SUMMARY OF
PRE-FEASIBILITY STUDIES
FOR
THE GOVERNMENT OF CANADA
DEPARTMENT OF REGIONAL ECONOMIC EXPANSION

COKE PLANTS FOR
1,000,000 TONS PER YEAR
2,000,000 TONS PER YEAR
5,000,000 TONS PER YEAR

Submitted by

ARTHUR G. McKEE & COMPANY OF CANADA LTD.

ENGINEERS AND CONSTRUCTORS

21 VOYAGER COURT SOUTH
REXDALE, ONTARIO
CANADA

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NOVEMBER 1978

CCL-348

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ENGINEERS AND CONSTRUCTORS

November 8, 1978

Government of Canada,
Department of Regional Economic Expansion,
6th Floor,
200 rue Principale,
Hull, Quebec
K1A 0M4

Attention : Mr.Suresh Khandelwal
Senior Analyst
Department of Project Assessment

Dear Mr.Khandelwal :

We are pleased to submit twelve copies of our "Pre-Feasibility Study for Coke Plants sized 1,000,000 tons per year, 2,000,000 tons per year and 5,000,000 tons per year" based on the McKee-Otto coke oven technology and utilizing approximately 75% Devco high volatile and 25% imported low volatile coal.

The Study is based on the Terms of Reference forming part of Contract No.2757. It reflects the capital and operating costs of the third quarter of 1978.

We thank you for your cooperation and if there are any further questions please feel free to contact us.

Yours very truly,
ARTHUR G.McKEE & COMPANY OF CANADA, LTD.

A.Berndl,Ph.D.,P.Eng.,
Project Manager

Attach:
JLH/mc.

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TORONTO, ONTARIO

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I. INTRODUCTION

This report has been prepared by Arthur G. McKee & Company of Canada, Ltd., for the Minister of Regional Economic Expansion acting for the Government of Canada, in accordance with the understanding in the Terms of Reference attached to the contract dated September 14, 1978, and amended later to include the largest size of plant design. The Terms of Reference are included at the end of this section.

The basic purpose for this study is the definition of three sets of coke plant facilities to produce 1,000,000 tons, 2,000,000 tons and 5,000,000 tons of merchant coke per year respectively from indigenous high volatile and imported low volatile coking coals. In addition to metallurgical quality coke, coke oven gas, tar, anhydrous ammonia, elemental sulfur and light oils are to be produced as saleable products. The results of the study, contained herein, will be used by Department of Regional Economic Expansion personnel to determine the opportunities for manufacturing metallurgical coke in Nova Scotia for the world export market.

The study at the 5,000,000 tons per year required an initial phase of 3,000,000 tpy, followed by Phase II of 2,000,000 tpy. The contract for the design and construction of Phase II would be given 4 years after completion of construction of the Phase I facilities.

The study has been prepared in a limited time period and accordingly it has been necessary to maximize the utilization of in-house work developed for prior feasibility and engineering studies. In this regard, Dr. C. Otto & Comp. GmbH of Bochum, West Germany, has provided information based on their proprietary coke ovens and auxiliary equipment. The facility complement described herein reflects the Dr. C. Otto design.

All references to tons in this report mean metric tons. All references to dollars in this report mean Canadian dollars.

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TERMS OF REFERENCE

"The work to be performed by the Contractor is as follows:

1. The study to assume that coke facilities will be a free standing plant, i.e. greenfield site.

2. Soil conditions to be based on those known for Sydney, Nova Scotia.

3. Construction and operating cost estimates will be provided for a conventional type plant, e.g. incorporating wet quenching (for both 1M and 2M metric ton sizes). Based on the above, a differential analysis will be provided assuming dry quenching techniques.

   The differential analysis will, as a minimum, provide the cost differences in percentage terms between the plant incorporating wet quenching (for both 1 and 2M metric ton sizes), however, the contractor will make a best effort to provide the differential analysis in dollar terms as well. The contractor's report will also contain a description of preheating and pipeline charging processes and how they might be applied in the subject plant.

4. Study will be based on approximately 75% DEVCO high volatile coal and approximately 25% low volatile coal from either Virginia, U.S.A. or British Columbia. The coke of specifications of 55 to 60 stability, 0.7% sulfur and 8 to 9% ash, will, in essence, determine the coal blend(s). As far as possible use of DEVCO coal will be maximized.

5. Accuracy of the estimates will be at least ± 35%.

6. For this study, starting point will be a car dumper to receive DEVCO coal in rail cars, and dock side equipment to receive low and medium volatile coal.

7. Coke plant will include coal preparation coke (about 6 meter) ovens, minimal by-product plant, shipping facilities (rail, barge and ships), maintenance shops, offices, storage facilities.

8. Storage facilities will be sufficient to hold 30-day inventory of DEVCO (high volatile) coal, 90-day inventory of low and medium volatile coal as well as of manufactured products, e.g. coke, tar, light oils, ammonia and sulfur.

9. Engineering estimates would include an estimate of equipment which will be required to transfer surplus coke oven gases to a purchaser at battery limits.

10. Capital cost breakdown, among other things, should clearly list equipment and its cost related to pollution abatement requirement. The study should also discuss cost and effectiveness of the various pollution abatement alternatives.

11. Study will incorporate the current U.S. pollution control requirements (OSHA and EPA). A summary of these requirements will be provided.

12. Imported items will be identified, and Canadian/Non-Canadian costs will be shown. (Where possible indicating Customs and Excise duty, federal and Nova Scotia sales tax.)

13. The Study will explicitly state the kind of dollars (nominal, current or otherwise) in its reports.

14. The Study, wherever possible, would indicate prices in both Canadian and U.S. dollars.

15. Real estate cost - land and improvements - should be separately identified for each plant size.

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16. The study data will be arrayed in a manner that can be readily utilized for Departmental economic and financial analysis.

17. Construction labor requirements to be identified by craft and by year, based on Hamilton, Ontario rates and productivity.

18. A factor of 1.35 will be applied to Hamilton manhours to reflect construction efficiency at the proposed site.

19. Contractor will provide a complete description of the nature and size of all infrastructure requirements relating to the two plants. The infrastructure would include, among other things, dock and wharf, water and power to plant site and other facilities viewed as a part of requisite infrastructure for such a facility.

20. Material flow sheets will be prepared but no engineering drawings will be provided."

II. SUMMARY

GENERAL

The basic purpose for this study is to define and compare coke plant facilities to produce merchant coke from indigenous high volatile and imported low volatile coking coals, at the three plant design capacities of 1 million, 2 million and 5 million tons per year. The results of the study will be used by Department of Regional Economic Expansion personnel to determine the opportunities for manufacturing metallurgical coke in Nova Scotia for the world export market.

FACILITIES

The facilities required in order to produce 1,000,000 tons of coke will consist of one unit of 90 ovens of 6.5 meter size with the necessary complement of oven machinery. The larger plants are multiples of these coking oven batteries.

Minimal by-product facilities are provided to recover tar, light oil, ammonia liquor, sulfur and the coke oven gas. The ammonia liquor is upgraded to anhydrous ammonia for improved storage and sale. Excess coke oven gas is available for sale to a user such as a power plant.

The description of the facilities is based on a conventional coke plant, if preheating and hot charging are desired the investment costs are of the same order of magnitude.

The coal storage facilities are based on the sizes requested by DREE.

Coal can be received by rail or by sea and handled at the rate of 2,000 tons per hour to surface stockpiles. The coal will be finely crushed, put into separate stockbins, mixed and conveyed to the coke batteries.

After a period of 16 - 18 hours of coking, the coke is removed from the ovens, quenched and then screened to remove the breeze. Thereafter the facilities consist of stockpiles to hold three months quantities of coke and of coke breeze. Recovery systems will deliver 2,000 tons per hour to dockside loading of ships or railway cars for export or Canadian use. At the 5 million ton per year rate, a second system to deliver coke to the dockside is a strong probability and has been included in these costs.

No allowance has been made for docking or quayside dredging or similar works.

It is estimated that from the date of a contract being awarded, approximately three years would be required to complete the assignment. The figures in the subsequent tables average 84.4% of the construction labour hours and 83.0% of the material costs as being spent in the second and third years. These figures are close to the initial estimates of 80.0% and 85% respectively.

Table IV-1 shows the dispersion of the Capital Costs of the different plants.

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TABLE II-1
CAPITAL COST

The following table indicates the dispersal of the Capital Cost of the three plants under review, in Millions of $.

	Plant Size (Tons of Coke Per Year)				
	1×10^6	2×10^6	3×10^6	2×10^6	5×10^6
Materials & Machinery of Canadian manufacture	86.65	145.425	207.1	131.55	338.65
Construction labour wages	52.0	90.0	129.0	84.0	213.0
Other field expenses, heatup, professional expenses & fee	30.0	44.4	55.7	38.1	93.8
Land purchase	1.5	2.0	4.0	-	4.0
Total Canadian $	170.15	281.825	395.8	253.65	649.45
Purchase of foreign refractory bricks & machinery	19.35	37.875	56.3	37.85	94.15
Other field costs & foreign expenses & fee	10.8	14.6	17.9	14.5	32.4
Total $ required to be spent on foreign resources	30.15	52.475	74.2	52.35	126.55
Total Plant Cost	200.3	334.3	470.0	306.0	776.0

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OPERATING COSTS

Operating costs have been provided for the cost of coke in the form of unit quantities and/or dollar values and credits have been alloted for by-products.

The estimated operating manpower requirements are as follows:

1,000,000 tpy	275 people
2,000,000 tpy	395 people
3,000,000 tpy	523 people
5,000,000 tpy	784 people

This produces the following labour and supervision costs and office expense per ton as follows:

	$ Per Ton of Coke Produced	
	Labour Costs	Office Expense
1,000,000 tpy	5.50	0.75
2,000,000 tpy	3.85	0.60
3,000,000 tpy	3.41	0.50
5,000,000 tpy	3.06	0.40

The value given to coke oven gas of $18.72 per ton of coke produced is a major credit requirement.

III. DESCRIPTION OF FACILITIES

a. INTRODUCTION

The three facilities are sized to produce metallurgical quality coke at the capacities of 1 million, 2 million or 5 million tons per year. The facility complement includes coal unloading and handling equipment, stocking and reclaiming facilities, coke oven battery, by-products plant, product storage and shipping facilities. The installations, as conceived, will produce merchant products at a "greenfield" location.

For the purpose of this study, a mix of 75% high volatile and 25% low volatile coals has been assumed. The high volatile requirement will be met by indigenous DEVCO coals from Cape Breton Island. Pocahantas #3, from the state of West Virginia, U.S.A. , has been assumed to meet the low volatile requirement. Pocahantas #3 is the world standard for low volatile, by-product, metallurgical coal. Representative analyses for these coals are as follows:

	Devco	Pocahantas #3
Ash	4.1%	4.0%
Volatile Matter	33.9%	17.0%
Fixed Carbon	62.0%	76.0%
Sulfur	1.25%	0.5%
Gross Calorific Value	8190 kcal/kg	8120 kcal/kg

In actual practise, as long as the coke specifications can be maintained, the use of local DEVCO coal would be maximized, possibly to above 75% of the mixture.

The coal mix and the selected carbonization facilities will produce a metallurgical grade coke of the following approximate analysis:

Volatile Matter	0.7 - 1.2%
Fixed Carbon	90.0 - 92.0%
Ash	5.0 - 7.0%
Sulfur	0.8 - 0.9%
Moisture	3.0 - 5.0%
Stability	55.0 - 60.0%
Hardness	64.0 - 68.0%

Provisions are made for receiving in-bound coal and shipping coke by rail or by water. Secondary products, i.e. tar, anhydrous ammonia, light oils and elemental sulfur, will be shipped by rail, road or sea. Coke oven gas with a heating value of approximately 4450 kcal/cubic meter is piped to the boundary limits for off-site consumption by others.

The coke oven gas is expected to have the following analysis:

		%, by volume
Hydrogen,	- H_2	55
Methane	- CH_4	28
Carbon Monoxide	- CO	6
Nitrogen	- N_2	4

The facility complement is described on the following pages.

b. MATERIAL HANDLING

COAL STOCKPILE

Low volatile coal will be imported by ships which have their own unloading equipment. Receiving bins at the dockside and transfer conveyors will transport this coal at the rate of 2,000 tons per hour to a radial stacker and thence to a stockpile sufficient for 90 days' operation of the coke plant. In cases where this amount will be very large, part of the total will be as a reserve stockpile situated nearby. The reserve stockpile will require front-end loaders for moving the coal to and from it.

Coal will be received by rail and unloaded with a car dumper capable of handling 100 ton coal cars, as unit trains. This will mainly serve the supply of local high volatile coal and will use the same radial stacker to form an equal sized stockpile, sufficient for 30 days of coke manufacture.

The size of each stockpile for either the low volatile or the high volatile coal will be as follows, for each plant size:

Plant Size	Quantity of Coal (t)	Stockpile Volume (m^3)	Tons in Reserve
1×10^6 tpy	96,000	120×10^3	Nil
2×10^6 tpy	192,000	240×10^3	Nil
3×10^6 tpy	288,000	360×10^3	96,000
5×10^6 tpy	480,000	600×10^3	288,000

COAL RECOVERY, CRUSHING & MIXING

The coals will be recovered from the radial stockpile by an underground conveyor system to feed the coal impactors. Recovery from the reserve stockpiles will be with surface equipment as well as by conveyor.

The coal will be crushed by the impactors, at a rate of 800 tph, to the size of all minus 18 mm and 80% minus 3 mm; then conveyed to stock surge bins, before being mixed at the required weight ratio and conveyed to the 2,000 ton coal storage bins which will be situated on top of the coke batteries.

COKE HANDLING

The coke from the ovens will be collected in the quench cars and taken for quenching. Then the coke will be deposited on the coke wharf to cool and drain.

Then, it will be conveyed to a screen house for the removal of the minus 20 mm sized material. The product will be stockpiled or via the stockpile conveyors sent for shipment.

Recovery from the stockpile will be by chutes and vibrating feeders to an underground conveyor system that will collect it at the rate of 2,000 tph. Then the coke will be delivered by a conveyor to the dockside ship loader; this piece of equipment will be partially mobile, having a movement of 15^{o} either side of the straight forward position.

The coke has to be protected from breakage by adequate retractable downcomers from the delivery conveyor.

The stockpiles will hold three months stock of the merchant coke and will be sized as follows:

Plant Size	Quantity (t)	Volume (m^3)
1×10^6 tpy	250,000	521,000
2×10^6 tpy	500,000	1,042,000
3×10^6 tpy	750,000	1,563,000
5×10^6 tpy	1,250,000	2,605,000

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COKE BREEZE STOCKPILE

The breeze stockpile will be a size to hold 90 days' storage, which will vary with the plant capacity as follows:

Plant Size	Quantity (t)	Volume (m^3)
1×10^6 tpy	17,500	37,500
2×10^6 tpy	35,000	75,000
3×10^6 tpy	52,500	112,500
5×10^6 tpy	87,500	187,500

The breeze will normally be shipped by rail although recovery conveyors will be linked to the coke shiploader for 2,000 tons per hour loading of breeze to barges or ships.

BY-PRODUCTS

The ammonia, sulfur, light oils and tar products will be sold and transported by road, rail or by sea.

COKE OVEN GAS

Coke oven gas will be transferred by a pipeline for consumption by a local power plant.

c. BATTERIES

GENERAL

The plant will consist of batteries of 90 nominal 6.5 meter ovens complete with oven machinery and a by-product plant.

The ovens are designed to produce from each battery 1,000,000 metric tons of sized blast furnace coke (+ 20 mm) per year at a 25 mm per hour coking rate. Provisions for future installation of coal preheating will be included.

The general cold dimensions of the ovens are approximately as follows:

Width

Oven Chamber, average	470 mm
Oven Chamber, pusher side	430 mm
Oven Chamber, coke side	500 mm
Center to Center of Ovens	1,350 mm
Oven Taper	75 mm

Length

Inside of Oven Door Lining	14,720 mm
Face to Face of Brickwork	15,480 mm
Inside of Regenerators	14,730 mm

Height

Oven Sole to Oven Roof	6,750 mm
Oven Roof to Top of Battery (Average)	1,390 mm
Oven Pad to Oven Sole	5,280 mm
Oven Pad to Top of Battery	13,450 mm

Capacity Figures

Hot Volume	43.2 m^3
Bulk Density of Coal (Wet)	800 kg/m^3
Tons per Charge	34.6 t

BATTERY FOUNDATIONS AND SUBSTRUCTURE

The battery substructure will consist of the bottom slab, the nozzle decking supports and girders, the nozzle decking and the angular retaining wall, the foundations for the pusher machine track and the quench car track.

WASTE GAS FLUE, STACK FLUE, BATTERY STACK

The waste gas flue will run along the coke side of the battery. The stack flues will be constructed from heavy-duty reinforced concrete with a 50 mm thick lining of fireclay material.

The battery stacks will consist of an outer reinforced concrete column and the full height self-supporting independent brick lining.

REFRACTORY OVEN BLOCK

The refractory oven block will rest on the reinforced concrete nozzle decking between the reinforced concrete pinion walls, it will consist of the sole flues, the regenerators with the checkers, the heating walls forming the oven chambers, and the oven roof.

The refractory materials will be:

- fireclay for the sole flues, the lower regenerator courses, upper roof courses and the checkers.
- silica for the upper generator courses
- high density silica for the heating walls

The oven top will be covered with special concrete slabs that will be sloped from the battery axis to both sides.

OVEN BRACINGS

The oven bracing will be:

- the longitudinal bracing with all necessary connections
- the upper cross bracing consisting of tie rods for each oven wall
- the oven top bracing
- the lower cross bracing consisting of tie rods for each oven wall

- the buckstay girders for fastening the buckstays at the concrete columns on coke and pusher side
- the buckstays for coke and pusher sides of wide flanged beams
- the wall protection plates behind the buckstays

- the regenerator bracing
- the additional bracing under the benches
- the bracing below the oven sole

BENCHES AND PLATFORMS

The coke and pusher side benches will be constructed of structural steel. They will be filled with rammed concrete between the top girders and have a course of hard burned red brick paving.

The end and intermediate platforms will also be constructed of structural steel with reinforced concrete slabs.

OVEN DOORS AND FRAMES

The door frames and doors will be cast from heat resistant ductile iron. The frames will have a square cross section. The doors will be the self-sealing type, box-type door body; other features are the special fused silica door plugs, the two spring-loaded latch gears, and the NICUTE sealing strips.

The pusher side doors will be equipped with leveller doors.

HEATING SYSTEM

The heating system will consist of:

- the coke oven gas supply main from the by-product plant to and within the battery area with the steam heated gas preheaters
- the coke oven gas distribution main along the battery

- the pipe connections between the distribution main and the coke oven gas headers with shut-off cocks and reversing cocks
- the coke oven gas headers, including the riser pipes and the coke oven gas nozzles

The decarbonizing air system with heavy-duty fans, the air headers and the connection pipes to the reversing cocks.

REVERSING SYSTEM

The reversing system will consist of:

- the hydraulic reversing winch with rods, chains, sprockets, brackets, etc., for operating the waste gas valves, air flaps at the air inlet boxes and the coke oven gas reversing cocks

GAS COLLECTION SYSTEM

Each battery will be equipped with refractory-lined standpipes, on the coke and pusher sides, with elbows and collecting main valves with flushing liquor spray nozzles, and a steam jet. Each battery of 90 ovens will have two collecting mains with two off-take mains on the pusher side and two collecting mains and two crossover mains on the coke side. The collecting mains will be equipped with liquor sprays and remote controlled liquor sealed bleeders.

The two crossover mains will convey the gas from the coke side collecting mains to the pusher side off-take mains.

The off-take mains will run across the pusher machine tracks to the suction main.

The suction main will run along the battery and to the primary coolers.

OVEN TRACKS

The oven tracks for the pusher machine, the coal charging car and the coke guide/door machine will extend beyond the battery ends to allow parking of a spare machine. The quench car track between the quench station and the coke wharf, will include a turnout for parking of a spare quench car.

DOOR RACKS

Two electrically operated slewable and winch-tiltable door racks on the coke and the pusher sides of one end platform will be provided, including a hoist for each battery. The door service area will be weather-enclosed, heated and illuminated.

Four spare door racks for the recesses at the pinion walls and four steel frames at each end and intermediate platforms will be provided.

RAM AND LEVELLER BAR CHANGING STATION

A changing station will be provided for the ram and the leveller bar in each end platform.

QUENCH STATION

The quench towers will be made of concrete with brick lining. They will include a wooden mist suppressor with a flushing system. The quench water tanks will be supported on a steel structure at the settling pond.

The settling ponds will be constructed of reinforced concrete.

COKE WHARF

Each battery will have a wharf approximately 70 meters long, inside to inside, and approximately 11 meters from center line quench car track to center line of the wharf conveyor.

The wharf will be constructed of reinforced concrete and the sloping surfaces lined with hard burned brick pavers.

The trenches will extend beyond the length of the wharf to accommodate the plough maintenance platforms and stairways.

Two ploughs, each capable of reclaiming 200 tons per hour, will be provided for each battery. One will be a standby.

PIPING IN THE BATTERY AREA

The necessary supply piping and connecting piping for flushing liquor, steam, service water and compressed air will be installed.

PUSHER MACHINES

Pusher machines will be provided for door removal, door replacement, pushing, automatic door and jamb cleaning etc.; these actions will be performed without respotting. An interlocking system between the pusher machine and the coke side will ensure that the pusher is accurately positioned before being used.

COKE GUIDE/DOOR MACHINES

One-spot coke guide/door machines will be used for door removal and replacement, automatic door and jamb cleaning, coke guide positioning, etc. These operations can be performed without respotting.

COAL CHARGING CARS

Coal charging cars will be used, which will remove and replace the charging hole lids, clean goosenecks and standpipes, and charge coal, etc. These jobs can be done from one position (one-spot).

COKE SIDE EMISSION CONTROL SYSTEM

A system for coke side emission control will consist of, hooded quench cars, a duct along the battery to the quench station and a scrubber unit.

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QUENCH CARS

One-spot quench cars of the fixed bottom type will be used.

QUENCH LOCOMOTIVES

Quench locomotives will use standard gauge railroad and weigh about 25 tons.

COAL BIN

Concrete coal bins with 2,000 t storage capacity each with 2 bays and 4 outlet hoppers per bay will be included.

Offices and facilities for personnel and maintenance services will be provided in the space below the bin area. Service elevators will be provided with landings at various levels, for ease of access.

SUMMARY OF MAJOR EQUIPMENT

	Plant Capacity - TPY			
	1×10^6	2×10^6	3×10^6	5×10^6
Battery	1	2	3	5
Pusher Machine	2	3	4	7
Coke Guide/Door Machine	2	3	4	7
Coal Charging Car	2	3	4	7
Quench Car	2	3	4	7
Quench Locomotive	2	3	4	7
By-Product Plants	1	1	1	2

d. BY-PRODUCTS

PRIMARY COOLERS

Direct spray-type primary coolers process the coke oven gas derived from each battery.

Each primary cooler is designed for a volumetrical coke oven gas throughput of 75%.

FLUSHING LIQUOR SYSTEM

Flushing liquor decanters will handle the returned flushing liquor from each battery.

Each decanter is designed for a 75% flushing liquor throughout, with a retention time of 25 minutes.

AMMONIA LIQUOR TREATMENT PLANT

Gas condensates and process water, will be collected in several intercepting sumps adjacent to the respective process units, and processed through the ammonia stills. Caustic soda will be injected into the stills to control the pH-value of the treated effluent and to release ammonia from the fixed ammonia compounds.

The vapors from the still contain other compounds, as well as the ammonia; these compounds will be recycled to the coke oven gas for further processing.

EXHAUSTER

The exhausters will be designed to draw off the gas from the Coke Oven Battery. They provide sufficient positive pressure to deliver the gas through the by-product plant and to transfer the appropriate quantity of cleaned gas for underfiring back to the Coke Oven Batteries.

Exhauster drivers will be back pressure steam turbines. The exhaust steam will be utilized in several sections of the by-product plant either for heating and/or stripping purposes.

ELECTROSTATIC TAR PRECIPITATOR

The electrostatic tar precipitators will be designed for the tar removal efficiency of 98% under normal operating conditions.

PHOSAM PLANT

Ammonium phosphate solution will be used to scrub the ammomia from the coke oven gas; this solution will be steam stripped to produce an aqua ammonia condensate. Subsequently, this condensate will be fractionated to yield a high purity anhydrous ammonia.

FINAL GAS COOLER

Process heat generated by the Phosam Plant will be removed in the final gas cooler. The gas will be cooled to the lowest possible temperature in order to improve the light oil absorption efficiency in the subsequent Light Oil Plant.

LIGHT OIL PLANT

Light oil will be removed in an absorption and stripping operation by means of mineral wash oil.

The product of the plant will be a light oil mixture comprising mainly of benzene, toluene, xylene and some solvent naphtha fractions.

STRETFORD PLANT

Hydrogen sulfide will be selectively absorbed from the coke oven gas by an aqueous sodium carbonate solution with subsequent oxidation to elemental sulfur.

Formation of fixed cyan-sulfur compounds within the Stretford Plant will be reduced by processing the coke oven gas through an HCN-Removal Section prior to the Stretford Plant.

The blowdown quantities from the HCN-Removal Section and the Stretford Plant will be treated in a Waste Liquor Incineration System. The vapors and the condensates derived from the incineration will be recycled to the Stretford Plant.

GAS HOLDER AND FLARE STACK

After being processed through the by-product plant, the gas will enter the gas distribution system where it will be divided into a stream to the battery for coke oven underfiring and a stream to the consumers. A gas holder will be installed to serve as a buffer tank, and avoid surges in the coke gas distribution system.

A gas flare stack will be necessary to release into the atmosphere and ignite any excess gas from the gas system.

WASTE WATER TREATMENT

Waste water treatment facilities have been provided.

e. INFRASTRUCTURE

The following facilities or items represent some of the known infrastructure requirements at the given plant capacities. When a specific location is selected, others may exist.

	Plant Capacity - TPY			
	1×10^6	2×10^6	3×10^6	5×10^6
a) Dock (meters)	400	400	600	800
b) Water - potable (m^3/day)	46	92	125	175
- industrial (m^3/day)	42,600	85,000	125,000	210,000
c) Electric Power (kwh/day)	70,000	140,000	210,000	350,000

d) Access roads for cars and trucks to the battery limits of the plant

e) Railroad tracks to battery limits

f. BUILDINGS - MISCELLANEOUS

Buildings and equipment have been provided for an administrative office, maintenance shops, a laboratory and a warehouse.

IV. CAPITAL COSTS

This section of the report presents the capital cost requirements for the construction of coke and by-product plants for the three capacities under review. The plants are for the production of 1,000,000 tpy, 2,000,000 tpy and 5,000,000 tpy of merchant grade coke. The estimates are based on 3rd quarter 1978 costs. The accuracy of the estimates are at least ± 35 percent.

INCLUSIONS

The estimates include the cost of equipment and material, engineering, purchasing, field supervision, and construction labor, tools and equipment required for construction, and overhead charges incurred during construction.

Moneys have been included for nominal site preparation, land costs and taxes.

The equipment and material costs have been increased by 10% for a 1½% allowance for shipping expenses and an 8½% allowance for possible taxes.

EXCLUSIONS

No provisions have been made for infrastructure items, such as dock, harbor dredging and breakwall, if required, water or power supply to the battery limits, roads or railroads to the battery limits.

Escalation has not been included.

TOTAL CONSTRUCTION COST

The construction cost for the coke plants are estimated to be as follows:

Size of Plant	Cost $
1×10^6 ton/yr.	200,300,000
2×10^6 ton/yr.	334,300,000
3×10^6 ton/yr.	470,000,000
5×10^6 ton/yr.	776,000,000

A breakdown of the estimates are presented on the following pages.

COST OF SPARES AND MOBILE EQUIPMENT

Mechanical and Electrical spare parts have been included in each estimate together with purchases of locomotives, rolling stock and heavy F.E. loader equipment.

Size of Plant	$ Spares	Railway & Heavy Mobile Equipment
1×10^6 ton/yr.	2,500,000	4,000,000
2×10^6 ton/yr.	3,500,000	4,000,000
3×10^6 ton/yr.	5,000,000	5,000,000
5×10^6 ton/yr.	8,000,000	6,500,000

FIELD COSTS

Field costs include all field labour and field indirects, including construction supervision, temporary construction, construction equipment, small tools, consumables and payroll burden.

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TABLE IV-1.1 - CAPITAL COSTS

1 MILLION TPY

(Thousands of $ - 3rd Quarter 1978)

	Domestic Supply	Foreign Supply	Total
Battery			
Equipment			
Refractory		18,500	18,500
Oven Machinery	9,000	800	9,800
Castings	6,600	-	6,600
Other Equipment	2,100	-	2,100
Materials	14,000	-	14,000
Sub-contract Materials	6,700	-	6,700
Field Costs	33,000	1,500	34,500
Professional Services & Fee	5,300	5,700	11,000
Total Battery	76,700	26,500	103,200
By-Products			
Equipment	7,500	-	7,500
Materials	7,500	-	7,500
Sub-contract Materials	11,500	-	11,500
Field Costs	22,000	500	22,500
Professional Services & Fee	3,100	3,100	6,200
Total By-Products	51,600	3,600	55,200
Materials Handling			
Equipment & Materials	19,300	-	19,300
Field Costs	14,500	-	14,500
Professional Services & Fee	3,900	-	3,900
Total Materials Handling	37,700	-	37,700
Land	1,500	-	1,500
Heating up of Battery	200	-	200
Mechanical & Electrical Spare Parts	2,450	50	2,500
Total Plant	170,150	30,150	200,300

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TABLE IV-1.2 - CAPITAL COSTS

2 MILLION TPY

(Thousands of $ - 3rd Quarter 1978)

	Domestic Supply	Foreign Supply	Total
Battery			
Equipment			
Refractory		36,600	36,600
Oven Machinery	13,400	1,200	14,600
Castings	13,200	-	13,200
Other Equipment	4,300	-	4,300
Materials	26,600	-	26,600
Sub-contract Materials	13,500	-	13,500
Field Costs	62,700	2,300	65,000
Professional Services & Fee	7,200	7,600	14,800
Total Battery	140,900	47,700	188,600
By-Products			
Equipment	13,600	-	13,600
Materials	13,600	-	13,600
Sub-contract Materials	18,800	-	18,800
Field Costs	36,300	600	36,900
Professional Services & Fee	4,100	4,100	8,200
Total By-Products	86,400	4,700	91,100
Materials Handling			
Equipment & Materials	25,000	-	25,000
Field Costs	18,800	-	18,800
Professional Services & Fee	4,900	-	4,900
Total Materials Handling	48,700	-	48,700
Land	2,000	-	2,000
Heating up of Battery	400	-	400
Mechanical & Electrical Spare Parts	3,425	75	3,500
Total Plant	281,825	52,475	334,300

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TABLE IV-1.3 - CAPITAL COSTS

3 MILLION TPY

(Thousands of $ - 3rd Quarter 1978)

	Domestic Supply	Foreign Supply	Total
Battery			
Equipment			
Refractory	-	54,600	54,600
Oven Machinery	17,400	1,600	19,000
Castings	19,800	-	19,800
Other Equipment	5,800	-	5,800
Materials	38,600	-	38,600
Sub-contract Materials	20,000	-	20,000
Field Costs	90,100	3,000	93,100
Professional Services & Fee	8,900	9,300	18,200
Total Battery	200,600	68,500	269,100
By-Products			
Equipment	21,000	-	21,000
Materials	19,500	-	19,500
Sub-contract Materials	27,100	-	27,100
Field Costs	49,200	800	50,000
Professional Services & Fee	4,800	4,800	9,600
Total By-Products	121,600	5,600	127,200
Materials Handling			
Equipment & Materials	33,000	-	33,000
Field Costs	24,700	-	24,700
Professional Services & Fee	6,400	-	6,400
Total Materials Handling	64,100	-	64,100
Land (400 Acres) 160 Hectares	4,000	-	4,000
Heating up of Battery	600	-	600
Mechanical & Electrical Spare Parts	4,900	100	5,000
Total Plant	395,800	74,200	470,000

TABLE IV-1.4 - CAPITAL COSTS

2 MILLION TPY

	(Thousands of $ - 3rd Quarter 1978)		
	Domestic Supply	Foreign Supply	Total
Battery			
Equipment			
Refractory	-	36,600	36,600
Oven Machinery	13,400	1,200	14,600
Castings	13,200	-	13,200
Other Equipment	4,300	-	4,300
Materials	26,600	-	26,600
Sub-contract Materials	13,500	-	13,500
Field Costs	62,700	2,300	65,000
Professional Services & Fee	7,200	7,600	14,800
Total Battery	140,900	47,700	188,600
By-Products			
Equipment	13,500	-	13,500
Materials	12,300	-	12,300
Sub-contract Materials	18,500	-	18,500
Field Costs	35,400	600	36,000
Professional Services & Fee	4,000	4,000	8,000
Total By-Products	83,700	4,600	88,300
Materials Handling			
Equipment & Materials	13,300	-	13,300
Field Costs	10,000	-	10,000
Professional Services & Fee	2,600	-	2,600
Total Materials Handling	25,900	-	25,900
Land	-	-	
Heating up of Battery	200	-	200
Mechanical & Electrical Spare Parts	2,950	50	3,000
Total Plant	253,650	52,350	306,000

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TABLE IV-1.5 - CAPITAL COSTS

5 MILLION TPY

(Thousands of $ - 3rd Quarter 1978)

	Domestic Supply	Foreign Supply	Total
Battery			
Equipment			
Refractory	-	91,200	91,200
Oven Machinery	30,800	2,800	33,600
Castings	33,000	-	33,000
Other Equipment	10,100	-	10,100
Materials	65,200	-	65,200
Sub-contract Materials	33,500	-	33,500
Field Costs	152,800	5,300	158,100
Professional Services & Fee	16,100	16,900	33,000
Total Battery	341,500	116,200	457,700
By-Products			
Equipment	34,500	-	34,500
Materials	31,800	-	31,800
Sub-contract Materials	45,600	-	45,600
Field Costs	84,600	1,400	86,000
Professional Services & Fee	8,800	8,800	17,600
Total By-Products	205,300	10,200	215,500
Materials Handling			
Equipment & Materials	46,300	-	46,300
Field Costs	34,700	-	34,700
Professional Services & Fee	9,000	-	9,000
Total Materials Handling	90,000	-	90,000
Land	4,000	-	4,000
Heating up of Battery	800	-	800
Mechanical & Electrical Spare Parts	7,850	150	8,000
Total Plant	649,450	126,550	776,000

HEATING-UP OF BATTERY

The drying out and heating-up to temperature of a new coke battery requires approximately 10 weeks (70 days).

The labour for this procedure is included in the total manhour requirements, but at a greenfield site location oil for the drying and heating functions will have to be purchased. Since, it is assumed that all excess coke oven gas from the plant is sold, a similar expense is estimated for the Phase II heating-up of the 5 million tpy plant.

The cost for the fuel oil and possibly a storage tank, lines, etc., is estimated; these figures are reported in the Capital Cost of each plant on pages 4/3 to 4/7

SPENDING SCHEDULE

The spending schedules as shown below represents the 3 - year project schedule with a carry over into the 4th year for performance guarantees, field charge, deferred charges, etc., for each size of plant estimated. This schedule includes the constructed plant, battery heat-up expense, and spare parts.

	Spending, Millions of Dollars				
Size of Plant	Year 1	Year 2	Year 3	Year 4	Total
1×10^6 tpy	30.0	100.0	65.3	5.0	200.3
2×10^6 tpy	51.5	161.5	113.3	8.0	334.3
3×10^6 tpy	90.0	220.0	150.0	10.0	470.0

	Year 8	Year 9	Year 10	Year 11	Total
2×10^6 tpy	44.0	150.0	105.0	7.0	306.0

Details have been tabulated in the following set of Tables, IV-2.1 to IV-2.4. Foreign spending for materials or professional and field services are shown on Table IV-3 in millions of dollars.

ESCALATION

The Consultant's reply to DREE's request for a forecast of the escalation rate in the construction industry for the next three years follows:

U.S.A. - 9 percent per year

Canada - 8 percent per year

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TABLE IV-2.1 - SPENDING SCHEDULE

1 MILLION TPY

	Year 1	Year 2	Year 3	Year 4	Total
Battery					
Equipment					
Refractory - Foreign	2.0	14.5	2.0	-	18.5
Oven Machinery - Domestic	0.9	4.7	2.9	0.5	9.0
- Foreign	0.1	0.3	0.4	-	0.8
Castings	0.5	3.5	2.1	0.5	6.6
Other Equipment	-	0.5	1.6	-	2.1
Materials	4.0	5.0	4.5	0.5	14.0
Sub-contract Materials	-	3.0	3.2	0.5	6.7
By-Products					
Equipment	0.5	4.5	2.0	0.5	7.5
Materials	-	3.5	3.5	0.5	7.5
Sub-contract Materials	-	6.5	4.5	0.5	11.5
Material Handling					
Equipment & Materials	2.5	11.0	5.3	0.5	19.3
Field Costs					
Labour - Domestic	7.2	25.6	19.2	-	52.0
- Foreign supervisor	-	0.7	1.2	0.1	2.0
Other	2.8	9.2	5.1	0.4	17.5
Professional Services & Fee					
Domestic	4.5	4.9	2.5	0.4	12.3
Foreign	3.5	2.6	2.6	0.1	8.8
Land	1.5	-	-	-	1.5
Heat up of Battery	-	-	0.2	-	0.2
Spare Parts					
Domestic	-	-	2.45	-	2.45
Foreign	-	-	0.05	-	0.05
Totals	30.0	100.0	65.3	5.0	200.3

TABLE IV-2.2 - SPENDING SCHEDULE

2 MILLION TPY

	Year 1	Year 2	Year 3	Year 4	Total
Battery					
Equipment					
Refractory - Foreign	4.0	29.0	3.6	-	36.6
Oven Machinery - Domestic	1.4	7.5	3.8	0.7	13.4
- Foreign	0.1	0.5	0.5	0.1	1.2
Castings	1.0	7.0	4.4	0.8	13.2
Other Equipment	-	1.0	3.3	-	4.3
Materials	8.0	10.0	7.8	0.8	26.6
Sub-contract Materials	-	6.5	6.2	0.8	13.5
By-Products					
Equipment	1.0	9.0	2.8	0.8	13.6
Materials	1.0	8.0	3.8	0.8	13.6
Sub-contract Materials	-	12.0	6.0	0.8	18.8
Material Handling					
Equipment & Materials	3.2	14.0	7.0	0.8	25.0
Field Costs					
Labour - Domestic	13.5	35.5	41.0	-	90.0
- Foreign supervisor	-	1.0	1.8	0.1	2.9
Other	5.5	10.7	10.9	0.7	27.8
Professional Services & Fee					
Domestic	6.8	6.0	2.7	0.7	16.2
Foreign	4.0	3.8	3.8	0.1	11.7
Land	2.0	-	-	-	2.0
Heat up of Battery	-	-	0.4	-	0.4
Spare Parts					
Domestic	-	-	3.425	-	3.425
Foreign	-	-	0.075	-	0.075
Totals	51.5	161.5	113.3	8.0	334.3

TABLE IV-2.3 - SPENDING SCHEDULE
5 MILLION TPY - PHASE I

	Year 1	Year 2	Year 3	Year 4	Total
Battery					
Equipment					
Refractory - Foreign	6.0	42.6	6.0	-	54.6
Oven Machinery - Domestic	1.9	8.9	5.7	0.9	17.4
- Foreign	0.1	1.1	0.3	0.1	1.6
Castings	2.0	11.0	5.8	1.0	19.8
Other Equipment	0.5	1.5	3.8	-	5.8
Materials	17.0	12.4	8.2	1.0	38.6
Sub-contract Materials	2.0	9.0	8.0	1.0	20.0
By-Products					
Equipment	2.2	12.0	5.8	1.0	21.0
Materials	2.4	9.1	7.0	1.0	19.5
Sub-contract Material	2.5	11.6	12.0	1.0	27.1
Material Handling					
Equipment & Materials	5.0	18.0	9.0	1.0	33.0
Field Costs					
Labour - Domestic	23.4	54.4	50.7	0.5	129.0
- Foreign supervisor	-	1.5	2.2	0.1	3.8
Other	7.0	14.9	12.7	0.4	35.0
Professional Services & Fees					
Domestic	8.5	6.9	3.8	0.9	20.1
Foreign	5.5	5.1	3.4	0.1	14.1
Land	4.0	-	-	-	4.0
Heat up of Battery	-	-	0.6	-	0.6
Spare Parts					
Domestic	-	-	4.9	-	4.9
Foreign	-	-	0.1	-	0.1
Totals	90.0	220.0	150.0	10.0	470.0

TABLE IV-2.4 - SPENDING SCHEDULE

5 MILLION TPY - PHASE II

	Year 8	Year 9	Year 10	Year 11	Total
Battery					
Equipment					
Refractory - Foreign	4.0	29.0	3.6		36.6
Oven Machinery - Domestic	1.4	7.5	3.8	0.7	13.4
- Foreign	0.1	0.5	0.5	0.1	1.2
Castings	1.0	6.4	5.0	0.8	13.2
Other Equipment	-	1.0	3.3	-	4.3
Materials	8.0	10.0	7.8	0.8	26.6
Sub-contract Material	-	6.5	6.2	0.8	13.5
By-Products					
Equipment	1.0	9.0	2.7	0.8	13.5
Materials	1.0	6.8	3.7	0.8	12.3
Sub-contract Material	-	7.0	10.7	0.8	18.5
Material Handling					
Equipment & Materials	1.0	6.0	5.9	0.4	13.3
Field Costs					
Labour - Domestic	12.6	39.1	32.0	0.3	84.0
- Foreign Supervisor	-	1.0	1.8	0.1	2.9
Other	3.9	11.2	8.8	0.2	24.1
Professional Services & Fees					
Domestic	6.0	5.2	2.3	0.3	13.8
Foreign	4.0	3.8	3.7	0.1	11.6
Land					
Heat up Battery	-	-	0.2	-	0.2
Spare Parts					
Domestic	-	-	2.95	-	2.95
Foreign	-	-	0.05	-	0.05
Totals	44.0	150.0	105.0	7.0	306.0

TABLE IV-2.4 - SPENDING SCHEDULE

5 MILLION TPY - PHASE II

	Year 8	Year 9	Year 10	Year 11	Total
Battery					
Equipment					
Refractory - Foreign	4.0	29.0	3.6		36.6
Oven Machinery - Domestic	1.4	7.5	3.8	0.7	13.4
- Foreign	0.1	0.5	0.5	0.1	1.2
Castings	1.0	6.4	5.0	0.8	13.2
Other Equipment	-	1.0	3.3	-	4.3
Materials	8.0	10.0	7.8	0.8	26.6
Sub-contract Material	-	6.5	6.2	0.8	13.5
By-Products					
Equipment	1.0	9.0	2.7	0.8	13.5
Materials	1.0	6.8	3.7	0.8	12.3
Sub-contract Material	-	7.0	10.7	0.8	18.5
Material Handling					
Equipment & Materials	1.0	6.0	5.9	0.4	13.3
Field Costs					
Labour - Domestic	12.6	39.1	32.0	0.3	84.0
- Foreign Supervisor	-	1.0	1.8	0.1	2.9
Other	3.9	11.2	8.8	0.2	24.1
Professional Services & Fees					
Domestic	6.0	5.2	2.3	0.3	13.8
Foreign	4.0	3.8	3.7	0.1	11.6
Land					
Heat up Battery	-	-	0.2	-	0.2
Spare Parts					
Domestic	-	-	2.95	-	2.95
Foreign	-	-	0.05	-	0.05
Totals	44.0	150.0	105.0	7.0	306.0

TABLE IV-3 - FOREIGN SPENDING

Plant Size	Year 1	Year 2	Year 3	Year 4	Total
1×10^6 tpy					
Materials	2.1	14.8	2.45	-	19.35
Field Supervision	-	0.7	1.2	0.1	2.0
Prof. & Fees	3.5	2.6	2.6	0.1	8.8
	5.6	18.1	6.25	0.2	30.15
2×10^6 tpy					
Materials	4.1	29.5	4.175	0.1	37.875
Field Supervision	-	1.0	1.8	0.1	2.9
Prof. & Fees	4.0	3.8	3.8	0.1	11.7
	8.1	34.3	9.775	0.3	52.475
3×10^6 tpy					
Materials	6.1	43.7	6.4	0.1	56.3
Field Supervision	-	1.5	2.2	0.1	3.8
Prof. & Fees	5.5	5.1	3.4	0.1	14.1
	11.6	50.3	12.0	0.3	74.2

	Year 8	Year 9	Year 10	Year 11	
2×10^6 tpy					
Materials	4.1	29.5	4.15	0.1	37.85
Field Supervision	-	1.0	1.8	0.1	2.9
Prof. & Fees	4.0	3.8	3.7	0.1	11.6
	8.1	34.3	9.65	0.3	52.35

PROJECT SCHEDULE

It is estimated that the construction schedule for these projects would cover a period of about 36 months. This begins with the award of the contract through to start of operations. It is anticipated that the major engineering work, site preparation and some civil work would occur in the first year, with the major construction and erection and the heating-up of the batteries taking place in the next 24 months.

CONSTRUCTION LABOUR, BY CRAFT, BY YEAR

The total estimated construction manhours by craft and by year are shown in Tables IV-4.1 to 4.4. This includes journeymen helpers, apprentices, labourers, etc.

The manhours required to construct the project reflect an adjustment of 1.35 as an index of the labour efficiency in the Nova Scotia area.

CONSTRUCTION LABOUR COST

The average of several categories of Nova Scotia Construction labour rates resulted in a value of $9.05/hr; since many of these rates are under re-negotiation the figure of $9.50 is preferred to represent our August 1978 value.

The multiplier to factorise this rate is as follows:

Fringe Benefits		
Unemployment Insurance,		
Canadian Pension,		
Union Pension,		
Medical & Welfare	22.0%	
Workmen's Compensation	2.0%	
Vacation & Holiday Pay	8.5%	32.5%
Tools & Equipment Allowance		10.0%
Supervision		15.0%
Management		20.0%
Board, Allowance		15.0%
		92.5%

$9.50 x 1.925 = $18.29

Rate taken $18.30 per construction labour hour.

TABLE IV-4.1 - CONSTRUCTION LABOUR

1 MILLION TPY

ESTIMATED MANHOURS, BY CRAFT, BY YEAR

	Thousands of Construction Manhours			
	Year 1	Year 2	Year 3	Total
Boilermakers	5	80	50	135
Bricklayers	5	165	15	185
Carpenters	115	135	110	360
Electricians	8	172	150	330
Ironworkers	20	230	130	380
Millwrights	30	140	180	350
Operating Engineers	20	60	50	130
Teamsters	6	8	6	20
Pipefitters	50	220	260	530
Labourers	134	184	92	410
Misc. Crafts	7	6	7	20
Total	400	1,400	1,050	2,850

TABLE IV-4.2 - CONSTRUCTION LABOUR

2 MILLION TPY

ESTIMATED MANHOURS, BY CRAFT, BY YEAR

	Thousands of Construction Manhours			
	Year 1	Year 2	Year 3	Total
Boilermakers	16	100	154	270
Bricklayers	8	260	92	360
Carpenters	200	280	150	630
Electricians	12	180	278	470
Ironworkers	60	310	380	750
Millwrights	50	200	210	460
Operating Engineers	30	100	90	220
Teamsters	12	16	12	40
Pipefitters	80	250	550	880
Labourers	240	230	310	780
Misc. Crafts	12	14	14	40
Total	720	1,940	2,240	4,900

TABLE IV-4.3 - CONSTRUCTION LABOUR
5 MILLION TPY - PHASE I
ESTIMATED MANHOURS, BY CRAFT, BY YEAR

Thousands of Construction Manhours

	Year 1	Year 2	Year 3	Total
Boilermakers	15	240	145	400
Bricklayers	40	430	60	530
Carpenters	300	320	300	920
Electricians	20	310	400	730
Ironworkers	200	320	400	920
Millwrights	60	200	430	690
Operating Engineers	80	140	110	330
Teamsters	20	20	10	50
Pipefitters	225	500	525	1,250
Labourers	320	480	370	1,170
Misc. Crafts	20	20	20	60
Total	1,300	2,980	2,770	7,050

TABLE IV-4.4 - CONSTRUCTION LABOUR

5 MILLION TPY - PHASE II

ESTIMATED MANHOURS, BY CRAFT, BY YEAR

Thousands of Construction Manhours

	Year 8	Year 9	Year 10	Total
Boilermakers	10	150	100	260
Bricklayers	10	250	90	350
Carpenters	130	300	160	590
Electricians	10	200	250	460
Ironworkers	110	250	240	600
Millwrights	60	140	200	400
Operating Engineers	55	70	85	210
Teamsters	10	20	10	40
Pipefitters	135	400	365	900
Labourers	160	340	250	750
Misc. Crafts	10	20	10	40
Total	700	2,140	1,760	4,600

TRAINING

The consultant recommends that an allowance be provided for the recruiting and training of personnel as this is a greenfield site concept. Furthermore, experienced personnel would require some retraining to effectively operate the proposed modern coke and by-product facilities.

A few selected supervisory personnel as well as key operating and maintenance people should be sent to a coke plant with comparable equipment for training.

A training period of approximately three months is envisaged and might cost as follows for the different plant capacities.

Size of Plant	
1×10^6 tpy	\$ 250,000 - 300,000
2×10^6 tpy	\$ 350,000 - 400,000
3×10^6 tpy	\$ 500,000
2×10^6 tpy	\$ 100,000

TECHNICAL AND OPERATING ASSISTANCE

It is recommended that provisions be made for technical and operating assistance during the first year or so of operations. A selected engineering or operating company can provide this type of service.

Specialists would assist in the initial phase of operations in the analysis and solution of technical and operating problems and in attaining satisfactory levels of quality and efficiency.

An estimated cost for these services including salaries, fee, travel and living expenses in Nova Scotia is between \$150,000 and \$250,000 depending on the size of the plant.

POLLUTION CONTROL

In order to indicate possible pollution control requirements, a summary of some of the United States regulations are listed below. It should be pointed out that the pollution control requirements vary from state to state in the U.S.A., as well as from municipality to municipality. In addition, some of the previously approved processes or equipment are not now acceptable. Nevertheless, the facilities provided for this project meet the generally accepted current U.S. pollution control requirements.

- Environmental Protection Agency (Federal) Iron and Steel Manufacturing Point Source Category - Effluent Guidelines and Standards, Volume 39, Number 126, dated 6-28-74. Subpart A - By-product Coke Subcategory 420.10 describe, define and establish guidelines.

- State E.P.A. Regulations: (Typical Example) State of Illinois Pollution Control Board AR Pollution Regulations, Rules 202 and 203 (d) (6), Part II.

- Municipal E.P.A. Regulations: (Typical Example) Environmental Control Ordinance, Chapter 17 of the Municipal Code of the City of Chicago, Section 17-2.3 and 17-2.4.

- OSHA Regulation (Federal Register): Department of Labour, Occupational Safety and Health Administration, Exposure to Coke Oven Emissions, Part III, Dated 10-22-76 covers:

Charging Emission	Raw Material Handling Emission
Pushing Emission	Product Handling Emission
Employee Exposure	Water and Air Pollution
Quenching Emission	Equipment & Environmental Noise Control

TABLE IV.5

ESTIMATED COSTS RELATED TO POLLUTION ABATEMENT REQUIREMENTS

THOUSANDS OF $

Description	Plant Size				
	1×10^6	2×10^6	3×10^6	2×10^6	5×10^6
Second Gas Collecting Main	150	300	450	300	750
Larry Car Equipment	100	200	300	200	500
Steam Aspiration	250	500	750	500	1,250
Door Machine Enclosure	50	100	150	100	250
Coke Side Emission System	4,500	9,000	13,500	9,000	22,500
Quench Tower Baffles	100	200	300	200	500
H_2S Removal	10,000	17,000	22,000	17,000	39,000
Final Effluent Treatment Plant	10,000	16,000	20,000	16,000	36,000
Conveyors-Dust Collection	500	500	800	200	1,000
	25,650	43,800	58,250	43,500	101,750

V. OPERATING COSTS

GENERAL

This section concerns the development of operating costs for coke. Pertinent data relative to production volumes, yields, unit costs, labour requirements, etc., are presented herein.

PRODUCTION VOLUME AND OPERATING SCHEDULE

Three facilities that have capacities of 1,000,000, 2,000,000 and 5,000,000 tons of coke per year are compared in this section.

The coke plant operations are scheduled to work 365 days per year.

The production rates and yields used in the configuration represent reasonable attainable operations.

a) Yield:

Coal, as received to sized coke	65%
or, Dry coal to dry sized coke	70%

b) Approximate quantity of by-products recovered per ton of coal charged:

Coke oven gas	340 Nm^3
Tar	40.6 kg
Light oil	12 kg
Anhydrous ammonia	3 kg
Sulfur	3.5 kg

A material flow chart is shown on the following page for 1 million tpy of coke, larger facilities are simple multiples of these numbers.

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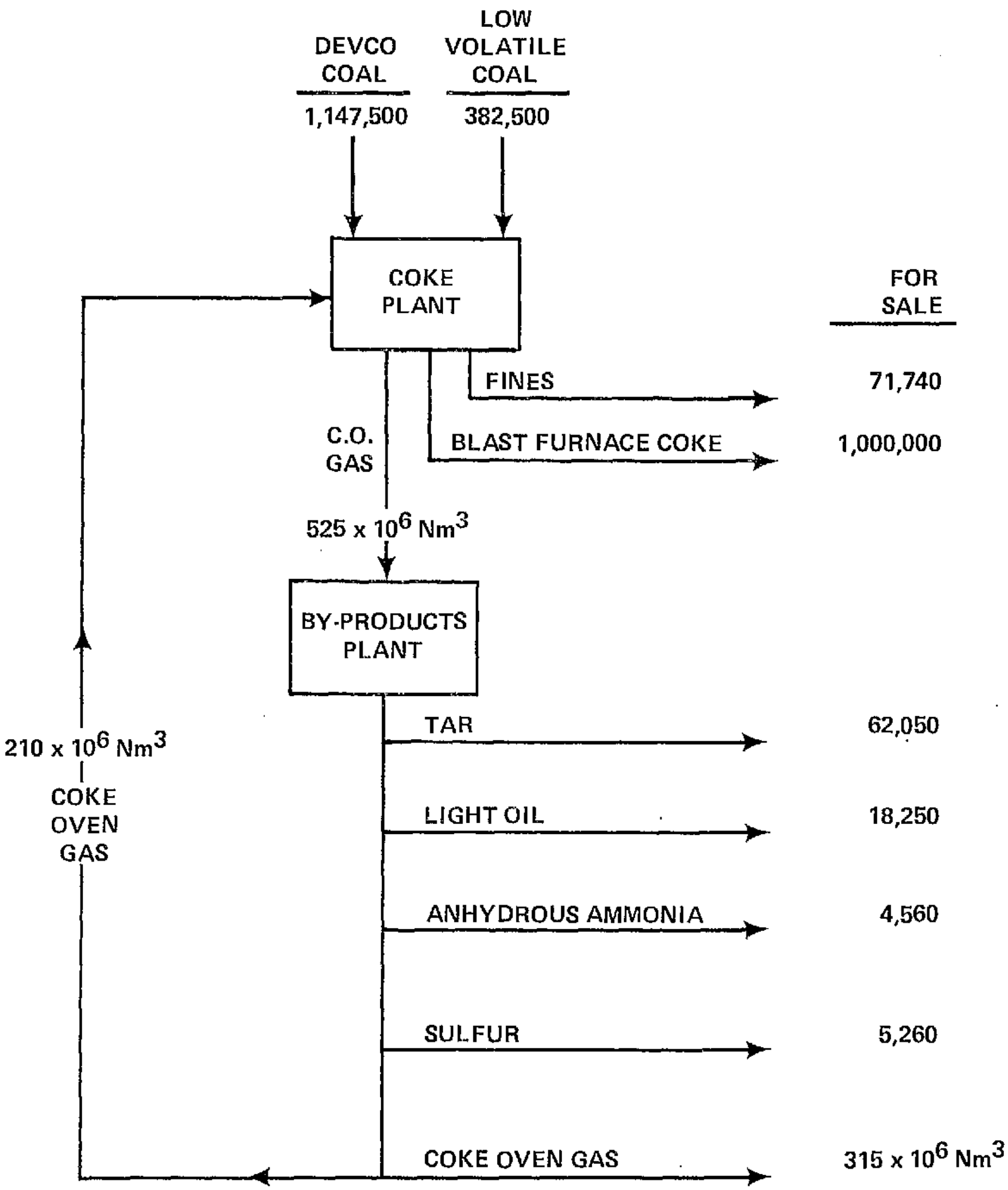
MATERIAL FLOW CHART

(METRIC TONS PER YEAR--
EXCEPT AS INDICATED)



It is forecast that in the start-up year of operations approximately 80 percent of capacity will be attained. In the second year, production should be at the projected level.

BASIC UNIT COSTS

The unit costs shown below represent data provided by DREE and by data developed by McKee. Other unit costs, as required for the economic analysis, will be developed by DREE.

Description	Unit	Dollars Per Unit	Source
Coal - DEVCO (H.V.)	ton		DREE
- Low Volatile	ton		DREE
Coke Fines	ton		DREE
Coke Oven Gas	10^6 kcal	8.00[2]	McKee
Tar	ton	130.00	McKee
Light Oil	ton	145.00	McKee
Sulfur	ton	25.00	McKee
Anhydrous Ammonia	ton	125.00	McKee
Electric Power	kwh	.04	McKee
Water	m^3	.065	McKee
Steam	ton	8.25	McKee
Labour [1]	Manhour	9.05	DREE
Salaried, average including fringe benefits, etc.	Manhour	12.50	McKee

[1] Basic Wage Rate (average) $6.85

Fringe Benefits	
- Unemployment insurance, Canadian pension, Company pension, group insurance, medical	22.0%
- Workmen's Compensation	2.1%
- Vacation and holiday pay	8.0%
Total Fringe	32.1%

[2] Based on cost of fuel oil at $13.00 per barrel.

ESTIMATED OPERATING COSTS

The operating costs include the cost of raw materials (in this case the unit quantities to be provided by McKee) and the other items of expense such as labour, fuel, utilities, maintenance materials, supplies (consumables such as lubricants, by-product chemicals, etc.), and miscellaneous office and sales expense.

Credits are proposed for the various by-products derived from the coking process.

START-UP OPERATING COSTS

McKee recommends that the standard operating costs as shown in Table V-1 be adjusted by 25 percent in the first year to recognize the impact of the "learning curve" with its lower operating performances, lower yields and higher spending rates during the first year of operations; this is the natural and unavoidable consequence of breaking in new equipment, processing problems, and the learning period for operating personnel in addition to lower productivity.

McKee

TABLE V-1 - OPERATING COSTS

1 MILLION TPY

	Quantity	Unit	Dollars Per Unit	Dollars Per Ton
Materials				
Low Volatile Coal	0.382	ton		
High Volatile Coal	1.148	ton		
Labour, Supervision, Clerical				5.50
Fuel	0.94	10^6 kcal	8.00	7.52
Utilities				
Electricity	25.00	kwh	0.04	1.00
Steam	0.23	ton	8.25	1.90
Water	15.5	m^3	0.065	1.00
Maintenance Materials				2.00
Consumable Supplies				1.00
Office & Sales Expense				0.75
Total Material & Operating Costs				
Sales of By-Products				
Coke Fines	0.072	ton		
Coke Oven Gas	2.340	10^6 kcal	8.00	(18.72)
Tar	0.062	ton	130.00	(8.06)
Light Oil	0.018	ton	145.00	(2.65)
Sulfur	0.005	ton	25.00	(0.13)
Anhydrous Ammonia	0.004	ton	125.00	(0.52)
Total Credits from Sales				
Total Cost - Screen Coke				

TABLE V-2 - COST COMPARISON

$ PER TON

	Plant Size			
	1×10^6	2×10^6	3×10^6	5×10^6
Materials				
Low Volatile Coal	*	*	*	*
High Volatile Coal	*	*	*	*
Labour, Supervision, Clerical	5.50	3.85	3.41	3.06
Fuel	7.52	7.52	7.52	7.52
Utilities				
Electricity	1.00	1.00	1.00	1.00
Steam	1.90	1.90	1.90	1.90
Water	1.00	1.00	1.00	1.00
Maintenance Materials	2.00	2.00	2.00	2.00
Consumable Supplies	1.00	1.00	1.00	1.00
Office & Sales Expense	0.75	0.60	0.50	0.40
Total Cost				
Sales of By-Products				
Coke Fines	*	*	*	*
Coke Oven Gas	18.72	18.72	18.72	18.72
Tar	8.06	8.06	8.06	8.06
Light Oil	2.65	2.65	2.65	2.65
Sulfur	0.13	0.13	0.13	0.13
Anhydrous Ammonia	0.52	0.52	0.52	0.52
Total Credits from Sales				
Total Cost - Screen Coke				

* By DREE

MANPOWER REQUIREMENTS

A summary of the manpower requirements for the various design capacities is shown in Table V-3.

The personnel have been classified into the following categories:

	CWS Job Classification
Unskilled	1 - 3
Semi-skilled	4 - 9
Skilled	10 and up
Office & Clerical	
Technical	
Management	

Examples of occupations included in the various classification categories follow:

J.C. 1 - 3	Labourer, Janitor
J.C. 4 - 9	Helpers, Lidman, Coke Loader, Light Oil Operator, Sampler
J.C. 10 and up	Heater, Pusher Operator, Exhauster Engineer, Maintenance Tradesmen
Office & Clerical	Secretaries, Accounting Clerks, Clerk Typists
Technical	Engineer, Draftsman, Computer Operator
Management	Manager, Foreman

Tables V-4.1 to V-4.4 present the labour force by classification and by department for the design capacities of 1,000,000, 2,000,000, 3,000,000 and 5,000,000 tons respectively.

TABLE V-3 - OPERATING MANPOWER

		Plant Size			
		1×10^6	2×10^6	3×10^6	5×10^6
1.0	Executive	5	6	7	8
2.0	Accounting, Storeroom	22	31	39	50
3.0	Engineering	5	7	7	11
4.0	Industrial Relations, Plant Protection	19	24	26	30
5.0	Quality Control	5	8	11	15
6.0	Purchasing, Traffic, Raw Material	3	4	5	6
7.0	Marketing (Sales)	7	10	15	22
8.0	Coke Plant Management	33	39	55	72
9.0	Docks, Storage Yard, Coal and Coke Handling	29	45	61	86
10.0	Batteries	48	88	125	215
11.0	By-Products	18	20	21	41
12.0	Assigned Maintenance	42	57	75	120
13.0	Shop Maintenance	25	36	50	75
14.0	Services	10	15	20	25
15.0	Utilities	4	5	6	8
	Total	275	395	523	784

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TABLE V-4.1

MANPOWER REQUIREMENTS BY CLASSIFICATION

(1,000,000 TPY)

Department	Unskilled	Semi-Skilled	Skilled	Clerical	Technical	Management	Total
Executive & Administrative, etc.	3	13	5	16	14	15	66
Plant Management, Production and Maintenance	-	-	-	2	-	31	33
Docks, Storage Yard, Coal and Coke Handling	8	18	3	-	-	-	29
Batteries	13	15	20	-	-	-	48
By-Products	1	8	9	-	-	-	18
Maintenance and Shops	8	24	35	-	-	-	67
Service and Utilities	7	3	4	-	-	-	14
TOTALS	40	81	76	18	14	46	275

McKee

TABLE V-4.2

MANPOWER REQUIREMENTS BY CLASSIFICATION

(2,000,000 TPY)

Department	Unskilled	Semi-Skilled	Skilled	Clerical	Technical	Management	Total
Executive & Administrative, etc.	5	18	6	25	20	16	90
Plant Management, Production and Maintenance	-	-	-	4	-	35	39
Docks, Storage Yard, Coal and Coke Handling	12	27	6	-	-	-	45
Batteries	21	29	38	-	-	-	88
By-Products	3	8	9	-	-	-	20
Maintenance and Shops	13	31	49	-	-	-	93
Service and Utilities	10	5	5	-	-	-	20
TOTALS	64	118	113	29	20	51	395

5/10

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TABLE V-4.3

MANPOWER REQUIREMENTS BY CLASSIFICATION

(3,000,000 TPY)

Department	Unskilled	Semi-Skilled	Skilled	Clerical	Technical	Management	Total
Executive & Administrative, etc.	7	21	8	34	24	16	110
Plant Management, Production and Maintenance	-	-	-	6	-	49	55
Docks, Storage Yard, Coal and Coke Handling	16	36	9	-	-	-	61
Batteries	26	43	56	-	-	-	125
By-Products	4	8	9	-	-	-	21
Maintenance and Shops	17	40	68	-	-	-	125
Service and Utilities	13	8	5	-	-	-	26
TOTALS	83	156	155	40	24	65	523

5/11

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TABLE V-4.4

MANPOWER REQUIREMENTS BY CLASSIFICATION

(5,000,000 TPY)

Department	Unskilled	Semi-Skilled	Skilled	Clerical	Technical	Management	Total
Executive & Administrative, etc.	12	27	10	40	34	19	142
Plant Management, Production and Maintenance	-	-	-	8	-	64	72
Docks, Storage Yard, Coal and Coke Handling	24	48	14	-	-	-	86
Batteries	48	73	94	-	-	-	215
By-Products	7	17	17	-	-	-	41
Maintenance and Shops	25	67	103	-	-	-	195
Service and Utilities	16	12	5	-	-	-	33
TOTALS	132	244	243	48	34	83	784

SECTION VI

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VI. PREHEATING AND CHARGING OF PREHEATED COALS

GENERAL

The preheating and hot charging of coking coals into coking ovens is a recent addition to coke plant technology. The basic underlying premise is that when coals are externally heated to a temperature of 260°C, all of the moisture is driven off prior to charging and the time required in the capital intensive coke ovens is significantly reduced. Depending upon the coal used, reductions in coking time and, hence, increases in production rates are reported to be on the order of 35 to 50%.

The removal of the moisture results in a significantly higher bulk density than can be achieved with the conventional untamped method of wet coal charging. The effective result of this factor is that medium volatile coals can be substituted for the low volatile portion or, if the same coals are utilized, a larger percentage of high volatile coals can be charged. The results of existing commercial installations are difficult to assess due to the wide variety of coal mixes charged in different coke plants.

All operators agree, however, that there are advantages to preheating. In addition to those previously mentioned, the higher and more evenly distributed bulk density of the preheated coal produces a more consistent and, in general, a better quality metallurgical coke. Appreciable increases in coke stability have been noted when a given coal mix is subjected to preheating prior to carbonization compared to conventional wet charging. The improvement in coke quality varies according to the rank of coal being carbonized to the extent that the magnitude of improvement is greater for the lower grade coking coals. In general, the abrasion resistance of coke will show improvement. In many cases it is this factor of coke quality improvement which might make the preheating system attractive, especially when lower cost coals could not otherwise be used.

The thermal shock to the oven chamber brickwork is considerably reduced and should, therefore, give a longer battery life expectancy.

The self-leveling nature of preheated coal eliminates the possible pollution source of an open leveler door and reduces the duty cycle of the ram machines.

In general, preheating has little effect on yield or composition of gas and by-products, except predictably, the quantity of ammoniacal liquor is appreciably reduced.

Dry, preheated, pulverized coal tends to flow like water. This characteristic greatly facilitates the charging and, as previously pointed out, the leveling functions. There are two principal methods being used today to transfer the preheated coal mix into the ovens, pipeline and gravity charging. In the former method the coal is conveyed under pressure from a storage bin and through a refractory lined circular conduit which runs the length on the charging side of the oven battery. At the appropriate times, valves are manipulated to permit the coal to flow directly into the oven being charged. There are two principal gravity methods being used: one utilizing a "hot car" which transfers one oven charge of preheated mix from metering bins directly to the coke oven, and one utilizing a "hot car" fed by redler conveyors transferring the mix from a storage bin.

The pipeline system claims certain advantages because the coal mix remains totally enclosed during charging, but because of the nature of its admission through the side of the ovens under pressure, the coal must settle of its own weight and some is carried over into the exhaust gases and tar stream. The "hot car" system must include dust collecting systems at transfer points, but because the charge is released downward into the oven by gravity, the charge is more dense and larger charges are possible. The "hot car" also has the flexibility of being able to charge wet coals should the preheater be out of service for any reason. All of the hot charging methods are "clean" by existing pollution guidelines.

DESCRIPTION OF PROCESS

There are many proven commercial processes used for dry coals as well as several methods for charging the preheated coal. The following is a brief description of the Coaltek System.

Wet coal is withdrawn from a storage bin by screw conveyors and screened, crushed and discharged to the preheater feed hopper.

Coal from the hopper is fed to the preheater by variable speed screw. The wet coal is fed into a flash-drying entrainment section where it comes into contact with a stream of hot oxygen-free gas. The gas carries the partly dried coal up to a dilute phase fluidized bed. A rotating swing hammer crusher in the lower part of the fluid bed chamber provides rapid dispersion and agitation of the coal particles in the gas stream and breaks the larger pieces into smaller pieces. All preheated coal goes overhead and is recovered in conventional cyclone separators.

Hot coal from the cyclones is conveyed to a hot coal receiving bin. From the receiving bin, the hot coal is conveyed as needed to an elevated measuring bin for transport to the ovens. The coal is conveyed through a pipeline to the ovens whenever an oven is ready. Coal transport in the pipeline is induced by means of steam jets strategically spaced along the pipeline.

COST COMPARISON

At the present time, the capital and operating cost differences between preheating and pipeline charging and conventional wet coals with larry car charging are not discernible within the estimating limits of this study.

Of the capital cost items, the higher cost due to the inclusion of the preheating facilities are offset by the reduced number of coking ovens required to produce the same tonnage as conventional wet charge ovens.

The operating costs are similarly related.

The cost of preheating the coal mix is offset by the reduced heating requirements in the subsequent carbonization stage. Manpower requirements and by-product recovery are reasonably the same for either the preheated or the conventional coking system

DRY COKE QUENCHING VS. WET QUENCHING

The major advantages of dry cooled coke expressed by proponents of the process are:

1. Utilization of the sensible heat in coke to produce 0.35 tons of steam at gauge pressure per ton of coke.

2. Improvement in the quality of the coke.

3. Provides coke devoid of moisture, therefore a savings in transportation costs.

CAPITAL COSTS

The published quotes for dry coke quenching facilities escalated to current prices, when compared to wet quenching costs require the additional costs as shown below.

Plant Size	Cost, $\$ \times 10^6$
1×10^6	9
2×10^6	14
3×10^6	20
5×10^6	34

OPERATING COSTS

It would appear that the dry quenching process would require one additional man per shift to operate the cooling station vs. no operators in a wet quench tower.

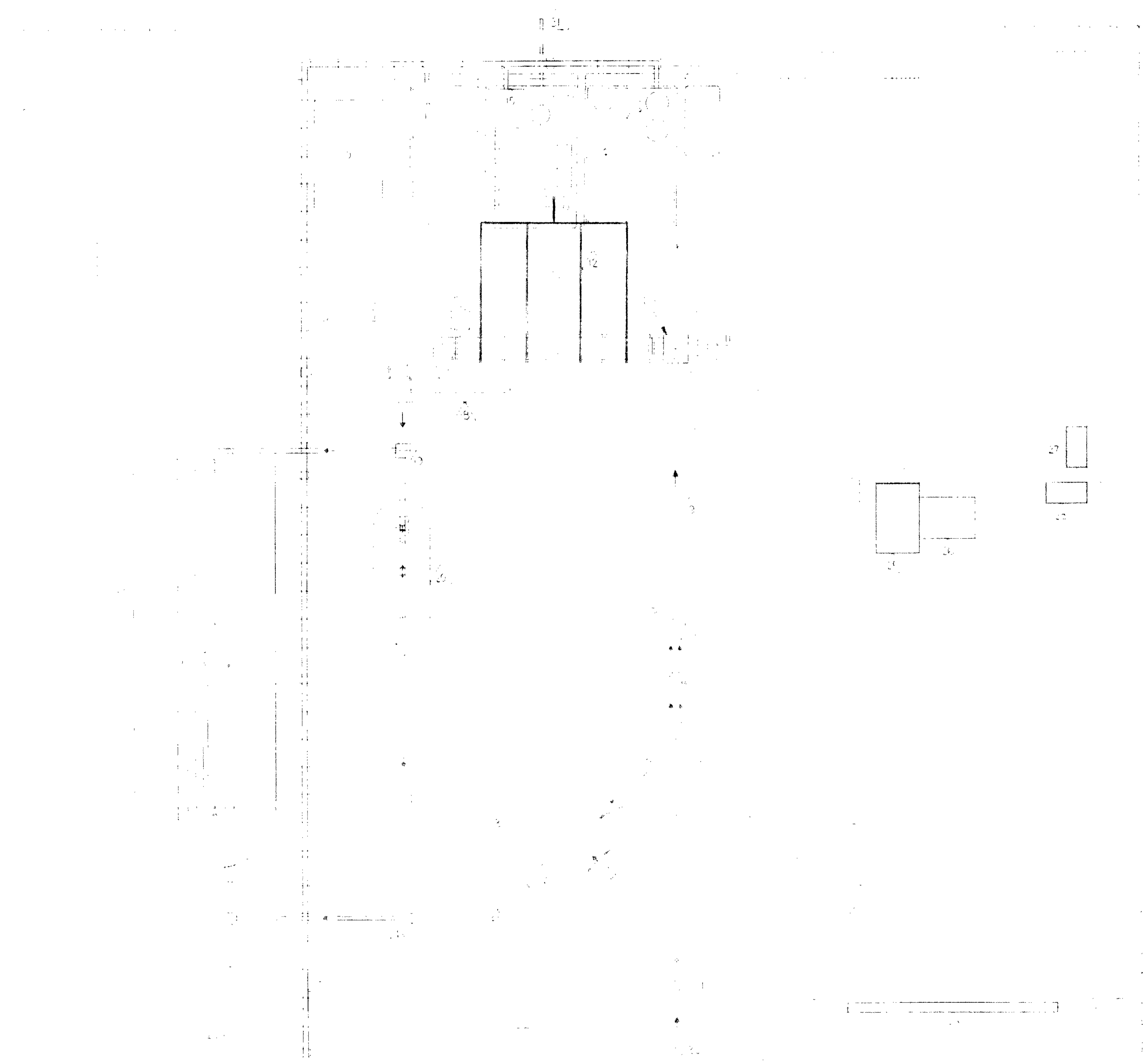
The maintenance costs required in the dry process would be somewhat offset by a reduction in quench car maintenance which is quite high in the wet process.

Both of the above items are relatively small and would increase the operating costs less than 0.4 percent.

The economic justification for the dry quenching process is based on credits derived from savings of fuel, i.e. utilization of the sensible heat of the coke. Dry coke cooling uses practically inert gas, which is recycled through a vertical shaft cooler where the gas is heated and the heat is then transferred via heat exchangers to produce steam or hot pressurized air for hot turbines; or 60 to 70% of the heat can be utilized most economically for coal drying and preheating.

The above credits are only applicable if the steam can be sold or the heat utilized in some manner.

As an example, a current cost for steam is about $8.25 per ton and at 0.35 tons of steam produced per ton of coke a savings in operating costs of about $3.00 could be realized.



ITEM NO.	DESCRIPTION	CAPACITY
1	COAL DUMPER	[illegible] TONNES
2	RADIAL STACKER [illegible] RADIUS	
3	STOCKPILE (HIGH VOLATILE)	[illegible] DAYS [illegible]
4	STOCKPILE (LOW VOLATILE)	[illegible] DAYS [illegible] TONNE
5	RECLAIM CONVEYORS	[illegible] TONNES/HR
6	CRUSHERS (2 REQUIRED)	[illegible] TONNES/HR
7	CRUSHED COAL STOCK BINS	[illegible] TONNES
8	MIXING STATION	
9	[illegible]	
10	COAL [illegible]	[illegible] TONNES
11	COKE OVENS ([illegible])	
12	BYPRODUCT PIPING	
13	LIGHT OIL STORAGE	[illegible] DAYS
14	TAR STORAGE	[illegible] DAYS
15	ANHYDROUS AMMONIA STORAGE	[illegible]
16	SULPHUR STORAGE	[illegible]
17	PIPE RACK FOR DOCKSIDE	
18	COKE WHARF	
19	SCREEN HOUSE	
20	COKE BREEZE STOCKPILE	[illegible] TONNES
21	COKE PRODUCT STOCKPILE	30 DAYS [illegible] TONNES
22	DOCKSIDE COAL UNLOADING	
23	[illegible] LOADING	
24	COKE BREEZE SHIPPING	
25	WORKSHOPS	
26	WAREHOUSE	
27	ADMINISTRATION OFFICES	
28	SECURITY FIRST AID & CHANGE ROOMS	
29	WASTE WATER TREATMENT PLANT	
30	THAWING SHED	
31	COKE [illegible]	

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GOVERNMENT OF CANADA
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ECONOMIC EXPANSION

McKee
ENGINEERS AND CONSTRUCTORS
TORONTO, ONTARIO

[illegible] TONNE PER YEAR
COKE PLANT
PLOT PLAN

CCL348A-10-1

ITEM NO.	DESCRIPTION	CAPACITY
1	COAL DUMPER	100 TONNES
2	RADIAL STACKER 100 M RADIUS	
3	STOCKPILE (HIGH VOLATILE)	[illegible] DAYS [illegible]
4	STOCKPILE (LOW VOLATILE)	[illegible] DAYS [illegible]
5	RECLAIM CONVEYORS	[illegible] TONNES/HR
6	CRUSHERS (2 REQUIRED)	[illegible]
7	CRUSHED COAL STOCK BINS	[illegible] TONNES
8	MIXING STATION	
9	[illegible]	
10	COAL HEADER BINS (2 REQUIRED)	[illegible]
11	COKE OVENS [illegible]	
12	BYPRODUCT PIPING	
13	LIGHT OIL STORAGE	[illegible] DAYS
14	TAR STORAGE	[illegible] DAYS
15	ANHYDROUS AMMONIA STORAGE	[illegible] DAYS
16	SULPHUR STORAGE	[illegible] DAYS
17	PIPE RACK [illegible]	
18	COKE WHARF	
19	SCREEN HOUSE	
20	COKE BREEZE STOCKPILE	[illegible] DAYS
21	COKE PRODUCT STOCKPILE	[illegible]
22	DOCKSIDE COAL UNLOADING	
23	[illegible] LOADING	
24	COKE BREEZE [illegible]	
25	WORKSHOPS	
26	WAREHOUSE	
27	ADMINISTRATION OFFICES	
28	SECURITY FIRST AID & CHANGE ROOMS	
29	WASTE WATER TREATMENT PLANT	
30	THAWING SHED	
31	[illegible]	

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DEPARTMENT OF REGIONAL
ECONOMIC EXPANSION

McKee
ENGINEERS AND CONSTRUCTORS
TORONTO, ONTARIO

TITLE: 2,[illegible],000 TONNE PER YEAR
COKE PLANT
PLOT PLAN

SCALE 1:2000

CCL348A-10-2

NO	DESCRIPTION	BY	CH	APPROVED	DATE

DESIGNED
DRAWN
CHECKED
APPROVED 1
APPROVED 2
APPROVED 3

McKee

DOCKING FACILITIES

We have received advice from the Swan Wooster Engineering Company of of Vancouver in regard to docking facility costs. Their company has worked with McKee on several previous projects including dock facilities for the Granduc Operating Company Limited, British Columbia and, also in Chile.

Three methods have been suggested.

Scheme I is suitable for 1 million tons per year of coke production and would cost in the order of $6,000,000 including engineering and contingencies, but not including dredging or other forms of excavation in the berth area; with 350 meters of berth there is capacity for one vessel.

Scheme II & III are suitable for berthing two vessels. In Scheme II, the partially mobile loader requires the ship to move for complete loading and therefore the berth length would be about 600 meters and the cost is estimated at approximately $10,000,000.

Scheme III requires a fully mobile type of shiploader at a cost of $1,000,000 more than the Scheme II, but the docking facility would be only 450 meters long and would cost approximately $8,000,000.

This combination is therefore less expensive than Scheme II.

A sketch of these schemes is enclosed as drawing 348B-10-4.

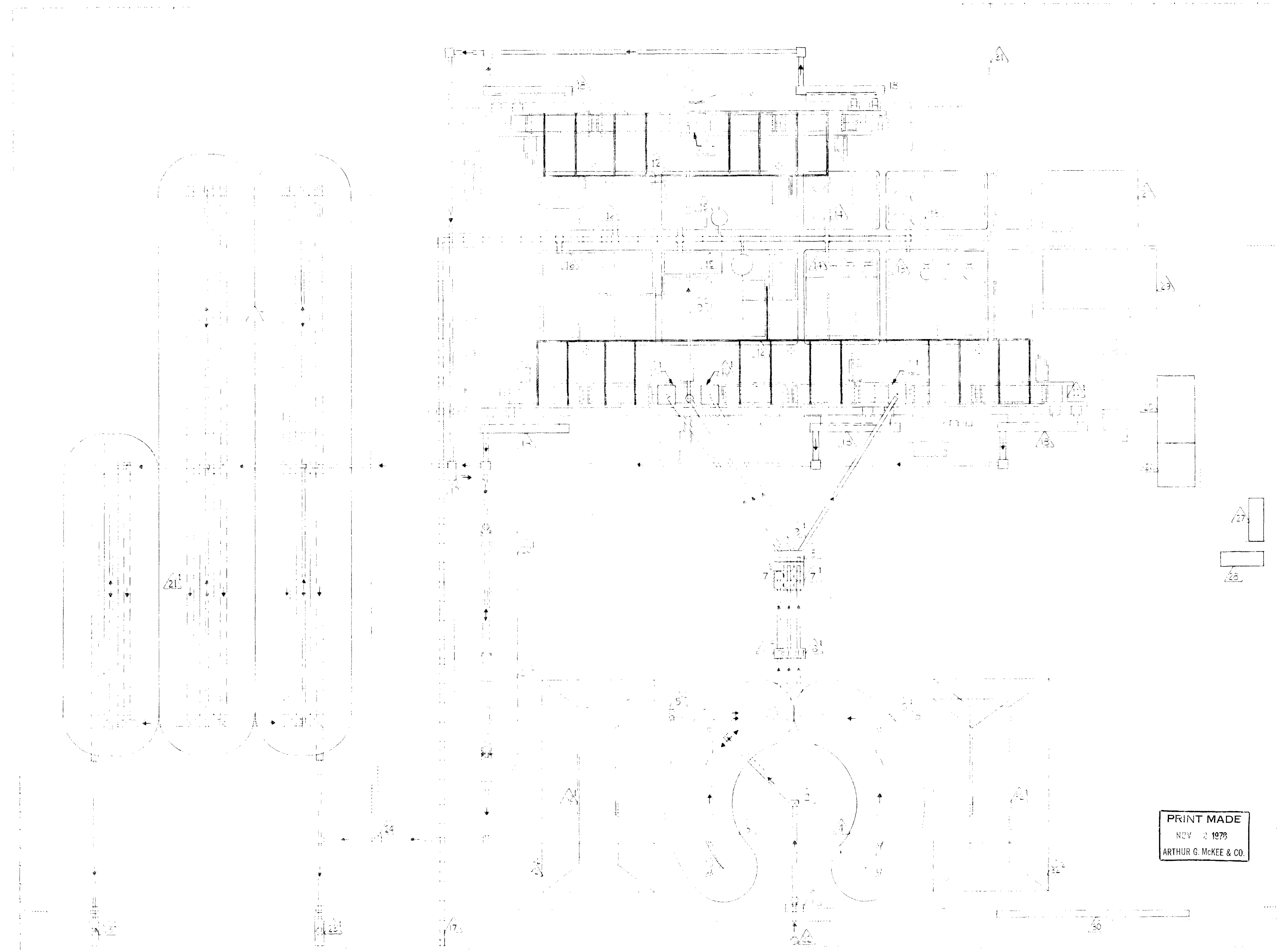
SECOND DOCKLOADER

The second dockloader that is included with Phase II of the 5 million tons per year coke facility is estimated to cost approximately $3.0 million, this would include the associated conveyor from the stockpiles and weighing equipment for use at 2,000 tons per hour.

This could become a second alternative to the Dock Facility Scheme III, or it may be superfluous depending on the experience of Phase I operations.

COKE STORAGE FACILITIES

The stockpile and recovery systems for 250,000 tons of merchant coke are estimated to cost approximately $5.5 millions. Relative to the total plant cost this is quite small, but it would show that Phase II could be reduced by $11.0 million of the storage requirements were reduced.



ITEM	DESCRIPTION	CAPACITY
1	COAL DUMPER	100 TONNES
2	RADIAL STACKER ~ 100M RADIUS	2000 TONNES/HR
3	STOCKPILE (HIGH VOLATILE)	132 000 TONNES
4	STOCKPILE (LOW VOLATILE)	132 000 TONNES
5[1]	RECLAIM CONVEYORS (2 SYSTEMS)	800 TONNES/HR
5[2]	RECLAIM CONVEYORS (3 SYSTEMS)	
6[1]	CRUSHERS (3 REQUIRED)	[illegible] TONNES/HR
6[2]	CRUSHERS (4 REQUIRED)	
7[1]	CRUSHED COAL STOCK BINS	2400 TONNES
7[2]	CRUSHED COAL STOCK BINS	3 000 TONNES
8	MIXING STATION	
9[1]	CONVEYORS TO COAL BINS	
9[2]	CONVEYOR TO COAL BINS	
10[1]	COAL BINS (3 REQUIRED)	3000 TONNES/EA
10[2]	COAL BINS (5 REQUIRED)	
11[1]	COKE OVENS (3 BATTERIES OF 90)	
11[2]	COKE OVENS (5 BATTERIES OF 90)	
12	BYPRODUCT PIPING (PHASE I & II)	
13	LIGHT OIL STORAGE (PHASE I & II)	90 DAYS
14	TAR STORAGE (PHASE I & II)	30 DAYS
15	ANHYDROUS AMMONIA STORAGE (PHASE I & II)	30 DAYS
16	SULPHUR STORAGE (PHASE I & II)	30 DAYS
17	PIPE RACK FOR DOCKSIDE	
18	COKE WHARF	
19[1]	SCREEN HOUSE (2 SCREENS REQUIRED)	
19[2]	SCREEN HOUSE (3 SCREENS REQUIRED)	
20[1]	COKE BREEZE STOCKPILE	90 DAYS 52 500 TONNES
20[2]	COKE BREEZE STOCKPILE	90 DAYS 87 500 TONNES
21[1]	COKE PRODUCT STOCKPILE	90 DAYS 750 000 TONNES
21[2]	COKE PRODUCT STOCKPILE	90 DAYS 1250 000 TONNES
22	DOCKSIDE COAL UNLOADING	
23[1]	DOCKSIDE COKE LOADING	
23[2]	DOCKSIDE COKE LOADING	
24	COKE BREEZE SHIPPING	
25	WORKSHOPS	
26	WAREHOUSE	
27	ADMINISTRATION OFFICES	
28	SECURITY FIRST AID & CHANGE ROOMS	
29	WASTE WATER TREATMENT PLANT (PHASE I & II)	
30	THAWING SHED	
31	COKE OVEN GAS MAIN	
32[1]	RESERVE COAL STOCKPILE	36 000 TONNES
32[2]	RESERVE COAL STOCKPILE	288 000 TONNES

NOTES

1. ITEMS DENOTED THUS $\triangle^{1}$ INDICATE PHASE I
2. ITEMS DENOTED THUS $\triangle^{2}$ INDICATE PHASE II
3. ITEMS WITHOUT SUFFIX ARE FOR PHASE I & II OR AS INDICATED IN DESCRIPTION
4. CAPACITIES & QUANTITIES SHOWN FOR PHASE II ITEMS INCLUDE PHASE I

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ARTHUR G. McKEE & CO.

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CLIENT
GOVERNMENT OF CANADA
DEPARTMENT OF REGIONAL
ECONOMIC EXPANSION

McKee
ENGINEERS AND CONSTRUCTORS
TORONTO, ONTARIO

TITLE
5 000 000 TONNE PER YEAR
COKE PLANT – PHASES I & II
PLOT PLAN

SCALE [illegible] B.M. NO.

CCL348A-10-3

REVISION

NO.	DESCRIPTION	BY	CH.	APPROVED	DATE

NO.	DESCRIPTION	BY	CH.	APPROVED	DATE

DESIGNED
DRAWN
CHECKED
APPROVED 1
APPROVED 2
APPROVED 3

SECTION VIII

McKee

CONTENTS

HEADQUARTERS
OF
ARTHUR G. McKEE & COMPANY OF CANADA LTD.
21 VOYAGER COURT SOUTH
REXDALE, ONTARIO M9W 5R9

The Canadian headquarters of Arthur G.McKee & Company of Canada Ltd. was constructed in 1974 on a 3.3 acre site in Rexdale, Ontario. This modern engineering facility comprises 45,000 sq. ft. of space and provides working facilities for a total staff of approximately 350 engineers and supporting personnel.

Located adjacent to the Toronto International Airport and its connecting expressways, this building is designed with an attractive yet totally functional environment, high-level lighting and total climate control and provides ideal conditions for efficient and accurate performance by McKee personnel. The construction of this wholly-owned facility is an indication of the confidence which McKee places in the future potential of the Canadian industrial community and McKee's ability to service these requirements.

Entrance lobby, where our receptionist will greet you on your arrival.

Typical scene of the general office area, Procurement Department.

HISTORY

Arthur G. McKee & Company was founded in 1905 as a firm of Consulting Engineers. Since that time, the company has evolved into an international, highly diversified corporation specializing in project planning and development, complete engineering, and construction services for the process industries. Today, the McKee Corp. consists of four divisions serving the Iron & Steel, Petroleum & Chemical, Mining and Non-Ferrous and Food & Pharmaceutical industries.

Arthur G. McKee & Company of Canada Ltd., a wholly owned subsidiary of the McKee Corp., was organized and established in Toronto in July 1952. To meet the growing demands of Canadian industry, a fully staffed engineering office was opened in July of 1956. Since that time, more than 300 projects have been successfully completed throughout Canada. Further, the staff and facilities have been expanded to include procurement, expediting and inspection services. The Ontario Construction Division was established in 1975 to more fully serve the engineering and construction requirements of the process industries.

The following pages provide a detailed outline of the full range of McKee services for the planning, project management, engineering, procurement, expediting, inspection and construction of future projects.

SERVICES

Arthur G. McKee & Company of Canada Ltd. is organized and staffed to execute major projects in their entirety — from initial concept through plant start-up — yet offers the capability of performing and/or supervising any one or any combination of services required by a client in the course of a project. Whether it is a single service or a total program, McKee is prepared to assume undivided responsibility, under a single contract, for all details of the work involved. Services are provided under several different types of contracts, each of which offers certain distinct advantages to the client.

The services offered by McKee are comprehensive and range from feasibility studies through basic design, engineering, procurement, construction and plant start-up.

The McKee organization in Canada includes specialists with know-how in a wide range of process techniques. When required, additional process expertise is immediately available from any of the technical centres of the McKee organization. The company is in a position to provide the following services, either as a total package or in any combination:

Project Management

- Integrating and handling of all resources necessary to complete a project that meets or exceeds technical requirements.
- The management of manpower, equipment, material and capital.

At McKee, this is done using an integrated project management approach in which the responsibility for a project is assigned to one highly competent and experienced engineer of senior rank. The project manager and his staff plan, direct, co-ordinate and control every phase of the project execution.

McKee has developed a sophisticated and proven method for effective project control including estimating, scheduling, and cost control, either manually or by computer depending on the needs of the project.

Complete Engineering

- Engineering, including finalized flow diagrams, site plan and general arrangement drawings plus specification of all process and utility equipment.

Design being reviewed at one of the modern drafting stations in the Engineering Department.

Computer Terminal linking Toronto with major computer facilities in North America, to provide full range of programs for accounting, engineering, procurement and construction functions.

- Working drawings, including complete architectural, civil, structural, mechanical, piping, electrical and instrumentation drawings.

McKee's engineering staff includes specialists in refrigeration, heating, ventilating, air conditioning and environmental control.

Environmental control is an integral part of all new McKee constructed plants. As a result of this capability, McKee provides consulting and complete engineering services for the abatement of air and water pollution, and noise control.

All work is organized on a project basis and the McKee project manager is responsible for liaison with the client on all phases of engineering procurement and construction. Process and equipment specifications are tailored to the customer's requirements and will include the latest innovations and concepts.

Purchasing, Expediting and Inspection

- Procurement of all necessary materials and equipment required for construction of the plant being designed.

Using detailed engineering specifications, bids are solicited, received and evaluated. Orders are negotiated, deliveries expedited and equipment inspected at time of delivery. When advantageous to the client, purchasing is done in collaboration with his own organization.

McKee's purchasing experience has grown from a long history of relations with hundreds of suppliers all over the world. These associations can be invaluable in securing hard-to-get materials and equipment.

Engineering model of process unit for a modern Petroleum Refinery. Use of models reduces drawing requirements, and aids Field Construction Planning and Supervisory Staff Training.

Construction

- Complete construction services from the earliest stages to start-up of the project.

Through the Ontario Construction Division every project has the close attention of experienced on-site supervision. Carefully developed scheduling and cost control techniques produce a timetable which integrates all phases of construction, results in effective use of manpower, equipment and controlled costs to meet the project budget and on time completion. McKee construction experts take pride in maintaining and often exceeding construction schedules. Local employment and safety rules are strictly observed as are all laws and customs in the various locations. Skilled local labour is employed wherever possible. In many cases, McKee conducts training programs involving classroom and on-the-job instruction, especially on projects in undeveloped areas.

Start-up and Initial Operation

- Follow-through responsibility including working with client personnel in initial start-up of the new plant.

Where desired, McKee will aid in procuring and training of competent operators.

From start to finish, McKee functions as an extension of the owner's organization in order to assure on-schedule completion — *within budget and totally operational*. Painstaking attention to every detail is a major factor in contributing to the McKee reputation for sound, efficient engineering and responsible contractual execution.

7000 tons per day copper concentrating facility engineered and constructed at the edge of a glacier near Stewart, British Columbia for The Granduc Operating Company, Stewart, British Columbia.

Conveyor bridge over the docking slip forms part of a coal stocking out and reclaim facility, designed and constructed for The Algoma Steel Corporation at Sault Ste. Marie, Ontario.

Complete sintering plant, including facilities for raw materials storage and handling, preparation and dust collection. Engineered and constructed for the Algoma Ore Division of The Algoma Steel Corporation at Wawa, Ontario.

#4 blast furnace and ancilliaries, computer controlled operation and modern environmental controls provide efficient operation of this 4000 tons per day blast furnace engineered and constructed for Dominion Foundries and Steel Limited at Hamilton, Ontario.

Construction for a 100,000 barrels per day refinery being built for Texaco Canada Limited at Nanticoke, Ontario.

500 ton per day uranium concentrator engineered for Rio Algom Limited at Moab, Utah.

"E" blast furnace — largest blast furnace in Canada at the time having a capacity of 3500 tons of iron per day with provision for expansion to 5000 tons per day. One of 3 blast furnaces designed and built for The Steel Company of Canada Limited at Hamilton, Ontario.

20,000 BPD catalytic reformer process unit constructed at the Montreal East refinery of Shell Canada Limited.

Mixed feed hydrofiner which, along with other major units such as a hydrocracker, powerformer, cryogenic hydrogen purification unit, hydrogen synthesis unit and light ends revamp, comprises a $50 million refinery expansion for Imperial Oil Limited at Sarnia, Ontario.

LIST OF CLIENTS

Since McKee established a total capability office in Toronto, services have been provided to all sections of the process industry in Canada. The company is very proud of the following list of valued clients:

The Algoma Steel Corporation
— Canadian Furnace Division
— Algoma Ore Division
Algoma Central Railway (Algocen Mines Ltd.)
Atlas Steels Company
Canada Packers Ltd.
Canadian Industries Limited
Consumers Glass Company
Cyanamid of Canada Ltd.
Department of Regional Economic Expansion
Dominion Foundries & Steel Limited
Eastern Mining & Smelting Ltd.
Electric Reduction Company of Canada Ltd.
Esso Chemicals Canada Ltd.
Ethyl Corporation of Canada Ltd.
Falconbridge Nickel Mines Ltd.
B.F. Goodrich Co.
Gulf Oil Canada Limited
Imperial Oil Limited
Inco Limited
Interprovincial Pipelines Ltd.
Kukatush Mining Corp.
Lakeshore Inc.
McGraw - Edison of Canada Ltd.
Nashwauk of Canada Ltd.
Noranda Mines Limited
Page Hersey Tubes Ltd.
Petrofina Canada Limited
Premium Iron Ores Ltd.
Quebec Cartier Mining Ltd.
Robin Hood Multi-Foods Ltd.
Rio Algom Ltd.
Shell Canada Limited
Steel Company of Canada Limited
Steep Rock Iron Mines Ltd.
Sydney Steel Corporation
Texaco Canada Limited

ARTHUR G. McKEE & COMPANY

Offices and Subsidiaries

Corporate Headquarters, 6200 Oak Tree Boulevard, Cleveland, Ohio 44131
Telephone [216] 524-9300 Telex 980-233

BERKELEY HEIGHTS, NEW JERSEY
100 Oak Way 07922

CHICAGO, ILLINOIS
10 South Riverside Plaza 60606

HIBBING, MINNESOTA
2729 13th Avenue E. 55746

HOUSTON, TEXAS
1111 Fannin Bank Building 77030

ST. LOUIS, MISSOURI
111 West Port Plaza 63141

SAN MATEO, CALIFORNIA
2700 Campus Drive 94403

WASHINGTON, D.C.
Suite 433, 1001 Connecticut Avenue, N.W. 20036

WAYZATA, MINNESOTA
Lindgren Exploration Company
330 South Walker Avenue 55391

ARGENTINA
A.G. McKee & Co. Argentina S.A.
Alsina 633
1384 Buenos Aires, Argentina

AUSTRALIA
McKee Pacific Pty. Ltd.
582 St. Kilda Road
Melbourne 3004, Australia

BELGIUM
CTB Engineers & Constructors
[Jointly owned with Tractionel]
rue d'Arlon 53
1040 Brussels, Belgium

BRAZIL
Arthur G. McKee & Company do Brasil Ltda.
Rua Frei Caneca, 1407-1 Andar - Sala 104
CEP 01307 - Consolacao
Sao Paulo, Brazil

CHILE
McKee Chile Ltda.
Isidora Goyenechea 3162
Casilla 14283
Santiago, Chile

ECUADOR
McKee Ingenieros y Constructores
Amazonas 353, Oficina 301
Quito, Ecuador

ENGLAND
McKee U.K. Ltd.
97-107 Uxbridge Road
Ealing
London W5 5TP, England

FRANCE
Compagnie Technique McKee S.A.
57 rue de Villiers
92 Neuilly/Seine
Paris, France

IRAN
McKee-Taleghani Daftary
Zafar Ave.
Takharestan Street
Tehran, Iran

MEXICO
A.G. McKee de Mexico S.A. de C.V.
Leibnitz 14-603
Mexico 5, D.F., Mexico

NETHERLANDS ANTILLES
A.G. McKee & Co.
San Nicolas, Aruba
Netherlands Antilles

SPAIN
McKee Ingenieros S.A. [MCI]
Avenida del Generalisimo, 71/A
Madrid 16, Spain

ARTHUR G. McKEE & COMPANY OF CANADA LTD.

21 Voyager Court South, Rexdale, Ontario M9W 5R9 • Telephone [416] 675-5800
Telex 06-968690 Cable "MACCAN"

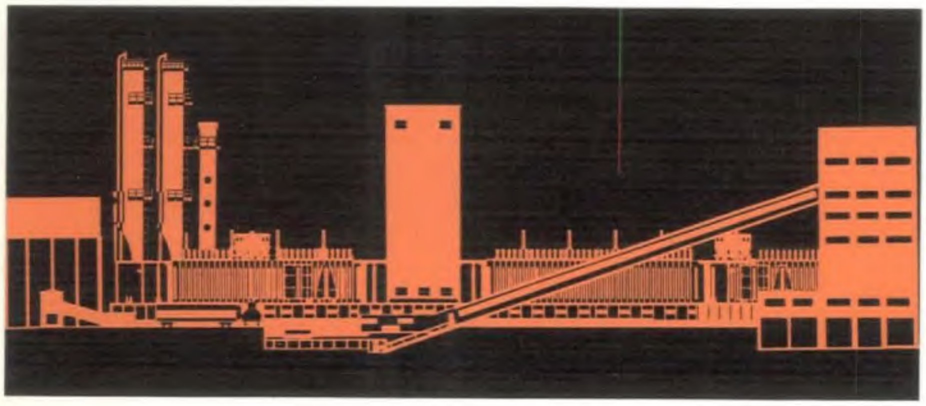
McKee-OTTO

Modern Coke Plants for the Steel Industry

Contents

McKee-Otto

Modern Coke Plants for the Steel Industry



To better serve the steel industry in the United States, Arthur G. McKee & Company has joined with Dr. C. Otto & Comp. of West Germany and Otto Construction Company of New York to provide design, engineering and construction services for coke and coke by-product plants.

This joint-venture undertaking broadens the scope of McKee and Otto services to their clients by offering the advantages of Otto technology combined with McKee's engineering and construction capabilities to provide superior coke facilities under a single contract.

A. McKee Corporate Headquarters, Cleveland, Ohio

B. Extension of Otto Main Offices, Bochum, West Germany

A.

B.

Arthur G. McKee & Company

Founded in 1905 as a firm of consulting engineers, Arthur G. McKee & Company has evolved into a large, highly diversified corporation specializing in project planning, project development and complete engineering and construction services for the process industries. Today, evidence of McKee technology spans the earth in the form of more than 4,000 major facilities for the processing of iron, steel, petroleum, chemicals, nonferrous metals, minerals, food and pharmaceuticals. The preponderance of this work has been done as repeat business from customers who rely on the cumulative talent, skill and experience McKee brings to each new undertaking.

McKee has maintained a position of leadership in engineering, construction and process technology for the iron and steel industries, and stands alone in its capability to provide facilities for every phase of iron ore processing and steel production on a worldwide basis.

Among McKee's many capabilities are major projects for iron ore mining, beneficiation, pelletizing and sintering, coke plants, blast furnaces, electric and basic oxygen plants, direct reduction units, continuous casting plants, rolling mills and finishing facilities.

Dr. C. Otto & Company

Recognized internationally for the design and construction of coke ovens and by-product plants since 1872, Dr. C. Otto & Comp., GmbH, of Bochum, West Germany, has developed many technical features that are now almost universally employed in the coke making process. Included are the use of silica brick, the underjet firing principle and "hairpin" flue systems. Currently more than 65,000 coke ovens of Otto design have been built throughout the world.

To satisfy the demand in recent years for continuing increases in the output of coke oven plants, the Company has introduced the Otto high-capacity coke oven, which is described in pages 5-8.

In addition, Otto has developed and offers technology for by-product recovery. Experience in this field includes the design, construction and maintenance of integrated plants or individual processing units for the purification of coke oven gas and the separation and processing of by-products.

Project Management at Work

McKee-Otto is organized and staffed to execute major projects in their entirety—from initial concept through plant start-up—and is prepared to assume undivided responsibility, under a single contract, for all details of the work involved.

Successful completion of a project, in minimum time and at minimum cost, is dependent on the effective management of resources—the management of manpower, equipment, materials and capital. McKee-Otto accomplishes this by utilizing an integrated project management approach in which responsibility for management of a project is assigned to one highly competent and experienced engineer of senior rank, the Project Manager, who, with his staff, plans, directs, coordinates and controls every phase of project execution.

McKee-Otto services include studies and reports, engineering, planning and scheduling, estimating and cost control, procurement, construction, construction management and start-up.

Studies and Reports

At the outset of a project, McKee-Otto provides invaluable assistance in developing economic and/or technical feasibility studies covering every aspect of project planning. All essential factors affecting the project are given professional analysis and evaluation.

A. Computer center at McKee headquarters.

B. Spacious working areas designed for efficient performance of engineering sections.

C. Project team meets monthly to review status of materials and equipment.

A.

B.

C.

Engineering

Basic and detail engineering for each project is performed under the direction of a Senior Project Engineer who is responsible to the Project Manager for all design work, specifications and drawings required for procurement and construction of the plant. McKee-Otto's engineering departments are staffed with specialists in each of the disciplines involved in project engineering, assuring the ready availability of qualified personnel for every assignment.

Planning and Scheduling

To increase the effectiveness of project management and minimize delays which could jeopardize the timely completion of a project, McKee-Otto has developed and uses proven "time-control" procedures for controlling work progress on every phase of project execution.

A. Recently built coke oven plant at SIDMAR steel complex in Belgium. Plant includes 100 coke ovens.

B. By-product plant at Italsider Steelworks, Taranto, Italy. Shown is one of three by-product lines, each with a capacity of 2,540,000 cu. ft. STP/h.

C. Coke oven plant, Steel Company of Canada, Hamilton, Ontario.

A.

B.

C.

Estimating and Cost Control

Systematic application of cost control techniques is an important element of project management at McKee-Otto, serving to alert the Project Manager to potential problems in time for corrective action and, through periodic reports, keep McKee-Otto management and clients informed of current and projected levels of spending.

Procurement Services

McKee-Otto maintains a procurement department in each major office, responsible for purchasing materials, equipment and subcontractor services at the lowest ultimate cost compatible with project and client requirements. Procurement services include not only purchasing but also systematic follow-up to ensure that all materials and equipment bought are manufactured or fabricated in accordance with engineering specifications and are delivered to the construction site on schedule.

Construction and Construction Management

McKee-Otto construction and construction management are based on the four imperatives of successful project management: planning, direction, coordination and control. Members of the construction team, under direction of a Project Construction Manager, participate in all stages of project planning, from design through procurement, concurrently working with Planning and Scheduling personnel to develop construction plans and schedules for incorporation in the overall project plan. Planning includes analysis of manpower requirements, working conditions at the construction site, local manpower availability, labor relations, labor rates, safety regulations and tool and equipment requirements.

Start-Up and Initial Operation

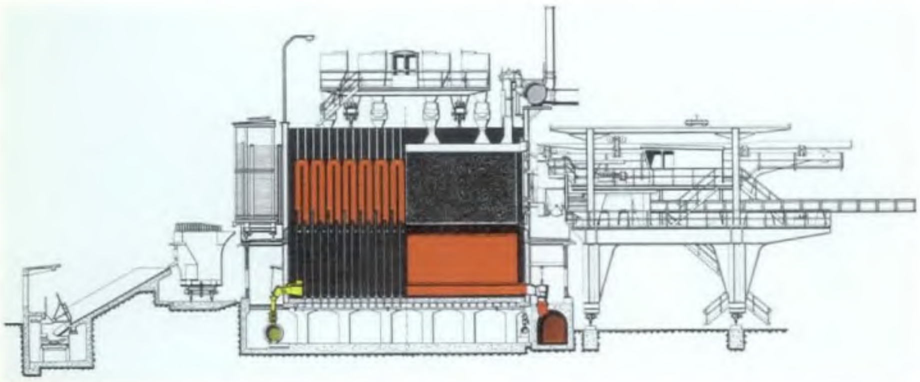
In the final phase of project execution, McKee-Otto services available to assist the client in plant start-up and initial operation include preparation of operating and maintenance instructions, recruitment of experienced operators and classroom training of inexperienced personnel. During the period of initial operation, McKee-Otto representatives remain available to evaluate operating procedures and assist in overcoming problems.

Otto High-Capacity Coke Oven

A. Overall view of Otto high-capacity coke oven.

B. Typical coking plant.

C. Otto gas-fired coke oven showing separate heating units utilizing single flow method.



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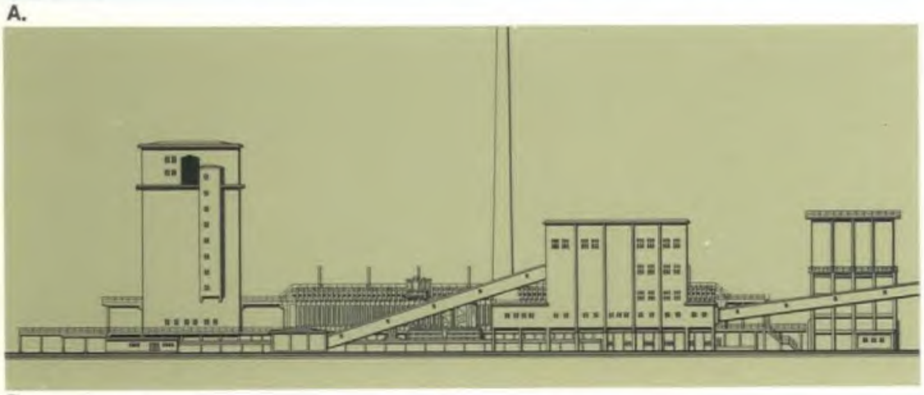

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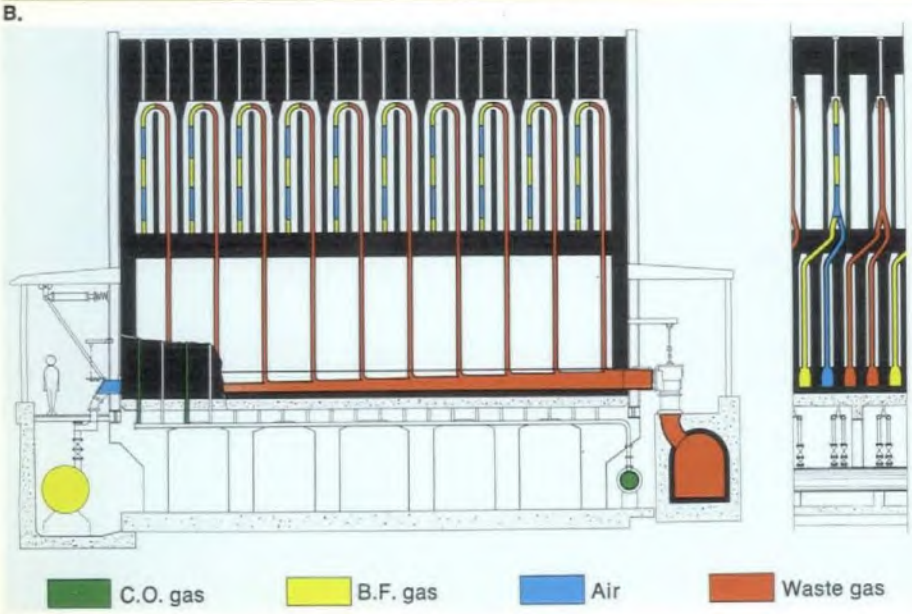


C.

The worldwide success of the Otto coke oven can be attributed to three design characteristics which have remained unchanged for many years: heating units, underjet firing and hairpin flues.

Outstanding features include a strong, reinforced concrete substructure with spacious basement, sturdy brickwork and bracing design, the unique Otto collector main, hydraulic reversing mechanism, self-sealing coke oven doors and other time-proven design elements.

Heating Units

The Otto coke oven is divided into separate heating units, each of which contains a hairpin heating flue and requisite regenerator sections. Carefully controlled flows of fuel gas and air enter from the bottom of the heating unit. Coke oven gas is directed straight to the burner while air and blast furnace gas pass through the upstream regenerator sections. After combustion, waste gas leaves the hairpin flue in still controlled flows via the downstream regenerator sections and passes to the sole flues. Distribution and recollection of air or air/blast furnace gas and waste gas take place in the sole flues. The Otto coke oven has only one waste gas flue leading to the battery stack, which can be positioned on either the pusher or the coke side of the oven.

6

Otto High-Capacity Coke Oven

A. Section of Otto oven showing individual heating units and basement.

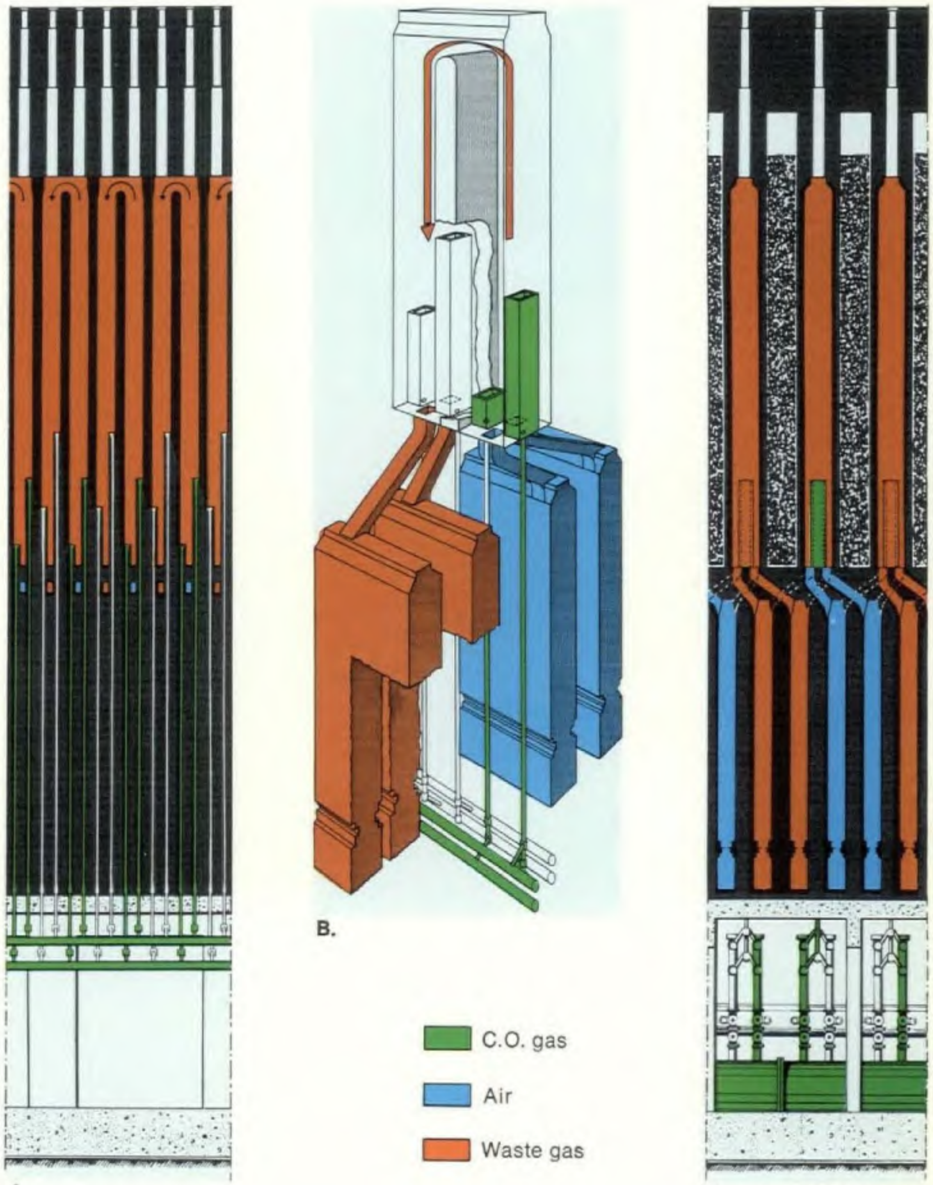
B. Perspective view of the heating unit of one twin flue with its corresponding regenerator cells.

C. Detail of oven section showing nozzle arrangement and gas, air and waste gas flows.

Underjet Firing

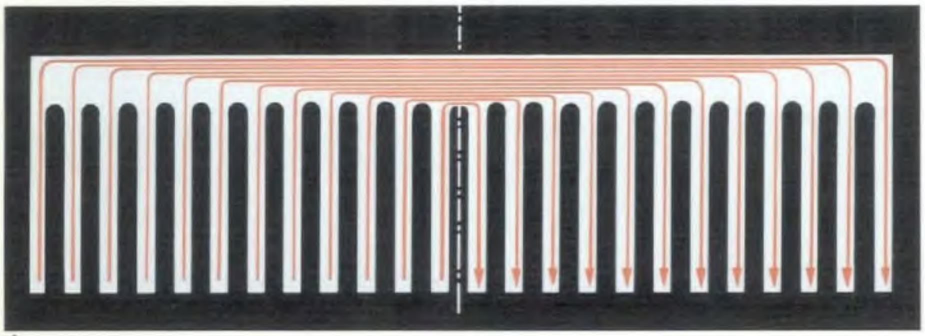
Underjet firing provides complete control of air and gas flow. Each gas burner in the hairpin flues of the oven heating walls has its own calibrated nozzle in the battery basement.

Air, in the case of coke oven gas heating, or air and blast furnace gas, in the case of blast furnace gas underfiring, is distributed through calibrated nozzle plates located between the sole flues and regenerator chambers. Nozzles and nozzle plates are easily adjusted.



A. B. C.

A. Half-divided oven wall.
B. Four-divided oven wall.
C. Crossover flue oven wall.
D. Otto hairpin flue oven wall.



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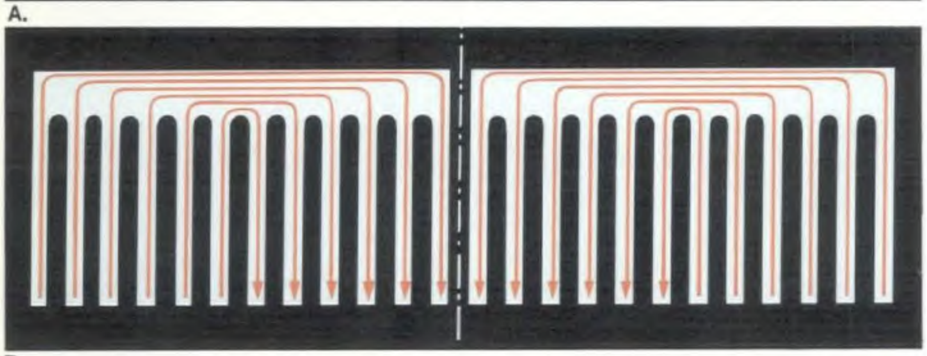

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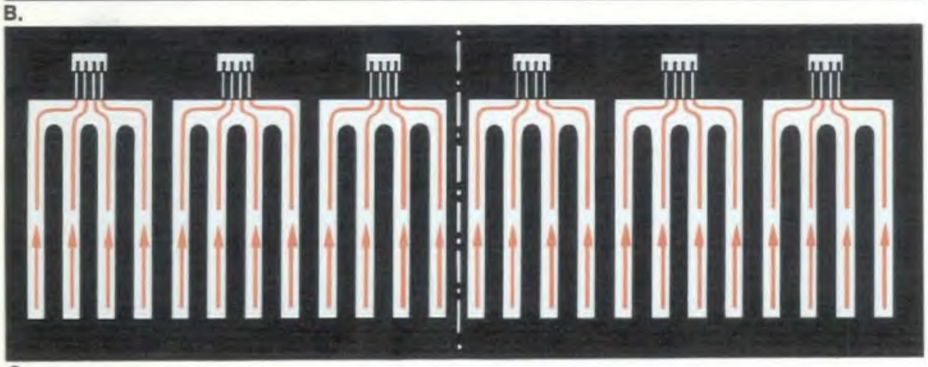

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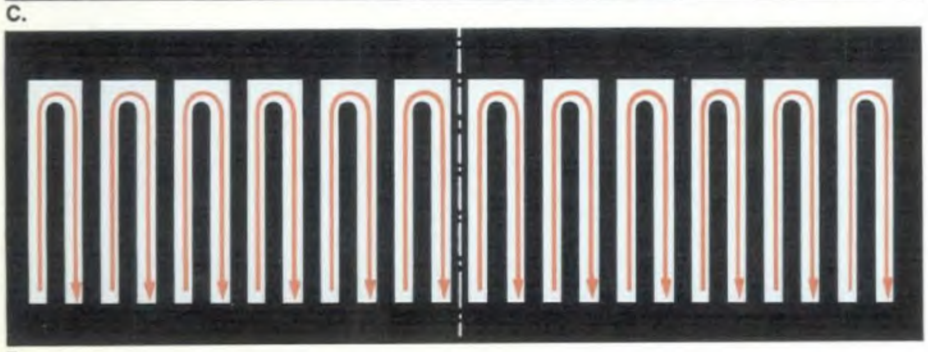


D.

Hairpin Flues

Fifty years after its introduction, the Otto hairpin flue still offers advantages over other designs (at left). The elimination of horizontal bus flues provides superior stability and wall strength. Pressure resistance is minimal because the accumulation and redistribution of downstream waste gas required with the use of bus flues is eliminated. Uniform heat distribution is provided by burning gas in every other flue.

8

Otto High-Capacity Coke Oven

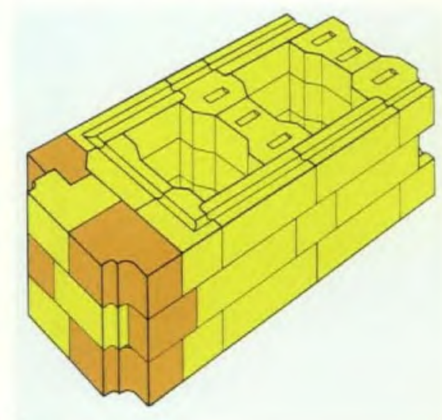
Brickwork

The brickwork of Otto coke ovens reflects the knowledge and experience of one of the world's oldest manufacturers of coke oven refractories. Because of the simplicity inherent in Otto oven design, only a minimum number of refractory shapes is required. Wall heads are protected by thermal, shock-resistant, hard fireclay jamb bricks interlocked with the silica brickwork of the oven walls.

The use of silica and fireclay bricks with zones of varying temperatures and material expansion requires a sturdy, but flexible, bracing system. The springloaded bracing system shown in the accompanying illustration reflects Otto's decades of engineering and construction experience.

A. Otto springloaded bracing system.

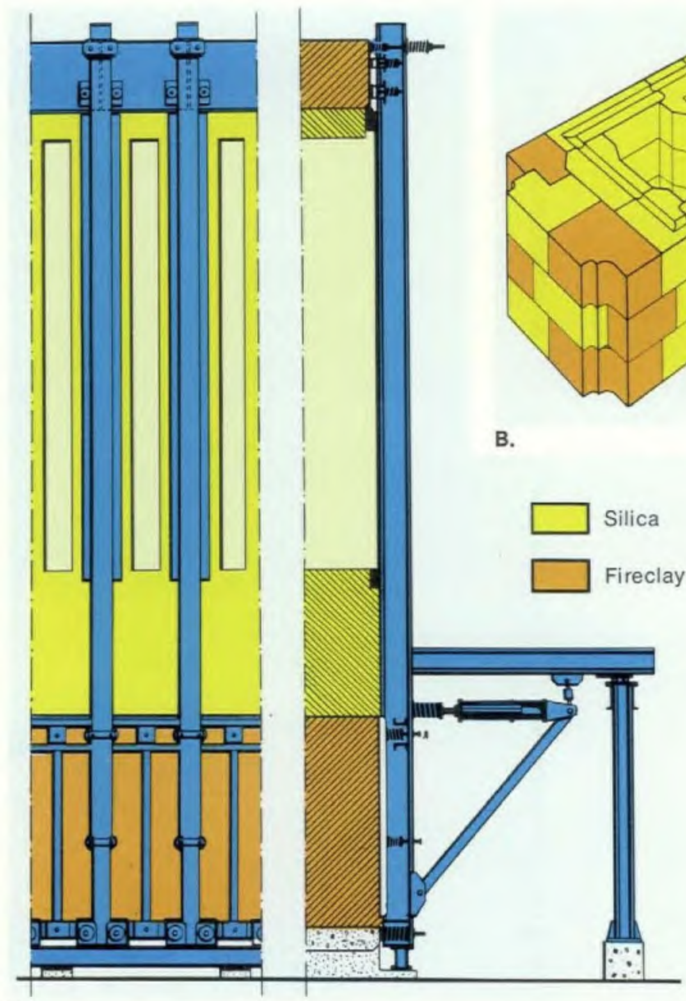
B. Oven jamb bricks.



B.

Silica

Fireclay



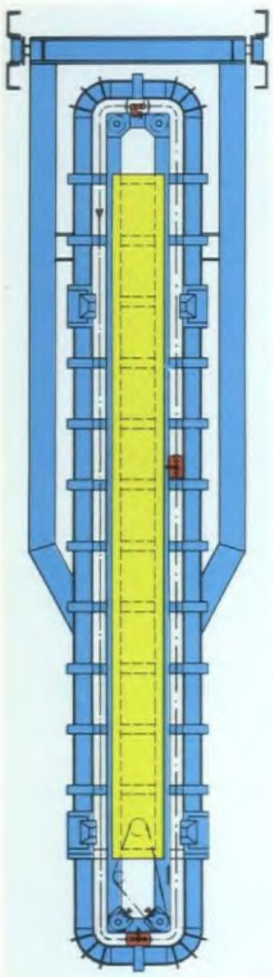
A.

A. Otto coke oven door cleaner.

A1. Scraper cleaning plug.

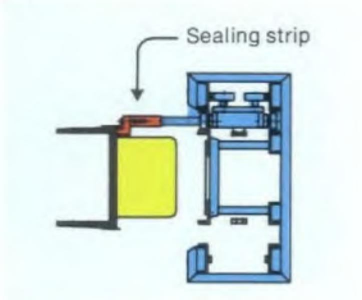
A2. Scraper cleaning sealing strip.

B. Automated Otto coke oven machine.

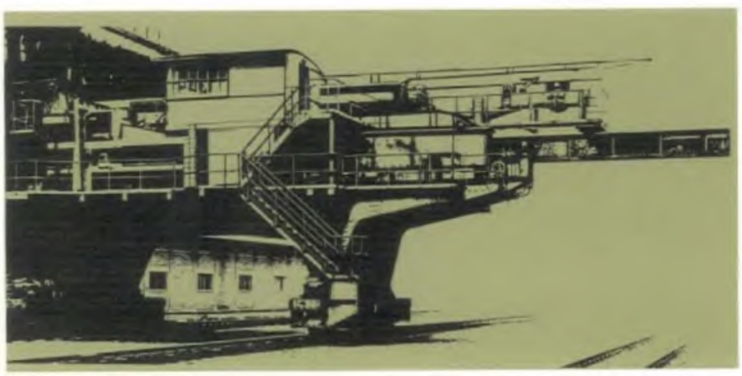


A.

A1.



A2.



B.

Mechanized Equipment

With tall ovens working at fast coking rates, large, modern coke oven batteries require mechanized equipment for certain operations. McKee-Otto offers a wide array of custom-made mechanized equipment including:

- Coke oven door and jamb cleaners for the pusher and coke sides of the battery.
- Standpipe and standpipe elbow cleaners on the coal larry.
- Mechanized coke gates for existing coke wharfs.
- Plow feeders for new installations.

Coke Oven Machines and Battery Automation

Large batteries equipped with coke oven machines, operating at fast coking rates, can be automated to increase production. Otto machines are adaptable to either semi- or fully-automatic operations and include these modern design features:

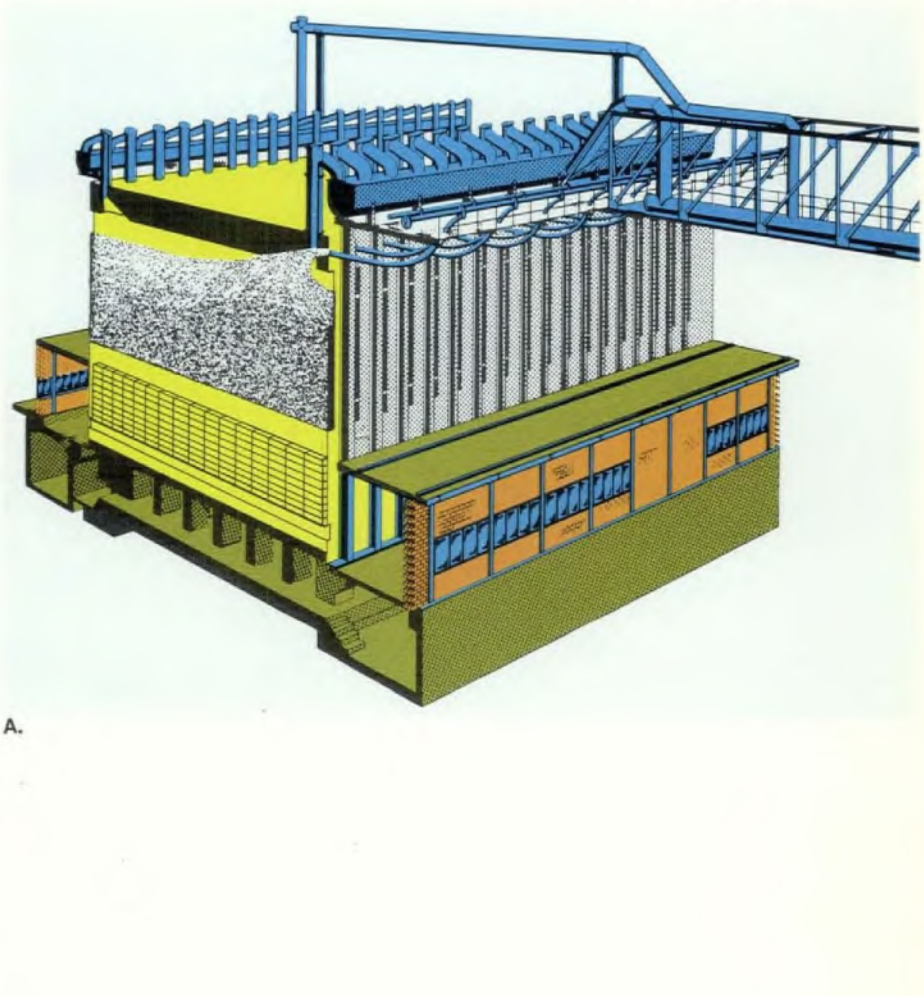
- One-spot coal larry with automatic lid lifting device.
- Combination one-spot pushing machine, designed in accordance with the pushing schedule and including door extractor and door and jamb cleaners.
- Coke guide and door extractor as separate or combination machines with door and jamb cleaners.
- Quench cars with fixed or tiltable bottoms, with or without integral travelling drive.

10

Coke Oven Plant Environmental Control

Smoke and dust emission during the charging of coal can be controlled with a one-spot, modified gravity-type coal larry used in conjunction with single or double collector mains. Possible air pollution is avoided by using preheated coal in a totally enclosed pipecharging system as licensed by Coaltek Associates. Other totally enclosed coal charging systems using wet or preheated coal are in the development stage.

A. Hot coal pipecharging system.



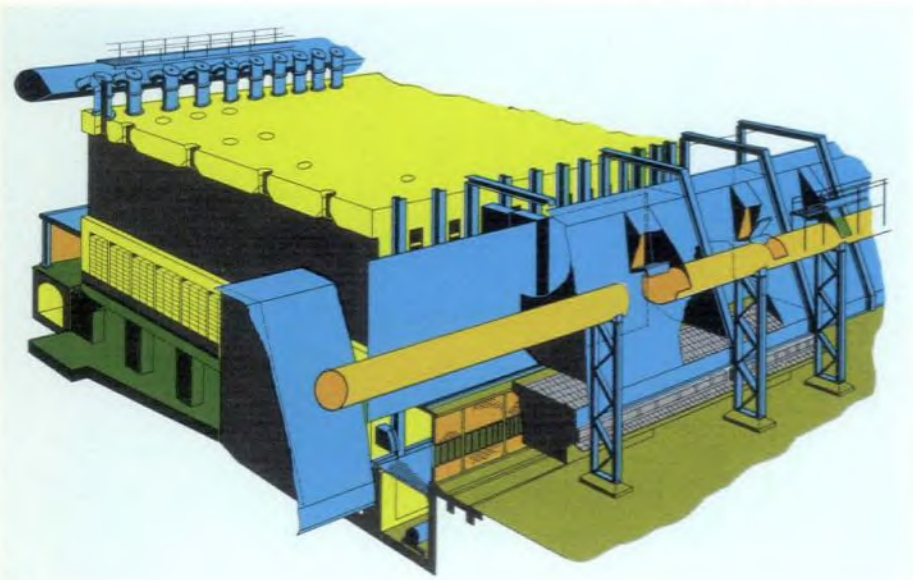
A.

Coke Oven Plant Environmental Control

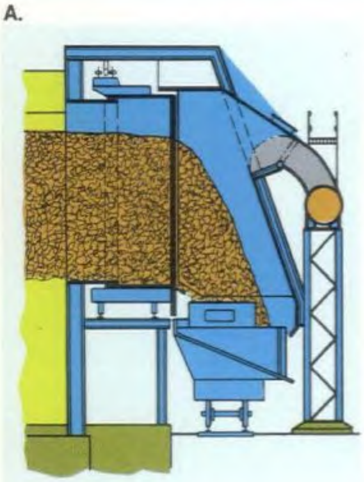
A. **Quench track hood.**

A1. **Cross section.**

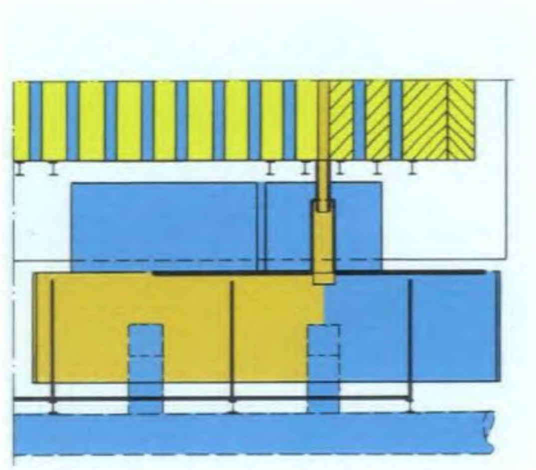
A2. **Ground plan.**



A.



A1.



A2.

Environmental protection for existing coke oven batteries can be achieved by installing an Otto coke side hood over the entire quench car track. The hood is divided into compartments, each compartment accommodating up to five coke ovens each. Stationary wet scrubbers are connected to these compartments. Shields mounted on the coke guide and door extractor machine effectively seal off compartments where coke is to be pushed.

The Otto hood is superior to previous designs in that the entire length of the hot coke car is covered thereby facilitating fume collection and removal.

Coke Oven Plant Environmental Control

A. Three-stage movable quenching machine.

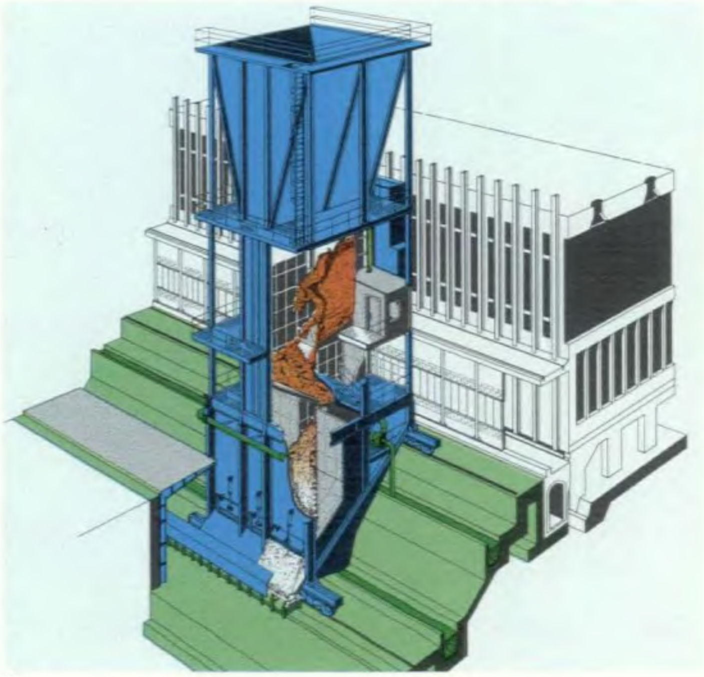
B. Dry cooling chamber system.

Three-Stage Movable Quenching Machine

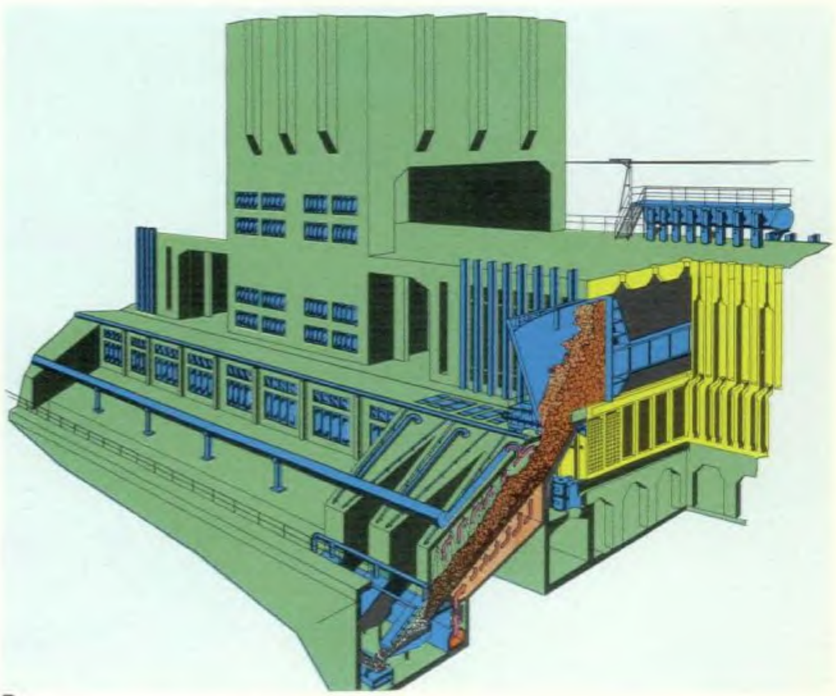
The three-stage movable quenching machine replaces conventional coke side equipment, such as the hot coke car and locomotive, the quench station and the coke wharf. Recommended for new coke oven battery installations, the three-stage quencher eliminates coke combustion and dust emission. Intensive quenching with adjustable sprays produces low-moisture coke.

Dry Cooling Systems

An alternate to the three-stage quenching machine is provided by Otto's dry cooling systems. Inert gas and auxiliary quenching is used to cool coke chambers or retorts to produce a low moisture content product.



A.

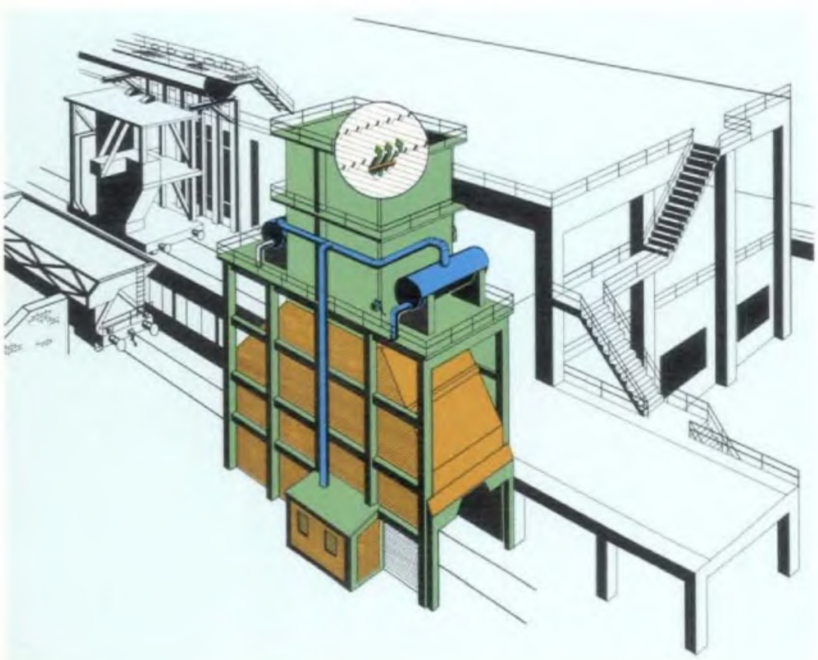


B.

C. Dry cooling retort system.

D. Mist suppressing system.

C.



D.

Low Emission Quench Station

Otto mist suppressing systems effectively reduce the emission of coke particles from coke quenching station stacks.

By-Product Plants

McKee-Otto can provide complete plants for the effective treatment of coke oven gas and recovery and refining of by-products under both normal and elevated pressures; for sulfur removal by wet or dry processes; for gas drying and for ammonium destruction. Environmental control capability includes design and construction of phenol and other waste water treatment plants.

McKee-Otto Laboratories

Large, modern McKee-Otto laboratories, housing technical equipment and pilot plants, provide a place for chemists, physicists and engineers to carry on research and development work devoted to solving your problems.

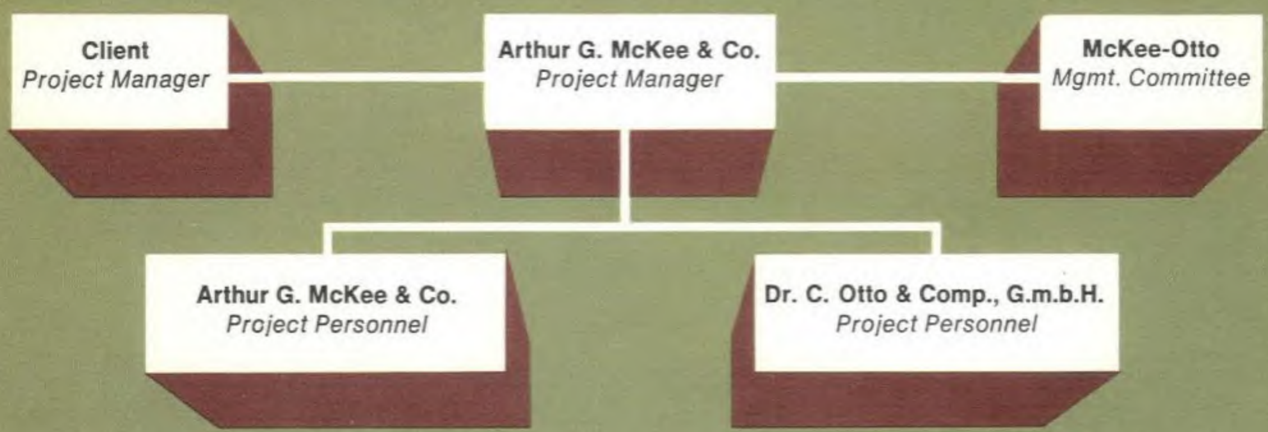
A. By-product plant, part of coking facility at Steel Company of Canada steel complex, Hamilton, Ontario.

B. Otto coal laboratory at Bochum-Dahlhausen, West Germany.

A.

B.

McKEE-OTTO PROJECT ORGANIZATION



McKEE-OTTO OPERATIONAL RESPONSIBILITY

	McKee	Otto
Engineering	*Design* • Electrical • Instrumentation • Coal Handling System • Coke Handling System • Off sites	*Basic Process Design* *Design* • Battery and by-products except as shown under McKee
Purchasing, Inspection and Expediting	*Non-European Equipment and Materials*	*Refractories* *European Equipment* (If applicable)
Construction	*Supervision*	*Specialists*
Start-Up	*Service Engineers*	*Supervision*

McKee-OTTO

Modern Coke Plants for the Steel Industry

Arthur G. McKee & Company
6200 Oak Tree Boulevard
Cleveland, Ohio 44131
Telephone: 216-524-9300
Cable Address. Macco
Telex: 98-0233

Dr. C. Otto & Comp., G.m.b.H.
463 Bochum, Christstr. 9,
Federal Republic of Germany
Telephone: Bochum (o 23 21) 37321
Address: 463 Bochum, Postfach 1849
Cable Address: Ottokoks Bochum
Telex: 02 25 865

Otto Construction Corporation
111 Fourth Avenue
New York, New York 10003
Telephone: 212-254-5000
Cable Address: Ottocoke
Telex: 12-7720

McKee

ENGINEERS AND CONSTRUCTORS