,000 DWT vessels to full draft or 160,000 DWT vessels to partial draft. Phase 2 will expand stockpile capacity to $1.4 \cdot 10^6$ tonnes and add a second loading berth inshore for 160,000 DWT vessels, or alternately an off-shore berth for up to 250,000 DWT vessels (see Fig. 1). Phase 1 is designed to permit construction of Phase 2 without interruption of operation.

The design incorporates a variety of innovative features for enhanced reliability and ease of maintenance and clean-up. In particular, the environmental controls incorporate the best modern technology and represent a comprehensive approach including dust suppression and control, truck washing, noise control, fire prevention, water treatment, landscaping and aesthetic considerations, as well as features to increase the safety and convenience of the operating personnel.

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2. System Concept

The facility is designed to receive, simultaneously, deliveries by both road and rail. A multiplicity of grades require to be stockpiled in separate cargo lots. The majority of the tonnage will arrive by rail, in bottom dump wagons of 77 tonnes capacity. Trainloads will initially be up to 2,500 tonnes, to be increased in the future (see Fig. 2).

Trains will be dumped, in motion, traversing a loop track into a shallow 300 tonne capacity pit, at approximately $^1/_2$ hour per train. For Phase II a second loop and pit will be provided. Trucks will dump directly into one of three 2,200 tonne capacity receiving bins. All coal received is treated for dust suppression, passed through a magnet, weighed and stockpiled at the rate of 4,400 t/h.

There are two stacking conveyors with the unusual arrangement of each serving 2 travelling stackers. This innovative system eliminates waiting between trains, since while coal of a certain grade is dumped by one train and stock-piled by one of the stackers, the other stacker traverses to the position corresponding to the grade of coal in the next train. With stockpile length of over 1 kilometer, it may be appreciated that considerable train waiting time is saved by prepositioning the stackers.

The coal grades dumped by truck may be stacked simultaneously, on the stacking belt not serving the railroad at any given time.

Coal is reclaimed by bucket-wheel at the rate of 6,600 t/h onto a yard conveyor in the center. Thus, there needs to be only one pile for each grade of coal, and it is accessible to the bucket-wheel at all times. A second bucket-wheel provides complete back-up against break-down and as for the stackers, it can be pre-positioned to save bucket-wheel travel time when changing grades.

Phase II will incorporate a second yard conveyor and a third bucket-wheel, to enable simultaneous delivery to two berths.

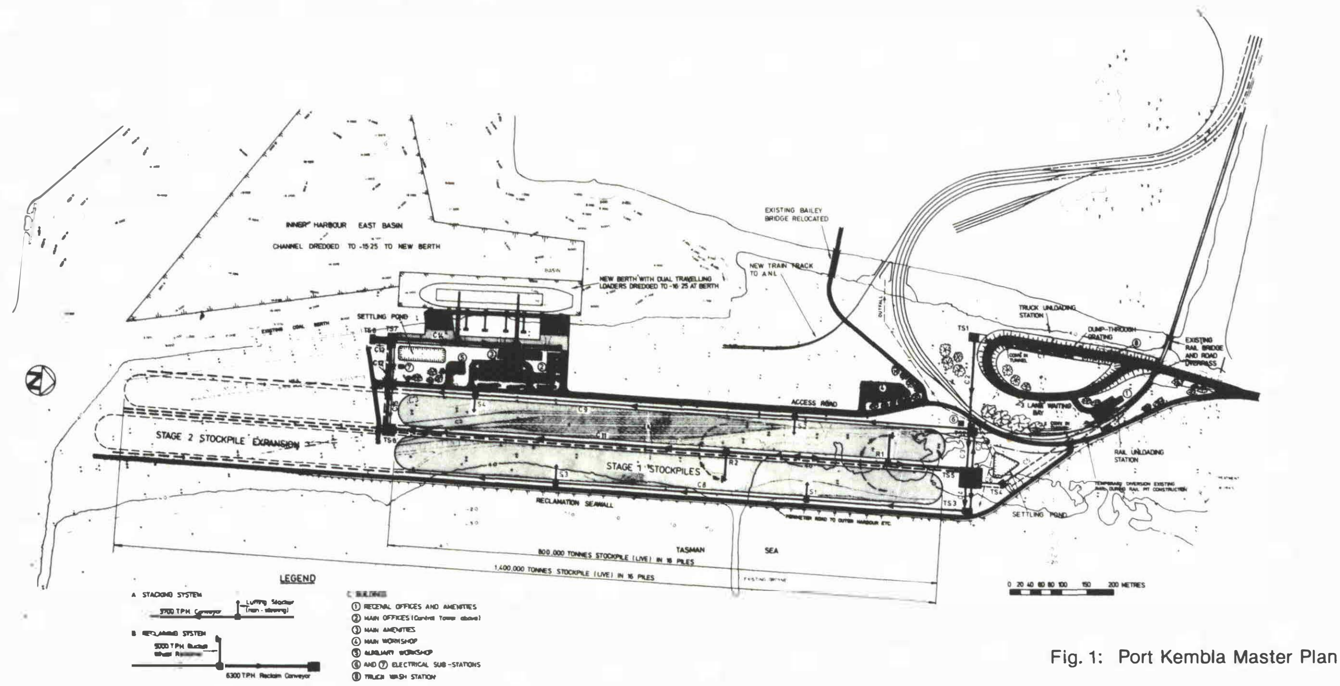

Fig. 1: Port Kembla Master Plan

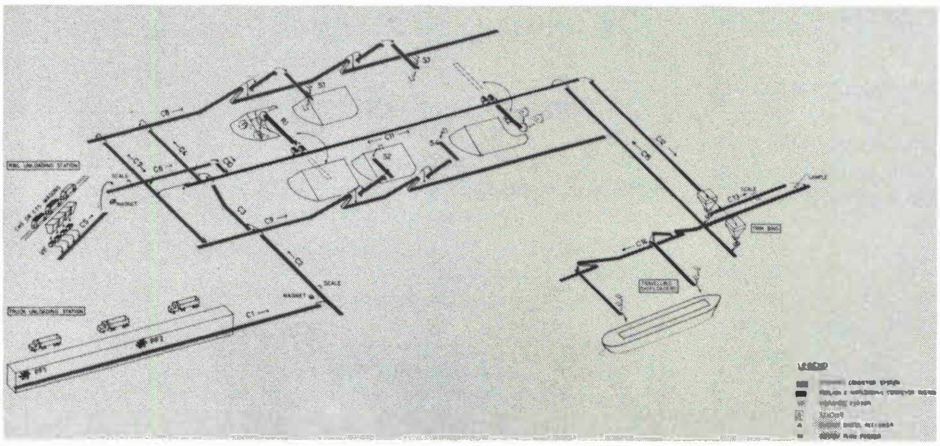

Fig. 2: Flow diagram of Phase I

The coal is weighed and sampled on its way to the dock conveyor.

A novel feature of the loading berth arrangement is the use of two travelling shiploaders served by the same dock conveyor. This makes it possible to switch from loading one hold of the vessel to another without interruption and provides back-up against shiploader breakdown.

Multiple switch bins before the dock conveyors are another first that permits purging the system of any excess coal when switching coal grades or trimming a vessel, thus reducing a source of delay. From the switch-bins coal may be returned to the stacking system via a reversed yard conveyor. The same material flow pattern is used for recirculation for stockpile re-organization.

A computer controlled stockpile inventory system keeps track of the multiple grade deliveries and shipments, as well as logging other operating information.

3. Railroad Receiving

Moving trains bottom-dump into a shallow 300 ton surge hopper equipped with 6 controllable variable speed vibrating feeders. The combined feeder capacity is considerably in excess of the 4,400 t/h conveyor capacity, in order to provide the flexibility to cope with the uneven speed and distribution of the coal being dumped.

The unloading station is designed to operate with any one of the feeders out of service. Chemical agglomerating sprays for dust control are located within the hopper and at the vibrating feeder discharges.

4. Truck Unloading

The truck unloading station is a slot storage with three 2,200 tonne capacity compartments inside of a man-made mound, with a three lane road on top (Fig. 3).

One of the lanes is open, with a grating over each compartment (Fig. 4).

The system allows up to 3 coal grades to be received and dumped by up to 10 trucks at the same time.

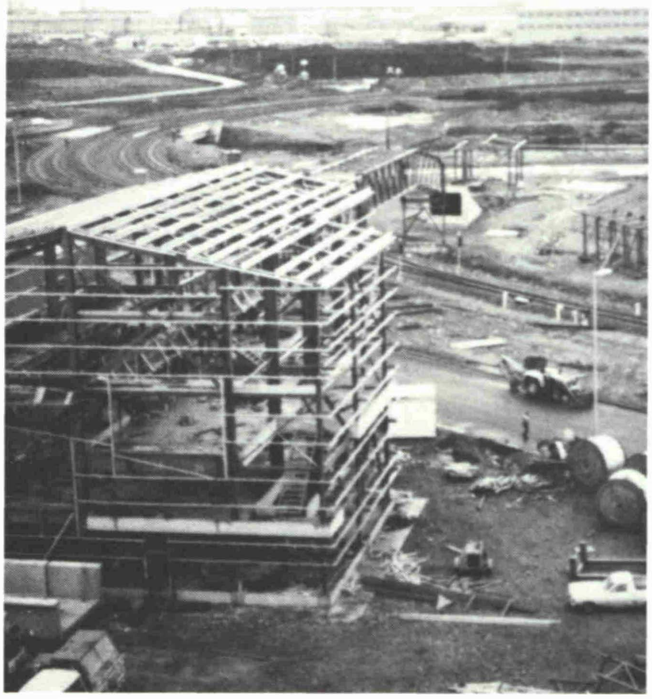

Fig. 3: View of TS-2 with railroad loop and 3-lane truck ramp loading to top of slot storage

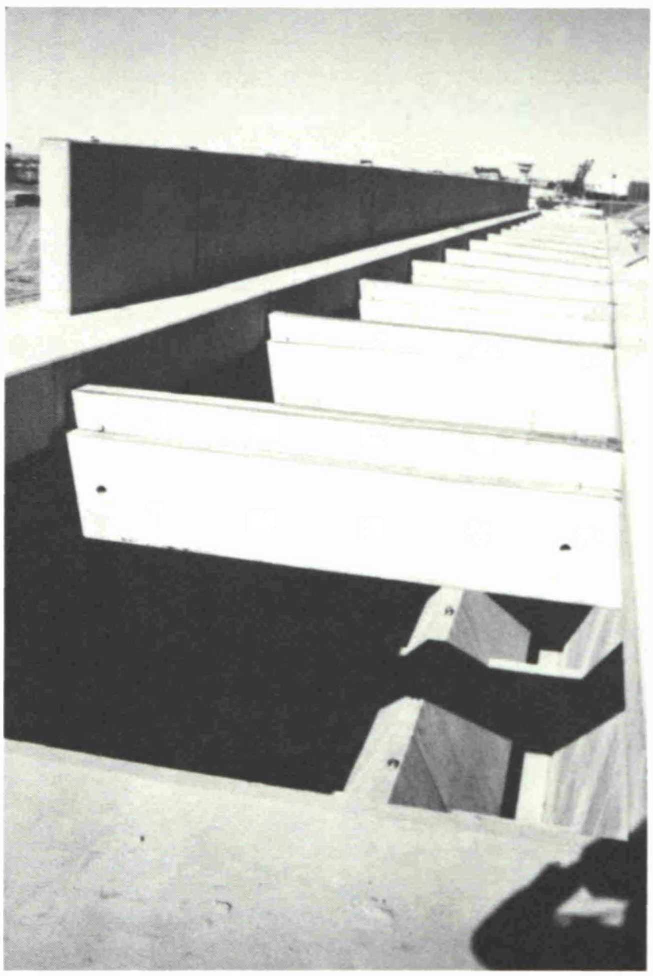

Fig. 4: Top of slot storage, before installation of grating

The slot storage is of concrete construction with 70° wall angles. Stored coals will be withdrawn by two plow feeders (2,200 t/h each) traversing in a tunnel under the compartments.

Maintenance bays for the plow feeders are provided at each end of the tunnel (Fig. 5). Dust agglomerating sprays are located at the compartments and plow feeders.

All trucks are to be thoroughly cleaned at an automatic wash station before departing, in order to minimize discharge of fugitive dust and drippings on plant and public roads. Washdown water, fully recyclable, will move to a settlement tank, with recovered solids returned to the stockyard, or used for landfill if suitable. An oil arrestor is also to be provided, with provision for offsite disposal along with workshop oil wastes.

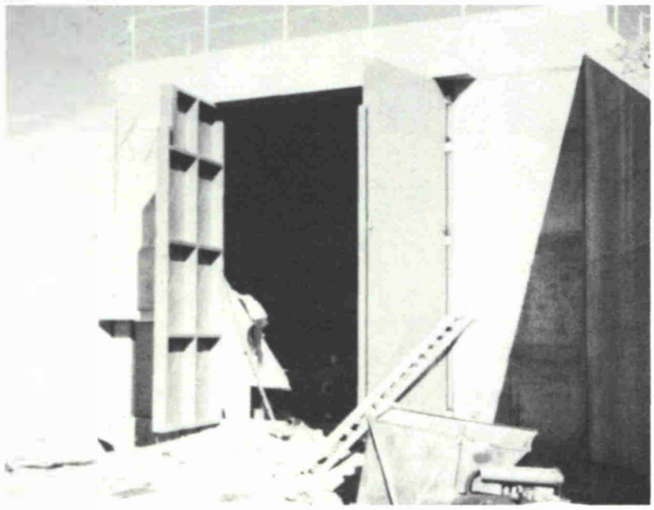

Fig. 5: Doors to the plow feeder maintenance bays under the slot storage

5. Conveyor System

Many of the local coals have difficult handling properties, being sticky and wet with 7—12 % moisture upon arrival, increased up to 9—14 % by the agglomerating spray system, being typical. This required special attention and know-how in respect to design details.

All transfers are belt-to-belt, in straight line or at right angles. Multiple discharges are via moving heads, in order to avoid the use of flop gates or two-way chutes that are a source of trouble with sticky coals. Chutes were designed with adjustable curved impact plates and steep plate angles with stainless steel liners to collect the scrapings from dual scrapers.

All yard conveyors are elevated and mounted on long span trusses supported by T-shaped concrete posts, to prevent dust accumulation and to provide unrestricted access for clean-up by machine (Fig. 6). Such access is paramount for clean-up when torrential rains can cause local slide/slippings from stockpile. Elsewhere, all elevated conveyors are in galleries with concrete floors and waist-high concrete walls. All transfer stations and galleries are enclosed with concrete floors and piping to facilitate wash-down. Tail pulleys are elevated to prevent build-up of spillage, that could

Fig. 6: Yard conveyors are on concrete posts to facilitate clean-up. Side berm protects against "slumping"

otherwise be an operational and fire hazard. Where scrapings cannot be returned to the floor, they are collected in 3-sided containers on the ground floor for mechanical disposal.

Front end loaders will have unrestricted access through transfer station ground floors since the design features off-ground loading areas, and minimum equipment on the concrete ground floors (Fig. 7).

The connected conveyor horsepower of Phase 1 is 9,100. Drive modules are standardized to minimize spare parts inventory. The stacking conveyors are the only ones that will be lengthened in Phase II and have been designed accordingly (see Fig. 1).

Fig. 7: TS-5 and control tower. Conveyors are elevated, with concrete floors and walls, for washdown. Ground floor has unrestricted access for clean-up.

6. Coal Yard

The coal stockpile pads are in 2 parallel rows. Typically, there may be some 16 separate coal grades on these pad areas. In Phase I, the yard is 1 km long, with an effective capacity of 800,000 tons; the design allows for lengthening to 1,700 m for Phase II.

Rubber-tired or bulldozer traffic is not permitted on the stockpiles, in order to avoid dust-creating material turbulence. The bucket-wheel reclaimers have 52 m long booms and use special runways in order to create completely live piles. The embankments at the toe of the piles also serve to protect the runways from being buried from the coal pile "slumping" in the rainy season. Low cost slag available from the nearby steelworks was used for stacker and reclaimer runway and stockpile base construction (Fig. 8).

7. Stackers and Reclaimers

The system incorporates 4 one arm luffing stackers with conveyor bypass, served by 2 stacking conveyors. Two stacking conveyors and 3 stackers are being installed in Phase I.

In Phase II the stacking conveyors will be lengthened and the fourth stacker added. The trailer and boom conveyors have a vertical curve. This design was developed to reach the required 26 m stacking height with minimum trailer and boom length (and hence cost) consistent with the limited slope at the loading point and on the conveyor, before wet coal would slide back (Fig. 8). The conveyor bypass is accomplished by changing the distance between the tripper and the stacker-trailer (Fig. 9).

The bucket-wheels are the largest capacity coal reclaimers, with a rating of 6,600 t/h each. The wheel diameter is 10.5 m, with bucket capacities of 2,700 litres. Boom length is 52 m.

A pantograph counter weight system minimizes displacement of the center of gravity under varying load and operating conditions, and dampens machine vibrations. A surge bin with feeders evens out surges in the reclaim rate. In Phase I, two vibrating feeders feed the yard belt located off-center. In Phase II a second set of two feeders will feed the second yard belt.

In view of the different soil conditions, the machines traverse on two sets of twin rails. Both the stackers and bucket-wheel reclaimers are constructed to special criteria, similar to other major installations engineered by Soros Associates [1].

8. Stockpile Spray System

A comprehensive dual water spray system will maintain sufficient moisture in the pile surface crust, which is necessary for maintaining the effectiveness of the agglomerating agent applied at several key points in the terminal.

One of the spray systems has conventional larger sprinkler heads which are effective when the wind is predominantly along the stockpile axis.

The second spray system creates a vertical curtain of water mist when the wind is predominantly at right angles to the pile.

The combination of the two systems can effectively cope with wind from any direction and at the same time be soft enough with controlled application not to fracture the crust of the agglomerate treated coal.

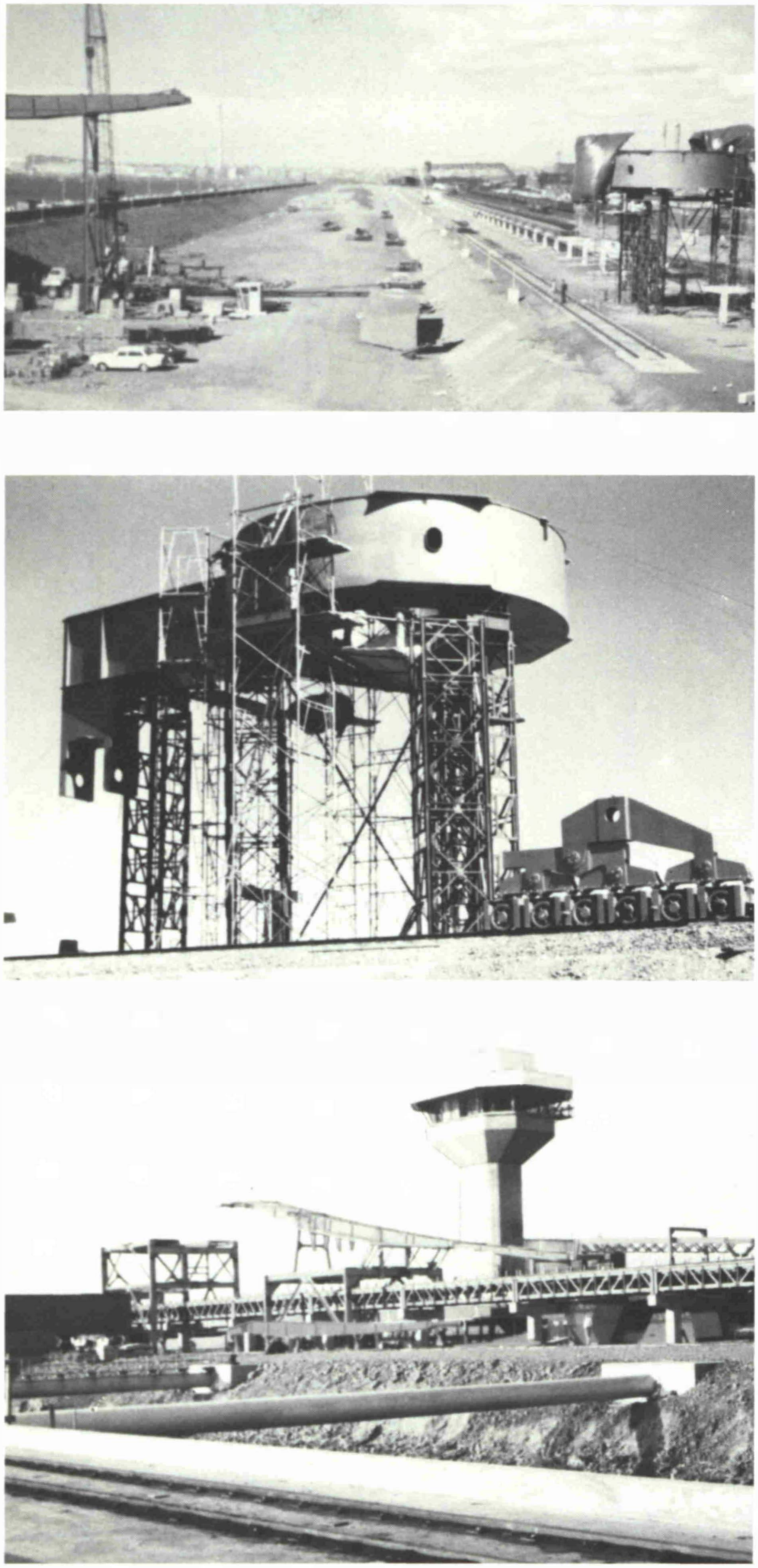

Fig. 8: Side berms reduce dead storage. 6,600 t/h reclaimer under construction will be largest in the world.

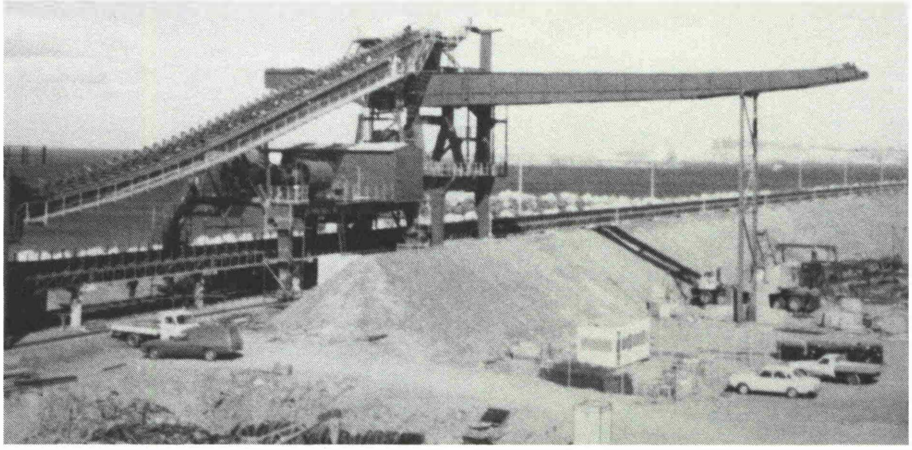

Fig. 9: Stracker trailer and boom have vertical curves, to reduce belt slope at loading points

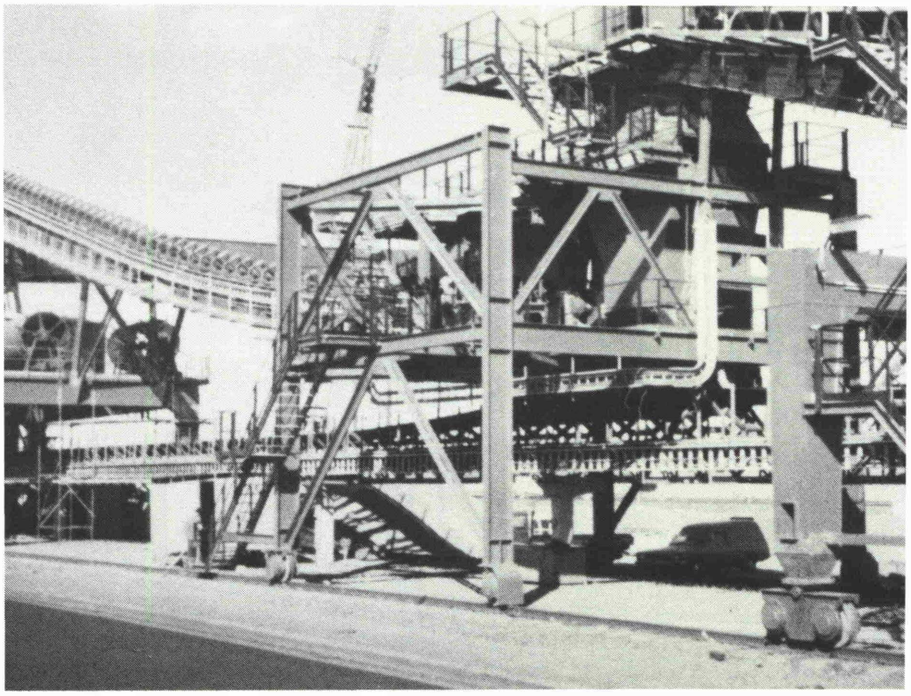

Fig. 10: Stacker conveyor by-pass

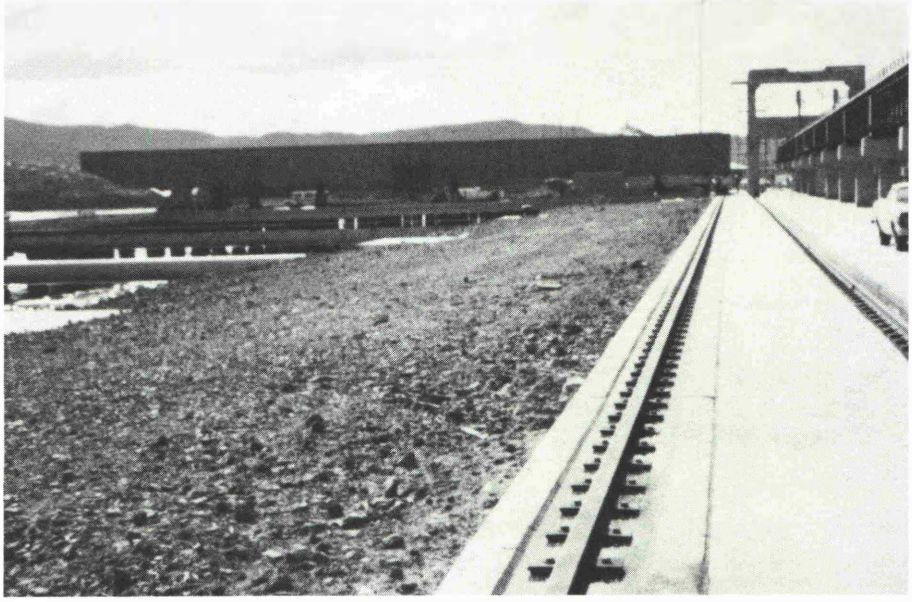

Fig. 11: Pier is a narrow roadway supporting the front end of the loader, braced back to strong-points on shore

The spray system is computer programmed for automatic operation, with sensing elements monitoring wind speed and direction, coal type, solar intensity and rainfall. It may also be controlled manually when conditions call for additional spraying.

An automatic cycle is initiated by a 10 m/sec transverse wind activating wind-side sprinklers on both sides of the piles. A wind shift aborts the cycle operating and initiates the appropriate other. An automatic cycle will also be initiated if 60 minutes have elapsed since the beginning of the last similar cycle, or if sensors show that pile surface moisture from natural precipitation is inadequate.

Operator manual controls can be used to initiate a cycle not triggered by the automatic mode, or to operate selected groups of sprinklers on a continuous basis. The manual mode can be stopped at any time for reversion to automatic, and the automatic system overrides manual if environmental conditions require spraying to begin. Excess spray water evaporates, or is collected by the drainage system.

9. Storm Water, Drainage and Settling Ponds

Site grading was designed so that all storm water will be directed inwards and will either percolate to ground water or be collected in the drainage system. This system of pipes and channels gravitates to two settling ponds, one at the northern end and the other at the southern end. A silt trap settles heavy particles and passes the first flush of storm water from the entire catchment area to the ponds. A weir system incorporated in the traps directs subsequent inflow to submerged discharged points in the inner harbor.

The ponds are sized to accept run-off from the entire site during a storm of one year recurrence. Discharge to inner harbour will then commence with back flow from the settling ponds being prevented by an arrangement of weirs and baffles.

The overall drainage system is sized to accommodate a storm of 10 year recurrence interval to ensure flood protection of the low levels of the materials handling plant. When a storm of this intensity occurs with initially empty ponds, flow will be stored until just after peak discharge is reached and the majority of the site will still be thoroughly flushed before discharge to the inner harbor commences.

Open drains were avoided wherever there was a risk of coal infill, which would create a maintenance headache. This system can be either manually or automatically flushed on a regular basis to inhibit silt build-up. Wire baskets in inlet pits prevent ingress of larger particles. Short relief drains through the stockpile berms ensure that excessive elevation of the water table does not occur when the stockyard is full.

All water subject to significant pollutants is collected and retained for treatment. The treatment is by gravity settlement and filtration. Except for storm overflow discharge, ponded water is recycled for washdown uses.

A large site reservoir provides potable water, make-up water for washdown and stockpile sprays, plus a 4 hour fire fighting reserve supply, pressured via the powerful stockpile spray pumps.

10. Shiploading

The shiploading berth is dredged to 16.25 m below low water to fully load 110,000 DWT vessels in Phase I. The shiploader has an outreach for full coverage of 160,000 DWT vessels, which may be partially loaded in Phase I, and fully loaded in the future, with additional dredging. There are 2 shiploaders fed by a single dock conveyor. Coal can be switched from one loader to the other, via a tripper by-pass, without stopping the conveyors (see Fig. 10). It is the first time this has been accomplished with only one instead of two dock conveyors.

One criterion for the shiploader design was to fully retract the loading boom and spout, to be accessible for service from land. This, coupled with restricted positions available for conveyor and transfer locations, resulted in a bridge-type shiploader configuration, with the rear rail some 60 m from the dock's face.

The pier is of open design to take advantage of this feature. It is a narrow roadway and support for the front rail of the loader and the dock fenders on piles that provide only vertical support. The large forces from ship impact and mooring are braced back to raker pile strong points on the land (Fig. 11). There is a solid deck maintenance area at both ends for the loaders in the parked position.

The shiploaders are equipped with sealed floors to retain any coal spillage and enable washdown of the machines when they are coupled to the drainage system in the parking bays (Figs. 12 & 13).

The operators cab is located over the hold. It can rotate around the pivoting chute, for maximum visibility.

11. Control System

There are two central control towers.

One, with a good view of the railroad loop and truck ramp, controls simultaneous receiving and stockpile management.

Shiploading, which is independent of receiving, is controlled from a second tower, near the loading berth. The two towers are about 1 km apart.

The operations are automated to a great extent, facilitated by the use of programmable controllers.

12. Contract Procedures

The philosophy adopted for the design, documentation and Tendering was aimed at minimum cost and to provide the Owner with a fixed price for the whole project, subject only to escalation, prior to authorizing construction. The project was sub-divided into a number of separate contract packages.

The scope of work in each contract was matched to the firms invited to tender, which meant that each contractor would be working to capacity on the type of work he specializes in, rather than merely subcontracting large portions.

The success of the Tendering which was within 5 % of the engineer's estimates, may be judged from Fig. 14 [2].

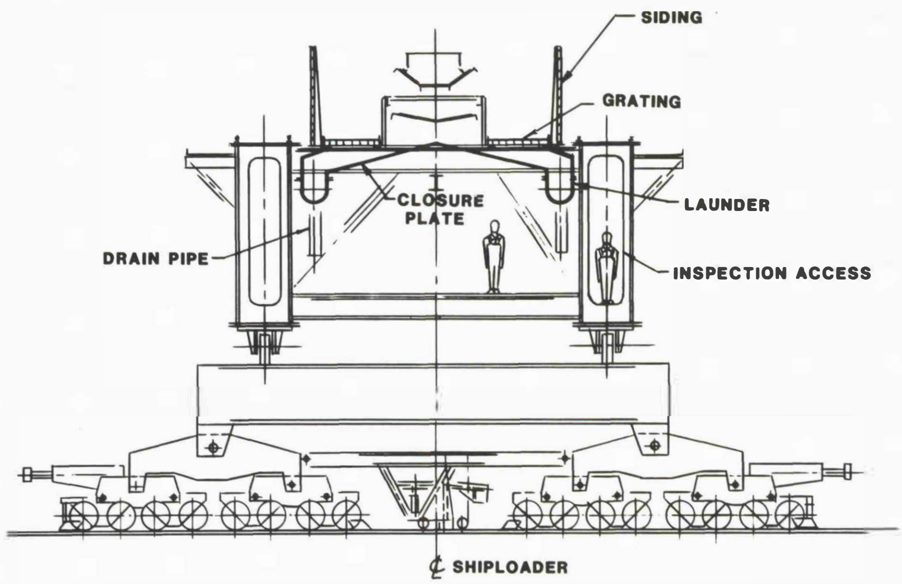

Fig. 12: Shiploader is designed for complete access to all structures for inspection and painting

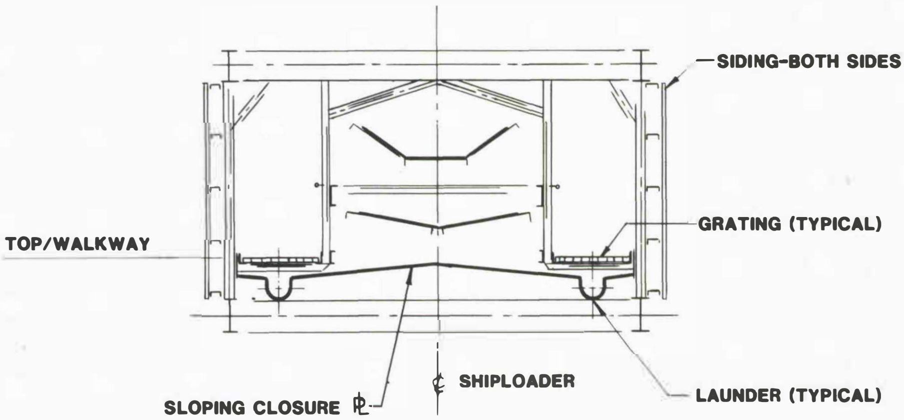

Fig. 13: Shiploader is completely sealed for washdown of any spillage

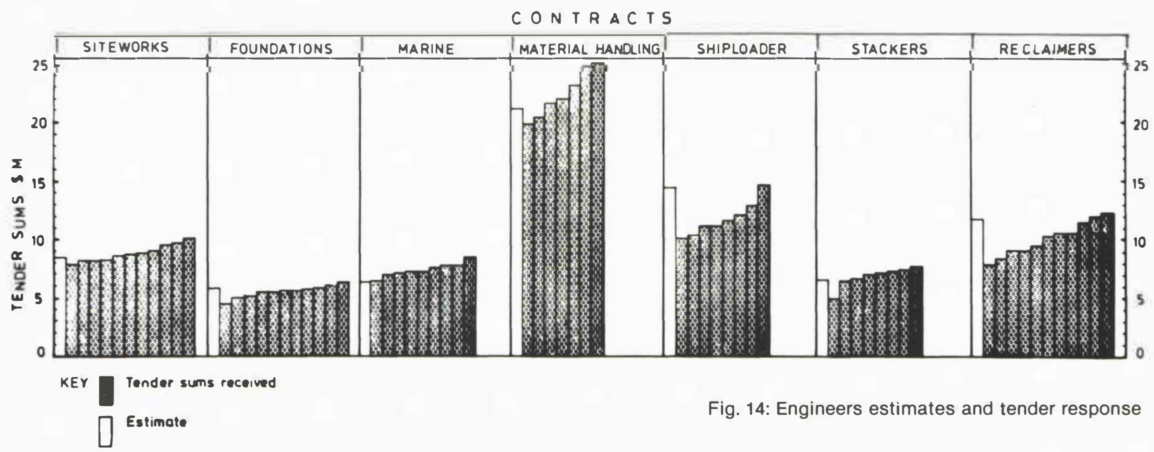

Fig. 14: Engineers estimates and tender response

13. Construction

The construction of Phase I required the early commissioning of the new rail receival facility in order to de-commission an existing rail yard serving the old control loader. This requirement to keep the existing facility operational whilst constructing the new one, provided a challenge for the engineers, both in design and implementation. Construction has proceeded to the stage of successfully commissioning the new rail receival facility.

Soros Associates and Soros-Longworth & McKenzie are providing construction planning and resident engineering services. With a major share of the construction completed, the project is within budget and on time.

References

[1] Soros, P., "Narvik Expansion Completed", Engineering & Mining Journal, July 1981

[2] Soros, P. and Ferguson, N., "Port Kembla — Contracts Awarded", Bulk Systems, October 1980