bulk solids handling Volume 1, Number 4, December 1981

Coal Loading Facilities in the Port of Newcastle

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Die Kohle-Verladeanlagen im Hafen von Newcastle
Installations de chargement du charbon dans le port de Newcastle
Instalaciones para carga de carbón en el puerto de Newcastle

ニューカースル港の石炭積込み設備

纽卡斯尔港口的装煤设施

تسهيلات تحميل الفحم في ميناء نيوكاسل

Summary

The Newcastle Export Coal Trade has developed over the last 180 years such that there are more than 37 discrete seams of coal with a requirement for blending at the port area. This and the linking together of two export facilities has created a unique operating environment which has resulted in the development of some unusual methods of integrating the various port operations.

1. The Export Industry

1.1 Historical Development

Coal was first discovered in Newcastle in 1797 and in 1799 a vessel named "The Hunter" took a shipment of coal, gathered from the foot of cliffs, to Bengal via Sydney. The first direct overseas shipment from Newcastle was in a vessel named the "Anna Josepha" to the Cape of Good Hope in 1802.

A penal settlement was established at Newcastle in 1804 and convict labour worked the coal seams and loaded the vessels. In 1831 a short wharf and a loading chute 13 ft above high water mark were erected for the Australian Agricultural Company.

Following the discovery of gold in California in 1847 and the tremendous influx of population which it engendered, there was a ready market for coal on the west coast of the United States. The development of this trade heavily taxed the port's rather elementary loading facilities. All of the vessels engaged in this trade were larger and of deeper draft than vessels used previously and it became necessary to moor these larger vessels in the stream and load them from lighters and small vessels.

A period of development ensued and by 1890 the Port of Newcastle had steam and hydraulic cranes and two loading staiths for coal loading.

In 1886 further outcroppings of coal were discovered west of Newcastle and development of the industry began moving inland up the Hunter River Valley.

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Coal exports to foreign and interstate ports during 1907 exceeded $4.5 \cdot 10^6$ tons. In 1913 a record of 5,236,621 tons was exported and the authorities were talking of making the Port capable of loading $21 \cdot 10^6$ tons of coal per annum. However, World War I intervened and high freight rates after the war were a deterrent to the revival of the overseas trade.

In 1958, to supplement the electric cranes of the time, a small, fixed head conveyor belt loader of 300 t/h capacity was installed. This was known as the Dyke Coal Loader and while it relied on a direct feed from rail wagons, primarily of the privately owned 7 to 12 ton capacity variety it was the forerunner of the modern conveyor type loader.

In 1964 work commenced on a modern loader, backed by stockpile facilities in the Eastern Basin of Newcastle Harbour for the Maritime Services Board of N.S.W. In 1967 the Basin Coal Loader was completed and consists of a 90,000 tonne stockpile area and two 1,000 t/h luffing shiploaders. The stockpile area is serviced by one 2,000 t/h bridge reclaimer and two luffing 1,000 t/h stackers.

In 1971 a further stockpiling area serviced by bulldozers and front end loaders was established by Canwan Coals Pty. Ltd. and connected to the Basin Coal Loader by a 2,000 t/h conveyor belt.

The capacity of this total system was approximately $7—8 \cdot 10^6$ tonnes per annum.

In June 1974 the State Government accepted an offer from Gollin & Co. Ltd. (which owned Canwan Coals Pty. Ltd.) to finance and construct a new loader at Port Waratah. The site chosen was a rail marshalling yard which had been built to accommodate large numbers of privately owned wooden coal wagons of 15 ton capacity used for live storage of coal awaiting export (see Fig. 1).

In 1976, because of financial difficulties experienced by Gollin and Co., a group of N.S.W. coal shippers together with Japanese coal consuming interests formed Port Waratah Coal Services Limited (PWCS) to acquire the project and to assume responsibility for its funding, construction and operation (see Fig. 2).

PWCS is now upgrading this plant to handle, in conjunction with the Basin Coal Loader, $25 \cdot 10^6$ tonnes per annum by December 1982.

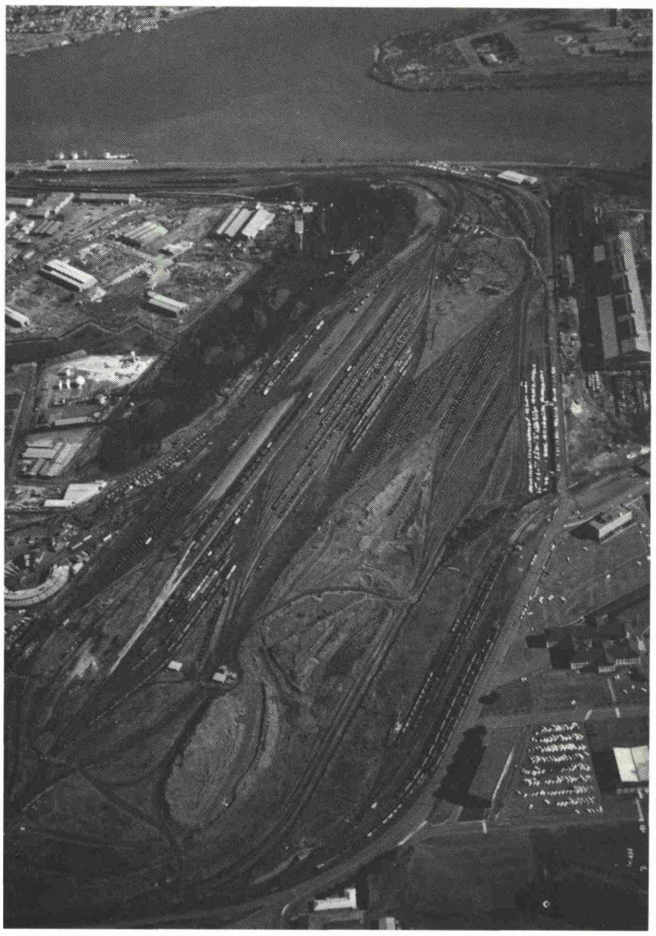

Fig. 1: Marshalling yards at Port Waratah, 1974

It is anticipated that this capacity will be fully utilized by 1984 and hence design work has commenced on a Third Coal Loader for the Port to be built on Kooragang Island.

1.2 Sources of Coal

Most of the coal exported through Newcastle comes from the Newcastle, Singleton, South Maitland and Gunnedah areas (see Fig. 3).

In 1979 there were 50 mines producing in the northern regions and 39 in the southern and western regions.

The complexity of mining operations is demonstrated by the number of seams worked in each area, i.e., 32 in Newcastle & South Maitland and 32 in Singleton and Gunnedah.

Many of the mines constitute a multi-seam operation and hence blending techniques have been developed over a long period.

There are currently some sixteen companies involved in the export of coal through Newcastle with nineteen more companies involved in the development of further mines.

1.3 Export Demand

1.3.1 Metallurgical Coal

For many years the Japanese Steel Industry has been the dominant buyer of Hunter Valley coal. This dominance has been reduced in recent years but it is expected that the Japanese Steel Industry will continue, for the foreseeable future, to provide the major export market for Hunter Valley coal.

Fig. 2: PWCS coal handling facility at Port Waratah, 1978

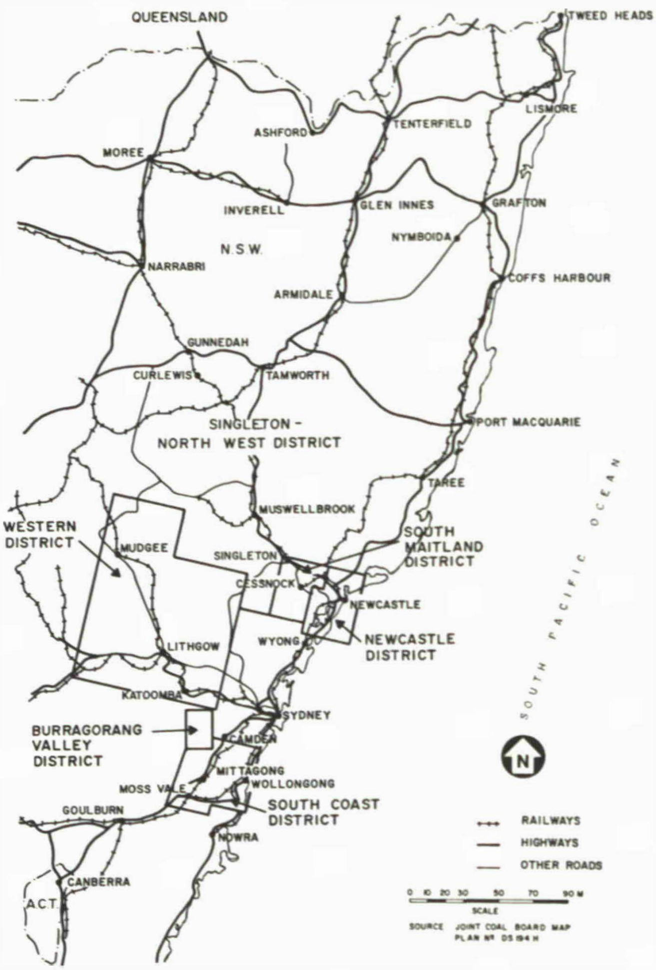

Fig. 3: New South Wales exporting districts

The Korean Steel Industry expanded strongly during the 1970s and increased plant is being constructed. N.S.W. has been a major supplier of coking coal to the industry.

Another growing market is in Taiwan where current steel capacity is to be rapidly expanded. India and Pakistan have also been buying coking coal from Australia.

Markets in Europe, the Middle East and South and Central America may also purchase small quantities of coking coal from New South Wales.

1.3.2 Steaming Coal

Japan is building several large coalfired power stations and some oilfired plants are being converted. Coal is rapidly replacing oil in Japanese cement plants and there are prospects of other industries using coal. Korea, Taiwan and other Asian countries are also likely to become major importers of steaming coal. Usage of electric power is growing rapidly and most currently depend on imported oil for power generation, cement production, paper manufacture etc.

Many European countries are interested in importing steaming coal from Australia and the USA and Israel have been importing Australian coal.

2. The Coal Export Facilities of Newcastle

The Port's coal loading facilities consist of two areas — the Port Waratah Coal Services area and the Maritime Service Board's Basin Coal Loader (see Figs. 4 and 5).

Under a current dredging contract, Newcastle Harbour is being deepened to 15.2 m in the main channel and 13.1 m in the Basin area. The work on this contract will be completed

Fig. 4: Port of Newcastle showing coal export facilities

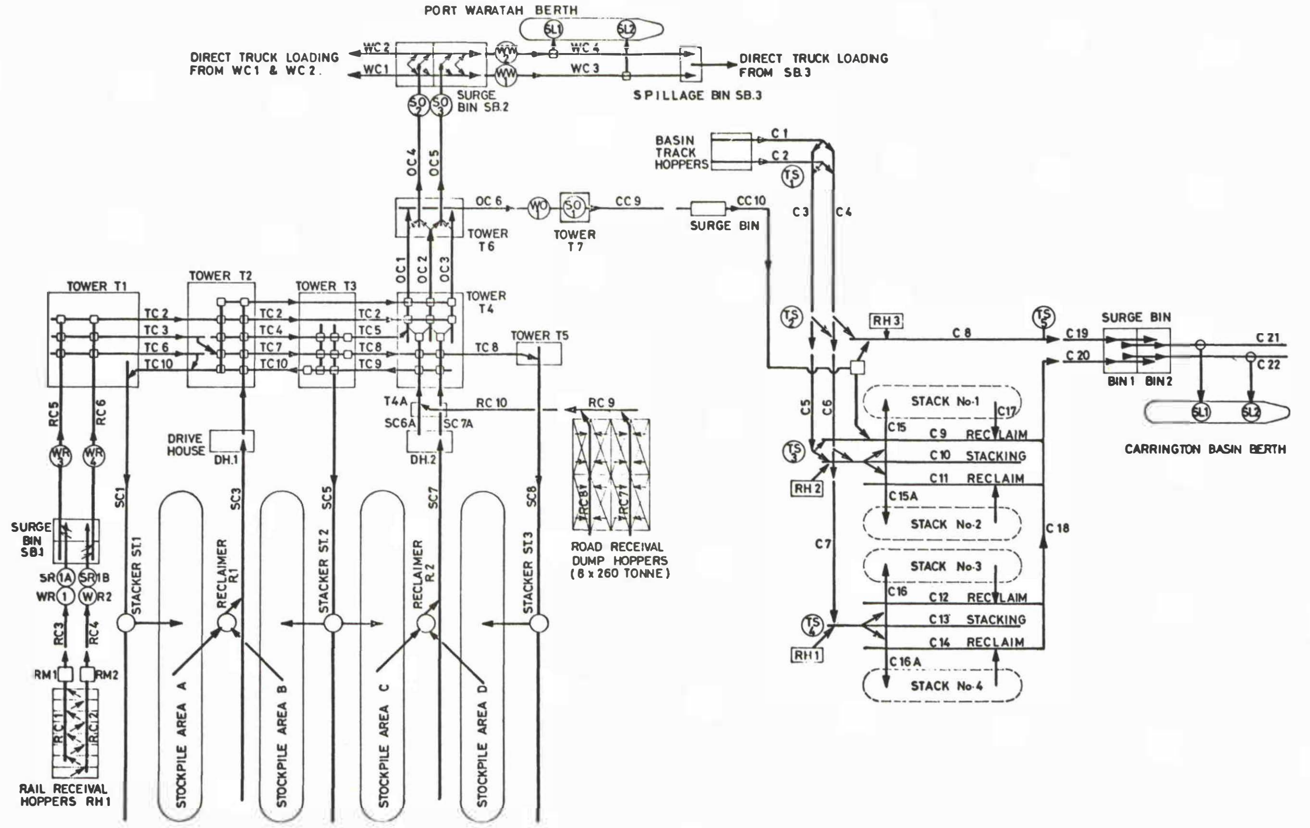

Fig. 5: Schematic layout of Port of Newcastle coal loading facilities

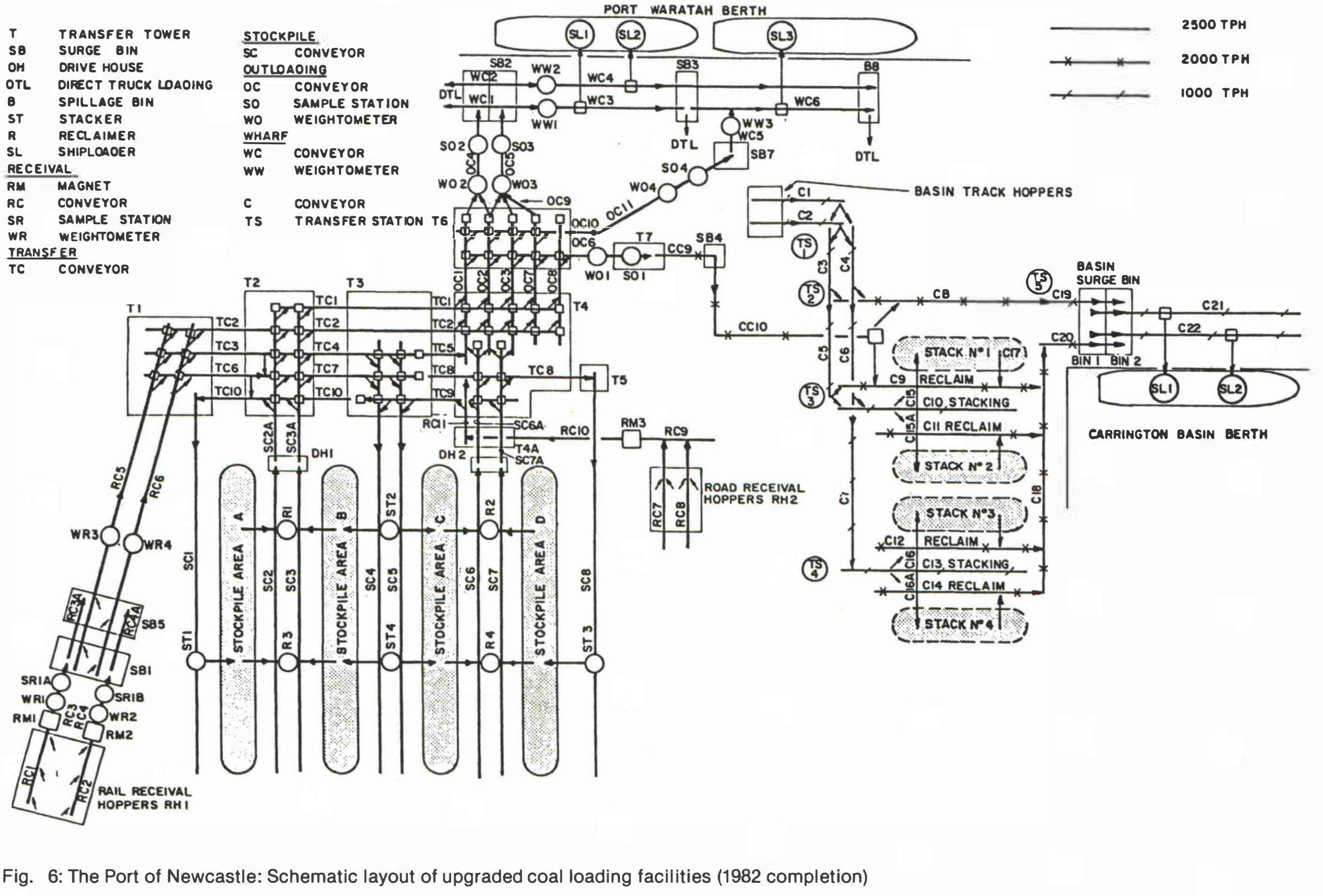

Fig. 6: The Port of Newcastle: Schematic layout of upgraded coal loading facilities (1982 completion)

by 1982 but an interim depth of 12.5 m is now available in the Steelworks Channel. The 12.5 m depth allows approximately 70,000 dwt vessels to fully load, while the 15.2 m will allow vessels of up to approximately 120,000 dwt to fully load. Investigations of the feasibility of further deepening are in progress.

2.1 The Basin Coal Loader

Berth Details

Design ship size	58,000 dwt
Dredged depth	11.6 m
Length of berth	366 m
Maximum beam	33 m

Shiploaders

2 travelling, luffing machines

Travel range	345 m
Hourly loading rate	1,000 t/h each
Air draft	15.2 m above I.S.L.W.

Receival

a) Rail in bottom dump wagons. The unloading rate is approximately 1,200 t/h. Coal can be directed to the loading heads or into the stockpile area.
b) Conveyor belt from PWCS. A 2,000 t/h conveyor belt carries coal to the 400 tonne Basin Surge Bin; from the Surge Bin coal is directed to the loading heads.

Stockpile Area

The stacking area contains four stockpiles with a nominal capacity of 90,000 tonnes. Two rail-mounted double-armed luffing stackers are used to transfer coal to the stockpile at 1,000 t/h.

Reclaiming

Reclaiming is performed by a rail-mounted chain bucket wheel bridge reclaimer at 2,000 t/h. A transfer car allows the movement of the reclaimer between stockpiles.

2.2 Port Waratah Coal Services Area
(Steelworks Channel Loader)

Berth details

Design ship size	120,000 dwt
Dredged depth	16.5 m
Length of berth	308 m
Maximum beam	42 m

Shiploaders

2 travelling, luffing machines

Travel Range	187 m
Hourly loading rate	2000 t/h
Air Draft	20.0 m above I.S.L.W.

Rail Receival

A balloon loop surrounding the stockpile area contains a 1,200 tonne dump hopper over which the bottom dump wagons are hauled and released whilst the train is moving. The coal is then removed via two 2,000 t/h belts into the receival Surge Bins which have a total capacity of 4,200 tonnes (2 x 1,000 and 2 x 1,100 tonne compartments). The facility is designed to dump a 3,100 tonne payload train every hour.

Road Receival

Approximately $1.3 \cdot 10^6$ tonnes of coal per year are presently received through the road receival station which is equipped with a weighbridge and truckwashing facility. Road trucks of 25 tonne capacity discharge into one of four bins each holding 500 tonnes. The bins discharge over vibrating feeders onto a series of belt conveyors connected to the stockpile area.

Stockpile area

Storage is provided in four stockpile areas, each 1 km long and 44 m wide. The nominal capacity is 1 million tonnes (however, this is restricted operationally to approximately 650,000 tonnes).

Stacking is carried out by three rail-mounted luffing, slewing stackers rated at 2,000 t/h each.

Reclaiming is performed by two rail-mounted luffing, slewing boom bucket wheel reclaimers. Each machine has a boom length of 50 m and is fitted with a rake to enable uniform recovery from coal heaps up to a height of 11 m. The reclaimers have a capacity of 2,000 t/h and are fitted with a 60 tonne surge hopper and feeder to ensure a uniform feed onto the belt conveyors.

2.3 PWCS Upgrading

A three stage upgrading programme is currently underway to develop the existing facility to its maximum capacity within the constraints of the existing site.

Stage 1

This stage, to be completed in April 1981, involves an increase in the capacity of the plant conveyor system from 2,000 t/h to 2,500 t/h with the exception of the rail receival conveyors and the conveyor to the Basin Loader. This stage also involves the upgrading of three stackers, two reclaimers and two shiploaders to 2,500 t/h working capacity.

Stage 2

This stage is the construction of two reclaimers and one stacker, all rated at 2,500 t/h to be completed by May 1982.

Stage 3

This stage to be completed by December 1982 includes the conversion of the existing tie-up berth into a second loading berth. One extra shiploader served by a new wharf conveyor will be installed on this berth. In addition one of the existing wharf conveyors will be extended to enable shiploader SL2 to also serve both berths.

Fig. 6 shows the schematic layout of the upgraded port facilities.

3. Present Operating Practices

As noted previously there are a large number of exporting companies, mines and seams within the Newcastle region and hence the trade has developed such that there are currently in excess of forty brands being exported. There are at present some seventy coal types being delivered to the port area to be blended into the forty export brands. As far as we are aware this situation is unique in the world and provides a significant operating challenge.

The most detrimental effect of this number of brands is to reduce further the very limited port storage area since each brand must be physically separated from each other. Consequently, the working capacity of the PWCS area is reduced to approximately 650,000 tonnes for a current throughput of $14 \cdot 10^6$ t/year. The traditional concept of port buffer stockpiles cannot operate in Newcastle for throughputs in excess of $6—7 \cdot 10^6$ t/year.

Indeed to handle $25 \cdot 10^6$ t/year will require the total port contents to be turned over 35 times per annum or once every 10 days.

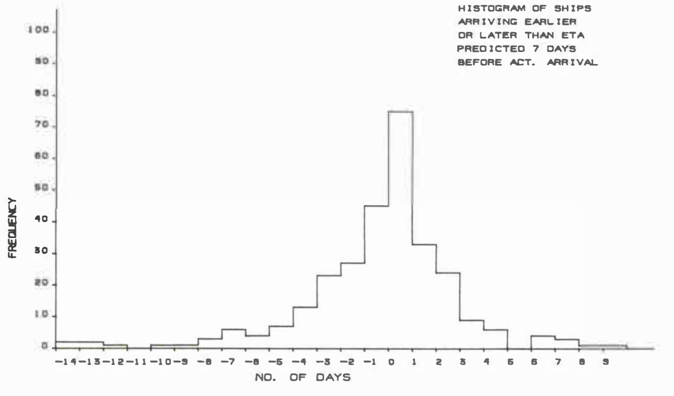

Fig. 7: Arrival pattern

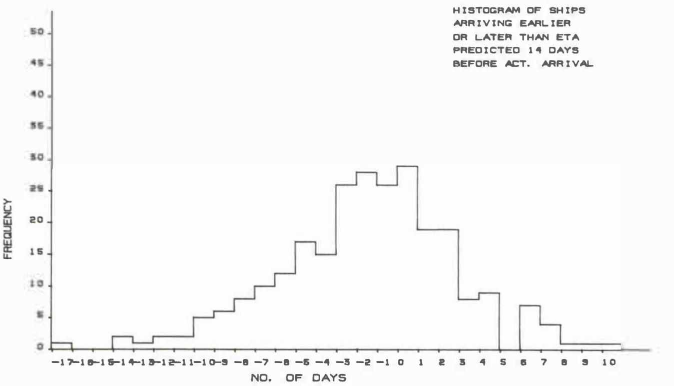

Fig. 8: Arrival pattern

3.1 Port Management

To achieve this high stock turnover a port management philosophy based on the assembling of cargoes has been developed. This entails a list of ships with their cargo requirements being produced and from this the shippers and rail authorities determine the requirements for transport of coal from the various loading points.

This generates a programme of train and truck arrivals at the PWCS cargo assembly area for the various cargoes. PWCS then determines where each coal is to be stacked within the yard. This raises several complexities since the stacking tasks have to be spread fairly evenly over the three stackers in such a way that the reclaimers are able to access the coal types required for shipping without incurring delays. This is achieved by dividing the cargoes on arrival into two stockpiles, each of which is accessible by one of the two reclaimers. Cargoes comprising more than one coal type require careful consideration to determine the division between reclaimers. Since the Basin Coal Loader also takes over 60 % of its coal from the PWCS yards there are at present three possible output streams with only two reclaimers.

Given that the port operates on cargo assembly the rail task is made complex by the daily changes in the requirements for different coal types at the port to satisfy cargoes.

A fixed number of trains operate between the port and the loading points. Some loading points and rail lines have operating restrictions so that the total fleet is necessarily made up of a number of different sized units ranging from 1,000 tonnes nett to 3,150 tonnes nett.

Some trains are able to be programmed to loading points on a time horizon (14 days or more) which is longer than the average PWCS turnover rate. This occurs where the loading points are 'common user' terminals with a steady large throughput. Other trains are scheduled over a shorter horizon (7 days or less) to make up the total rail arrivals and these are used to adjust for any deviations in arrival time or size of vessel.

The variation in arrival times of vessels is apparent in Figs. 7—10 showing the difference between E.T.A. (estimated time of arrival) and the actual arrival time for various prediction periods. As expected the predictions are more accurate the shorter the prediction period.

Stockpile management is hence a dynamic operation with each cargo requirement being carefully considered before a decision is taken on where it should be placed within the yard.

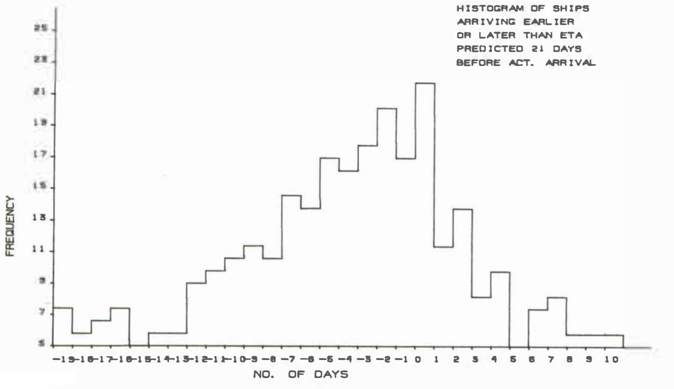

Fig. 9: Arrival pattern

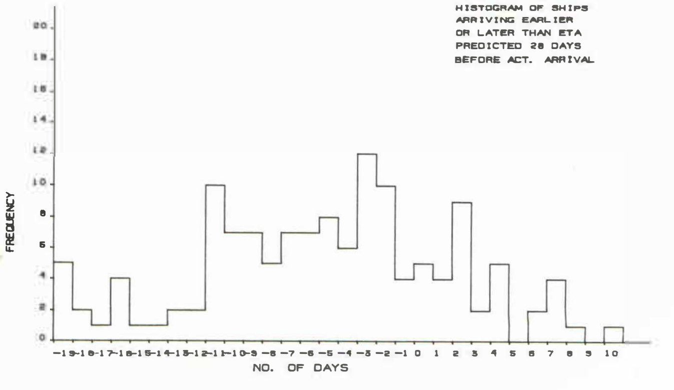

Fig. 10: Arrival pattern

3.2 Blending

The PWCS area was designed to provide a method of blending constituent coals into a homogeneous quality product. The method currently used is windrow stacking and is carried out on receipt. This practice is more expensive in its uses of the stockpile resource than normal coneply stacking since the total length of the stockpile must be used for the first batch of coal. As a consequence, when the facility is used for cargo assembly in order to maximize the limited stockpile resource the available time to assemble cargoes is substantially reduced. Approximately 70 % of coals exported currently require windrow blending.

3.3 Computer Monitoring

To assist in the operations of PWCS a real time computer system has been installed. The primary function of this system is to maintain a complete record of all coal movements through the facility. The reports derived from this record constitute the basis for accounting functions as well as providing the first level of data for stockpile management and forward planning. Secondary functions include the gathering of data on equipment utilization and down times, the facilitation of day to day operations in the control tower, port planning calculations and simulation.

The basic philosophy behind the system design is that as much as possible of the required data should be obtained at the point of operation. Hence, the control tower and the road receival weighbridge contain interactive terminals where information is entered by the operators.

The computer system hardware consists of two HP 1000 processors connected by a serial link. The first of these, referred to as the real time system, is devoted purely to plant monitoring and data gathering. The real time system consists of a processor, a multiprogrammer (plant signal scanner), a 15 megabyte disc storage unit, control terminal and plant video terminals. The relevant data pertaining to plant monitoring is sent across the serial link to the second or multi-user system. All subsequent data manipulation and reporting is carried out on the multi-user system. This system also serves as a standby in the event of the real time system becoming unavailable. The multi-user system consists of a processor, a multi-programmer, a 50 megabyte and a 15 megabyte disc storage units, a magnetic tape unit, control terminal and various video terminals. Video terminals attached to this system are in various key personnel's offices to allow them instantaneous access to plant status information.

Fig. 12: Computer centre showing plant monitoring and commercial computer

Fig. 11: Control tower operations monitoring the movement of coal with the use of a control panel and a VDU terminal