Dick Luff

ENGINEERING REPORT

RELINE & REBUILD OF STOVES #1, #2, #3 and #4 AND NATURAL GAS MAIN

#1 BLAST FURNACE - HAMILTON PLANT

JULY 30, 1965

REVISED MARCH 17, 1966

WORKS ENGINEERING
ARMCO STEEL CORP.
MIDDLETOWN WORKS

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BLUE, SMALL RED, YELLOW (W-A), SMALL YELLOW, ORANGE, PURPLE

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I INTRODUCTION AND SUMMARY: The Hot Metal requirement for the Middletown Expansion Program (Phase I) is 6,000 net tons of molten iron per day. This is predicated on the anticipated production goals. Hot metal production is to be obtained, for this phase, by modifications of the existing facilities. The subsequent report defines the modification of the stoves associated with the #1 Blast Furnace at the Hamilton Plant. This proposed rennovation is a portion of the overall Blast Furnace Project 7121, and is reported as a singular identification.

The objectives of hot metal production from Furnace #1 will, in part, be attained by increasing the Blast temperature to 2000° F. straight line. Included with these modifications is the installation of natural gas fuel injection to the furnace.

To achieve the anticipated effect, the following individual facilities are required.

1. New burners, fans, valves, and piping.
2. Increase height of three of the four stoves.
3. New support valves, i.e. hot blast, cold blast, chimney, etc., to sustain projected temperatures and flows.
4. New ceramic checkers and brickwork in stoves to sustain elevated temperatures and flows.
5. Structural supports and modifications necessary for installation and service.
6. Natural gas main.

Proposed stove modifications are to be performed in conjunction with the Furnace Reline and the installation of Semi-automatic

Stove Controls. Appropriations for the Reline and Control Conversion are requested against the Middletown Works Normal Budget, and are referred to in this report only in terms of scheduling. Individual components are required for installation during the Reline tenure.

In this report, the economical advantages of improved blast heat and stove operations are considered secondary to production and conservation of coke. However, the results of similar conversions at the Middletown Blast Furnace indicated a substantial economical savings.

II GENERAL DESCRIPTION: The existing burner arrangements are insufficient to attain a straight line blast temperature of 2000° F. Consequently, new burners and associated fans, valves, and electrics are proposed. The proposed units are to be of such capacities to eliminate marginal operational fallacies often encountered.

Design investigations indicate the required heat storage capacity and heat transfer abilities can be achieved by increasing the height of Stoves #1, #2, and #3 to that of #4. This, in conjunction with new domes and miscellaneous repairs to steelwork, platforms, and openings, will render the existing shells useable.

The linings of the combustion chamber, dome, walls, and checkers of each Stove are to be compatible with the projected temperatures and flows. Likewise, the required operational gas and air valves are to be in line with these physical requirements.

Natural gas is presently unavailable in the Hamilton Plant. The proposal includes correlation with the Cincinnati Gas and Electric Co. to extend their main across the Great Miami River onto the plant site. Armco would then route the main inside the plant.

Due to the extreme congestion in the immediate area of the Stoves and Furnace, several items relating to compactness of valving, piping, fan arrangements, etc. have been taken into consideration.

Operation control will be exercised from the pyrometer, control center, proposed in the Semi-automatic valve operators project. (Normal Budget)

III EQUIPMENT DESCRIPTION:

a) Stove domes and shell extensions Stoves #1, #2 and #3:

Welded, 1/2" plate, ASTM A-285 Grade C Firebox. Top platform and access are to be raised compatible with the Stove extensions.

b) Linings:

Combustion chamber, domes, checkers, wall insulation and supports are to be designed for 2,500° F. dome temperature, and 1,000°F. chimney temperature to maintain 2,000° F. straight line blast temperature with 60,000 cfm flow. Checkers are to be multihole, interlocked, affording a total heating surface of approximately 160,000 ft. ^{2}

The Combustion Chamber will be approximately 25 ft. ^{2} area which will afford a gas area ratio of 900 ft. ^{3} gas/ft. ^{2}. The quality of ceramic will be as specified by Research Center. The proposal includes mullite in dome and combustion chamber and twenty feet of checkers, next ten feet of lesser mullite and the lower fifty-two feet of high quality. This proposal has been reviewed with Research personnel, Plant Management, Operational Supervision, Division Engineering, and Works Engineering. The review and discussions were made collectively and everyone was in accord with this economical zoning effect.

c) Lining Support:

Metallic checkers are of cast iron ASTM A-48-56 Class 35. The columns, girders and grids are of steel 1% Cr., 5% Mo. similar to ASTM A-182 Grade F-12.

d) Platforms:

Platforms, access stairs, maintenance levels, and service decks will be provided for all valves, drives and mechanisms.

e) Cold Blast Main and Valves:

The proposed modifications of the cold blast main include new regulating valves, shut-off valves, and associated piping and fittings to each Stove. Connections will be welded, using 3/8" plate of ASTM A-283 Grade C steel. Regulation of air will be by 30" disc butterfly valves. The valves will be powered by drive units, proposed in the Semi-automatic stove control project (Normal Budget). They will also have manual hand wheels in case of power failure. The isolation shut-off valves will be 30" gate type, also power and manually operated as noted above.

f) Hot Blast Valves:

The 42" hot blast valves are of the improved mushroom design with water cooled flanges. They are welded construction of ASTM A-387 Grade C Firebox steel. The opening or closing time is approximately 15 seconds, obtained by an electric power operator.

g) Stove Burners and Valves

Each Stove is to be equipped with a proposed burner rated at 22,500 SCFM of enriched blast furnace gas with a heating value of approximately 90 BTU/ft.^{3}. The burners are fabricated steel with appropriate supports, inspection ports, drains, etc. The mixer arrangement is to be of suitable design, commensurate with the gas and air characteristics to afford proper flame propogation.

Combustion fans are to be single inlet type, inlet vane control, direct driven air foil. Their rating is 22,500 scfm at 1750 rpm at 40" W.C. static pressure. Drives required are 180 bhp maximum. An outlet damper to control system pressure will be installed, as well as an inlet stack to afford clean combustion air.

Burner isolation valves will be water cooled, gate type, 48" diameter. Operators will be approximately 5 HP and will open or close valve in about ten seconds.

Coke gas, up to 1.3 million ft.^{3} per day, will be used for fuel enrichment. This additional gas therefore, will not be available for Middletown Works. Regulating will be by butterfly valves operated and controlled by the facilities installed in the Control Project (Normal Budget).

Blast Furnace gas will be the primary fuel. New 36" connections will be made due to the new burners. Valves will include plate goggle, butterfly regulating, and safety shutoffs. The regulating units will be electric operated and controlled by the facilities included in the Control Project (Normal Budget).

h) Chimney Valve:

Combination chimney - blowoff valves are proposed for each Stove. These units are motor operated, cast steel, water cooled seat, elbow type. The operators will be installed under the Control Project. Manual operations will be afforded in case of a power failure. Operating time for the electric drive will be approximately ten seconds.

i) Maintenance and Service Lighting:

Suitable area lighting is proposed for night-time inspection, operations and maintenance.

j) Natural Gas

A 12" gas main is proposed to terminate in the Blast Furnace area. This line will be extended from a Meter Station to which the Cincinnati Gas & Electric Co. will provide a suitable utility feed. The 12" Armco line will be approximately 2,300 lineal feet with suitable valves, fittings, and supports.

Number 1 Blast Furnace, with a blast temperature in the 2000° - 2200° F. range could use up to 5.2 million ft.^{3} of Natural Gas per day. This is based on gas requirements of 5% at 50 lbs./in.^{2}.

k) Electrical Equipment

A 750 KVA Substation is proposed to furnish power for the fan drives. Conduit, wire and switchgear suitable in capacity will be installed in conjunction with the Substation.

l) Cold Blast-Mixer Connections

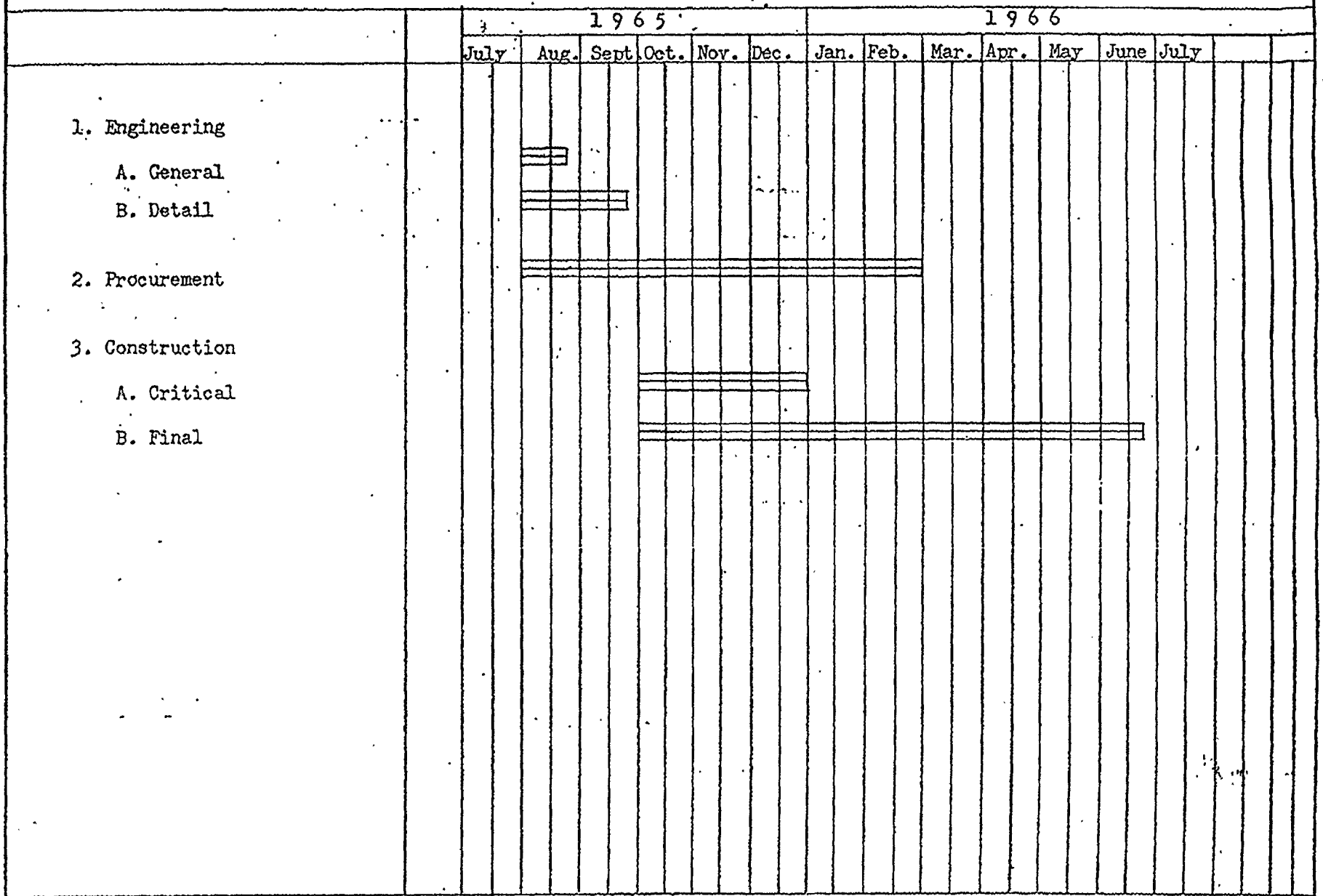
The existing 20" mixer line will be relocated and modified to include one butterfly regulating valve in the cross connection from the cold blast main. The individual Stove connections will include motor driven 20" gate valves to isolate the mixer air when it is not required.

V SCHEDULE: Work covered by this report is tentatively proposed as per the following gross schedule. The prime qualification of this alignment is the expedient approval of appropriations.

BLUE, SMALL RED, YELLOW (W-A), SMALL YELLOW, ORANGE, PURPLE

AKE-003069

Engineering & Construction Schedule Reline and Rebuild Stoves and Natural Gas Main, #1 Blast Furnace, Hamilton Plant



Project No. 7121

WORKS ENGINEERING

10

VI CHART OF ACCOUNTS: The project sections indicated below scope the modifications to the Stoves of #1 Blast Furnace.

7121-401	Raise Stoves #1, #2 and #3; Reline Stoves #1, #2, #3 and #4
7121-402	Chimney Valves and Flues
7121-403	Gas Piping to Burners
7121-404	Gas Burners
7121-405	Blowers
7121-406	Mixer Piping
7121-407	Cold Blast Main
7121-408	Coke Oven Gas
7121-409	Hot Blast Valves
7121-411	Mechanical Replacement Parts
7121-710	12" Natural Gas Main
7121-820	Electrical Equipment
7121-830	Conduit and Wiring
7121-841	Electrical Replacement Parts
7121-910	Job Supervision
7121-920	Temporary Construction
7121-940	Engineering
7121-970	Contingency
7121-980	Fees
7121-995	Small Tools and Consumables

7121-401 RAISE STOVES #1, #2 AND #3; RELINE STOVES #1, #2, #3 AND #4

This Project Section shall include all cost for labor, materials, and equipment to increase the height and to reline the Stoves.

020 Remove

This account shall include all costs for removal of the lining and checker supports of Stoves #1, #2, #3 and #4, also the relocation of support facilities such as small piping, misc. accesses, platforms, and piping openings. This account shall also include relocating the domes on Stoves #1, #2, and #3.

027 Patch Plates at Cleanout Manholes

This account shall include all costs for patching shell plates at the location of existing cleanout manholes.

033 Excavation

This account shall include all costs for the excavation of platform support foundations.

035 Backfill

This account shall include all costs for backfill adjacent to support foundations.

177 Concrete - Footings

This account shall include all costs for platform foundations.

220 Miscellaneous Steel and Iron

This detail account shall include all costs for platform supports, accesses, decking, and the like.

221 Checker Supports

This account shall include all costs for purchase and installation of heat resistant alloy castings to support the checkers.

222 New Shell Plate for Stoves #1, #2 and #3

This account shall include all costs for the extension to Stoves #1, #2, and #3 (approx. 11'-0") to attain required checker volume.

366 Painting

This account shall include all costs for painting Stove shells, domes, platforms, and unprotected steel work.

438 False Bottoms for Stoves

This account shall include all costs for labor and material to erect false bottoms in 4 Stoves to insure proper gas seal.

590 Lighting

This account shall include all costs for lighting of platforms, maintenance areas, and facilities used for continuous operations.

640 Start-up

This account shall include necessary services to start-up and test Stoves before placing Stoves in operation.

650 Repairs

This account shall include all costs for labor and material for repairs to existing facilities including lummite floor, platforms, domes on #1, #2, #3 and #4 Stoves, and miscellaneous units that are to remain in operation.

660 Reline and Dryout Stoves

This account shall include all costs of labor and material for the relining of Stoves #1, #2, #3 and #4. Lining and drying-out costs shall also be included in this account.

7121-402 CHIMNEY FLUES

This project section shall include all costs for labor, materials and equipment used to install new combination chimney and blow-down valves conforming with Stove requirements.

020 Removal

This account shall include all costs for the removal of existing valves, the relocation of chimney valve connections on the Stove shells and the temporary reinstallation of the existing chimney valves.

461 Water Piping

This account shall include all costs of materials only for cooling water piping.

462 Chimney Valves

This account shall include all costs of material only for four combination chimney valves conforming with proposed Stove requirements.

464 Pipe Installation

This account shall include the labor and services to install the proposed valves, flues, and piping.

650 Repair Flue Lining

This account shall include all costs for labor and materials to repair the flues and valve sand seals of the four stoves.

7121-403 GAS PIPING TO BURNERS

This project section shall include labor, material, and services required to connect Blast Furnace gas piping to the stove burners.

026 Relocate

This account shall include all costs of labor, field materials and services necessary to relocate the burner take-off lines to the gas main, install temporary leg from main to existing burner and permanent leg to new burner.

033 Excavation

This account shall include all costs for excavation of piping and valve support foundations.

035 Backfill

This account shall include all costs for backfill as required adjacent to the valve and pipe support foundations.

177 Concrete

This account shall include all costs of concrete required for the foundations for the valves and piping supports.

220 Miscellaneous Steel and Iron

This account shall include all costs of steel work as required for supports and service platforms in conjunction with the gas valves.

461 Piping

This account shall include all costs of materials for safety seal water piping to the burners on four stoves.

462 Valves

This account shall include all costs for goggle and regulating valves for the Blast Furnace gas to the four stove burners.

464 Pipe Installation

This account shall include all costs for the installation of piping and valves associated with the water seal piping to the burners.

650 Repair

This account shall include all costs for repairs to the existing gas main, supports and associated units of the gas piping system that will remain in service.

7121-404 GAS BURNERS

This project section shall include the replacement of existing burners with units capable of attaining the requirements of the proposed operations.

020 Removal of Existing Burners & Blowers

This account shall include all costs for the removal of the existing burners and blowers of Stoves #1, #2, #3 and #4.

033 Excavation

This account shall include all costs for the excavation of burner foundations.

035 Backfill

This account shall include all costs for labor and materials suitable for backfill adjacent to the burner foundations.

177 Concrete

This account shall include all costs for concrete and placement of the burner foundations.

220 Miscellaneous Steel and Iron

This account shall include all costs of steel work for maintenance platforms supports and stairs associated with the proposed burners.

461 Piping

This account shall include all costs for piping and connections (material cost only) between the burners and stoves.

462 Valves

This account shall include all costs for the burner isolation valve (material cost only) between the burner and stove.

464 Pipe and Valve Installation

This account shall include all costs of labor and services necessary to install piping and valves.

610 Burners

This account shall include all costs for the purchase of the burner equipment for four stoves.

620 Burner Installation

This account shall include all costs for labor and services to install the burner equipment on four stoves.

7121-405 BLOWERS

This project section shall include the fans, motors, piping, etc. associated with the stove-burner.

461 Air Intake Piping

This account shall include all costs for purchase of inlet piping to the four fans in order to obtain clean combustion air.

464 Piping Installation

This account shall include all costs for labor and service to install the intake piping.

560 Motors

This account shall include all costs to purchase and install four (approx. 180 HP each) blower electric motors.

610 Blowers

This account shall include all costs to purchase four blower fans and appurtanenses.

620 Installation

This account shall include labor and service to install the blower equipment scope of work same as on #610.

7121-406 MIXER PIPING

This project section shall include the relocation and alterations to the cold blast mixer line.

026 Temporary Connections

This account shall include all costs for all temporary and relocated mixer line connections to the Cold Blast Main and the Hot Blast Valve from the new mixer main.

461 Piping

This account shall include purchase cost only for the 20" pipe necessary to alter the mixer lines.

462 Valves

This account shall include purchase cost only for the regulating valves and shut-off valves in the mixer line and in the connections to the hot blast mixing valves.

464 Installation

This account shall include all costs of labor and services to erect the piping, valves, and supports associated with the cold blast mixer piping.

7121-407 COLD BLAST MAIN

This project section shall include the connections of the cold main to the stoves, relocations, and valves associated with these connections.

026 Relocate and Repair Cold Blast Line

This account shall include all costs of labor and material charges to repair and relocate existing cold blast main piping and connections.

461 Piping

This account shall include purchase cost only for pipe necessary to rework the cold blast stove connections.

462 Valves

This account shall include purchase cost only for regulating and isolating valves to achieve the proposed stove operations.

464 Installation

This account shall include all costs of labor and services to install piping for cold blast stove connections and valves.

7121-408 COKE GAS

This project section shall include the coke enriching gas arrangement to the burners of the four stoves.

026 Relocate and Repair Gas Line

This account shall include all costs of labor and materials to relocate the coke gas header.

461 Piping

This account shall include purchase cost only of 8" main and runouts of 4" pipe.

462 Valves

This account shall include purchase cost only of the manual shut-off valves, regulating valves and orifice metering equipment for the 4" connections to each burner.

464 Pipe Installation

This account shall include all costs of labor and services to install the piping and valves associated with the 8" main and four 4" runouts for coke gas to the stove burners.

7121-409 HOT BLAST VALVES

This preoject section shall include the replacement of hot blast valves and related connections.

020 Removal

This account shall include all costs for the removal of the existing hot blast valves, flanges, drives and connections.

026 Temporary Lower Valve Section

This account shall include all costs of labor and material required for the temporary connection of the hot blast valve to existing lower section of the existing valve and provide refractory timing for all temporary connections.

033 Excavation

This account shall include all costs for excavation necessary for foundation to support valves.

035 Backfill

This account shall include all costs for backfilling the blast valve support foundations.

177 Concrete

This account shall include all costs for concrete and placement for the hot blast valve foundations.

462 Valves

This account shall include purchase costs of the 42" mushroom valve equipment for all four Stoves.

464 Installation

This account shall include all costs of labor and services for the installation of the proposed hot blast valves.

660 Refractories for Lining Valves

This account shall include all costs of materials and installation for the lining of the four hot blast valves.

7121-411 MECHANICAL REPLACEMENT PARTS

This project section shall include the mechanical replacement parts required.

643 Replacement Parts

This account shall include all costs for the purchase of the valve seats, valves, gears, coupling, etc. considered as replacement parts.

7121-710 12" NATURAL GAS MAIN

This project section shall include the natural gas main from meter station to the Blast Furnace area. This proposed system is required for gas injection in the furnace.

034 Ditching and Backfill

This account shall include all costs for trenching and backfill for the proposed 12" Natural Gas Main.

037 Track Crossing

This account shall include all costs for materials, labor and services to make eight track crossings for the proposed natural gas line.

038 Roadway Crossings

This account shall include all costs of materials, labor and services to construct two roadway crossings for the 12" natural gas main.

461 Pipe and Fittings

This account shall include purchase costs for pipe and fitting materials only for the proposed 12" Natural Gas Main.

462 Valves

This account shall include purchase costs only for valves as required for truck lines and main on the proposed Natural Gas Line.

464 Installation

This account shall include all costs of labor and services to install the 12" natural gas transmission facilities. This account shall not include crossing protection or excavations.

466 Hangers and Supports

This account shall include all costs of labor and materials for supports, bents and trusses as required for the Natural Gas Line.

7121-820 ELECTRICAL EQUIPMENT

This project section shall include electrical power requirements for the proposed stove rennovation.

026 Temporary Connections

This account shall include all costs of labor and materials required to provide temporary operation of motor controls.

570 Substation and Motor Controls

This account shall include all costs to purchase a 1000 KVA Substation package and motor control equipment for the burner combustion fans.

580 Installation

This account shall include all costs of labor and services to install the 1000 KVA Substation and motor controls.

7121-830 CONDUIT AND WIRE

This project section shall include the electric power transmission facilities for the proposed stove facilities. This project section does not include any arrangement associated with the Semi-automatic stove control project. (Normal Budget)

026 Temporary Conduit and Wire and Relocation

This account shall include all costs of labor and material for conduit and wire for temporary valve operator, starter, etc.

511 Feeder

This detail account shall include all cost for materials, labor and services for 4.16 KV Feeder for the proposed power requirements.

513 Wiring

This account shall include all cost of labor, materials, and services for 600 V. class wiring in conjunction with the stove electrical requirements. Terminal connection to equipment shall also be included with this account.

521 Conduit

This account shall include all cost of labor, material, and services for the installation of conduit, and fittings for the proposed stove improvements.

7121-841 ELECTRICAL REPLACEMENT PARTS

This project section shall include the electrical replacement parts required.

643 Replacement Parts

This account shall include purchase cost of relays, limit switches, indicator lights, etc. considered as replacement parts for the project.

VIII ESTIMATE:

In the following detail, estimate expenditures necessary for the subsequent outlined facilities are analysed based on preliminary engineering drawings, and major equipment vendors quotes.

ARMCO STEEL CORPORATION
Steel Division

LOCATION Hamilton DATE 2/25/66 SUMMARY SHEET NO. 1
PROJECT Raise and Reline Stoves #1 B.F. PROJECT NO. 7121 BY HCE - DR
CONTRACTOR McGraw Const. Co., Inc. ESTIMATE NO. 1 - Rev. 3 NOTED WOL - HLO

PROJECT SECTION NUMBER	DESCRIPTION - QUANTITY	LABOR	BURDEN	EQUIP. USAGE	MATERIAL	SUB CONTRACT	ENGINEERED EQUIPMENT	TOTAL
401	Raise and Reline Stoves	458,395	64,205	29,885	88,755	----	987,500	1,628,740
402	Chimney Valves and Flues	16,805	2,355	1,000	8,800		40,000	68,960
403	Gas Piping to Burners	60,030	8,230	2,025	16,465		58,000	144,750
404	Gas Burners	28,580	4,005	2,340	21,150		96,000	152,075
405	Blowers	16,100	2,205	800	9,800		56,000	84,905
406	Mixer Piping	10,950	1,540	800	3,600		15,000	31,890
407	Cold Blast Main	34,000	4,760		9,600		16,000	64,360
408	Coke Oven Gas	5,380	755		5,940			12,075
409	Hot Blast Valves	84,570	11,925	2,815	11,445		136,000	246,755
411	Mechanical Replacement Parts	1,930	270				57,800	60,000
710	12" Natural Gas Main	27,140	3,810	1,450	27,300			59,700
820	Electrical Equipment	6,700	935		2,550		42,500	52,685
830	Conduit and Wire	24,250	3,295		29,050			56,595
841	Electrical Replacement Parts	620	80				9,300	10,000
	Sub Totals Direct Cost	775,450	108,370	41,115	234,455	-----	1,514,100	2,673,490
911	Construction Management & Supervision							58,060.
912	Field Engineering							5,000
913	Warehouse Operation Mat'l. Control & Hdlg.							12,500.
915	Complementary Construction Overhead							31,520.
921	Temporary Construction Facilities							21,020.
941	Project Engineering							44,500.
942	Accounting							10,000.
	Sub Total Indirect Cost							182,600
970	Contingency							178,520
980	Fees							60,390.
	TOTAL							3,095,000

Armco Steel Corporation

LOCATION Hamilton DATE 2.24.66 SHEET 1 OF 1

PROJECT Raise and Reline Stoves #1 B.F. PROJECT NO. 7121 BY HCE DR

CONTRACTOR McGraw Construction Co., Inc. ESTIMATE NO. 1-Rev.3 NOTED WOL HLO

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
401		Raise Stoves #1, #2, and #3 and Reline Stoves #1, #2, #3, and #4														
	020	Remove Lining Stoves 1;2;3; and 4		ls						20000	2800	8000	4500			92300
		Remove Checker Supports		ls						5000	700		1000			6700
		Relocate Flue Openings in Shell	4	ea	2000		2000			8000	1120		8000			17120
		Relocate Burner Openings in Shell	4	ea	2000		1000			8000	1120		4000			13120
		Relocate Hot Blast Openings in Shell	4	ea	2200		1000			8800	1230		4000			14030
		Relocate Platforms; Stairs, Etc.	60	T	250	25	25			15000	2100	1500	1500			20100
		Relocate Steam and Water Piping		ls						7000	980		6000			13980
		Relocate Domes		ls						10000	1400	4000	4000			19400
		Relocate Downleg & Equipment Supports		ls						9200	1290	1200	1500			13190
	027	Patch B's and Cleanout Manholes	12	ea	100		50			1200	170		600			1970
	033	Excavation - Hand	70	cy	10	1	1.50			700	100	70	105			975
	035	Backfill	35	cy	2.		1.50			70	10	15	50			145
	177	Concrete-Platform Footings	35	cy	35		42			1225	170		1470			2865
	220	Misc.Steel-Platforms-Supports	50	T	75	15	385			3750	525	750	19250			24275
	221	Checker Support Steel-ASTM--182F	80	T	150	20				12000	1680	1600			125000 ✓	140280
		Checker Support Steel-Ductile	42	T	75	20				3150	440	840			33000 ✓	37430
	222	New Shell PL's Stoves-1;2 & 3	40	T	300	50				12000	1680	2000			18000 ✓	33680
	366	Painting-Incl.Shell Platform		ls						10500	1500		3200			15200
	438	False Bottoms for Stoves	4	ea	900		1400			3600	505		5600			9705
	590	Lighting		ls						5000	700		3500			9200
	640	Start-Up and Test		ls						18400	2575					20975
	650	Repair Lumnite Refractory		ls						6000	840		10000			16840
		Repair Shell PL		ls						15000	2100	950			7500	25550
		Repair Domes 1;2; and 3		ls						4800	670	960	480		24000 ✓	30910
	660	Reline Stoves-Incl.Shrout-4 ea		ls						220000	30800	8000	10000		200000	1048800
		Totals Project Section - 401								458395	64205	29885	88755		987500	1628740
		TOTAL														

Armco Steel Corporation

LOCATION Middletown DATE 2/25/76 SHEET 2 OF 7

PROJECT Boiler and Boiler Stack - #1 B. F. PROJECT NO. 7121 BY MCE-DH

CONTRACTOR McGraw Construction Co., Inc. ESTIMATE NO. 1 - Rev. 3 NOTED WOL-RLO

COST ACCOUNT acct.	COST ACCOUNT dev.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60		TOTAL
402		Chimney Valves and Flues															
	020	Remove Existing Chimney Valves	4	Ea.	420	100	100			1680	235	400	400				2 715
		Relocate (Temp.) Exist. Chimney Valves	1	LS						4800	670	400	400				6 670
		Relocate Valve Opening	1	LS						525	75		100				700
	461	Cooling Water - Piping	1	LS									1 000				1 000
	462	56" Valves	4	Ea.											40 000	✓	40 000
	464	Install Water Piping	1	LS						525	75						600
		Install 56" Valves	4	Ea.	800		625			3200	450		2 500				6 150
	550	Repair Flue Lining	1	LS						3675	525		3 200				7 390
		Repair Sand Seals and Rings	1	LS						2400	335		1 000				3 735
		Project Section Totals								14805	2355	1 000	8 800		40 000		68 960
403		Gas Piping To Burners															
	026	Relocate Connections to Gas Main	4	Ea.	1000		200			4000	560		800				5 360
		Relocate (Temp.) Piping to Burners	4	Ea.	6500	200	300			18000	2520	800	1 200		8 000	✓	30 520
	033	Excavation - Hand	36	cy	10	.50	.50			360	50	20	55				485
	035	Backfill	12	cy	2.50	.50	.50			30	5	5	20				60
	177	Concrete Footings	24	cy	35		42			840	120		1 010				1 970
	220	Misc. Steel Supports and Platforms	10	T	130	20	380			1300	180	200	3 800				5 480
	461	Piping - Water	1	LS									3 800				3 800
	462	Valves - Goggle	4	Ea.											20 000	✓	20 000
		Valves - Regulating	8	Ea.											16 000	✓	16 000
	464	Install Piping - Water Incl. Header	1	LS						19500	2730	1 000					23 230
		Install Valves - Goggle	4	Ea.	700		65			2800	390		260				3 450
		Install Valves - Regulating	8	Ea.	400		65			3200	450		520				4 170
		Rework Goggle Valves	1	LS						1 000	140						1 140
	550	Repair Existing Gas Main	1	LS						1450	205		900				2 555
		Repair Gas Downlegs	1	LS						7550	880		4 100		14 000		26 530
		Project Section Totals								60030	8230	2 025	16 665		58 000		144 750
		TOTAL															

FORM - REV. 6/66

Armco Steel Corporation LOCATION Middletown DATE 3/25/76 SHEET 3 OF 7

PROJECT Reline and Rebuild Stoves #1 B.F. PROJECT NO. 7121 BY RCE-DR

CONTRACTOR McCraw Construction Co., Inc. ESTIMATE NO. 1 - Rev. 3 NOTED MDL-NLC

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY		UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60		TOTAL
404		Gas Burners															
	020	Remove Existing Burners & Blowers		LS						2 000	280		800				3 080
	033	Excavation	150	cy	4.-	2.-	1.-			600	85	300	150				1 135
	035	Backfill	40	cy	2.-	1.-	1.50			80	10	40	60				190
	177	Concrete	120	cy	45		55			5 400	760		6 240				12 400
	220	Misc. Steel - Platforms and Supports	20	T	125	40	480			2 500	350	800	9 600				13 250
	461	Piping (Burner to Stove Cplng.)		LS											8 000	✓	8 000
	462	Valves	4	Ea.											40 000	✓	40 000
	464	Install Piping		LS						1 200	170		300				1 670
		Install Valves	4	Ea.	2200	300	500			10 800	1510	1 200	2 000				15 510
	610	Gas Burners	4	Ea.											48 000	✓	48 000
	620	Install Gas Burners	4	Ea.	1500		500			6 000	840		2 000				8 840
		Total Project Section 404								28 580	4005	2 340	21 150		96 000		152 075
405		Blowers															
	461	Air Intake Piping		LS									8 000				8 000
	464	Install Intake Piping		LS						4 300	625						5 425
	540	Motors		LS						1 300	180		400		18 000	?	20 080
	610	Blowers	4	Ea.											38 000	✓	38 000
	620	Install Blowers	4	Ea.	2500	200	300			10 000	1400	800	1 200				13 400
		Total Project Section 405								16 100	2205	800	9 800		56 000		84 905
406		Mixer Piping															
	026	Relocate (Temp.) Mixer Connections		LS						7 000	980	800	1 200				9 980
	461	Piping - 20"		LS									1 800		4 800	✓	6 600
	462	Valve - 36"	1	Ea.											1 200	✓	1 200
		Valve - 20"	5	Ea.											9 000	✓	9 000
	464	Install Piping		LS						1 900	270						2 170
		Install - 36" Valves	1	Ea.	425		200			425	60		200				685
		Install - 20" Valves	5	Ea.	325		80			1 625	230		400				2 255
		Total Project Section - 406								10 950	1540	800	3 600		15 000		31 890
		TOTAL															

Armco Steel Corporation

LOCATION Hamilton DATE 2.25.66 SHEET 4 OF 7

PROJECT Reline & Rebuild Stoves #1-B.F. PROJECT NO. BY HCP DR

CONTRACTOR McGraw Construction Co., Inc. ESTIMATE NO. NOTED HOL HLO

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
407		Cold Blast Main														
	026	Relocate & Repair Cold Blast Lines		ls						20000	2800		2 000			24 800
	461	Piping		ls									6 000			6 000
	462	Valves		ls											16 000 ✓	16 000
	464	Install Piping		ls						8000	1120					9 120
		Install Valves		ls						6000	840		1 600			8 440
		Total Project Section 407								34000	4760		9 600		16 000	64 360
408		Coke Oven Gas														
	026	Relocate & Repair Gas Line		ls						2500	350		500			3 350
	461	Piping		ls									3 000			3 000
	462	Valves	8	ea			300						2 400			2 400
	464	Install Piping		ls						1600	225					1 825
		Install Valves	8	ea	160		5			1280	180		40			1 500
		Total Project Section 408								5380	755		5 940			12 075
409		Hot Blast Valves														
	020	Remove Existing H.B.Valves	4	ea	800	100	100			3200	450	400	400			4 450
	026	Temporary Lower Valve Section	4	ea	200	500	100			4800	670	200	400			6 070
		Temporary Relocation H.B.V.Connection	4	ea	1000	100	100			4000	560	400	1 200			6 240
		Refractory Lining of Temp.Connections	4	ea	4000	100	500			16000	2240	400	2 000		4000	24 640
		Temporary Connections to Exist.H.B.V.		ls						16000	2240		3 000			21 240
	033	Excavation - Hand	20	cy	10		500	50		200	30	10	30			270
	035	Backfill	10	cy	2		500	50		20	5	5	15			45
	177	Concrete	10	cy	35		40			350	50		400			800
	462	Valves	4	ea											120000 ✓	120 000
	464	Install - Valves	4	ea	7000		150	500		28000	3920	600	2 000			34 520
	660	Lining - Valves	4	ea	3000		200	500		12000	1680	800	2 000		12000	28 480
										84570	11925	2815	11 445		136000	246 755
		TOTAL														

BLUE, SMALL RED, YELLOW (W-A), SMALL YELLOW, ORANGE, PURPLE

Armco Steel Corporation

LOCATION: Hamilton DATE: 2/25/86 SHEET 5 OF 7

PROJECT: Raise and Reline Stone - #1 B.F. PROJECT NO.: 7121 BY: RCE-DB

CONTRACTOR: McCrav Construction Co., Inc. ESTIMATE NO.: 1 - Rev. 3 NOTES: WOL-KLO

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
411		Mechanical Replacement Parts														
	643	Replacement Parts, Valves, Valve Seats, Etc.		LS						1 930	270				57 800	60 000
		Total Project Section - 411								1 930	270				57 800	60 000
710		12" Natural Gas Main														
	034	Ditching and Backfill	1700	LF	2.-	50	3.-			3 400	475	850	5 100		[illegible]	9 825
	037	Track Crossing	8	Ea	330	50	250			2 640	370	600	2 000		[illegible]	5 610
	038	Roadway Crossing	2	Ea	550	100	400			1 100	155	200	800		[illegible]	2 255
	461	Pipe and Fittings - 12"	2300	LF			7						16 100		16 100	16 100
	462	12" Valves	5	Ea			300						1 500		[illegible]	1 500
	464	Installation Pipe	2300	LF	8					18 400	2 575				20 [illegible]	20 975
		Installation Valves	5	Ea	80					400	65				[illegible]	165
	466	Hangers and Supports		LS						1 200	170		1 800		[illegible]	3 170
		Total Project Section - 710								27 140	3 810	1 450	27 320		[illegible]	59 700
		TOTAL														

4002 - REV. 8/85

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AKE-003097

Armco Steel Corporation

LOCATION RALEIGH DATE 2-25-66 SHEET 6 OF 7
PROJECT Raleo & Meline Stores - Fl B.F. PROJECT NO. 7121 BY RCE DR
CONTRACTOR McCraw Construction Co., Inc. ESTIMATE NO. 1-Rev. #3 NOTED WOL RLO

COST ACCOUNT SECT.	COST ACCOUNT REV.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
820		Electrical Equipment														
	026	Temporary Connections		ls						3000	420		600			4020
	570	750 KVA Substation													12 500	12500
		Motor Controls													30 000	30000
	580	Install 750 KVA Substation								1400	195		400			1995
		Install Motor Controls								2300	320		3550			4170
		Total Project Section 820								6700	935		2550		42 500	52685
830		Conduit and Wire														
	026	Temporary Conduit & Wire & Relocation		ls						7000	980		6500			14480
	511	4160 V. Feeders-(Blowing Hse. to Pyr. Hse.)		ls						6750	1945		11250			18945
	513	600 V. Class Wiring		ls						8700	1220		8900			18820
	520	Conduit & Fittings		ls						1800	150		2400			4350
		Total Project Section 830								24250	3295		29050			56595
841		Electrical Replacement Parts														
	643	Replacement Parts								620	80				9 300	10000
		Total Project Section 841								620	80				9 300	10000
		TOTAL														

Armco Steel Corporation

LOCATION Hamilton — DATE 2/25/66 — SHEET 1 OF 1

PROJECT Raise and Reline Stoves #1 B.F. — PROJECT NO. 7121 — BY MCE - DR

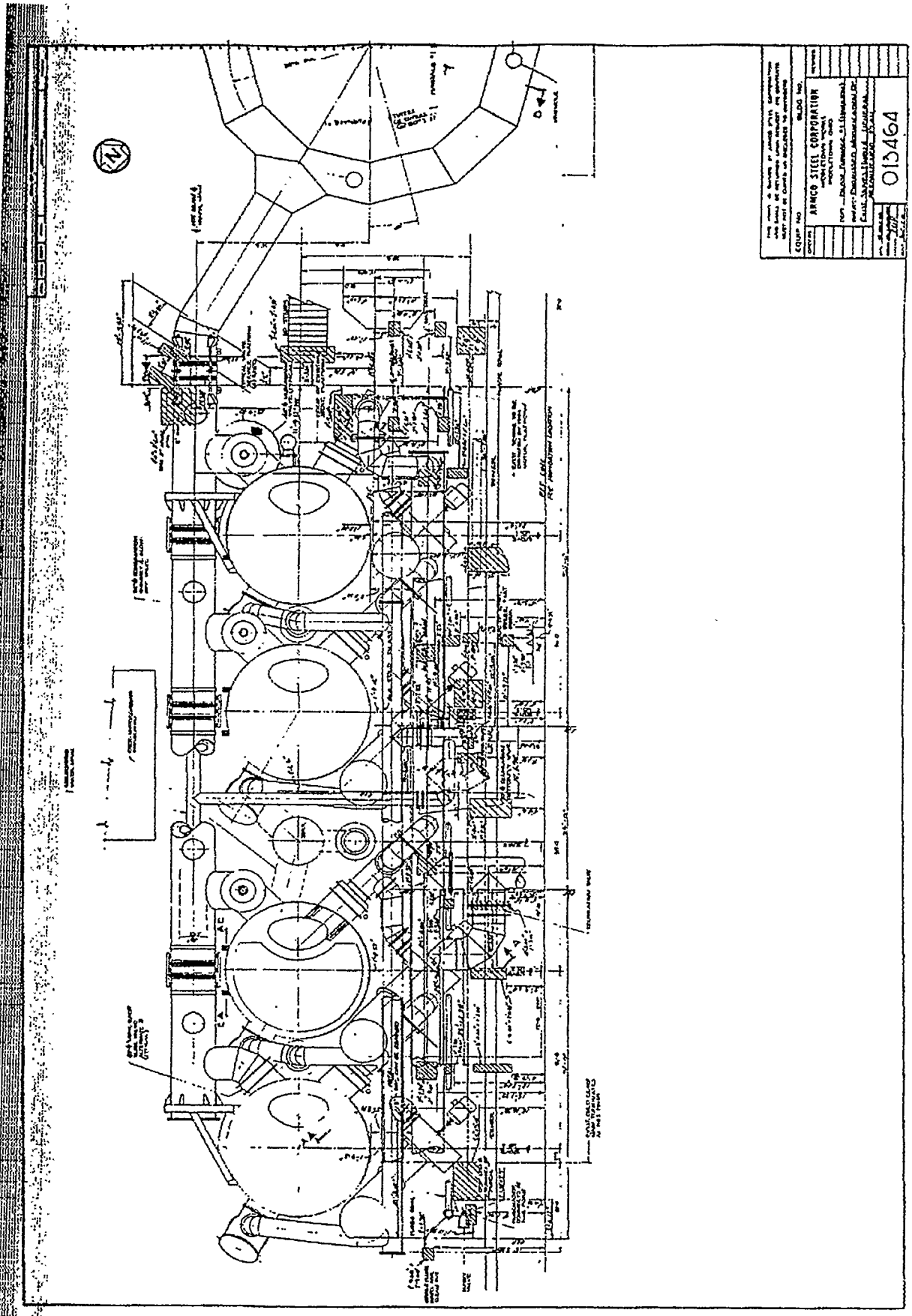
CONTRACTOR McGraw Const. Co., Inc. — ESTIMATE NO. 1 - Rev. 1 — NOTED WOL - MLO

COST ACCOUNT SECT.	COST ACCOUNT DET.	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE L	UNIT PRICE EU	UNIT PRICE M	UNIT PRICE SC	LABOR MAN-HOURS	LABOR 00	BURDEN 10	EQUIPT. USAGE 20	MATERIAL 30	SUB-CONTRACT 50	ENGINEERED EQUIPMENT 60	TOTAL
		-Construction Overhead-														
911	900	Construction Management & Supervision														58,060
912	900	Field Engineering														5,000
913	900	Warehouse Operation Material Control & Hdlg.														12,500
915		Complementary Construction Overhead														
	958	Small Tools and Consumables														21,020
	964	Clean-up														10,500
		Total Project Sect. 915														71,520
921	934	Temporary Construction Facilities														21,020
941	900	Project Engineering														44,500
942	900	Accounting														10,000
970	900	Contingency														178,520
980	900	Fees														60,390
		TOTAL														

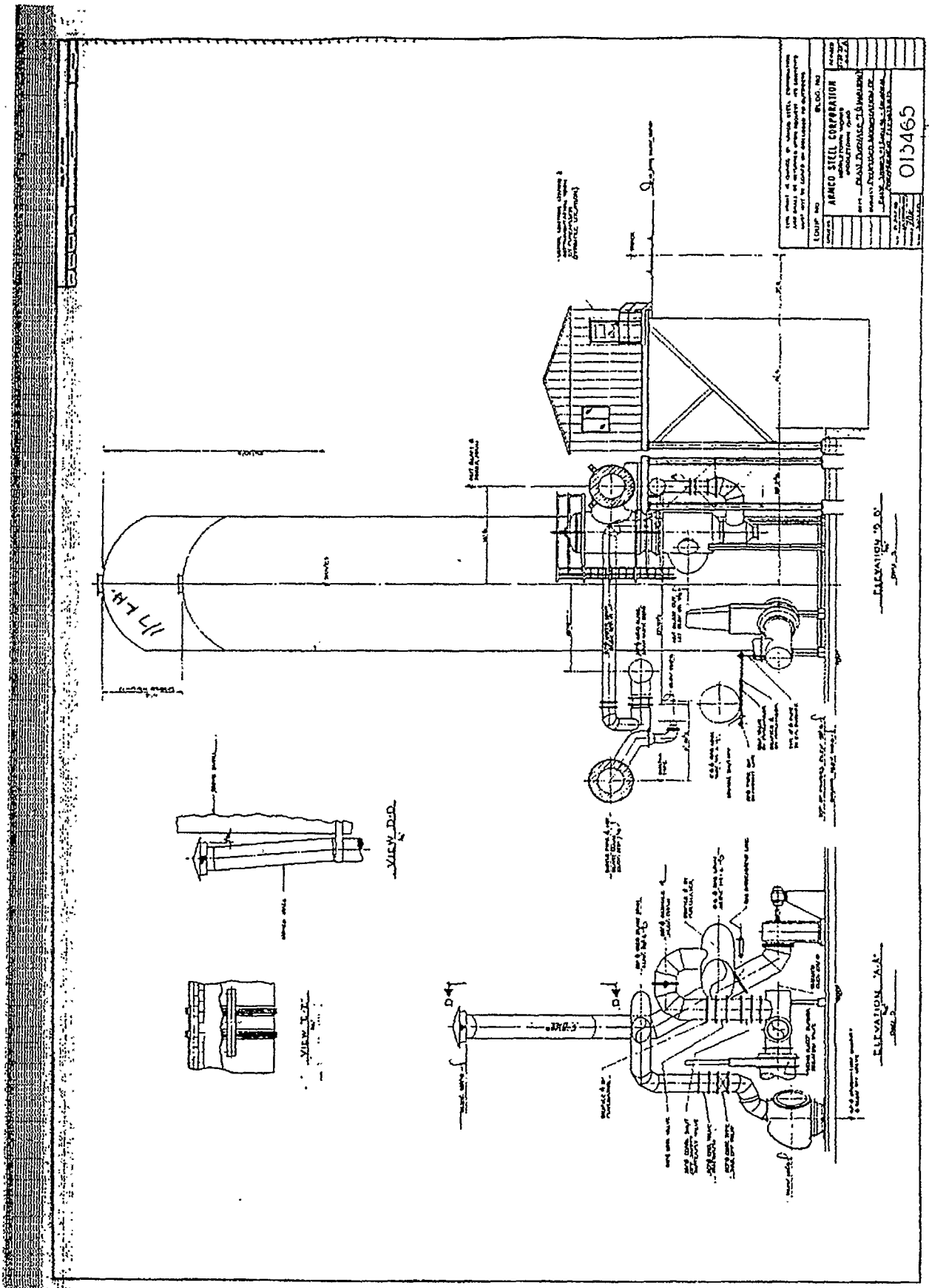
X ARRANCEMENT DRAWINGS

The following drawings which outline the scope of this project are attached:

1. 013464
2. 013465



BLUE, SMALL RED, YELLOW (W-A), SMALL YELLOW, ORANGE, PURPLE



BLUE, SMALL RED, YELLOW (W-A), SMALL YELLOW, ORANGE, PURPLE