

Leith Coal Outloading Plant

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Summary

Different grades of coal are at present unloaded and outloaded within the estuarial ports administered by the Forth Ports Authority. Grabbing cranes unload the coal to road vehicles and railway wagons and the outloading of coal is handled using a modern 3,000 tonnes per hour (t/h) capacity coal outloading plant at the Authority's Leith Docks.

The plant has been erected on the site of the last remaining coal wagon hoist which was built in the year 1932 and was operational until it was demolished in the year 1974 to clear a suitable site for the projected new plant. The Authority's remaining coal outloading facilities, four coal hoists at Methil Docks, one coal hoist at Grangemouth Docks and a coal outloading conveyor at Granton Harbour were also demolished at various times. Until then a diminishing amount of coal was still being outloaded from Methil Docks using wagon hoists but by the year 1974 the Fife Coalfields ceased to produce coal in excess of what was required for consumption by local power stations and this situation resulted in a decision being made to demolish the hoists.

The following article traces the various stages to completion from the initial identification of the need for a modern coal outloading facility sited at Leith Docks to handle the only surplus of coal available at the time for shipment which would be from the nearby Lothian Coalfields to Power Stations in the South of England.

The involvement of the National Coal Board and British Rail in the initial design of the project is described.

British Rail "merry-go-round" trains, already associated with the nearby Cockenzie Power Station, were the method of feed for which the plant was designed, i.e., with bottom wagon doors being automatically opened as the wagons move continuously at slow speed over the underground hopper which receives the coal and feeds it to the conveyor system.

General agreement on design guidelines allowed the Authority to invite tenders from a number of Contractors who then submitted competitive designs to achieve the specified capacity and fit the restricted site available for the plant.

The completed project which included deep foundations and

new rail track approaches and sidings gave the Authority a facility which was almost unique in Britain.

1. General Description of Plant

The coal handling plant is a fixed structure situated on the north side of Edinburgh Dock and is capable of loading ships up to 7,200 DWT at rates up to 3,000 t/h from British Rail "merry-go-round" trains consisting of up to 25 bottom discharging wagons of 32 tonnes capacity each. The wagons are discharged automatically by retractable lineside equipment into a band feed divided hopper at a continuous train speed of 0.8 km/h. A train of 800 tonnes capacity can be discharged over a period of 20 minutes.

Bottom discharge wagons which are not the "merry-go-round" type can also be discharged at approximately the same speed by hand tripping, the doors being closed later.

The plant consists of two parallel belt conveyor streams each consisting of a 1,830 mm wide feed-on conveyor band, a 1,220 mm wide conveyor band inclined at 20° and a 1,370 mm wide boom conveyor band. The two sets of inclined conveyor bands are each capable of taking coal streams of up to 1,500 t/h at a speed of 180 m/min.

The operating ranges of each of the two booms are 17° up and 9° down with each having a horizontal slewing range of 20° outwards from the central position. The booms are designed to telescope 1.8 m and are fitted with enclosed rotating inclined chutes at their extremity in order to assist the spread of coal evenly over the ship's hold.

The maximum outreach from the quay edge for the straight-out position of the booms is 11 m and the clearance from quay to the underside of the booms when in the horizontal position, is 4.8 m. The booms can be raised to a vertical position and latched to the structure when not in use. An anemometer measures the speed of the wind and the plant is closed down at 71 km/h.

Plastic coated steel cladding sheets fitted to the steel structure protect the conveyor systems and electrical equipment.

2. Weighers

Belt weighing machines are installed on each of the inclined conveyors to register the weight of coal (or any other suitable commodity) passing on the conveyors, the individual weights

being indicated at the weighing machines and in the remote boom operator's cabin along with the summation of weights on a totaliser.

3. Operator's Cabin

The main operator's cabin is of fibreglass construction and is situated high on the front of the structure overlooking the ship's hold. The other operator's cabin is situated above the hopper and is also of fibreglass construction. It houses the controls for the lineside wagon door tripping equipment and photo-electric equipment for the automatic monitoring of the passage of the locomotive before the wagon door trip mechanisms come out automatically from their retracted position. A third operator is in attendance at ground level in the hopper area for general duties.

4. Communications

Communication between operators is by intercom telephones and telephone communication with outside subscribers is available with reference to timing the arrival of trains etc.

5. Underground Hopper

The feed to the conveyors is from a 40 tonnes coal capacity steel hopper below rail level. The hopper has a top grid and a lateral central division to part the continuous wagon discharge evenly to the two conveyors. An adjustable gate on each conveyor regulates the flow to the rated capacity of the conveyor bands or less. Heavy steel beams are fitted under the rail track over the hopper to take the weight of the heavy locomotives and loaded wagons. The hopper is installed in a deep concrete pit with automatic pump drainage. It has "high level" probes to prevent overflowing. The locomotive can be stopped by the driver on seeing remote red stop lights along the track if a situation occurs which would require the flow of coal from the wagons to cease. A hand trip wire emergency stop system is fitted at the hopper and along the conveyor bands to stop the conveyors and signal the locomotive driver to stop the train. A shelter has been built over the hopper area to give weather protection to the hopper and lineside equipment.

6. Rail System

A complete new rail track system complete with cross-overs to British Rail approval was designed and laid to suit unloading operations and easy movement of trains with heavy locomotives into and out of the docks area. A new signalling system controls the safe movement of the trains. Improvement to signalling and the use of BR personnel are periodically under review by British Rail.

7. Power Supply

A new substation was built for the Plant and connected into the Dock High Voltage Network. A transformer and LV switchboard provide the necessary LV supplies to the plant. Lighting is provided throughout the plant and suitable area floodlighting is available for night operations.

8. Roads

The road access along the quay and under the plant's structure was reconstructed and a new road diversion built to make room for the length of a waiting M.G.R. train which stretches back over an existing level crossing now unused.

9. Other Uses of Plant

The open approaches to the plant have recently allowed one band of the plant to be used for outloading grain discharged directly into the plant's hopper from road vehicles. Schemes were being considered for providing a more permanent facility for operations involving road transport. The materials which can be handled by the plant as designed are limited by their ability to pass up to the 20° slope of the conveyors.

10. Historical Conception of Plant

The export of coal through the ports on the River Forth from the Fife, Lothian and other coal mines was extensive in the past judging from the number of loading out appliances, mainly coal hoists, that are shown on old drawings of large and small docks and harbours on the River Forth. Many ports were owned by Railway Companies in those times. The Forth Ports Authority's port of Methil was one of these ports and had a record export of over 4 million tonnes of coal in one particular year.

Exports of coal through the Forth Ports began to drop considerably but exports from Methil remained steady for a time at the reduced rate of 300,000 tonnes per annum.

The state of the four remaining coal hoists became critical as spares for the water hydraulic parts and any requirement for replacement of the huge hydraulic cylinder castings could not be met in the event of serious wear or damage. Corrosion of the main structures was becoming serious, leading to the Authority's decision to scrap the remaining four hoists.

Notice was therefore given to the National Coal Board regarding the impending loss of the Methil outloading facilities and consideration was then given to refurbishing the remaining coal hoist at Leith Docks but the cost of repairs and replacement of parts, if they could be found, led the Authority to enter into talks with the National Coal Board and British Rail on the concept of designing and constructing a new type of outloading plant sited at Leith to supply, for shipment, coal from Lothian Region Coalfields. This meeting took place on the 9th December 1974 and an outline design of a plant which would accept British Rail's "merry-go-round" train system was tabled by the National Coal Board and later passed to Forth Ports Authority Engineers to investigate and prepare a design specification and drawings of the plant for tender purposes along with an exact location and a layout of the rail system.

A visit was made by the Authority's Engineers to Longannet Coal Burning Power Station on the Forth to study the automatic discharge of coal trains into a long hopper and onto a conveyor.

The Authority's Engineers kept in close touch with the Coal Board Engineers up to receipt of tenders for the plant and reporting on the adjudication of the tenders. The Contract was

then placed with GEC Mechanical Handling Limited on 11th November, 1975 with a start on site on 20th September, 1976 and completion in June 1977.

11. Design Specification

The overall project was discussed in detail with the National Coal Board and an outline arrangement drawing of a proposed plant was agreed on the basis of NCB experience in handling coal and the Authority's experience in cargo handling. The final design of the rail track layout was carried out by the Authority and Contractor's Consultants were responsible for the design of the deep concrete pit housing for the large coal hopper. The Contract Tender Documents and Drawings were compiled by the Authority giving in general terms the design and specification expected from the Contractors tendering. The Conditions of Contract were the General Conditions of Contract, Model Form 'A' for use in connection with Home Contracts with erection as recommended by the Institutions of Mechanical and Electrical Engineers and the Association of Consulting Engineers (1966 Edition). The 1976 Edition had not been published at the time of placing the Contract. The Authority's Special Conditions qualifying the Model 'A' Conditions with respect to dock work were also included in the Contract.

The Contractor was required, under the heading "Description of Work" to design, manufacture, supply and deliver to Leith Docks, unload, ship and site paint, erect on prepared foundations, test and commission at Edinburgh Dock, a Coal Handling Plant complete with all necessary parts, including hopper, feeders, conveyors, belt weighers, gantry, transfer house and boom loaders. The Contractor was to erect the Plant on prepared foundations, these foundations being constructed under a separate contract with details of the maximum loadings on the foundation being supplied by the Coal Plant Contractor.

Vibration and noise within the transfer house and noise in the vicinity of the plant was to be limited to 90 dBA.

Dust and fire problems were not expected due to the dampness of the coal.

The Contractor was required to guarantee the maximum rate of discharge within the range of 2,800/3,000 t/h from railway wagons moving at a set speed of 0.8 km/h and carrying coal of size 25 mm to dust.

A Provisional Sum of £ 20,000 was included in the Contract for Contingency Work.

Contract Drawings included the following:

1. Outline of Coal Handling Plant.
2. Plan showing Coal Handling Plant and Layout of Associated Rail Tracks.
3. Bar Chart of Conjectural Programme and Site Plan.

Further plans and additional information were to be furnished by the Engineer at the request of the Tenderer if so required.

A section was included in the Contract Document under Offer No. 2 for the offer of an alternative design of plant, in entire accordance with the Authority's required performance and suitability.

Five Specifications were detailed:

- Specification 1 — Detailed description of Coal Handling Plant.
- Specification 2 — Details of Workmanship, Structure, Bolting, Welding and Testing.
- Specification 3 — Materials, steel bolts, tubes, forgings, cast iron, gunmetal and bronze.
- Specification 4 — Surface treatment and paint based on five coat treatment based on Micaceous Oxide.
- Specification 5 — Description of Electrical Supply, Distribution, and Control Equipment, motors, cables, limit switches, lighting etc.

Four information schedules for design of the plant were supplied in the Tender Document as follows:

- Schedule No. 1 — Information by the Authority giving capacities, speeds and general dimensions.
- Schedule No. 2 — Information required from the Tenderer regarding loading, weights and stability. Information on motors, starters, conveyor belting, feeders, gravity loop take-up and belt weighers, and additional information supplied separately by the Tenderer.
- Schedule No. 3 — List of Proposed Sub-Contractors.
- Schedule No. 4 — List of Recommended Spares, numbers and estimated cost.

A Site Plan and Conjectural Programme was bound with the Document relating the Coal Plant Contract to the other three main Contracts placed and proceeding concurrently with the main Contract.

12. Motors

The following Main Motors were supplied and fitted on the Plant:

Location	kW	Number	Speed
Inclined Conveyor	110	2	3.05 m/sec.
Boom	56	2	2.38 m/sec
Luffing	26	2	—
Slewing	15	2	—
End Swivel	1.5	2	—
Feeder Conveyor	56	2	0.51 m/sec
Telescoping	3	2	—
Sump Pump	2.2	1	—

13. Weight

The total weight of the Plant is 230 tonnes including 120 tonnes of steelwork.

A diagrammatic illustration of the plant is shown in Fig. 1. Fig. 2 shows the installation upon completion and during operation.

TWIN SYSTEM ~ CONVEYORS AND BOOMS

MATERIAL ~ CORAL 0"-1" @ 55 lbs/FT³ : 1400 TONS/HOUR (1500 PEAK) EACH SYSTEM.

M/C DATA:

	WIDTH	SPEED	H.P.
FEEDEES (2)	1800 (72")	·51 M/SEC = 100 F.P.M.	75
INCLD CONVS (2)	1200 (48")	3·05 M/SEC = 600 "	150
BOOM - " (2)	1400 (54")	2·38 M/SEC = 460 "	75
WINCHES (2)	-	15 M/M = 49 "	35
BOOM CHUPES (2)	-	-	2
BOOM SLEW (2)	-	-	20

RAIL WAGONS

32 TONS CAPACITY 14 T. TARE
SPEED 1/2 M.P.H ~ 44 F.P.M.
WAGON LENGTH 30 FT.
1 WAGON EVERY 41 SECS.
25 WAGONS PER TRAIN (800 TONS) 17 mins/Train

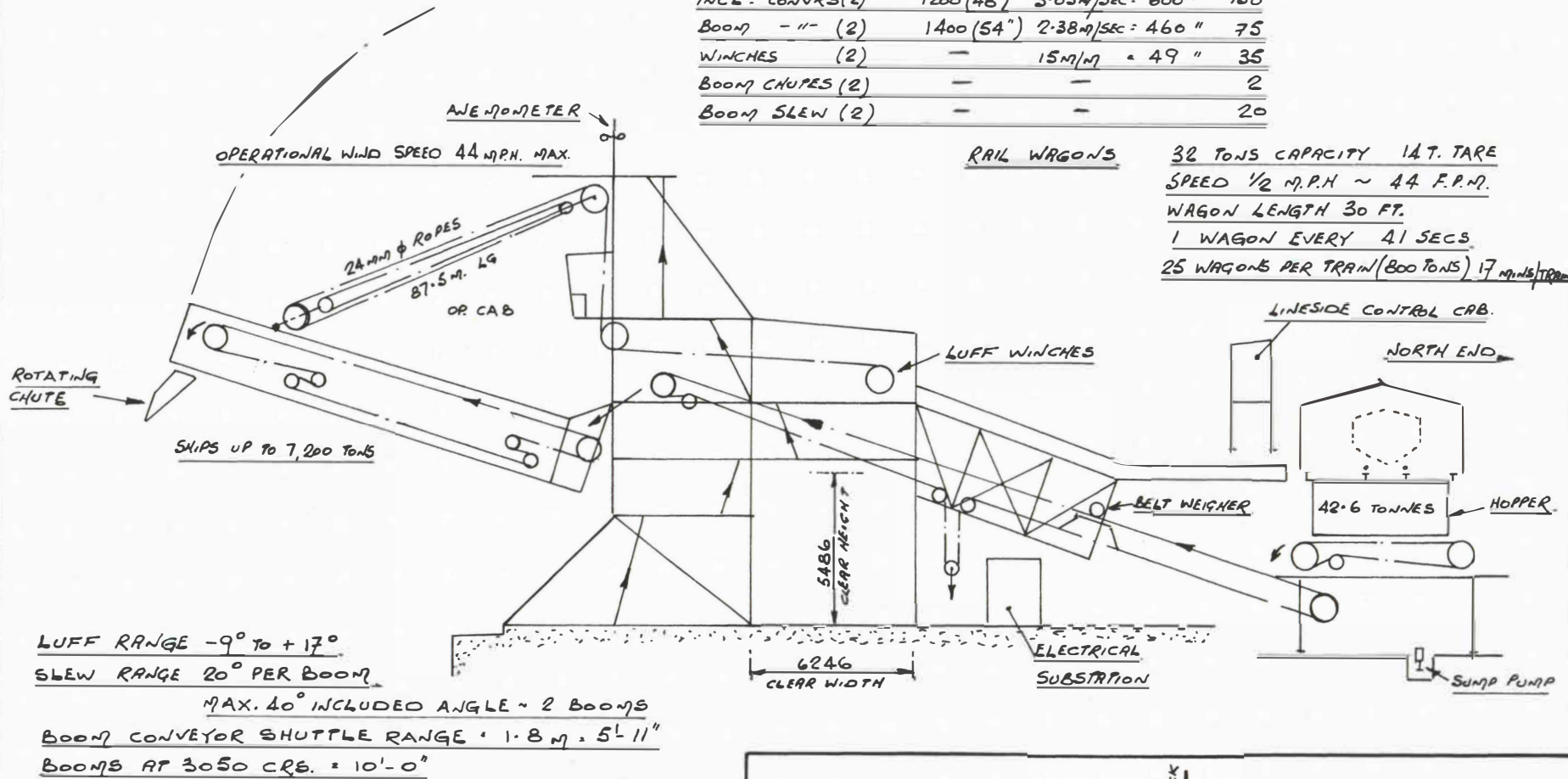
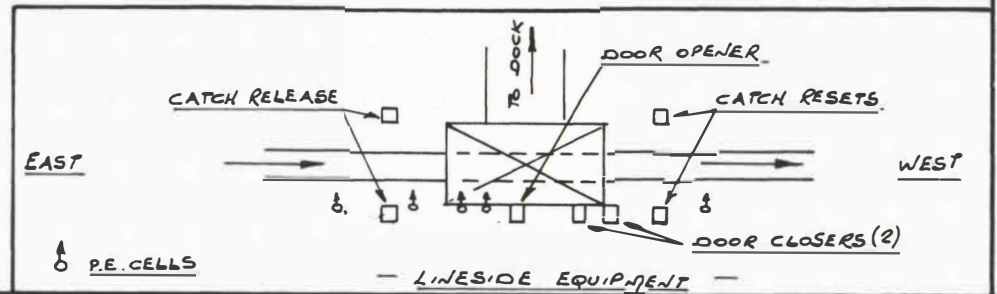


Fig. 1: Diagrammatic arrangement of rail to ship coal handling plant



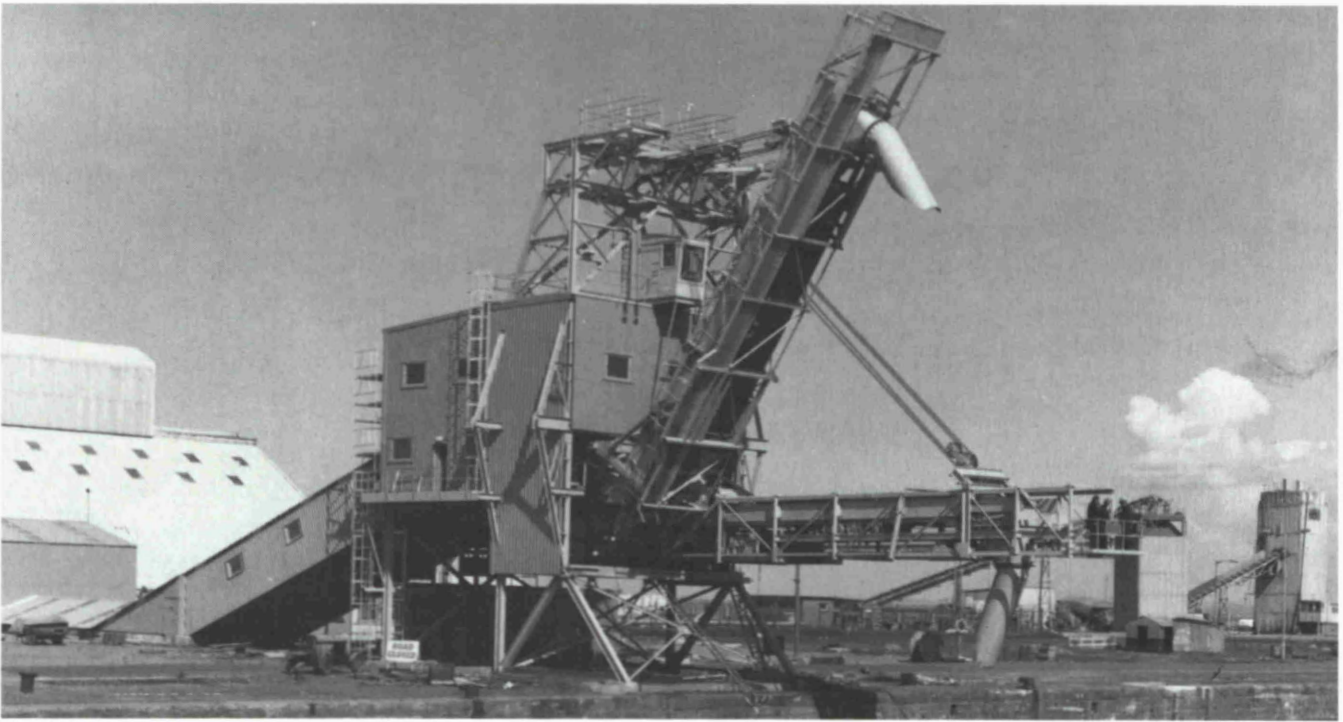


Fig. 2: View of the outloading plant

14. Commissioning

The main commissioning tests were held on 16th August 1977 when a ship, the MV "Sir William Walker" of 3,400 DWT became available for loading. The tests were successful but a few incidents occurred.

The spread of the coal into the underground hopper was uneven but the manufacturer of the lineside equipment had allowed for alternative positioning of their seatings. The hopper length was said to be the shortest in Britain.

Some coal was occasionally left in wagons when doors were automatically closed. This could be observed from the elevated cabin housing the lineside control equipment. Some rodding would be necessary in temperatures below freezing.

The ship had to be moved along the berth in order to put the appropriate hold under the fixed plant but this proved to be a simple operation. The small sized old type of ship provided, highlighted the need for a large 4 m fender and a gangway sufficiently long to require a crane to handle it.

Subsequent ships were larger and did not cause the same problem.

Topping up of the holds was also required and this was achieved by using a topping-up train.

The difficulty for the operators mounting the 20° slope in the gantry was noted and metal treads were welded to the floor to alleviate the difficulty.

Additional machinery guards were decided by a small committee consisting of the Factory Inspector and three others one of whom was the guard manufacturer.

15. Costs

The main costs involved in construction of the Plant were as follows:

Main Contract for Plant	£ 483,000
Foundations	£ 137,000
Railtracks	£ 53,000
Purchase of Railtrack	£ 95,000
Road Division	£ 36,000
Lighting	£ 10,000
Power Supply	£ 26,000
	<u>£ 840,000</u>

The addition of many other costs associated with the project made a summary total cost approaching a million pounds.

16. Current and Future Applications

Recent Government support for the increasing use of coal had again aroused interest in the Coal Handling Plant as a means of increasing the use of rail and sea transport of coal as desirable environmental factors consistent with the economics of speed and convenience.

An abundance of coal lies under the ground in the River Forth Area and as new coal seams are developed any surplus coal may be exported using the Plant at Leith.

The Plant is at present being used for power station coal, the export of coal to Scandinavian countries and has been used for the occasional export of smokeless fuels and grain. It has been considered for export of suitable commodities arriving at the Plant by road transport.

The National Coal Board have recently been in consultation with the Forth Ports Authority to consider modifying the plant to allow stockpiling of coal on the quay back-up area and reclaiming from stockpile during intervals when no coal trains are available thereby giving faster turnaround of ships.