

FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL-SCALE INDUSTRIAL PROJECT

MASTER

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ERIE MINING COMPANY
Pickands Mather & Company,
Managing Agent
1100 Superior Avenue
Cleveland, Ohio 44114

Prepared for the

U.S. DEPARTMENT OF ENERGY

Assistant Secretary for Energy Technology
Office of Fossil Fuels

Under CONTRACT EW-78-C-02-5066
(Formerly CONTRACT ET-78-C-01-2578)

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ERIE MINING COMPANY
FUEL GAS
DEMONSTRATION PLANT
PROGRAM
SMALL-SCALE INDUSTRIAL PROJECT

COMMERCIAL PLANT DESIGN
AND ECONOMIC EVALUATION

PHASE I
INTERIM REPORT

2 OF 2

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DECEMBER, 1978

D.O.E. CONTRACT ET-78-C-01-2578

9.0ENGINEERING DATA9.01 Engineering Requisitions

- G-1 - Gas Booster Compressors
- H-1 - Coal Gas Burners
- H-6 - Packaged Steam Boilers
- U-1 - Train Positioner/Rotary Dumper System
- U-2 - Coal Crusher
- W-1 - Preliminary Plant Site Subsurface Exploration
- W-20 - Coal Gasification Unit Subcontract
- W-21 - Stretford Unit Subcontract
- W-40 - Ambient Noise Surveys

9.02 Specifications

- 254 - Summary of Utility, Site and Utility Cost Data
- 270 - Piping and Instrument Diagram
- 275 - Process Plant Design

9.03 Major Equipment Summary Sheets

- Coal Handling - Area 01
- Gasification and Gas Clean Up - Area 02
- Sulfur Removal - Area 03
- Gas Transmission - Area 04
- Waste Water Treatment - Area 05
- Utilities - Area 06
- Safety Systems - Area 07

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Furnish gas booster compressors and motor drives with speed increasers for distributing coal gasification gas in accordance with the operating conditions and requirements specified on the data sheets and in the specifications of the Engineering Requisition, as follows:</p>		
		<p><u>A. G. McKee Specifications</u></p>		
	254	Summary of Utility, Site, and Utility Cost Data		
	266	Instruction to Vendors for Data Submittal		
	291	Spare Parts		
	450	Centrifugal Compressors		
	451	Vendor Data Requirements for Compressors		
	458	Lube, Shaft Sealing and Control Oil System		
	701	Shop Painting		
	751	Equipment Noise Specification		
	1105	A.C. Motors		

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ENGINEERING REQUISITION

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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
1	2	Gas Booster Compressors Tag No.: C-401 A&B		
2	2	Motor Drives for Item 1 Tag No.: CM-401 A&B		
3	2	Speed Increaseers Tag No.: CX-401 A&B		

ENGINEERING REQUISITION

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Form M-200-1 - 2/76 (Rev. 3/77)

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR ORD NUMBER
		<p><u>Additional Information</u></p> <ol style="list-style-type: none"> 1. The booster compressor shall be a multistage centrifugal type, and connected to the driver through a speed increaser by flexible coupling. A guard shall be provided for the coupling. 2. The casing shall be constructed of cast steel, and split horizontally along the centerline of the rotor shaft. 3. The gas inlet and outlet nozzles shall be an integral part of the casing, flanged, and located on the bottom of the casing. 4. Condensate drains shall be provided on the bottom of the casing. 5. The shaft seal shall be the dry seal labyrinth type made of stainless steel. Automatic shutdown seals shall be provided for use during standby. 6. No brass, bronze, aluminum, or rubber shall be used in contact with the gas or condensate. 7. The compressor and driver shall be mounted on a fabricated steel baseplate. 8. A console type pressure lubrication system shall be provided. The system shall be complete, and include all the necessary pumps, coolers, filters, reservoir, piping, gauges and safety switches. 9. The rotor assembly shall be checked for static and dynamic balance. 10. Accessories shall include panel boards and vibration detectors. 		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR ORD NUMBER
		<p>11. The Bidder shall fill in the information on Data Sheet Form 533 100 7-65 for the items that will be included in his proposal.</p>		

VENDOR REQUIREMENT DATA SHEET

McKee

FORM M-693 7/76

PROPOSAL REQUIREMENTS

ITEM	DESCRIPTION	REQUIRED
1.1	A statement MUST be submitted that equipment offered is in strict compliance with specifications, otherwise a complete list of exceptions is required.	X
1.2	Preliminary outline and arrangement drawings.	X
3	Descriptive literature including cross sectional drawings.	X
	Data sheet completed by supplier when included as a part of this E/R.	X
	Material specifications.	X
	Date for furnishing drawings.	X
	Operating weights.	X
	Lifting weights.	X
	Hydraulic Test Weights-- Vessels & Tanks	
	complete data sheet (M-250 for Vessels, M-300 for Tanks) whichever	
	... rves	X
	...	X

REV. _____
 BY _____
 DATE 7/21/78

BY	CHECKED BY	PAGE	OF	CONT. NO.	E/R NO.
		5		4814	G-1

ARTHUR G. McKEE & COMPANY
CENTRIFUGAL COMPRESSOR

REVISION DATE:

DATE: 7/24/78

SHEET 1 OF 2

SERVICE: COAL GAS BOOSTER COMPRESSOR	ITEM NO.: , TAG NO.: C-401A&B
DRIVER: TYPE MOTOR	NO. UNITS REQ'D.: , NO. CASINGS/UNIT:
FURNISHED BY COMPRESSOR VENDOR	MANUFACTURER:
GEAR: TYPE	MFR. SIZE & MODEL:
FURNISHED BY COMPRESSOR VENDOR	SERIAL NO.: , PERF. CURVE:

APPLICABLE STANDARDS: API 617.

OPERATING CONDITIONS

	RATED	WESTERN		EASTERN	
		NORMAL	DESIGN	NORMAL	DESIGN
GAS HANDLED					
CAPACITY, LBS/HR		114,970	155,355	124,700	168,535
MOLES/HR		5,025	6,790	5,320	7,190
MOL. WEIGHT		22.88	22.88	23.44	23.44
SCFM (at 14.7 PSIA, 50°F)		31,780	42,945	33,650	45,475
ATMOS. PRESSURE, PSIA		13.9	13.9	13.9	13.9
INLET CONDITIONS					
PRESSURE, PSIA		14.1	13.9	13.5	13.4
TEMPERATURE, °F		95	95	100	100
% RELATIVE HUMIDITY		100	100	100	100
K-C-Cv		1.384	1.384	1.383	1.383
COMPRESSIBILITY		1.00	1.00	1.00	1.00
CFM					
DISCHARGE CONDITIONS					
PRESSURE, PSIA		24.3	25.6	24.5	26.1
TEMPERATURE, °F					
COMPRESSIBILITY					
CFM					
COMPRESSION RATIO					
ADIABATIC HEAD (FT) (IN H ₂ O)					
SURGE LIMIT, INLET CFM					
COMPRESSOR DHP					
COMPRESSOR RPM					

CONSTRUCTION AND MATERIALS

TYPE: CASING SPLIT (VERTICALLY) (HORIZONTALLY)	IMPELLER(S): NO. , DIA. , IN. TIP SPEED FPM
SUCTION: (VERTICAL) (HORIZONTAL) (RIGHT) (LEFT)*	(OPEN) (SEMICLOSED) (WELD.) (CAST) (RIVETED)
SIZE , ASA RATING	RADIAL BEARINGS:
DISCHARGE: (VERTICAL) (HORIZONTAL) (RIGHT) (LEFT)*	THRUST BEARINGS:
SIZE , ASA RATING	SHAFT SEAL: (LABYRINTH) (OIL)
INTERSTAGE COOLING: (NONE) (LIQUID INJECTION) (DIAPHRAGM)	(BASE) (SOLE) (PLATE (COMMON) (SEPARATE)
(EXTERNAL) BY	FOR (COMPRESSOR) (GEAR) (DRIVER)
	MATERIALS
RPM: MAX. CONTINUOUS	CASING , SHAFT
1st CRITICAL , 2nd CRITICAL	IMPELLER , DIAPHRAGMS
ROTATION FACING COUPLING END: (CW) (CCW)	CASING MECHANICAL DESIGN LIMITATIONS: PSIG @ °F

*VIEWED FACING COUPLING END

REMARKS: Each compressor shall be suitable for the above requirements.

MADE BY	CHECKED BY	PAGE <u>5</u> OF	CONT. NO.	6-1
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ARTHUR G. MCKEE & COMPANY
CENTRIFUGAL COMPRESSOR

REVISION DATE:

DATE: 7/24/78

SHEET 2 OF 2

CONTROLS	
CONTROLLED FOR: (SUCTION PRESS) (DISCHARGE PRESS <input checked="" type="checkbox"/>) (FLOW)	
METHOD:	
(CONSTANT SPEED) (INLET GUIDE VANES) (SUCTION THROTTLING <input checked="" type="checkbox"/> BY <u>OTHERS</u>)	
(VARIABLE SPEED) THROUGH (DRIVER) (HYDRAULIC CPLG.) (MAGNETIC CPLG.) BY	
ACTUATION: (MANUAL) (AUTOMATIC <input checked="" type="checkbox"/>)	
TYPE OF SYSTEM: (PNEUMATIC) (HYDRAULIC) (ELECTRICAL)	
CONTROL AIR PRESSURE RANGE: . PSIG	
DIRECTION OF CHANGE: MAX. SPEED (FLOW) @ . PSIG	
UPON SIGNAL AIR PRESS. FAILURE	

LUBE SYSTEM	
(SEPARATE) (COMMON <input checked="" type="checkbox"/>) FOR (COMPR <input checked="" type="checkbox"/>) (GEAR <input checked="" type="checkbox"/>) (DRIVER <input checked="" type="checkbox"/>)	
CONSOLE (YES <input checked="" type="checkbox"/>) (NO) BY	
OIL RESERVOIR: (INTEGRAL <input checked="" type="checkbox"/>) (SEPARATE)	
RETENTION TIME . MINUTES. HEAT. COIL (YES <input checked="" type="checkbox"/>) (NO)	
MAIN PUMP: TYPE . MAT'L.	
DRIVER . HP . RPM	
SPARE PUMP: TYPE . MAT'L.	
DRIVER . HP . RPM	
OIL COOLER: (YES <input checked="" type="checkbox"/>) (NO) TYPE	
TUBES: MAT'L. . DIA. . BWG	
OIL FILTER: (YES <input checked="" type="checkbox"/>) (NO) TYPE . MICRON	
UTILITIES: STM . PSIG @ . °F. EXHAUST . PSIG	
CURRENT VOLT/PHASE/CYCLE	

SEALING SYSTEM	
COMBINED WITH LUBE OIL SYSTEM: (YES) (NO)	
TYPE:	
GAS INJECTION: (YES) (NO) . EDUCTOR SYSTEM: (YES) (NO) .	
SEALING GAS: . AVAIL. @ . PSIG & . °F	
CONSOLE: (YES) (NO) BY	
OIL RESERVOIR: (INTEGRAL) (SEPARATE)	
RETENTION TIME . MINUTES. HEAT. COIL (YES) (NO)	
CONTAMINATED OIL GPM:	
MAIN PUMP: TYPE . MAT'L.	
DRIVER . HP . RPM	
SPARE PUMP: TYPE . MAT'L.	
DRIVER . HP . RPM	
OIL COOLER: (YES) (NO) TYPE	
TUBES: MAT'L. . DIA. . BWG	
OIL FILTER: (YES) (NO) TYPE . MICRON	
UTILITIES: STM . PSIG @ . °F. EXHAUST . PSIG	
CURRENT VOLT/PHASE/CYCLE	

DRIVER	
ELECTRIC MOTOR	
MFR.:	TAG NO.: <u>CM-401A23</u>
TYPE:	
HP:	RPM: . ROTATION (CW) (CCW) *
ENCLOSURE:	INSUL.: . TEMP. RISE: . °C
VOLT/PHASE/CYCLE: <u>460/3/60</u> . NEMA FRAME:	
BEARINGS:	LUBE:
EXCITER: (DIRECT CONN.) (M. G.) (RECTIFIER) BY	
POWER FACTOR . FOR DETAILS SEE	
OTHER	
(STEAM TURBINE) (GAS TURBINE) (INTERNAL COMBUSTION ENGINE)	
FOR DETAILS SEE B/M . PAGE	

GEAR & COUPLING	
GEAR: MFR. & MODEL	
AGMA MIN. SERVICE FACTOR: . NO. REDUCTIONS:	
OUTPUT SHAFT: RPM . ROTATION (CW) (CCW) **	
RATIO: . MECH. EFFICIENCY: %	
BEARINGS: . LUBE:	
MAT'L.: CASING . GEAR . PINION	
COUPLING: TYPE, MFR. & MODEL	
HIGH SPEED	
LOW SPEED	

INSTRUMENTATION	
INSTRUMENT PANEL: (YES <input checked="" type="checkbox"/>) (NO) . PANEL MOUNTED = (PM)	
PRESS. GAUGES:	
THERMOMETERS:	
L. LEVEL GAUGES:	
SIGHT FLOW:	
TACHOMETER: . RANGE	
ALARMS:	
TRIPS:	

GENERAL	
ELECTRIC COMPONENTS: EXPLOSION-PROOF (YES) (NO)	
CURRENT TO CONTROLS: VOLT/PHASE/CYCLE / /	
COOL. WATER: AVAIL. @ . °F & . PSIG. TOTAL GPM	
UNIT INSTALLED: (INDOOR) (OUTDOOR) . ROOF (YES) (NO)	
WINTERIZATION (YES) (NO)	
WEIGHTS, LBS: COMPR. . BASE . DRIVER	
GEAR . TOTAL . MAX. TO LIFT	
INSPECTION & TESTS (WITNESSED = W. NOT WITNESSED = NW):	
SHOP INSP. . MECH. RUN . HYDRO. . PSIG.	
PERFORMANCE (AIR) (GAS) . DRIVER + COMPR.	
SPECIAL	
<u>CLASS I GROUP 2 DIV II</u>	

*VIEWED FACING MOTOR COUPLING END
REMARKS:

**VIEWED FACING GEAR OUTPUT SHAFT END

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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER																																										
		<u>COAL GAS BOOSTER COMPRESSOR</u> <u>C-401</u> <u>GAS ANALYSIS</u>																																												
		<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Component</u></th> <th style="text-align: center;"><u>Western Coal Case 1 Mol %, "wet"</u></th> <th style="text-align: center;"><u>Eastern Coal Case 2 Mol %, "wet"</u></th> </tr> </thead> <tbody> <tr><td>CO</td><td style="text-align: center;">24.57</td><td style="text-align: center;">23.75</td></tr> <tr><td>CO₂</td><td style="text-align: center;">6.40</td><td style="text-align: center;">5.73</td></tr> <tr><td>H₂</td><td style="text-align: center;">21.16</td><td style="text-align: center;">18.12</td></tr> <tr><td>N₂</td><td style="text-align: center;">40.87</td><td style="text-align: center;">44.30</td></tr> <tr><td>CH₄</td><td style="text-align: center;">0.61</td><td style="text-align: center;">0.66</td></tr> <tr><td>C₂H₆</td><td style="text-align: center;">0.19</td><td style="text-align: center;">0.28</td></tr> <tr><td>H₂S</td><td style="text-align: center;">0.16</td><td style="text-align: center;">0.01</td></tr> <tr><td>COS</td><td style="text-align: center;">0.05</td><td style="text-align: center;">0.09</td></tr> <tr><td>NH₃</td><td style="text-align: center;">0.39</td><td style="text-align: center;">0.31</td></tr> <tr><td>HCN</td><td style="text-align: center;">0.002</td><td style="text-align: center;">0.01</td></tr> <tr><td>H₂O</td><td style="text-align: center;">5.60</td><td style="text-align: center;">6.74</td></tr> <tr><td></td><td style="text-align: center;"><u>100.00</u></td><td style="text-align: center;"><u>100.00</u></td></tr> <tr><td></td><td style="text-align: center;">(Note 1)</td><td style="text-align: center;">(Note 1)</td></tr> </tbody> </table>	<u>Component</u>	<u>Western Coal Case 1 Mol %, "wet"</u>	<u>Eastern Coal Case 2 Mol %, "wet"</u>	CO	24.57	23.75	CO ₂	6.40	5.73	H ₂	21.16	18.12	N ₂	40.87	44.30	CH ₄	0.61	0.66	C ₂ H ₆	0.19	0.28	H ₂ S	0.16	0.01	COS	0.05	0.09	NH ₃	0.39	0.31	HCN	0.002	0.01	H ₂ O	5.60	6.74		<u>100.00</u>	<u>100.00</u>		(Note 1)	(Note 1)		
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		<p>NOTES:</p> <p>1. Gas may contain up to .01 gr/scf of tar and .01 gr/scf solids.</p>																																												

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Provide burners for use with low Btu gas from a coal gasification system in accordance with this requisition and the following specifications.</p> <p><u>Arthur G. McKee Specifications (to be provided later)</u></p> <p>266 Instructions to Vendors for Data Submittal 290 Welding Fabrication, Weld Examination and Inspection 291 Spare Parts</p> <p><u>Industry Specification</u></p> <p>ASME Sect. VIII Latest</p>		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO	PUR. ORD NUMBER
1	54	Low Btu gas burners		
2	54	Oil guns for air atomization		
3	1	Prototype burner with oil gun		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS

DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER																						
		<p><u>Design Notes</u></p> <p>1. Provide gas burners suitable for a fuel with the analysis listed below:</p> <table style="margin-left: 100px;"> <thead> <tr> <th></th> <th style="text-align: right;">% by Vol.</th> </tr> </thead> <tbody> <tr><td>CO</td><td style="text-align: right;">27.65</td></tr> <tr><td>CO₂</td><td style="text-align: right;">3.54</td></tr> <tr><td>H₂</td><td style="text-align: right;">19.32</td></tr> <tr><td>N₂</td><td style="text-align: right;">42.83</td></tr> <tr><td>Ch₄</td><td style="text-align: right;">2.14</td></tr> <tr><td>C₂h₆</td><td style="text-align: right;">0.07</td></tr> <tr><td>COS</td><td style="text-align: right;">0.06</td></tr> <tr><td>H₂O</td><td style="text-align: right;">4.37</td></tr> <tr><td>NH₃</td><td style="text-align: right;">0.01</td></tr> <tr><td>H₂S</td><td style="text-align: right;">Trace</td></tr> </tbody> </table> <p>2. The total energy input through a single burner shall range from 5.0 MMBtu/hour to 20.0 MMBtu/hour including the energy reflected as temperature in the fuel stream. The gas temperature will range from 270°F to 600°F; therefore, the minimum firing rate shall be 5.0 MMBtu/hour with full temperature 600°F and maximum firing rate 20.0 MMBtu/hour with fuel at 270°F.</p> <p>3. The burner will fire vertically and will be mounted in the bottom or floor of a vertical cylindrical combustion chamber. Chamber inside dimensions are 7' wide by 18'6" in height.</p> <p>4. The products of combustion are directed from the combustor to a metalurgical furnace and are required for the metalurgical use at 2350°F. The combustion products must therefore be diluted with ambient air diverted from the main combustion air duct to achieve the required product temperature.</p>		% by Vol.	CO	27.65	CO ₂	3.54	H ₂	19.32	N ₂	42.83	Ch ₄	2.14	C ₂ h ₆	0.07	COS	0.06	H ₂ O	4.37	NH ₃	0.01	H ₂ S	Trace		
	% by Vol.																									
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ENGINEERING REQUISITION

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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>During start-up and in refractory dry out periods the combustion chamber is operated at 600° F. While this performance can be achieved with alternate fuels, if necessary, it will be advantageous to use the coal gas in this operating period. Vendors shall review their equipment for the 600° F operation and state whether or not the equipment is suitable for that purpose.</p>		
		<p>5. The plant elevation is 1615' above sea level. The combustion chamber operates at a pressurized condition ranging from a low of 4 psig to a high of 5.5 psig. The high pressure condition exists at the maximum firing rate, the low pressure condition at the low firing rate.</p>		
		<p>6. The nature of the process causes a constant fluctuation in the combustion chamber pressure of approximately 0.3 psig (8" H₂O). The burner vendor shall supply a burner or recommend auxiliary control equipment that will provide reliable service at all flow conditions with a fluctuating pressure condition in the chamber. The cyclic period of the pressure fluctuation is approximately 30 seconds.</p>		
		<p>7. The combustion air blowers provide air for multiple process uses but include ample air for the burner requirements stated herein. The rating of the blowers includes an 8 psig discharge pressure. Wear in the blowers, long duct runs with flow measurement and control valves suggests that the maximum air pressure which can be anticipated at the burner when the pressure in the combustor is at 5.5 psig, is 7.0 psig.</p>		
		<p>8. Fuel is discharged from the gasifier at slightly above atmospheric pressure and must be compressed for use in the burners. The compressor and the energy required to drive the compressor are major costs to the consumer because of the large quantity of fuel that will be consumed. The vendor shall consider that a low fuel</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO	PUR. ORD. NUMBER
		<p>pressure system is a major consideration in evaluating equipment.</p> <p>A single burner is desirable, however, if the fuel line pressure can be substantially reduced or performance improved, multiple burners will be considered.</p> <p>9. The existing system injects dilution air around the burner. Moving the point of injection for dilution air means additional duct work and modification of existing refractory linings. Dilution air injection in the burner vicinity is considered an advantage if it does not interfere with the combustion reaction or burner performance.</p> <p>10. The metallurgical process requires a constant flow of air at 2350°F from each furnace. The historical mode of operation has been to manually establish constant air flows at the burner nozzle and at the dilution air nozzle allowing the fuel flow to float automatically to maintain the desired discharge temperature.</p> <p>The vendor shall state the anticipated excess primary air condition at which the burner will function safely and shall include recommendations in the need for ratio control equipment.</p> <p>11. Alternate fuels have been and will be burned when the primary fuel supply (coal gas) is not available. Those alternate fuels are:</p> <ul style="list-style-type: none"> a. #2 fuel oil b. #6 fuel oil heated to approximately 240°F c. Coal tar with the same viscosity as #6 fuel oil heated to 240°F. 		

ENGINEERING REQUISITION

Price

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS

DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT

CONTRACT 4814

ITEM NO	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>d. Natural gas</p> <p>Liquid fuels have been air atomized with the combustion air stream previously described.</p> <p>12. New burners shall include necessary equipment to burn the alternate fuels and it shall be possible to switch to an alternate fuel with only minimum or no downtime. A flanged nozzle closed with a blind flanged in which a liquid fuel gun can be inserted is acceptable if no easier alternative is available.</p> <p>13. If pilot burners are required to maintain liquid fuel ignition or coal gas ignition during start-up or during normal operation, pilots shall fire propane, natural gas or coal gas if coal gas is feasible.</p> <p>Vendor shall confirm the fuels which can be burned with the pilot burner and shall state when the use of the pilot burner is required. If it is necessary to alter or modify pilot burners for the various fuels, the vendor should describe the changes which are necessary when switching from one fuel to another.</p> <p>14. A prototype burner will be purchased and performance tested prior to the conversion of production equipment.</p> <p>15. Because the system is pressurized with either combustibles or hot flue gas, ASME Section VIII has been specified for the design of pressure parts. If this presents a problem for vendors, other reasonable standards will be accepted providing that safety is assured.</p> <p>16. A welding specification is referenced to assure safe construction of the production equipment. Vendor's standard procedures for the manufacture of castings or weld fabricated equipment will be acceptable in the prototype burner.</p>		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>17. Vendor's proposals shall include sketches which illustrate the size and dimensions of the equipment including all nozzles, as well as the refractory installation (burner tile, etc.). The proposal shall include the pressure and flow requirements for all streams and any recommendations for instrumentation and controls. A complete description is required to project the furnace modifications that will be required.</p>		

ENGINEERING REQUISITION

MCKEE

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY 19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		Furnish the packaged steam boilers specified herein and in accordance with the requirements of the following specifications:		
		<u>A. G. McKee Specifications</u>		
		254 Summary of Utility, Site and Utility Cost Data 266 Instructions to Vendors for Data Submittal 291 Spare Parts 432 Vendor Data Requirements for Steam Boilers 481 Pressure Vessel Design 482 Pressure Vessel Fabrication 561 Safety Valves 701 Shop Painting 751 Equipment Noise Specification 1105 A. C. Motors		
		<u>Industry Specifications</u>		
		ASME Boiler and Pressure Vessel Code ANSI Codes for Pressure Piping		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY '19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1	2	Packaged Steam Boilers Tag: H-601A and H-601B		
2	1	Blowdown Separator Tag: D-607		

VENDOR REQUIREMENT DATA SHEET

McKee

FORM M-693 7/76

PROPOSAL REQUIREMENTS

ITEM	DESCRIPTION	REQUIRED
1.1	A statement MUST be submitted that equipment offered is in strict compliance with specifications, otherwise a complete list of exceptions is required.	X
1.2	Preliminary outline and arrangement drawings.	X
1.3	Descriptive literature including cross sectional drawings.	X
1.4	Data sheet completed by supplier when included as a part of this E/R.	X
1.5	Material specifications.	X
1.6	Date for furnishing drawings.	X
1.7	Operating weights.	X
1.8	Shipping weights.	X
1.9	Hydrostatic Test Weights-- Vessels & Tanks	
1.10	Vendor shall complete data sheet (M-250 for Vessels, M-300 for Tanks) whichever is applicable.	
1.11	Performance Curves	X
1.12	Noise Data Sheet	X

REV.						
BY						
DATE						
DATE	MADE BY	CHECKED BY	PAGE	OF	CONT. NO.	E/R NO.
9/19/78	JR	TS	3	7	MC-4814A	H-6

ENGINEERING REQUISITION

Mckee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY 19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER														
		<p>1.0 <u>DESIGN NOTES</u></p> <p>1.1 The boilers shall be designed for 150 psig in accordance with the ASME Boiler and Pressure Vessel Code and in accordance with this Engineering Requisition. The vendor shall verify the design conditions.</p> <p>1.2 Each boiler shall be designed to perform as follows:</p> <table> <tr> <td>Continuous steam generation, lb/hr</td> <td>27,600</td> </tr> <tr> <td>Steam temperature, °F</td> <td>353</td> </tr> <tr> <td>Steam pressure, psig</td> <td>125</td> </tr> <tr> <td>Feedwater temperature, °F</td> <td>225</td> </tr> <tr> <td>Maximum blowdown rate, %</td> <td>5</td> </tr> <tr> <td>Minimum efficiency based on HHV of fuel oil, %</td> <td>Vendors to advise</td> </tr> </table> <p>1.3 The boiler feed will be a mixture of 0-40% condensate and treated Colby Lake water. The treated water will have less than 100 ppm of dissolved solids, and total alkalinity 3.0 ppm (max.) as CaCO₃.</p> <p>1.4 The fuel to be used is by-product liquid hydrocarbon recovered from the coal gasification process. This liquid will have characteristics similar to those of No. 5 fuel oil. As an alternative, the unit should also be capable of producing the specified capacity continuously when firing either this fuel or Bunker "C" fuel oil in any combination. During startup, the boilers will be fired with natural gas at 1000 BTU/cu. ft. or propane.</p> <p><u>By-Product Liquid Hydrocarbon Fuel Characteristic</u></p> <table> <tr> <td>Temperature, °F</td> <td>165-175</td> </tr> </table>	Continuous steam generation, lb/hr	27,600	Steam temperature, °F	353	Steam pressure, psig	125	Feedwater temperature, °F	225	Maximum blowdown rate, %	5	Minimum efficiency based on HHV of fuel oil, %	Vendors to advise	Temperature, °F	165-175		
Continuous steam generation, lb/hr	27,600																	
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Minimum efficiency based on HHV of fuel oil, %	Vendors to advise																	
Temperature, °F	165-175																	

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY 19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		Pressure, psig		As required
		Viscosity, cp		for burner
		@100°F		150
		@200°F		17
		@250°F		9
		Specific Gravity, 60/60°F		0.980
		Net Heating Value, HHV, BTU/lb		15,900
		Sulfur wt. %		0.2 - 1.0
		<u>Bunker "C" Fuel Characteristic</u>		
		Temperature, °F		250
		Pressure, psig		As required
		Viscosity, cp		for burner
		@100°F		1500
		@200°F		82
		@250°F		32
		Specific gravity, 60/60°F		0.9752
		Net heating value, HHV, BTU/lb		17,300
		1.5 Boilers shall be suitable for operating at a 4:1 turndown ratio.		
		1.6 Utilities available will be as specified in 4814 General Specification 254.		
		1.7 The stack emissions from the boilers when firing the fuels listed in paragraph 4 shall be guaranteed to meet the requirements of APC-4 of the Minnesota Pollution Control Agency, Air Pollution Control Division entitled "Standards of Performance for Fossil Fuel Burning, Indirect Heating Equipment", 1976 Amendment.		
		1.8 Site conditions will be as specified in 4814 General Specification 254.		
		1.9 The boilers shall include but not necessarily be limited to the following equipment and features:		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY 19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. C. NUME
		1.9.1 Forced draft fan		
		1.9.2 Air atomization with air compressor module mounted, piped, and wired on the boiler		
		1.9.3 Controls shall meet FIA requirements.		
		1.9.4 Electronic flame safety system to protect the unit against flame failure (either pilot or main flame).		
		1.9.5 Gas fired pilot and gas pilot regulator. Pilot will be supplied with natural gas or propane.		
		1.9.6 Control circuit transformer		
		1.9.7 Fuel oil controller with built-in oil metering valve, bypass valve and pressure reducing valve.		
		1.9.8 Low fire hold control to limit the firing of a cold boiler		
		1.9.9 Blowdown valves		
		1.9.10 Combination pump controller and low water cutoff		
		1.9.11 Gauge glass		
		1.9.12 Steam gauge		
		1.9.13 Stack thermometer		
		1.9.14 Required pressure controls		
		1.9.15 Control panel		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PACKAGED STEAM BOILERS DATE JULY 19, 1978
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT CONTRACT MC4814A

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>1.10 The blowdown separator shall be sized for the boilers specified herein and shall be complete with inlet, drain, vent, aftercooler, temperature regulating valve, strainer, thermometer and floor support.</p> <p>1.11 Vendor shall state the performance of his boiler based on the fuels and conditions specified.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Provide an electro-mechanical system to move a unitized coal train, singly index each car onto a rotary car dumper, and dump the coal into a hopper. The system shall be in accordance with the operating and functional requirements stated herein and the following specifications.</p> <p><u>Arthur G. McKee Specifications</u></p> <p>266 Instructions to Vendors for Data Submittal 290 Weld Fabrication and Weld Examination and Inspection 501 Basic Instrumentation Requirements 701 Shop Painting 702 Field Painting 802 HVAC Equipment - Standard Industrial Environment 908 General Notes for Piping Components 1004 Coal Dust Suppression Equipment 1105 AC Motors 1150 Vendor Data Requirement for Electrical Equipment</p> <p><u>National Codes</u></p> <p>AGMA American Gear Manufacturing Association AISC American Institute of Steel Construction AREA American Railway Engineering Association NFPA National Fluid Power Association NEMA National Electrical Manufacturers Association NFPA National Fire Protection Association</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1	1	Train positioner CP101 to include train locks, positioning carriage, cable drive system, positioner arm and motor driven cable take-up.		
2	1	Rotary car dumper DU101 to include counter-weighted dumper cradle, structural strength to sustain the weight of road locomotives, positive drive system and clamping mechanism.		
3	1	Hand operated centralized lubrication system.		
4	1	Wet dust suppression system.		
5	1	Coal hopper BN101 to include a grizzly.		
6	1	Operators pulpit to provide full vision of the unloading operation complete with heating, ventilating, and air-conditioning system. Noise levels inside the operators pulpit are not to exceed NC 45 (Noise Criteria Curve 45).		
7	1	Complete electrical system and wiring from substation and including controls for the unloading and storing operation.		
8		Complete erection of all mechanical equipment and electrics, including field painting.		
9		Complete volumes of operating and maintenance manuals		
10		Start-up and place the system in first class operating condition and train operating personnel.		
11		Drawings showing complete foundation requirements and loads.		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p style="text-align: center;"><u>SYSTEM DESCRIPTION</u></p> <p>The system moves an entire unit train, including locomotives, from train arrival through positioning, dumping and departure. The locomotives do the initial car spotting. After the initial spotting of the train, control and movement of the train are handled automatically by a positioner. Cars are indexed onto the dumper platen, precisely position, and train locks hold the train in position for the dumping sequence. Dumping of each car is performed in an integrated sequence. The car dumper clamps the car on the platen rails, rotates the car for dumping, and returns the car to its original position, and releases the clamps; all without uncoupling the car. A hopper below the dumper directs the coal onto conveyor feeders. This positioning-dumping sequence continues until the entire train is empty.</p> <p>System operation is automatic and initiated by one man through a pushbutton. This single operator will monitor the function and initiate dumping each car. Selecting the manual operational mode provides complete manual control of all of the system functions.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p><u>Design Notes</u></p>		
		<p>1. The unit trains will be made up of 3 locomotives, 50 gondola coal cars, and a caboose.</p>		
		<p>2. Each gondola car will be 53'-1" long over the coupler face, 10'-8" wide, and 12'-9" high. Each car will weigh 131.5 ton filled with 100 ton of coal. Each car truck will be equipped with antifriction roller bearings.</p>		
		<p>3. Each locomotive will be 15'-9" high and 10'-5" wide. For design purposes use a locomotive weight of 270 ton each.</p>		
		<p>4. Cars will be equipped with rotary couplers.</p>		
		<p>5. Cars will be equipped with interchangeable standard draftgears.</p>		
		<p>6. The car dumper shall rotate clockwise when viewed in the direction of a loaded train travel.</p>		
		<p>7. The train positioning equipment shall be located at the exit end of the car dumper and on the right side of the tracks when viewed in the direction of train travel.</p>		
		<p>8. The system shall be designed for continuous 24 hours per day heavy duty service and a cycle time of 2 minutes per car.</p>		
		<p>9. The system control shall be suitable to handle a unit train that is not equipped with rotary coupler. The operation of the system shall be initiated by placing the selector switch in the manual mode. Individual pushbuttons shall be used to initiate each function of the system. Before the dumping function is initiated the car will be manually uncoupled from the train. Cycle time for this operation shall be 4.2 minutes per car.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p>10. The rotary dumper shall be capable of occasionally holding a fully loaded frozen car in the 180 degree rotated position and returning the car to an upright position.</p> <p>11. Cars in the unit train without rotary couplings may vary in physical size. The size may vary in length from a maximum of 53'-1" over the coupler face to 37'-0" in height from a maximum 13'-6" to a minimum of 11'-0", and in width from a maximum 10'-8" to a minimum of 9'-9".</p> <p>12. Drawing X-00-51-2 shows the track layout, grades and curves.</p> <p>13. Drawing X-01-51-2 shows the typical arrangement of the system.</p> <p>14. Drawings Y-01-10-2 and Y-01-11-2 shows the instrumentation.</p> <p>15. Ambient temperature range is -20F to 100F.</p> <p>16. The design for the rotary dumper shall include sufficient structural and mechanical integrity to allow for starting and stopping a locomotive when the locomotive is on the dumper platen.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p style="text-align: center;"><u>BINS</u></p> <p>Tag Number <u>BN-101</u> <u>Service</u> <u>Dumper Hopper</u></p> <p>General Type <u>Rectangular, rectangular outlet</u> Material Handled <u>Coal</u> Material Bulk Density + Loose (lb/cf) <u>45</u> + Packed (lb/cf) <u>50</u> Angle of Repose (DEG) <u>40</u> Top Opening (ft) <u>As required for the system dumping rate</u> Taper Height (ft) <u>As required for the system</u> Net Capacity (ST) <u>As required for the system</u> Design Temperature (°F) <u>Ambient</u> Material <u>CS with SS Liner</u></p> <p><u>Remarks:</u></p> <ol style="list-style-type: none"> 1. All bins shall be designed to be self-emptying. 2. All bins and hoppers shall be equipped with a means of stopping flow to allow removal of feeder equipment for maintenance. 3. Hopper top shall be equipped with a grizzly screen suitable for occasional bulldozer operation. 4. Opening ^{Opening} shall be 6" square. 5. Hopper angle = 55 degree min. to horizontal. 6. Liners shall be replaceable. 		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL CRUSHER

DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Provide coal crushing equipment, ring type, complete with drive and lubrication system to produce a granular coal product. The units shall be in accordance with the operating and functional requirements stated herein and the following specifications:</p> <p><u>Arthur G. McKee Specifications</u></p> <p>266 Instructions to Vendors for Data Submittal. 290 Weld Fabrication and Weld Examination and Inspection 291 Spare Parts 458 Lubrication, Shaft-Sealing and Control Oil Systems 459 Sizing of Drivers and Transmissions 701 Shop Painting 751 Equipment Noise 1105 AC Motors</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL CRUSHER DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1	2	Ring type coal crushers X-104A and X-104B		
2	2	Circulating oil lubrication systems to include all components and necessary fittings and to exclude all interconnecting oil piping and electrical services.		
3	2	Direct connected drives to include motor, coupling and guard.		

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL CRUSHER DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p style="text-align: center;"><u>System Description</u></p> <p>The crushers will be installed in an open circuit coal preparation system of a coal gasification facility. Initially the facility will operate as a demonstration facility which will be eventually expanded to a commercial facility. The crushers are required to operate at a capacity to satisfy the coal requirements of either facility.</p> <p>Sized western sub-bituminous or eastern bituminous coal will be reclaimed from a storage pile and crushed. A grizzly, positioned immediately before the crushers, removes minus 1-1/2 inch x 0 coal while passing plus 1-1/2 inch coal to the crushers. A tramp iron magnet, with metal detectors mounted before and after the magnet, is positioned above the reclaim collector conveyor to provide protection for the crushers.</p>		

ENGINEERING REQUISITION

MCKEE

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION: COAL CRUSHER

DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER																														
		<p><u>Design Notes</u></p> <p>1. Each crusher shall be capable of crushing western sub-bituminous and eastern bituminous coal.</p> <p>2. Each crusher shall be designed for a commercial facility duty cycle of operating 365 days per year, 18 hours per day.</p> <p>3. <u>Coal physical characteristics:</u></p> <table style="margin-left: 40px;"> <thead> <tr> <th></th> <th style="text-align: center;">Western Sub-bituminous</th> <th style="text-align: center;">Eastern Bituminous</th> </tr> </thead> <tbody> <tr> <td>Bulk Density (lb/cf)</td> <td style="text-align: center;">45</td> <td style="text-align: center;">45</td> </tr> <tr> <td>Grindability (Hardgrove Index)</td> <td style="text-align: center;">44-51</td> <td style="text-align: center;">46-60</td> </tr> <tr> <td>Moisture Content (wt %) as received</td> <td style="text-align: center;">16-26 (1)</td> <td style="text-align: center;">3.5-15 (1)</td> </tr> </tbody> </table> <p>(1) Total moisture (inherent plus surface)</p> <p>4. <u>Operating Conditions:</u></p> <table style="margin-left: 40px;"> <tbody> <tr> <td>Discharge Product Size (inches)</td> <td colspan="2" style="text-align: center;">Minus 1-1/2 x plus 1/2</td> </tr> <tr> <td>Discharged Fines Size (inches)</td> <td colspan="2" style="text-align: center;">Minus 1/2 x 0</td> </tr> <tr> <td>Maximum Fines Generation (wt %)</td> <td colspan="2" style="text-align: center;">15</td> </tr> <tr> <td>Crushing Capacity Range (tph)</td> <td colspan="2" style="text-align: center;">14-58</td> </tr> </tbody> </table> <p><u>Maximum Feed Size (inches)</u></p> <table style="margin-left: 40px;"> <tbody> <tr> <td>Normal (assumed)</td> <td style="text-align: center;">2-3</td> <td style="text-align: center;">2-3</td> </tr> <tr> <td>Frozen (assumed)</td> <td style="text-align: center;">6</td> <td style="text-align: center;">6</td> </tr> </tbody> </table> <p>5. Each crusher shall be designed for a maximum capacity of 285 tph.</p> <p>6. The crusher frame shall be fabricated of heavy steel plates and shapes and provided with quick-opening inspection doors with dust tight seals. Provisions shall</p>		Western Sub-bituminous	Eastern Bituminous	Bulk Density (lb/cf)	45	45	Grindability (Hardgrove Index)	44-51	46-60	Moisture Content (wt %) as received	16-26 (1)	3.5-15 (1)	Discharge Product Size (inches)	Minus 1-1/2 x plus 1/2		Discharged Fines Size (inches)	Minus 1/2 x 0		Maximum Fines Generation (wt %)	15		Crushing Capacity Range (tph)	14-58		Normal (assumed)	2-3	2-3	Frozen (assumed)	6	6		
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Normal (assumed)	2-3	2-3																																
Frozen (assumed)	6	6																																

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL CRUSHER DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>also be included to permit removal of the rotor without dismantling the crusher.</p> <p>7. Renewable abrasion-resistant steel liners and components shall be furnished in all areas subject to excessive wear.</p> <p>8. Provide a suitable mechanical adjustment mechanism for the cage frame.</p> <p>9. Provide oil lubricated antifriction bearings with suitable seals and mounted on the outside of the crusher frame.</p> <p>10. Provide a complete continuous flow lubricating system for each crusher. The system shall include a head tank, bearing housing input fittings, sight flow gages, control valves and thermometers, and main reservoir with pump and filter systems. The lubricating system shall ensure continuous lubrication and cooling of the bearings. The system shall be monitored by a pressure sensing switch which can be interlocked with the crusher motor and feed conveyors to stop this equipment on loss of oil pressure. A time delay shall be included to keep the pump circulating oil for a limited time after the crusher motor is de-energized. An immersion heater shall be provided in the main reservoir to maintain proper oil viscosity during cold weather.</p> <p>11. Provide a tramp iron trap in the crusher frame with deflector plate. An access door shall be provided to facilitate the removal of debris.</p> <p>12. A direct coupled drive complete with motor, coupling and guard shall be provided for each crusher.</p> <p>13. The rotor assembly shall be statically balanced.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL CRUSHER DATE AUGUST 7, 1978

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		14. The rotor shaft shall be fabricated of forged alloy steel, suitably sized and heat treated for maximum strength.		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PRELIMINARY PLANT SITE SUBSURFACE EXPLORATION DATE NOVEMBER 11, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Furnish all labor, materials, equipment and supervision for subsurface borings, samples tests, boring records and reports for the subsurface exploration borings as shown on attached sketch (page 3).</p> <p>1. Subsurface Exploration</p> <p>A. Borings</p> <p>Borings shall consist of seven (7) holes. Five (5) test borings will be extended to anticipated bed-rock or, where bed-rock is not accessible, to a minimum 50 feet depth. Two (2) test borings (marked No. 2 and No. 6 on the sketch) shall be extended to 70 feet depth or, if rock is encountered at a higher elevation, shall be carried at least 10 feet into the rock ledge.</p> <p>B. Site Work and Location</p> <p>The boring contractor shall obtain boring locations from the Erie Mining Co. survey and shall be responsible for recording his boring logs - particularly in regard to elevation data. The actual boring location may vary slightly from the survey location if terrain features dictate and upon approval of the Erie Mining Co.</p> <p>2. Boring Records and Reports</p> <p>A. Boring Records</p> <p>The subsurface exploration contractor shall furnish logs of each hole started showing in standard form all pertinent data regarding the soils and the bed-rock, including elevation data.</p> <p>B. Final Report</p> <p>The report shall contain a general description of the geology of the area, a description of rock and soil and a compilation of all boring logs along with results of core tests. The report shall also</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION PRELIMINARY PLANT SITE SUBSURFACE EXPLORATION DATE NOVEMBER 11, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>ascertain the allowable capacities of the bearing material (both soil and anticipated rock) and shall include foundation recommendations.</p> <p>3. Commencement and Completion of Work</p> <p>Testing shall begin as soon as possible and the completion of this subsurface exploration contract shall be as noted in the letter of inquiry. This includes having the final report edited, copied and ten (10) copies in the hands of the Project Engineer by this date.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>4.) Furnish the services and materials, as specified, to provide process designs, gasifier retort design, cost estimate and gasifier retort procurement complete with refractory lining, including construction and start up services as required, for a coal gasification demonstration unit. In addition, furnish a process design for a commercial size coal gasification unit.</p> <p>The subcontractor is required to perform all work in accordance with the documents and attachments as described in the following sections:</p> <p>1.0 GENERAL</p> <p>2.0 SCOPE OF WORK</p> <p>3.0 INSTRUCTION TO BIDDERS</p> <p>4.0 PROCESS DESIGN SPECIFICATION</p> <p>5.0 DESIGN AND CONSTRUCTION NOTES</p> <p>6.0 APPLICABLE SPECIFICATION</p> <p>7.0 COMPLETION RESPONSIBILITIES</p> <p>3.) 8.0 PHASE II SCOPE OF WORK</p> <p>3.) 9.0 PHASE III SCOPE OF WORK</p> <p>1.0 <u>GENERAL</u></p> <p>1.1 The subcontractor shall provide process designs, and gasifier retort design consistent with the process as described in Section 4.0.</p> <p>1.2 This E/R specifies the onsite duty requirements for the coal gasification unit battery limits to be included as part of the Fuel Gas Demonstration Plant.</p>		

Rev. 1) 3/27/78
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Rev. 2) 4/6/78
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Rev. 4) 6/19/78
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Completely Revised
As Purchased All
Pages

Pgs. 3,4,6-9,12,
16-25,32,

Pgs. 1,31,
Added Pgs. 29A,B,C,D,

Pgs. 1,3,29,29C,37,

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>1.3 The demonstration plant is jointly funded by Erie Mining Company and the U.S. Department of Energy (D.O.E.). The plant will be located in Hoyt Lakes, Minnesota at Erie Mining Company's Hoyt Lakes Plant.</p> <p>1.4 The fuel gas produced will be used to supplement natural gas and fuel oil as the fuel for iron ore pellet induration.</p> <p>1.5 The subcontractors scope of work for the Gasification Unit shall be performed in the following three phases:</p> <p>Phase I -</p> <p>1.5.1 Process and unit design for a commercial unit including design and operating requirements.</p> <p>The commercial unit design shall incorporate the demonstration unit as an operating module. The demonstration unit shall be the basis for expansion to the commercial unit in an economical manner.</p> <p>1.5.2 Process and unit design for a demonstration unit, design and detail engineering of stirred two stage, air blown, fixed bed gasifier retorts to handle caking and noncaking coals, and cost estimates for Phase II and Phase III work.</p> <p>The demonstration unit shall be designed to be expanded to provide the requirements for the commercial unit in an economical manner.</p> <p>1.5.3 The design specification and cost estimate for the demonstration unit shall include work lists and cost estimates for converting the</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200 1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT

DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>caking coal gasifier retort to the noncaking coal design which can be guaranteed by the subcontractor. The subcontractor shall also provide work lists and cost estimates for converting the noncaking coal design to the caking coal design.</p> <p>Phase II - The subcontractor shall furnish engineering, procurement, and construction services for the demonstration unit sufficient to maintain the guarantees. The subcontractor shall furnish five gasifier retorts for the demonstration unit.</p> <p>Phase III - The subcontractor shall furnish operator training, start-up, and performance testing services for the demonstration unit.</p> <p>1.6 The process design specification package for a commercial unit shall represent a model of a commercial coal gasification unit that would use highly caking coals as feedstocks. DELETED</p> <p>1.7 The subcontractor shall not design the control room. Board space will be provided in a common plant control room by others.</p> <p>1.8 The coal gasifiers and some associated equipment will be in an enclosure that will be designed and constructed by others.</p> <p>1.9 The feedstock coals are defined as follows: 1.9.1 The term "caking coal," as used in this Engineering Requisition refers to a coal with a free swelling index greater than 2.5 and a sulfur content over 2.5%. The gasifier</p>		

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Rev. 1) 3/27/78
BEB

Rev. 2) 4/6/78
BEB

Rev. 4) 6/19/78
BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR ORD NUMBER
		<p>retorts will be tested with coals having a free swelling index greater than 5.</p> <p>1.9.2 The term noncaking coal, as used in this Engineering Requisition, refers to a coal with a free swelling index up to 2.5.</p> <p>1.10 All of the components in the demonstration and commercial units shall be sized to handle all the coals shown in Table I, except lignite. Each component shall be designed for the condition which results in the maximum size. If this approach results in an abnormality in the design of any single component, it shall be brought to the attention of McKee. The components shall be designed for coal variation flexibility rather than for a specific coal.</p> <p>2.0 <u>SCOPE OF WORK</u></p> <p>2.1 The subcontractor shall prepare the process design specifications for the gasification unit. The design shall include all onsite equipment data sheets and required utilities within the unit area (see diagram of battery limits - Appendix A).</p> <p>2.2 The subcontractor shall supply as a minimum, in Phase I, the following items in the <u>demonstration unit</u> process design specification package.</p> <p>2.2.1 The basis of the components design shall be based on providing a fuel gas product capacity that yields 6.9 billion Btu/day LHV, (nominally 7.4 billion Btu/day HHV), utilizing as feedstock, any of the coals listed in Table I, except lignite. The following shall be provided on this basis:</p>		

Rev. 1) 3/27/78
BEB

Rev. 2) 4/6/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<ul style="list-style-type: none"> a. Complete piping and instrumentation diagrams. b. All equipment sized and specified in detail, including internals. c. Material specification for all process equipment and lines. d. Plot plan and elevations to scale showing all major equipment items. e. List of and prices for laboratory equipment and/or test facilities required to monitor unit performance. f. Major inline instrumentation data sheets. g. Flare, blowdown and emergency systems flow diagrams. h. Electrical area classification drawings. i. Electrical single line diagrams. j. Start-up and shutdown procedures in outline form including emergency shutdown procedures. k. Preliminary operating manual in outline form. l. Lubrication and hydraulic systems specifications. 		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT

DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<ul style="list-style-type: none"> m. Maintenance supply requirements for the gasifier retorts: <ul style="list-style-type: none"> 1. Routine supplies 2. Recommended inventory 3. Recommended major spare parts n. Ash handling system to ash storage silo including system flow diagram and all equipment sized and specified. 		
2)		<p>2.2.2 The design basis for the following items shall utilize one "worst case" noncaking coal and one "worst case" caking coal. The specific components of these coals will be agreed upon by the subcontractor and McKee prior to the initiation of the design.</p> <ul style="list-style-type: none"> a. Process description b. Process flow diagrams c. Heat and material balances d. Main process parameters on which design is based, for example: <ul style="list-style-type: none"> 1. Coal composition and characteristics 2. Coal residence time in gasifier 3. Steam requirements for grate cooling 4. Pressure drops through gasifier and cyclones 		

Rev. 1) 3/27/78
BEB

Rev. 2) 4/6/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT

DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<ul style="list-style-type: none"> e. Identify product and by product yields qualities and compositions f. Identify effluent streams, yields qualities, and compositions, and provide "in-house" background environmental data g. Determine raw material feed quantities h. Operating data <ul style="list-style-type: none"> 1. Manpower requirements, operations and maintenance 2. Estimate of utilities and chemicals consumptions <ul style="list-style-type: none"> a) Plant, utility and instrument air b) Steam, production and consumption c) Boiler feedwater, quantity and quality d) Cooling water e) Electrical power f) Inert gas g) Chemicals quantity and costs <p>2.3 The subcontractor shall supply as a minimum in Phase I the following items in the <u>commercial unit</u> process design specification package:</p> <p>2.3.1 The components shall consist of the components designed for the demonstration</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>unit with sufficient iteration of the components to assure a fuel gas product capacity that yields 18.7 billion Btu/Day LHV (nominally 20 billion Btu/Day HHV), utilizing as feedstock, any of the coals listed in Table I, except lignite assuming satisfactory stirred gasifier operation if they are included in the design.</p> <ul style="list-style-type: none"> a. Complete piping and instrumentation diagrams b. All equipment sized and specified in detail, including internals c. Material specifications for all process equipment and lines d. Plot plan and elevations to scale showing all major equipment items e. List of and prices for laboratory equipment and/or test facilities required to monitor unit performance. f. Major inline instrumentation data sheets g. Flare, blowdown, and emergency systems flow diagrams h. Electrical area classification drawings i. Electrical single line diagrams j. Start-up and shutdown procedures in outline form including emergency shutdown procedures 		

1) 3/27/78 2) 4/6/78
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ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<ul style="list-style-type: none"> k. Preliminary operating manual in outline form l. Lubrication and hydraulic systems specifications m. Maintenance supply requirements for the gasifier retorts: <ul style="list-style-type: none"> 1. Routine supplies 2. Recommended inventory 3. Recommended major spare parts n. Ash handling system to ash storage silo including system flow diagram and all equipment sized and specified. <p>2.3.2 The design basis for the following items shall utilize one "worst case" noncaking coal and one "worst case" caking coal. The specific components of these coals will be agreed upon by the subcontractor and McKee prior to the initiation of the design.</p> <ul style="list-style-type: none"> a. Process description b. Process flow diagrams c. Heat and material balances d. Main process parameters on which design is based, for example: <ul style="list-style-type: none"> 1. Coal composition and characteristics 2. Coal residence time in gasifier 		

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Rev. 1) 3/27/78 Rev. 2) 4/6/78
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ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<ul style="list-style-type: none"> 3. Steam requirement for grate cooling 4. Pressure drop through gasifier and cyclones e. Identify product and by-product yields qualities and composition f. Identify effluent streams, yields qualities, and composition, and provide "in-house" background environmental data g. Determine raw material feed quantities h. Operating Data <ul style="list-style-type: none"> 1. Manpower requirements, operating and maintenance 2. Estimate of utilities and chemicals consumptions <ul style="list-style-type: none"> a) Plant, utility and instrument air b) Steam, production and consumption c) Boiler feedwater, quantity and quality d) Cooling water e) Electrical power f) Inert gas g) Chemicals quantity and costs 		
		2.4 Other subcontractor responsibilities, coordination		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>procedures and completion responsibilities for Phases I, II and III are defined in McKee Specification 789.</p> <p>2.5 Within two weeks after notice to proceed with the work, the subcontractor shall prepare and submit a definitive overall project schedule based in part on the milestones presented in the attached subcontract schedule for items deliverable to McKee.</p> <p>2.6 The caking coal gasifier retort shall include features which allow for conversion to a noncaking coal gasifier retort.</p> <p>The noncaking coal gasifier retort shall include features which allow conversion to the caking coal gasifier retort.</p> <p>The Phase III operating plan envisions initial operation of one or more caking coal gasifier retorts operating on caking coals, and the remaining will be noncaking coal gasifier retorts operating on noncaking coals. Following the successful start-up and operation of the plant the noncaking coal gasifier retorts initially started up on noncaking coals will be converted to the caking coal style in accordance with the gasifier operating test procedure developed during Phase I.</p> <p>2.7 During Phase I the subcontractor shall design a stirred two-stage gasifier to handle caking coals, and report the work done in a separate package.</p> <p>2.8 During Phase I the subcontractor shall design a caking coal gasifier retort. The subcontractor shall also design a noncaking coal gasifier retort for which the performance shall be guaranteed. These designs shall be presented in two design</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>packages which shall include, but not limited to, the following:</p>		
		<p>2.8.1 General arrangement drawings showing the following:</p>		
		<p>a. Major dimensions of vessel</p>		
		<p>b. Nozzle locations and orientation</p>		
		<p>c. Water jacket dimensions</p>		
		<p>d. Grate design and location</p>		
		<p>e. Poke hole design and location</p>		
		<p>f. Internal ash quench design and location</p>		
		<p>g. Stirrer and drive design and location</p>		
		<p>h. Coal lock hopper and valve design and location</p>		
		<p>i. Ash lock hopper design and location</p>		
		<p>j. Pneumatic ash handling system</p>		
		<p>2.8.2 Designs of the gasifier retorts shall include the following:</p>		
		<p>a. Vessel design drawings</p>		
		<p>b. Refractory lining drawings with sufficient information for installation, including Bills of Materials.</p>		
		<p>2.8.3 Design of the ash level control system, including the following:</p>		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<ul style="list-style-type: none"> a. Design drawings of the thermocouple system used to reset grate speed. b. Design drawings of poke-holes and annular Venturi steam shields. <p>2.8.4 Design of stirrer and drive including the following:</p> <ul style="list-style-type: none"> a. Stirrer design drawings b. Design drawings of stirrer drive and support. c. Design drawings of stirrer shaft seals. d. Design calculations for the stirrer and drive. <p>2.8.5 Gasifier support design drawings.</p> <p>2.8.6 Calculations for structural design of the gasifier vessel and supports including all allowable nozzle forces and moments.</p> <p>2.8.7 Table of weights including all components of the gasifier, and all operating and test loads, as well as loading diagram and loads required for maintenance.</p> <p>2.8.8 Gasifier vessel calculations to comply with the ASME code, where applicable.</p> <p>2.8.9 Recommendations for pressure testing</p> <p>2.9 The gasifier shall not be designed specifically to handle lignite.</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>2.10 During Phase I the subcontractor shall perform coal tests for guarantee purposes on Rosebud and McKay sub-bituminous coals. Samples for these tests shall be provided by others. The other coals listed in Table I may also be tested to evaluate the suitability of these coals as gasifier feedstocks. The results shall be reported in a coal tests report.</p> <p>2.11 During Phase I the subcontractor shall prepare the following definitive cost estimates (+ 15%) for the erected demonstration unit and report the work in a demonstration unit cost estimate report.</p> <p>2.11.1 One estimate shall be based on five caking coal gasifier retorts.</p> <p>2.11.2 One estimate shall be based on five noncaking coal gasifier retorts.</p> <p>2.11.3 Definitive cost estimate, per gasifier retort to convert a caking coal gasifier retort to a noncaking coal gasifier retort.</p> <p>2.11.4 Definitive cost estimate, per gasifier retort, to convert a noncaking coal gasifier retort to a caking coal gasifier retort.</p> <p>2.11.5 The cost, per gasifier retort to fabricate and deliver to the job site both types of gasifier retorts.</p> <p>2.11.6 The cost estimates described in 2.11.1, 2.11.2, 2.11.3 and 2.11.4 shall each include technical and commercial bid tabs containing three approved subcontractor bids, per gasifier retort, for field installation or conversion of the refractory linings. It</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT

DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>shall be the responsibility of the subcontractor to recommend, contract, and administer the subcontract(s) for the refractory lining.</p> <p>2.12 During Phase I the subcontractor shall supply a definitive manpower and cost estimate for subcontractors Phase II and Phase III participation. The subcontractor shall include as part of this estimate a "statement of the work" required by the subcontractor to maintain guarantees.</p> <p>2.13 In order to be consistent with the cost estimates that McKee is preparing for the balance of the coal gasification plant the subcontractor shall prepare the <u>+15%</u> cost estimates based on methods and procedures as agreed between McKee and the subcontractor.</p> <p>2.14 During Phase I the subcontractor shall provide the coal feed requirements and limitations of physical and chemical characteristics, i.e., size range, quantity, moisture, and ash contents, and softening temperature in oxidizing and reducing atmospheres, free swelling index, and any other coal characteristics which control its use in the two types of gasifier retorts.</p> <p>2.15 During Phase I the subcontractor shall make suggestions for waste stream clean up.</p> <p>2.16 All cost estimates prepared by the subcontractor for cost estimates previously stated shall have, where applicable, the royalties and licensing fees listed separately and payable in United States dollars.</p> <p>2.17 During Phase I the subcontractor shall submit a list of recommended vendors and/or subcontractors that he</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>will have bid on the fabrication and/or supply of major components of the gasifiers.</p> <p>2.18 During Phase I the subcontractor shall submit a list of at least three vendors for each major piece of equipment as shown on the completed flow diagram.</p> <p>2.19 During Phase I the subcontractor and McKee shall mutually develop a gasifier operating test program to be performed during Phase III.</p> <p>2) 2.20 Pneumatic ash handling system to storage silo will be by subcontractor. Subcontractor shall furnish components for suitably preparing the ash for the pneumatic ash handling system.</p> <p>2) 2.21 Coal fines agglomeration system will be by others. Subcontractor shall advise test requirements. DELETED</p> <p>2) 3.0 <u>INSTRUCTION TO BIDDERS</u> DELETED all sections except 3.3</p> <p>3.1 Bidder shall base his process design for the unit on the data given in the Process Design Specification per Section 4.0 of this E/R. DELETED</p> <p>3.2 The proposal shall include the following: DELETED</p> <p>3.2.1 The bidder shall provide the following information to be used in evaluating the bid: DELETED</p> <p>a. A lump sum price to provide a complete process design specification package for the demonstration unit delineated under Paragraph 2.2. DELETED</p> <p>b. A lump sum price to provide a complete</p>		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>process design specification package for the commercial unit delineated under Paragraph 2.3. DELETED</p> <p>c. A budget cost estimate of the completed commercial unit cost breakdown, and a statement of what the estimate includes. The estimate should have the following costs broken out: DELETED</p> <ol style="list-style-type: none"> 1. The cost of handling caking coals. DELETED 2. The cost to measure ash level in order to comply with the environmental and safety standards. DELETED 3. The cost of equipment required to allow feeding of fines to the gasifiers, if applicable. DELETED 4. The cost of ash handling equipment within the battery limits. DELETED <p>d. An outline of the data to be included in the process design specification packages. DELETED</p> <p>e. A definition of process guarantees to include limits of liabilities for the process design. DELETED</p> <p>f. A project completion schedule for the process design specification packages outlining time frames for individual phases of the project to include review procedure for each phase. DELETED</p>		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>g. An outline of project execution procedure to include resumes of key personnel to be assigned, where design work will be done. DELETED</p> <p>h. A process description highlighting the principal processing methods used in the gasification unit. DELETED</p> <p>i. A preliminary process flow diagram showing major equipment items and principal control instrumentation for the commercial unit delineated under Section 4.0 of this E/R. DELETED</p> <p>j. Preliminary heat and material balances based on the commercial unit design case and keyed to the process flow diagram. The balance shall include stream temperatures, pressures, and compositions. Tar and solid loadings should be indicated for the product fuel gas stream leaving the battery limits of the gasification unit. DELETED</p> <p>k. A summary of estimated operating requirements for the demonstration unit and, commercial unit case including: DELETED</p> <ol style="list-style-type: none"> 1. Plant, utility and instrument air DELETED 2. Steam, production and consumption DELETED 3. Boiler feedwater, quantity and quality DELETED 		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		 4. Cooling water DELETED 5. Electrical power DELETED 6. Chemicals (if required) quantity and cost DELETED 7. Operating labor and supervision DELETED 8. Inert gas DELETED 1. An indication of coal feed requirements and limitations, i.e., size range, quantity, moisture, and ash contents, ash softening temperature in oxidizing and reducing atmospheres, free swelling index, and any other coal characteristics which control its use in the supplier's gasifier. DELETED m. An indication of tar quantity, particulate matter, quality (including sulfur content) and the sensitivity of product gas and tar tar yields to various process variables DELETED n. Summary of all intermittent and continuous gaseous vent streams and their approximate analyses including entrained solids and tars. DELETED o. Summary of all intermittent and continuous aqueous waste streams including an indication of suspended solids, dissolved organic and inorganic compounds, toxic materials, BOD and COD. DELETED 		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT

DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>p. Requirements for waste stream clean up. DELETED</p> <p>q. The lump sum price for each of the Phase I work items described in Scope of Work paragraphs 2.8, 2.9, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16 and Design Notes paragraphs 5.8, 5.9 and 5.10. DELETED</p> <p>3.2.2 The bidder shall provide the following mechanical information to be used in evaluating the bid: DELETED</p> <p>a. Equipment list including sizes, and weights of major equipment of the commercial unit. DELETED</p> <p>b. Sketch of gasifier with outline dimension and rough weight of the gasifier. DELETED</p> <p>c. Number of gasifiers required for production of desired quantity of fuel gas plus one spare to achieve the desired 95% onstream factor for both the commercial unit and demonstration unit. DELETED</p> <p>d. Sketches illustrating methods of coal feed, ash removal and highly caking coal processing. DELETED</p> <p>e. Plot plan of the commercial unit showing elevations of equipment within the battery limits. Assume there are no area limitations that would interfere with judicious plot layout. DELETED</p>		

Rev. 1) 3/27/78
BEB

Rev. 2) 4/6/78
BEB

ENGINEERING REQUISITION

MCKEE

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>f. Clearly identify any data or information regarded as proprietary. DELETED</p> <p>3.2.3 The bidder shall provide budget cost estimate for each of the following Phase II and III items for the demonstration unit to be used in evaluating the bid. DELETED</p> <p>a. The price to perform the detail engineering and procurement of all bulk order materials required and all equipment and other items shown on the piping and instrumentation diagrams. DELETED</p> <p>b. The price to construct the unit complete ready for start-up. DELETED</p> <p>c. The price to prepare operating instruction manuals for the equipment within the battery limits. DELETED</p> <p>d. The price for start-up participation including the level of effort and the basis of costs. DELETED</p> <p>e. The price for Phase III coal testing including a description of coal tests required to maintain guarantees and location of where test will be done. DELETED</p> <p>f. The price for operator training including the level of effort and the basis of costs. DELETED</p> <p>3.2.4 The bidder may be required to perform all or part of the items listed in Paragraph 3.2.3.</p>		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

MADE BY: BEB

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PAGE 21 OF

E/R W-20

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p>In the event that one or more of these items is not to be done by the Subcontractor, please provide the following: DELETED</p> <ul style="list-style-type: none"> a. Advise if there are any gasifier internals or appurtenances to the gasifiers that the bidder considers as proprietary information. DELETED b. Advise level of effort, rationale, and cost basis of participation required by the bidder (to maintain guarantees) during detail engineering and procurement if the bidder does not do detail engineering and procurement. DELETED c. Advise level of effort, rationale, and cost basis of participation required by the bidder (to maintain guarantees) during construction if the bidder is not the constructor. DELETED d. Advise the budget price per gasifier to design, detail, fabricate and deliver to the plant site. Refractory lining and installation of gasifier vessels shall be by others. Advise budget price with and without stirrer and drive to permit use of caking coals. DELETED <p>3.2.5 Cost control procedure DELETED</p> <p>3.2.6 Furnish and advise specific project requirements regarding the following: DELETED</p> <ul style="list-style-type: none"> a. Secrecy Agreements DELETED 		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
BEB BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>b. Licensing Fees DELETED</p> <p>c. Royalties DELETED</p> <p>d. Proprietary Information DELETED</p> <p>3.2.7 List of recent similar projects completed, work scope, dollar value, and client names. DELETED</p> <p>3.2.8 Phases of design and construction necessary to subcontract, names and qualifications of proposed subcontractors. DELETED</p> <p>3.2.10 Estimated man-hours by discipline required to complete each of the three phases of the demonstration unit. DELETED</p> <p>3.2.11 Current technical manpower capabilities to complete the job. DELETED</p> <p>3.3 Coordination Procedure and Document Distribution</p> <p>Section 13 and 15 of McKee Specification 789 outline the requirements covering administration of correspondence, drawings, engineering data, manuals and similar items between subcontractor and McKee. The subcontractor shall submit an outline of project execution procedures including cost control procedures.</p> <p>3.3.1 This procedure shall be used by subcontractor as a method to control quantity, quality and format required in the production of all data, drawings, reports and documentation that will be prepared and transmitted to McKee under this subcontract.</p>		

Rev. 1) 3/27/78 BEB Rev. 2) 4/6/78 BEB

MADE BY: BEB

CHECKED BY: RKS

PAGE 23 OF

E/R W-20

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>3.3.2 Bidder shall include the cost of reproduction and distribution of all documents in his bid.</p> <p>3.3.3 Exact timing for the preliminary issue of Operating Manuals for McKee review and approval will be set through agreement between McKee and the subcontractor. DELETED</p> <p>3.4 Additional McKee specifications for detail engineering, procurement, and construction shall be issued to the subcontractor. DELETED</p> <p>4.0 <u>PROCESS DESIGN SPECIFICATION</u></p> <p>4.1 Unit Duty</p> <p>The coal gasification unit facilities shall be designed to produce fuel gas yielding the following:</p> <p>4.1.1 Commercial Unit: Design - 18.7 billion Btu/Day LHV, (nominally 20 billion Btu/Day HHV and 1500 Tons/Day coal feed)</p> <p>4.1.2 Demonstration Unit: Design - 6.9 billion Btu/Day LHV, (nominally 7.4 billion Btu/Day HHV and 500 Tons/Day coal feed)</p> <p>4.2 Design Basis for the Units</p> <p>4.2.1 The design of components in the demonstration unit shall be based on providing a fuel gas product capacity that yields 6.9 billion Btu/day LHV (nominally 7.4 billion Btu/day HHV) utilizing as feedstock, any of the coals listed in Table I, except lignite.</p> <p>4.2.2 The commercial unit shall consist of the components designed for the demonstration</p>		

Rev. 1) 3/27/78 Rev. 2) 4/6/78
 BEB BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
2)		<p>unit with sufficient iteration of these components to assure a fuel gas product capacity that yields 18.7 billion Btu/day LHV (nominally 20 billion Btu/day HHV), utilizing as feedstock, any of the coals listed in Table I, except lignite.</p> <p>4.2.3 The following items of both the demonstration unit and the commercial unit, shall be developed utilizing one "worst case" noncaking coal and one "worst case" caking coal. The specific components of these coals will be agreed upon by the subcontractor and McKee prior to the initiation of the design.</p> <ul style="list-style-type: none"> a. Process description b. Process flow diagrams c. Heat and material balances d. Main process parameters e. Product and by-product yield f. Effluent streams g. Raw material feed h. Operating data <p>4.3 Turndown Capability</p> <p>The gasification units for both the demonstration and commercial units shall be capable of a turndown to 25% of the design gas rate. The subcontractor shall advise maximum turndown.</p>		
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Rev. 1) 3/27/78 BEB Rev. 2) 4/6/78 BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>4.4 Other Considerations</p> <p>4.4.1 Service Factor - During the operating period, a service factor of 95% is required. Critical equipment including gasifier shall have installed spare(s).</p> <p>4.4.2 Product Steam - Steam production from gasifier jackets and waste heat recovery shall be decided by agreement between subcontractor and McKee.</p> <p>4.4.3 Equipment Numbering - Onsite equipment shall be numbered beginning with 201. General guidelines for equipment and instrument numbering are given in Table II.</p> <p>4.4.4 Utilities and meteorological design characteristics supplied to the battery limits are shown in McKee Spec. 254.</p> <p>4.4.5 The plant design life shall be 20 years minimum with normal maintenance.</p> <p>5.0 <u>DESIGN AND CONSTRUCTION NOTES</u></p> <p>5.1 Products Design Basis</p> <p>5.1.1 The clean fuel gas must exit at battery limits at 20" H₂O. The clean fuel gas, on a dry basis, should have a higher heating value of at least 160 BTU/scf, including sensible heat prior to sulfur removal.</p> <p>5.1.2 The tar and oil by products shall be collected for delivery to common storage and will be used as a supplementary fuel for iron ore pellet induration, and/or in plant use.</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>5.2 Design Basis for Nonprocess Features</p> <p>Information on utilities and other nonprocess features contained in McKee Spec. 254 are to be considered an integral part of this specification.</p> <p>5.3 Special Design Consideration</p> <p>5.3.1 One of the objectives of the demonstration unit operation is to demonstrate operability on highly caking high sulfur bituminous coal with a FSI greater than 5.</p> <p>5.3.2 The unit must meet Erie Mining Company safety standards.</p> <p>5.3.3 The gas will necessarily be cooled to be suitable for feeding to a Stretford fuel gas desulfurization unit. This necessitates a high level of tar and particulate removal from the fuel gas.</p> <p>5.3.4 Process gas coolers may be used as a means of recovering heat. The process gas cooling schemes shall be agreed upon by the subcontractor and McKee.</p> <p>5.3.5 A statement shall be made about the ability of the gasification units to process lignite.</p> <p>5.3.6 The units must be designed to conform, from an environmental and safety viewpoint, to all applicable local, state and federal government requirements.</p> <p>5.3.7 Energy conservation shall be included as one of the important design parameters for the coal gasification unit facility. The cost of</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>utilities are given in McKee Specification 254.</p> <p>5.3.8 The subcontractor shall inform McKee of any unusual safety problems.</p> <p>5.3.9 Provision shall be made for the orderly and safe shutdown of all process equipment. Electrical and/or mechanical interlocks shall be specified where necessary to assure proper sequence of the shutdown operation. Subcontractor shall identify equipment and instrumentation, if any, that require uninterrupted power supply.</p> <p>5.3.10 All documents shall be prepared in the English (engineering) system of measurement.</p> <p>5.3.11 For all economic evaluations a two year payout, before taxes, shall be used.</p> <p>5.3.12 The flare system shall carry vented streams to the battery limits or as otherwise agreed.</p> <p>5.4 Average seasonal climatic and seismic conditions of Hoyt Lakes, Minnesota shall be taken into consideration in the design. Refer to McKee Specification 254.</p> <p>5.5 Site preparation shall be done by others.</p> <p>5.6 For the demonstration unit stubs for tie-in for expansion to the commercial unit shall be designated.</p> <p>5.7 Subcontractor shall advise McKee on utility requirement for refractory lining installation. Utilities will be provided at the battery limits by others.</p>		

Rev. 1) 3/27/78
BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																								
		<p>5.8 The design of the stirred two-stage, fixed bed, air-blown gasifier retort shall be as stated by Woodall-Duckham (U.S.A.) Ltd. in section 2.3 (Pages 13 to 18) and section 5.4.3 (Pages 101 and 102) of their "Proposal for Coal Gasification Facilities" dated January 6, 1978, and attached as Appendix C. Deviations shall be approved by McKee.</p> <p>5.9 For the design of the stirrers the subcontractor shall use Mr. George Hamilton and Mr. Morton L. Markowitz, or agreed upon alternates.</p> <p>5.10 McKee shall provide, and subcontractor shall use, drafting linen with special title blocks for all new drawings applicable to this project.</p> <p>6.0 <u>APPLICABLE SPECIFICATIONS</u></p> <p>6.1 McKee Specifications</p> <table border="0"> <thead> <tr> <th><u>Specification No.</u></th> <th><u>Title</u></th> </tr> </thead> <tbody> <tr> <td>GS-254</td> <td>Site and Utility Data</td> </tr> <tr> <td>GS-260</td> <td>Design Drawing</td> </tr> <tr> <td>GS-261</td> <td>Drafting Standard</td> </tr> <tr> <td>GS-266</td> <td>Instructions to Vendors for Data Submittal</td> </tr> <tr> <td>GS-270</td> <td>Piping and Instrumentation Diagram</td> </tr> <tr> <td>GS-275</td> <td>Process Plant Design</td> </tr> <tr> <td>GS-291</td> <td>Spare Parts</td> </tr> <tr> <td>GS-501</td> <td>Basic Instrument Requirements</td> </tr> <tr> <td>GS-746</td> <td>Winterizing of Equipment, Piping and Instruments</td> </tr> <tr> <td>GS-780</td> <td>Equipment Protection</td> </tr> <tr> <td>GS-789</td> <td>Subcontract Spec for Process Units</td> </tr> </tbody> </table> <p>7.0 <u>COMPLETION RESPONSIBILITIES</u></p>	<u>Specification No.</u>	<u>Title</u>	GS-254	Site and Utility Data	GS-260	Design Drawing	GS-261	Drafting Standard	GS-266	Instructions to Vendors for Data Submittal	GS-270	Piping and Instrumentation Diagram	GS-275	Process Plant Design	GS-291	Spare Parts	GS-501	Basic Instrument Requirements	GS-746	Winterizing of Equipment, Piping and Instruments	GS-780	Equipment Protection	GS-789	Subcontract Spec for Process Units		
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Rev. 1) 3/27/78
BEB

Rev. 4) 6/19/78
BEB

ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>The subcontractor completion responsibilities are as listed in McKee Specification 789.</p> <p>3) 8.0 <u>PHASE II SCOPE OF WORK</u></p> <p>8.1 During Phase II the subcontractors engineering scope of work shall be as follows:</p> <p>8.1.1 Review of and commentary on A. G. McKee specifications for tagged equipment items including control system components within the defined battery limits.</p> <p>8.1.2 Review of and commentary on selection of all tagged equipment items within the battery limits.</p> <p>8.1.3 Review of and commentary on all arrangement drawings and model.</p> <p>8.1.4 Review and commentary on all piping drawings within the battery limits.</p> <p>8.1.5 Review and commentary on selected structural designs, particularly the gasifier supports.</p> <p>8.1.6 Review and commentary of final P & I drawings, instrument schematics and control logic, panel details.</p> <p>8.1.7 Preparation of detailed start-up, operating and shutdown instruction manuals for those facilities within the battery limits.</p> <p>8.1.8 Preparation of detailed maintenance procedure manuals for those facilities within the battery limits.</p>		

Rev. 1) 3/27/78 Rev. 3) 6/15/78
BEB BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>8.1.9 Other selected tasks as mutually agreed by BCI and A. G. McKee.</p> <p>8.2 During Phase II the subcontractors procurement, construction and prestart-up scope of work shall be as follows:</p> <p>8.2.1 Supply and erection, on foundations and structural steel supplied by others, the following:</p> <ul style="list-style-type: none"> a. Five - Gasifiers including refractory lined retort, water jacket, grate and ash lock hoppers, air blast inlets, grate thermocouples and grate drive units and, for the stirred gasifier(s), stirrer drives and integral controls. b. Five - Steam Drums c. Five - Sets thermosyphon piping interconnecting the steam drum and gasifier water jacket. d. Five - Coal lock hoppers complete with valves and coal level indicator/controller and purging connections. e. One - Lubrication system to lubricate grates, including connection piping. f. One - Hydraulic system to provide hydraulic power to grate drives, including interconnecting piping. <p>8.2.2 Construction advisor, on site, during erection of all battery limits construction.</p>		

Rev. 3) 6/15/78
BEB

ENGINEERING REQUISITION

McKEE

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p>8.2.3 Process engineer to lead selected Erie Mining personnel on any training visits that may be agreed.</p> <p>8.2.4 Witness and operator training during check out and prestart-up tests.</p> <p>8.2.5 Not included in the subcontractors scope of work are the following:</p> <ul style="list-style-type: none"> a. Interconnecting electrical wiring b. Instrumentation other than those items which are an integral part of the gasifier or lock hopper c. Insulation: d. Final painting: e. Construction utilities: f. Engineering services for operator training, prestart-up checks and operations advice. 		
3)		<p>9.0 <u>PHASE III SCOPE OF WORK</u></p> <p>9.1 During Phase III the subcontractors start-up and testing scope of work shall be as follows:</p> <p>9.1.1 Provide intensive start-up assistance for 12 weeks as assumed in BCI proposal of January 6, 1978, plus 24 months involvement of one man full time plus 100 man-hours per month for reviews and engineering services including the following:</p>		
4)				

Rev. 3) 6/15/78
BEB

Rev. 4) 6/19/78
BEB

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>a. Start-up assistance comparable to 9.1.1 above if gasifiers are converted from stirred to conventional form or vice versa, or if gasifiers are changed to caking coal operation following initial start-up on noncaking coal.</p> <p>b. Assistance comparable to 9.1.1 above during performance guarantee tests.</p> <p>9.2 During Phase III the subcontractors operations review scope of work shall be as follows:</p> <p>9.2.1 Review of daily operations logs, analyses, maintenance procedures and equipment condition. To be accomplished by one full time resident engineer plus liaison with other BCI staff for the duration of Phase III.</p> <p>9.2.2 Provision of specialist advisors as required.</p> <p>9.2.3 Operations review meetings at 3 monthly intervals or as otherwise mutually agreed throughout Phase III. These meetings would provide a formal review of the testing program, discussion of action to be taken to meet the program goals, a review of general operating data, and discussion of any problems. BCI attendance would be a minimum of four people plus the resident BCI engineer.</p> <p>9.2.4 Process engineering investigations, heat and material balance checks, assistance with sampling and special instrumentation as required.</p>		

Rev. 3) 6/15/78
BEB

TABLE I
COAL FEED

The following coals or equivalents will be used as feedstocks to the demonstration plant; the analyses are typical of the coal types:

Coal Type Coal Seam	Sub-bituminous		Lignite*	
	<u>Rosebud</u>	<u>McKay</u>	<u>Coteau</u>	
Moisture, Wt.%	15.8-25.6	19.7-25.0	34.5	
Proximate Analysis, Wt.%				
Volatile Matter	36.4-39.8	34.3-36.2	43.5	
Fixed Carbon	48.3-56.0	55.2-57.7	49.6	
Ash	5.6-15.2	8.0-8.6	6.9	
Wt.% Sulfur	0.6-4.1	0.5-1.6	0.3	
Ash softening Temp. °F	2180-2460	2150	2500	
Free Swelling Index	-	-	-	
Hardgrove Grind Index	44-51	46	34	
HHV, Btu/Lb. as Received	9000	9760	7040	
Coal Type Coal Seam		Bituminous		
	<u>Brookville</u>	<u>Clarion</u>	<u>Davis-Dekoven</u>	<u>Kittaning</u>
Moisture, Wt.%, As Received	8.0-13.7	6.2-14.7	3.4-8.1	4.3-11.6
Proximate Analysis, Wt.%				
Volatile Matter	42.4-46.7	42.7-46.4	38.4-42.6	32.4-45.2
Fixed Carbon	45.5-48.8	45.7-47.6	47.4-52.3	44.9-54.3
Ash	5.7-11.0	6.0-10.7	8.4-12.0	5.4-18.0
Sulfur, Wt.%, As Received	3.0-3.5	3.0-3.9	3.3-4.0	0.6-3.6
Ash Softening Temp. °F	2030-2280	2080-2180	2000-2080	2030-2910
Free Swelling Index	3.0-4.0	3.5-5.0	4.5-7.0	2.5-8.0
Hardgrove Grind Index	46	51	54-60	46-61
HHV, Btu/Lb. As Received	11,800	12,000	12,800	11,580-13,660

* It is not now anticipated that lignite would be used as a feedstock.

TABLE II

GUIDELINES FOR EQUIPMENT AND INSTRUMENTS NUMBERING

- All coal gasification battery limits equipment will be numbered in the 200 series, starting 201.
- 3) - Equipment numbers will be preceded by an alphabetic symbol indicating the type of equipment. Refer to McKee Specification 270 symbols.
- Spares or multiple units on the same service should have the same numbers followed by an alphabetic designation, e.g. P-201A, P-201B.
- The instrument identification shall be written according to ISA specifications.
- Instrument loops shall be numbered consecutively by variable type (flow, pressure level, etc.) ranging from 201 to 299.
- Individual instruments within an instrument or control loop, such as transmitters, alarms, recorders and control valves shall have the same designation as the primary instrument except in the case of a loop containing two or more actuating devices. In such cases, one device shall have the same number as the primary instrument, the second (or more) device shall be consecutively numbered.

REVISION	3									
BY	BEB									
DATE	6/15/78									
DATE	10/20/77	MADE BY	BEB	CHKD BY	RKS	PAGE 31	OF	CONT. NO.	4814	

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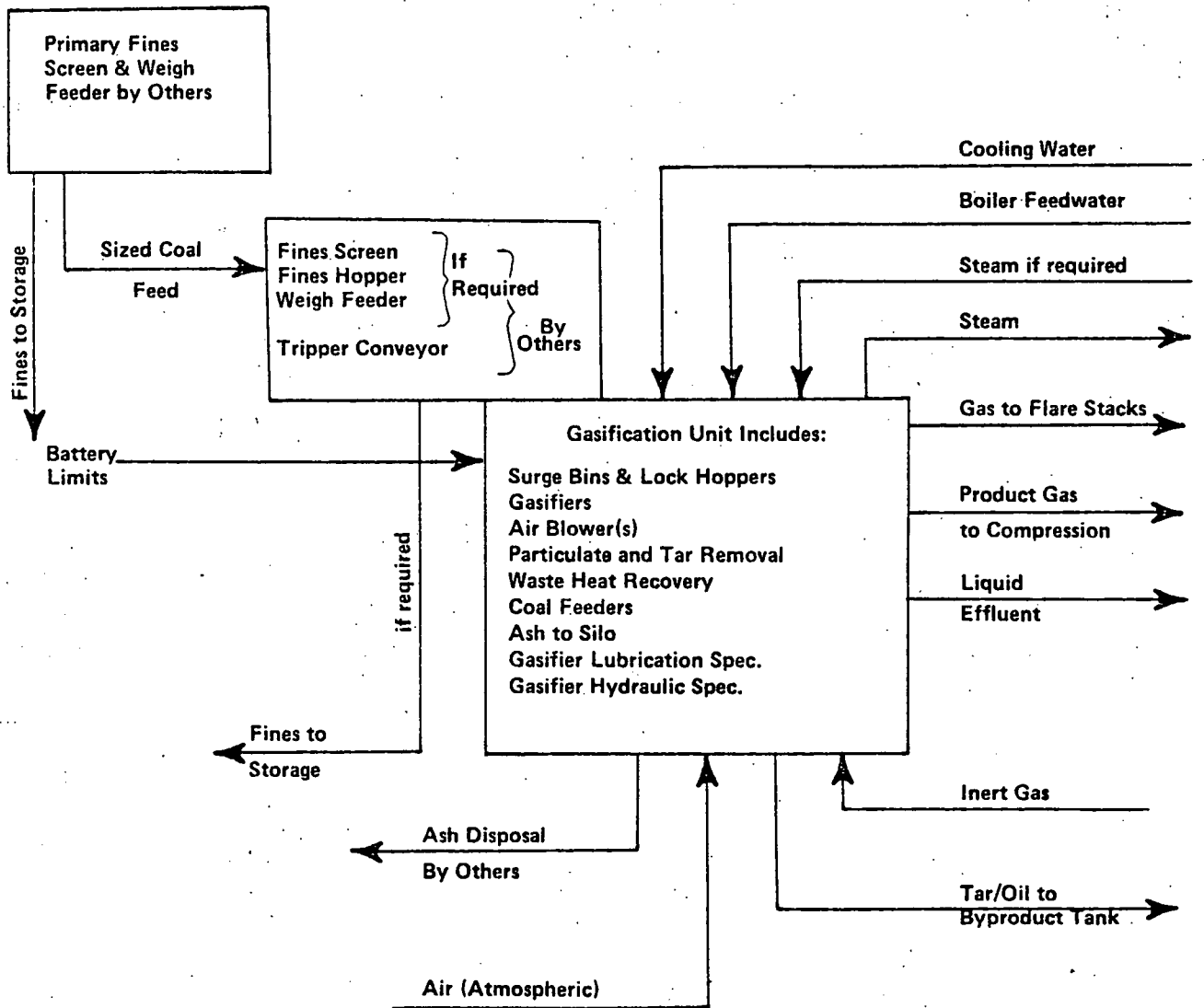
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Form M-200-2 9/76

DESCRIPTION COAL GASIFICATION UNIT SUBCONTRACT DATE OCTOBER 20, 1977
 UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814
 REVISION DATE (1) 3/27/78 (2) 4/6/78

APPENDIX A
 PHASE I
 BATTERY LIMITS FOR
 COAL GASIFICATION UNIT SUBCONTRACT



COAL GASIFICATION UNIT
SUBCONTRACT SCHEDULE FOR PHASE I

3/27/78
REV. 0

ITEMS DELIVERABLE TO McKEE	CALENDAR WEEKS AFTER NOTICE TO PROCEED																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
DETAIL SCHEDULE			▲4															
2) SCHEDULE OF PAYMENTS			▲4															
GASIFICATION UNIT ARRANGEMENT PLAN				▲4														
COAL TEST REPORT					▲4													
DEMO. PROCESS PACKAGE				▲1	▲3			▲2		▲4								
COMM. PROCESS PACKAGE								▲1	▲3	▲2	▲4							
STIRRER DESIGN PACKAGE						▲5			▲4									
GASIFIER DESIGN PACKAGE (NON-CAKING COAL)						▲4												
GASIFIER DESIGN PACKAGE (HIGH CAKING COAL)									▲4									
DEMO. COST EST. REPORT								▲6			▲4							
FINAL REPORT															▲4			

MILESTONE KEY

- ▲1 PROCESS FLOW DIA. TO McKEE
- ▲2 P & I'D TO McKEE
- ▲3 EQUIPMENT DATA SHEETS TO McKEE

- ▲4 ITEMS TO McKEE FOR REVIEW/APPROVAL
- ▲5 DATA FOR PROCESS PACKAGE COMPLETE
- ▲6 BEGIN PRICING EQUIPMENT

2.3 DESIGN CONSIDERATIONS

The primary developmental goal of the program, and of this proposal, is the gasification of high-swelling and caking coals in a modified two-stage gasifier. The selection of a deep-bed mechanical stirrer is based on consideration of alternate methods, such as increased taper angle in the distillation section, pretreatment methods, and the use of additives. It is most important that the method chosen should be readily adaptable to regular industrial use, and should be able to handle a wide range of coals, as indicated by the inquiry. These considerations lead towards the selection of deep-bed stirring as being both flexible for a wide range of coals and much less complex than a pretreatment plant.

The overriding justification for deep-bed stirring is the substantial amount of experience and data available, covering a wide range of coals (including the Rosebud design basis coal and many high-swelling coals) and several plant configurations. Therefore, it is believed that the risk element of this demonstration program is substantially reduced. The stirrer also offers additional potential advantages in terms of fines utilization, increased output per gasifier, and consistency of operation.

2.3.1 Stirred Two-Stage Gasifier Design

General. The design of the stirred two-stage gasifier will be a combination of the proven gasifier design in the lower half of the gasifier (up to the clear gas outlets), together with an undivided distillation section based on Woodall-Duckham/II Gas Integrale process designs and operating experience in the upper half, and a compound-motion stirrer to handle high-swelling caking coals.

The design of the lower half of the gasifier -- grate, water jacket, and refractory-lined section up to the clear-gas outlets -- will be modelled on the proven 3.6 meter dry-grate design, and will consist of a revision of the relevant sections of the Genoa design to U. S. standards and fabrication practices.

The design of the coal feed system -- belt feeder, lock-hopper and coal distributor plus automatic sequence control -- will also be based on the 3.6 meter design as used at Genoa, modified both for U. S. standards and to allow stirrer access.

The process-related parameters of the stirred distillation section of the gasifier will be based on prior designs and operating experience. This includes the heat and mass balances and, based on these, the gasifier temperature profile, and gas velocities. Residence time in the distillation section, and hence its height, has already been set for the purposes of this proposal. Due to the increased cross-sectional area of the stirred distillation section compared to the unstirred, conventional design, the height of the distillation section could be reduced to maintain the same residence time. However, it has been decided to retain the conventional height and to provide for increased residence time. If, in practice, this is shown to be unnecessary, the coal level in the gasifier could be lowered by modifying the coal distributor (lengthened dip-legs).

For the purpose of developing the basic parameters for the stirrer design, two parallel approaches will be taken and compared. The first approach will be to base the design of the stirrer on parameters from the operation of existing commercial stirred gasifiers (single stage).

The second approach will be to evaluate similar operations and extrapolate the basic parameters for these operations to the operation of a stirred two-stage gasifier.

The basic design parameters developed by these two approaches will be evaluated. Differences will be noted and the design parameters which will form the basis of the detailed design of the stirrer will be established.

Stirrer Conceptual Design - Existing Commercial Basis.

Woodall-Duckham has made arrangements for the services of a recognized expert in the field of gasifier stirrer design to be available on a consultancy basis. This consultant is George Hamilton; his resume is included in Section 5.7 of this proposal. Mr. Hamilton has been involved in the design, construction and commissioning of stirred single-stage gasifiers for the last thirty years, including the MERC stirred gasifier. Based on this experience, Mr. Hamilton will recommend the following parameters:

- A. Shaft torque.
- B. Rotation speed range.
- C. Number and placement of arms.
- D. Blade configuration.
- E. Clearance between stirrer blades and refractory wall.
- F. Range and speed of vertical motion.

Woodall-Duckham will work closely with Mr. Hamilton providing him with all the information he requires, such as the dimensions of the gasifier, positions of gas outlets, temperature profile, coal characteristics and throughput.

Stirrer Conceptual Design - Extrapolation Basis. Woodall-

Duckham has arranged for the services of another prominent expert in the field of mechanical equipment design, Mr. ~~Herbert D. Link,~~ Morton L. Markowitz, whose ~~resume is also included in Section 5.7 of this proposal.~~

~~Mr. Link has worked for Woodall-Duckham previously~~

Markowitz's

While the majority of Mr. ~~Link's~~ work will consist of the detailed design of the stirrer, its drive, and supporting components, he will initially work in parallel with Mr. Hamilton to develop a conceptual design and will be provided with the same process and overall gasifier dimensions. His initial work will consist of the following activities:

Review of all literature on the MERC gasifier and the Bureau of Mines literature on low BTU gasifiers over the last twenty years.

Review of all published literature on the numerous domestic and international gasifiers installed with stirring devices over the last forty years.

Practices both past and current in the extractive metallurgy industries use process materials with similar temperatures and physical properties to these coal gasifiers. They also use similarly sized vessels (twelve-sixteen foot diameter), and stirring devices. The published literature both technical and trade will be extensively researched for physical properties and hardware.

The information collected from these sources will be compared and evaluated to provide a base for design of the compound-motion stirrer.

The system geometry with the objective of establishing an envelope type silhouette for plant layout purposes will be set early in the design procedure.

Mr. Link has already commenced a review of MERC records and data on other stirred systems, which will be valuable not only to the Phase I design, but also to a review of the program at the end of Phase I.

Detailed Stirrer Design. The design parameters developed in the two preceding sections will be evaluated and the parameters which will form the basis of the detailed design established. The detail design will include the following:

Candidate materials for construction of the shaft and rabble will be considered with and without cooling of the rabble.

Shaft and rabble structural design will be prepared using normal practices (consideration of torque, deflection, etc.), with geometry of parts dictated by the initially gathered data.

Seal will be designed after considering hydraulics, lip seals, stuffing boxes and the recorded experience.

The agitator drive and motor will be designed as a custom assembly externally supported.

External loads and forces transmitted to vessel and structure will be calculated. A design for the vessel entry nozzle will be submitted.

The stirrer shaft and blades will be designed so that they can pass through manholes in the gasifier for final assembly.

The stirrer drive will be designed to provide both rotation and vertical movement. Two alternate drive systems will be evaluated; one based on electric motor drive, the other on hydraulic drive. In selecting the drive, consideration will be given to compactness so that the coal feed mechanism can be readily fitted at the top of the gasifier.

5.4.3 Task 2 - Developmental Work

~~This task is broken down into two areas: stirred two stage gasifier development, and fines agglomeration.~~

Task 2.1. Stirred Two-Stage Gasifier. The work to be completed under this task includes all of the following:

- A. Establish basic process data
 - temperature profiles
 - gas composition range
 - seal pressure

- B. Parameters from existing stirred gasifiers
 - shaft torque
 - rotation speed range
 - number and placement of arms
 - blade configuration
 - clearance between blades and refractory wall
 - range and speed of vertical motion

- C. Extrapolative basis
 - review literature on MERC gasifier
 - review literature on other gasifiers
 - review literature on the extractive metallurgy industries

D. Detailed design

- compare results
- establish basis for detailed design
- material selection
- structural design
- seal design
- motor and drive
- structural support requirements

Task 2.2. Fines Agglomeration. The work to be completed under this task includes all of the following:

A. General data on Agglomeration schemes

- establish likely coals to be processed
- establish probable quantity of undersize material
- establish availability of binders locally

B. Roll Briquetting scheme evaluation

- select equipment manufacturer for testing
- test coal(s) and binders
- test resultant briquettes for mechanical properties
- prepare preliminary design for plant
- preliminary estimate of capital and operating costs

C. Auger Extrusion scheme

- select equipment manufacturer for testing
- test coal(s) and binders

ENGINEERING REQUISITION

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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977
 UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Furnish the services, as specified, to provide process designs, cost estimates, startup and construction services as required for a Stretford demonstration unit. In addition, furnish a process design and cost estimate for an expansion to a commercial size Stretford unit.</p> <p>The subcontractor is required to perform all work in accordance with the documents and attachments as described in the following sections:</p> <p>1.0 GENERAL</p> <p>2.0 SCOPE OF WORK</p> <p>3.0 INSTRUCTION TO BIDDERS</p> <p>4.0 PROCESS DESIGN SPECIFICATION</p> <p>5.0 DESIGN AND CONSTRUCTION NOTES</p> <p>6.0 APPLICABLE SPECIFICATION</p> <p>7.0 COMPLETION RESPONSIBILITIES</p> <p>8.0 PHASE II PROCESS GUARANTEE CONDITIONS</p> <p>9.0 PHASE III SCOPE OF WORK</p>		

Rev.: 1) 4/21/78 2) 6/28/78 3) 9/19/78
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 Revised as 13, 16, 17,19,21
 Purchased Added 16A

MADE BY: BEB

CHECKED BY: RKS

PAGE 1 OF

E/R W-21

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>1.0 <u>GENERAL</u></p> <p>1.1 The subcontractor shall provide process designs consistent with the processes as described in Section 4.0.</p> <p>1.2 This Engineering Requisition specifies the onsite duty requirements for the Stretford unit battery limits to be included as part of the Fuel Gas Demonstration Plant.</p> <p>1.3 The demonstration plant is jointly funded by Erie Mining Company and the U.S. Department of Energy (D.O.E.). The demonstration plant will be located in Hoyt Lakes, Minnesota, at Erie Mining Company's Hoyt Lakes Pellet Plant.</p> <p>1.4 The fuel gas produced will be used to supplement natural gas and fuel oil as the fuel for iron ore pellet induration.</p> <p>1.5 The subcontractors scope of work for the Stretford unit shall be performed in the following three phases:</p> <p style="padding-left: 40px;">Phase I</p> <p style="padding-left: 40px;">1.5.1 Process and unit design and cost estimate for a commercial unit including design and operating requirements.</p> <p style="padding-left: 80px;">The commercial unit design shall incorporate the demonstration unit as an operating module. The demonstration unit shall be the basis for expansion to the commercial unit in an economical manner.</p> <p style="padding-left: 40px;">1.5.2 Process and unit design for a demonstration</p>		

1) 4/21/78
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ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>unit and cost estimate for Phase II and Phase III work.</p> <p>The demonstration unit shall be designed to be expanded to provide the requirements for the commercial unit in an economical manner.</p> <p>Phase II</p> <p>The subcontractor shall furnish engineering, procurement, and construction consulting service for the demonstration unit sufficient to maintain the guarantees.</p> <p>Phase III</p> <p>The subcontractor shall furnish operator training, start-up, performance testing, and consulting services, for the demonstration unit.</p>		
1)		1.6 The commercial unit shall consist of the demonstration unit plus an additional single Stretford unit. The combination of the two units shall have the capacity to desulfurize the process effluent gas from a commercial size coal gasification facility. The process design specification and cost estimate for the commercial Stretford unit shall be based on the above mentioned single individual unit.		
1)		1.7 The subcontractor shall not design the control room. Board space will be provided in a common plant control room by others.		
1)		1.8 The Stretford demonstration unit shall be enclosed in a building, designed and constructed by others. The tanks will be covered and connected to a vapor		

1) 4/21/78
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ENGINEERING REQUISITION



Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>recovery system to preclude unwanted vapors and odors in the building. Ductwork from subcontractors blower will be by others.</p> <p>1) 1.9 The term "flaked sulfur" as used in this Engineering Requisition has the following meaning:</p> <p>It is sulfur in the form of flakes that is produced by processing the molten sulfur collected in the H₂S removal system. These flakes may be used for landfill.</p> <p>The term "purge" has the following meaning:</p> <p>It is the means of removing sulfate salts to prevent them from building up in the Stretford solution.</p> <p>1)2) 2.0 <u>SCOPE OF WORK</u></p> <p>2.1 The subcontractor shall prepare the process design specifications for the Stretford unit. The design shall include all onsite equipment data sheets and required utilities within the unit area.</p> <p>2.2 The subcontractor shall supply, as a minimum in Phase I, the following items in the <u>demonstration unit</u> process design specification package:</p> <p>1) 2.2.1 A process description highlighting the principal process methods including molten sulfur, flaked sulfur and purge facilities.</p> <p>2) 2.2.2 Details concerning the major process parameters on which design is based such as:</p> <ul style="list-style-type: none"> a. Sulfide loading of rich solution b. Reactor tank or drum and oxidizer residence times 		

1) 4/21/78 2) 6/28/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>c. Actual vs. theoretical air requirements.</p> <p>2.2.3 Process Flow Diagrams which shall show major equipment items and principal process control loops.</p> <p>2.2.4 A heat and material balance based on the design case and keyed to the Process Flow Diagram.</p> <p>2.2.5 Piping & Instrument Diagrams showing the complete unit piping and instrumentation.</p> <p>2.2.6 All equipment sized and specified in detail including internals.</p> <p>2.2.7 Electrical single line diagrams.</p> <p>2.2.8 Material specification for all process equipment and piping.</p> <p>2.2.9 Plot plan and elevations drawn to scale showing all major equipment items.</p> <p>2.2.10 Compositions and rates of purge streams.</p> <p>2.2.11 Compositions and rates of gaseous vents.</p> <p>2.2.12 Start-up and shutdown procedures in outline form.</p> <p>2.2.13 Operating data</p> <p>1) a. Manpower requirements, operations and maintenance</p> <p>1) b. Estimate of utilities and chemical consumptions</p>		

1) 4/21/78
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ENGINEERING REQUISITION

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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<ol style="list-style-type: none"> 1. Plant and instrument air 2. Steam consumption (summer and winter) 3. Cooling water (summer and winter) 4. Electrical power 5. Chemical quantity and costs including initial charge, normal make up, design and operating 		
1)		2.2.14 Data sheets for all instruments required for control loops and indicating, recording, alarm or interlock points (e.g. transmitters, recorders/indicators, switches and controlled devices).		
1)		2.2.15 Identify all product and by-product yields, qualities and compositions and provide "In House" background environmental data.		
1)		2.2.16 Identify effluent streams, yield qualities and compositions, and provide "In House" background environmental data.		
1)		2.2.17 Flow diagrams for blowdown, safety or emergency systems (if required).		
1)		2.2.18 Electrical area classification drawing.		
1)		2.2.19 Maintenance supply requirements such as: <ol style="list-style-type: none"> 1. Routine supplies 2. Recommended inventory 3. Recommended major spare parts 		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1)		2.2.20 Start-up and shut down procedures in outline form including emergency shut down procedure.		
1)		2.2.21 Preliminary operating manual in outline form.		
		2.3 The subcontractor shall supply, as a minimum in Phase I, the following items in the <u>commerical unit</u> process design specification package:		
1)		2.3.1 A process description highlighting the principal process methods including molten sulfur, flaked sulfur and purge facilities.		
2)		2.3.2 Details concerning the major process parameters on which design is based such as: a. Sulfide loading of rich solution b. Reactor tank or drum and oxidizer residence times c. Actual vs. theoretical air requirements.		
		2.3.3 A process flow diagram which shall show major equipment items and principal process control loops.		
		2.3.4 A heat and material balance based on the design case and keyed to the process flow diagram.		
		2.3.5 Piping & Instrument Diagrams showing the complete unit piping and instrumentation.		
		2.3.6 All equipment sized and specified in detail including internals.		
		2.3.7 Electrical single line diagrams.		

1) 4/21/78 2) 6/28/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
1)		2.3.8 Cost estimate for the completion of the commercial unit +20%. Refer to 2.11.		
		2.3.9 Material specification for all process equipment and piping.		
		2.3.10 Plot plan and elevations drawn to scale showing all major equipment items.		
		2.3.11 Compositions and rates of purge streams.		
		2.3.12 Compositions and rates of gaseous vents.		
		2.3.13 Start-up and shutdown procedures in outline form.		
1)		2.3.14 Operating data		
		a. Manpower requirements, operations and maintenance		
		b. Estimate of utilities and chemical consumptions		
		1. Plant and instrument air		
		2. Steam consumption (summer and winter)		
		3. Cooling water (summer and winter)		
		4. Electrical power		
		5. Chemical quantity and costs including initial charge, normal make up, design and operating		
1)		2.3.15 Data sheets for all instruments required for control loops and indicating recording,		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		alarm, or interlock points (e.g. transmitters, controllers, recorders/indicators, switches, and controlled devices).		
1)		2.3.16 Identify all product and by-product yields, qualities and compositions, and provide "In House" background environmental data.		
1)		2.3.17 Identify effluent streams, yield quantities and compositions, and provide "In House" background environmental data.		
1)		2.3.18 Flow diagrams for blowdown, safety or emergency systems (if required).		
1)		2.3.19 Electrical area classification drawings.		
1)		2.3.20 Maintenance supply requirements such as: <ul style="list-style-type: none"> 1. Routine supplies 2. Recommended inventory 3. Recommended major spare parts 		
1)		2.3.21 Start-up and shutdown procedures in outline form including emergency shutdown procedure.		
		2.3.22 Preliminary operating manual in outline form.		
1)		2.4 Other subcontractor responsibilities, coordination procedures and completion responsibilities for Phases I, II and III are defined in McKee Specification 789.		
1)		2.5 Within two weeks after notice to proceed with the work, subcontractor shall prepare and submit a		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		definitive overall project schedule based on the subcontract schedule presented in Table V for items delivered to McKee.		
1)		2.6 All cost estimates prepared by the subcontractor for Phase II and Phase III work shall have, where applicable, the royalties and licensing fees listed separately and payable in United States dollars.		
1)		2.7 During Phase I, the subcontractor shall submit a list of at least three recommended vendors and/or subcontractors having previous experience of bidding on the fabrication and/or supply of major components of the Stretford units.		
1)		2.8 During Phase I, the subcontractor shall prepare, for the demonstration Unit, a definitive cost estimate (+15%). This estimate shall be for molten sulfur and flaked sulfur with purge facilities.		
2)				
1)		2.9 During Phase I, the subcontractor shall prepare a definitive manpower and cost estimate for subcontractors Phase II and Phase III participation. The contractor shall include as part of the estimate a "statement of work" required by the subcontractor to maintain guarantees.		
1)2)3)		2.10 During Phase II and III the subcontractor shall guarantee the Phase I design and the operability of the Plant as designed.		
1)		2.11 During Phase I, the subcontractor shall prepare a +20% cost estimate for the detail engineering, procurement, construction, operator training, start-up and performance testing of a commercial unit.		
1)		2.12 In order to be consistent with the cost estimates		

1) 4/21/78 2) 6/28/78 3) 9/19/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>that McKee is preparing for the balance of the coal gasification plant, the subcontractor shall prepare cost estimates based on methods and procedures as agreed between McKee and the subcontractor.</p> <p>2.13 During Phase I the subcontractor shall make suggestions for wash stream clean-up.</p> <p>3.0 <u>INSTRUCTION TO BIDDERS</u></p> <p>3.1 Coordination Procedure and Document Distribution</p> <p>Section 13 and 15 of McKee Specification 789 outline the requirements covering administration of correspondence, drawings, engineering data, manuals, and similar items between subcontractor and McKee. The subcontractor shall submit an outline of project execution procedures including cost control procedures.</p> <p>3.1.1 This procedure shall be used by subcontractor as a method to control quantity, quality, and format required in the production of all data, drawings, reports, and documentation that will be prepared and transmitted to McKee under this subcontract.</p> <p>3.1.2 Subcontractor shall include the cost of reproduction and distribution of all documents in his bid.</p> <p>4.0 <u>PROCESS DESIGN SPECIFICATION</u></p> <p>4.1. Scope of Specification</p> <p>This specification presents the duty requirements for a demonstration and commercial size Stretford unit to desulfurize the process effluent gas from a coal gasification facility.</p>		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1)		<p>4.2 Unit Duty</p> <p>Product gas will be used as a fuel gas in the owner's facilities. The demonstration unit shall be nominally designed to remove 15 tons per day of sulfur from the feed gas. The commercial unit shall be designed to remove 40 tons per day.</p>		
2)		<p>4.3 Design Basis</p> <p>The feed gas rate and composition for both the demonstration and commercial units are given in Table I. The product gas shall contain a maximum of 50 PPMV H₂S.</p>		
2)		<p>4.4 Turndown Capability</p> <p>The unit shall be capable of operation at 50% of the design gas feed rate.</p>		
		<p>4.5 Operating Parameters</p>		
1)		<p>4.5.1 All essential equipment in the Stretford unit shall have installed spare(s) to insure 95% on stream reliability at design capacity.</p>		
1)		<p>4.6 Sulfur Product Specification</p> <p>The owner desires to recover a flaked sulfur product. Flaked sulfur shall have a minimum purity of 99.5 wt. percent.</p>		
1)		<p>4.7 Other Considerations</p> <p>4.7.1 Utilities and meteorological design characteristics supplied to the battery limits are shown in McKee Specification 254.</p>		

1) 4/21/78 2) 6/28/78
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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p>4.7.2 The plant design life shall be 20 years minimum with normal maintenance.</p> <p>5.0 <u>DESIGN AND CONSTRUCTION NOTES</u></p> <p>5.1 Products Design Basis</p> <p>5.1.1 Provision shall be made for mixing and adding the Stretford makeup solution.</p> <p>5.1.2 The rate of formation of sulfate, thiosulfate, and thiocyanates in solution shall be minimized by means of adequate control in order to minimize the solution purge rate. The subcontractor shall provide the purge rate, purge composition, and the duration and frequency of purges.</p> <p>5.1.3 Flaking shall be included as part of the design package.</p> <p>5.1.4 The owner desires to compress the gas after the Stretford unit. Thus, the inlet gas pressure to the absorber at battery limit will be 15" W.C.</p> <p>5.1.5 Provisions shall be included to minimize all gaseous and aqueous waste disposal streams, e.g., a closed oxidizer shall be required. The subcontractor shall identify all such streams as to their rates and compositions.</p> <p>5.2 Design Basis for Nonprocess Features</p> <p>5.2.1 Information on utilities and other nonprocess features contained in McKee Specification 254 are to be considered an integral part of this specification.</p>		

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ENGINEERING REQUISITION

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Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1)		<p>5.2.2 All utility lines shall be sized based on the requirements of the commercial unit.</p> <p>5.3 Special Design Consideration</p> <p>5.3.1 Provisions shall be made for orderly and safe shutdown of all process equipment. Electrical and/or mechanical interlocks shall be provided where necessary to assure the proper sequence of the shutdown operation. All equipment and instrumentation, if any, requiring uninterrupted power supply shall be identified.</p> <p>5.3.2 Average seasonal climatic and seismic conditions of Hoyt Lakes, Minnesota, shall be taken into consideration in the design.</p> <p>5.3.3 The unit must be designed to conform, from an environmental and safety viewpoint, with all applicable local, state, and federal government requirements.</p> <p>1) Subcontractor shall recommend a means of effluent disposal which his experience indicates to be acceptable in the U.S.A. As a minimum, safety requirements of the Mine Safety and Health Administration shall be complied with.</p> <p>5.3.4 Energy conservation shall be included as one of the important design parameters for the Stretford unit. The cost of utilities is given in McKee Specification 254.</p> <p>5.3.5 The subcontractor shall inform McKee of any unusual safety problems and all waste streams associated with these facilities.</p>		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER												
		<p>5.3.6 The unit must meet Erie Mining Company and D.O.E. safety standards.</p> <p>5.3.7 General guidelines for equipment and instrument numbering are given in Table III.</p> <p>5.3.8 All documents shall be prepared in the English (engineering) system of measurement.</p> <p>5.3.9 Site preparation will be done by others.</p> <p>5.3.10 Stubs for tie-in of future units shall be provided if required.</p> <p>5.3.11 McKee shall provide and subcontractor shall use, drafting linen with special title blocks, for all new drawings applicable to this project.</p> <p>5.3.12 Subcontractor shall use the battery limit concept for designing all lines to and from the Stretford unit. Provisions shall be made for by-passing the unit when necessary. The by-pass valves shall be located within the battery limits.</p> <p>6.0 <u>APPLICABLE SPECIFICATIONS</u></p> <p>6.1 McKee Specifications</p> <table border="0"> <thead> <tr> <th><u>Spec. No.</u></th> <th><u>Title</u></th> </tr> </thead> <tbody> <tr> <td>254</td> <td>Site and Utility Data</td> </tr> <tr> <td>260</td> <td>Design Drawing</td> </tr> <tr> <td>261</td> <td>Drafting Standard</td> </tr> <tr> <td>266</td> <td>Instructions to Vendors for Data Submittal</td> </tr> <tr> <td>270</td> <td>Piping and Instrumentation</td> </tr> </tbody> </table>	<u>Spec. No.</u>	<u>Title</u>	254	Site and Utility Data	260	Design Drawing	261	Drafting Standard	266	Instructions to Vendors for Data Submittal	270	Piping and Instrumentation		
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1) 4/21/78
GWC

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		Diagram		
	275	Process Plant Design		
	291	Spare Parts		
	501	Basic Instrument Requirements		
	746	Winterizing of Equipment, Piping and Instruments		
	789	Subcontract Spec. for Process Units		
		7.0 <u>COMPLETION RESPONSIBILITIES</u>		
		The subcontractor completion responsibilities are as listed in McKee Specification 789.		
		8.0 <u>PHASE II PROCESS GUARANTEE CONDITIONS</u>		
		Subcontractor shall perform the following functions:		
		8.1 Prepare operating manuals for the Demonstration Unit.		
		8.2 Review vendor data for the venturi scrubber, crystallizes, aerators, flakers, oxidizers, reactor tank and knockout drum absorber.		
		8.3 Review the 100% completed model or piping layouts and elevations with vessel vendor data.		
		Subcontractor shall assume:		
		8.4 Specifications provided with the design package will be adhered to.		
		8.5 Procurement will be made from sources recommended by subcontractor.		
		8.6 Changes recommended by subcontractor resulting from review of the model, drawings and vendor data will be incorporated in the design.		

1) 4/21/78 2) 6/28/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
2)		8.7 No changes will be made to the subcontractor P&ID's, plot plans and elevations as issued in the design package without subcontractor review and approval.		
2)3)		9.0 <u>PHASE III SCOPE OF WORK</u> 9.1 The subcontractor shall furnish operator training, start-up, performance testing and consulting services consisting of 63 mandays of labor, for the demonstration unit.		

2) 6/28/78 3) 9/19/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT

DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. OR. NUMBER																								
		<p>TABLE I</p> <p>STRETFORD UNIT</p> <p><u>FEED STREAM</u></p> <p><u>Battery Limits Conditions</u></p> <p>1) Temperature, °F 95</p> <p>1)2) Pressure, Inches W.C. 15</p> <p>1)2) Outlet Pressure, Inches W.C. 2) Battery Limits to Battery Limits</p> <p><u>Design Feed Rate</u></p> <p>1) Demonstration Unit 1.89 x 10⁶ SCFH</p> <p>1) Commercial Unit 5.09 x 10⁶ SCFH</p> <p><u>Composition</u></p> <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Component</u></th> <th style="text-align: right;"><u>MOL %</u></th> </tr> </thead> <tbody> <tr><td>CO</td><td style="text-align: right;">27.13</td></tr> <tr><td>CO₂</td><td style="text-align: right;">3.50</td></tr> <tr><td>H₂</td><td style="text-align: right;">18.90</td></tr> <tr><td>N₂</td><td style="text-align: right;">41.90</td></tr> <tr><td>CH₄</td><td style="text-align: right;">2.09</td></tr> <tr><td>C₂H₆</td><td style="text-align: right;">0.07</td></tr> <tr><td>H₂S</td><td style="text-align: right;">0.75</td></tr> <tr><td>COS</td><td style="text-align: right;">0.08</td></tr> <tr><td>H₂O</td><td style="text-align: right;">5.58</td></tr> <tr><td>HCN</td><td style="text-align: right;">10 ppmv (est.)</td></tr> <tr><td>NH₃</td><td style="text-align: right;">70 ppmv (est.)</td></tr> </tbody> </table>	<u>Component</u>	<u>MOL %</u>	CO	27.13	CO ₂	3.50	H ₂	18.90	N ₂	41.90	CH ₄	2.09	C ₂ H ₆	0.07	H ₂ S	0.75	COS	0.08	H ₂ O	5.58	HCN	10 ppmv (est.)	NH ₃	70 ppmv (est.)		
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		GWC GWC																										

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>TABLE II - SEE GENERAL SPECIFICATION 254*</p> <p>STRETFORD UNIT</p> <p><u>UTILITY COSTS</u></p> <p><u>Utility</u> <u>Unit Cost \$</u></p> <p>Coal, Ton 20.00</p> <p>Steam, M Lb.</p> <p>Cooling Water, M Gal.</p> <p>Fuel Oil, Gal.</p> <p>BFW, M Gal. 0.42</p> <p>Electricity, KWH</p> <p>Operating Labor, Manhour</p>		
		*Summary of Utility, Site and Utility Cost Date		

1) 4/21/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p style="text-align: center;">TABLE III</p> <p style="text-align: center;">STRETFORD UNIT</p> <p><u>GUIDELINES FOR EQUIPMENT AND INSTRUMENT NUMBERING</u></p> <p>All Stretford unit battery limits equipment will be numbered in the 300 series, starting with 301.</p> <p>Equipment numbers will be proceeded by an alphabetic symbol indicating the type of equipment. Refer to McKee Specification 270 for Symbols.</p> <p><u>Types of Equipment</u> <u>Symbol</u></p> <p>DELETED</p> <p>Spares or multiple units on the same service should have the same numbers followed by an alphabetic designation, e.g., P-301A, P-301B.</p> <p>The instrument identification shall be written according to ISA specifications.</p> <p>Instrument loops shall be numbered consecutively by variable type (flow, pressure level, etc.) ranging from 301 to 399.</p> <p>Individual instruments within an instrument or control loop such as transmitters, alarms, recorders, and control valves shall have the same designation as the primary instrument</p>		

1) 4/21/78 2) 6/28/78
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ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>except in the case of a loop containing two or more actuating devices. In such cases, one device shall have the same number as the primary instrument, the second (or more) device shall be consecutively numbered.</p>		

1) 4/21/78
GWC

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION STRETFORD UNIT SUBCONTRACT DATE OCTOBER 24, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

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		<p>TABLE IV - SEE GENERAL SPECIFICATION 254*</p> <p>STRETFORD UNIT</p> <p><u>CHARACTERISTICS OF UTILITIES AND METEOROLOGICAL AND SOIL DESIGN CONDITIONS</u></p> <p>The utility characteristics given are the estimated conditions at the consumer utilization point at grade upstream of any throttling valve.</p> <table border="0"> <thead> <tr> <th><u>Utilities</u></th> <th><u>Conditions</u></th> </tr> </thead> <tbody> <tr> <td>1. Inert Gas</td> <td>70 psig at Amb. Temp.</td> </tr> <tr> <td>2. Steam</td> <td>50 psig, saturated</td> </tr> <tr> <td>3. Process Water</td> <td></td> </tr> <tr> <td>4. Potable Water (Fire and Service)</td> <td></td> </tr> <tr> <td>5. Boiler Feed Water</td> <td>50 psig at 210°F</td> </tr> <tr> <td>6. Electricity</td> <td></td> </tr> <tr> <td>7. Instrument Air</td> <td>80 psig @ Amb. Temp.</td> </tr> </tbody> </table> <p>The production cost should be evaluated using the unit costs for the utilities given in Table II.</p> <p><u>Meteorological Design Conditions</u></p> <p>Site Elevations: Approx. 1541 Ft. Above MSL</p> <p>Ambient Air Temperatures:</p> <p>*Summary of Utility, Site and Utility Cost Data</p>	<u>Utilities</u>	<u>Conditions</u>	1. Inert Gas	70 psig at Amb. Temp.	2. Steam	50 psig, saturated	3. Process Water		4. Potable Water (Fire and Service)		5. Boiler Feed Water	50 psig at 210°F	6. Electricity		7. Instrument Air	80 psig @ Amb. Temp.		
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1) 4/21/78 2) 6/28/78
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**TABLE V
STRETFORD UNIT
SUBCONTRACT SCHEDULE FOR PHASE I**

ITEMS DELIVERABLE TO McKEE	CALENDAR WEEKS AFTER NOTICE TO PROCEED (See Note #1)																													
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23					
DETAIL SCHEDULE			██████████		▲																									
SCHEDULE OF PAYMENTS			██████████		▲																									
UNIT ARRGT. PLAN, & ELEV.						██████████						▲																		
DEMO. PROCESS PACKAGE			██████████												▲															
COMM. PROCESS PACKAGE			██████████												▲															
DEMO. COST EST. REPORT								██████████						▲																
COMM. COST EST. REPORT										██████████						▲														
FINAL REPORT																	██████████			▲										

PAGE 02 OF 02

MILESTONE KEY

- ▲1 PROCESS FLOW DIAGRAM WITH HEAT AND MATERIAL BALANCE AND MAJOR LINE SIZES TO McKEE
- ▲2 P & ID'S TO McKEE.
- ▲3 EQPT. DATA SHEETS TO McKEE
- ▲4 INSTR. DATA SHEETS TO McKEE
- ▲5 ITEMS TO McKEE FOR REVIEW/APPROVAL
- ▲6 BEGIN PRICING EQPT.

(3) Note 1: All deliverables are due two (2) weeks after signing of contract.

END

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

DESCRIPTION AMBIENT NOISE SURVEY DATE DECEMBER 16, 1977

UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
1		<p>Provide three ambient noise surveys at the Erie Mining Company, Taconite Plant, Hoyt Lakes, Minnesota.</p> <p>The following standards shall apply:</p> <ol style="list-style-type: none"> 1. NPC-2, Noise Standards - Minnesota Pollution Control Agency, 1974. 2. S1.1-1960, Acoustical Terminology - American National Standards Institute, 1960. 3. S1.2-1962, Method for Physical Measurement of Sound - American National Standards Institute, 1962. 4. S1.4-1971, Specification for Sound Level Meters - American National Standards Institute, 1971. 5. S1.6-1967, Preferred Frequencies and Band Numbers for Acoustical Measurements - American National Standards Institute, 1967. 6. S1.11-1966, Octave, Half-Octave and One-Third Octave Filter Sets, American National Standards Institute, 1966. 7. EA-7301 - Guidelines on Noise - American Petroleum Institute, 1973. <p>The following surveys shall be performed:</p> <p>1A A preconstruction noise survey shall be taken on a day with the nearby pelletizing plant shut down (approximately January, 1978).</p> <p>1B A preconstruction noise survey shall be taken on a day with the nearby pelletizing plant operating at "normal" conditions (approximately March, 1978).</p> <p>1C A post-construction noise survey shall be taken after</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

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UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p>construction of the new gasifier facilities and with the pelletizing plant operating at "normal" conditions (approximately March, 1981).</p> <p>Survey points 1-2 shall be used for the collection of statistical ambient data over a 72 hour period. Survey points 3-6 shall be used for the collection of environmental ambient data. Survey points 7-8 shall be used for the measurement of impulse noise.</p> <p>Additional survey points may be added in the field. Bidders should include unit cost.</p> <p>All survey locations shall be recorded on the plot plan and referenced to fixed points so that a future survey may be made at the same points.</p> <p>Acoustical data shall consist of:</p> <ol style="list-style-type: none"> 1. Statistical Ambient Data 2. Environmental Ambient Data 3. Impulse Data <p>Statistical ambient data shall consist of L_{eq}, L_{50}, L_{10}, and L_{90} measurements between the hours of 0700-2200 and 2200-0700 and hourly readout of L_{eq}.</p> <p>The statistical analyzer used for the collection of statistical ambient data shall be a weathersealed unit, capable of 72 hour continuous operation, in subfreezing temperatures ($-42^{\circ}F$). Vendors shall state if utilities are required for this operation.</p> <p>The microphone used with the statistical analyzer shall conform to the applicable sections of ANSI-Type 1 specifications. This microphone shall be remote from the</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

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UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

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		<p>analyzer, held by a tripod, equipped with a windscreen, and located at 5 feet above the ground.</p> <p>A detector time constant of "slow" shall be used during data collection along with a minimum sampling rate of one second.</p> <p>An indication shall be provided when wind exceeds 10 mi./hr. during the 72 hour measurement period for statistical ambient data.</p> <p>Environmental Ambient data shall consist of:</p> <ol style="list-style-type: none"> 1. Overall Sound Pressure Levels (dB-SPL) 2. Overall A-Weighted Sound Levels (dBA) 3. Octave Band Sound Pressure Levels (dB-SPL) 4. Central Tendency and Range of Each Reading in dB. <p>Octave band data shall be taken at the center frequencies of 63, 125, 250, 500, 1000, 2000, 4000 and 8000 Hertz.</p> <p>Headphones shall be worn during all environmental ambient measurements.</p> <p>Tape recordings shall be taken of Environmental Ambient data, for record only, for 5 minutes, flat response and maintained for a period of two years. A cassette copy will be provided to McKee.</p> <p>Weather conditions recorded for Environmental Ambient data shall include temperature, wind velocity and relative humidity. Environmental Ambient data will not be taken when wind is in excess of 10 mi./hr.</p> <p>A precision sound level meter (ANSI - Type 1) shall be used for all Environmental Ambient measurements.</p>		

ENGINEERING REQUISITION

McKee

Form M-200-1 - 8/76 (Rev. 3/77)

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD NUMBER
		<p>Impulse data measurements shall be taken for evaluation of blasting noise.</p> <p>All equipment for acoustical data collection shall be calibrated before and after each set of measurements by a calibrator which is traceable to the National Bureau of Standards.</p> <p>At each measurement location, the character of the sound field shall be recorded (eg. free field, reverberent field).</p> <p>The microphone shall be remote from the sound level meter, held by a tripod, equipped with a windscreen, and located at five feet above the ground.</p> <p>All plant safety rules shall be obeyed.</p> <p>A final report of the ambient survey shall be written and submitted and shall include:</p> <ol style="list-style-type: none"> 1. All raw field data obtained. 2. Overall, A-weighted and octave band data that has been corrected for microphone pressure response, free field, windscreens and random incidence corrector (if used). 3. Hourly L_{eq}. 4. L_{eq}, L_{50}, L_{90}, and L_{10} between the hours of 0700-2200 and 2200-0700. 5. The distributive data for L_{50}, L_{90} and L_{10} for each measurement period, maximum 2 dB increments. 6. Date of National Bureau of Standards calibration of calibrator used. 		

SUMMARY OF UTILITY, SITE ANDUTILTIY COST DATAGENERAL SPECIFICATION 254

INDEX

- | | | | |
|-----|--------------|-----|-------------------------------------------|
| 1.0 | GENERAL | 3.0 | SITE AND METEOROLOGICAL DESIGN CONDITIONS |
| 2.0 | UTILITY DATA | 4.0 | UTILTIY COST DATA |
-

1.0 GENERAL

This specifcation contains basic engineering data including utility cost information for utilities presently at the site. This specification shall be refered to in all Engineering Requisitions where a supplier requires part or all of the listed data to develop optimum mechanical design for his equipment.

2.0 UTILITY DATA

The utility characteristics given are preliminary conditions at the consumer utilization point at grade upstream of any throttling valve.

<u>Utilities</u>	<u>Process Design Pressure, Psig</u>	<u>Temperture °F</u>
2.1 Inert Gas	100	Amb. (Dew Pt.-50°F)
2.2 Steam		
Hi	125	353
Medium	50	297
Low	25	265

<u>Utilities</u>	<u>Process Design Pressure, Psig</u>	<u>Temperature °F</u>
2.3 Cooling Water		
(Barge Water)		
Summer Supply	75	75
Winter Supply	75	35
Return	55	(Max. 40°F rise)
2.4 Fire Water	16-170*	
	* With Existing Main Pumps Running	
2.5 Boiler Feed Water		
(Colby Lake Water)		
Low Pressure	50	220
High Pressure	175	220
2.6 Potable Water	95	Amb.
2.7 Instrument Air	100	Amb. (Dew Pt.-50°F)
2.8 Plant Air	100	Amb. (Dew Pt.-50°F)
2.9 Makeup Water		
(Colby Lake Water)	40	Amb.
2.10 Cold Condensate	100	100
2.11 Electricity**		4160, 480, 240/120 V
Up to 3/4 HP		115/230 Volts, 1 Phase, 60 Hz.
Over 3/4 HP & Under 125 HP		480 Volts, 3 Phase, 60 Hz.
125 HP & Up		4160 Volts

**For dust collection and vacuum cleaning electrical equipment, see Specification 1003, Section 4.1 and 1006, Section 2.11.

Barge Water Analysis

PH	8.6
TSS	4.8
TDS	365
Total Hardness	172
Ca++ Hardness	68
Mg++ Hardness	104

Colby Lake Water Analysis

Iron	4.0 ppm
Manganese	None
Silica	1.0 ppm
Alkalinity (Methyl Orange)	3.0 ppm
Alkalinity (Phenolphthalein)	0.0 ppm
Sulphates	10.0 ppm
Chlorides	1.5 ppm
Total Hardness	26.0 ppm
Calcium Hardness	12.0 ppm
Total Solids	101 ppm
PH	6.8
Turbidity	Less than 10 ppm
Dissolved Oxygen (at 75°F)	6.8 ppm
Color	240 ppm
Immediate Chlorine Demand	5 ppm
Coliform Bacteria	22 per 100 ml.
Total Bacteria	1664 per ml.
Saturation Index (Summer)	-3.47
Saturation Index (Winter)	-4.04

3.0 SITE AND METEOROLOGICAL DESIGN CONDITIONS:

- 3.1 Site Elevation: 1542 ft. above MSL.
- 3.2 Ambient Air Temperatures: Dry bulb (max.) 102°F
Dry bulb (min.) minus 42°F
- 3.3 Wind Loading: 30 lb./ft.² wind loading area uniform building code 1976
- 3.4 Snow Design Loading: 40 lb./ft.²
- 3.5 Soil Conditions: General description of area - Ledge rock covered by a shallow layer of glacial till with an occasional outcrop of ledge rock.

3.6 Seismic Zone:

1, uniform building code 1976
Production blasting produces maximum particle velocity of 0.5 in./sec. at one mile from blast, maximum sound reaching one mile from blast is 140 decibels (linear).

4.0 UTILITY COST DATA

<u>Utility</u>	<u>Unit Cost \$</u>
4.1 Coal, Ton	20.0
4.2 Steam, M Lb.	*
4.3 Cooling Water, M Gal.	0.05
4.4 Fuel Oil, Gal.	0.4
4.5 BFW, M Gal.	0.13**
4.6 Electricity, KWH	0.02
4.7 Operating Labor, Man-hour	14.00

* Unit cost of steam dependent on quality and end use. There is no inherent need for steam in the pellet plant, so if steam is generated, assign an end use within the battery limits. If steam drivers are used, assign a payback based on replacement of electric power @ 2 cent/kwh.

** Assuming steam pressure generated less than 200 psig.

PIPING AND INSTRUMENT DIAGRAMS

ORIGINAL

SPECIFICATION 270

INDEX

1.0	SCOPE	4.0	INSTRUMENTATION
2.0	GENERAL	5.0	PIPING
3.0	LAYOUT	6.0	EQUIPMENT
		7.0	MISCELLANEOUS

EXHIBITS

EXHIBITS 1, 2 AND 3	PIPING SYMBOLS
EXHIBIT 4	EQUIPMENT LETTER DESIGNATIONS
EXHIBITS 5,6,7,8,9 AND 10	EQUIPMENT SYMBOLS
EXHIBITS 11,12 AND 13	PIPING AND INSTRUMENT DIAGRAM ABBREVIATIONS
EXHIBITS 14 AND 15	MISCELLANEOUS SYMBOLS

1.0 SCOPE

- 1.1 This specification covers the minimum requirements for Piping and Instrument Diagrams.
- 1.2 The following is an integral part of this specification:
 - 1.2.1 McKee Specifications
 - a. Specification 255 - Bill of Material
 - b. Specification 260 - Design Drawing

c. Specification 261 - Drafting Standards ORIGINAL

1.2.2 Industry Standards

a. ISA S5.1 - Instrument Symbols and Identification

2.0 GENERAL

- 2.1 The exhibits of Specification 270 cover the symbols normally encountered in Piping and Instrument Diagram development.
- 2.2 Symbols shall be used to represent all equipment and instruments. Templates shall be utilized as much as possible to maintain neatness and uniformity.
- 2.3 All equipment, instruments, piping and etc. shall be shown only once on the Piping and Instrument Diagrams.
- 2.4 All utility headers and major auxiliary systems shall be shown on separate piping and instrument diagrams. However, the actual tie into the equipment shall be shown on the piping and instrument diagram on which the equipment is located.
- 2.5 The requirements for heat tracing and insulation including provisions for winterizing shall be shown.
- 2.6 All equipment and instruments that are furnished by others shall be noted as shown in Exhibit 15. Although this equipment is furnished by others, the process schematic flow shall be shown.

3.0 LAYOUT

- 3.1 All piping and instrument diagrams shall be prepared on 22 inches by 34 inches sheets.
- 3.2 Upper Base Line
 - 3.2.1 All major items of process equipment shall be shown along a common base line located on the upper half of the sheet.
- 3.3 Main Pipeway
 - 3.3.1 The main pipeway showing pipeway routing shall be shown as running from left to right and be located immediately below the upper base line.
- 3.4 Lower Base Line

- 3.4.1 Compressors, blowers and pumps shall be shown along a common base line located on the lower half of the sheet.
- 3.5 Tank farm storage, and its respective piping and instrumentation, shall be shown along the upper base line in the same manner as for process equipment. When considerable tank farm storage is involved, separate piping and instrument diagrams shall be prepared.
- 3.6 In cases of multilevel construction involving gravity transfer, equipment shall be shown in the same manner above and below each other with relative elevation of all equipment given.
- 3.7 Spare and Parallel
 - 3.7.1 All spare equipment shall be shown on the piping and instrument diagrams including the manifolding, valving, etc. In like manner, equipment for parallel operation shall also be shown. In the case of identical arrangements, a single typical note shall be sufficient. However, all line, equipment and instrumentation numbering for all systems or services shall be noted.

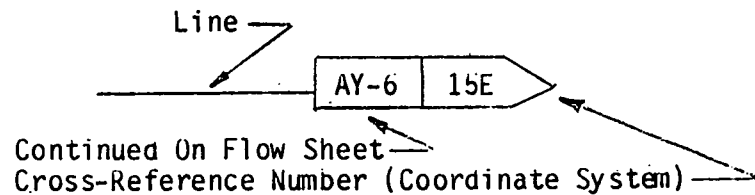
3.8 Lines

- 3.8.1 Lines shall be shown as single lines with square corners and flow arrows at all intersections and changes of direction. In order to avoid crossing of lines, all vertical lines shall be shown broken.
- 3.8.2 All process and utility lines shall be identified on piping and instrument diagram as follows:

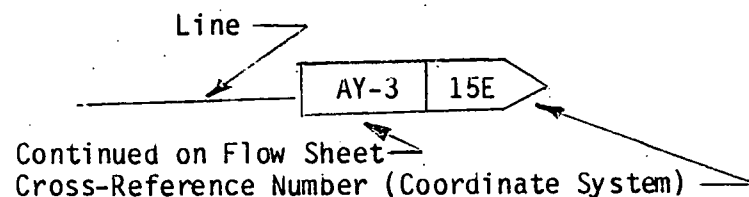
<u>Line Size</u>	<u>Unit Designation</u>	<u>Service Code</u>	<u>Line Number</u>	<u>Line Specification</u>	<u>Insulation Code</u>
XX	X	X	XXXX	XXX	XXX

- (R-3)
 - a. For unit designations, refer to Specification 260.
 - b. Line numbers shall appear above the line for horizontal lines and to the left of the line for vertical lines.
- 3.8.3 All process lines and utility lines entering or leaving the piping and instrument diagrams shall be cross-referenced as follows:

- a. As seen on Flow Sheet AY-3



- b. As seen on Flow Sheet AY-6



- 3.8.4 All lines going to, or coming from equipment shall schematically depict the physical arrangement.
- 3.8.5 All lines requiring slope, special routing, no pockets, special elevation requirements, special covering, etc. shall be noted.
- 3.8.6 The flow in the main process lines shall normally be shown as going from left to right.
- 3.8.7 Process lines entering the piping and instrument diagrams shall be shown as coming in from the left of the sheet as a horizontal line. Process lines leaving the sheet shall be shown as a horizontal line terminating at the right of the sheet.
- 3.8.8 Utility lines entering the piping and instrument diagrams shall be shown as vertical lines coming in at approximately 2-1/2 inches below the upper base line. Utility lines leaving the sheet shall be shown as vertical lines terminating approximately 2 1/2 inches below the upper base line. Where utilities are required for equipment located along the lower base line, they shall be shown as vertical lines terminating or coming in at the bottom of the sheet.

4.0 INSTRUMENTATION

- 4.1 All instrumentation shall be shown on the piping and instrument diagrams.

- 4.2 Details of instrument piping shall not be normally shown on the piping and instrument diagrams. Instrument piping refers to all piping after the first valve adjacent to the equipment and/or first block valve on takeoff from main line.
- 4.3 All instrument identification and symbols shall be per ISA S5.1.
- 4.4 The following data for control valves shall be shown on the piping and instrument diagram:
 - 4.4.1 Size
 - 4.4.2 Valve position with actuating medium failure (symbol)
 - 4.4.3 All block valves and bypass piping
 - 4.4.4 Handwheels and bleeds when required
- 4.5 The following data for safety valves shall be shown on the piping and instrument diagram:
 - 4.5.1 Size
 - 4.5.2 Set pressure
 - 4.5.3 Inlet and discharge piping
 - 4.5.4 Snuffing steam to discharge if required
 - 4.5.5 Car seal valves

5.0 PIPING

- 5.1 All valves shall be shown on the piping and instrument diagrams except as follows:
 - 5.1.1 Standard instrument piping valves
 - 5.1.2 Vent and drain valves unless required for operational purposes
- 5.2 Special valve requirements such as fullport, venturi, etc., shall be noted.
- 5.3 Valve sizes shall only be noted where it differs from line size except for the following:

- 5.3.1 All control valves
- 5.3.2 All safety valves
- 5.4 Flanges shall only be shown for exchangers, heaters and special piping requirements.
- 5.5 Fittings shall only be shown for special cases such as swing ell, drop-out spool, etc.
- 5.6 Typical details shall be used for standard installations.
- 5.7 Piping and symbols shall be as shown on Exhibits 1, 2 and 3.

6.0 EQUIPMENT

- 6.1 All process and mechanical equipment shall be shown on the piping and instrument diagrams.
- 6.2 Equipment Designation

6.2.1 Process and mechanical equipment shall be assigned identification designations as follows:

<u>Equipment Designation</u>	<u>Sequence Number</u>	<u>Suffix Letter/Number</u>
XX	XXXX	X

- 6.2.2 Equipment Designation - All process and mechanical equipment shall be assigned a letter (or letters) designation. See Exhibit 4 for assigned designations.
- 6.2.3 Sequence Number - Each project is subdivided into process and utility sections and each section shall be assigned a number series. Equipment within a given section shall be assigned a sequence number in that designated plant section series.
- 6.2.4 Suffix Letter - Spare, standby, or duplicate equipment shall be assigned a suffix letter. The unit in service shall be designated "A" and the additional unit or units shall be "B", "C", etc.
- 6.2.5 Driver Tag Numbers on major equipment shall consist of the driven equipment tag number with the appropriate driver suffix following the equipment letter designation e.g. CM-101 is the motor driving compressor C-101.

6.3 Equipment Data

6.3.1 The following data shall be shown on the piping and instrument diagram where it is applicable.

- a. Equipment Number
- b. Name
- c. Size (Vessels Only)
- d. Insulation Requirement

6.3.2 The equipment data shall appear near the edge of the sheet of the piping and instrument diagram either above or below the appropriate symbol.

6.4 Vessel elevation shall be noted by a dimension line.

6.5 Equipment symbols shall be as shown on Exhibits 5, 6, 7, 8, 9 and 10.

7.0 MISCELLANEOUS


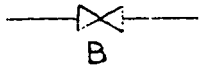
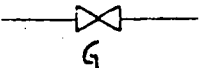
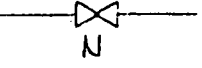
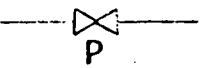

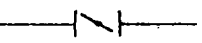
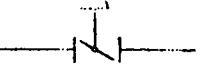




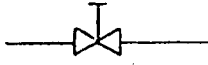




7.1 Piping and instrument diagram abbreviations shall be as shown on Exhibits 11, 12 and 13.

7.2 Miscellaneous symbols shall be as shown on Exhibit 14 and 15.

PIPING SYMBOLS

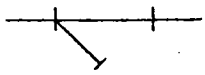
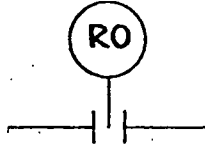
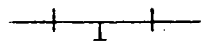
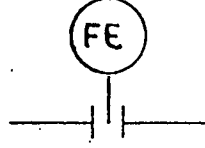
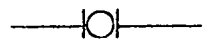
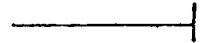
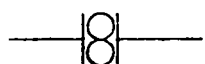

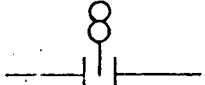
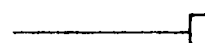
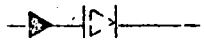
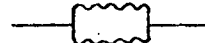

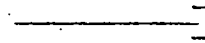
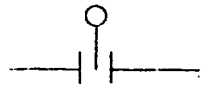
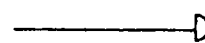
ORIGINAL

PROJECT NO. 4814

	GATE VALVE
	BALL VALVE
	GLOBE VALVE
	NEEDLE VALVE
	PLUG VALVE
	CHECK VALVE
	BUTTERFLY VALVE
	BUTTERFLY CONTROL VALVE
	CONTROL VALVE WITH HAND WHEEL
	DIAPHRAGM OPERATED CONTROL VALVE FC - VALVE CLOSSES ON ACTUATING MEDIUM FAILURE FO - VALVE OPENS ON ACTUATING MEDIUM FAILURE FCI-FC VALVE LOCKS IN LAST POSITION ON ACTUATING MEDIUM FAILURE
	BACK PRESSURE CONTROL VALVE
	PRESSURE REDUCING CONTROL VALVE
	HAND OPERATED CONTROL VALVE
	THREE WAY VALVE
	DIAPHRAGM OPERATED THREE WAY CONTROL VALVE
	SAFETY VALVE
	FLUSH BOTTOM VALVE

PIPING SYMBOLS

ORIGINAL

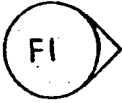

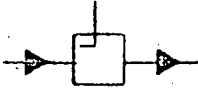


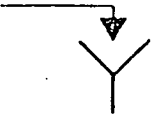
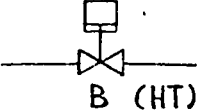
 <p>Y-TYPE STRAINER</p>	 <p>RESTRICTION ORIFICE</p>
 <p>T-TYPE STRAINER</p>	 <p>FLOW ELEMENT</p>
 <p>BASKET STRAINER</p>	 <p>BLIND FLANGE</p>
 <p>DUPLEX STRAINER</p>	 <p>REDUCER</p>
 <p>FIGURE 8 BLIND (SPECTACLE BLIND)</p>	 <p>HOSE CONNECTION</p>
 <p>TEMPORARY STRAINER</p>	 <p>EXPANSION JOINT</p>
 <p>HAMER BLIND</p>	 <p>PIPE CAP (THREADED)</p>
 <p>SPADE BLIND</p>	 <p>PIPE CAP (WELDED)</p>

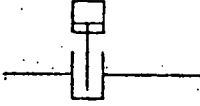
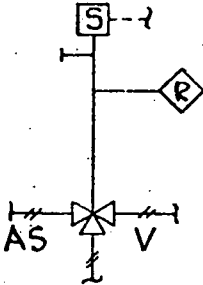
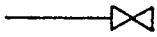
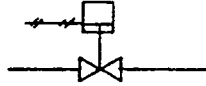
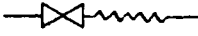
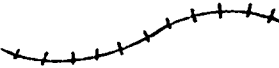
REVISIONS			
1	5/5/78	5	
2	7/19/78	6	
3	10/12/78	7	
4		8	

PIPING SYMBOLS

PROJECT NO. 4814

ORIGINAL

	ROTAMETER, FLOW INDICATOR
	VENTURI
	PITOT TUBE
	STRAINER (EQUIPMENT TYPE)
	TRAP
	OPEN DRAIN EC - CLEAN WATER EO - OILY WATER ES - SANITARY WATER
	PISTON OPERATED BALL VALVE B (HT) HIGH TEMPERATURE

	PISTON OPERATED SLIDE VALVE
	SOLENOID VALVE WITH MANUAL RESET AS - AIR SUPPLY V - VENT
	PO - PUMP OUT SO - STEAM OUT SC - SAMPLE CONN.
	PISTON OPERATED CONTROL VALVE
	SAMPLE CONNECTION W/ AIR COOLER
	FLEXIBLE HOSE

REVISIONS	1	5/5/78	5
	2	7/19/78	6
	3	10/12/78	7
	4		8

A. Process Equipment Letter Designations

<u>Description</u>	<u>Equipment Designation</u>
Mechanical Agitator	A
Blower	B
Compressor	C
Drum	D
Exchanger (All Types)	E
Filter	F
Heaters (Furnaces)	H
Ejectors	J
Pump	P
Reactor	R
Tower	T
Tank	TK
Cooling Tower	CT
Sump	PIT
Misc. Equipment	X
Drivers -	
Diesel Engine	D
Gas Engine	G
Electric Motor	M
Turbine	T

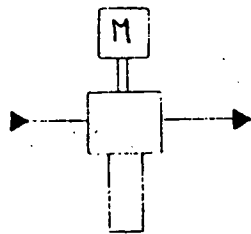
B. Solids Handling and Misc. Equip. Letter Designations

<u>Description</u>	<u>Equipment Designation</u>
Heating & Ventilating (HVAC)	HV
Air Conditioning	AC
Unit Heaters (HVAC)	UH
Engine Driven Generator	EG
Switch Gear	SW
Tripper Car	TC
Power Transformer	TR
Elevator	BE
Bin or Hopper	BN
Chute	CH
Conveyors (All Types)	CO
Cyclones	CY
Dust Collector	DC
Diverter Valve	DV
Gate Valve	GV
Extruder	EX
Feeder	MF
Exhaust Fan	EF
Vibrator	VB
Vibrating Screen	VS
Weigh Scale	WS
Car Positioner	CP
Car Dumper	DU
Mobile Equipment	ME

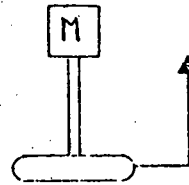
MADE BY					
AL					
CHECKED BY				CONTRACT	
				270	
APPROVED				Exhibit 4	
REVISIONS	1	5/5/78	5		
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	3	10/11/78	7		
	4		8		

EQUIPMENT SYMBOLS

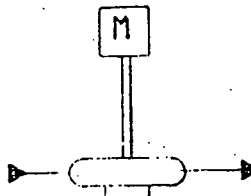
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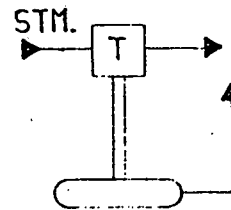
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(MOTOR DRIVEN)



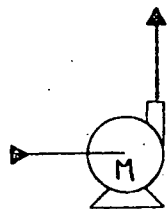
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(MOTOR DRIVEN)



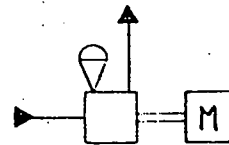
VERTICAL IN-LINE PUMP
(MOTOR DRIVEN)



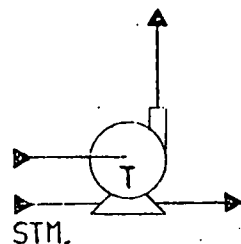
SUMP PUMP
(TURBINE DRIVEN)



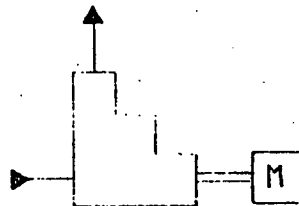
CENTRIFUGAL PUMP
(MOTOR DRIVEN)



METERING PUMP
DIAPHRAGM TYPE
(MOTOR DRIVEN)



CENTRIFUGAL PUMP
(TURBINE DRIVEN)

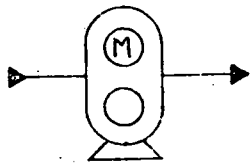


METERING PUMP
PISTON TYPE
(MOTOR DRIVEN)

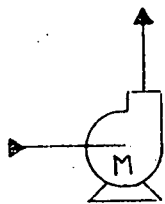
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	3	10/12/78	7
	4		8

EQUIPMENT SYMBOLS

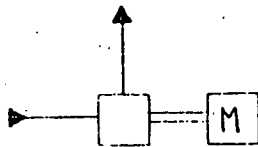
ORIGINAL



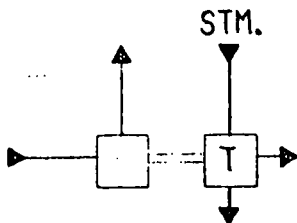
ROTARY OR GEAR PUMP
(MOTOR DRIVEN)



BLOWER
(MOTOR DRIVEN)

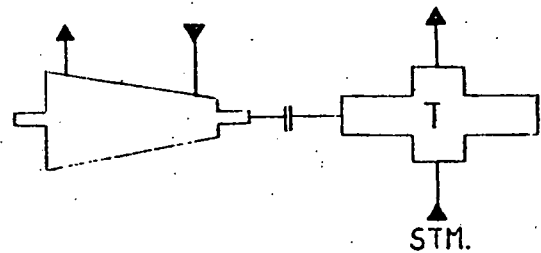


RECIPROCATING PUMP
(MOTOR DRIVEN)

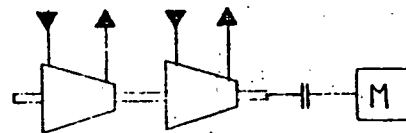


RECIPROCATING PUMP
(TURBINE DRIVE)

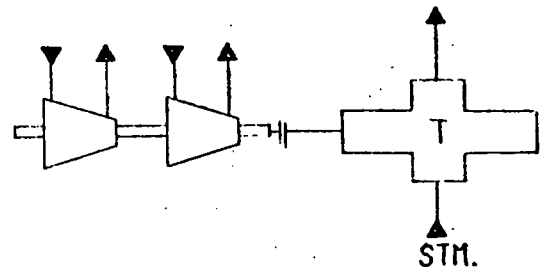
CENTRIFUGAL COMPRESSOR
(TURBINE DRIVEN)



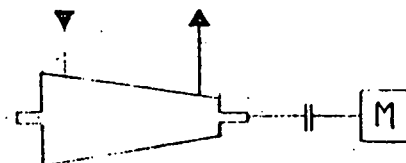
2 STAGE CENTRIFUGAL COMPRESSOR
(MOTOR DRIVEN)



2 STAGE CENTRIFUGAL COMPRESSOR
(TURBINE DRIVEN)



CENTRIFUGAL COMPRESSOR
(MOTOR DRIVEN)

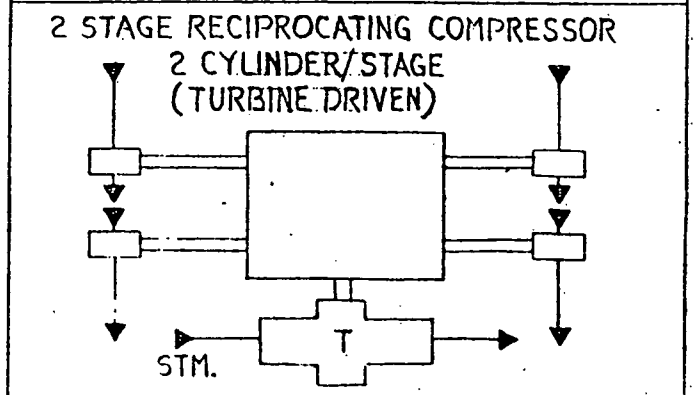
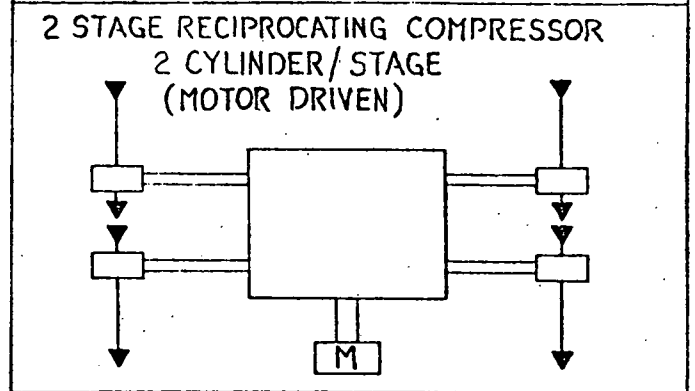
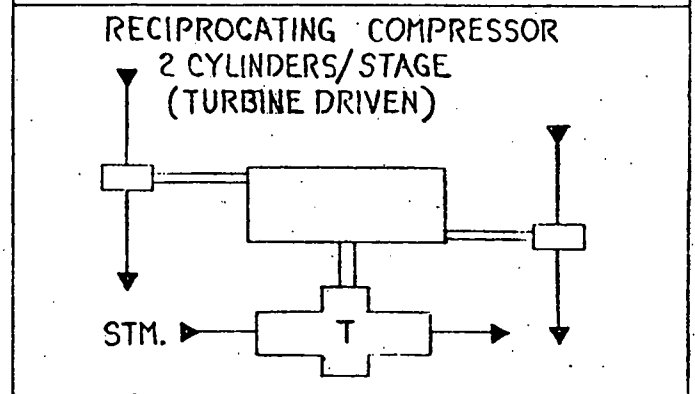
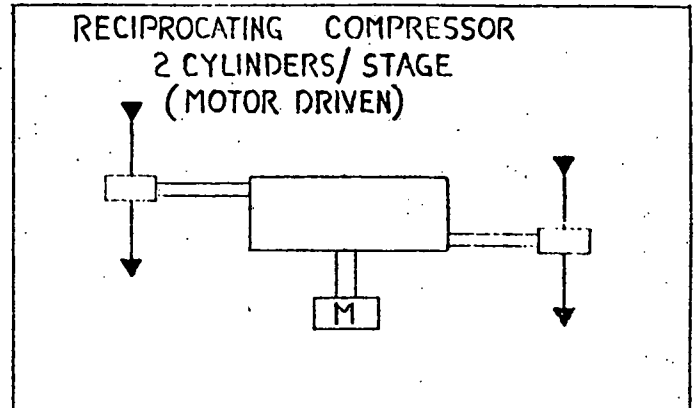
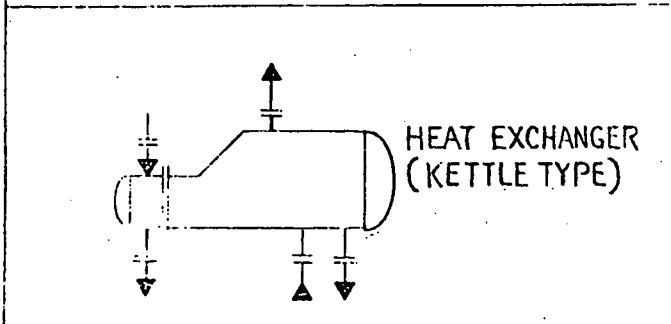
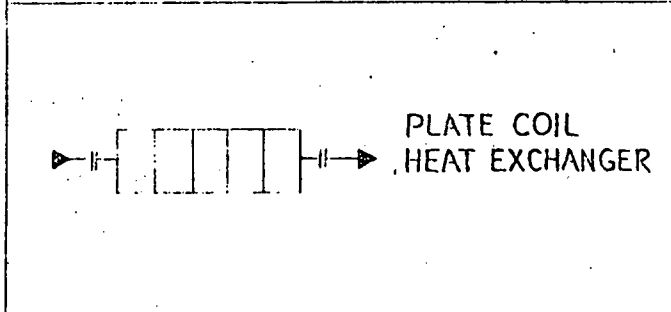
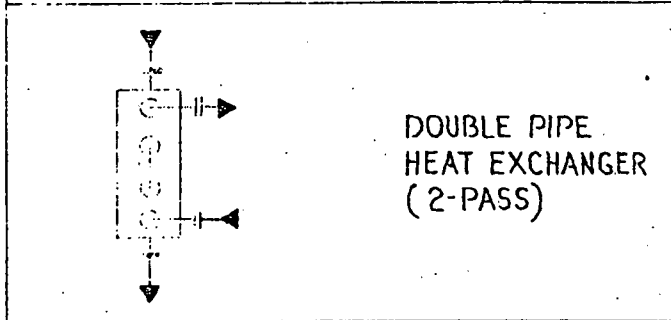
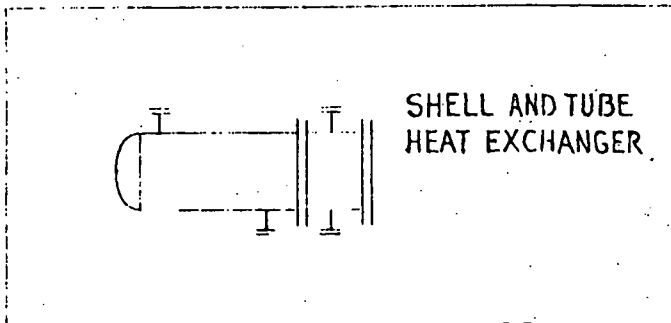


REVISIONS	1	5/5/78	5
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	3	10/12/78	7
	4		8

EQUIPMENT SYMBOLS

PROJECT NO. 4814

ORIGINAL



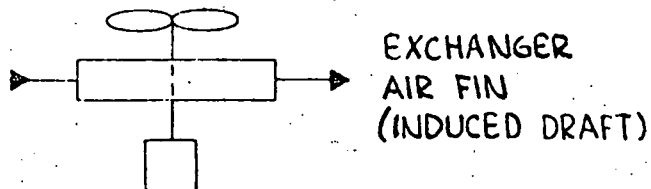
MADE BY	AL
CHECKED BY	
APPROVED	

EQUIPMENT SYMBOLS			
REVISIONS	1	5/5/78	5
	2	7/19/78	6
	3	10/12/78	7
	4		8
			270
			EXHIBIT 7

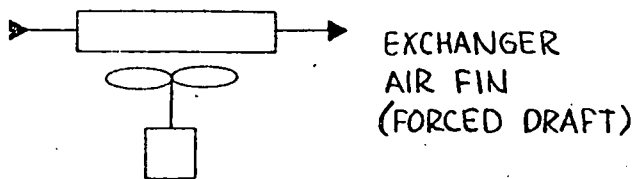
EQUIPMENT SYMBOLS

PROJECT NO. 4814

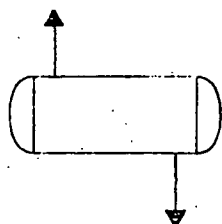
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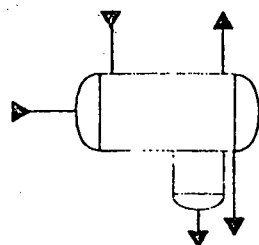
EXCHANGER
AIR FIN
(INDUCED DRAFT)



EXCHANGER
AIR FIN
(FORCED DRAFT)



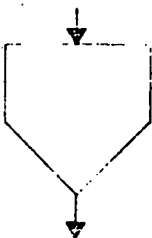
HORIZONTAL
DRUM



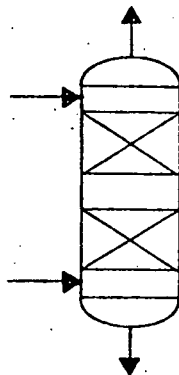
DRUM (LIQUID
DRAWOFF)



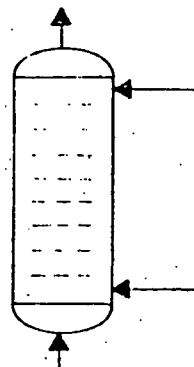
TANK,
CONE-ROOF



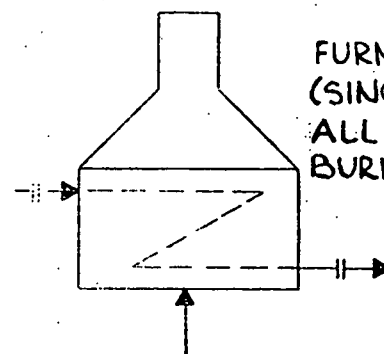
HOPPER



PACKAGED TOWER

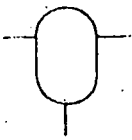
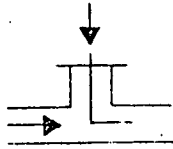
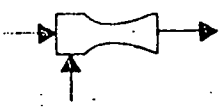
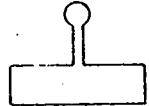
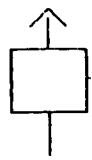
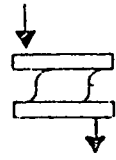
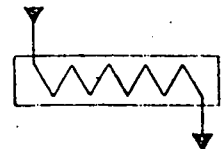
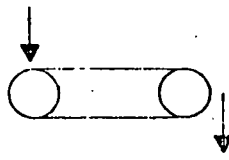


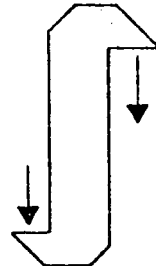
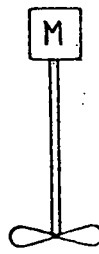
TOWER TRAY



FURNACE
(SINGLE PASS
ALL RADIANT ONE
BURNER - NO PILOT)

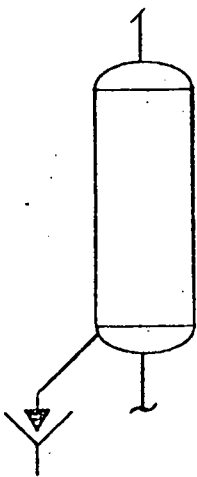
EQUIPMENT SYMBOLS

	SEPARATOR
	DESUPERHEATER SPRAY
	EJECTOR
	SCALES
	SPECIAL EQUIPMENT
	CONVEYOR (VIBRATING TYPE)
	CONVEYOR (SCREW TYPE)
	CONVEYOR (BELT TYPE)

	CONVEYOR (BUCKET TYPE)
	AGITATOR

REVISIONS	1	5/5/78	5
	2	7/19/78	6
	3	10/12/78	7
	4		8

EQUIPMENT SYMBOLS

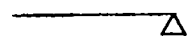


SILENCER


S	W	A	N
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UTILITY STATION


STEAM
WATER
AIR
NITROGEN



SPRAY NOZZLE



HYDRANT



EXHAUST HEAD

REVISIONS	1	5/5/78	5	
	2	7/19/78	6	
	3	10/12/78	7	
	4		8	

PIPING AND INSTRUMENT DIAGRAM ABBREVIATIONS

GENERAL

Absolute.....	ABS
Actual Cubic Feet Per Hour.....	ACFH
Approximate, approximately.....	APPROX
Atmosphere, atmospheric.....	ATM
Average.....	AVG
Barometer, barometric.....	BAR
Barrels.....	BBL
Barrels per calendar day.....	BBL/CD
Barrels per stream day.....	BBL/SD
British thermal unit.....	BTU
Calendar hour, calendar day, etc.....	CH, CD etc.
Calorie.....	CAL
Centigrade degrees.....	C
Centigram.....	CG
Centimeter.....	CM
Centipoise.....	CP
Concentrate, concentrated.....	CONC
Condensate.....	COND
Continued.....	CONT
Cubic Centimeter.....	CC
Cubic Feet.....	CU FT.
Cubic Feet per hour.....	CFH
Cubic Feet per minute.....	CFM
Cubic Feet per second.....	CFS
Cubic inch.....	CU IN
Cylinder.....	CYL
Degree.....	(°) DEG
Elevation.....	EL
External.....	EXT
Fahrenheit degrees.....	F
Feet per minute.....	FPM
Feet per second.....	FPS
Feet per second per second.....	FPS2
Foot, Feet.....	(') FT
Gallons.....	GAL
Gallons per day.....	GPD
Gallons per hour.....	GPH
Gallons per minute.....	GPM
Gallons per second.....	GPS
Gram.....	G
Gram calories.....	G-Cal
Grams per cubic centimeter.....	GPC

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Piping and Instrument Diagram Abbrev.

REVISIONS	1	5/5/78	5
	2	7/19/78	6
	3	10/12/78	7
	4		8

270

Exhibit 11

High pressure.....	HP
Horsepower.....	HP
Hour.....	HR
Inch.....	(") IN.
Inches per second.....	IPS
Inside diameter.....	ID
Insoluble.....	INSOL
Internal.....	INT
Kelvin degrees.....	K
Kilocalorie.....	KCAL
Kilogram.....	KG
Kilowatt.....	KW
Kilowatt hour.....	KWH
Liquid.....	LIQ
Log mean temperature difference.....	LMTD
Low pressure.....	LP
Maximum.....	MAX
Meter.....	M
Milligram.....	MG
Milliliter.....	ML
Millimeter.....	MM
Million.....	MM or spell out
Thousand.....	M
Molecular.....	MOL
Molecular weight.....	MOL WT
Month.....	Spell out
Number.....	NO.
Ounce.....	OZ
Percent.....	%
Percent weight.....	%W
Pound.....	LB
Pounds per cubic foot.....	PCF
Pounds per gallon.....	LB/GAL
Pounds per square foot.....	PSF
Pounds per square inch.....	PSI
Pounds per square inch, absolute.....	PSIA
Pounds per square inch, gauge.....	PSIG
Power factor.....	PF
Root mean square.....	RMS
Saybolt seconds universal.....	SSU
Second.....	SEC
Stream hour, stream day etc.....	SH, SD etc.
Solution.....	SOLN
Specific gravity.....	SP GR
Specific heat.....	SP HT
Square.....	SQ
Standard.....	STD
Standard cubic feet per hour (60°F at 1 atmosphere at sea level).....	SCFH

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MADE BY	Piping and Instruments Abbrev.		
CHECKED BY	21 5/5/78	51	270
APPROVED BY	31 7/19/78	61	
	31 10/12/78	71	

Stream trap..... ST
 Strainer..... STR
 Temperature..... TEMP
 That is..... IE
 Thousand..... M
 Tons per calendar day..... TON/CD
 Tons per stream day..... TON/SD
 Versus..... VS
 Viscosity..... VISC
 Viscosity index..... VI
 Watt..... W
 Week..... WK
 Weight..... WT
 Year..... YR

SAFETY

To atmosphere..... ATM
 To flare..... FLARE
 To stack..... STACK

UTILITIES

Boiler Feed Water..... BFW
 Condensate..... COND
 Cooling Water Supply..... CWS
 Cooling Water Return..... CWR
 Domestic Water..... DW
 Industrial Water..... IW
 Industrial Air..... UA
 Instrument Air..... IA
 Nitrogen - (pressure)..... Nitrogen - XXX
 Steam - (pressure)..... STM - XXX

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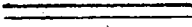

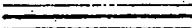



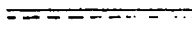

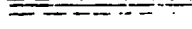




Piping and Instrument Diagram Abbrev.

1	5/5/78	5
2	7/19/78	6
3	10/12/78	7
4		8

270

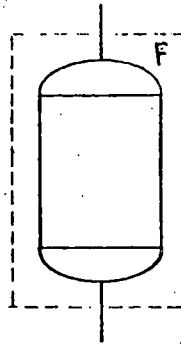
Exhibit 13

MISCELLANEOUS SYMBOLS

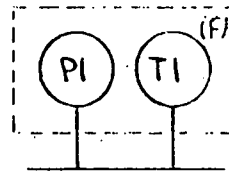
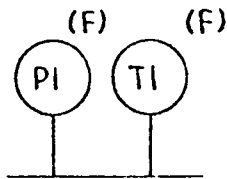
	PROCESS START POINT		ELECTROMAGNETIC &/OR SONIC SIGNAL
	TO OR FROM (UAL) UNIT AREA LIMIT		TRACED LINE
	MAIN PROCESS LINE		JACKETED LINE
	SECONDARY PROCESS LINE		INSULATION
	ELECTRICAL LINE		STEAM TRACED
	PNEUMATIC LINE		STEAM JACKETED
	CAPILLARY TUBING		MANWAY
	HYDRAULIC SIGNAL		LINE SPECIFICATION CHANGE

MISCELLANEOUS SYMBOLS

A. FURNISHED EQUIPMENT



B. FURNISHED INSTRUMENTS



C. FURNISHED PIPING



D. FUTURE PIPING



REVISIONS	1	5/5/78	5	
	2	7/19/78	6	
	3	10/12/78	7	
	4		8	

PROCESS PLANT DESIGNGENERAL SPECIFICATION 275

INDEX

- | | | | |
|-----|----------------------|-----|---------------------|
| 1.0 | SCOPE | 3.0 | MASTER PLANT LAYOUT |
| 2.0 | OPTIMUM PLANT DESIGN | 4.0 | CONCLUSION |

OIL INSURANCE ASSOCIATION

- Exhibit 1 - Recommended Spacing at Refineries, Chemical and Gasoline Plants for Buildings
 - Exhibit 2 - General Recommendations for Spacing in Refineries
 - Exhibit 3 - General Recommendations for Spacing in Petro-Chemical Plants
 - Exhibit 4 - General Recommendation for Spacing in Gasoline Plants
 - Exhibit 5 - General Recommendations for Spacing in Public Utility Natural Gas Pumping Stations
 - Exhibit 6 - General Recommendations for Spacing in Oil Pipe Line Pump Stations
-

PROCESS PLANT DESIGN1.0 SCOPE

This specification is intended as a guide to provide the basic parameters required to achieve a plant layout which shall have a functional arrangement, be economical to construct and efficient to operate. Furthermore, a well planned facility shall contribute to good community relations, personnel and property safety and general employee satisfaction.

There are two basic types of plant layout design problems. One is the "grass-roots", complete refinery complex or process unit, and the other is the process unit or units expansion, consisting of additional equipment and replacement or modification of existing equipment. For the latter type, the basic layout is determined by the existing area size, equipment locations, etc. Thus, the problem is more of a "make-do" approach without violating codes, specifications and basic safety considerations. This usually results in costly construction, less efficient unit operating cost and undesirable employee conditions.

However, since the same general parameters apply to both types of plant layout problems, and the intent is to provide guide lines or general formal and still allow for imaginative thinking, this specification shall approach the problems of process plant design of a "grass-roots" type project.

2.0 OPTIMUM PLANT DESIGN

Although it is beyond the scope of this specification to begin with the initial planning of a potential project, one basic philosophy must be determined before plant layout design can begin. This concerns the optimum initial installation for a plant that is planned for future expansion.

The Process Engineer must resolve if the expansion shall be accomplished by additional equipment, over sizing equipment or modification of equipment. Normally this is resolved in a combination of all three considerations and this philosophy must be passed on to the layout engineers as a basic concept to enable them to develop the "Master Plan" for the optimum plant layout.

3.0 MASTER PLANT LAYOUT

Assuming the decisions regarding future expansion are resolved and indicated on flow sheets, equipment data sheets, etc., the planning to arrive at the ultimate size and shape of the plant for the initial phase can begin. Often the plant site is already established and the shape, size and terrain are controlling factors in locating process units, support facilities and storage areas. The development of unit areas becomes the initial task.

3.1 Unit Area Layout Unit areas can be separated on the basis of primary process units with secondary or support process units within the same unit area. The equipment within the unit area can be placed in either a "grouped layout" or "flow-line" pattern. The "grouped layout" favors a larger unit with a large number of pumps, exchangers and drums which tends to facilitate operation,

maintenance and more economical construction. The "flow-line" pattern is more applicable to small units and the towers, pumps, exchangers, etc., appear almost as on the flow sheet in sequence of their use. However, this pattern also can apply to a large unit which has relatively few pumps and exchangers. In actual practice, the end result shall probably be a combination of both or a compromise between these concepts. In fact the layout design team objective should be to achieve an acceptable series of compromises which shall satisfy the basic principles of reasonable cost, accessible for maintenance and comfortable to operate. The following are some steps and general guide lines to develop each unit area:

- 3.1.1 Establish the equipment to be included in each unit area from the process flow diagrams, or P.I & D's and equipment list. Integrate as many process operations as possible for an economical operating staff.
- 3.1.2 Carefully evaluate equipment that should be elevated. Process, Mechanical and Project Engineers should work closely together to minimize the necessity for elevated equipment and structures.
- 3.1.3 The design team should include experienced personnel such that the flow sequence and function of each piece of equipment can be studied and thoroughly understood so that a practical and functional arrangement is realized.
- 3.1.4 Determine the maintenance requirements for each item considering frequency, method and accessibility.
- 3.1.5 Evaluate the operating hazards to develop the safest arrangement of equipment.
- 3.1.6 The most economical plot area is rectangular with a pipeway through the center and equipment located along both sides of the pipeway. The unit should be as compact as possible, consistent with adequate clearances, access, safety and such future requirements as required.
- 3.1.7 Locate pumps in a line along each side of the pipeway with drivers toward the accessway. Pump bases should be aligned at the pump end to simplify underground sewer layouts for drain cups.
- 3.1.8 Keep in mind the large shop fabricated equipment such as towers and reactors which shall require crane erection.

Try to set this equipment in a line away from pumps, minimize crane travel and still have erection access.

- 3.1.9 Locate the field fabricated equipment at one end of plot where unloading, erection and testing can be carried on without interfering or delaying work for other equipment.
- 3.1.10 Locate large exchangers and other equipment which require mobile cranes for maintenance, along or near plot perimeters. Roads and accessways must have overhead clearance and width for equipment required.
- 3.1.11 Centrifugal compressors require evaluation of an elevated unit with bottom suction and discharge vs. a top suction and discharge unit at grade. Turnaround time can be effectively reduced with the former but initial installation costs are greater.
- 3.1.12 Visualize accessway for operators to the principal equipment and control areas as well as for maintenance. Also provide adequate space for piping and control stations to avoid awkward configurations and equipment "blocked in" by piping or control valves. Remember, "compacting" the unit later is easier than expanding to accommodate unforeseen additional items.
- 3.1.13 Depending on soil conditions and/or equipment sizes, spread footings often influence equipment spacing. Combined "mat" foundations often help to compact the unit and may be more economical.
- 3.1.14 After all unit areas are developed, the orientation of units within the plant site can be resolved. Storage areas, support units, office buildings, etc., can be located to arrive at the overall plant size and shape.
 - a. This should be determined soonest in the overall review of the site. Arrangement of some equipment as heaters, compressors, etc. can better be located within the unit limits. (Prevailing wind must be taken into account).

3.2 Drainage and Waste Disposal

The ideal plant site is nearly level with the general slope running to one side or corner of the plot which is in the direction of off-site sewer connections. Special considerations

must be given to streams or waterways on or near the plot to avoid plant run-off and contamination of streams in violation of pollution regulations. Generally, the drainage and waste disposal systems can be separated into four categories.

- 3.2.1 Sanitary sewers for office buildings, change rooms, control rooms, gate houses, etc., which require either off-site treating or on-site treatment by a central facility or separate septic tank units.
- 3.2.2 Surface drainage for areas that do not contain process units or storage of liquids which could contaminate rain or wash water run-off.
- 3.2.3 Areas that include equipment which in the event of spills or upsets could contaminate surface run-off. This system should pass through a holding pond, basin or tank which can be constantly monitored before being released to public sewers or streams. It should have facilities to treat, separate and/or recycle waste depending on the type and quantities of possible contamination.
- 3.2.4 Active process areas and equipment which, due to normal leakage, wash down and frequent turnaround activity subject to draining and spillage, must have a chemical sewer or oily water sewer system which can be pumped through the necessary treating facilities or recycled.
- 3.2.5 Thus, to develop the "Master Plan", a detailed process study is required to design the proper facilities and the results shown on a utility flow diagram along with equipment data and flow quantities.

3.3 Terrain

Plant sites with decided changes in elevation can be an advantage. Storage may be possible at higher elevations to provide gravity loading of tank trucks and cars. Lower areas provide the location for holding ponds and treating facilities. Heavy equipment should be in areas requiring the least fill and having the best soil-bearing characteristics. Usually, again it becomes a series of compromises to achieve the best optimum arrangement.

3.4 Supports Units

The services required to support the process or "manufacturing" units include the power plant, maintenance shops, warehouse,

change house, office building, etc. These should be located for efficient movement of personnel, segregated for safety and minimum interference, yet maintain a compact, convenient plant site.

3.4.1 Utilities cover the generation and distribution of all steam, water, fuel oil, fuel gas, electric power, etc., that is not normally generated within the process unit. The distribution and quantity requirements are developed by the Process Engineer and shown on utility flow sheets. The generating facilities, such as power plant, pumping facilities, etc., should be located away from all process units. In the event of emergencies caused by explosions and fires, it is imperative that the utilities units continue to function. Also, utility units can be a hazard if placed too near the process areas.

3.4.2 All buildings containing personnel such as office buildings, laboratories, change houses, maintenance shops and warehouses, should be away from and upwind of the process areas. Office buildings and laboratories should be nearest the gate house with adequate parking areas. They should have easy access to the main highway. Plant operators and workers also may use the same gate house and parking facilities so the change house, maintenance shop and warehouse should have good access to plant process units as well as the main gate. The warehouse should have good access to highways as well as internal plant roads. If harbor facilities are included, product storage should be located in the vicinity of the docks yet far enough away to minimize the danger of fire.

3.5 Storage

Storage facilities can cover a wide range of items which shall include the feedstocks and chemicals required for processing, fuel stock for utility units as well as product storage. Basically, they are gas, liquid or solid and are either imported or exported. Storage of large volumes of gases is costly and hazardous. This is not a common practice and would require special consideration. Normally, storage of small volumes of inert gases, liquefied petroleum gases and compressed air is required and occasionally liquefied chlorine or ammonia for water treating facilities. The economics of storing large volumes of process gas is a basic part of the initial plant process design and such facilities as may be required should be located away from all process, support and utility units in strict accordance with all safety codes and good engineering judgement.

Liquid storage at atmospheric pressure is economically done in large metal tanks. Dikes are normally provided and tanks located to provide economical piping and pumping arrangements. Bulk storage for solids is normally nearer the process units than liquid storage and would be in plain cylindrical tanks as large as economically feasible. If a number of storage bins are required with smaller capacities, design the bins for shop fabrication and over the road delivery to cut erection cost. Bagging or boxing operations would require enclosures and storage which must be coordinated with railroad and truck loading facilities.

3.6 Roads

Roads for the process plant become the physical communication system which must meet various basic requirements.

- 3.6.1 A system of primary and secondary roads is required to service the total site with fire fighting equipment. Usually, this means a perimeter road, within the plant fence limits connecting to roads leading to process units. Dead end roads should be avoided.
- 3.6.2 Access roadways around all unit areas for mobile maintenance equipment and trucks.
- 3.6.3 Access into all units for maintenance equipment and trucks. Provide adequate overhead clearances.
- 3.6.4 Proper drainage must be provided for all types of road surfaces.
- 3.6.5 Roads in and out of plant to liquid or bulk loading facilities must be routed so as to avoid passing through or be a safe distance from process or liquid storage units.

3.7 Railroads

Railroads for the Process Plant shall be required to serve incoming stocks, materials, and equipment as well as exporting product from the plant site. The layout probably shall require both box car and tank car unloading and loading facilities as well as railroad car storage, both empties and loaded. Car puller, cleaning facilities and weigh stations may also be required. A thorough study of all activities is required before the railroad facilities can be designed. To assure an efficient layout, the following steps should be followed.

- 3.7.1 Determine the railroad which is to serve the plant and obtain from them a clear understanding of all specifications, clearances, regulations and other requirements for their equipment and operating procedures. It shall be important to the railroad as to type of cars and size, volume and frequency of traffic and general scope of activity to be expected in and out of the new plant.
- 3.7.2 Consider the usage requirements for construction as well as initial plant operation and future requirements. Details concerning number of shifts to unload, clean and load, box or tank cars to determine sliding, spur and car pulling requirements is essential.
- 3.7.3 Safety standards shall depend on type of products handled and various sources must be contacted for the latest information. Basic rules are furnished by the Interstate Commerce Commission, recommendations of the Manufacturing Chemists' Association and American Petroleum Institute. Also, producers or receivers of dangerous or toxic materials usually have developed special techniques for handling of such materials.
- 3.7.4 Consider adequate drainage not only for rain and surface water, but also for contaminated water from car washing stations and spillage at loading and unloading stations.
- 3.7.5 Most railroads require concrete headwalls and reinforcing of open culverts and special protection for underground piping.

4.0 CONCLUSION

Thus, the physical layout of a process plant is the art of combining all phases of the manufacturing and support units into a compact, economical plant at a given site compatible with maximum safety, maximum pollution control, and sound judgment. Each plant differs in many ways and only general principles can be used as a guide or "punch-list" to assure the layout team that all aspects have been considered.

OIL INSURANCE ASSOCIATION

Recommended Spacing at Refineries, Chemical, & Gasoline Plants for Buildings

MINIMUM DISTANCE
IN FEET

	<div style="display: flex; justify-content: space-between;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">FIRE RESIST. CONSTRUCTION WITH NON-COMB. CONTENTS.</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">NON-COMB. CONSTRUCTION WITH NON-COMB. CONTENTS.</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">ORD. CONSTRUCTION, IC & SIC WITH NON-COMB. CONTENTS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">FIRE RESIST. CONSTRUCTION WITH COMB. CONTENTS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">NON-COMB. CONSTRUCTION WITH COMB. CONTENTS</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">ORD. CONSTRUCTION WITH COMB. CONTENTS</div> </div>					
Fire Resistive Construction with Non-Comb. Contents	None	None	30	20	30	40
Non-Comb. Construction with Non-Comb. Contents	None	None	30	30	40	50
Ordinary Construction, IC, & SIC, with Non-Comb. Contents	30	30	50	40	50	60
Fire Resistive Construction with Comb. Contents	20	30	40	30	40	50
Non-Comb. Construction with Comb. Contents	30	40	50	40	40	50
Ordinary Construction with Comb. Contents	40	50	60	50	50	80

- FIRE RESISTIVE:** All construction details having at least a 3-hr. rating.
- NON-COMBUSTIBLE:** Materials incapable of igniting or supporting combustion.
- ORDINARY:** Generally masonry walls with wood roof and/or wood floors; also all frame construction.
- SIC OR IC:** Wood frame, incombustible sheathing.

OIL INSURANCE ASSOCIATION

General Recommendations for Spacing in Refineries

MINIMUM DISTANCE
IN FEET

Service Buildings	Process Units	Boilers, Utility & Elect. Generating Equipment, etc.	Fired Process Heaters	Process Vessels, Fractionating Equipment, etc.	Gas Compressor Houses	Large Oil Pump Houses	Control Houses *	Cooling Towers	Dropout Controls, Steam Snuffing, & Water Spray Controls	Blowdown Drums & Flare Stacks	Product Storage Tanks	Run-down Tanks	Blending Tanks	Hazardous Loading & Unloading Facilities, Including Docks	Fire Pumps	Turret Nozzles		Fire Hydrants		Fire Equip. Houses		
																50 ¹	50 ¹ to 250	50 ¹ to 100	50 ¹ to 100	50 ¹ to 250	50 ¹ to 100	
See Bldg. Chart	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	50 ¹	50 ¹ to 250	50 ¹ to 100				
	50 ³ to 100	100	—	100	100	100	100	100	100	100	100	100	100	100	100	50 ¹ to 100	50 ¹ to 250	100				
	100	100	—	100	100	100	100	100	100	100	100	100	100	100	100	50 ¹ to 100	50 ¹ to 250	100				
	100	50 ²	100	25 ²												50 ¹ to 100	50 ¹ to 250	100				
	100	—	100	50 ²	—											50 ¹ to 100	50 ¹ to 250	100				
	100	—	100	100 ²	30	See Bldg. Chart										50 ¹ to 250	50 ¹ to 100	100				
	100	—	100	100 ²	20	30	See Bldg. Chart									50 ¹ to 250	50 ¹ to 100	100				
		—	100	50 ²	50	50	30	See Bldg. Chart								50 ¹ to 250	50 ¹ to 100	100				
	50 ¹ to 100	100	100	100 ²	100	50	50	50	25 ⁶ to 50							50 ¹ to 100	50 ¹ to 250	100	to 200			
	—	—	—	50 ²	50	50	20	See Note	50	—						—	—	—				
	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	200 ⁸ to 300	—					100 ¹	100 ¹	250				
	200	250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	250 ⁴	200 ⁸ to 300	See Note				50 ¹ to 100	50 ¹ to 250	300				
	100	200 ³	200 ³	200 ³	200 ³	200 ³	200 ³	200 ³	200 ³	200 ³	200 ⁸ to 300	See Note	See Note			50 ¹ to 100	50 ¹ to 250	300				
	200	200	200	200 ²	200	200	200	200	200	200	200 ⁸ to 300	See Note	See Note	See Note		50 ¹ to 100	50 ¹ to 250	250				
	200	200	200	200 ²	200	200	200	200	200	200	200 ⁸ to 300	250 ⁴	250 ⁴	250 ⁴	50 to 250	50 ¹ to 100	50 ¹ to 250	250				
	50 ¹ to 100	250	0	250	250	100	100	—	—	—	300	300	300	300	300	—	—	—	—			

1. Special consideration should be given to the installation of fire hydrants and turret nozzles.
2. Small open flame devices should be located not less than 100' from any vapor-hazardous area.
3. Between battery limits.
4. Tanks over 10,000 bbls. capacity—250'; tanks less than 10,000 bbls. capacity—150'.
5. Tanks with capacities in excess of 5000 bbls.—200'; tanks less than 5000 bbls.—100'.
6. 25' to 50', considering area.
7. Controls may be installed adjacent to or inside, to serve as a shield.
8. Flare stacks less than 75' in height should be 300' distance; with stacks over 75' in height 200' distance.
9. Tanks with capacities up to 10,000 bbls. should be spaced 1/2 dia. apart; tanks from 10,000 to 50,000 bbls. capacity, space 1 dia. apart; and tanks over 50,000 bbls. should be spaced 1 1/2 dia. apart. Tanks over 250,000 bbls. require special consideration.
10. Service buildings include: offices, change houses, maint. whses., cafeterias, labs., hospitals, garages, except as specifically provided for as indicated.
11. Propane tank batteries, preferably, should be isolated to more remote sections of plant, and "aimed" away from major plant valves or occupancies. Spheres also should be remotely located whenever possible.

*Control houses serving unusually large or hazardous units and central control houses for multiple units or housing computer equipment, require greater spacing and may require blast-resistant construction.

OIL INSURANCE ASSOCIATION

General Recommendations for Spacing in Petrochemical Plants

MINIMUM DISTANCE
IN FEET

		PROCESS UNIT—HH	PROCESS UNIT—LH	TANK FARMS—HH	TANK FARMS—LH	PRODUCT WAREHSE—LH	SHIP'G. & REC'G.—LH	SHIP'G. & REC'G.—HH	SERVICE BUILDINGS	BOILER AREA	FIRE PUMPS	EMERGENCY CONTROLS	WATER SPRAY CONTROLS	TURRET NOZZLES	EMERGENCY FLARES	PILOT PLANTS	LARGE COOLING TOWERS	FIRE HYDRANTS	FIRED PROCESS HEATERS	
Process Unit—	HIGH HAZARD ^B	200								250	100	50 ⁵	50 - 100 to Center of Target For 100' Flare that is 25' above Surrounding Equipment, Use 300'		200	150	50 to 250	50 to 100		
Process Unit—	LOW HAZARD	100	50							150	50				200	100			50	
Tank Farms—	HIGH HAZARD ^C	250 ¹	250 ¹	1 1/2 Dia. Larger						250		100 ⁵			250	250			200	
Tank Farms—	LOW HAZARD	200 ²	100 ³	One Dia. Larger	1/2 Dia. Larger					200					200	200			200	
Product Warehouse	LOW HAZARD ^D	150	50 ⁴	250 ¹	100 ³	50 ⁴				200					200	150			100	
Shipping & Receiving—	HIGH HAZARD ^E	200	200	150 ²	100 ³	150	50			150	100	50 ⁵			200	200			200	
Shipping & Receiving—	LOW HAZARD	150	100	100	50	20	50	—		100	50				150	150			100	
Service Buildings		200	100	200	100	100	150	100	See Bldg. Chart	100					200	100			100	
Boiler Area		200	150	200	150	100	200	100	—	—					200	100			100	

- A. Distance between process units is measured from battery limits.
- B. A high hazard process unit has explosion classification under petrochemical schedule of E-4 or E-5.
- C. High hazard tanks are class "D" under the above schedule. Class "E" requires special consideration.
- D. High hazard product warehouses contain unstable materials, low-flash flammable liquids, or highly combustible solids. These require special consideration.
- E. High hazard shipping and receiving denotes stable materials with flash point below 110° F.
- F. High hazard shipping and receiving of unstable materials requires special consideration.
- G. Service buildings include offices, gate houses, change houses, laboratories, shops, garages, maintenance warehouses, cafeterias, hospitals, etc. Experimental laboratories classify as process units.
- H. Keep open flames 100' from vapor hazard area.
- I. Deviation from these distances requires special protective installations such as fixed foam systems, water spray, automatic sprinklers, fire-system grading of 4 or better, or superior construction.
- J. In borderline cases, high value requires high hazard classification.
- K. Vertical storage tanks should be individually diked. If not, capacity in single dike should not exceed 25,000 bbls. For horizontal storage tanks, maximum is 400,000 gallons per group, with 100' between groups, or other suitable arrangement.

Recommended Spacing Within Process Units

	REACT.	COMP.	TANKS	FRACT. EQUIP.	CONT. ROOMS														
Reactor	25 ⁶																		
Small Compressor House or Pump House	40 ⁶																		
Intermediate Stge. Tanks High Hazard Rundown-Feed	100 to 200	100 to 200	One Dia. ⁷																
Fractionation Equipment	50	30	100																
Control Rooms *	50 to 100	50 to 100	100	50 to 100	10														

- 1. For specific vertical tank, use 5 diameters.
- 2. For specific vertical tank, use 4 diameters.
- 3. For specific vertical tank, use 3 diameters.
- 4. Standard firewall and sprinklered warehouse acceptable. Limit warehouse to maximum 25,000 sq. ft. floor area.
- 5. Two stations desirable.
- 6. Barricades desirable for hazardous reactors.
- 7. Over 100,000 gallons requires special consideration.

*Control houses serving unusually large or hazardous units and central control houses for multiple units or housing computer equipment, require greater spacing and may require blast-resistant construction.

OIL INSURANCE ASSOCIATION

General Recommendations for Spacing in Gasoline Plants

MINIMUM DISTANCE
IN FEET

	SERVICE BUILDINGS	GAS COMPRESSOR HOUSE	LARGE PROCESS OIL PUMP HOUSE	DISTILLATION & FRACTIONATION	UTILITIES	PRESSURE TANKS	ATMOSPHERIC TANKS	LOADING RACKS	MAIN GAS CONTROL VALVE	FIRE PUMPS	OPEN FLAMES	ORDINARY ELECTRICAL STATION—MINIMUM OF 2	TURRET NOZZLES	FIRE EQUIPMENT HOUSE	FLARES	STEAM SNUFF AND/OR BLEWDOWN CONTROL	HYDRANTS	LEAN OIL PUMPS
Service Building	See Chart							50	100	0								
Gas Compressor House	100	—						250 to 500	200	100	50							
Large Process Oil Pump House	100	50	—					250 to 500	200	100								
Distillation and Fractionation	100	50 ¹	30	—				250 to 500	200	100								
Utilities	50	100	100	100	—			250 to 500	0	0								
Pressure Tanks	150	200	200	200	150	— ²			100	250	100							
Atmospheric Tanks	100	200	200	200	100	50	Two Dia. of Largest		100	250	100							
Loading Racks	100	200	200	200	100	100	100	50 to 100	100	150	100	100						
Fired Heaters	100	100	100	100	50	150	100	100	100	150	—							
Cooling Towers	50 to 100 ³	50 to 100 ³	50 to 100 ³	100	100	250	200	200	100		100							
Skid Unit for Package Plant	100	50	50	40	100	100	100	200	250 to 500	150	100							
Control Houses*	50	100	100	50	50	200	200	200	200 to 500	50	100							

Both Stations Should be Located at Least 250' and not over 500' from Compressor House, Process Area, Loading Racks, Heaters, and Main Gas Lines. Minimum 250' between Stations.

Height Less than 75', 300' from Plant.
Height over 75', 200' from Plant.

- Service buildings include: offices, laboratories, change houses, gate houses, shops, maintenance whses., garages, cafeterias, & hospitals.
- Utilities include: boilers, power houses and water treating.
- Where equipment is housed because of cold climate, a standard firewall should separate compressor and process equipment.
 - Maximum of 300,000 gallons per group; 100' between groups, or other suitable arrangements.
 - 50' for handling nonflammables, 100' for handling flammables.
- Fire water systems, with locations of hydrants and valves, require special consideration.
- More spacing may be required in unattended plants or in high-valued attended plants with complex control systems.

*Control houses serving unusually large or hazardous units and central control houses for multiple units or housing computer equipment, require greater spacing and may require blast-resistant construction.

OIL INSURANCE ASSOCIATION

General Recommendations for Spacing in Oil Pipe Line Pump Stations

MINIMUM DISTANCE
IN FEET

	CONTROL ROOM	SERVICE BUILDING	TANKS	MANUAL VALVES	EMERGENCY SHUTDOWN STATIONS	OPEN FLAME	FIRE PUMPS	DWELLINGS	FIRE HYDRANTS	LOADING RACKS								
Pump House	0	50	200	100	250	100		150	200	100	200							
Tanks	200	200	² Dia. Largest	100	250	100		200	200	100	250							

Terminals & Tank Farms

	PRODUCT STORAGE TANKS OTHER THAN L.P.G.	LOADING RACKS	PUMP HOUSES	SERVICE BUILDINGS	DOCKS	FIRE PUMPS	FIRE HYDRANTS	COMPRESSORS	OPEN FLAME	PRESSURE TANKS								
Product Storage Tanks other than L.P.G.	² Dia. Largest	250	200	200	350	300	100	200	200	[▲] 50								
Loading Racks	250	^{50 to 250}	200	200	200	150	100	200	200	100								
Open Flame	200	200	100	—	200	100	50	100	—	200								
Pressure Tanks	[▲] 50	100	100	100	100	200	^{50 to 100}	100	200	[▲] 50								

Off Shore Properties

	SERVICE BUILDINGS	PROCESS AND GAS SEPARATION EQUIPMENT	OPEN FLAME DEVICES	GAS COMPRESSOR HOUSES	EMERGENCY SHUTDOWN STATIONS & BLOCK VALVES	PRODUCT STORAGE TANKS	LOADING RACKS											
Service Buildings	20																	
Process & Gas Separation Equipment	50	—																
Open Flame Devices	—	100	—															
Gas Compressor Houses	[■] 50	50	50	—														
Emergency Shutdown Stations & Block Valves	50	100	100	^{50 to 250}	—													
Product Storage Tanks	[■] 50	50	100	200	100	—												
Loading Docks	100	100	100	100	100	100	—											

- Control room should be pressurized.
- Small open flame devices should be located not less than 50' from any vapor hazard area.
- Service buildings include: offices, change houses, maintenance warehouses, laboratories, garages, except as specifically indicated.
- ▲ 300,000 gallons per group; 100' between groups.

General Specification 275
EXHIBIT 6

CUSTOMER REF.: ET-78-C-01-2578

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/24/78

ORIGINAL REV: 0



LOCATION: HOYT LAKES, MINNESOTA
 ERIE MINING COMPANY
 UNIT OR PROJECT: COMMERCIAL

DESIGN DATA SUMMARY

PUMPS

SULFUR REMOVAL-03

ITEM NUMBER	SERVICE	GROUP TYPE	CAPACITY GPM		SUCTION PRESS. PSIG	ΔP@ MAX. CAP. PSI	PUMP TEMP. °F	S.G. @ P.T.	VIS. C.P.	NPSH AVAIL. FT.	WET END MATERIAL	SHAFT SEAL/PACK		DRIVER			REMARKS (INTERCHANGABLE WITH PUMPS)	
			NORM.	MAX.								API TYPE	FLUSH FLUID	TYPE	HIP	RPM		
P-305 A/B	SLURRY CHARGE	ROTARY	18	51	-0.5 7.5	93.7	100	1.07 1.25	2	22.9				MOTOR				
P-306 A/B/C	SOLUTION CIRCULATING	HORIZ. CENT.	2465	2712	-0.5	81.5	100	1.04 1.25	1.5	22.9			WATER	MOTOR				
P-307	CENTRIFUGE SLURRY	ROTARY	1.6	11	-0.5	92.5	100	1.25 1.42	THIXOTROPIC	20				MOTOR				
P-308	MAKE-UP	VERT. CENT.	50	55	0.0	19.5	100	1.04 1.25	1.5	23.8				MOTOR				
P-309 A/B	FLAKER FEED	HORIZ. CENT.	9	10	-0.5	12.2	270	1.8	12	17				MOTOR				
P-310 A/B	CAUSTIC METERING	METER & PROPOR.	0.1 GPH MIN.	31 GPH	-0.5		100	1.53						MOTOR				
P-331 A/B	WASH WATER	HORIZ. CENT.	50	55	16.7	5.6	100	1.0	.7	69				MOTOR				
P-334 A/B	CONDENSATE	HORIZ. CENT.	45	160	3.7	71	212	.958	.28	~9				MOTOR				
P-335	PURGE UNLOADING	HORIZ. CENT.	200	220	-0.5	30.7	85	1.0 1.25	1.0	23.8				MOTOR				
P-355 A/B	SLURRY CHARGE	ROTARY	64	85	-0.5	93.8	100	1.07 1.31	2	22				MOTOR				
P-356 A/B/C	SOLUTION CIRCULATING	HORIZ. CENT.	4047	4595	-0.5	81.5	100	1.04 1.25	1.5	23			WATER	MOTOR				
P-357	CENTRIFUGE SLURRY	ROTARY	7	18	-0.5	91.2	100	1.25 1.42	THIXOTROPIC	20				MOTOR				
P-358	MAKE-UP	VERT. CENT.	50	55	0.0	19.5	100	1.04 1.25	1.5	24				MOTOR				
P-359 A/B	FLAKER FEED	HORIZ. CENT.	14	15	-0.5	12.2	270	1.8	12	17				MOTOR				
P-360 A/B	CAUSTIC METERING	METER. PROP.	3.6 GPH MIN.	31 GPH	-0.5	15.7	100	1.53						MOTOR				
P-381 A/B	WASH WATER	HORIZ. CENT.	80	88	16.7	4.8	100	1.0	.7	69				MOTOR				
P-382	PURGE UNLOADING	HORIZ. CENT.	300	330	-0.5	32.7	85	1.0 1.25	.7 -1.5	23.8			WATER	MOTOR				

CUSTOMER REF: FT-78-C-01-2578

COAL GASIFICATION PROJECT

CONTRACT NO MC-4814

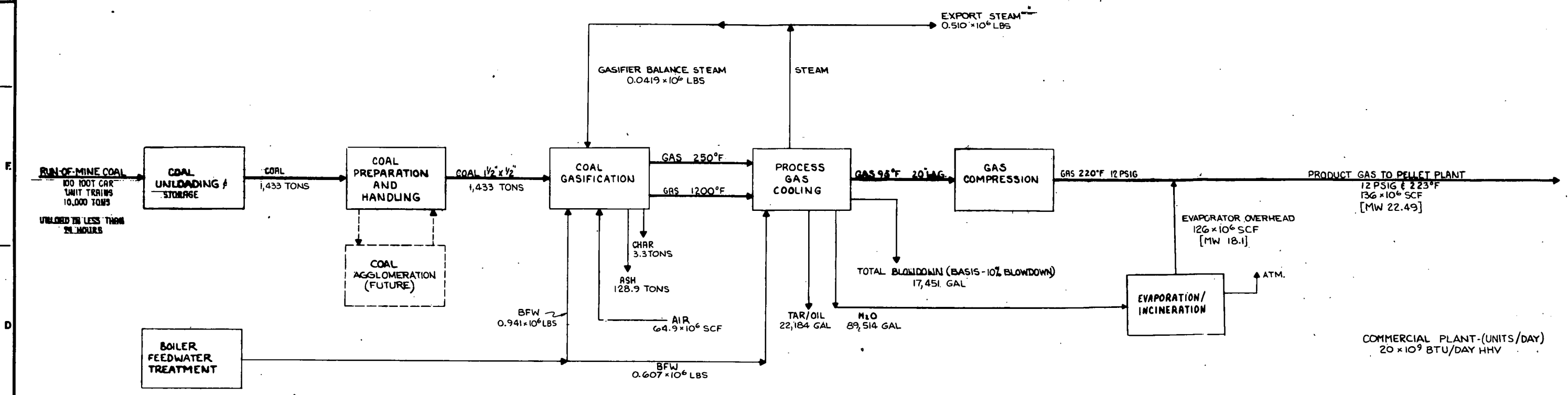
DATE: 10/25/78

ORIGINAL

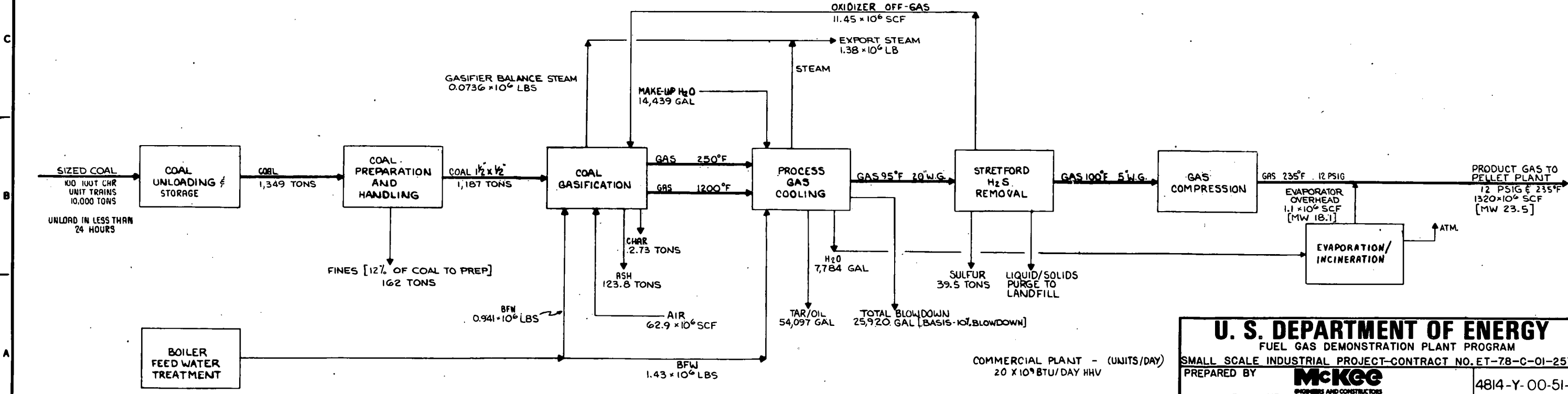
REV: 0

McClure ENGINEERS AND CONSTRUCTORS			LOCATION: HOYT LAKES, MINNESOTA ERIE MINING COMPANY				DESIGN DATA SUMMARY			TANKS	
UNIT OF PROJECT: COMMERCIAL			CAPACITY		DIAMETER FT.	HEIGHT FT.	CORR. ALLOW. IN.	MATERIAL	ROOF TYPE	REMARKS	
ITEM NUMBER	SERVICE	SPEC. GRAV.	M GALS.	M BBLs.							
TK-302-A	Sulfur Decanter No. 1				2'-0"	3'-6" Ves. BTM. T.L./ Flg. Face				Sulfur Removal - 03 Dwg. B-10-VS-4	
TK-302-B	Sulfur Decanter No. 2				3'-0"	4'-6" Ves. BTM. T.L./ Flg. Face				Dwg. B-10-VS-5	
TK-311	Reaction	1.35			24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-6	
TK-314-A	Oxidizer No. 1	1.35			24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-7	
TK-314-B	Oxidizer No. 2	1.35			24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-7	
TK-314-C	Oxidizer No. 3	1.35			24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-8 & B-10-VS-9	
TK-315	Froth				24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-10	
TK-316	Slurry Accumulator	1.35			3'-0"	3'-0" + 45° Conical BTM	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-11	
TK-317	Balance	1.35			24'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-10-VS-12	
TK-318	Sulfur Storage	1.8			11'-0"	13'-0"	1/8"	Carb. Stl.	Cone	Dwg. B-10-VS-13	
TK-319	Caustic	1.42			10'-0"	12'-0"	1/8"	Carb. Stl.	Cone	Dwg. B-10-VS-14	
TK-322	Condensate Drum	1.0			4'-6"	9'-3" T/T	1/8"	Shell & HD.- SA-285-C Support A-36	2:1 S.E.	Dwg. B-10-VS-16	
TK-336	Purge	1.35			11'-0"	13'-0"	1/8"	Carb. Stl.	Cone	Dwg. B-10-VS-15	
TK-352-A	Sulfur Decanter No. 1				2'-0"	4'-6" Ves. BTM T.L./ Flg. Face				Dwg. B-20-VS-4	
TK-352-B	Sulfur Decanter No. 2				3'-0"	6'-0" Ves. BTM T.L./ Flg. Face				Dwg. B-20-VS-5	
TK-363	Reaction	1.35			30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-6	
TK-364-A	Oxidizer No. 1	1.35			30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-7	
TK-364-B	Oxidizer No. 2	1.35			30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-7	
TK-364-C	Oxidizer No. 3	1.35			30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-8 & B-20-VS-9	
TK-365	Froth				30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-10	
TK-366	Slurry Accumulator	1.35			4'-0"	4'-0" + 45° Conical BTM	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-11	
TK-367	Balance	1.35			30'-0"	20'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-12	
TK-368	Sulfur	1.8			13'-0"	15'-0"	1/8"	Carb. Stl.	Flat Cover	Dwg. B-20-VS-13	
TK-369	Caustic	1.42			12'-0"	14'-0"	1/8"	Carb. Stl.	Cone	Dwg. B-20-VS014	
TK-383	Purge	1.35			13'-0"	15'-0"	1/8"	Carb. Stl.	Cone	Dwg. B-20-VS-15	

WESTERN COAL FEED

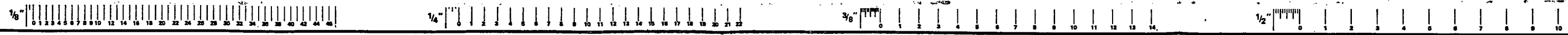


EASTERN COAL FEED

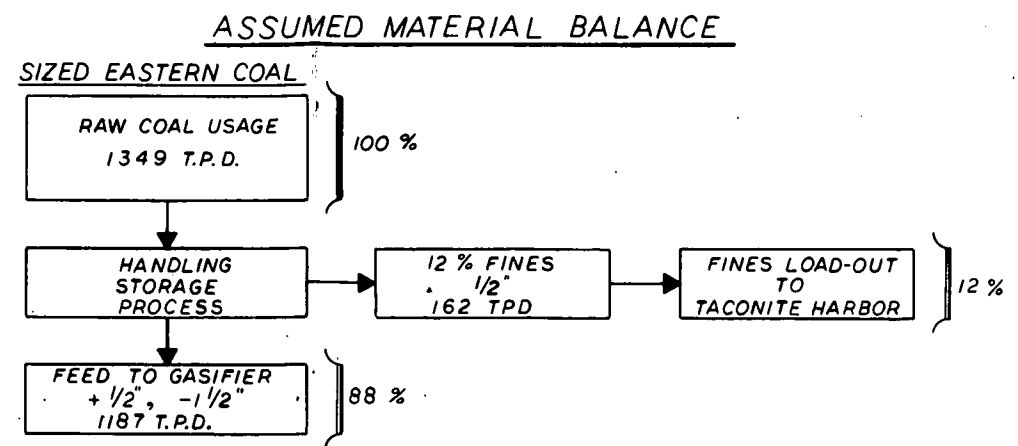
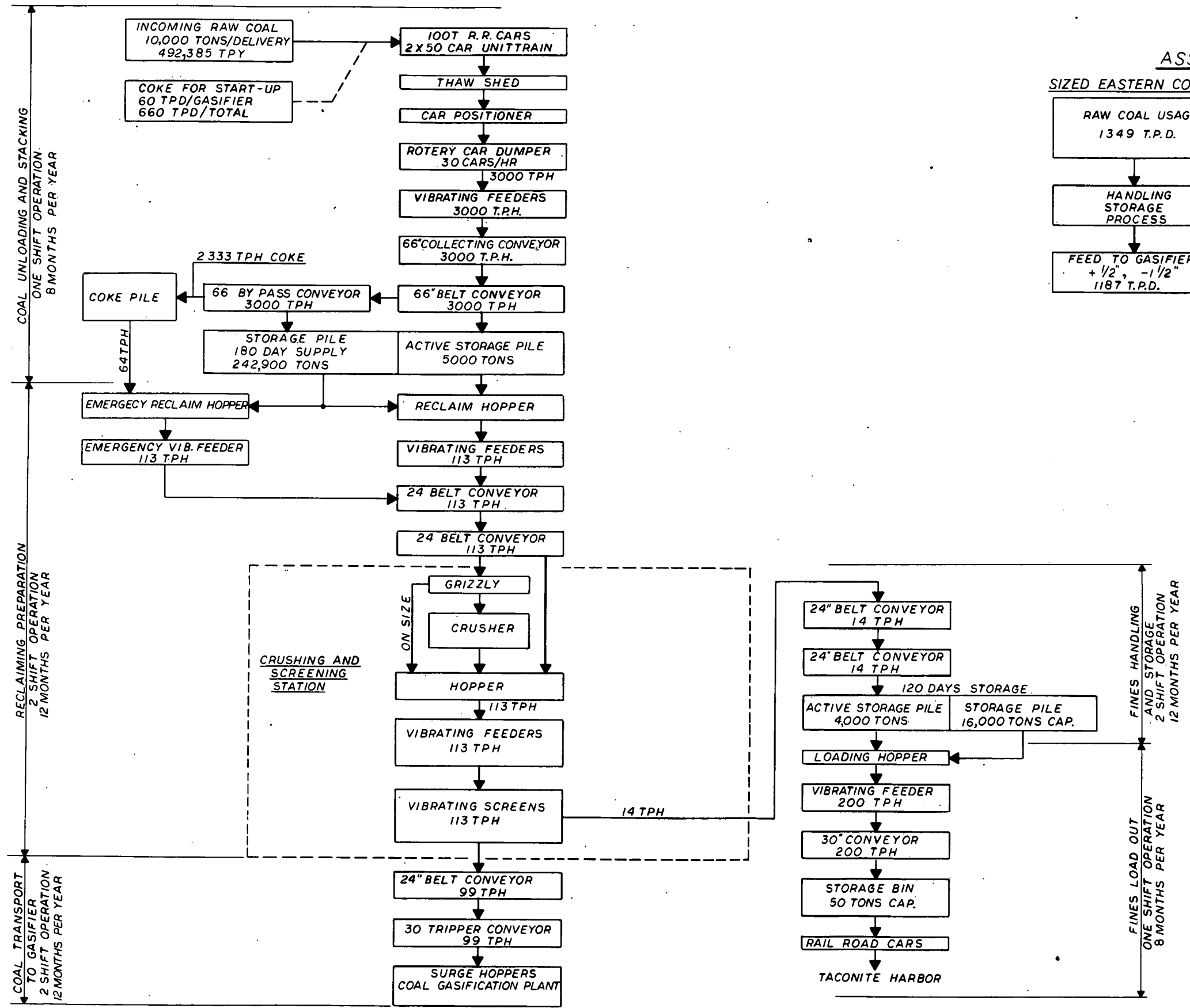


REVISION	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
1															
2															
3															
4															
5															
6	10-23-78	I.O.	W.B.	BASIS OF ESTIMATE	SPD										

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-00-51-2
ERIE MINING COMPANY PROJECT NO. P.E. NO. SCALE NONE
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 COAL GASIFICATION PLANT COMMERCIAL UNIT CONCEPTUAL BLOCK FLOW DIAGRAM
 REVISION Δ



DRAWING NO. 4814-Y-01-54-2



NOTE:
QUANTITIES SHOWN ARE AVERAGE FLOW RATES.

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **MCKEGE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-01-54-2

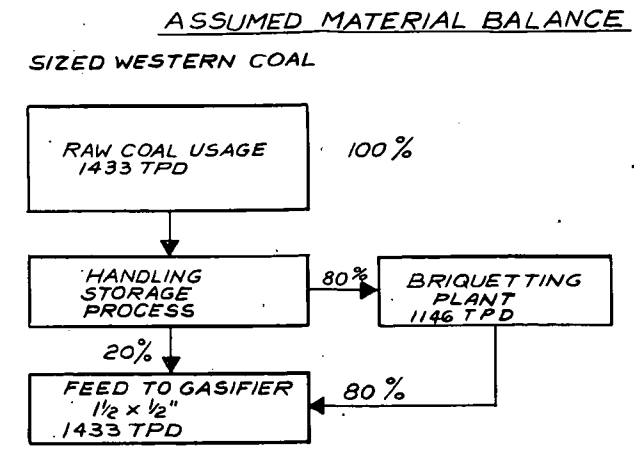
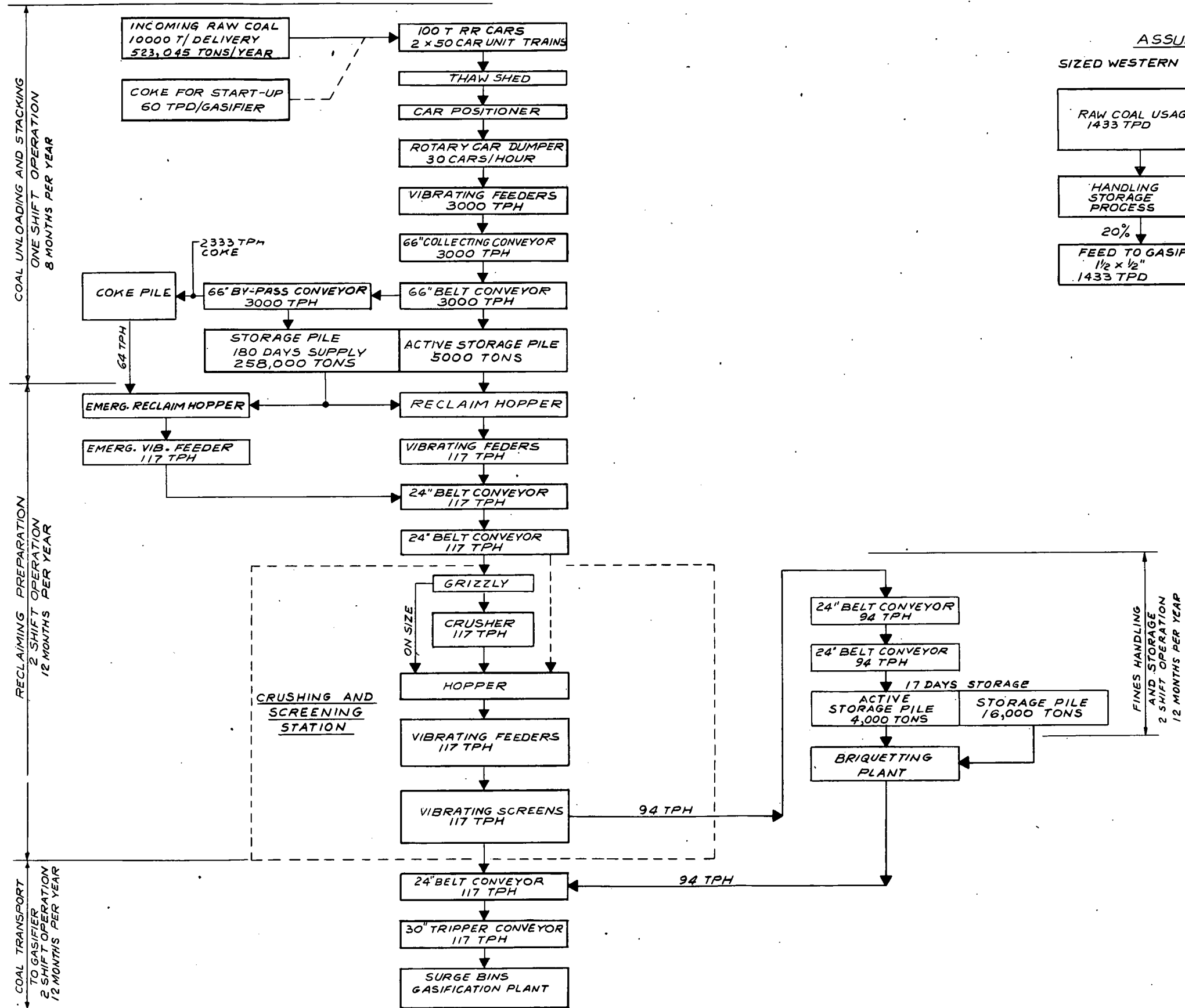
FOR ERIE MINING COMPANY
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

MATERIALS HANDLING
COMMERCIAL UNIT
BLOCK FLOW DIAGRAM — EASTERN COAL

PROJECT NO. P.E. NO.
SCALE NONE
REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10-13-78	MS	74	REDRAWN GENERAL REVISION	10-17-78
										9-19-78	AEG		ISSUED FOR REVIEW	

DRAWING NO. 4814-Y-01-55-2



NOTE:
QUANTITIES SHOWN ARE AVERAGE FLOW RATES.

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-01-55-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

MATERIALS HANDLING COMMERCIAL UNIT

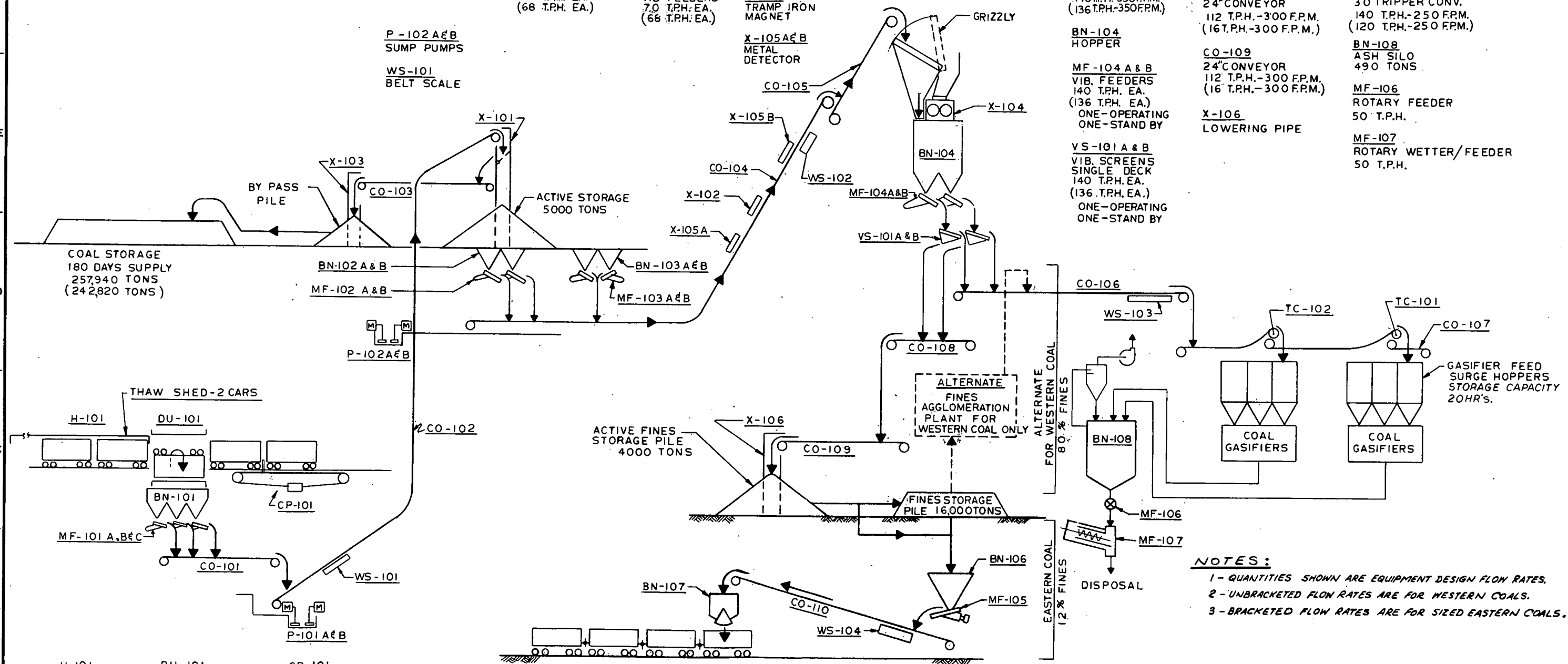
BLOCK FLOW DIAGRAM — WESTERN COAL

SCALE: NONE
REVISION: 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10-13-78	MS	TG	REDRAWN - GENERAL REVISION	MS 10-17-78
										9-19-78	AEG		ISSUED FOR REVIEW	

DRAWING NO. 4814-Y-01-562

- | | | | | | | |
|-----------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
| X-103
LOWERING PIPE | CO-102
66" CONVEYOR
3000 T.P.H. - 700 F.P.M. | X-101
LOWERING PIPE | CO-104
24" CONVEYOR
140 T.P.H. - 350 F.P.M.
(136 T.P.H. - 350 F.P.M.) | X-104
CRUSHER
140 T.P.H.
(136 T.P.H.) | CO-106
24" CONVEYOR
140 T.P.H. - 300 F.P.M.
(120 T.P.H. - 300 F.P.M.) | TC-101
TRIPPER CAR |
| CO-103
66" CONVEYOR
3000 T.P.H. - 700 F.P.M. | BN-102 A & B
RECLAIM HOPPERS | BN-103 A & B
RECLAIM HOPPER | WS-102
BELT SCALE | CO-105
24" CONVEYOR
140 T.P.H. - 350 F.P.M.
(136 T.P.H. - 350 F.P.M.) | WS-103
BELT SCALE | TC-102
TRIPPER CAR |
| P-102 A & B
SUMP PUMPS | MF-102 A & B
VIB. FEEDERS
70 T.P.H. EA.
(68 T.P.H. EA.) | MF-103 A & B
EMERGENCY
VIB FEEDERS
7.0 T.P.H. EA.
(68 T.P.H. EA.) | X-102
TRAMP IRON
MAGNET | BN-104
HOPPER | CO-108
24" CONVEYOR
112 T.P.H. - 300 F.P.M.
(16 T.P.H. - 300 F.P.M.) | CO-107
30 TRIPPER CONV.
140 T.P.H. - 250 F.P.M.
(120 T.P.H. - 250 F.P.M.) |
| WS-101
BELT SCALE | | | X-105 A & B
METAL
DETECTOR | MF-104 A & B
VIB. FEEDERS
140 T.P.H. EA.
(136 T.P.H. EA.)
ONE-OPERATING
ONE-STAND BY | CO-109
24" CONVEYOR
112 T.P.H. - 300 F.P.M.
(16 T.P.H. - 300 F.P.M.) | BN-108
ASH SILO
490 TONS |
| | | | | VS-101 A & B
VIB. SCREENS
SINGLE DECK
140 T.P.H. EA.
(136 T.P.H. EA.)
ONE-OPERATING
ONE-STAND BY | X-106
LOWERING PIPE | MF-106
ROTARY FEEDER
50 T.P.H. |
| | | | | | | MF-107
ROTARY WETTER/FEEDER
50 T.P.H. |



- NOTES:**
- 1 - QUANTITIES SHOWN ARE EQUIPMENT DESIGN FLOW RATES.
 - 2 - UNBRACKETED FLOW RATES ARE FOR WESTERN COALS.
 - 3 - BRACKETED FLOW RATES ARE FOR SIZED EASTERN COALS.

- | | | | | | | |
|---------------------------------------------------|---------------------------------------------------------------------|--------------------------------------|--------------------------------|----------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------|
| H-101
THAW SHED
HEATERS
5 CARS/HR | DU-101
ROTARY CAR DUMPER
20 CARS/HR | CP-101
CAR POSITIONER | BN-101
DUMPER HOPPER | CO-101
66" COLLECTING CONVEYOR
3000 T.P.H. - 700 F.P.M. | CO-110
30" CONVEYOR
(240 T.P.H. - 325 F.P.M.) | BN-106
LOADING HOPPER |
| | MF-101 A, B & C
VIBRATING FEEDERS
1000 T.P.H. EACH | P-101 A & B
SUMP PUMPS | | | BN-107
STORAGE BIN
50 TONS WITH GATE | MF-105
VIBRATING FEEDER
(240 T.P.H.) |
| | | | | | | WS-104
BELT SCALE |

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-01-56-2

FOR ERIE MINING COMPANY
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

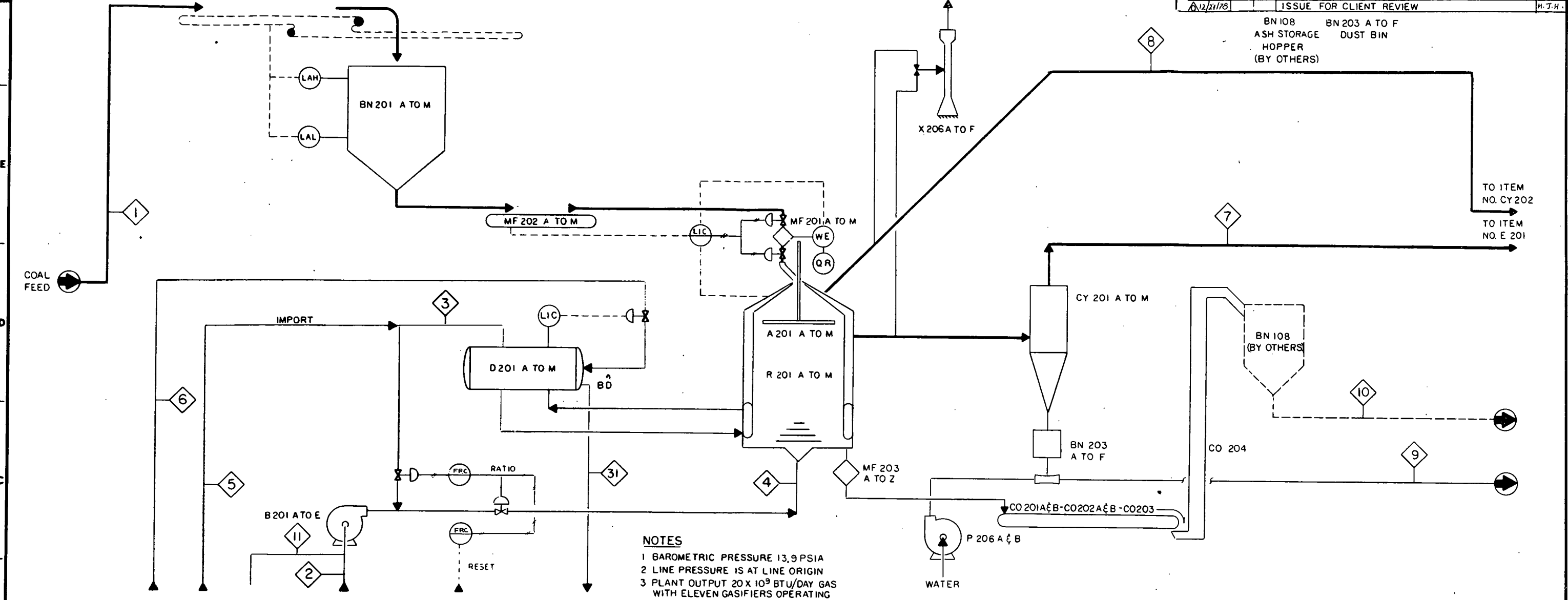
MATERIALS HANDLING P F D
COMMERCIAL UNIT
COAL HANDLING AND PREPARATION

REVISION **1**

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10-13-78	MS 74		REDRAWN - GENERAL REVISION	
										9-19-78	AE 4		ISSUED FOR REVIEW	

BN 201 A TO M COAL SURGE HOPPER CAPACITY 66 TONS C.S. LINED
 D 201 A TO M L.P. STEAM DRUM 4'-6" DIA 11'-6" T.T. C.S.
 MF 202 A TO M COAL FEEDER 83 TONS/HR
 MF 201 A TO M LOCK HOPPER CAPACITY 690^F C.S.
 A 201 A TO M STIRRER
 R 201 A TO M GASIFIER 12' I.D. 47' H
 X 206 A TO F FLARE STACK
 CY 201 A TO M DUST CYCLONE

REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.
▲					
▲					
▲					
▲	12/21/78			ISSUE FOR CLIENT REVIEW	H.T.H.



- NOTES**
- 1 BAROMETRIC PRESSURE 13.9 PSIA
 - 2 LINE PRESSURE IS AT LINE ORIGIN
 - 3 PLANT OUTPUT 20 X 10⁹ BTU/DAY GAS WITH ELEVEN GASIFIERS OPERATING
 - 4 DUPLICATE EQUIPMENT NEVER DESIGNATE "1" OR "0"
 - 5 ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 6 ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60° F
 - 7 STANDARD MOLAR GAS VOLUME IS 378.5 FT³

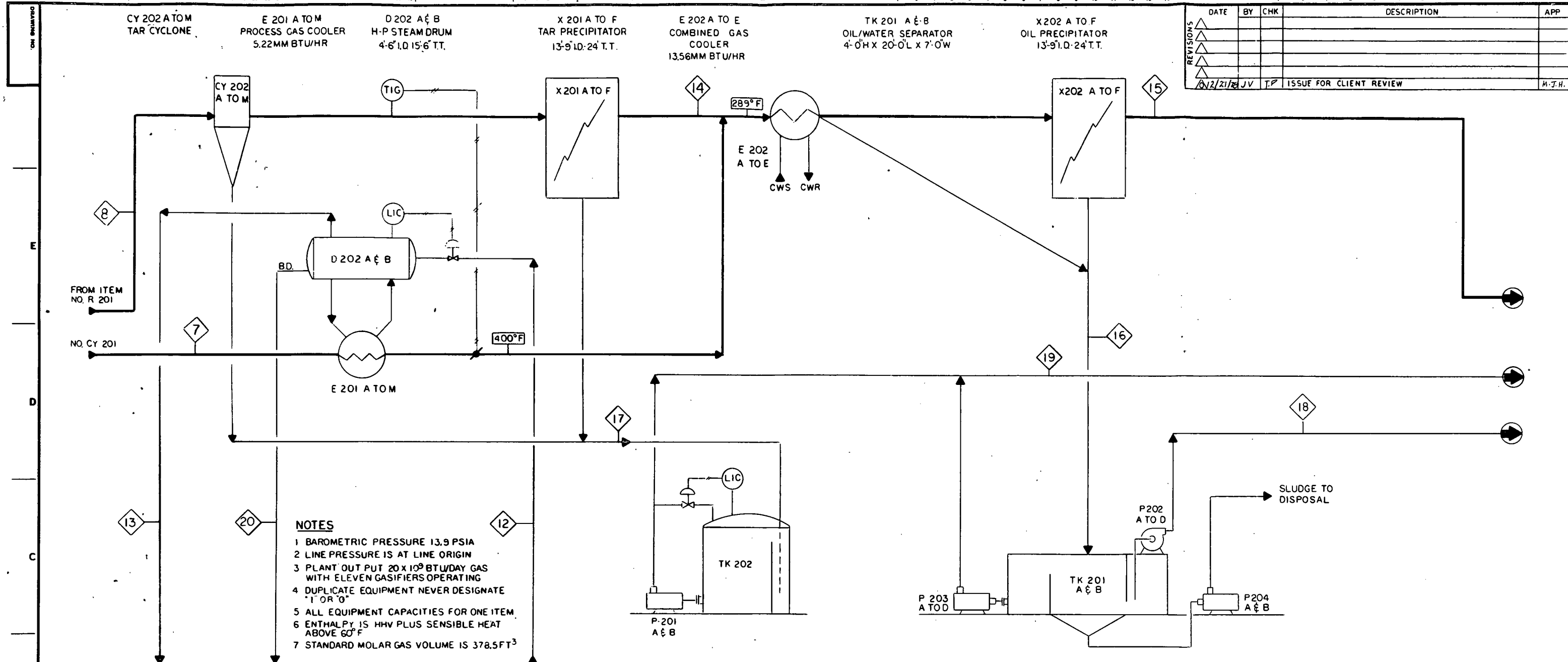
BABCOCK CONTRACTORS INC.
 PITTSBURGH, PA.
 A Subsidiary of Babcock International Inc.
 PROJECT NO. 3001 DRAWING NO. P 085 ISSUE NO. 0
 FOR CLIENT REVIEW SIGNED *[Signature]* DATE 12/21/78

CRITERIA	STREAM IDENTIFICATION														COAL FEED ANALYSIS		
	1	2	3	4	5	6	7	8	9	10	31						
	COAL FEED	AIR	STM PRODUCED	BLAST	BALANCE STM	L.P. B.F.W.	CLEAR GAS	TOP GAS	DUST	ASH	LP BLOWDOWN						
	#/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	#/HR MOL/HR	
MOISTURE FREE COAL	88,832																25.60
ASH/CHAR/DUST									273	10743							50.74
TAR/OIL																	3.53
CARBON MONOXIDE																	0.87
CARBON DIOXIDE																	0.01
HYDROGEN																	0.87
NITROGEN		154946	5533.8														10.11
METHANE																	8.27
C ₂ TO C ₄																	100.00
HYDROGEN SULFIDE																	877.58 BTU
CARBONYL SULFIDE																	
AMMONIA																	
HYDROGEN CYANIDE																	
OXYGEN		47122	1473.0														
CHLORIDE																	
WATER	30,568	2019	112.2	35676	1981.1	39438	2189.2	1749	97.0	39243	2180						
TOTAL	119400	204087	7192.0	35676	1981.1	241506	9197.3	1749	97.0	39243	2180						
M M SCFD																	
US GPM																	
PRESSURE PSIG OR # H ₂ O G	0	64.3	0	25 PSIG		83.5	60°	25 PSIG	25 PSIG	81.7°	35.2						
TEMPERATURE °F	60	60	267			147	267		210	1060							
DENSITY LB/FT ³	0.0718	0.0718	0.0952			0.0692	0.0952		59	0.0200							
ENTHALPY MM BTU/HR	1048.7	0	40.5			47.6	2.0		5.9	249.7							

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U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 4814-Y-02-85-2 SHEET 1 OF 2
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT R.F.D. - WEST COAL
 PROJECT NO. 3001 P.E. NO. 672
 PROCESS ENGINEERING APPROVAL BY: *[Signature]* DATE: 12/21/78
 REVISION 0

REVISIONS	DATE	BY	CHK	DESCRIPTION	APP
▲					
▲					
▲					
▲	12/21/78	JV	TP	ISSUE FOR CLIENT REVIEW	M.J.H.



- NOTES**
- 1 BAROMETRIC PRESSURE 13.9 PSIA
 - 2 LINE PRESSURE IS AT LINE ORIGIN
 - 3 PLANT OUT PUT 20×10^9 BTU/DAY GAS WITH ELEVEN GASIFIERS OPERATING
 - 4 DUPLICATE EQUIPMENT NEVER DESIGNATE "1" OR "0"
 - 5 ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 6 ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60°F
 - 7 STANDARD MOLAR GAS VOLUME IS 378.5 FT³

P 201 A & B
TAR TRANSFER PUMP
40 GPM AT 50 FT

TK 202
TAR TANK
4'-0" I.D. X 4'-0" H

P 204 A & B
SLUDGE PUMP
10 GPM AT 75 PSI

P 203 A TO D
OIL TRANSFER PUMP
10 GPM AT 50 FT.

P 202 A TO D
AQUEOUS EFFLUENT PUMP
40 GPM AT 50 FT.

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P086 ISSUE NO. 0
FOR CLIENT REVIEW SIGNED *J. L. ...* DATE 12/21/78

CRITERIA	7		8		12		13		14		15		16		17		18		19		20	
	CLEAR GAS		TOP GAS		H.P. B.F.W.		H.P. STEAM		DETARRED GAS		COOLED GAS		OIL/WATER		TAR		AQUEOUS EFFLUENT		TAP/OIL		HP BLOW DOWN	
	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
MOISTURE FREE COAL																						
ASH/CHAK/DUST																						
TAR/OIL											24	0.24	24	23.2	5466	54.66	11	0.11	7773	77.7		
CARBON DIOXIDE											93541	3340.5										
CARBON MONOXIDE											38392	872.4	119	2.7			119	2.7				
HYDROGEN											5891	2944.6										
METHANE											1558.55	5565.3										
ETHANE											1317	82.3										
PROPANE											1027	25.7										
HYDROGEN SULFIDE											733	21.43	5	0.22			5	0.22				
CARBONYL SULFIDE											379	6.30										
AMMONIA											176	10.4	24	1.43			24	1.43				
HYDROGEN CYANIDE											10	0.33	9	0.32			9	0.32				
OXYGEN																						
CHLORIDE													10	0.32			10	0.32				
WATER																						
TOTAL																						
MM SCFD	35.16		104.76		43.8	9.49		104.3		123.8		20"	0	66.76		10.81	25PSIG	62.2	25PSIG	15.4	125PSIG	4.3
USGPM																						
PRESSURE PSIG OR H2OG		40"		30"	150 PSIG		125 PSIG		25"		20"	0					25PSIG		25PSIG		125PSIG	
TEMPERATURE °F	1060		250		210	352		250		95		95	250		95		95		204		352	
DENSITY LB/FT ³	0.0200		0.0439		59	0.308		0.0452		0.0585		62	63.24		62.0		63		55.6			
ENTHALPY MM BTU/HR	249.7		770.3		3.09	21.86		677.2		867.3		14.83	93.08		.189		133.1		0.67			

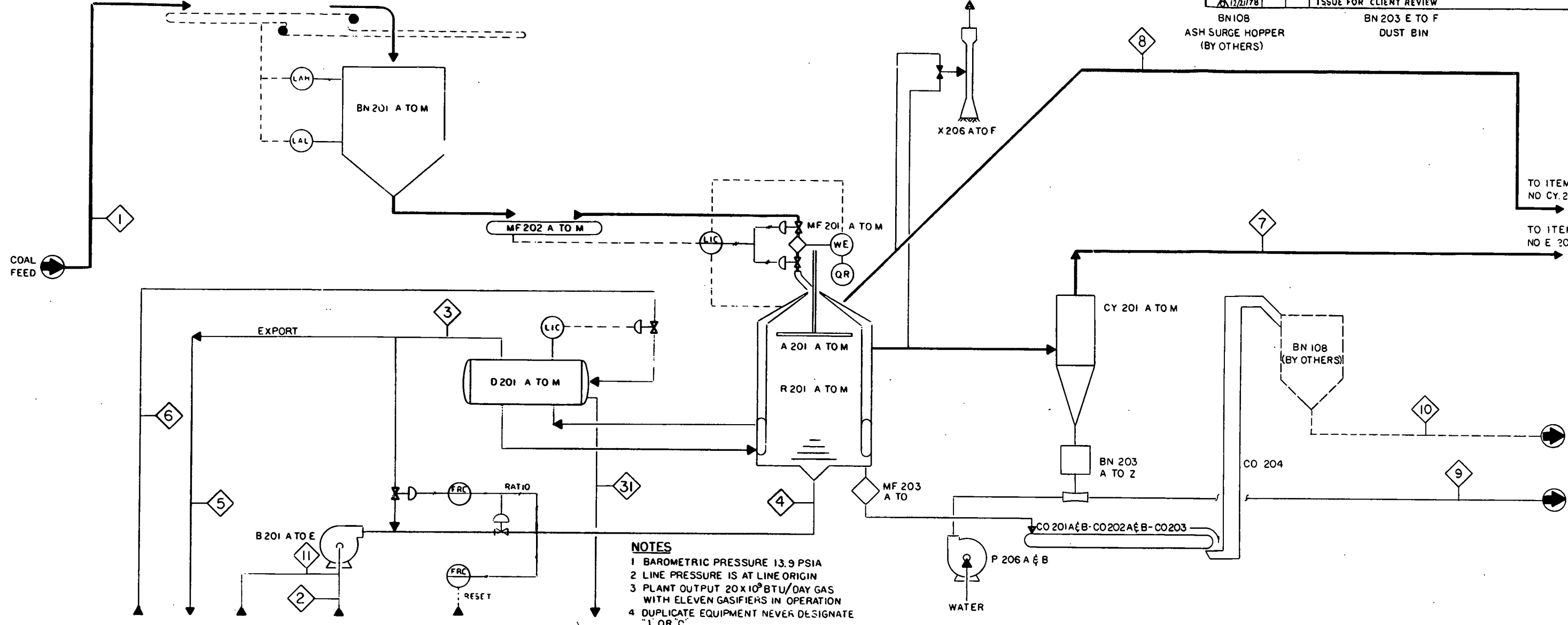
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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-Y-02-86-2
SHEET 2 OF 2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT
P.F.D. WEST COAL
PROJECT NO. 3001 P.E. NO. 3001
PROCESS ENGINEERING APPROVAL
BY M.J.H. DATE 12/21/78
REVISION 0

BN 201 A TOM COAL SURGE HOPPER CAPACITY 66 TONS C.S. LINED
 D 201 A TOM LP STEAM DRUM 4' 6" DIA. 11'-6" T.T. C.S.
 MF 202 A TOM COAL FEEDER 83 TONS/HR
 MF 201 A TOM LOCK HOPPER CAPACITY 690" C.S.
 A 201 A TOM STIRRER
 R 201 A TOM GASIFIER 12' I.D. 47' H
 X 206 A TO F FLARE STACK
 CY 201 A TOM DUST CYCLONE

REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.
1	12/21/78			ISSUE FOR CLIENT REVIEW	M.J.H.



- NOTES**
- 1 BAROMETRIC PRESSURE 13.9 PSIA
 - 2 LINE PRESSURE IS AT LINE ORIGIN
 - 3 PLANT OUTPUT 20 X 10⁹ BTU/DAY GAS WITH ELEVEN GASIFIERS IN OPERATION
 - 4 DUPLICATE EQUIPMENT NEVER DESIGNATE "1" OR "C"
 - 5 ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 6 ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60° F
 - 7 STANDARD MOLAR GAS VOLUME IS 378.5 FT³

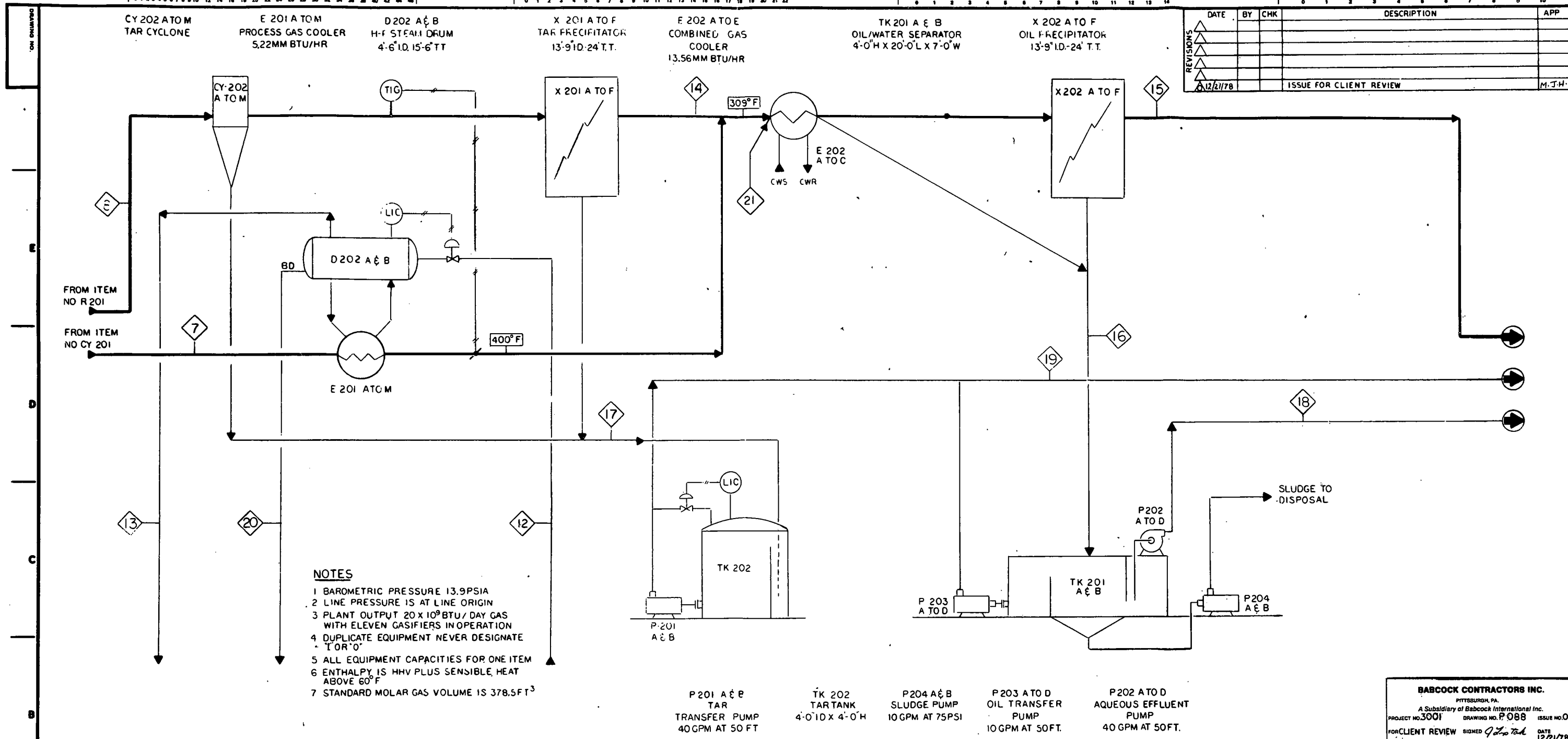
BABCOCK CONTRACTORS INC.
 PITTSBURGH, PA.
 A Subsidiary of Babcock International Inc.
 PROJECT NO. 3001 DRAWING NO. P 087 ISSUE NO. 0
 FOR CLIENT REVIEW SIGNED *[Signature]* DATE 12/21/78

CRITERIA	1		2		3		4		5		6		7		8		9		10		11		31		COAL FEED ANALYSIS		
	COAL FEED		AIR		STM. PRODUCED		BLAST		BALANCE STM.		L.P. B.F.W.		CLEAR GAS		TOP GAS		DUST		ASH		STRET FORD REC.		HP BLOW DOWN		MOISTURE		
	#/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	MOL/HR	%/HR	
MOISTURE FREE COAL	94659																									4.3	
ASH / CHAR / DUST																											71.21
TAR / OIL																											5.05
CARBON MONOXIDE							31.6	1.14																			1.13
CARBON DIOXIDE							276	6.27																			0.07
HYDROGEN							1.9	1.0																			3.33
NITROGEN							17803.4	6358.3																			5.30
METHANE																											9.61
C ₂ TO C ₄																											100.00
HYDROGEN SULFIDE																											HHV
CARBONYL SULFIDE																											12.977
AMMONIA																											
HYDROGEN CYANIDE																											
OXYGEN				460.8	1437.9																						
CHLORIDE																											
WATER																											
TOTAL	98913	199452	695649	35676	1980.3	34578	1910.4	4703	261.1	39243	2181.1																
MM SCFD																											
US GPM																											
PRESSURE PSIG OR °H ₂ O G	0	0		25 PSIG	60"	25 PSIG	60"	25 PSIG	25 PSIG	83.5	47.2																
TEMPERATURE °F	60	60		267	140	267	210	1140	250	1202	140																
DENSITY LB/FT ³				0.0718	0.0719	0.0788	0.0719	59	0.0485																		
ENTHALPY MM BTU/HR	1283.5	2.08		40.5	44.05	0.54	7.6	587.3	666																		

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U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND, OHIO
 4814-Y-02-87-2 SHEET 1 OF 2
ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES, MINNESOTA
 GASIFICATION COMMERCIAL UNIT P.F.D.-EAST COAL
 PROJECT NO. P.E. NO.
 PROCESS ENGINEERING APPROVAL
 BY: *[Signature]* DATE: 12/31/78
 REVISION Δ



DATE	BY	CHK	DESCRIPTION	APP
12/21/78			ISSUE FOR CLIENT REVIEW	M.T.H.

- NOTES**
- 1 BAROMETRIC PRESSURE 13.9 PSIA
 - 2 LINE PRESSURE IS AT LINE ORIGIN
 - 3 PLANT OUTPUT 20 x 10⁹ BTU / DAY GAS WITH ELEVEN GASIFIERS IN OPERATION
 - 4 DUPLICATE EQUIPMENT NEVER DESIGNATE "T" OR "O"
 - 5 ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 6 ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60°F
 - 7 STANDARD MOLAR GAS VOLUME IS 378.5 FT³

P-201 A & B TAR TRANSFER PUMP 40 GPM AT 50 FT
 TK-202 TAR TANK 4'-0" X 4'-0" H
 P-204 A & B SLUDGE PUMP 10 GPM AT 75 PSI
 P-203 A TO D OIL TRANSFER PUMP 10 GPM AT 50 FT.
 P-202 A TO D AQUEOUS EFFLUENT PUMP 40 GPM AT 50 FT.

BABCOCK CONTRACTORS INC.
 PITTSBURGH, PA.
 A Subsidiary of Babcock International Inc.
 PROJECT NO. 3001 DRAWING NO. P-088 ISSUE NO. 0
 FOR CLIENT REVIEW SIGNED *[Signature]* DATE 12/21/78

CRITERIA	7		8		12		13		14		15		16		17		18		19		20		21	
	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
MOISTURE FREE COAL																								
ASH/CHAR/DUST																								
TAR/OIL																								
CARBON MONOXIDE																								
CARBON DIOXIDE																								
HYDROGEN																								
NITROGEN																								
METHANE																								
C ₂ TO C ₆																								
HYDROGEN SULFIDE																								
CARBONYL SULFIDE																								
AMMONIA																								
HYDROGEN CYANIDE																								
OXYGEN																								
CHLORIDE																								
WATER																								
TOTAL																								
MM SCFD	83.5		47.2		115.68	251		46		128.55			17.5		25.97		6.35		37.57		9.95		10.8	
USGPM																								
PSIG OR H ₂ O G	40"		30"		125 PSIG	25" H ₂ O		25" H ₂ O		208 LL					25 PSIG				204		60		62	
TEMPERATURE °F	1140		250		210	352		250		95					95				204		60		62	
DENSITY LB/FT ³	0.0219		0.0485		5	0.306		0.0464		0.0581					61.7				63.24		62.1		62	
ENTHALPY MM BTU/HR	587.3		666		8.22	57.9		436		850.1					95.5				230.1		326		0	

This drawing, including the information it contains, is the property of Erie Mining Company, Pickands Mather & Co., Managing Agent. It is submitted only in connection with a project under contract between Erie and The United States Department of Energy and must not be used in any manner detrimental to the interests of Erie or the Department of Energy. The drawing is not to be copied and must be returned upon request.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM

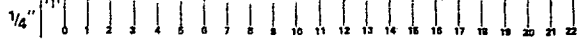
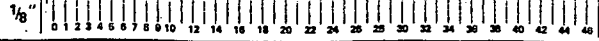
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKOG** 4814-Y-02-88-2
 CLEVELAND, OHIO SHEET 2 OF 2

FOR **ERIE MINING COMPANY** PROJECT NO. 3001 P.E. NO.
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES, MINNESOTA

GASIFICATION COMMERCIAL UNIT P.F.D.-EAST COAL

REVISION *[Signature]*



C-401 A/B/C
 COAL GAS BOOSTER COMPRESSORS
 CAP : 45,475 SCFM
 ΔP : 12.7 PSI

F-10 Y-05-51-2
FROM E-501 AND E-502

F-10 Y-05-52-2
FROM E-501

TO GASIFIER
AIR BLOWERS

FROM GASIFICATION UNIT
(WESTERN COAL)

FROM STRETTFORD UNIT
(EASTERN COAL)

TO PELLET PLANT

NOTES:

1. CONTINUOUS AVERAGE OF INTERMITTENT FLOW IS LISTED FOR STREAM
 INTERMITTENT FLOW RATE IS 7,988#/HR BASED ON WASTEWATER
 EVAPORATOR E-501 OPERATING 121 DAYS/YR FOR EASTERN COAL CASE.

WESTERN COAL CASE

STREAM COMPOSITION	1		2		3		4	
	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
TAR/OIL	23.2	0.24	23.2	0.24			23.2	0.24
CARBON MONOXIDE	93,449	3336	93,449	3336			93,449	3336
CARBON DIOXIDE	38,222	868.7	38,222	868.7	118.1	2.68	38,340	871.4
HYDROGEN	5747.3	2,851	5747.3	2,851			5747.3	2,851
NITROGEN	155,530	5,553	155,530	5,553			155,530	5,553
METHANE	1,316.8	82.08	1,316.8	82.08			1,316.8	82.08
C ₂ TO C ₅	1,027.3	25.68	1,027.3	25.68			1,027.3	25.68
HYDROGEN SULFIDE	730.8	21.43	730.8	21.43	5.9	0.17	736.7	21.60
CARBONYL SULFIDE	378.4	6.30	378.4	6.30			378.4	6.30
AMMONIA	904.9	53.14	904.9	53.14	97.8	5.75	1,002.7	58.89
HYDROGEN CYANIDE	8.6	0.32	8.6	0.32	8.6	0.32	17.2	0.64
WATER	13,681	759.5	13,681	759.5	24,789	1,377.2	38,470	2,136.7
PHENOL					7.6	0.08	7.6	0.08
CHLORIDE								
TOTAL	311,019	13,557.4	311,019	13,557.4	25,027	1,386.2	336,046	14,943.6
USGPM MMSCFD		123.32		123.32		12.61		135.93
PRESSURE, PSIG (H ₂ O)	(20")		12.2		12.2		12.2	
TEMPERATURE, °F	95		220		250		223	
DENSITY, LB/FT ³	0.0563		0.0821		0.0619		0.0801	

EASTERN COAL CASE

STREAM COMPOSITION	1		2		3 NOTE (1)		4	
	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
TAR/OIL								
CARBON MONOXIDE	95,716	3,416	95,716	3,416			95,716	3,416
CARBON DIOXIDE	36,232	823.2	36,232	823.2	4.4	0.10	36,236	823.3
HYDROGEN	5,254	2,606	5,254	2,606			5,254	2,606
NITROGEN	178,500	6,370	178,500	6,370			178,500	6,370
METHANE	1,523	94.9	1,523	94.9			1,523	94.9
C ₂ TO C ₅	1,758	39.9	1,758	39.9			1,758	39.9
HYDROGEN SULFIDE	24.5	50 PPMV	24.5	50 PPMV	24.3	0.71	48.8	100 PPMV
CARBONYL SULFIDE	639.2	10.65	639.2	10.65			639.2	10.65
AMMONIA	763.5	44.84	763.5	44.84	7.1	0.42	770.6	45.26
HYDROGEN CYANIDE	25.7	0.95	25.7	0.95			25.7	0.95
WATER	17,451	968.6	17,451	968.6	2,614	145.2	20,065	1,113.8
PHENOL								
CHLORIDE	70	2.03	70	2.03			70	2.03
TOTAL	337,957	14,377.1	337,957	14,377.1	2,650	146.4	340,607	14,523.5
USGPM MMSCFD		130.94		130.94		1.33		132.27
PRESSURE, PSIG (H ₂ O)	(5")		12.2		12.2		12.2	
TEMPERATURE, °F	100		235		250		235	
DENSITY, LB/FT ³	0.0551		0.0823		0.0620		0.0821	

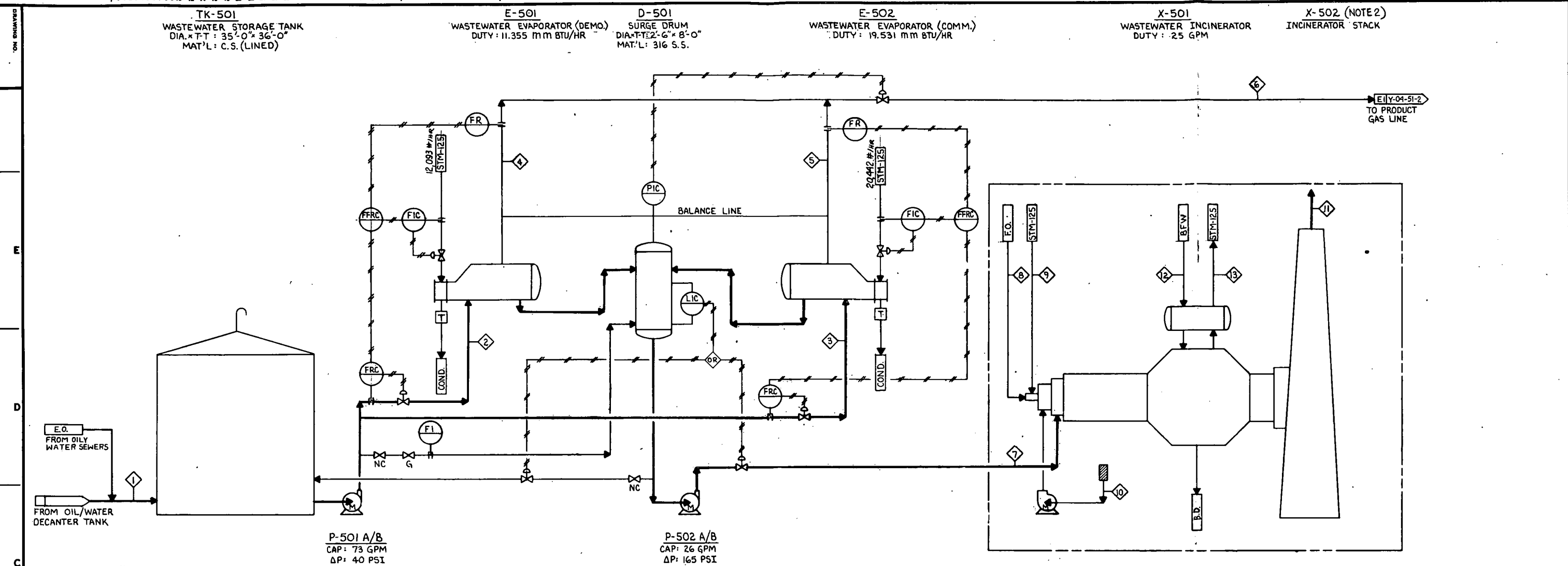
DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-04-51-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA

GAS TRANSMISSION COMMERCIAL UNIT GAS COMPRESSION (PFD)

REVISION 1



NOTES:

- TAR/OIL COMPOSITION IS AS FOLLOWS:

WT.2	
C	82.78
H	9.37
O	7.40
N	0.46
S	0.40
ASH*	0.19
MOISTURE	—
	100.00

 HHV=16,400 BTU/#
- X-502 MAY OR MAY NOT BE SUPPLIED BY THE INCINERATOR VENDOR.

STREAM	①		②		③		④		⑤		⑥		⑦		⑧		⑨		⑩		⑪		⑫		⑬	
	AQUEOUS WASTE		WASTE TO E-501		WASTE TO E-502		VAPOR FROM E-501		VAPOR FROM E-502		VAPOR TO GAS PRODUCT LINE		LIQUID TO INCINERATOR		TAR/OIL (NOTE 1)		ATOMIZING STEAM		COMBUSTION AIR		STACK GAS		BOILER FEED WATER		125 PSIG STEAM	
COMPOSITION	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
ASH															1475	—					2.8	0.03				
TAR/OIL																										
PHENOL	10.8	0.11	4.0	0.04	6.8	0.07	2.8	0.03	4.8	0.05	7.6	0.08	3.2	0.03												
CARBON DIOXIDE	118.1	2.68	43.9	1.00	74.2	1.68	43.9	1.00	74.2	1.68	118.1	2.68										4,454	101.2			
HYDROGEN SULFIDE	5.9	0.17	2.2	0.06	3.7	0.11	2.2	0.06	3.7	0.11	5.9	0.17														
AMMONIA	108.4	6.38	40.3	2.37	68.1	4.01	36.2	2.13	61.6	3.62	97.8	5.75	10.6	0.63												
HYDROGEN CYANIDE	8.6	0.32	3.2	0.12	5.4	0.20	3.2	0.12	5.4	0.20	8.6	0.32														
CHLORIDE	11.9	0.32	4.4	0.12	7.5	0.20							11.9	0.32								11.9	0.32			
WATER	30,967	1720.4	11,510	639.4	19,457	1,081.0	9,214	511.9	15,575	865.3	24,789	1,377.2	6,178	343.2			368	20.4	227	12.6	8,036	446.4	17,717	983.4	16,874	936.6
SULFUR DIOXIDE	3.4	0.05	1.3	0.02	2.1	0.03							3.4	0.05								15.2	0.24			
NITROGEN																					17,681	631.5	17,691	631.8		
OXYGEN																					5,336	166.8	1,067	33.34		
NO _x (AS NO ₂)																						16.7	300ppm			
TOTAL	31,234	1,730.4	11,609	643.1	19,625	1,087.3	9,302	515.2	15,725	871.0	25,027	1,386.2	6,207	344.2	1,475	—	368	20.4	23,244	810.9	31,295	1,213.7	17,717	983.4	16,874	936.6
US GPM/MMSCFO	62.7		23.3		39.4			4.69			7.92		12.61	13.2	2.8			0.19		7.38		11.04	37.1			8.53
PRESSURE, PSIG								15		15		12.2		250		125			-0.5		-0		220		125	
TEMPERATURE, °F	95		95		95			250		250		250		250		175			70		650		220		353	
DENSITY, LB/FT ³	62.1		62.1		62.1			0.0685		0.0685		0.0619		58.8		65.5		0.3106		0.0679		0.0301		59.6		0.3106

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y05-51-2
 SHEET 1 of 2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

WASTE TREATMENT COMMERCIAL UNIT
 WASTEWATER FACILITIES (PFD) WEST COAL

REVISION 1

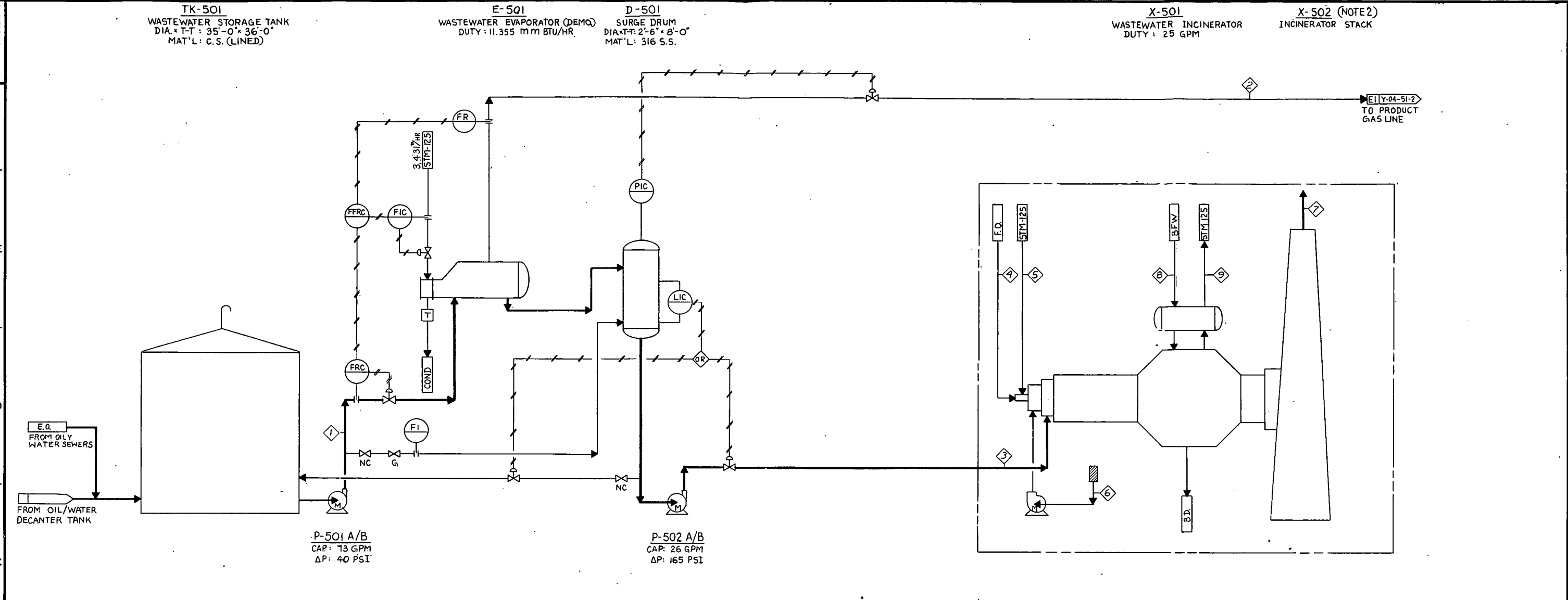
TK-501
WASTEWATER STORAGE TANK
DIA. x T-T: 35'-0" x 36'-0"
MAT'L: C.S. (LINED)

E-501
WASTEWATER EVAPORATOR (DEMO)
DUTY: 11,355 MM BTU/HR.

D-501
SURGE DRUM
DIA. x T-T: 2'-6" x 8'-0"
MAT'L: 316 S.S.

X-501
WASTEWATER INCINERATOR
DUTY: 25 GPM

X-502 (NOTE 2)
INCINERATOR STACK



STREAM COMPOSITION	1 AQUEOUS WASTE		2 VAPOR TO GAS PRODUCT LINE		3 LIQUID TO INCINERATOR		4 FUEL OIL (NOTE 1)		5 ATOMIZING STEAM		6 COMBUSTION AIR		7 STACK GAS		8 BOILER FEED WATER		9 125 PSIG STEAM	
	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
ASH							181.5						0.1	0.001				
TAR/OIL																		
PHENOL																		
CARBON DIOXIDE	4.4	0.10	4.4	0.10									565	12.85				
B HYDROGEN SULFIDE	24.3	0.71	24.3	0.71														
AMMONIA	42.2	2.48	7.1	0.42	35.1	2.06												
HYDROGEN CYANIDE																		
CHLORIDE	70.3	2.00			70.3	2.00							70.3	2.00				
WATER	3,268	181.6	2,614	145.2	654	36.33			45.3	2.52	33.2	1.84	972	54.0	2,180	121.1	2,071	115.1
SULFUR DIOXIDE	3.4	0.05			3.4	0.05							7.03	0.11				
NITROGEN											2,584	92.3	2,614	93.4				
OXYGEN											780	24.37	156	4.87				
NO _x (AS NO ₂)													2.32	300PPM				
TOTAL	3,413	186.9	2,650	146.4	763	40.5	181.5		45.3	2.52	3,397	118.5	4,387	167.3	2,180	121.1	2,071	115.1
A US GPM/MM SCFD	6.9			1.33	1.6		0.3			0.02			1.08	1.52				
PRESSURE, PSIG			12.2		250		175		125	-0.5			0				125	
TEMPERATURE, °F	95		250		250		175		353	70			650		220		353	
DENSITY, LB/FT ³	62.1		0.0620		58.8		65.5		0.3106	0.0679			0.0306		59.6		0.3106	

NOTES:

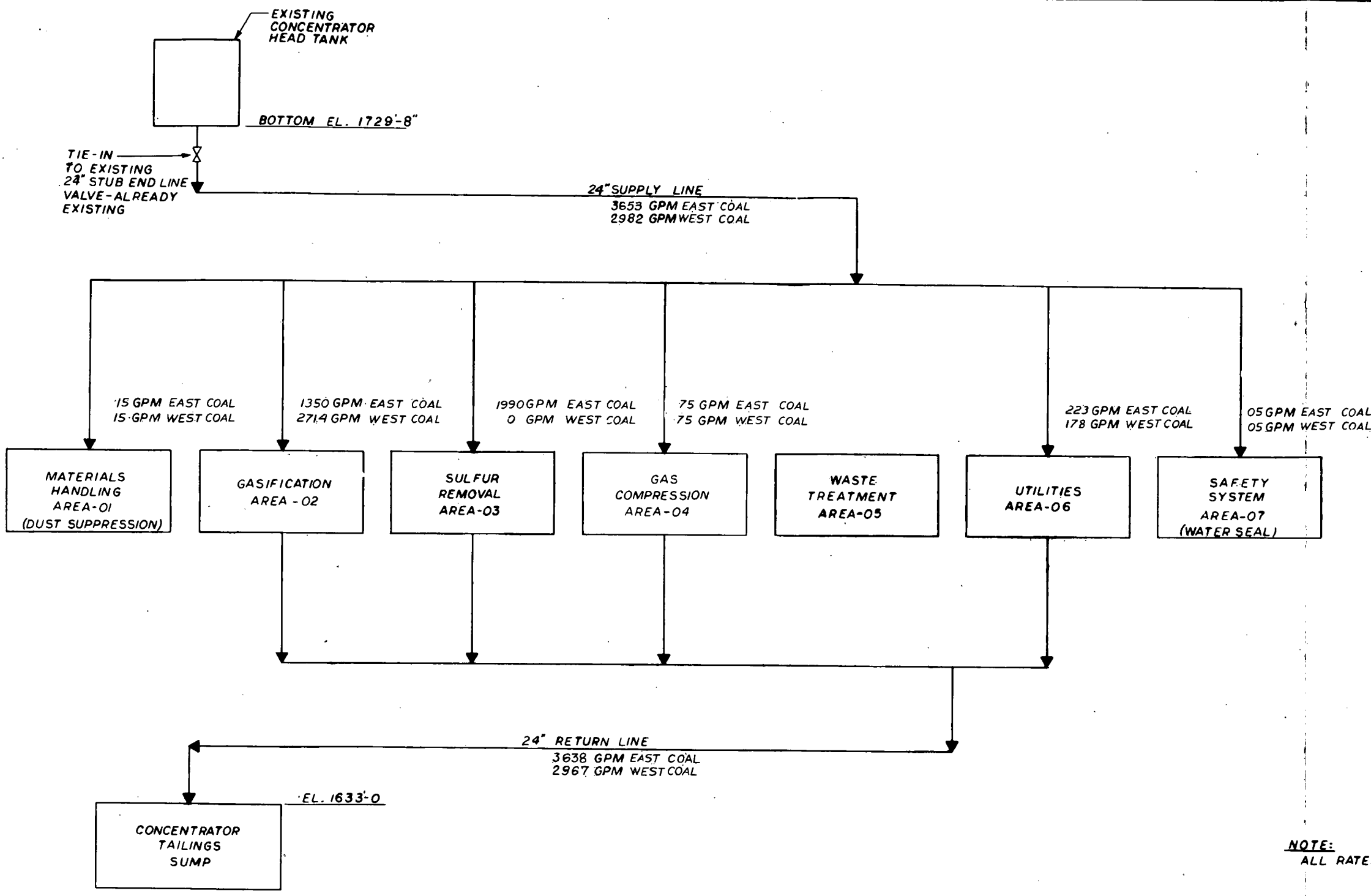
- ASSUMED FUEL OIL COMPOSITION IS AS FOLLOWS:

FUEL OIL	WT. %
C	84.95
H	11.10
O	0.06
N	0.71
S	1.00
ASH	0.04
MOISTURE	1.60
	100.00
- HHV: 16,400 BTU/*
- X-502 MAY OR MAY NOT BE SUPPLIED BY THE INCINERATOR VENDOR.
- ALL RATES LISTED ARE CONTINUOUS AVERAGES OF INTERMITTENT FLOWS TO OBTAIN ACTUAL FLOW RATES, MULTIPLY ALL RATES ON THIS PAGE (EXCEPT PUMP DESIGN RATES) BY 3.014 (BASED ON 121 DAYS/YR OPERATION).
- FOR EASTERN COAL E-502 (COMMERCIAL UNIT WASTEWATER EVAPORATOR) IS NOT REQUIRED.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO
 PROJECT NO. 4814-Y-05-52-2
 SHEET 2 of 2
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 WASTE TREATMENT COMMERCIAL UNIT
 WASTEWATER FACILITIES (PFD) EAST COAL
 REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										11-16-78	R.M. W.B.		ADDED FOR EASTERN COAL	SFD

DRAWING NO.
4814-Y
06-51-2



NOTE:
ALL RATES REPRESENT ANNUAL AVERAGES

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
PROJECT NO. 4814-Y-06-51-2

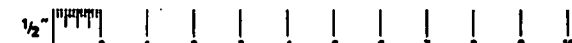
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

UTILITIES
COMMERCIAL UNIT
COOLING WATER FLOW DIAGRAM

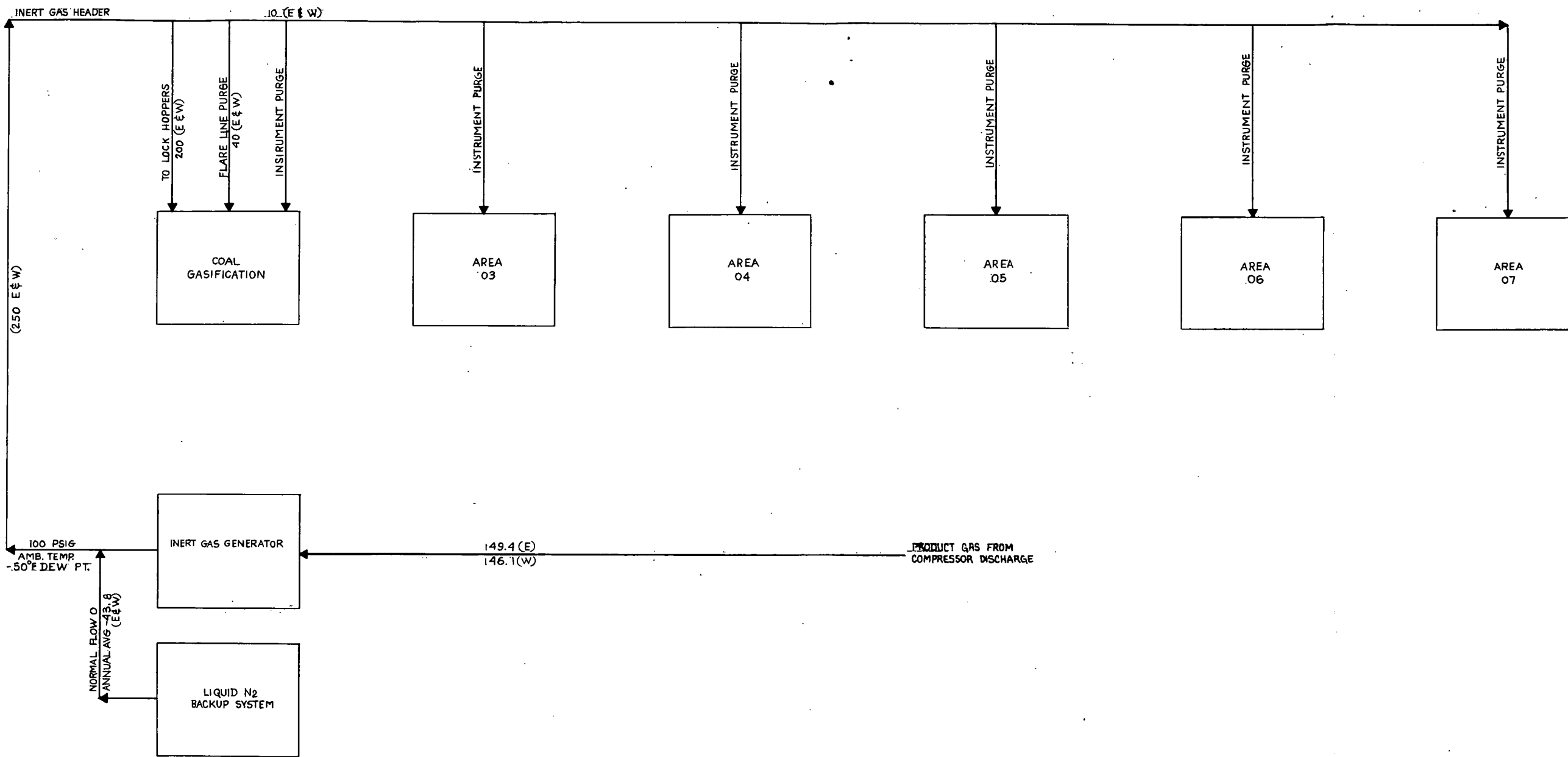
SCALE: NONE
REVISION: 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

0-11-15-78 MS WB ISSUED FOR ESTIMATING



BASIS: COMMERCIAL UNIT
 E= EASTERN COAL
 FLOW RATE, SCFM
 W= WESTERN COAL
 FLOW RATE, SCFM



DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-06-52-2

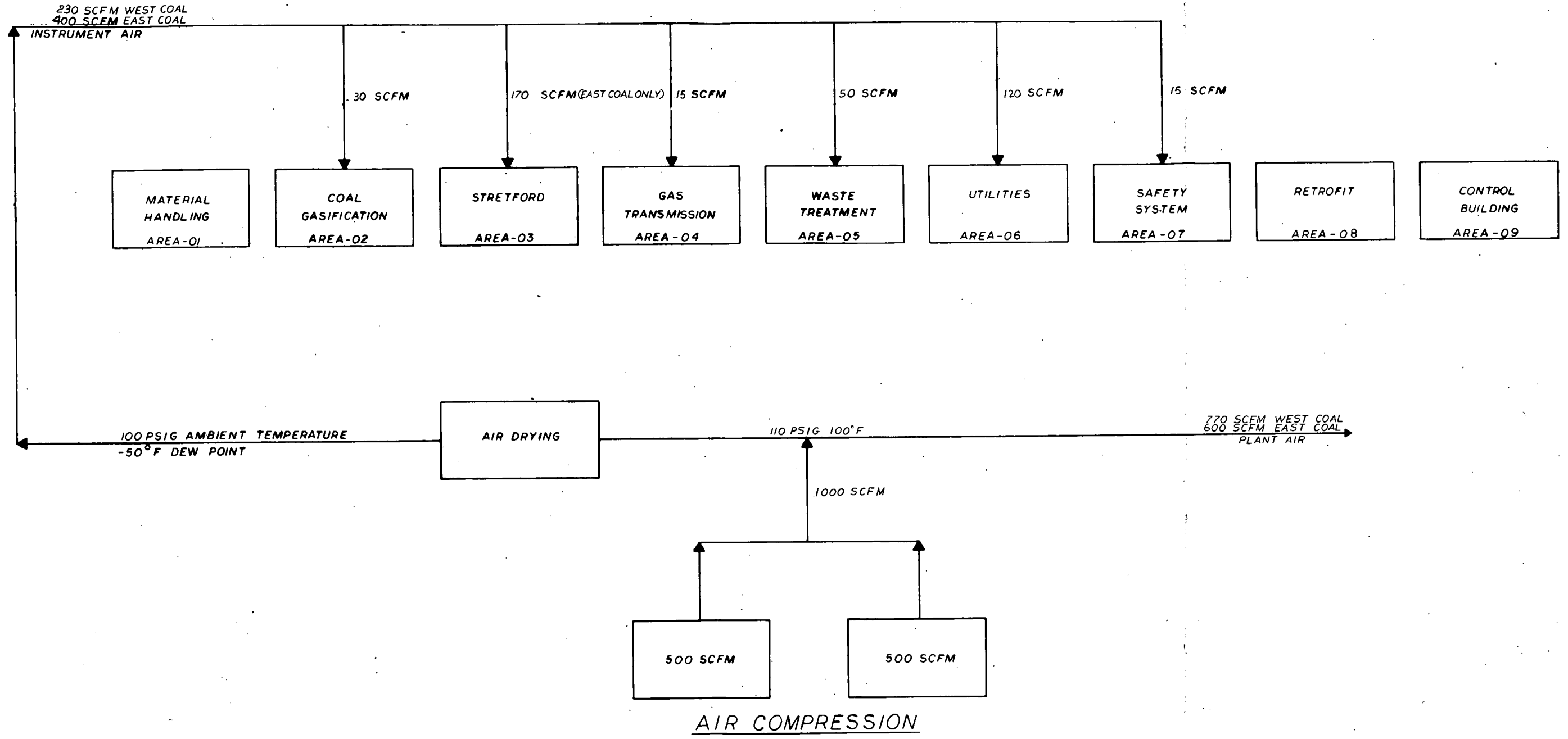
FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

UTILITIES BLOCK FLOW DIAGRAM
 COMMERCIAL UNIT
 INERT GAS AND NITROGEN

REVISION Δ 0

DATE: 10/16/78 BY: DM W.B. ISSUED FOR ESTIMATE

DRAWING NO.
4814-Y-06-542



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-06-542

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

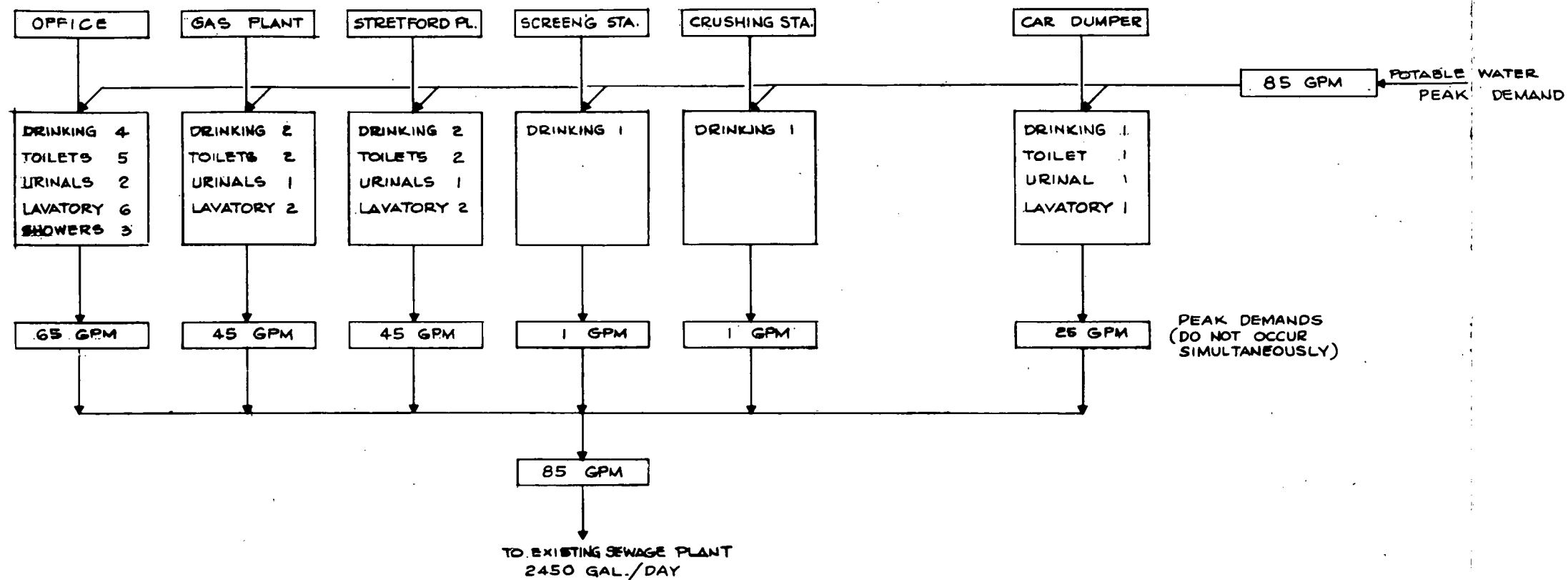
SCALE: NONE

UTILITIES COMMERCIAL UNIT
 PLANT AND INSTRUMENT AIR FLOW

REVISION Δ

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										11-16-78	MS	W.B.	INITIAL ISSUE	SFD

DRAWING NO. 4814-Y-06-55-2



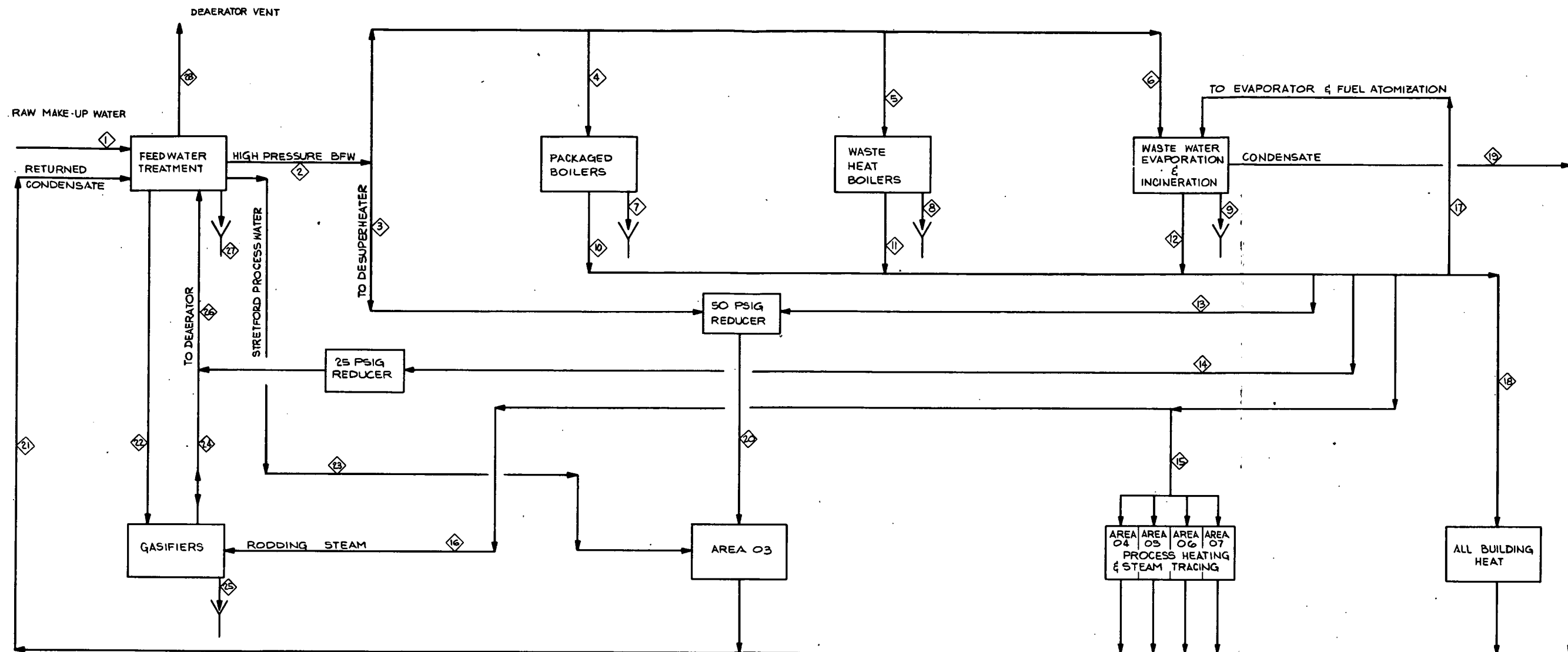
PEAK DEMANDS
(DO NOT OCCUR
SIMULTANEOUSLY)

NOTES:
 - FLOW RATES BASED ON EMPIRICAL DATA CONTAINED IN MINNESOTA PLUMBING CODE.
 - FACILITIES TO ACCOMMODATE A TOTAL OF 70 PERSONS PER DAY.

U. S. DEPARTMENT OF ENERGY	
FUEL GAS DEMONSTRATION PLANT PROGRAM	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY	4814-Y-06-55-2
McKee ENGINEERS AND CONSTRUCTORS	
CLEVELAND OHIO	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
UTILITIES - BLOCK FLOW DIAGRAM COMMERCIAL UNIT	
POTABLE WATER & SANITARY SEWER	
PROJECT NO.	P.E. NO.
SCALE	NONE
REVISION	0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

11-15-78 S.O. W.B. ISSUED FOR ESTIMATING *ZHB*



COMMERCIAL UNIT FLOW RATES

Table with 14 columns (STREAM No. 1-14) and 5 rows (STREAM NAME, EAST COAL LB/HR, WEST COAL LB/HR, MAX. OPER. LB/HR). Includes notes 1, 1, and 2.

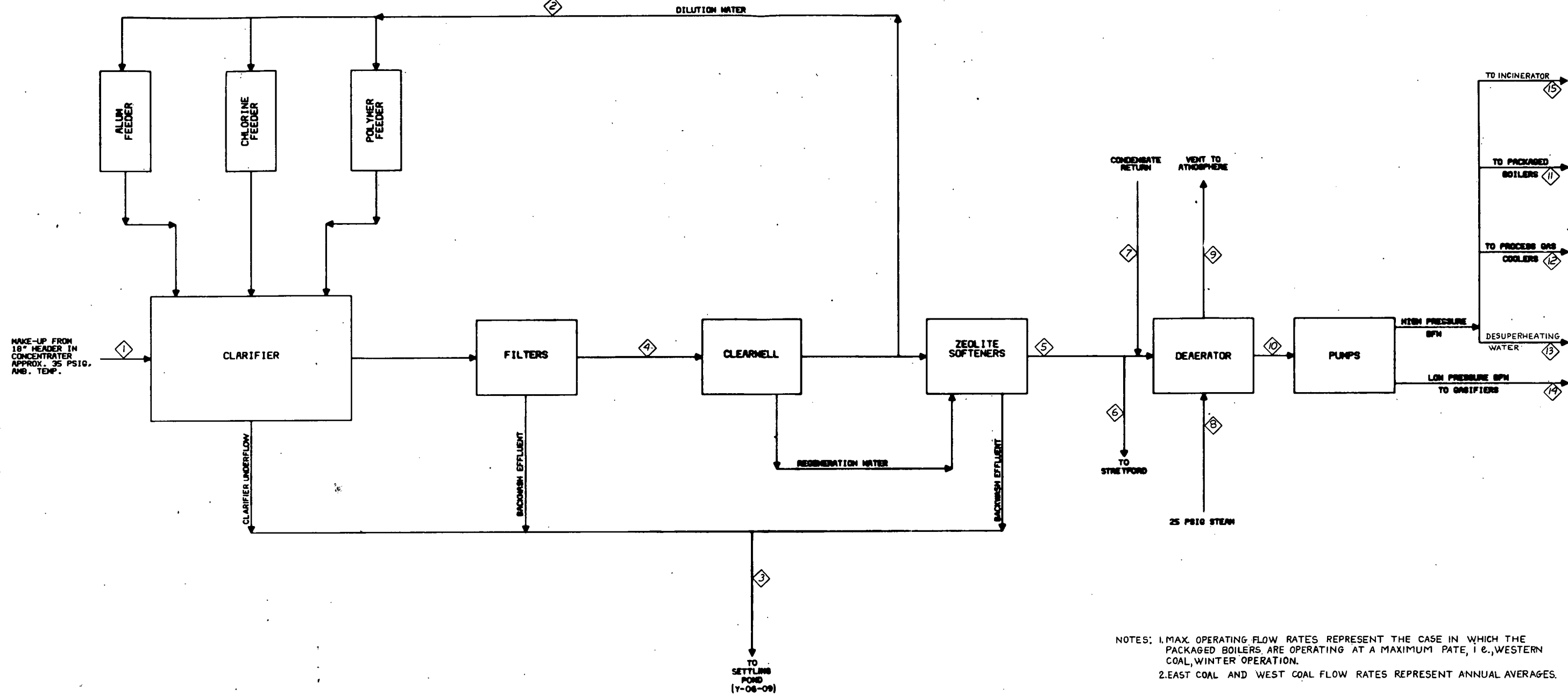
Table with 16 columns (STREAM No. 15-30) and 5 rows (STREAM NAME, EAST COAL LB/HR, WEST COAL LB/HR, MAX. OPER. LB/HR). Includes notes 1, 1, and 2.

NOTES:

- 1. EAST COAL AND WEST COAL FLOW RATES REPRESENT ANNUAL AVERAGES AND THEREFORE DO NOT NECESSARILY BALANCE
2. MAX. OPER. FLOW RATES REPRESENT THE CASE IN WHICH THE PACKAGED BOILERS ARE OPERATING AT A MAXIMUM RATE, I.E. WESTERN COAL, WINTER OPERATION.

U.S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM. SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578. PREPARED BY MCKEE ENGINEERS AND CONSTRUCTORS. OHIO. FOR ERIE MINING COMPANY. UTILITIES BLOCK FLOW DIAGRAM COMMERCIAL PLANT STEAM, BOILER FEEDWATER, AND CONDENSATE. REVISION 0.

Revisions table with columns: DATE, BY, CHK, DESCRIPTION, APP. Includes revision 1: 11/15/78, M.R. W.B. INITIAL ISSUE.



NOTES: 1. MAX. OPERATING FLOW RATES REPRESENT THE CASE IN WHICH THE PACKAGED BOILERS ARE OPERATING AT A MAXIMUM RATE, I.E., WESTERN COAL, WINTER OPERATION.
 2. EAST COAL AND WEST COAL FLOW RATES REPRESENT ANNUAL AVERAGES.

STREAM NUMBER	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
STREAM NAME	RAW WATER MAKE-UP	DILUTION WATER	EFFLUENT TO SETTLING POND	FILTERED WATER TO CLEARWELL	MAKE-UP BFW TO DEAERATOR	BFW TO STRETFORD	CONDENSATE RETURN	25° STEAM TO DEAERATOR	VENT	BFW FROM DEAERATOR	H.P. BFW TO PACKAGED BOILERS	H.P. BFW TO WASTE HEAT BOILER	H.P. BFW TO DESUPERHEATER	L.P. BFW TO GASIFIERS	H.P. BFW TO INCINERATOR
NOTE 2 EAST COAL LB/HR	100,570	11.5 GPM	30,170	82,130	70,400	4,500	31,620	5,050	250	102,320	940	59,800	200	39,200	2,180
NOTE 2 WEST COAL LB/HR	75,035	(EST.)	22,510	61,280	52,525	-0-	50,690	2,700	135	105,780	23,580	25,300	0	39,200	17,700
NOTE 1 MAX OP. LB/HR	91,070		27,320	74,380	63,750	-0-	76,150	5,700	285	145,315	63,115	25,300	0	39,200	17,700

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKOG** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-08-57-2

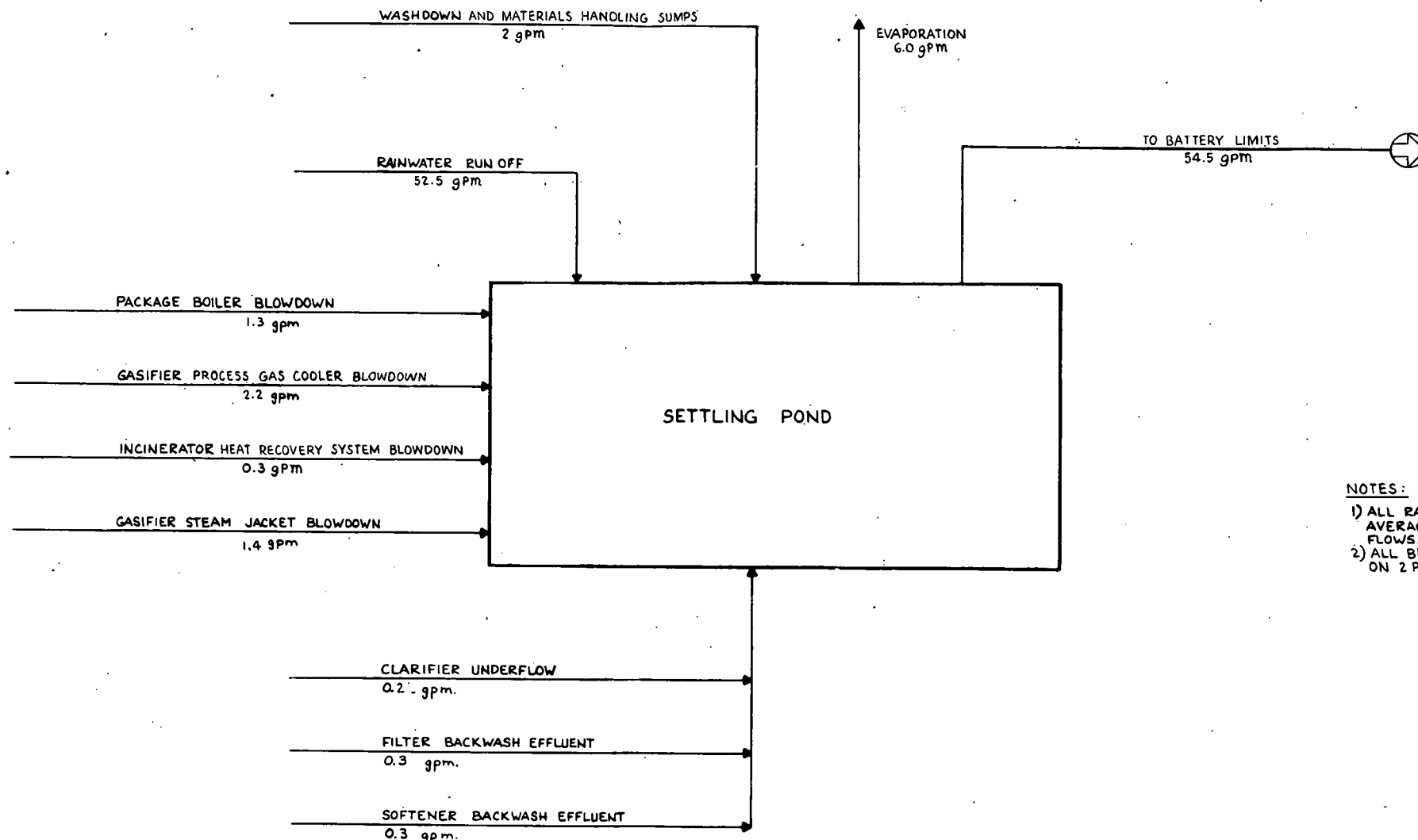
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

UTILITIES-BLOCK FLOW DIAGRAM
 COMMERCIAL UNIT
 BOILER FEEDWATER TREATMENT

REVISION **C**

105 A11378

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										11-17-78	S.O.	W.B.		



NOTES:
 1) ALL RATES ARE CONTINUOUS AVERAGES OF INTERMITTENT FLOWS.
 2) ALL BLOWDOWN RATES BASED ON 2 PERCENT BLOWDOWN.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 PROJECT NO. 4814-Y-06-59-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 UTILITIES COMMERCIAL UNIT
 SETTLING POND BLOCK FLOW DIAGRAM P&ID

REVISION \triangle 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

10-24-78 B.B. W.B. ISSUED FOR APPROVAL

ON DRAWING
 E
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F
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 A

SERVICE CODE

A	PROCESS AIR
AE	AQUEOUS EFFLUENT
BFH	BOILER FEEDWATER (HIGH PRESSURE)
BFL	BOILER FEEDWATER (LOW PRESSURE)
CA	CAUSTING
COND	CONDENSATE
CWS	COOLING WATER SUPPLY
CHR	COOLING WATER RETURN
DA	DUST COLLECTING AIR
DS	DUST SUPPRESSION WATER
DW	DOMESTIC WATER
E	EXHAUST GAS
EC	CLEAN WATER
EO	OILY WATER
ES	SANITARY
FG	FUEL GAS
FO	FUEL OIL
HS	I25# STEAM
IA	INSTRUMENT AIR
IG	INERT GAS
LS	25# STEAM
MS	50# STEAM
P	PROCESS GAS
S	LIQUID SULFUR
SL	SULFUR SLURRY
STR	STRETTFORD SOLUTION
SW	SUMP WATER
TR	TAR/OIL
UA	INDUSTRIAL AIR

INSTRUMENT SYMBOLS

	LOCALLY MOUNTED INSTRUMENT		SAFETY VALVE
	MAIN PANEL MOUNTED INSTRUMENT (XXX = PANEL LOCATION; SEE P & ID ABBREVIATION)		HAND OPERATED CONTROL VALVE
	LOCAL PANEL MOUNTED INSTRUMENT		DIAPHRAGM OPERATED CONTROL VALVE
	INSTRUMENT MOUNTED BEHIND PANEL		CLOSES ON ACTUATING MEDIUM FAILURE OPENS ON ACTUATING MEDIUM FAILURE LOCKS IN LAST POSITION ON ACTUATING MEDIUM FAILURE
	HEAT TRACED INSTRUMENT		BUTTERFLY CONTROL VALVE
	PNEUMATIC SIGNAL		CONTROL VALVE WITH HAND WHEEL
	ELECTRICAL SIGNAL		DIAPHRAGM OPERATED 3-WAY CONTROL VALVE
	CAPILLARY TUBING (FILLED SYSTEM)		BACK PRESSURE CONTROL VALVE
	HYDRAULIC SIGNAL		PRESSURE REDUCING CONTROL VALVE
	RADIOACTIVE, SONIC OR LIGHT SIGNAL		PISTON OPERATED BALL VALVE
	CONNECTION TO PROCESS, MECHANICAL LINK OR INSTRUMENT AIR SUPPLY		HIGH TEMPERATURE
	VENTURI		SOLENOID VALVE WITH MANUAL RESET
	PITOT TUBE		AS - AIR SUPPLY
	ROTAMETER FLOW INDICATOR		V - VENT
	RESTRICTION ORIFICE		
	FLOW ELEMENT		
	ORIFICE PLATE		
	CHEMICAL SEAL		

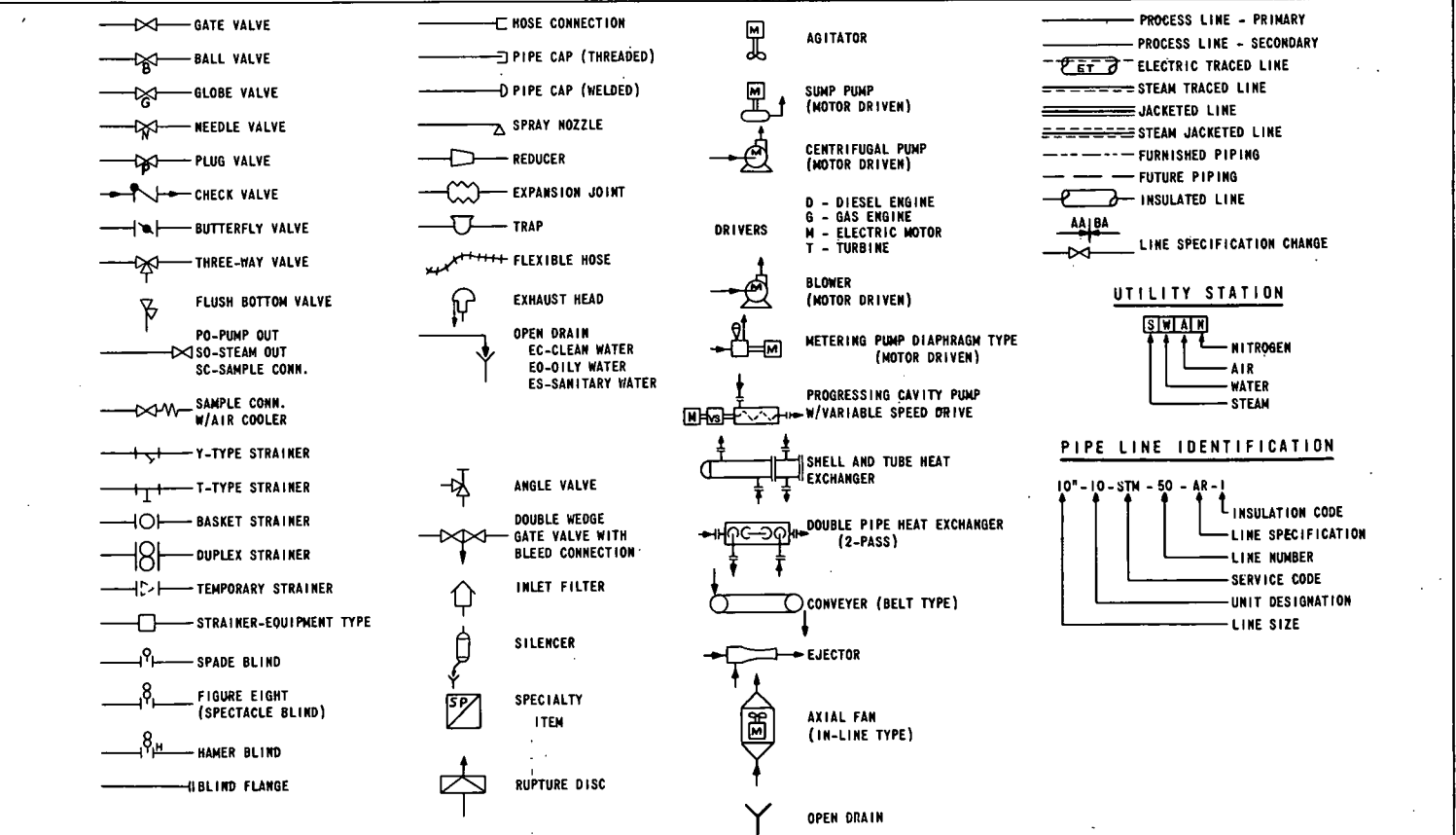
EQUIPMENT DESIGNATIONS

A	MECHANICAL AGITATOR
B	BLOWER
BA	BAGGING MACHINE
BE	ELEVATOR
BM	BIN OR HOPPER
C	COMPRESSOR
CH	CHUTE
CO	CONVEYORS (ALL TYPES)
CY	CYCLONES
D	DRUM
DC	DUST COLLECTOR
DV	DIVERTER VALVE
E	EXCHANGER (ALL TYPES)
EX	EXTRUDER
F	FILTER
MF	FEEDER
GV	GATE VALVE
H	HEATERS (FURNACES)
J	EJECTORS
P	PUMP
R	REACTOR
T	TOWER
TK	TANK
VB	VIBRATOR
VS	VIBRATING SCREEN
WS	WEIGH SCALE
X	MISCELLANEOUS

INSTRUMENT IDENTIFICATION

FIRST LETTER	SUCCEEDING LETTERS			
	MEASURED/INITIATING VARIABLE	MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT FUNCTION
A	ANALYSIS		ALARM	
B	BURNER FLAME			
C	CONDUCTIVITY (ELECTRICAL)			CONTROL
D	DENSITY (MASS) SPECIFIC GRAVITY	DIFFERENTIAL		
E	VOLTAGE (EMF)		PRIMARY ELEMENT	
F	FLOW RATE	RATIO (FRACTION)		
G	GAGING (DIMENSIONAL)		GLASS	
H	HAND (MANUALLY INITIATED)			HIGH
I	CURRENT (ELECTRICAL)		INDICATE	
J	POWER	SCAN		
K	TIME / TIME SCHEDULE			CONTROL STATION
L	LEVEL		LIGHT (PILOT)	LOW
M	MOISTURE/HUMIDITY			MIDDLE INTERMEDIATE
N				
O			ORIFICE (RESTRICTION)	
P	PRESSURE/VACUUM		POINT (TEST) CONNECTION	
Q	QUANTITY EVENT	INTEGRATE/TOTALIZE		
R	RADIOACTIVITY		RECORD/PRINT	
S	SPEED/FREQUENCY	SAFETY		SWITCH
T	TEMPERATURE			TRANSMIT
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE DAMPER/LOUVER
W	WEIGHT/FORCE		WELL	
X				
Y				RELAY/COMPUTE
Z	POSITION			DRIVE ACTUATE/UNCLASSIFIED FINAL CONTROL ELEMENT

FLOW SHEET SYMBOLS



PIPING AND INSTRUMENT DIAGRAM ABBREVIATIONS

GENERAL

- ATM - ATMOSPHERE
- AVG - AVERAGE
- BTU - BRITISH THERMAL UNIT
- COND - CONDENSATE
- CU. FT. - CUBIC FEET
- CFH - CUBIC FEET PER HOUR
- CFM - CUBIC FEET PER MINUTE
- CFS - CUBIC FEET PER SECOND
- CU. IN. - CUBIC INCH
- CYL - CYLINDER
- (°) DEG - DEGREE
- EL - ELEVATION
- EXT - EXTERNAL
- F - FAHRENHEIT DEGREES
- FPM - FEET PER MINUTE
- FPS - FEET PER SECOND
- (') FT. - FOOT-Feet
- GAL - GALLONS
- QPD - GALLONS PER DAY
- QPH - GALLONS PER HOUR
- QPM - GALLONS PER MINUTE
- QPS - GALLONS PER SECOND
- HP - HIGH PRESSURE
- HP - HORSEPOWER
- HR - HOUR
- (") IN. - INCH
- ID - INSIDE DIAMETER
- INT - INTERNAL
- KW - KILOWATT
- KWH - KILOWATT HOUR
- LIQ - LIQUID
- LP - LOW PRESSURE
- MAX - MAXIMUM
- MM - MILLION
- M - THOUSAND
- MOL - MOLES
- NO - NUMBER
- % - PERCENT
- LB - POUND
- PCF - POUNDS PER CUBIC FOOT
- LB/GAL - POUNDS PER GALLON
- #/HR - POUNDS PER HOUR
- PSF - POUNDS PER SQUARE FOOT
- PSI - POUNDS PER SQUARE INCH
- PSIA - POUNDS PER SQUARE INCH - ABSOLUTE
- SCFD - STANDARD CUBIC FEET PER DAY
- SEC - SECOND
- SG - SPECIFIC GRAVITY
- STD - STANDARD
- SCFH - STANDARD CUBIC FEET PER HOUR (60°F) AT 1 ATMOSPHERE AT SEA LEVEL
- ST - STEAM TRAP
- STR - STRAINER
- TEMP - TEMPERATURE
- T - TEMPORARY SERVICE
- VISC - VISCOSITY
- VI - VISCOSITY INDEX
- W - WATT
- WT - WEIGHT

SAFETY

- ATM - TO ATMOSPHERE
- FLARE - TO FLARE
- STACK - TO STACK

PANELS

- MCP - MAIN CONTROL PANEL
- DCP - DUMPER CONTROL PANEL

UTILITIES

- BFW - BOILER FEED WATER
- COND - CONDENSATE
- CWS - COOLING WATER SUPPLY
- CWR - COOLING WATER RETURN
- DW - DOMESTIC WATER
- IW - INDUSTRIAL WATER
- IA - INSTRUMENT AIR
- NITROGEN-XXX - NITROGEN (PRESSURE)
- STM-XXX - STEAM (PRESSURE)

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

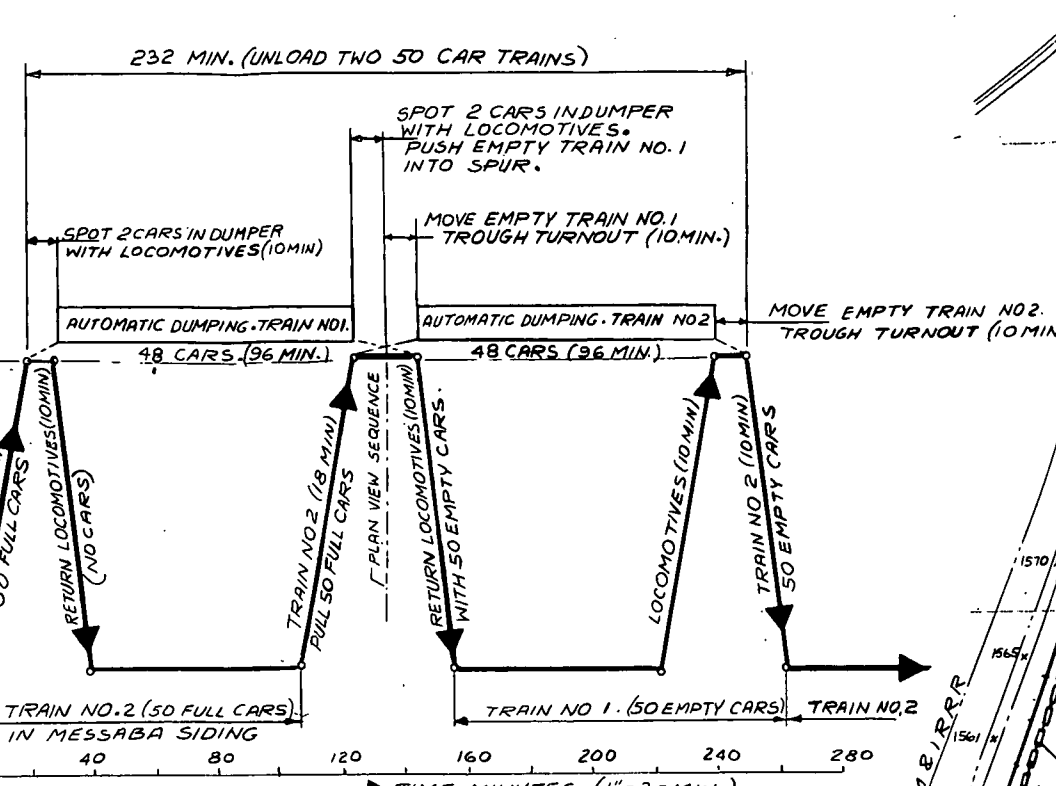
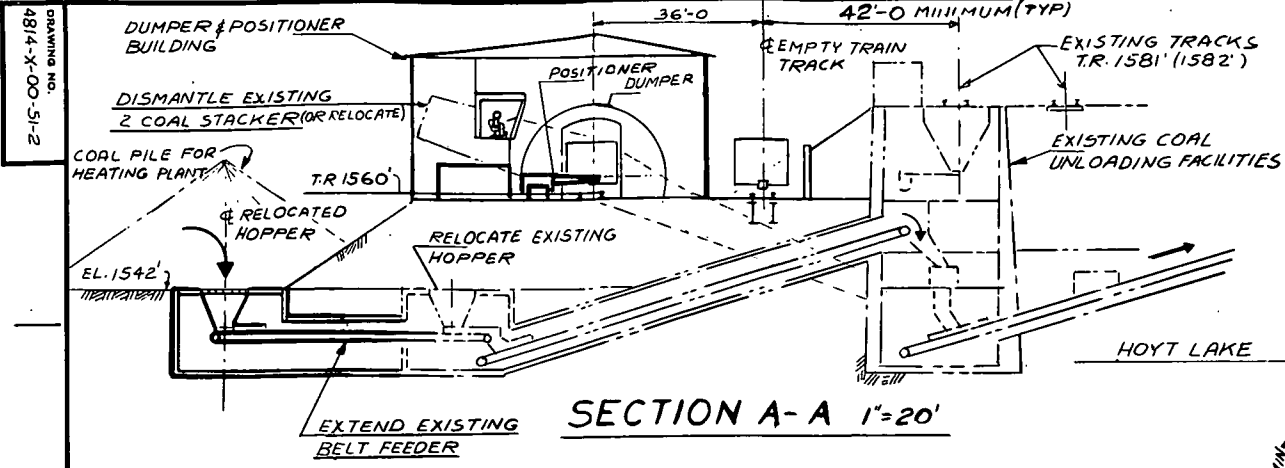
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-00-59-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

SCALE NONE
 REVISION 0

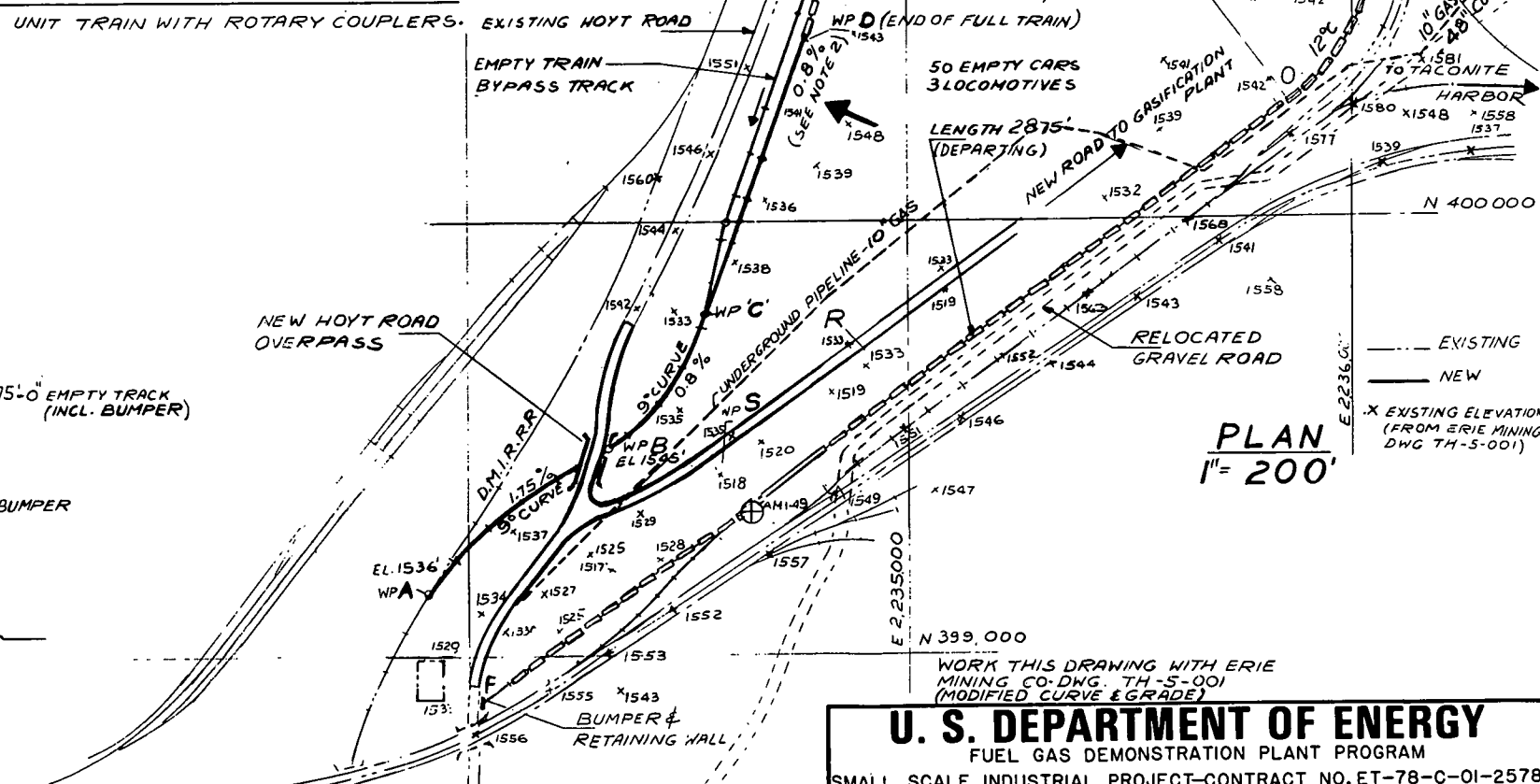
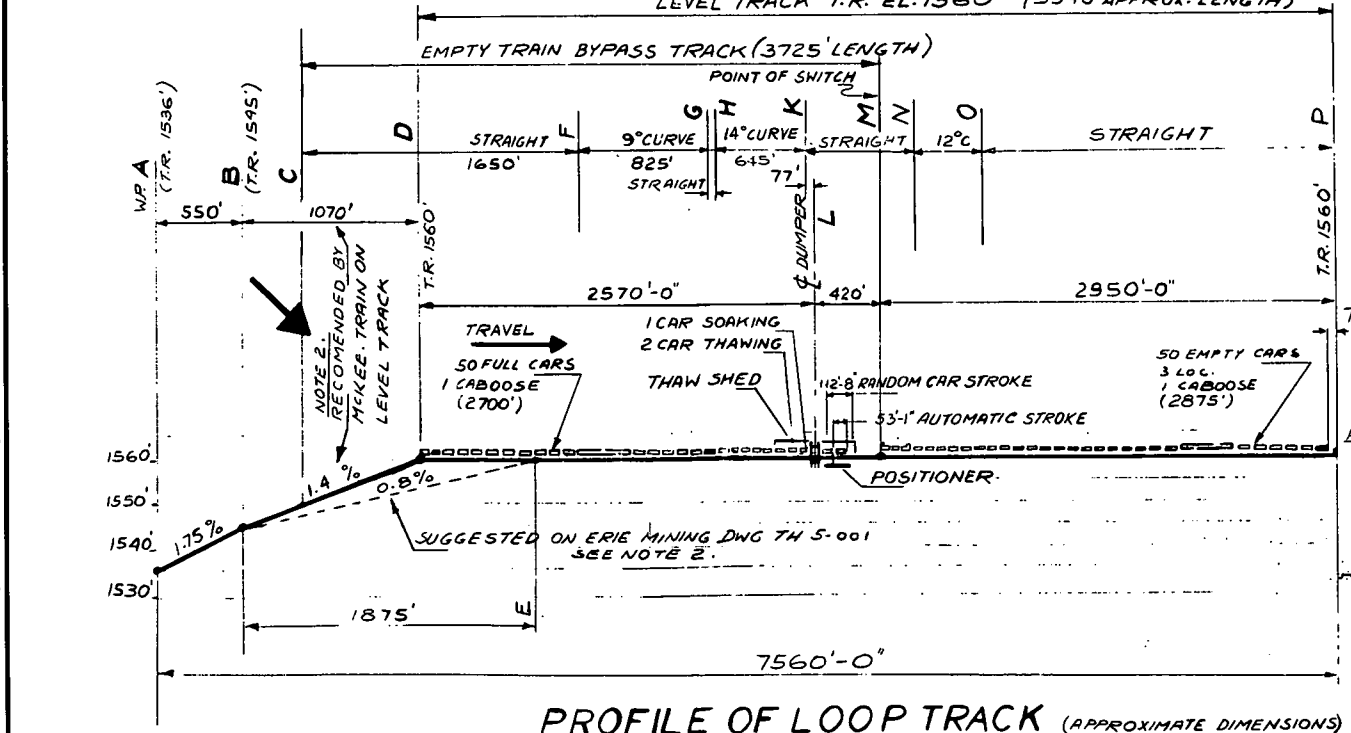
REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.

10-24-78 MS ISSUED FOR APPROVAL



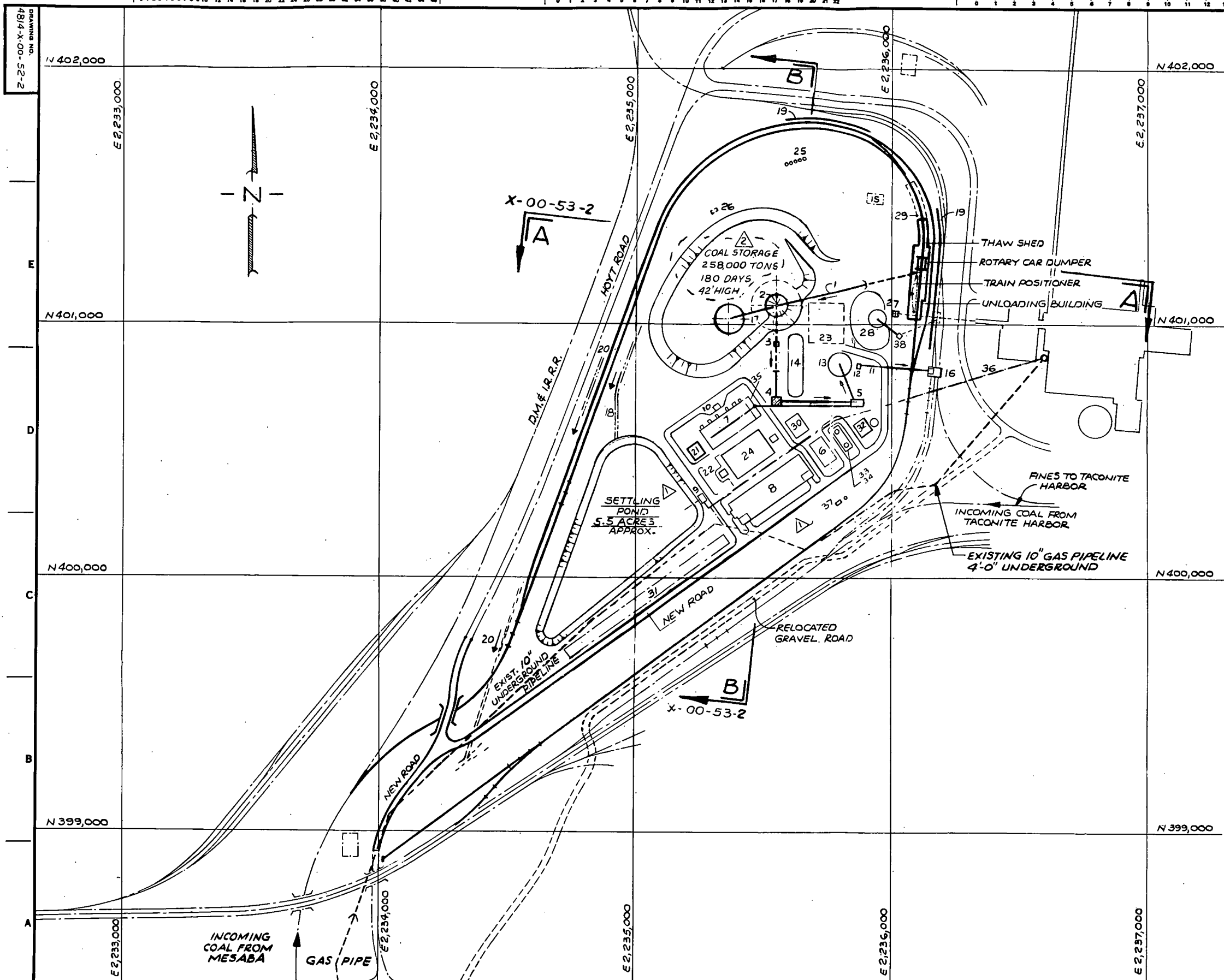
- UNLOADING REQUIREMENTS (RAW COAL) IN HOYT LAKE.**
- UNLOAD TWO UNIT TRAINS WITH 50 CARS IN EACH TRAIN. UNLOADING TIME WITH IDENTICAL CARS AND ROTARY COUPLER TO BE 232 MINUTES. THIS TIME INCLUDES THE LOCOMOTIVES SPOTTING THE FIRST TWO CARS OF EACH TRAIN FOR DUMPING. AUTOMATIC DUMPER AND POSITIONER CYCLE TIME IS 2 MINUTES FOR ONE CAR.
 - UNLOAD UNIT TRAIN WITH RANDOM CAR LENGTH AND WIDTH WITH THE DUMPER AND POSITIONER. CYCLE TIME FOR ONE CAR APPROXIMATE 4.3 MINUTE. 100 CARS IN 8 HOURS APPROXIMATE.
 - THAW AND UNLOAD FROZEN COAL AT A RATE OF 5 CARS PER HOUR. CARS WITH ROTARY COUPLER OR RANDOM LENGTH AND RANDOM WIDTH.

DESIGN CRITERIA.
 2 UNIT TRAINS, EACH CONSISTING OF 50 GONDOLA CARS @ 53'-1" LENGTH OVER COUPLERS. 100 TON COAL PER CAR. 31.5 TON CAR WEIGHT. 3 LOCOMOTIVES. CABOOSE. TRAIN LENGTH 2875'. ROLLER BEARINGS.



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 COAL GASIFICATION. COMMERCIAL UNIT TRACK PLAN AND PROFILE
 PROJECT NO. P.E. NO. SCALE AS NOTED REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										08-11-78	KH		ISSUED FOR ESTIMATING	



1. INCOMING COAL CONVEYOR
2. COAL RECLAIM HOPPERS
3. TEST FEED & RECLAIM HOPPER
4. TRANSFER STATION
5. CRUSHER & SCREENING STATION
6. UTILITIES BUILDING
7. GASIFICATION PLANT
8. STRETFORD
9. PUMP HOUSE
10. ASH SILO
11. FINES LOADOUT CONVEYOR
12. FINES RECLAIM HOPPER - ALTERNATE FOR EASTERN COAL ONLY.
13. FINES PILE
14. START-UP COKE 2000 TONS
15. EXISTING SEWAGE TREATMENT PLANT
16. FINES LOAD-OUT TRACK BIN
17. INCOMING COAL BY-PASS CONVEYOR
18. DRAINAGE DITCH AROUND COAL PILE-TO NATURAL DRAIN.
19. CRIB WALL
20. DRAINAGE DITCH AROUND TRACK
21. EMPLOYEE FACILITIES BUILDING
22. PARKING
23. ALTERNATE FINES AGGLOMERATION PLANT (FOR WESTERN COAL ONLY)
24. GAS CLEANING
25. EXISTING TANKS TO REMAIN
26. EXISTING TANK
27. EXISTING RECLAIM HOPPER RELOCATED (NOTE "A")
28. COAL PILE FOR EXISTING HEATING PLANT
29. POSSIBLE ADDITIONAL THAW SHEDS
30. COMPRESSOR BUILDING
31. ADDITIONAL PARKING AREA
32. INCINERATOR
33. TAR TANK
34. OIL TANK
35. CONTROL ROOM, OFFICE, ELECTRICAL EQUIPMENT
36. NEW PIPE GALLERY
37. SEAL DRUM & FLARE STACK
38. RELOCATED & ALTERED EXISTING COAL STACKER

NOTE A EXISTING RECLAIM HOPPER TO BE RELOCATED & BELT FEEDER TO BE LENGTHENED AS SHOWN ON DWG. 4814-X-00-51-2. EXISTING STACKER CONVEYORS TO BE ALTERED AND RELOCATED AS SHOWN ON DWG 4814-X-01-08-2

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-X-00-52-2

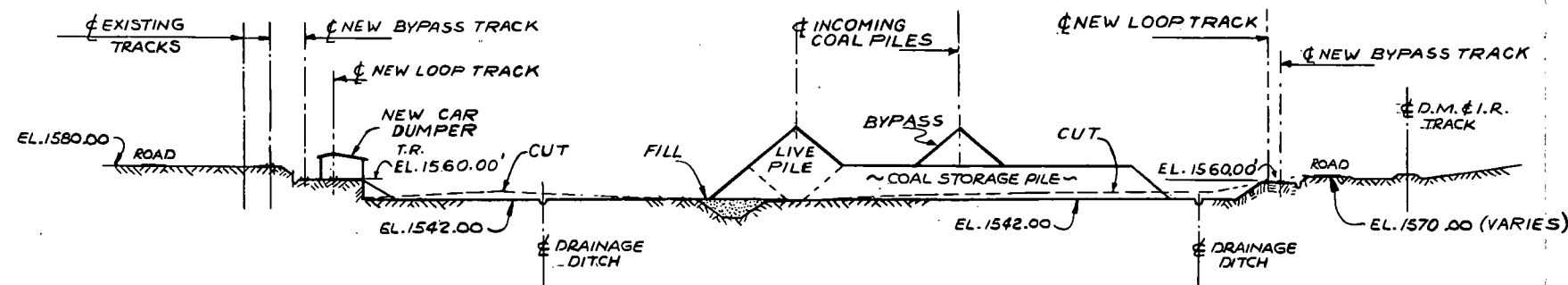
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

COAL GASIFICATION COMMERCIAL UNIT GENERAL ARRANGEMENT

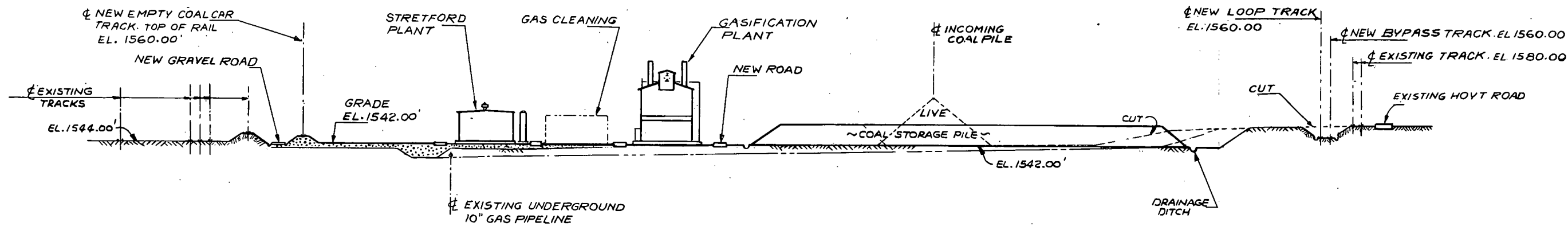
PROJECT NO. P.E. NO. SCALE 1" = 200' 0" REVISION **2**

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										9-18-78	KH		ITEM 4 WAS CRUSHING STATION, ADDED CRUSHER TO	
													ITEM 5, DELETED OFFICE FROM ITEM 21, ADDED ITEM 23, 35	
													DELETED OIL TANK. COAL STORAGE WAS 516,000 TON	
										8/1/78	KH		ADDED ITEMS 37 AND 38 - RELOCATED ITEMS 9 & 10	
										1/28/78	RVK		ISSUED FOR ESTIMATING	

4814-X-00-53-2



SECTION A-A (MC KEE DWG X-00-52-2)
LOOKING SOUTH



SECTION B-B (MC KEE DWG X-00-52-2)
LOOKING WEST

GASIFICATION PLANT.
CUT - 592,200 CU.YD.
FILL - 681,200 CU.YD.

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										8-11-76	KH		ISSUED FOR ESTIMATING	

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578 A

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-X-00-53-2

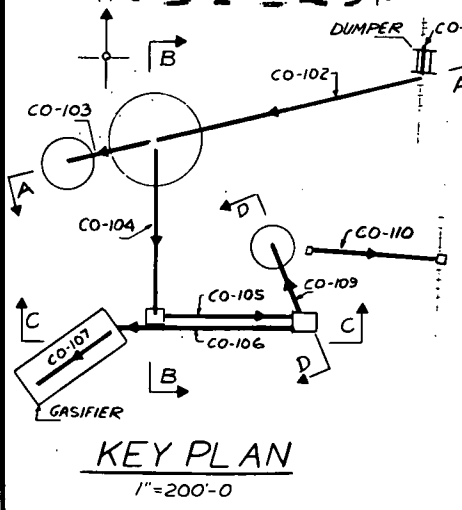
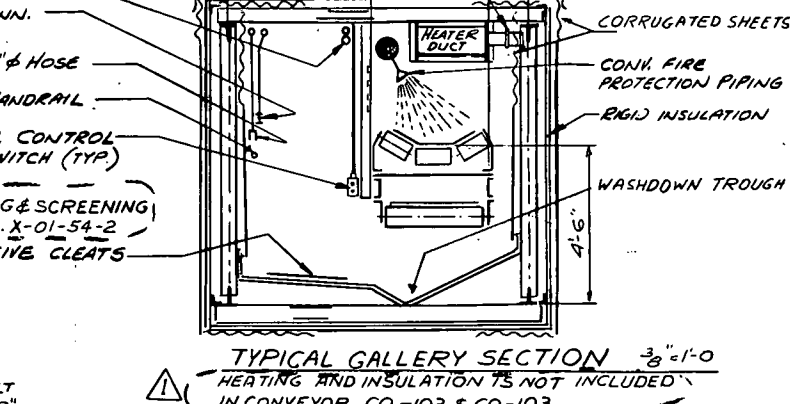
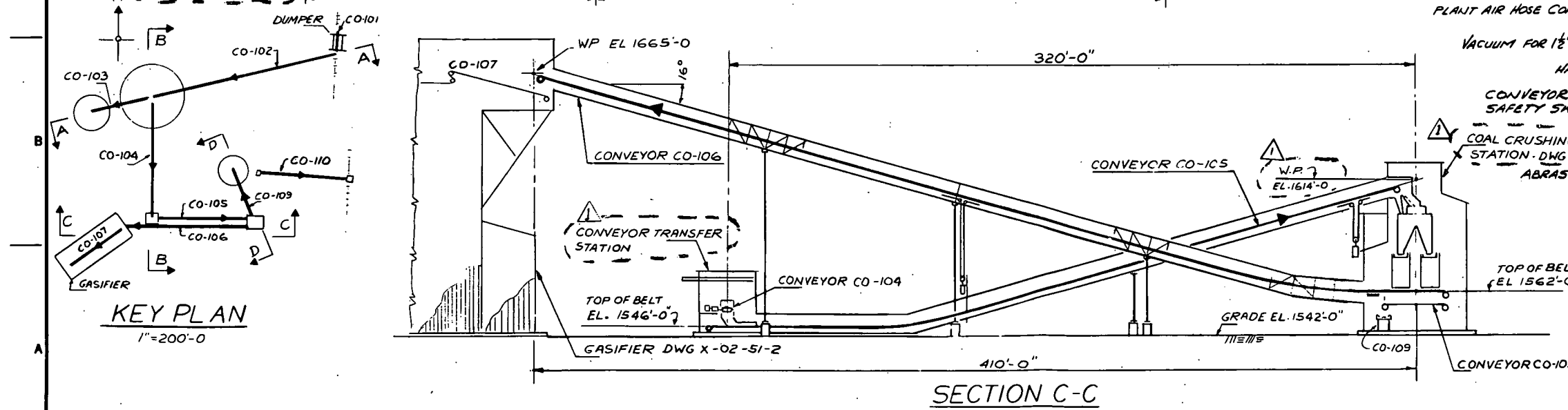
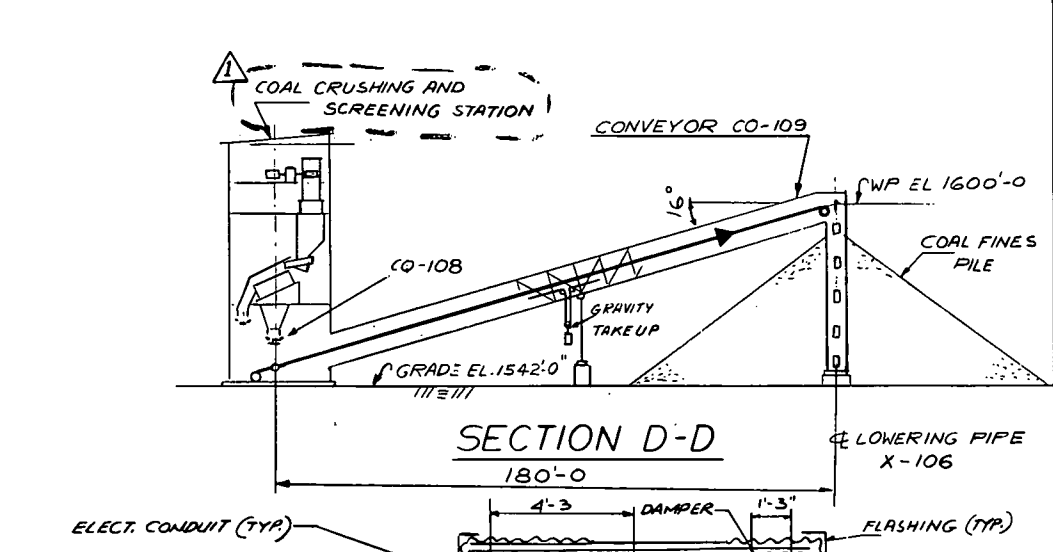
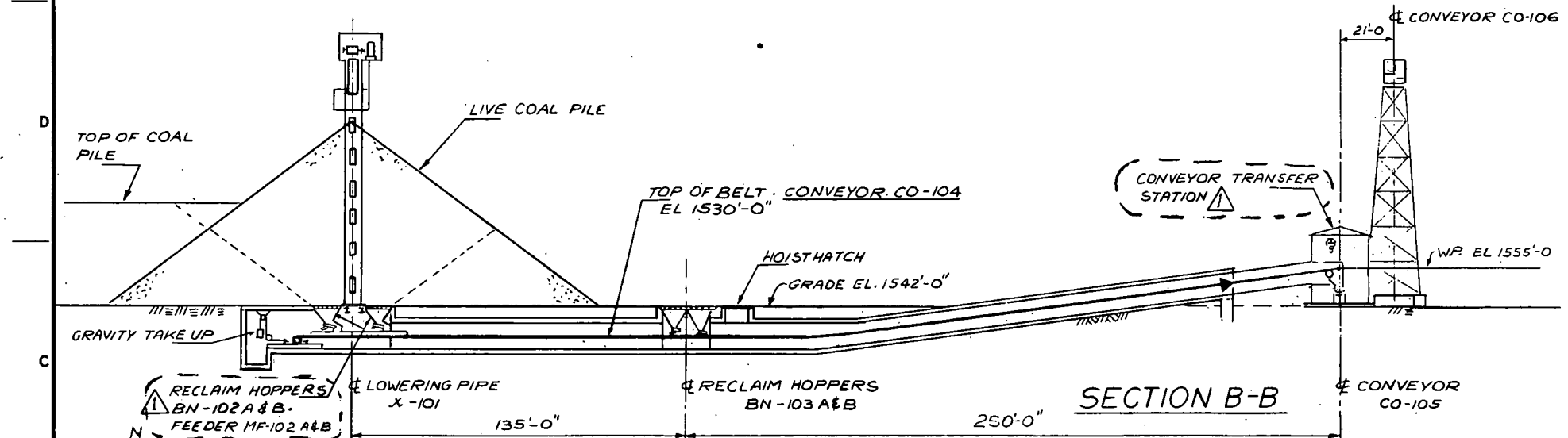
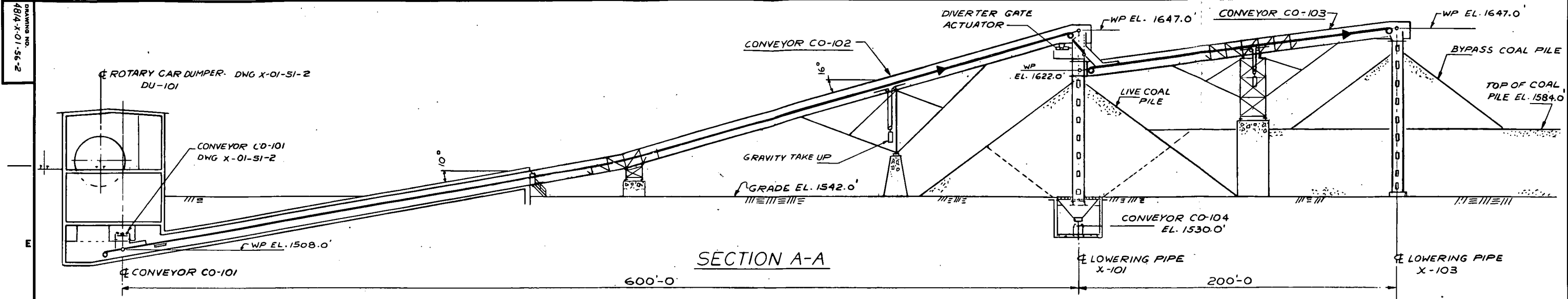
FOR ERIE MINING COMPANY
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA

SCALE 1" = 100'-0"

COAL GASIFICATION COMMERCIAL UNIT PLANT AREA PROFILES

REVISION Δ

DRAWING NO. 484-X-01-56-2



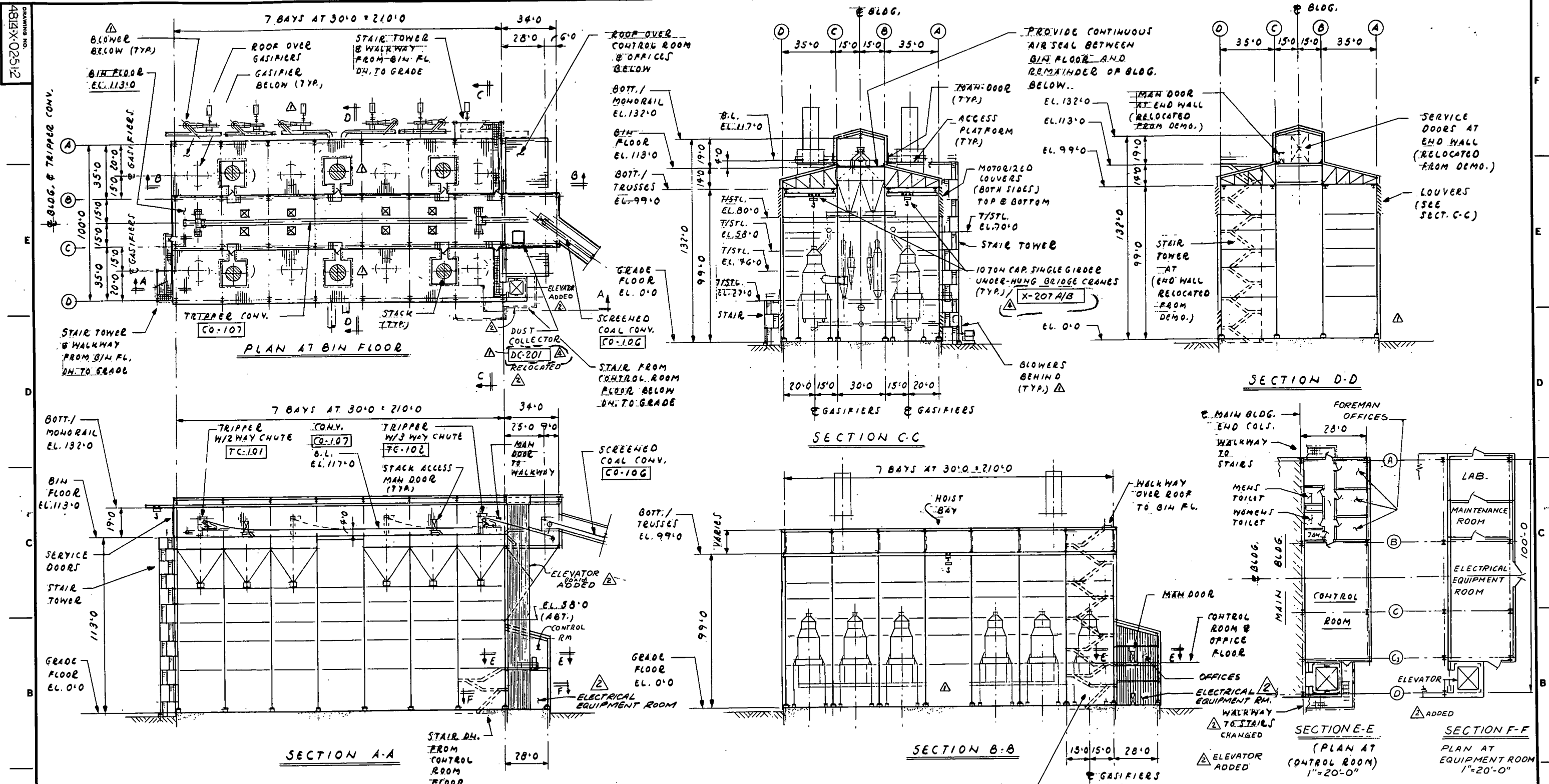
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 484-X-01-56-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

MATERIAL HANDLING
 COMMERCIAL UNIT
 CONVEYOR ELEVATIONS

REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
9-2-78	XH	TL	TRANSFER STATION WAS CRUSHER STATION, RELOCATED CRUSHER TO SCREENING STATION. BN-104 WAS 4 REQD. HEAD PULLEY W.P. ON CO-104 WAS 1578'-8", REMOVED HEATING AND INSULATION FROM CO-102 AND CO-103 ISSUED FOR ESTIMATING						

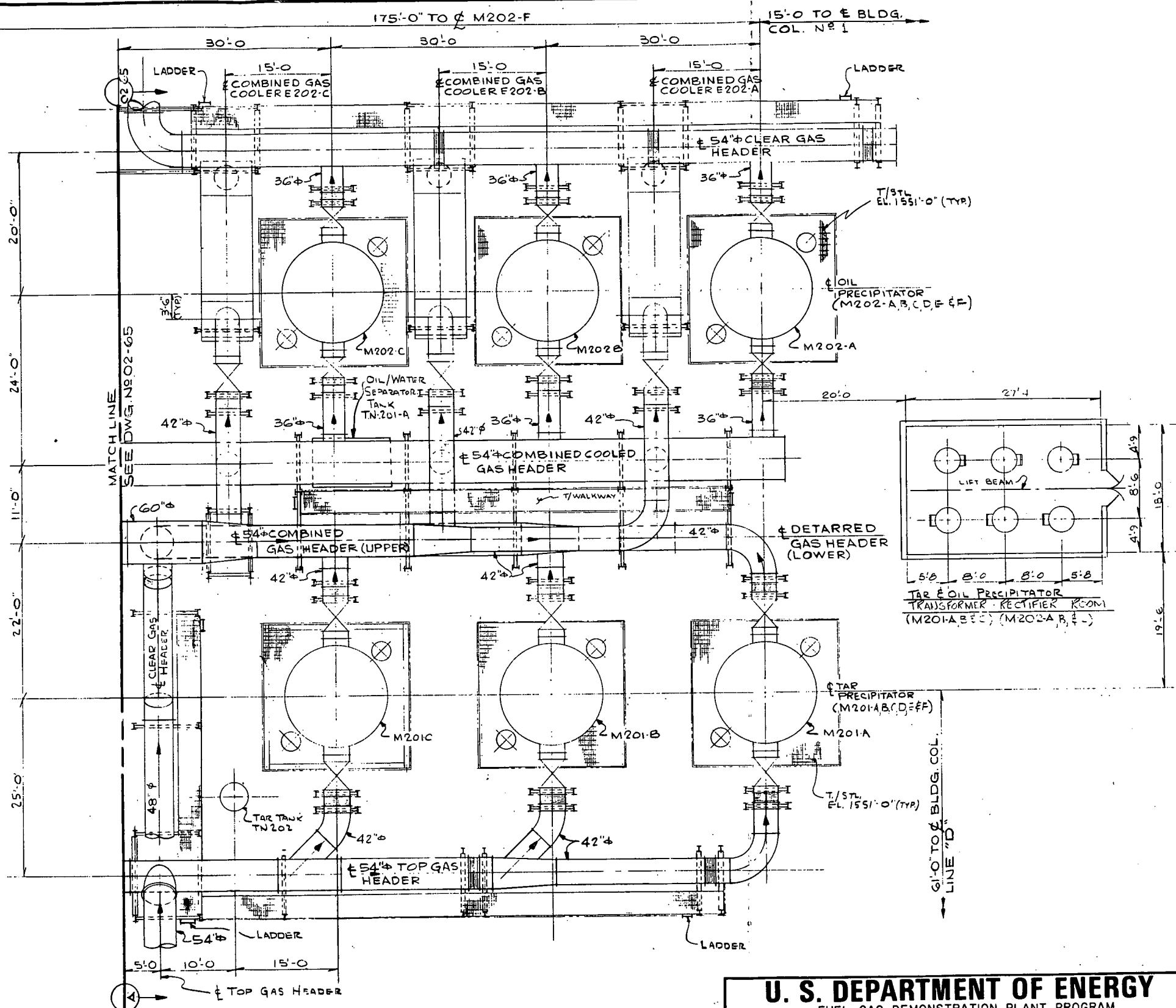


NOTE
 BUILDING TO BE INSULATED BUT NOT HEATED, EXCEPT TRIPPER AREA ABOVE EL. 113'-0" WHICH WILL BE INSULATED AND HEATED.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 PROJECT NO. 4814-X-02-51-2
 SCALE 1" = 30'-0"
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT GASIFIER BUILDING ARRANGEMENT
 REVISION 4

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
3-9-78	KH	TG	REVISED NOTE. BUILDING WAS INSULATED & HEATED		10-26-78	MS	TG	CHANGES AS CIRCLED	
			ADDED ELECTRICAL EQUIPMENT ROOM, ELEVATOR						
			SECTION F-F						
			STACKS, PLAT., BLOWERS, PIPING, DUST COLL. & TAG HOS ADDED; TRUCK DOOR DELETED						
			ISSUED FOR ESTIMATING						

SCALING RULES



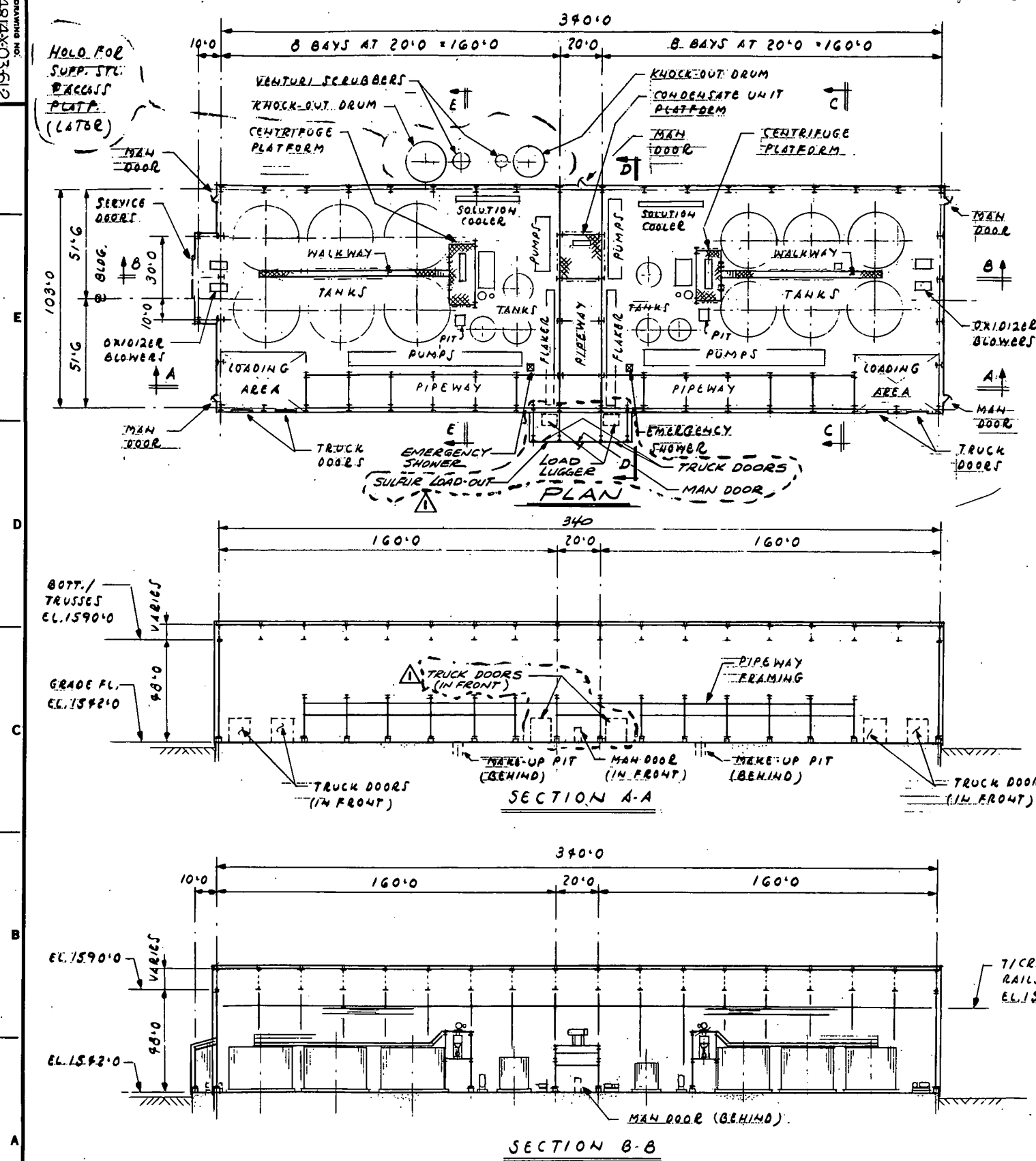
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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-X-0266-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
GASIFICATION COMMERCIAL UNIT - STAGE 2
GAS CL. PLANT-PLAN & ELEV-SHT. NO. 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.



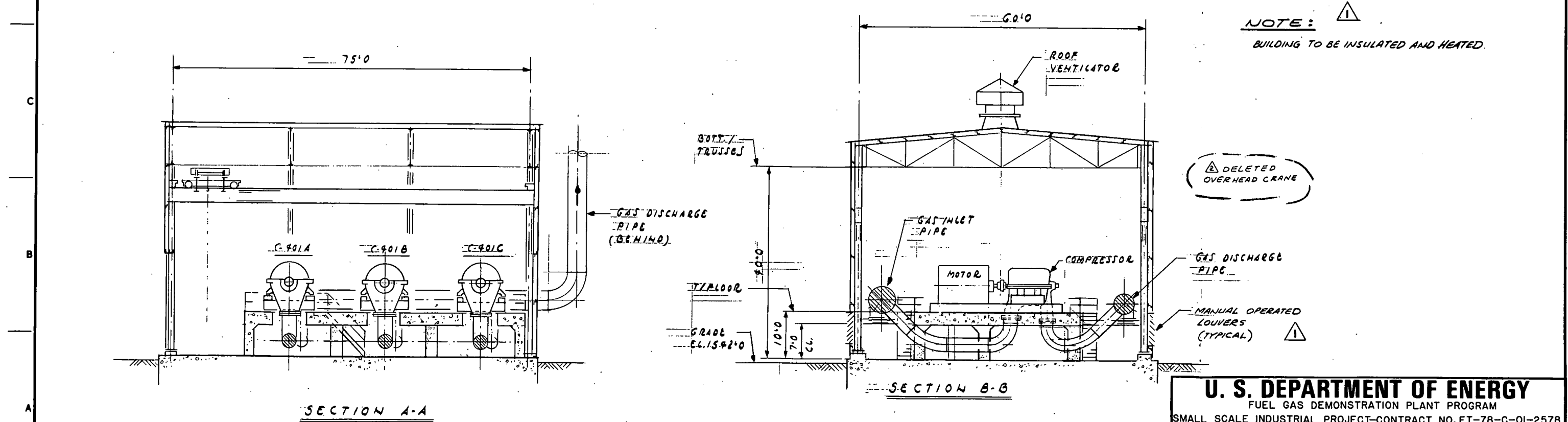
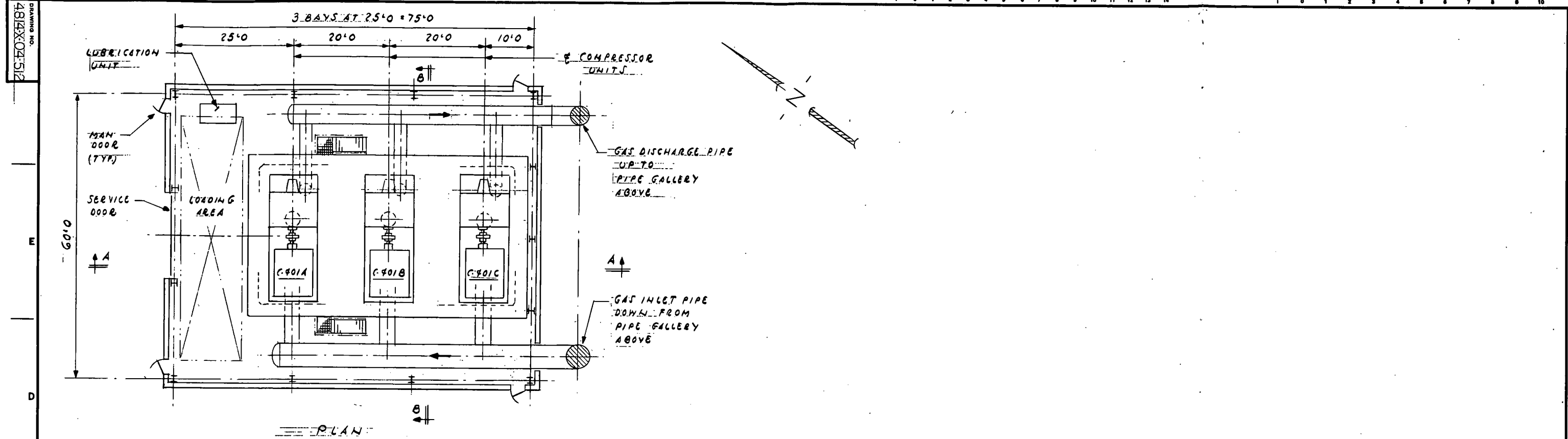
NOTE:
BUILDING TO BE INSULATED AND HEATED.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO

PROJECT NO. 4814-X-03-61-2
 P.E. NO.
 SCALE 1" = 30'0"
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 SULFUR REMOVAL
 COMMERCIAL UNIT
 STRET福德 BUILDING ARRANGEMENT

REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										9-13-78	MJS		ADDED LOAD-OUT ANNEX, REV. LOUVERS & ADDED NOTE	
										8-1-78	B.R.		ISSUED FOR ESTIMATING	



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-X-04-51-2

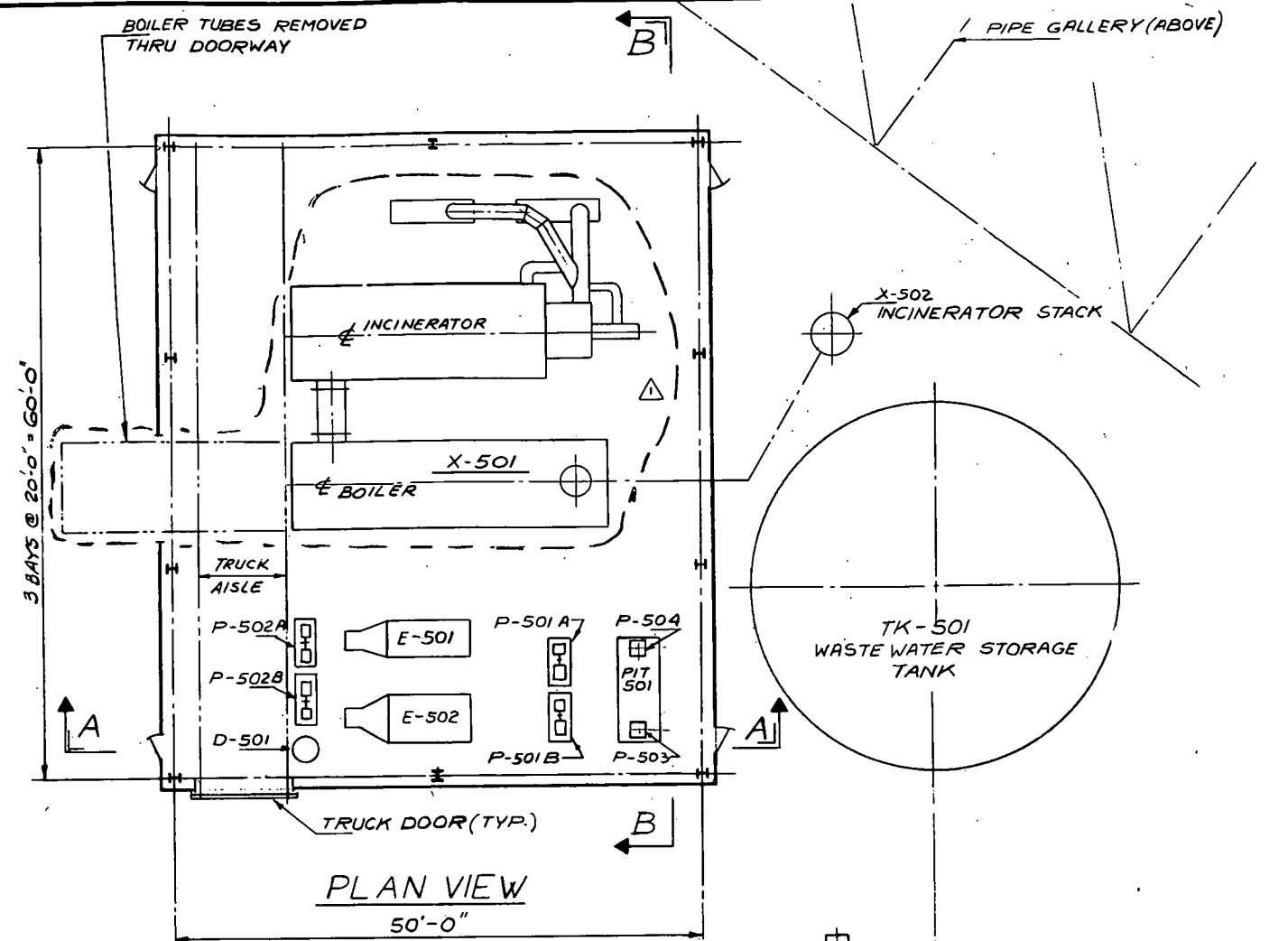
FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

GAS TRANSMISSION
 COMMERCIAL UNIT
 GAS COMPRESSOR BUILDING

PROJECT NO. P.E. NO.
 SCALE 1" = 10'-0"
 REVISION 2

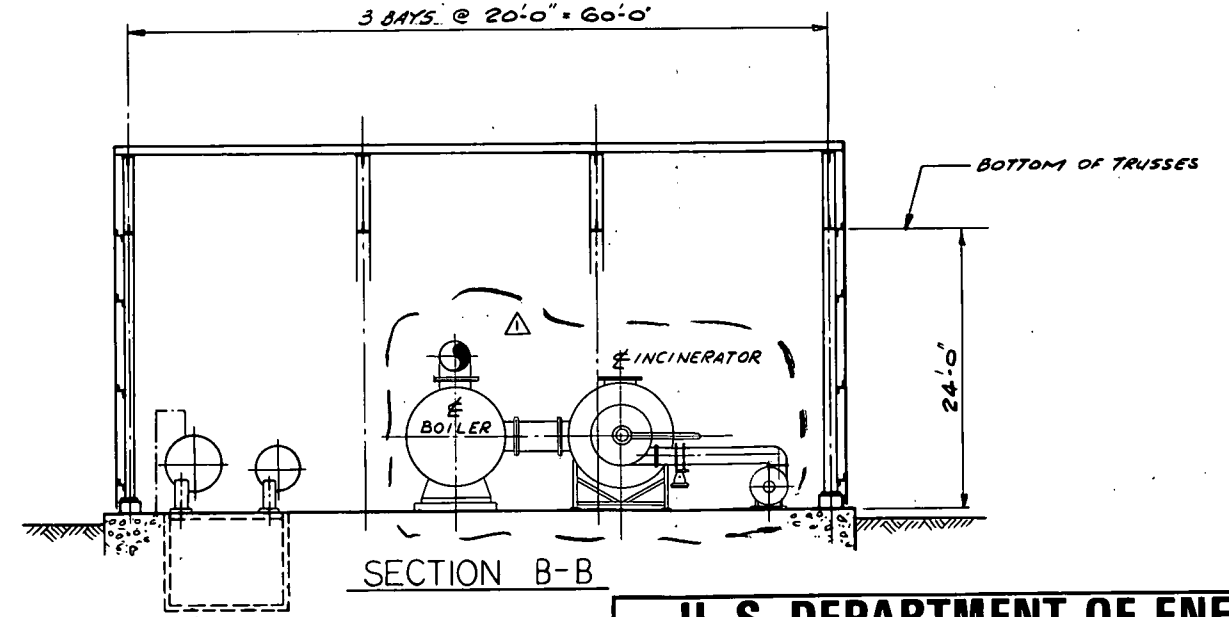
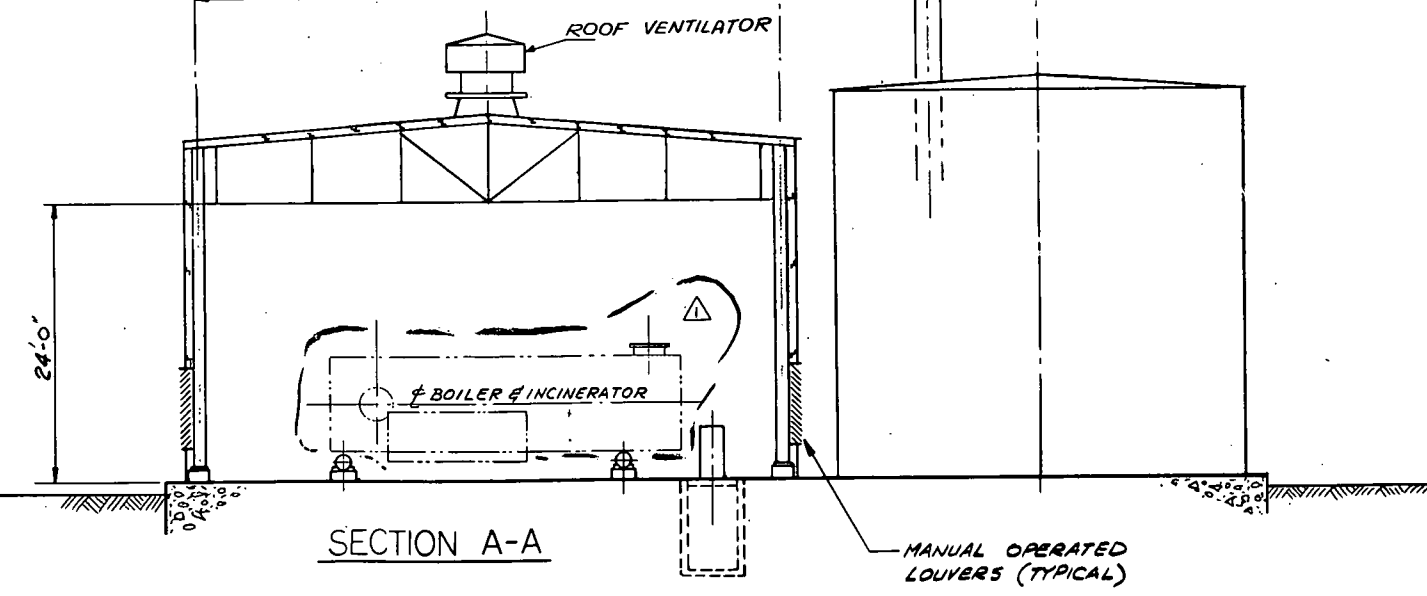
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										10-26-78	MS	TG	CHANGES AS CIRCLED	
										9-13-78	HJS		REV. LOUVERS & ADDED NOTE	
										8-11-78	KH		ISSUED FOR ESTIMATING	

DRAWING NO. 4814-X-05-51-2



- D-501 SURGE DRUM
- E-501 WASTE WATER EVAPORATOR (DEMO)
- E-502 WASTE WATER EVAPORATOR (COMM.)
- P-501A, P-501B EVAPORATOR FEED PUMP
- P-502A, P-502B INCINERATOR FEED PUMP

NOTE:
PRE-ENGINEERED BUILDING SYSTEM WITH STEEL PANELED WALLS & ROOF.
WALLS & ROOF TO HAVE INSULATION WITH AN INTERIOR VAPOR BARRIER.



DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
△														
△														
△														
△														
△										10-3-78	MS	TG	BOILER & INCINERATOR UNIT RELOCATED.	
△														
△														
△														

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

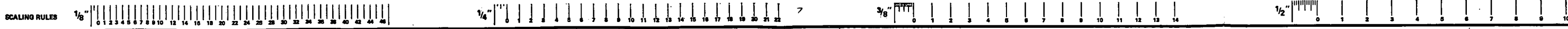
PROJECT NO. 4814-X-05-51-2 P.E. NO.

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. HOYT LAKES MINNESOTA
MANAGING AGENT

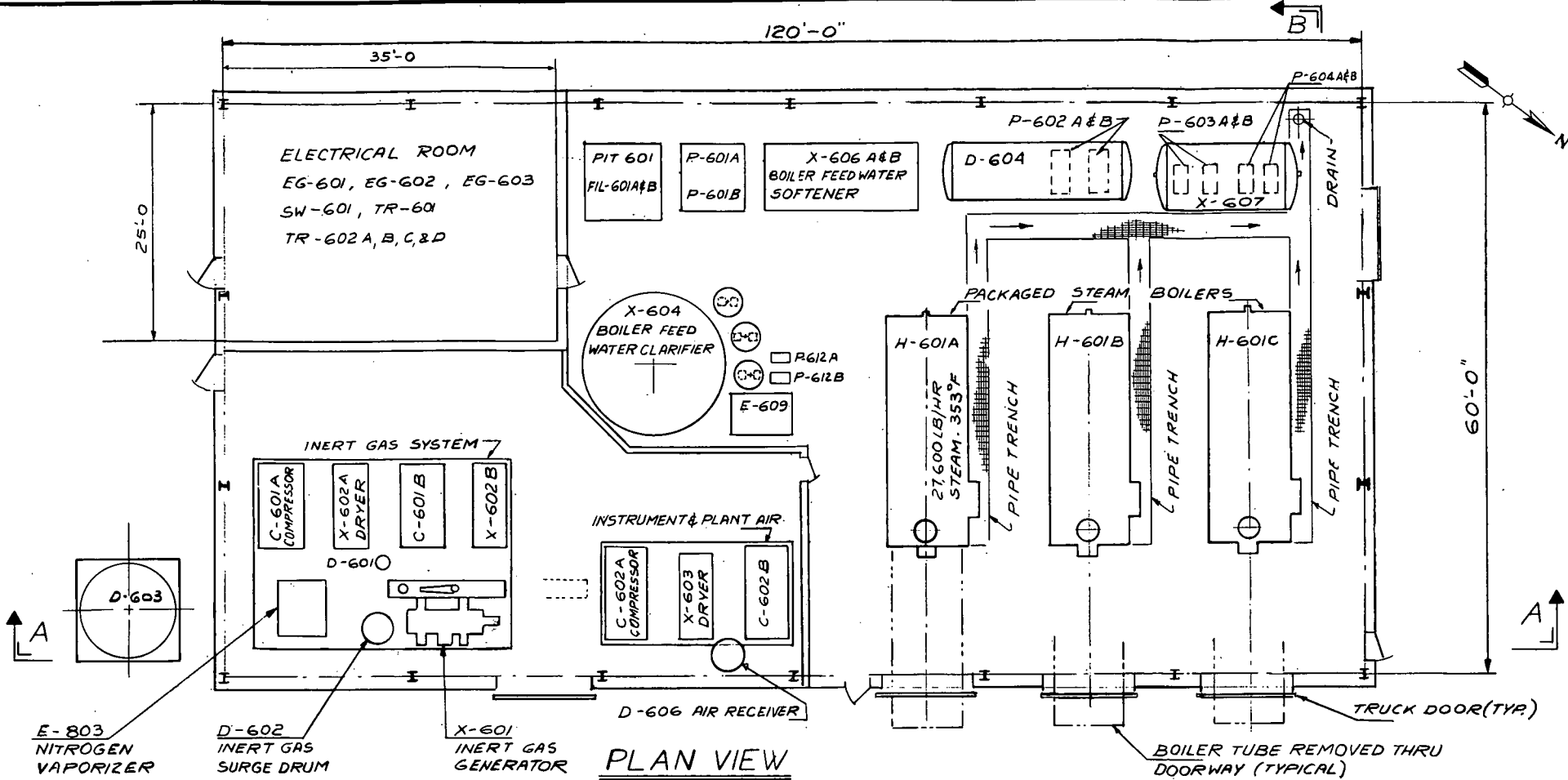
SCALE 1/8" = 1'-0"

WASTE TREATMENT COMMERCIAL UNIT INCINERATOR BUILDING

REVISION 1

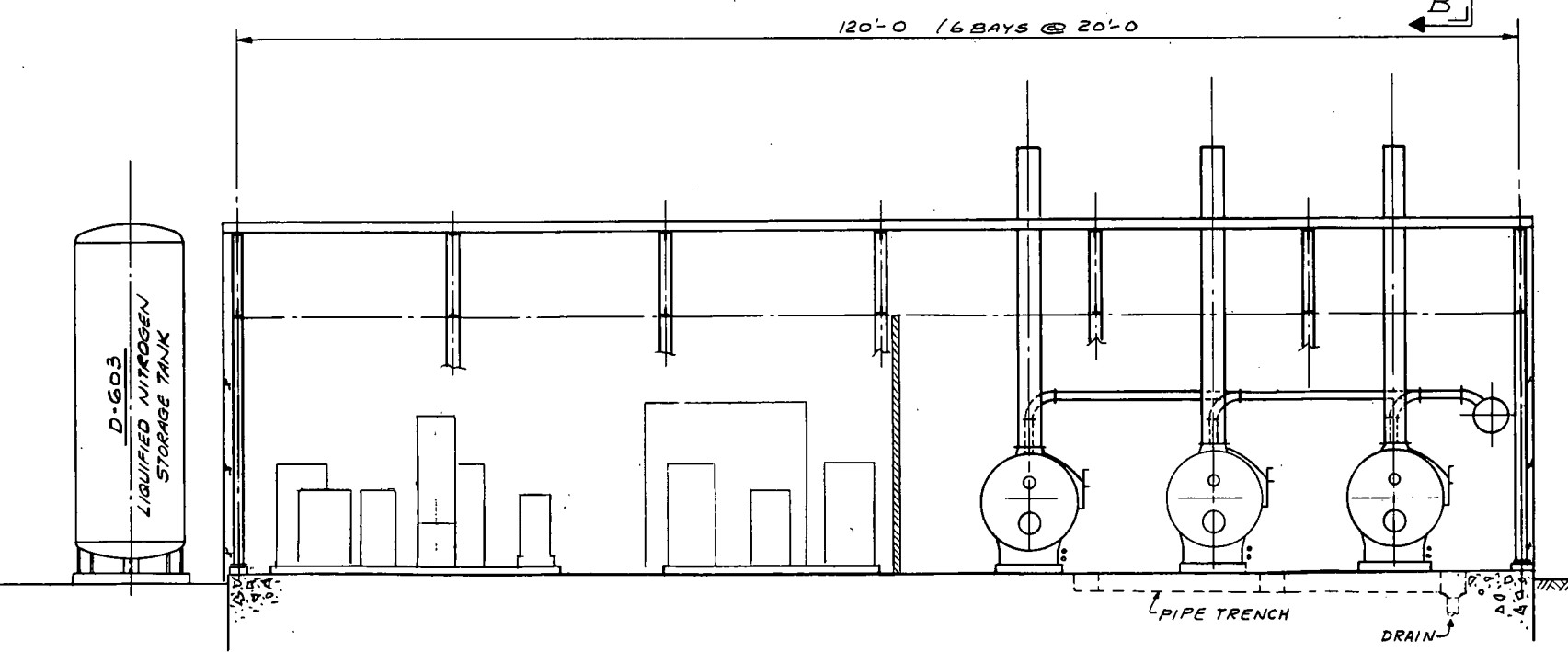


2-25-90-X-7187 ON DRAWING

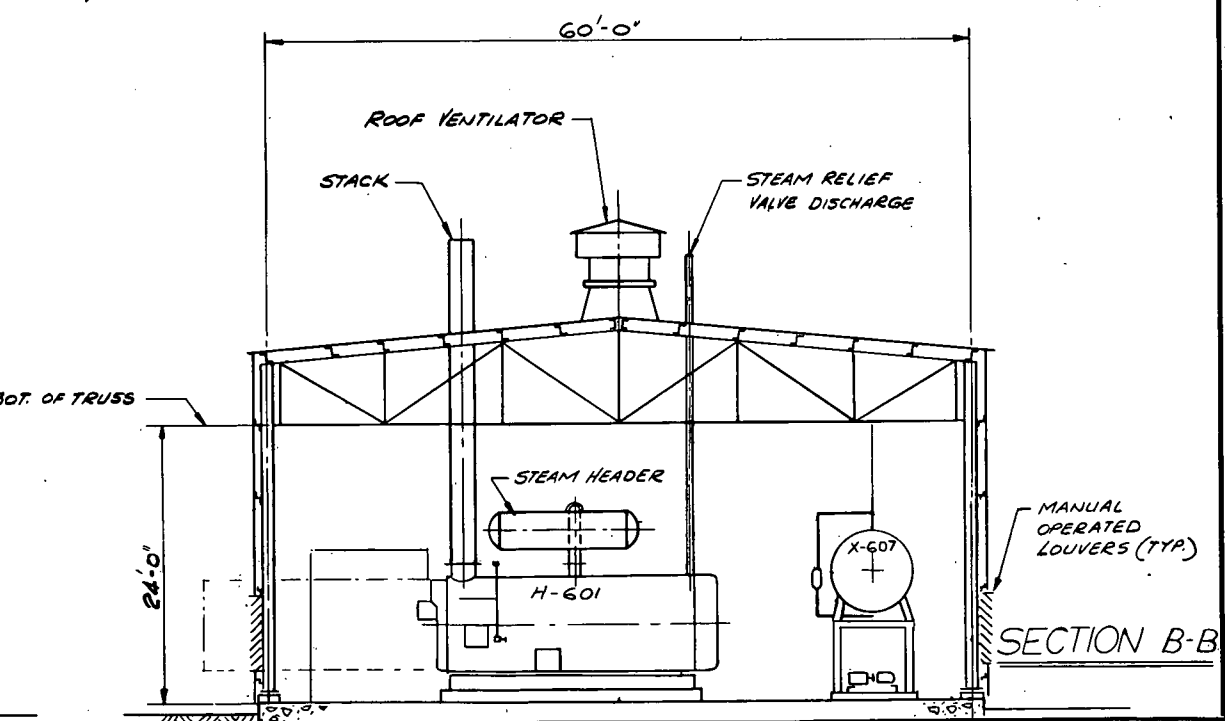


E-803 NITROGEN VAPORIZER
 D-602 INERT GAS SURGE DRUM
 X-601 INERT GAS GENERATOR

PLAN VIEW



SECTION A-A



SECTION B-B

- D-604 DEARATOR FEED SURGE TANK
- E-609 STRET福德 CONDENSATE COOLER
- FIL-601 A&B BOILER FEEDWATER FILTER
- P-601 A&B BOILER FEEDWATER SOFTENER PUMP
- P-602 A&B DEARATOR FEED PUMPS
- P-603 A&B LOW PRESSURE BOILER FEED PUMPS
- P-604 A&B HIGH PRESSURE BOILER FEED PUMPS
- P-612 A&B STRET福德 PROCESS WATER PUMPS
- X-607 BOILER FEEDWATER DEARATOR

NOTE:
 PRE-ENGINEERED BUILDING SYSTEM WITH STEEL PANELED WALLS & ROOF. WALLS & ROOF TO HAVE INSULATION WITH AN INTERIOR VAPOR BARRIER.

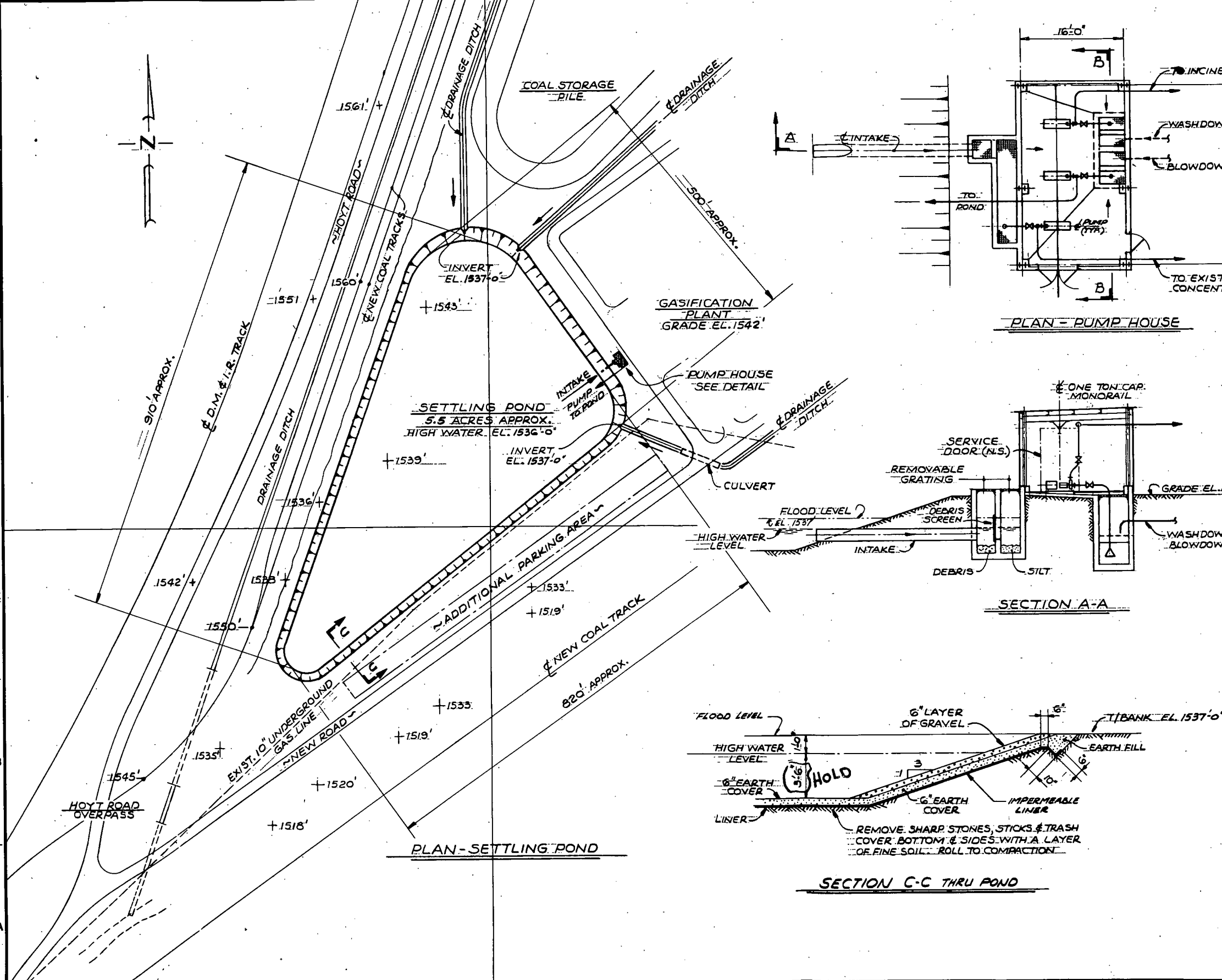
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-X-06-52-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 UTILITIES COMMERCIAL UNIT UTILITIES BUILDING
 PROJECT NO. P.E. NO. SCALE 1/8" = 1'-0" REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

ISSUED FOR CONSTRUCTION

2-55-53 X 4-53
06-53-2
MCKEE DRAWING



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO

PROJECT NO. 4814X-06-53-2
 P.E. NO. _____
 SCALE _____

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

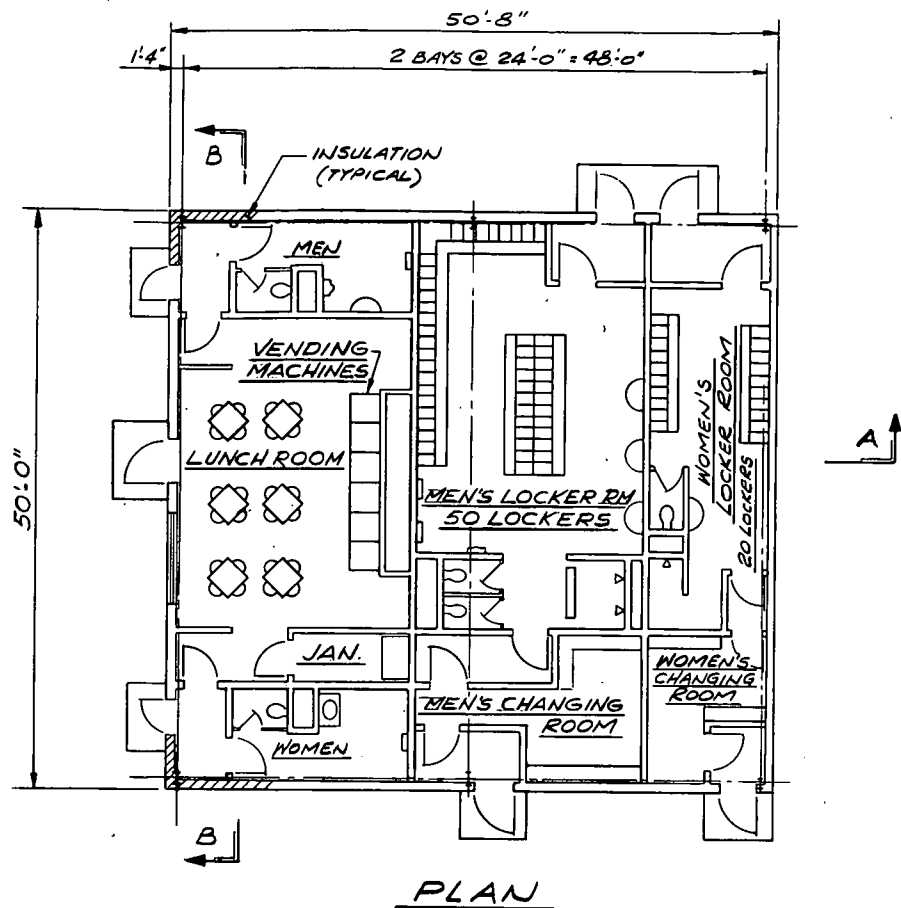
UTILITIES
 COMMERCIAL UNIT
 PUMP HOUSE & SETTLING POND

REVISION

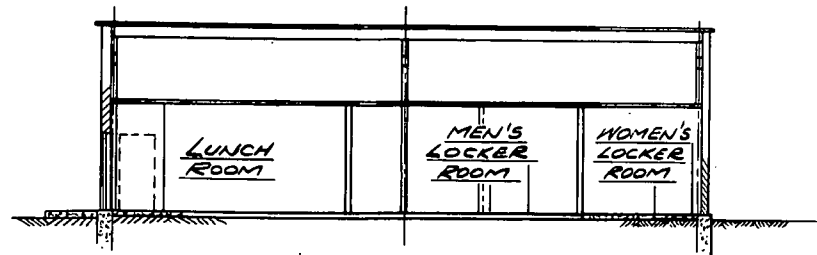
DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

9-11-78, RK ISSUED FOR ESTIMATING

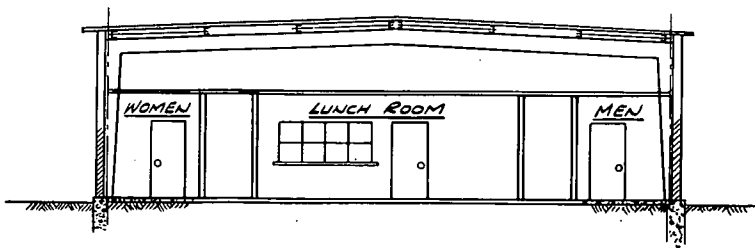
DRAWING NO. 4814-X-09-51-2



PLAN



SECTION A-A



SECTION B-B

NOTES :

PRE-ENGINEERED BUILDING SYSTEM WITH STEEL PANELED WALLS AND ROOF. WALLS AND ROOF TO HAVE INSULATION WITH AN INTERIOR VAPOR BARRIER.

ROOM FINISHES

CEILING:
SUSPENDED ACOUSTICAL TILE,
PLASTER IN WET AREAS.

FLOORS:
LUNCH ROOM, MEN'S & WOMEN'S LOCKER ROOMS AND
CHANGING ROOMS : VINYL ASBESTOS TILE.
TOILETS & SHOWERS : CERAMIC TILE.

WALLS:
TOILETS & SHOWERS : CERAMIC TILE.
ALL OTHER AREAS : DEMOUNTABLE PARTITIONS.

OSHA : 1910.141, 1910.142

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										9/1/78	WJS		REDRAWN	
										7/28/78	WJS		ISSUED FOR ESTIMATING	

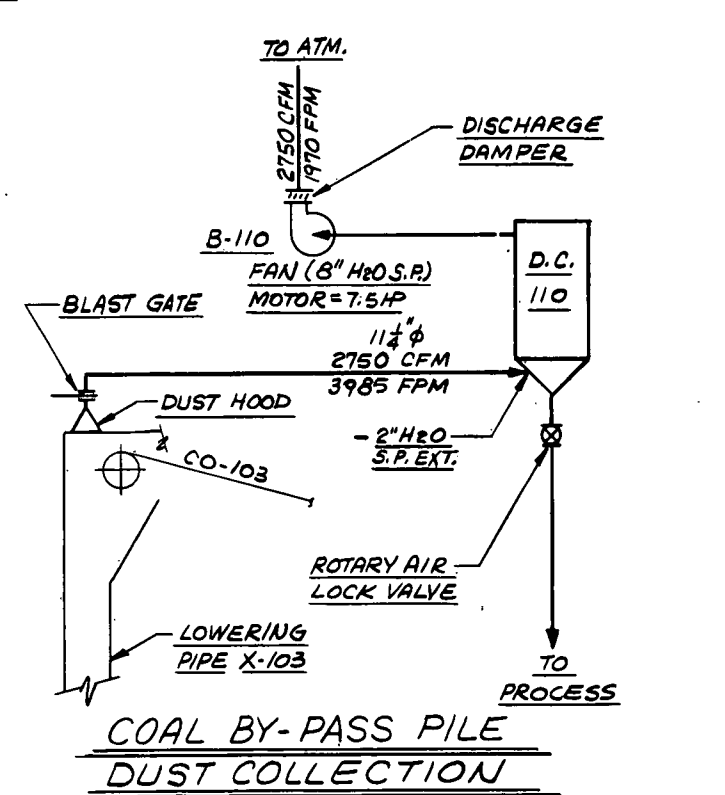
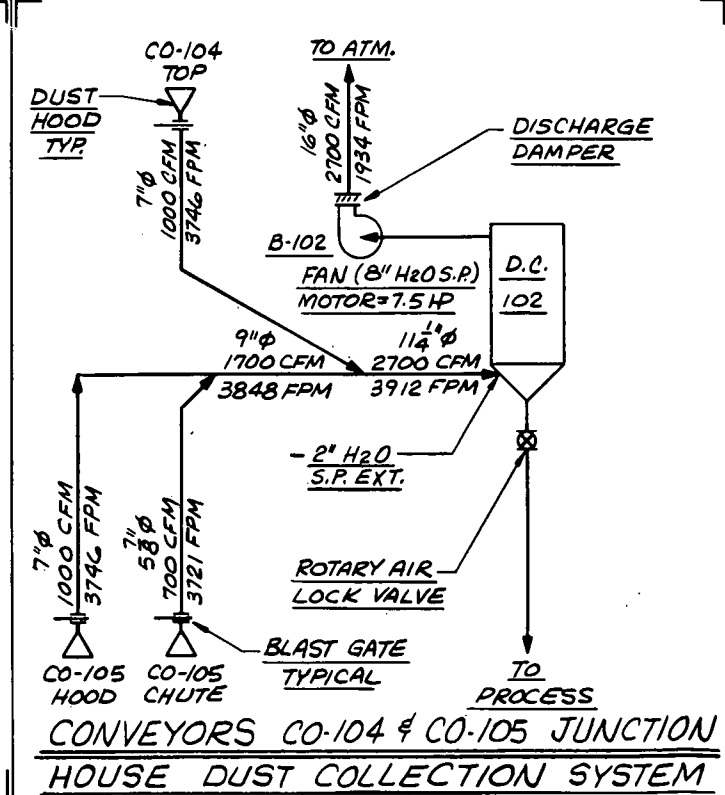
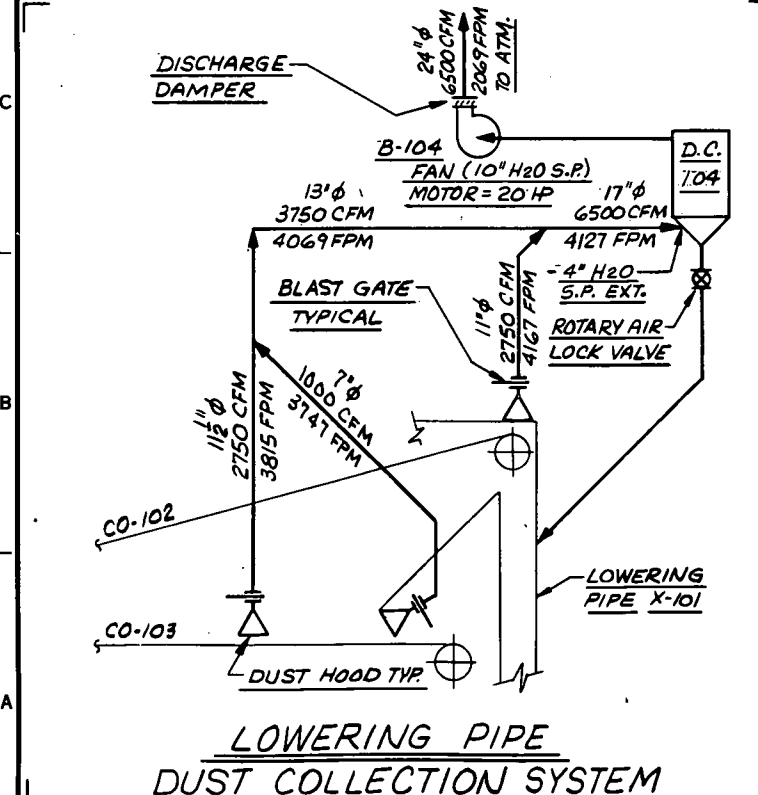
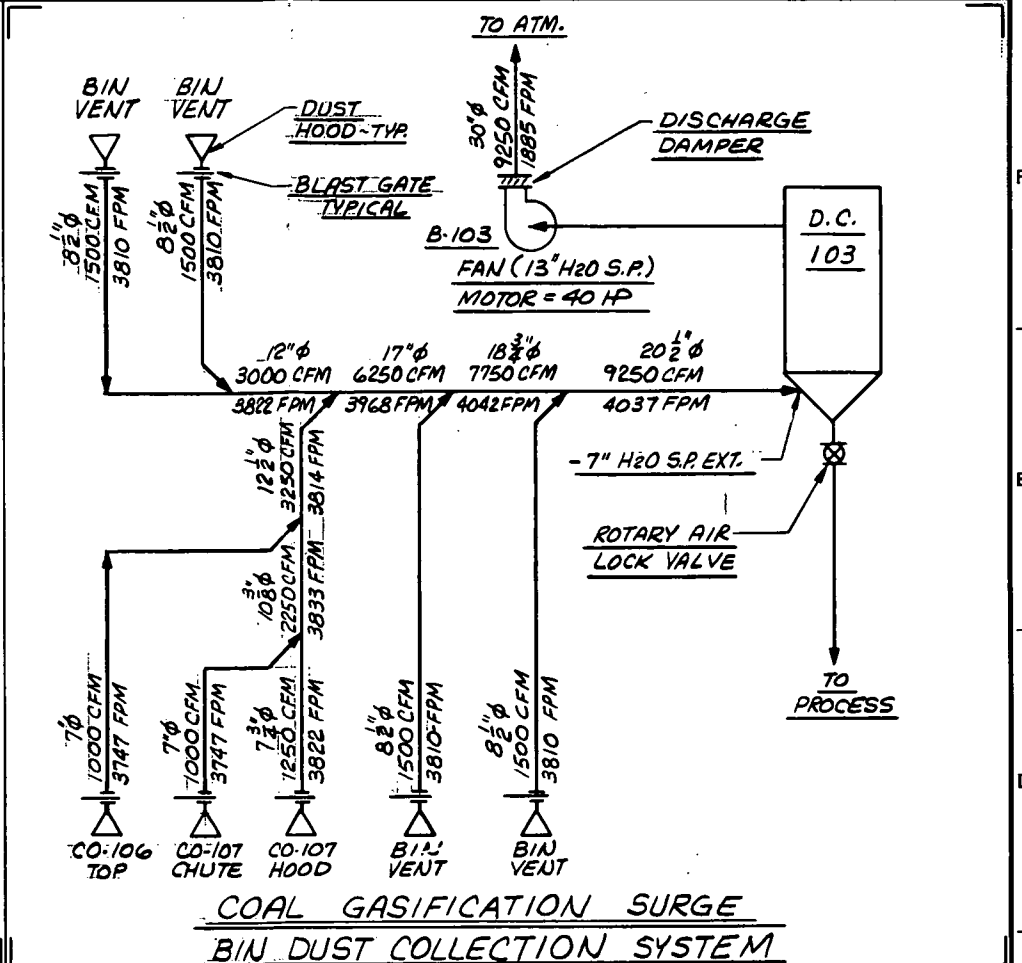
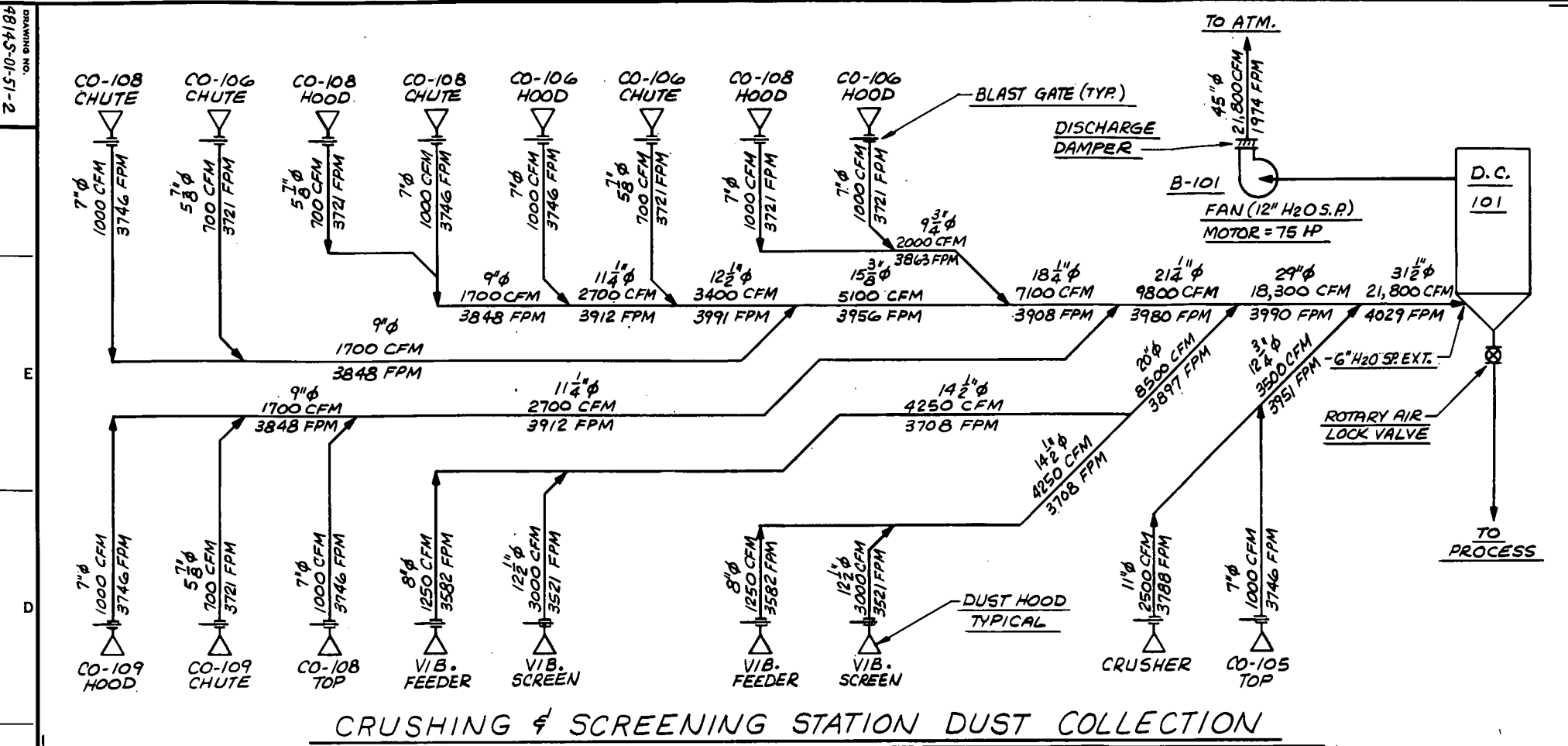
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-X-09-51-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

**EMPLOYEE FACILITIES
 COMMERCIAL UNIT
 ARRANGEMENT**

SCALE 1/8" = 12"
 REVISION 1



NOTE:
FOR EQUIPMENT DESIGN & FABRICATION REQUIREMENTS SEE A.G. MCKEE & CO. DUST & FUME COLLECTION GENERAL SPECIFICATION N° 1000 SERIES.

WORK THIS DWG. WITH DWG. 4814 S-01-52-2

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-S-01-51-2

REVISION	DATE	BY	CHK	DESCRIPTION	APP.
1	11-1-78	J.K.		ISSUED FOR ESTIMATE	

REVISION	DATE	BY	CHK	DESCRIPTION	APP.

REVISION	DATE	BY	CHK	DESCRIPTION	APP.

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. HOYT LAKES MINNESOTA
MANAGING AGENT
COAL GASIFICATION COMMERCIAL COAL HANDLING UNIT DUST FLOW DIAGRAMS
REVISION Δ

DRAWING NO. 4914-Y-01-60-2

H-101
THAW SHED HEATERS

DU-101
ROTARY CAR DUMPER

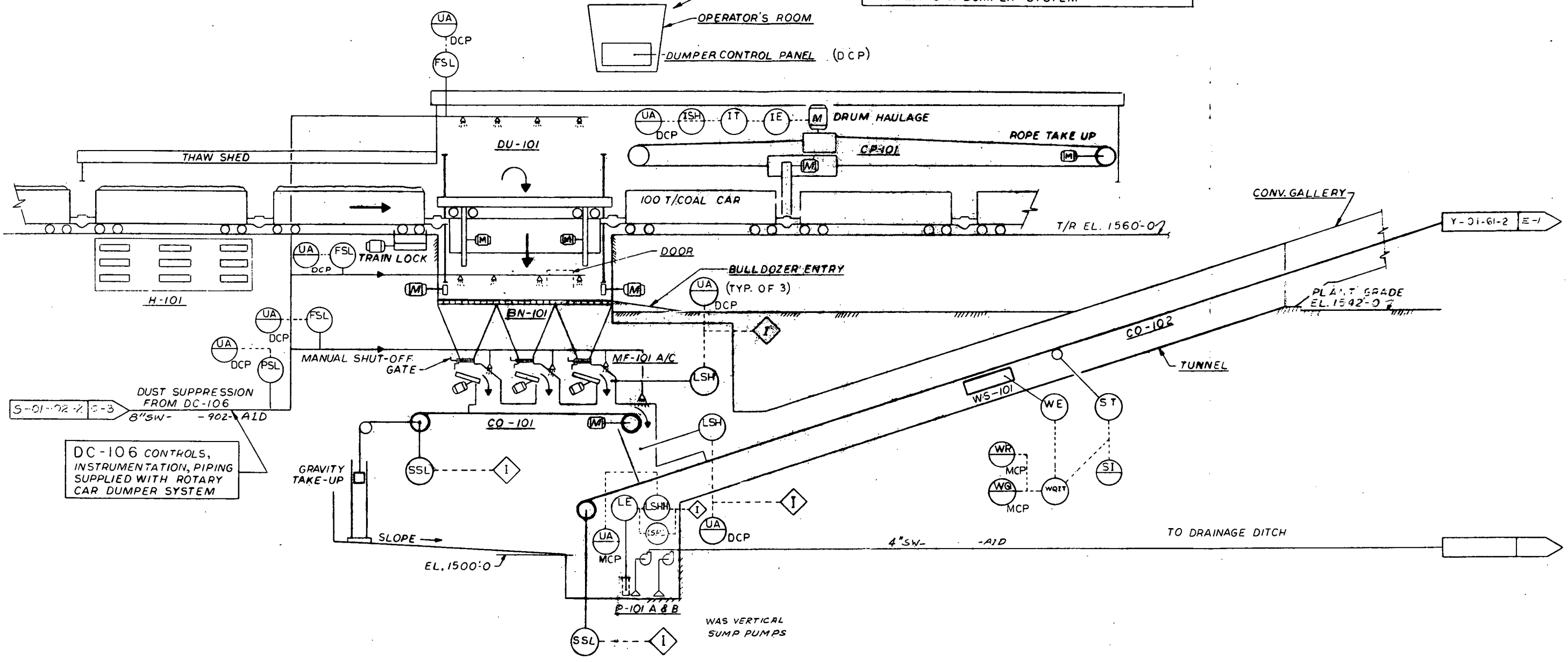
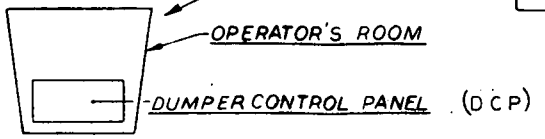
CP-101
CAR POSITIONER

WS-101
BELT SCALE

BN-101
DUMPER HOPPER

CO-102
TRANSPORT CONVEYOR

DU-101, CP-101, H-101, & DC-106 CONTROLS
INSTRUMENTATION, PIPING SUPPLIED WITH
ROTARY CAR DUMPER SYSTEM



DC-106 CONTROLS,
INSTRUMENTATION, PIPING
SUPPLIED WITH ROTARY
CAR DUMPER SYSTEM

MF-101A,B & C
VIBRATING FEEDERS

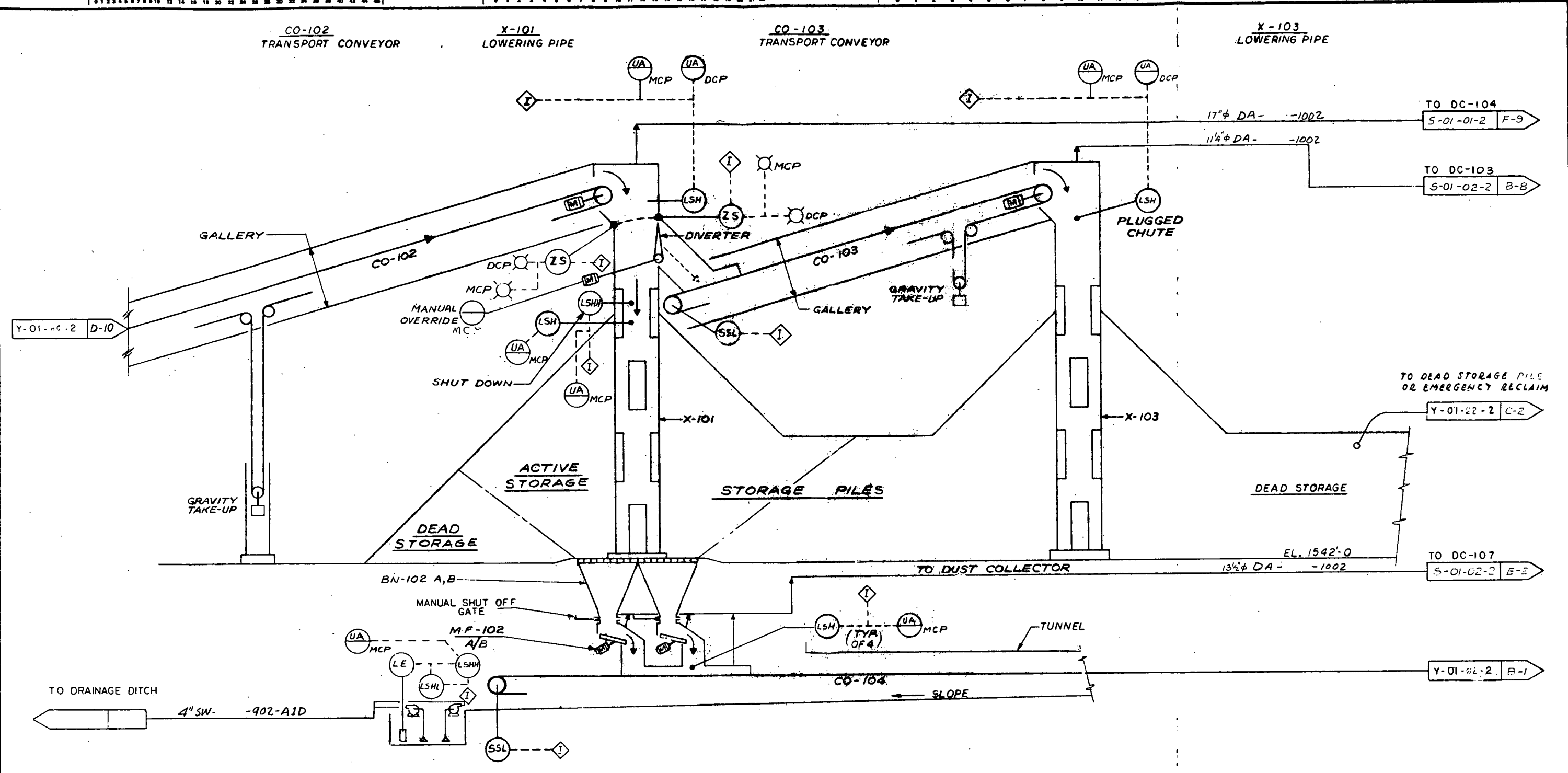
P-101 A & B
SUMP PUMPS

CO-101
COLLECTING CONVEYOR

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
PROJECT NO. 4814-Y-01-60-2
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
MATERIALS HANDLING P. & I. D.
COMMERCIAL UNIT
COAL UNLOADING STATION
REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

DRAWING NO. 4814-Y-01-61-2



P-102 A & B
SUMP PUMPS

BN-102 A, B,
RECLAIM HOPPER

MF-102 A, B,
VIBRATING FEEDERS

DELETED
BN-102C & BN-102D

DELETED
MF-102 C & MF-102D

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKEE**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

PROJECT NO. 4814-Y-01-61-2
SCALE NONE
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
MATERIALS HANDLING P. & I.D.
COMMERCIAL UNIT
COAL STORAGE

REVISIONS:
 2-10-78 MS TG CHANGES AS CIRCLED
 3-25-78 KH JF DELETED BN-102C, BN-102D, MF-102C, MF-102D
 8-17-78 E.E. ISSUED FOR ESTIMATING

DRAWING NO.
4814-Y-01-62-2

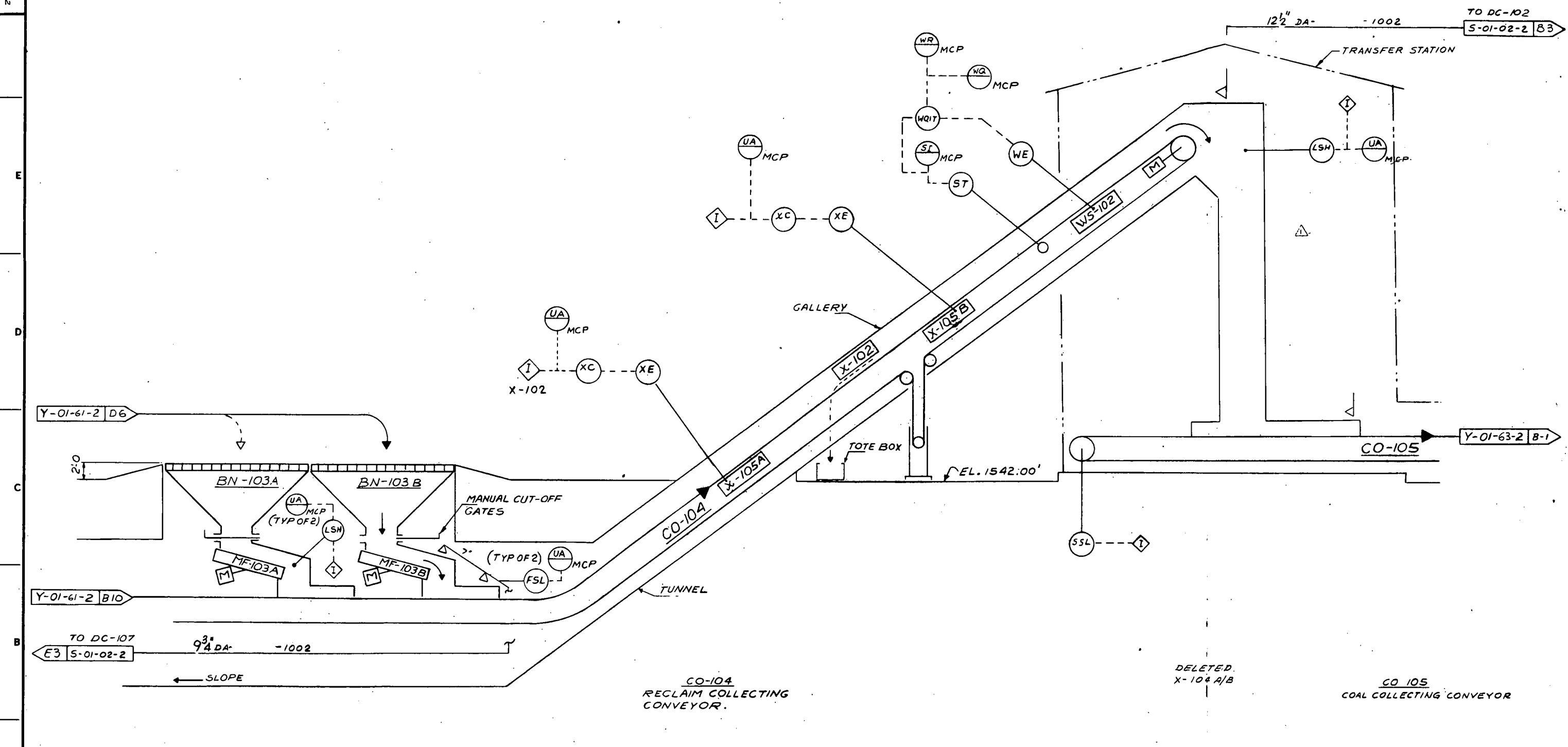
BN -103A, 103B
AUXILIARY RECLAIM
HOPPERS.

X-105A
METAL
DETECTOR

X-102
TRAMP IRON
MAGNET.

X-105B
METAL
DETECTOR

WS-102
BELT SCALE



MF 103 A & B
STORAGE PILE EMERGENCY
RECLAIM HOPPER FEEDERS

CO-104
RECLAIM COLLECTING
CONVEYOR.

CO 105
COAL COLLECTING CONVEYOR

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

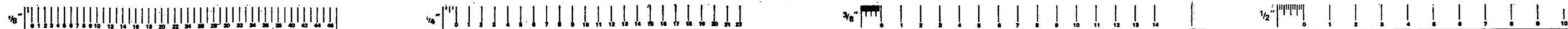
PREPARED BY **McKOG**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
MATERIAL HANDLING P. & I. D.
COMMERCIAL UNIT.
AUXILIARY HOPPER & TRANSFER STATION

PROJECT NO.	4814-Y-01-62-2
P.I.E. NO.	
SCALE	NONE
REVISION	1

DATE	BY	CHK	DESCRIPTION	APP.

REVISIONS
 9-13-78 MS ~~TR~~ WAS CRUSHER STATION
 8/22/78 KH ISSUED FOR ESTIMATING

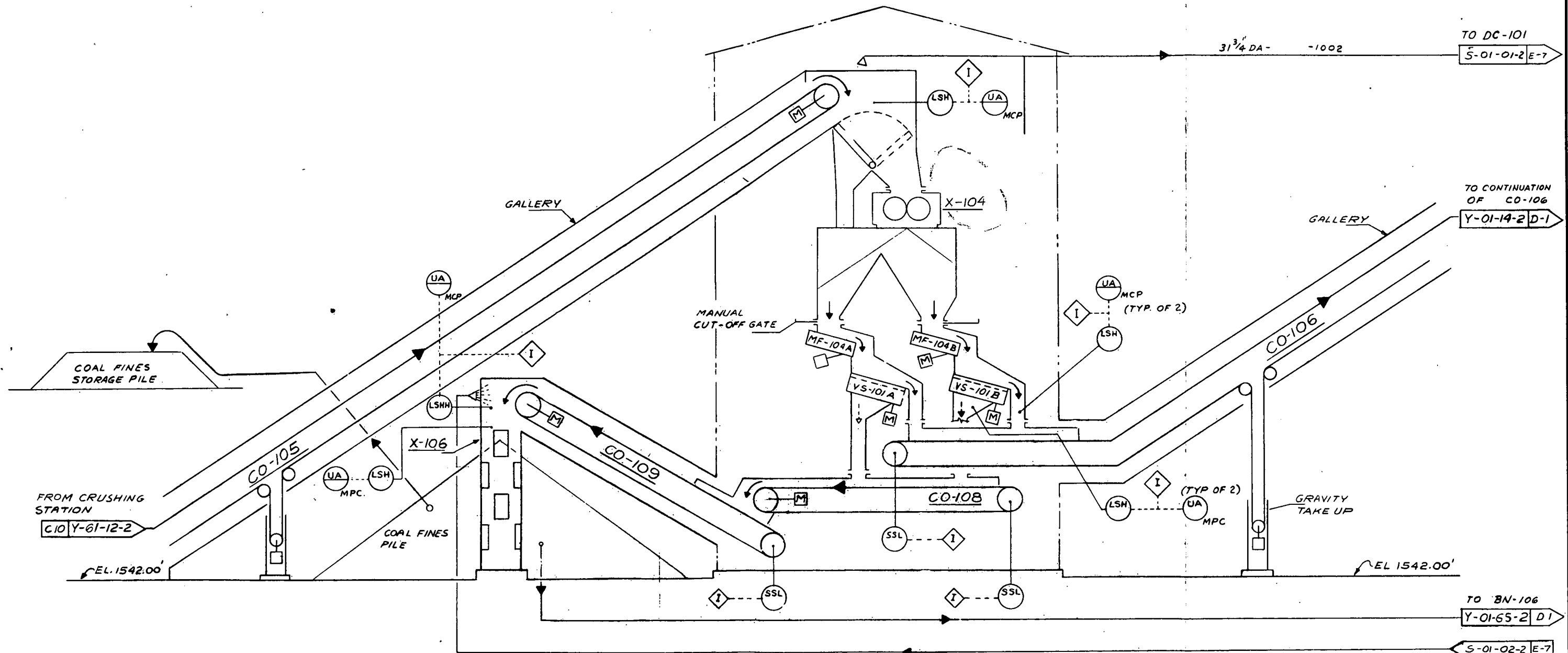


4814-Y-0163-2

MF-104 A/B VIBRATING SCREEN FEEDER
DELETED MF-104 C

BN-104 VIBRATING SCREEN SURGE HOPPER
X-104 CRUSHER

VS-101 A/B VIBRATING SCREEN
DELETED VS-101 C



CO-105
BYPASS & CRUSHED
COAL COLLECTING
CONVEYOR

X-106
LOWERING TUBE

CO-109
FINES TRANSPORT
CONVEYOR

CO-108
COAL FINES COLLECTING
CONVEYOR

CO-106
SCREENED COAL
COLLECTING CONVEYOR

S-01-02-2 E-7
FROM DC-109
DUST SUPPRESSION
UNIT

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKEE**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

PROJECT NO. 4814-Y-0163-2

SCALE NONE

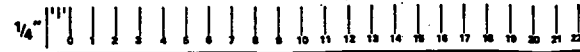
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

MATERIALS HANDLING P.&I.D.
COMMERCIAL UNIT
COAL SCREENING AND CRUSHING

REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										9-25-78	ER		ADDED CRUSHER X-104, DELETED MF-104 C AND VS-101 C	
													ISSUED FOR ESTIMATING	

SCALING RULES

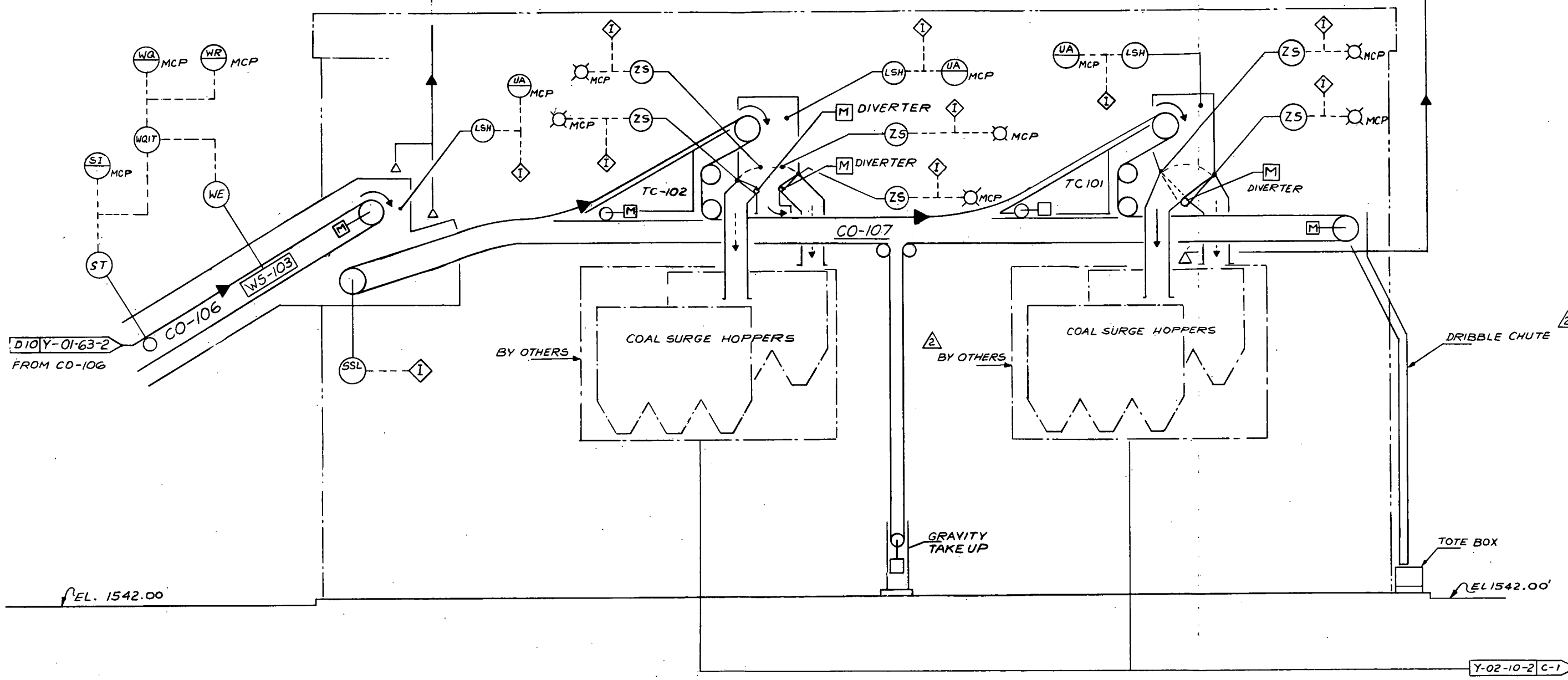


DRAWING NO.
4814-Y-01-64-2

TC-102
TRIPPER CAR

TC-101
TRIPPER CAR

TO DC-110
S-01-01-2 B-9



WS-103
BELT SCALE

CO-107
GASIFIER FEED
TRIPPER CONVEYOR

U. S. DEPARTMENT OF ENERGY	
FUEL GAS DEMONSTRATION PLANT PROGRAM	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY	4814-Y-01-64-2
MCKEE ENGINEERS AND CONSTRUCTORS	
CLEVELAND OHIO	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
MATERIAL HANDLING P. & I. D. COMMERCIAL UNIT GASIFIER FEED CONVEYORS	
PROJECT NO.	P.E. NO.
NONE	NONE
REVISION 4	

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10-24-78	MS	TK	REVISED AS CIRCLED		10-24-78	MS	TK	REVISED AS CIRCLED	
10-20-78	MS		REVISED AS CIRCLED		9-22-78	KH	JF	ADDED DRIBBLE CHUTE, TOTE BOX & SURGE HOPPER NOTE	PAS
8-11-78	NRS		"HOLD" REMOVED		7/27/78	KH		ISSUED FOR ESTIMATING	

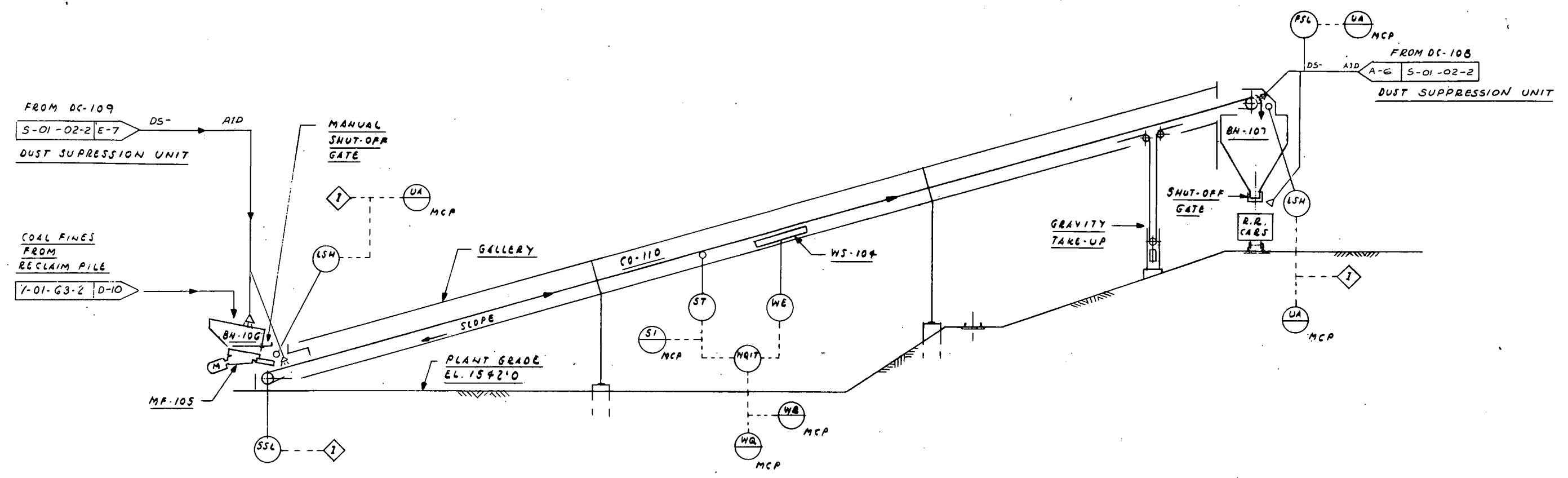
1 2 3 4 5 6 7 8 9 10

DRAWING NO. 4814-Y-0165-2

BN-106
RECLAIM HOPPER
MF-105
VIBRATING FEEDER

CO-110
TRANSPORT CONVEYOR
WS-104
BELT SCALE

BN-107
FINES LOAD-OUT BIN



U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-01-65-2

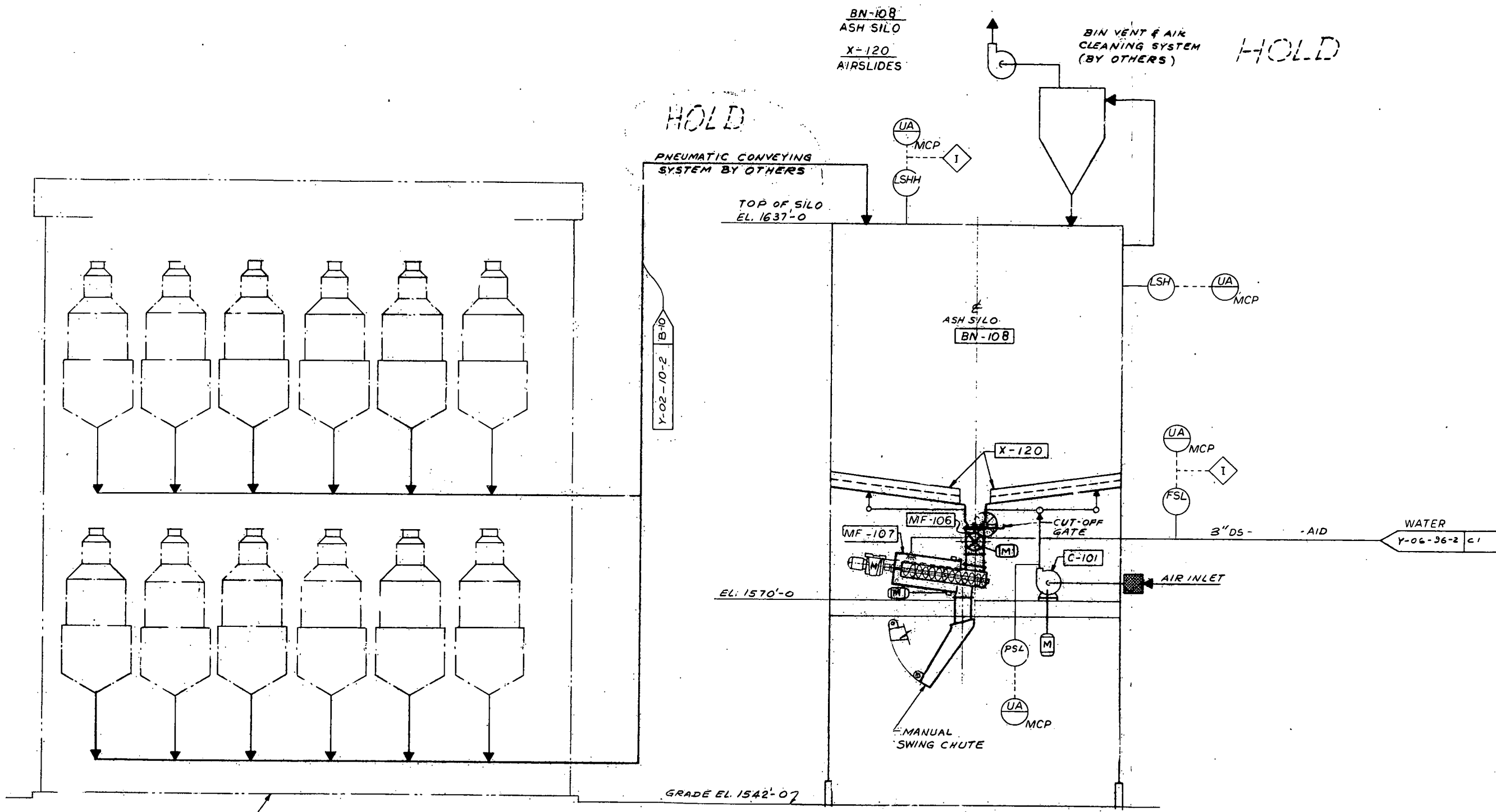
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. HOYT LAKES MINNESOTA
MANAGING AGENT

MATERIALS HANDLING COMMERCIAL UNIT COAL FINES RECLAIMING

REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										9-27-78	KH		ADDED DUST CONTROL TO BN-106 & REFERENCE NO. 21A	
										8-17-78	E.R.		ISSUED FOR ESTIMATING	

3-99-70
A - P/BP
FOR ESTIMATING



HOLD

HOLD

GASIFIER BUILDING

- C-101
AIRSLIDES BLOWER
- MF-106
STAR FEEDER
- MF-107
ROTARY UNLOADER

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

REVISIONS
 9-22-78 KH ADDED HOLDS #DNG. REF. NO.
 8/2/78 SM ISSUED FOR ESTIMATING

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO

4814-Y-01-66-2

FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

MATERIALS HANDLING P. & I. D.
 COMMERCIAL UNIT
 ASH HANDLING

PROJECT NO. P. E. NO.
 SCALE
 NONE
 REVISION Δ

INSTRUMENT IDENTIFICATION

I.S.A. STANDARD 55.1 - REV. 1973 SHALL APPLY FOR SYMBOLS AND IDENTIFICATION NOT PRESENTED ON THIS SHEET

FIRST LETTER	SUCCEEDING LETTERS			
	MEASURED/INITIATING VARIABLE	MODIFIER	READOUT/PASSIVE FUNCTION	OUTPUT FUNCTION
A	ANALYSIS		ALARM	
B	BURNER FLAME			
C	CONDUCTIVITY (ELECTRICAL)			CONTROL
D	DENSITY (MASS) / SPEC GRAVITY	DIFFERENTIAL		
E	VOLTAGE (EMF)		PRIMARY ELEMENT	
F	FLOW RATE	RATIO (FRACTION)		
G	GAGING (DIMENSIONAL)		GLASS	
H	HAND (MANUALLY INITIATED)			HIGH
I	CURRENT (ELECTRICAL)		INDICATE	
J	POWER	SCAN		
K	TIME / TIME SCHEDULE			CONTROL STATION
L	LEVEL		LIGHT (PILOT)	LOW
M	MOISTURE / HUMIDITY			MIDDLE INTERMEDIATE
N			ORIFICE (RESTRICTION)	
P	PRESSURE / VACUUM		POINT (TEST CONNECTION)	
Q	QUANTITY / EVENT	INTEGRATE / TOTALIZE		
R	RADIOACTIVITY		RECORD / PRINT	
S	SPEED / FREQUENCY	SAFETY		SWITCH
T	TEMPERATURE			TRANSMIT
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION MULTIFUNCTION
V	VISCOSITY			VALVE DAMPER / LOUVER
W	WEIGHT / FORCE		WELL	
X				
Y				RELAY / COMPUTE
Z	POSITION			DRIVE ACTUATE / UNCLASSIFIED FINAL CONTROL ELEMENT

PIPING & INSTRUMENT DIAGRAM ABBREVIATIONS

GENERAL

ATM ATMOSPHERE	LIQ LIQUID
AVG AVERAGE	LP LOW PRESSURE
BTU BRITISH THERMAL UNIT	MAX MAXIMUM
COND CONDENSATE	MM MILLION
CU.FT. CUBIC FEET	M THOUSAND
CFH CUBIC FEET PER HOUR	MOL MOLES
CFM CUBIC FEET PER MINUTE	NO NUMBER
CFS CUBIC FEET PER SECOND	% PERCENT
CU IN CUBIC INCH	LB POUND
CYL CYLINDER	PCF POUNDS PER CUBIC FOOT
DEG DEGREE	LB/GAL POUNDS PER GALLON
EL ELEVATION	*/HR POUNDS PER HOUR
EXT EXTERNAL	PSF POUNDS PER SQUARE FOOT
F FAHRENHEIT DEGREES	PSI POUNDS PER SQUARE INCH
FPM FEET PER MINUTE	PSIA POUNDS PER SQUARE INCH-ABSOLUTE
FPS FEET PER SECOND	PSIG POUNDS PER SQUARE INCH GAUGE
FT. FOOT- FEET	SCFD STANDARD CUBIC FEET PER DAY
GAL GALLONS	SEC SECOND
GPD GALLONS PER DAY	SG SPECIFIC GRAVITY
GPH GALLONS PER HOUR	STD STANDARD
GPM GALLONS PER MINUTE	SCFH STANDARD CUBIC FEET PER HOUR (60°F) AT 1 ATMOSPHERE AT SEA LEVEL
GPS GALLONS PER SECOND	ST STEAM TRAP
HP HIGH PRESSURE	STR STRAINER
HP HORSEPOWER	TEMP TEMPERATURE
HR HOUR	T TEMPORARY SERVICE
IN INCH	VISC VISCOSITY
ID INSIDE DIAMETER	VI VISCOSITY INDEX
INT INTERNAL	W WATT
KW KILOWATT	WT WEIGHT
KWH KILOWATT HOUR	

SAFETY

ATM TO ATMOSPHERE
FLARE TO FLARE
STACK TO STACK

UTILITIES

BFW BOILER FEED WATER	IW INDUSTRIAL WATER
COND CONDENSATE	UA INDUSTRIAL AIR
CWS COOLING WATER SUPPLY	IA INSTRUMENT AIR
CWR COOLING WATER RETURN	NITROGEN-XXX NITROGEN (PRESSURE)
DW DOMESTIC WATER	STM XXX STEAM (PRESSURE)

LINE & PIPING SYMBOLS IDENTIFICATION

TO OR FROM (UAL) UNIT AREA LIMIT	STEAM TRACED
MAIN PROCESS LINE	LINE SPECIFICATION CHANGE
SECONDARY PROCESS LINE	FURNISHED PIPING
ELECTRICAL LINE	FUTURE PIPING
PNEUMATIC LINE	ELECTRIC TRACED
CAPILLARY TUBING	* INDICATES FURNISHED WITH ASSOCIATED EQUIPMENT
HYDRAULIC SIGNAL	
ELECTROMAGNETIC &/OR SONIC SIGNAL	
INSULATION	

VALVES

	GATE VALVE		DIAPHRAGM OPERATED CONTROL VALVE
	BALL VALVE	FC	VALVE CLOSING ON ACTUATING MEDIUM FAILURE
	GLOBE VALVE	FO	VALVE OPENS ON ACTUATING MEDIUM FAILURE
	NEEDLE VALVE	FC/FO	VALVE LOCKS IN LAST POSITION ON ACTUATING MEDIUM FAILURE
	PLUG VALVE		BACK PRESSURE CONTROL VALVE
	CHECK VALVE		PRESSURE REDUCING CONTROL VALVE
	BUTTERFLY VALVE		THREE WAY VALVE
	BUTTERFLY CONTROL VALVE		DIAPHRAGM OPERATED THREE WAY CONTROL VALVE
	CONTROL VALVE WITH HANDWHEEL		PISTON OPERATED SLIDE VALVE
	HAND OPERATED CONTROL VALVE		CAR SEAL CLOSED
	SAFETY VALVE		
	FLUSH BOTTOM VALVE		
	PISTON OPERATED BALL VALVE HIGH TEMP		
	PISTON OPERATED CONTROL VALVE		

MISCELLANEOUS SYMBOLS

	Y-TYPE STRAINER		PO - PUMP OUT
	BASKET STRAINER		SO - STEAM OUT
	FIGURE 8 BLIND (SPECTACLE BLIND)		SC - SAMPLE CONN.
	TEMPORARY STRAINER		FLEXIBLE HOSE
	RESTRICTION ORIFICE		
	FLOW ELEMENT		
	BLIND FLANGE		
	REDUCER		
	HOSE CONNECTION		
	EXPANSION JOINT		
	PIPE CAP (THREADED)		
	PIPE CAP (WELDED)		
	ROTAMETER, FLOW INDICATOR		
	VENTURI		
	TRAP		
	OPEN DRAIN		
	EC - CLEAN WATER		
	EO - OILY WATER		
	ES - SANITARY WATER		

EQUIPMENT SYMBOLS

	CENTRIFUGAL PUMP (MOTOR DRIVEN)
	SUMP PUMP (MOTOR DRIVEN)
	POSITIVE DISPLACEMENT PUMP (MOTOR DRIVEN)
	BLOWER (MOTOR DRIVEN)
	CENTRIFUGAL COMPRESSOR (MOTOR DRIVEN)
	SHELL AND TUBE HEAT EXCHANGER
	HORIZONTAL DRUM
	HOPPER
	EDUCTOR
	CONVEYOR (BELT TYPE)
	AGITATOR
	SILENCER
	SCALES

LINE IDENTIFICATION

LINE SIZE	UNIT DESIGNATION	SERVICE CODE	LINE NUMBER	LINE SPECIFICATION	INSULATION CODE
XX	X	X	XXXX	XXX	XXX

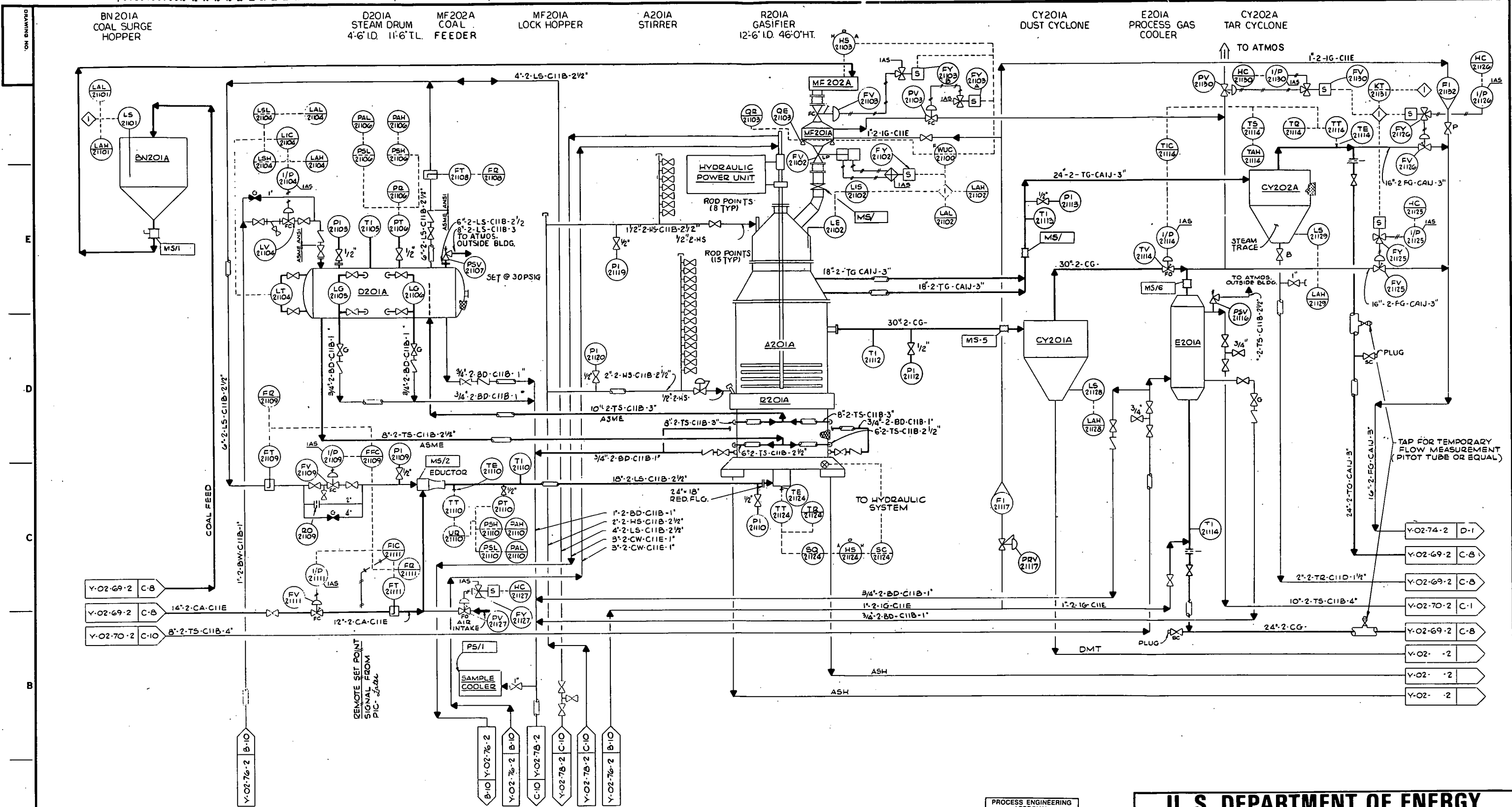
SERVICE	LINE NO.	SPEC	CODE	SERVICE	LINE NO.	SPEC	CODE
COMBUSTION AIR			CIIE CA	BLOWDOWN			CIIB BD
ASH BLOWER AIR			CIIE AA	AQUEOUS EFF.			CIIE AE
INERT GAS			CIIE IG	INST. AIR			G75A IA
BOILER FEED H ₂ O			CIIB BW	POTABLE WATER			B75 & G75 PW
SLUDGE			CIIF SL				
L.P. STEAM			CIIB LS	THERMOSYPHON			CAIJ TS
H.P. STEAM			CIIB HS	COMBINED GAS			CAIJ MG
TOP GAS			CAIJ TG	GREASE			GR FG
CLEAR GAS			CG	FLARE STACK GAS			CAIJ PA
OIL			CIIE OL	PLANT AIR			CIIE CD
TAR			CIID TR	CHEMICAL DRAIN			CIIE PG
HYDRAULICS			CGIA HY	PILOT GAS			CIIB CO
COOLING WATER			CIIE CW	CONDENSATE			

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U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4614-Y-02-55-2
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT STAGE II SYMBOLS AND LEGEND
 PROJECT NO. 3001 P.I.C. NO. NONE REVISION

DATE	BY	CHK	DESCRIPTION	APP.



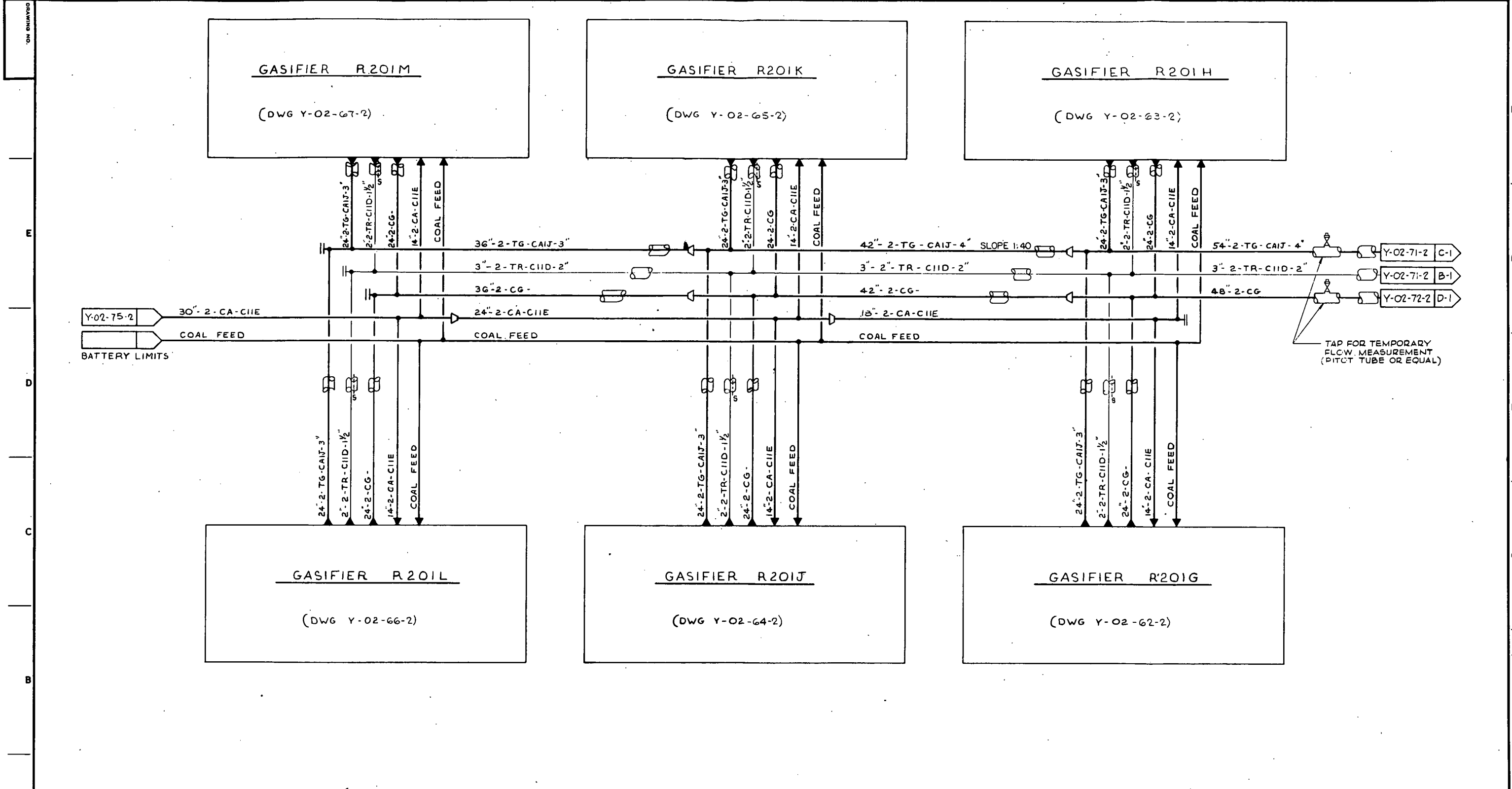
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 FOR SIGNED DATE

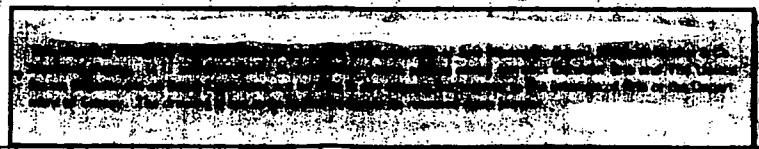
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 4814-Y-02-56-2

DATE	BY	CHK	DESCRIPTION	APP.

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT - STAGE II
 P & I.D. GASIFIER R201A
 PROJECT NO. 3001 P.E. NO. NONE
 REVISION



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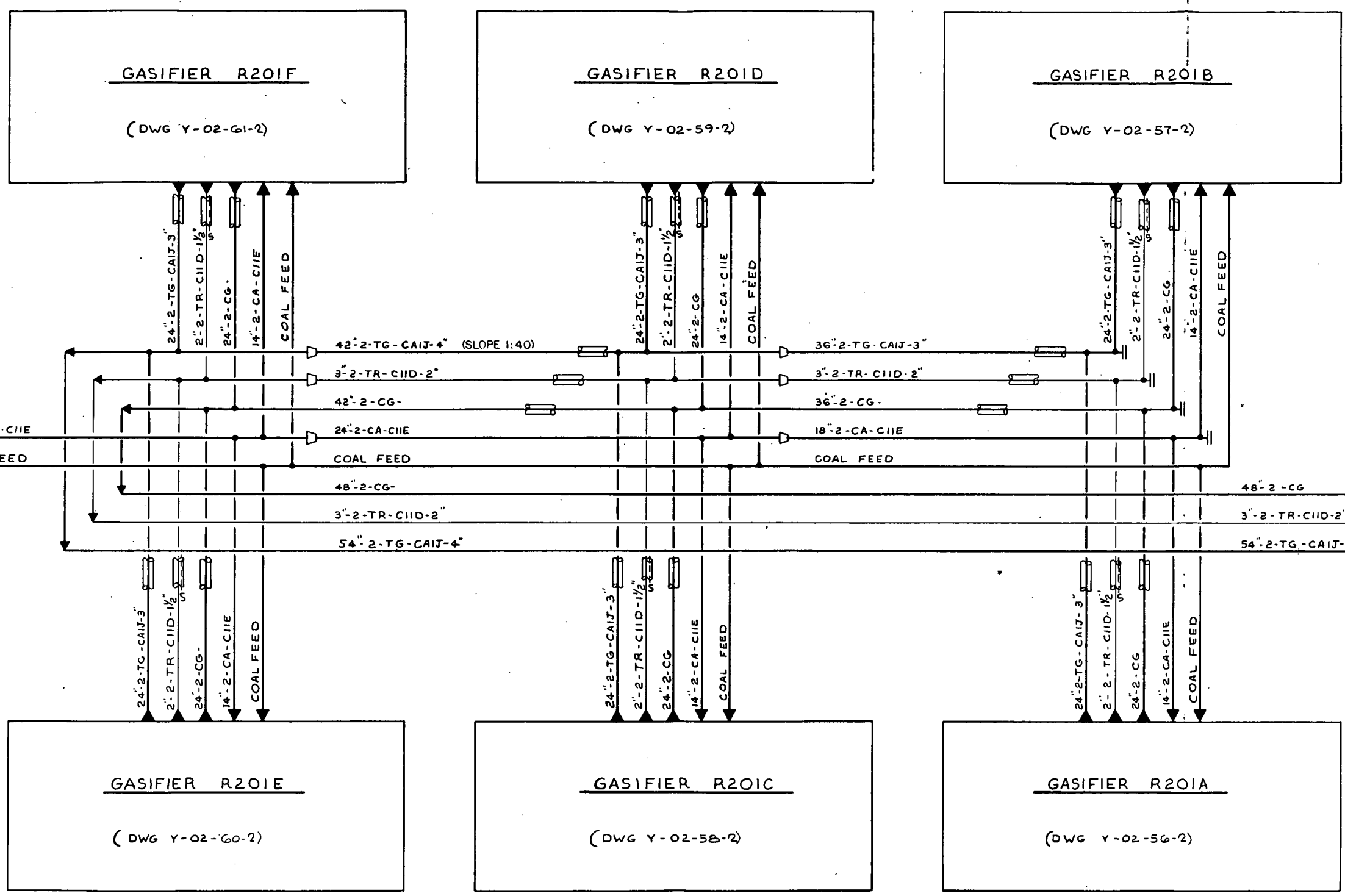


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BABCOCK CONTRACTORS INC.
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 PROJECT NO. 3001 DRAWING NO. P-068 ISSUE NO. _____
 FOR _____ SIGNED _____ DATE _____

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 4814-Y-02-68-2

FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT STAGE II
 P&ID PROCESS INTERCONNECTING

PROJECT NO. 3001	P.E. NO.
SCALE NONE	
REVISION	



TAP FOR TEMPORARY
FLOW MEASUREMENT
(PITOT TUBE OR EQUAL)

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APPROVAL
BY _____ DATE _____

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SIGNED _____ DATE _____

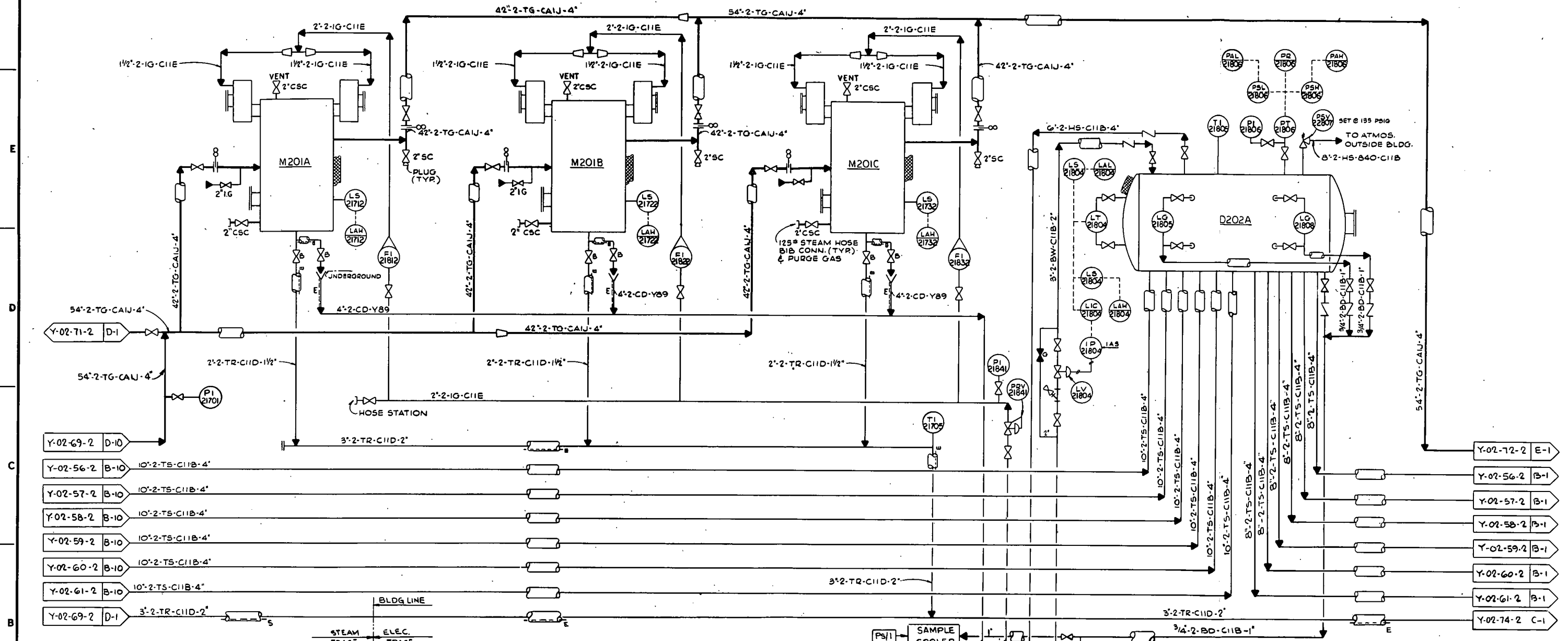
U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **MCKEE**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO
PROJECT NO. 3001 P.E. NO. 4814-Y-02-69-2

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FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID PROCESS INTERCONNECTING
SCALE NONE
REVISION

M201A, B & C
TAR PRECIPITATOR

D202A
H.P. STEAM DRUM



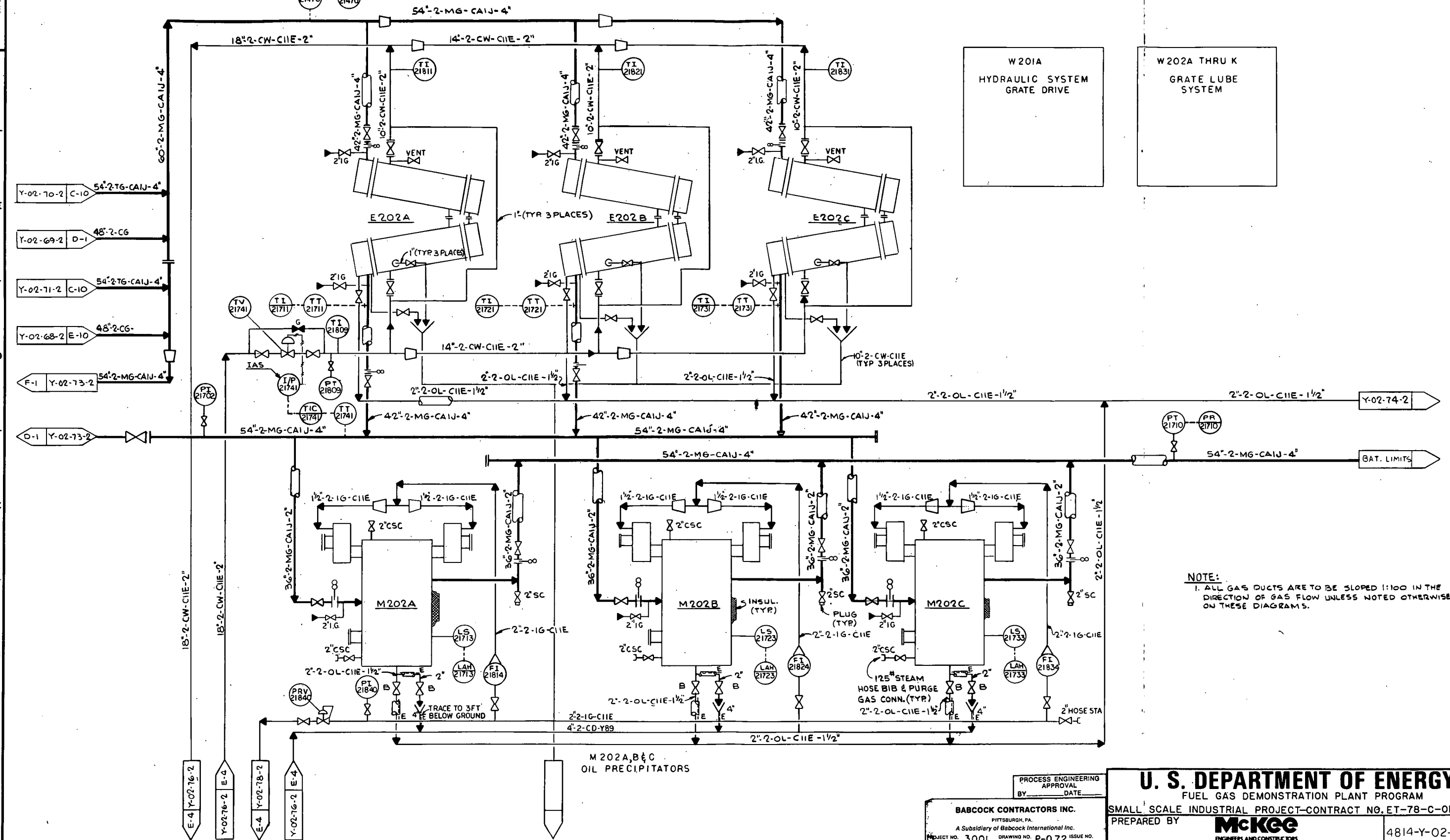
NOTE:
1. ALL GAS DUCTS ARE TO SLOPE 1:100
IN THE DIRECTION OF GAS FLOW UNLESS
NOTED OTHERWISE ON THESE DIAGRAMS

PROCESS ENGINEERING
APPROVAL
BY _____ DATE _____
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PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P.070 ISSUE NO. _____
FOR _____ SIGNED _____ DATE _____

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO
4814-Y-02-70-2
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT STAGE II
P&I.D. DETARING
PROJECT NO. 3001 P.E. NO. _____
SCALE NONE
REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

E202A,B&C
COMBINED GAS COOLER



W201A
HYDRAULIC SYSTEM
GRATE DRIVE

W202A THRU K
GRATE LUBE
SYSTEM

NOTE:
1. ALL GAS DUCTS ARE TO BE SLOPED 1:100 IN THE DIRECTION OF GAS FLOW UNLESS NOTED OTHERWISE ON THESE DIAGRAMS.

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APPROVAL
BY _____ DATE _____

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FOR _____ SIGNED _____ DATE _____

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **McKee**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID DEOILING-GAS COOLING

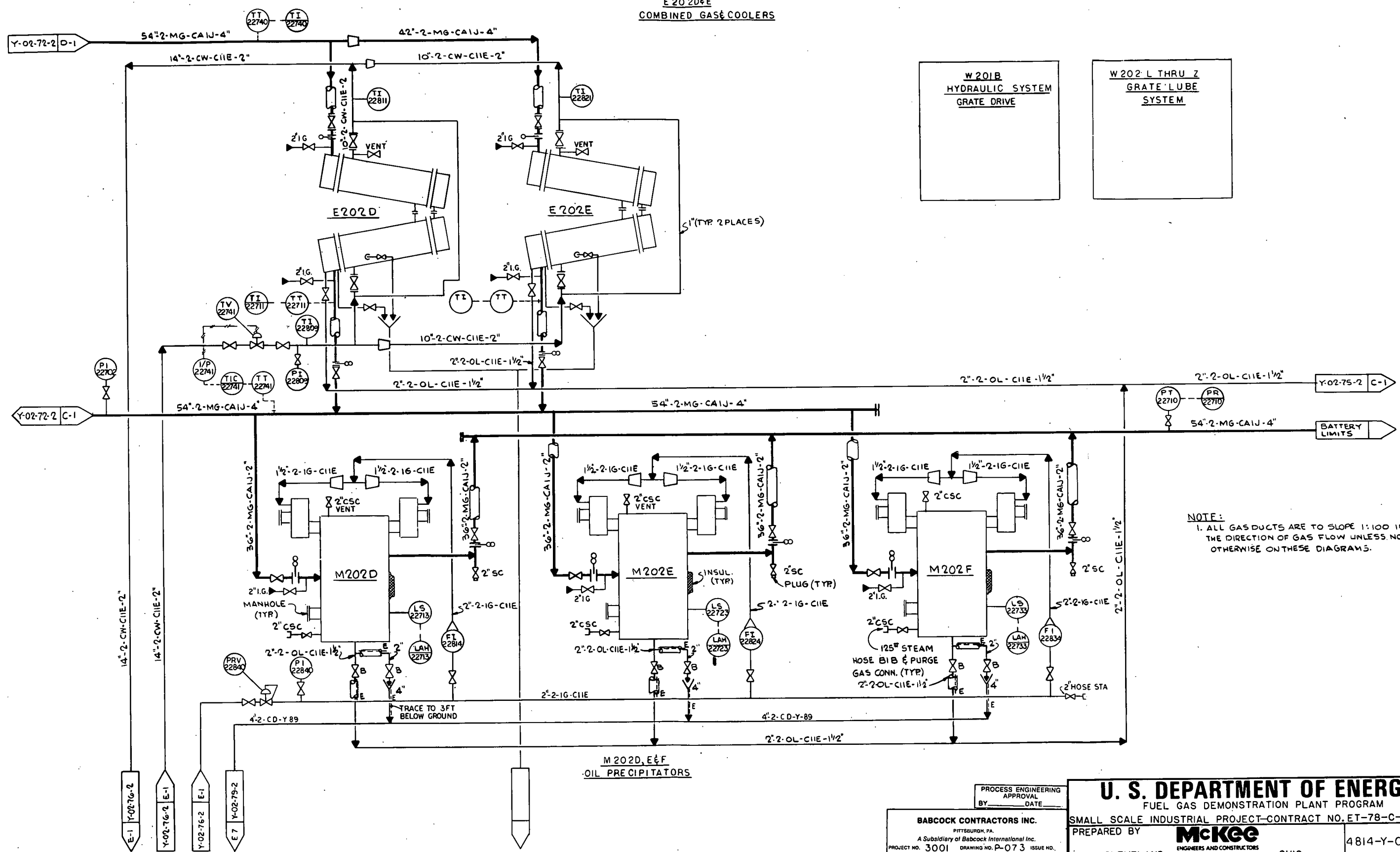
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SCALE NONE
REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

E 202D+E
COMBINED GAS & COOLERS

W 201B
HYDRAULIC SYSTEM
GRATE DRIVE

W 202 L THRU Z
GRATE LUBE
SYSTEM



NOTE:
1. ALL GAS DUCTS ARE TO SLOPE 1:100 IN THE DIRECTION OF GAS FLOW UNLESS NOTED OTHERWISE ON THESE DIAGRAMS.

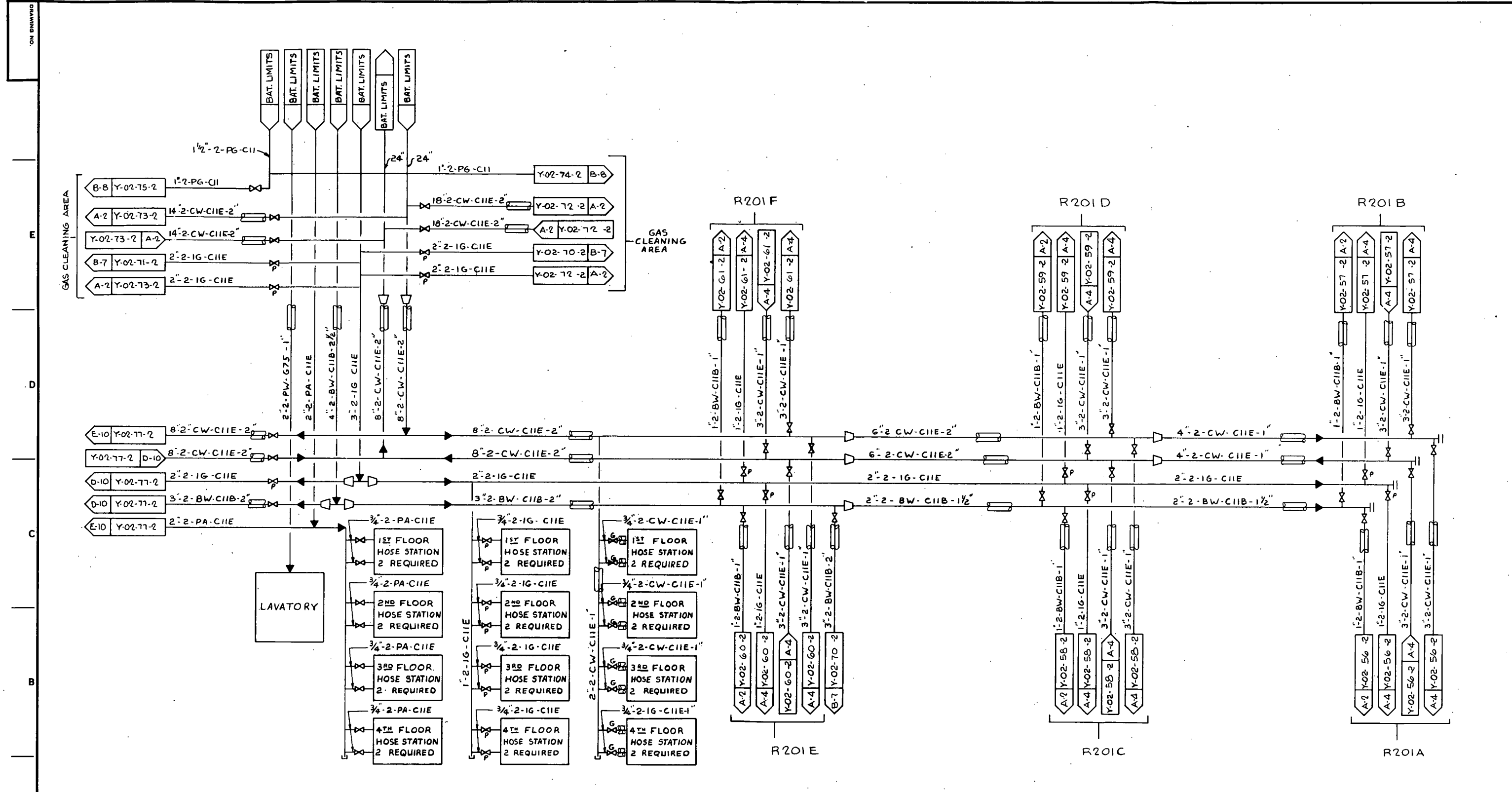
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PROJECT NO. 3001 DRAWING NO. P-073 ISSUE NO. _____
FOR _____ SIGNED _____ DATE _____

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-02-73-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT STAGE II
P & ID DEOILING-GAS COOLING

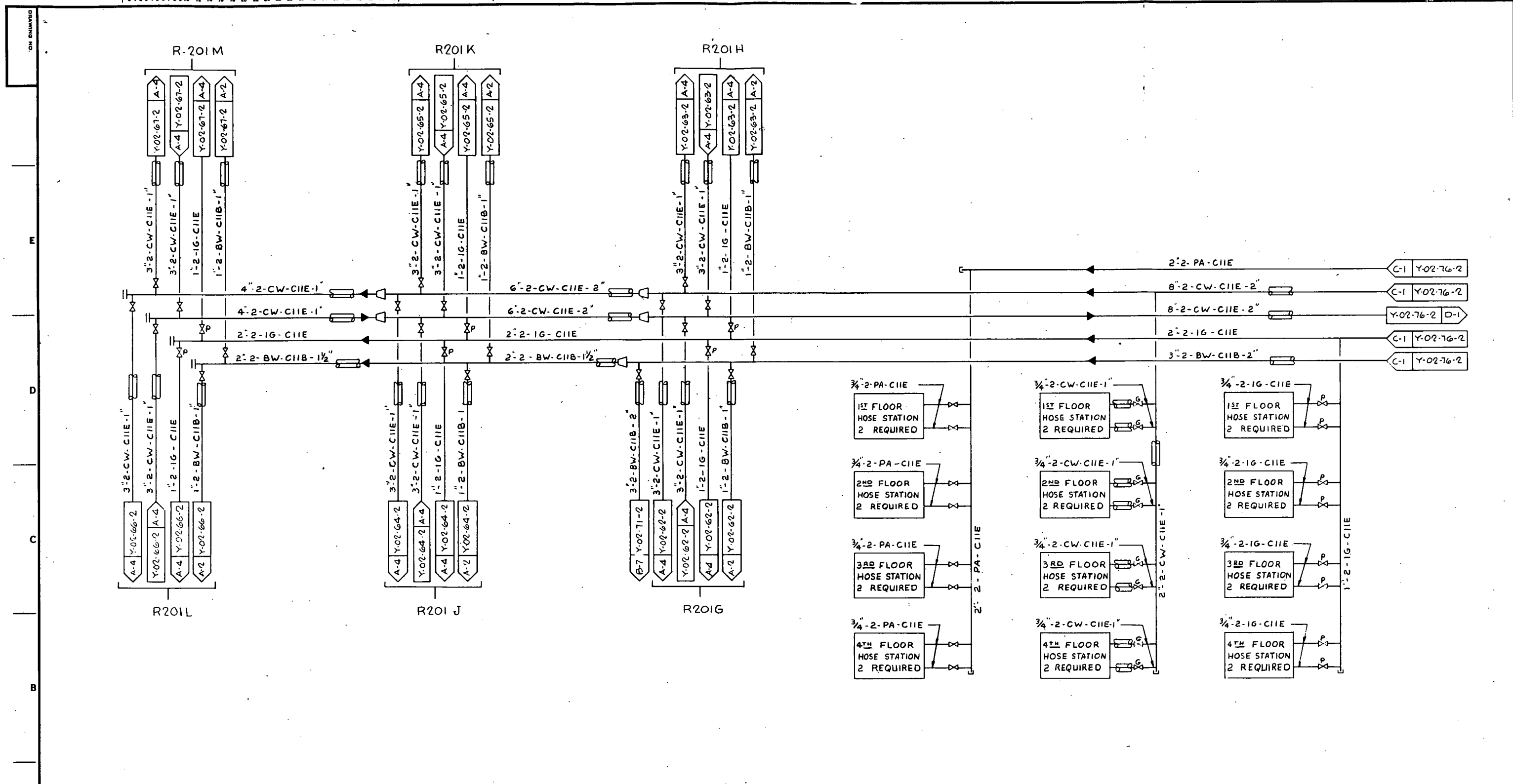
PROJECT NO. 3001
SCALE NONE
REVISION



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 PROJECT NO. 3001 DRAWING NO. P-076 ISSUE NO. _____
 FOR _____ SIGNED _____ DATE _____

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 PROJECT NO. 3001 P.E. NO. 4814-Y-02-76 -2 A
 SCALE NONE
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 GASIFICATION
 COMMERCIAL UNIT STAGE II
 P&ID, UTILITY
 REVISION



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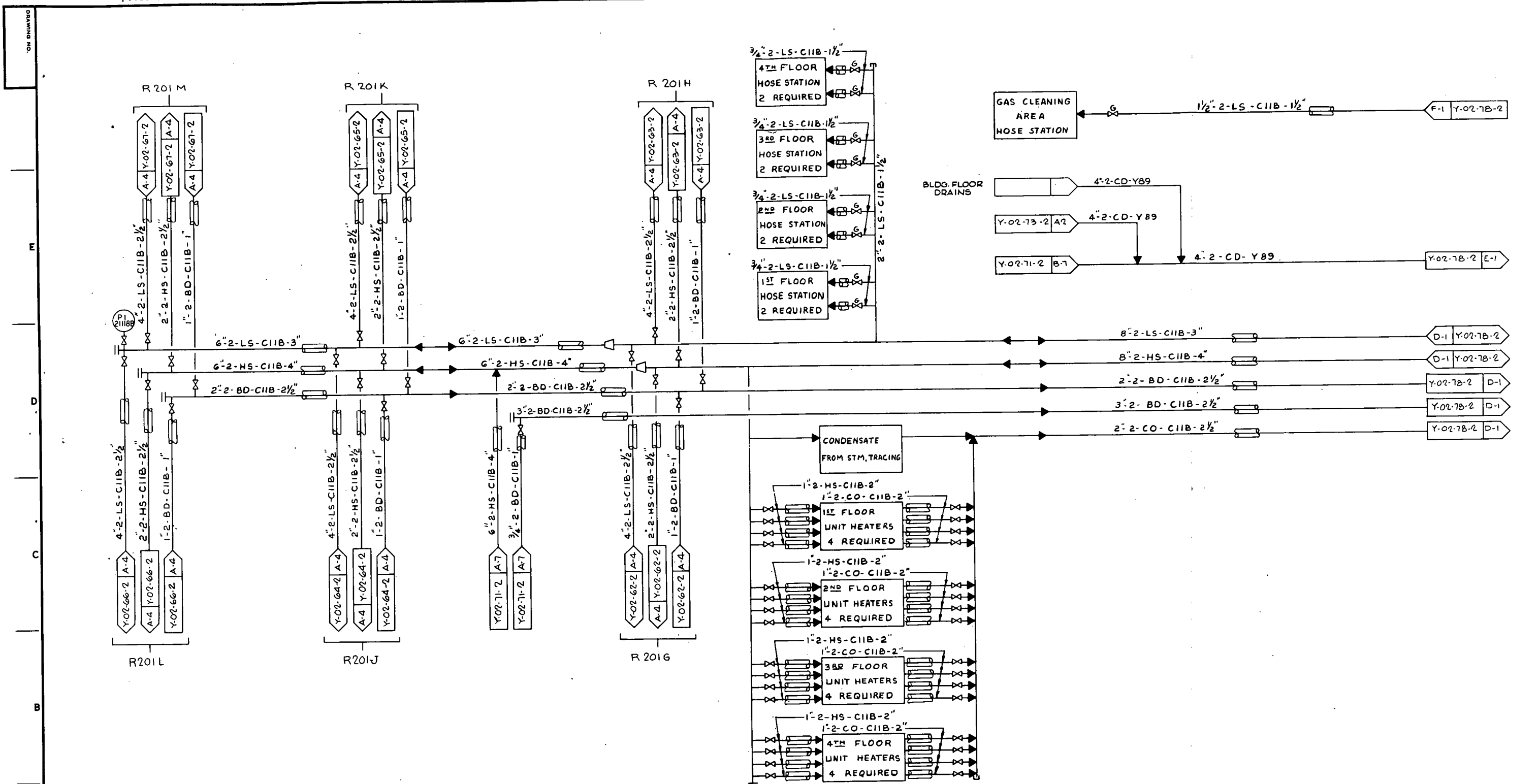
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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKEE**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO
PROJECT NO. 3001 P.E. NO. 4814-Y-02-77 -2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID UTILITY
SCALE NONE
REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.



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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKEE**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

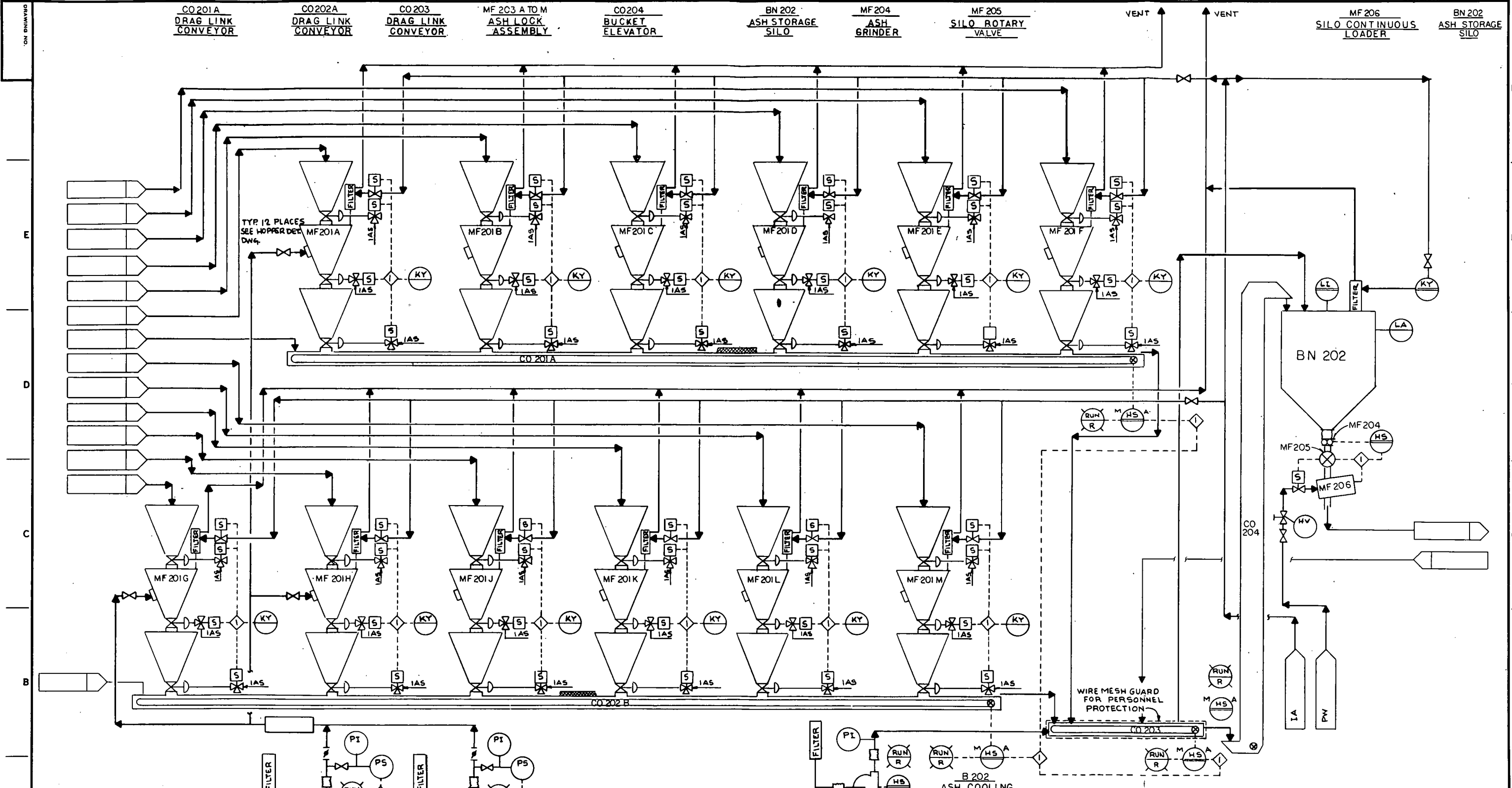
PROJECT NO. 3001 P.E. NO. 4814-Y-02-79-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

GASIFICATION
COMMERCIAL UNIT STAGE II
P&I.D. UTILITY

SCALE NONE
REVISION

DATE	BY	CHK	DESCRIPTION	APP.



DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

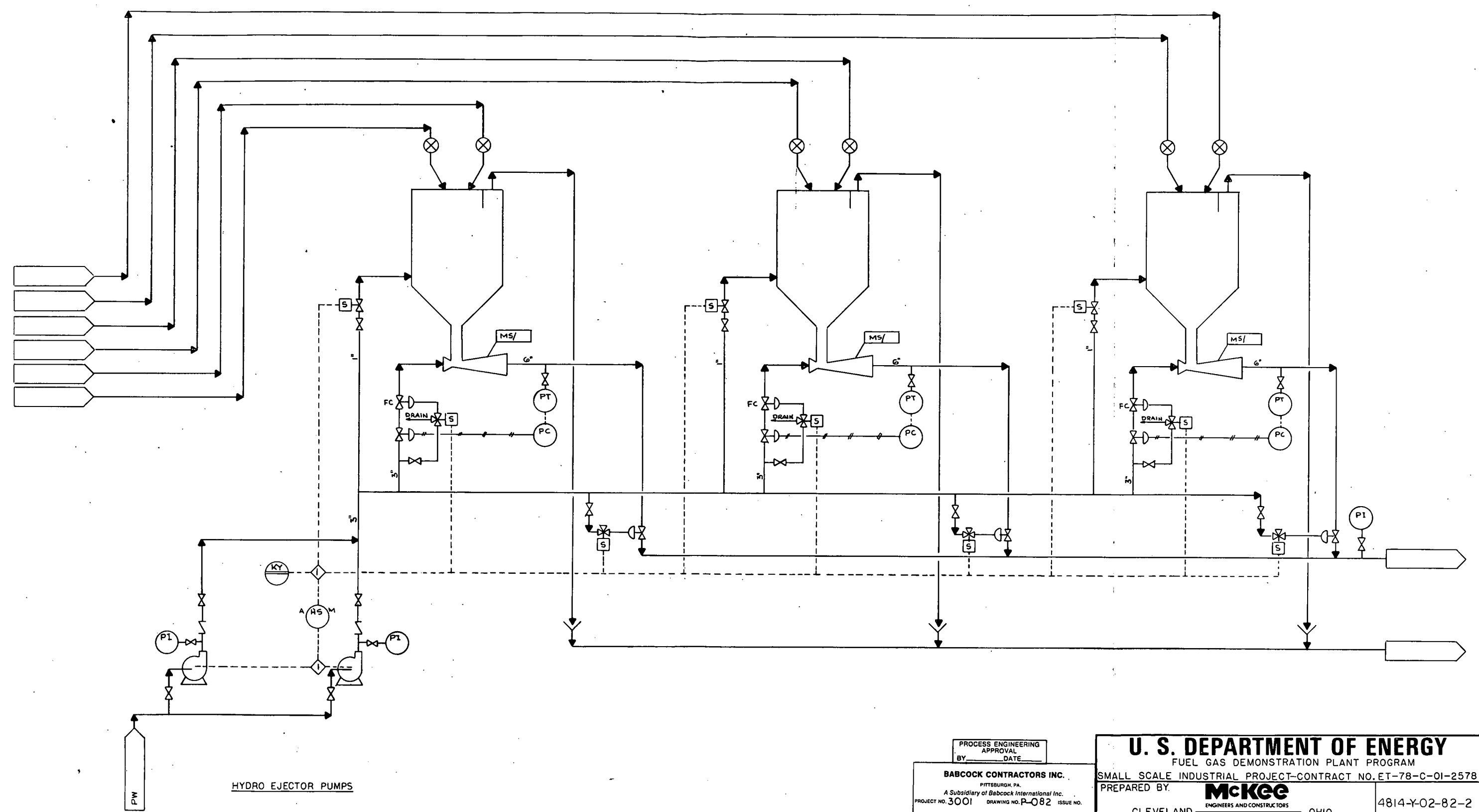
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 4814-Y-02-80-2

FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 GASIFICATION COMMERCIAL UNIT - STAGE II
 P&ID ASH HANDLING

PROJECT NO. P.E. NO. SCALE NONE REVISION

PROCESS ENGINEERING APPROVAL BY DATE
BABCOCK CONTRACTORS INC.
 PITTSBURGH, PA.
 A Subsidiary of Babcock International Inc.
 PROJECT NO. 3001 DRAWING NO. P-080 ISSUE NO.
 FOR SIGNED DATE

DUST ROTARY FEEDER DUST BIN



PROCESS ENGINEERING APPROVAL
BY: _____ DATE: _____

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P-082 ISSUE NO. _____
FOR: _____ SIGNED: _____ DATE: _____

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY: **McKee**
ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-Y-02-82-2

DATE	BY	CHK	DESCRIPTION	APP.

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT-STAGE II
P&I.D. ASH HANDLING

PROJECT NO.	P.E. NO.
SCALE	
NONE	
REVISION	

A

B

C

D

E

F

ON DIMENSIONS

A

B

C

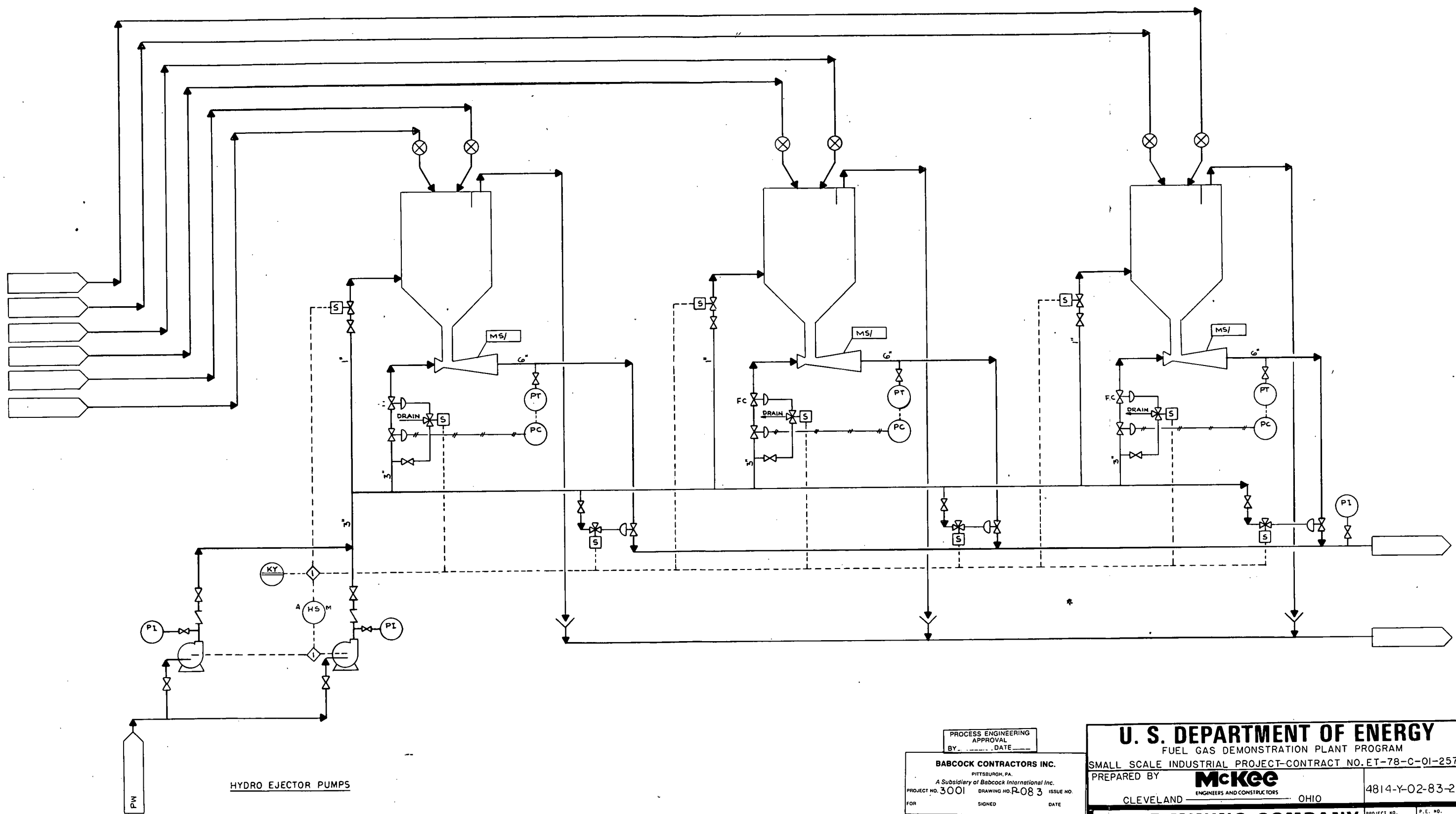
D

E

F

DUST ROTARY FEEDER

DUST BIN



HYDRO EJECTOR PUMPS

PROCESS ENGINEERING APPROVAL
BY: _____ DATE: _____

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. R-083 ISSUE NO. _____
FOR _____ SIGNED _____ DATE _____

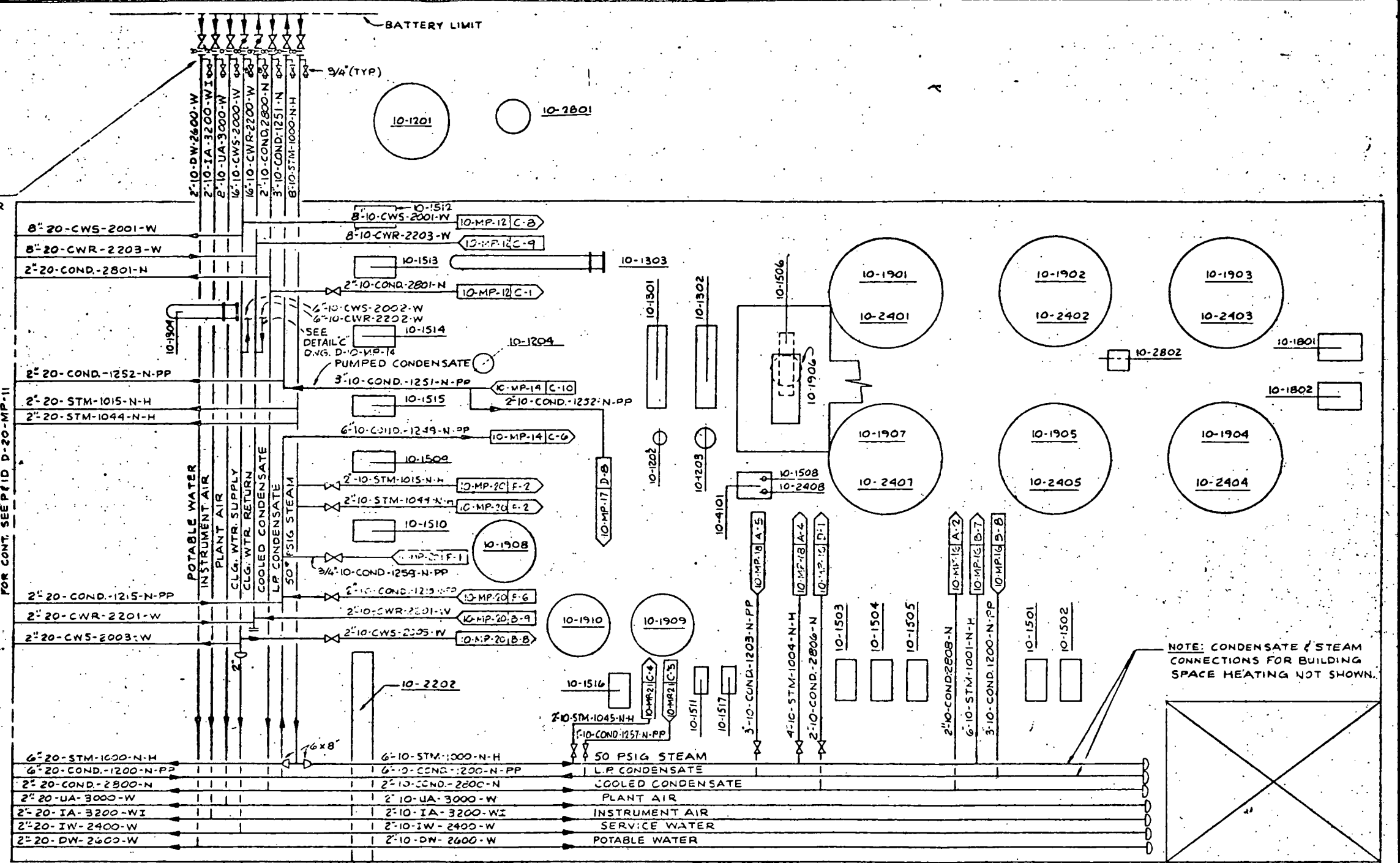
U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO
4814-Y-02-83-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION
COMMERCIAL UNIT-STAGE II
P&I.D. ASH HANDLING

PROJECT NO. _____ P.E. NO. _____
SCALE: NONE
REVISION:

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
▲					▲					▲				
▲					▲					▲				
▲					▲					▲				
▲					▲					▲				

ELECTRICAL TRACING REQUIRED ON ALL LIQUID LINES AND UTILITY AIR LINE OUTSIDE THE BUILDING.



FOR CONT. SEE P.I.D. D-20-MP-11

NOTE: (1) UTILITY STATIONS TO BE ADDED.

DATE	BY	CHK	DESCRIPTION	APP	DATE	BY	CHK	DESCRIPTION	APP

RMP
THE RALPH M. PARSONS COMPANY
PASADENA CALIFORNIA

PARSONS DRAWING NUMBER	REV. NO.
5840-1	D-10-MP-22

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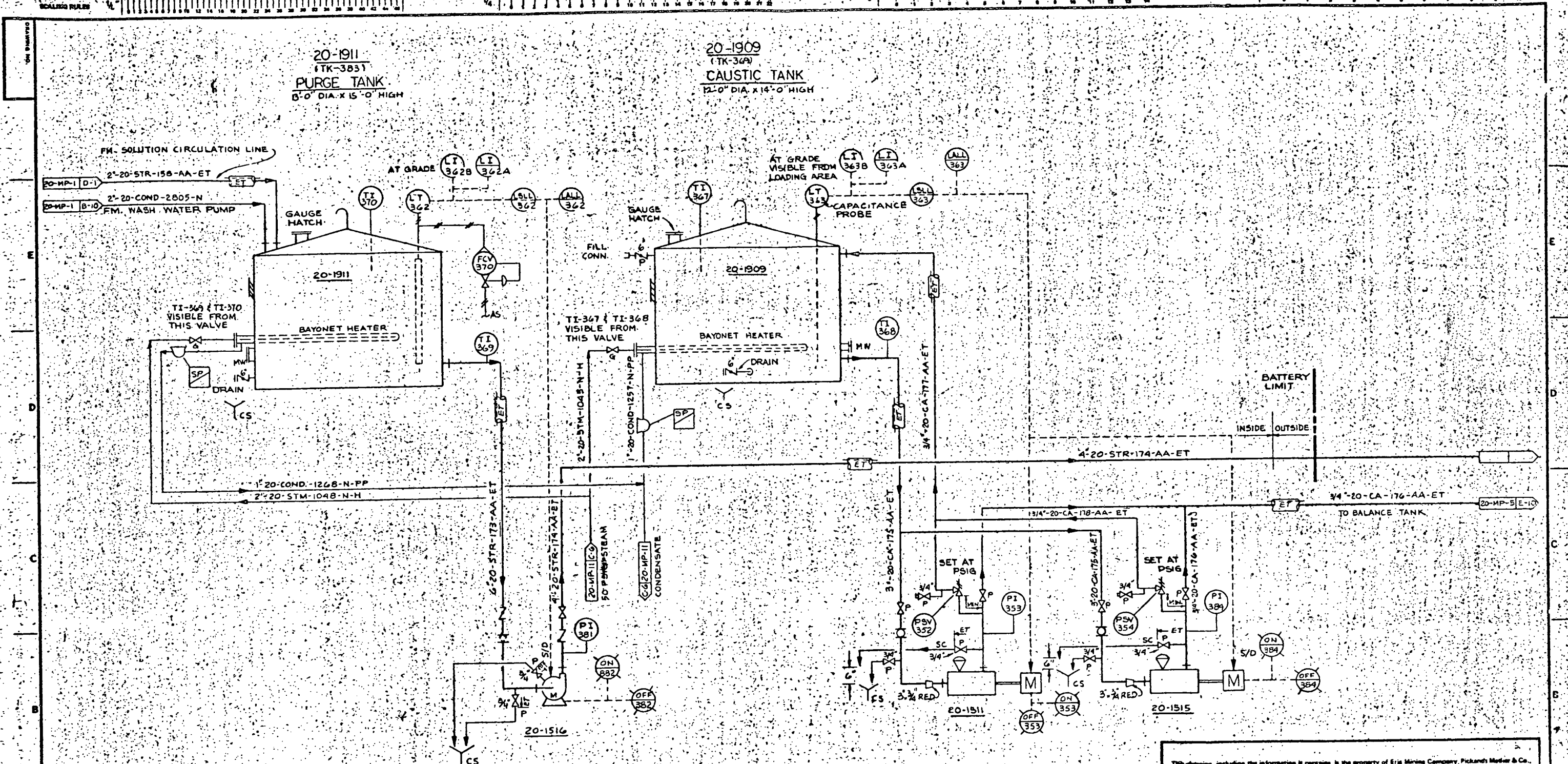
U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee**
ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

SULFUR REMOVAL-COMMERCIAL UNIT STAGE 1 (CEMD)
PIPING & INSTRUMENTATION DIAGRAM
UTILITIES

REVISION: NONE



20-1911
(TK-383)
PURGE TANK
6'-0" DIA. X 15'-0" HIGH

20-1909
(TK-36A)
CAUSTIC TANK
12'-0" DIA. X 14'-0" HIGH

20-1514
(P-382)
PURGE UNLOADING PUMP
RATED AT 330 GPM
71 PSI ΔP

20-1511, 1515
(P-360A(B))
CAUSTIC METERING PUMPS
NO. 1 & NO. 2 SPARE
RATED AT 652 GPM
16 PSI ΔP

RMP
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

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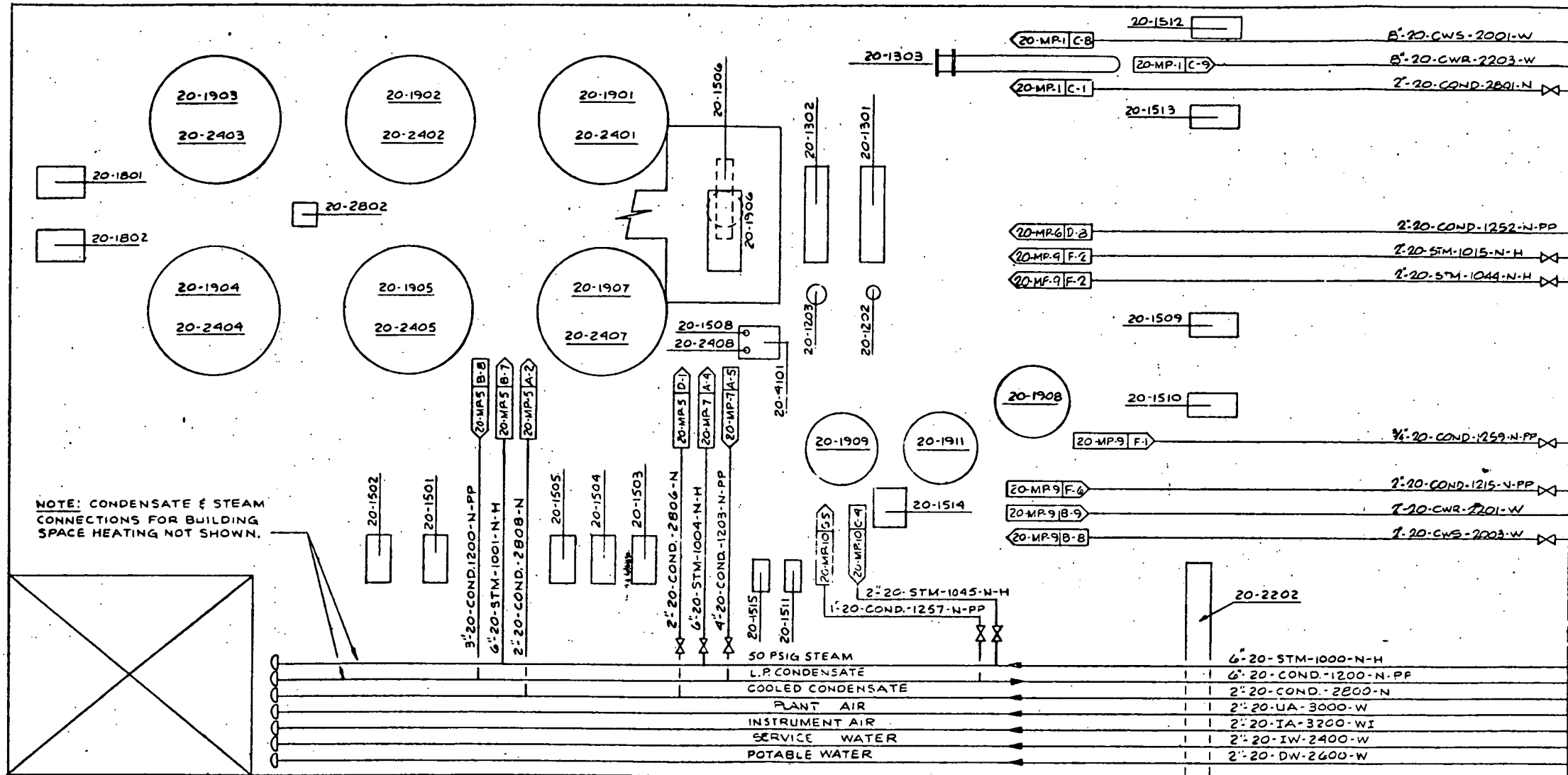
U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PARSONS DRAWING NUMBER: 5840-1
REV NO: D-20-MP-10

PREPARED BY: **McKee**
ENGINEERS AND CONSULTANTS
CLEVELAND, OHIO
4814-Y-03-B1-2

DATE	BY	CHK	DESCRIPTION	APP	DATE	BY	CHK	DESCRIPTION	APP

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
SULFUR RECOVERY-COMMERCIAL UNIT STAGE II
PIPING & INSTRUMENTATION DIAGRAM
CAUSTIC TANK AND PURGE TANK



NOTE: CONDENSATE & STEAM CONNECTIONS FOR BUILDING SPACE HEATING NOT SHOWN.

NOTE: (1) UTILITY STATIONS TO BE ADDED LATER.

FOR CONT. SEE P4 ID D-10-MP-11

R/P
 THE RALPH M. PARSONS COMPANY
 PASADENA, CALIFORNIA

PARSONS DRAWING NUMBER	REV. NO.
5840-1	D-20-MP-11
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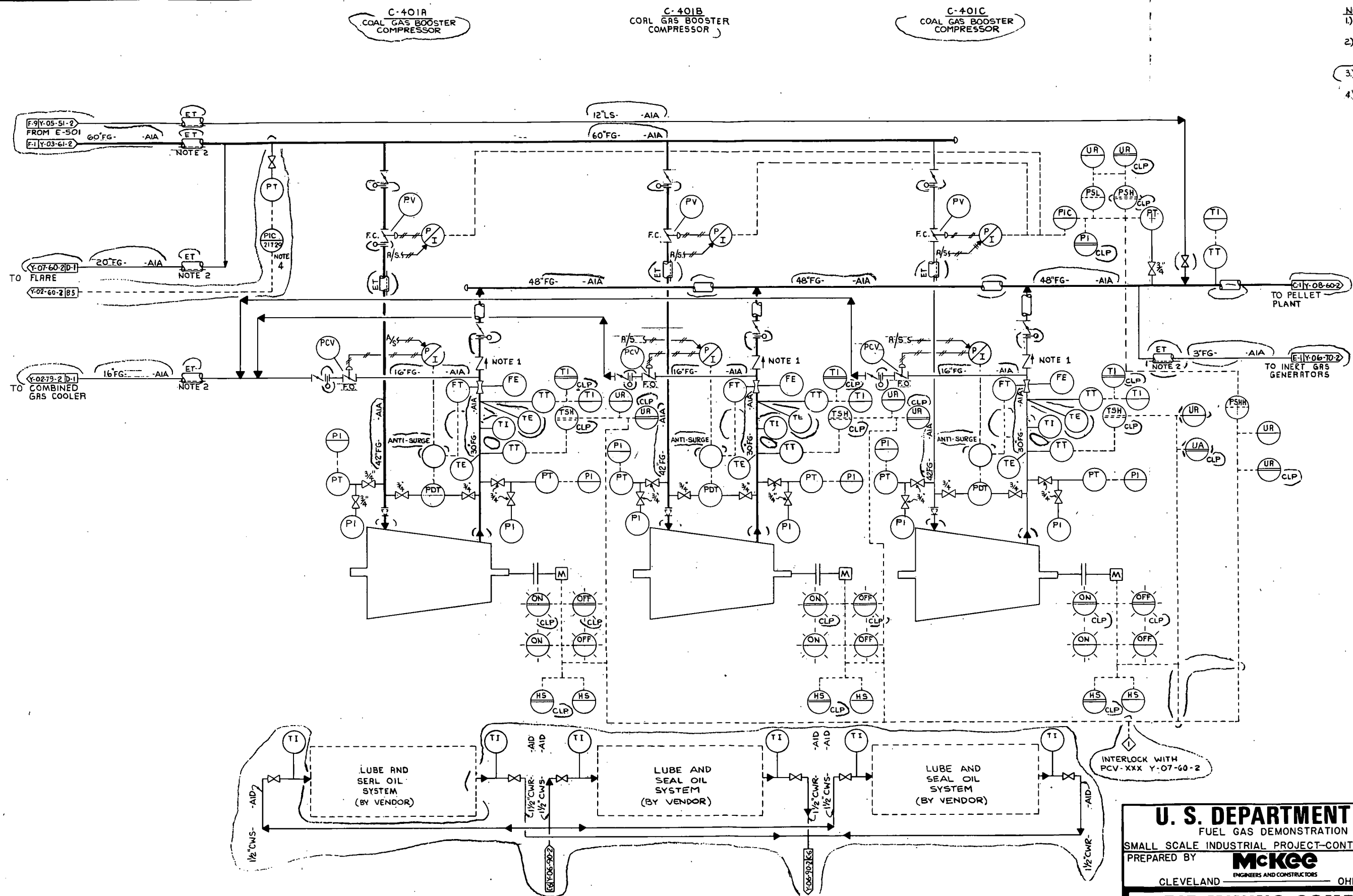
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U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
 7 CLEVELAND, OHIO

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES, MINNESOTA
 SULFUR REMOVAL-COMMERCIAL UNIT STAGE II
 PIPING & INSTRUMENTATION DIAGRAM
 UTILITIES

DATE	BY	CHK	DESCRIPTION	APP.

- NOTES:**
- MISSION TYPE CHECK VALVE OR EQUAL.
 - TRACE AND INSULATE SECTION OF PIPING RUN EXPOSED TO AMBIENT ENVIRONMENT.
 - CLP-COMPRESSOR LOCAL PANEL
 - PIC 21720 BY OTHERS



DATE	BY	CHK	DESCRIPTION	APP.

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DATE	BY	CHK	DESCRIPTION	APP.

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-04-61-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 GAS TRANSMISSION
 COMMERCIAL UNIT
 GAS COMPRESSION P&ID

PROJECT NO. P.E. NO. SCALE REVISION 1

PIT-501
OIL/WATER SEPARATOR SUMP
10'-0" LONG x 4'-0" WIDE x 8'-0" DEEP

TK-501
WASTEWATER STORAGE TANK
35'-0" DIA x 36'-0" HIGH

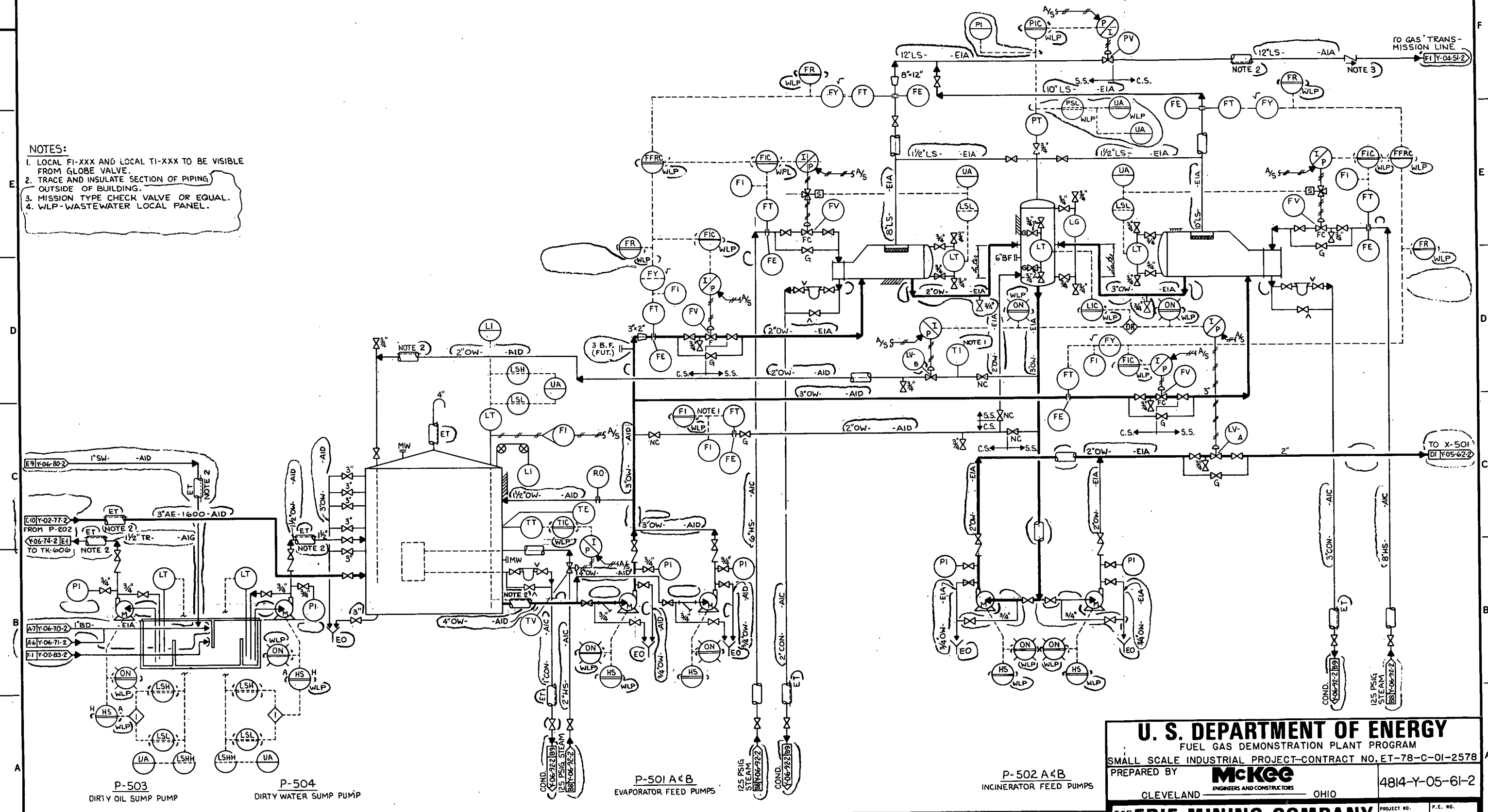
E-503
WASTEWATER STORAGE TANK HEATER

E-501
WASTEWATER EVAPORATOR

D-501
SURGE DRUM
2'-6" DIA x 8'-0" T-T

E-502
WASTEWATER EVAPORATOR

- NOTES:**
1. LOCAL FI-XXX AND LOCAL TI-XXX TO BE VISIBLE FROM GLOBE VALVE.
 2. TRACE AND INSULATE SECTION OF PIPING OUTSIDE OF BUILDING.
 3. MISSION TYPE CHECK VALVE OR EQUAL.
 4. WLP - WASTEWATER LOCAL PANEL.



REVISION	DATE	BY	CHK	DESCRIPTION	APP.
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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

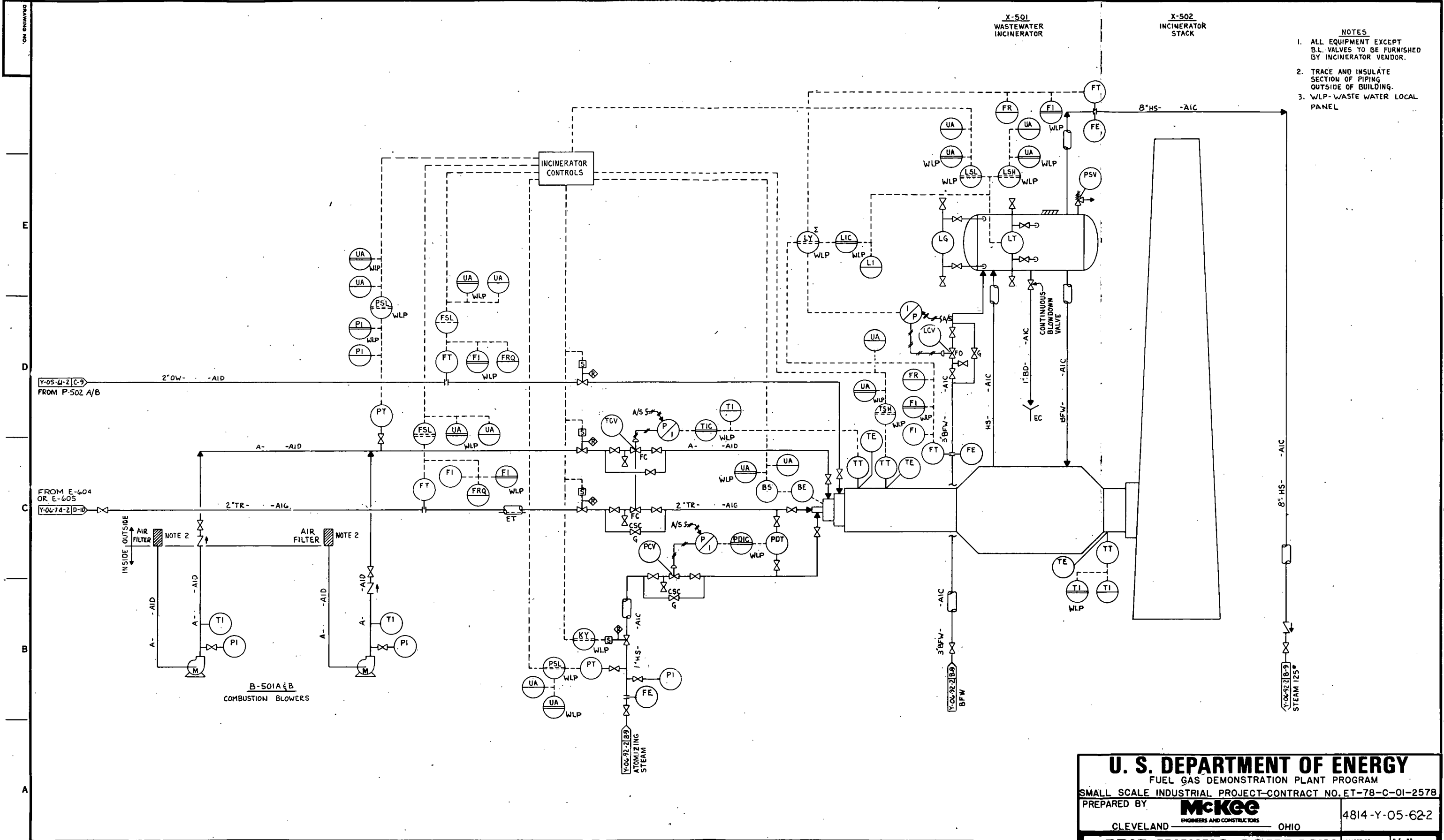
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO

PROJECT NO. 4814-Y-05-61-2
P.E. NO.

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

WASTEWATER TREATMENT
COMMERCIAL UNIT
WASTEWATER EVAPORATION (P&ID)

REVISION 1



- NOTES
1. ALL EQUIPMENT EXCEPT B.L. VALVES TO BE FURNISHED BY INCINERATOR VENDOR.
 2. TRACE AND INSULATE SECTION OF PIPING OUTSIDE OF BUILDING.
 3. WLP-WASTE WATER LOCAL PANEL

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee**
ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO 4814-Y-05-622

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

WASTE WATER TREATMENT
 COMMERCIAL UNIT
 INCINERATOR & STACK SYSTEM (P&ID)

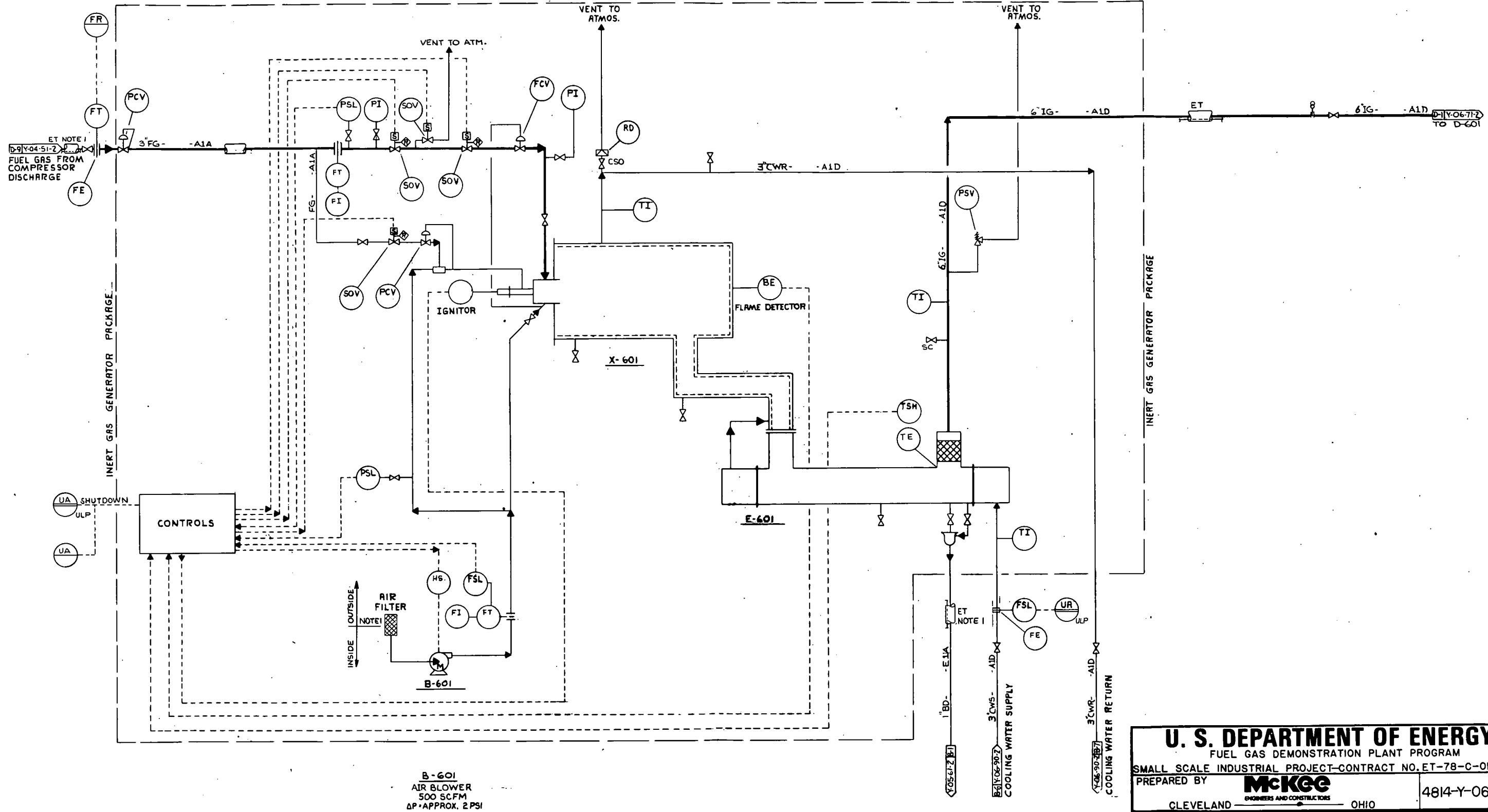
REVISION **O**

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10-19-78	I.O.	W.B.	ISSUED FOR APPROVAL											

X-601
INERT GAS GENERATOR
CAPACITY: 20,000 SCFH

E-601
INERT GAS GENERATOR
AFTER COOLER
DUTY: 340 BTU/HR.

- NOTES:
- 1. TRACE AND INSULATE SECTION OF PIPING OUTSIDE OF BUILDING.
 - 2. ULP - UTILITIES LOCAL PANEL.



CONTROLS

B-601
AIR BLOWER
500 SCFM
ΔP APPROX. 2 PSI

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO
 4814-Y-06-70-2
 FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 UTILITIES COMMERCIAL UNIT
 INERT GAS GENERATION P&ID
 REVISION Δ

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

10-17-78 I.O. W.B. ISSUED FOR APPROVAL

D-601
INERT GAS COMPRESSOR
SUCTION
K.O. DRUM
1'-6" DIA. X 4'-6" T-T

E-606
INERT GAS COMPRESSOR INTER-COOLER
DUTY: *later* BTU/HR

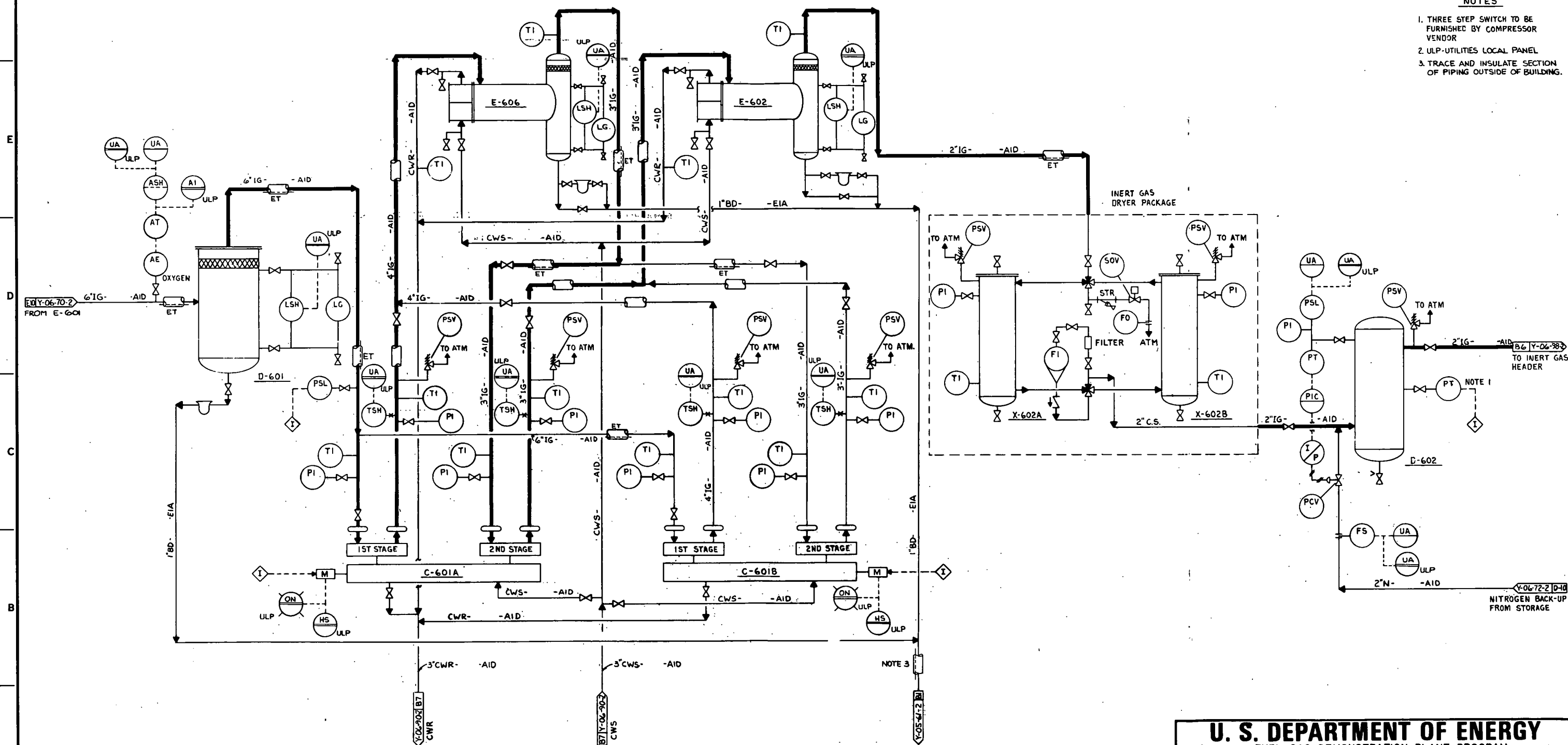
E-602
INERT GAS COMPRESSOR AFTER COOLER
DUTY: *later* BTU/HR

X-602 A&B
INERT GAS DESSICANT TYPE DRYERS

D-602
INERT GAS SURGE DRUM
3'-6" DIA. X 10'-0" T-T

NOTES

- 1. THREE STEP SWITCH TO BE FURNISHED BY COMPRESSOR VENDOR
- 2. ULP-UTILITIES LOCAL PANEL
- 3. TRACE AND INSULATE SECTION OF PIPING OUTSIDE OF BUILDING.



C-601 A&B
INERT GAS COMPRESSOR & SPARE
20,000 SCFM
ΔP = 110 PSI

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA

PROJECT NO. 4814-Y-06-71-2
P.E. NO. _____
SCALE _____
REVISION Δ 0

UTILITIES
COMMERCIAL UNIT
INERT GAS COMPRESSION & DRYING (P&ID)

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

10-27-78 G.C. W.B. ISSUED FOR APPROVAL

SCALING RULES 1/8" 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46

1/4" 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

3/8" 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

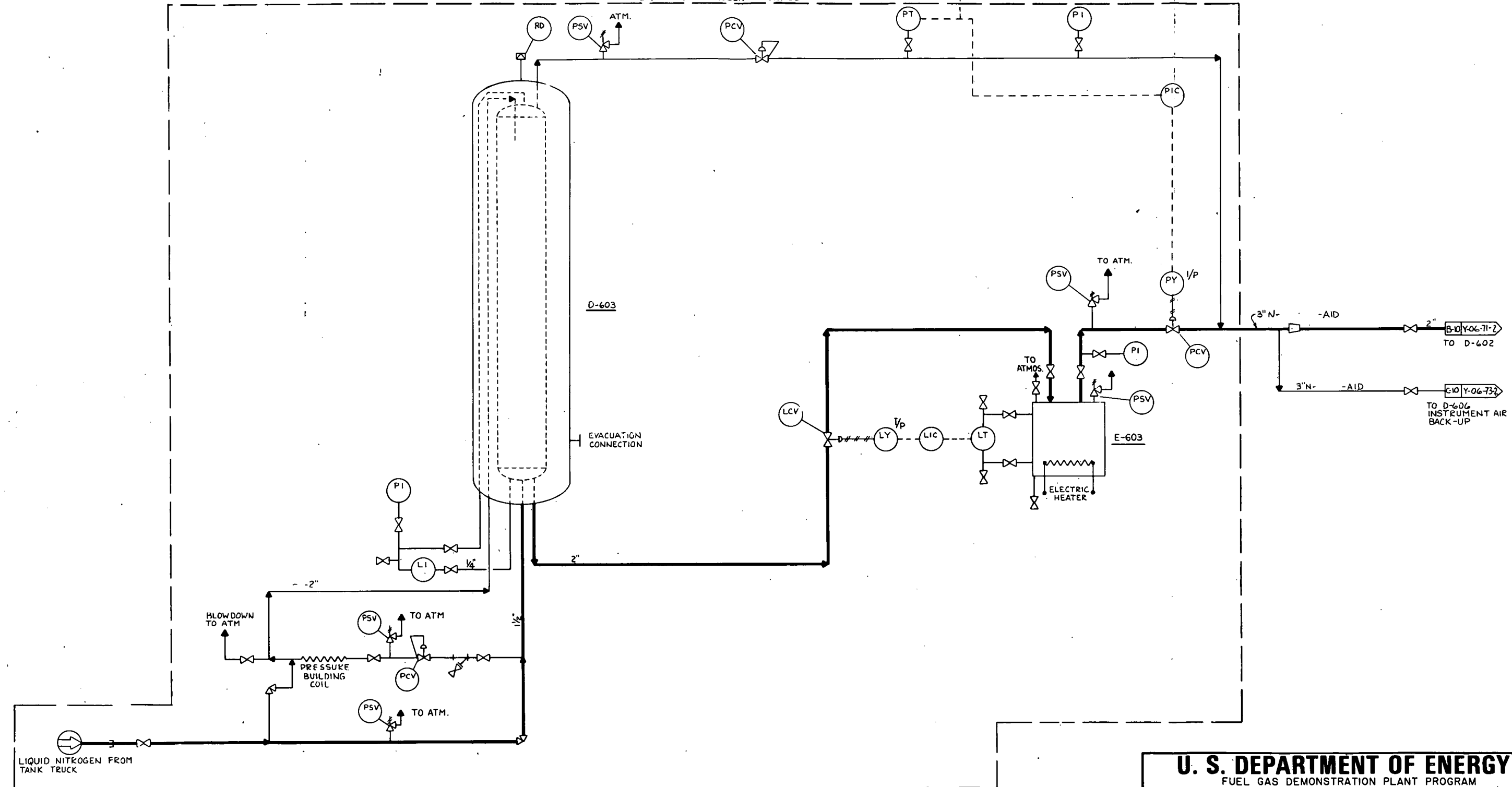
1/2" 0 1 2 3 4 5 6 7 8 9 10

D-603
LIQUEFIED NITROGEN STORAGE TANK
OUTER CASING: 10'-2" ϕ x APPROX. 28'-0" T-T.
DESIGN: PSIG @ °F

E-603
NITROGEN VAPORIZER
DUTY: 4.2 BTU/HR

NOTES:
1) ULP - UTILITIES LOCAL PANEL

LIQUEFIED NITROGEN PACKAGE



U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-06-72-2
FOR **ERIE MINING COMPANY** PROJECT NO. P.E. NO. SCALE
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
UTILITIES COMMERCIAL UNIT REVISION Δ
LIQUEFIED NITROGEN STORAGE & VAPORIZATION P&ID

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

10-19-78 I.O. W.B. ISSUED FOR APPROVAL

E-607A
INSTRUMENT & PLANT AIR INTERCOOLER

E-608A
INSTRUMENT & PLANT AIR AFTERCOOLER

E-607B
INSTRUMENT & PLANT AIR INTERCOOLER

E-608B
INSTRUMENT & PLANT AIR AFTERCOOLER

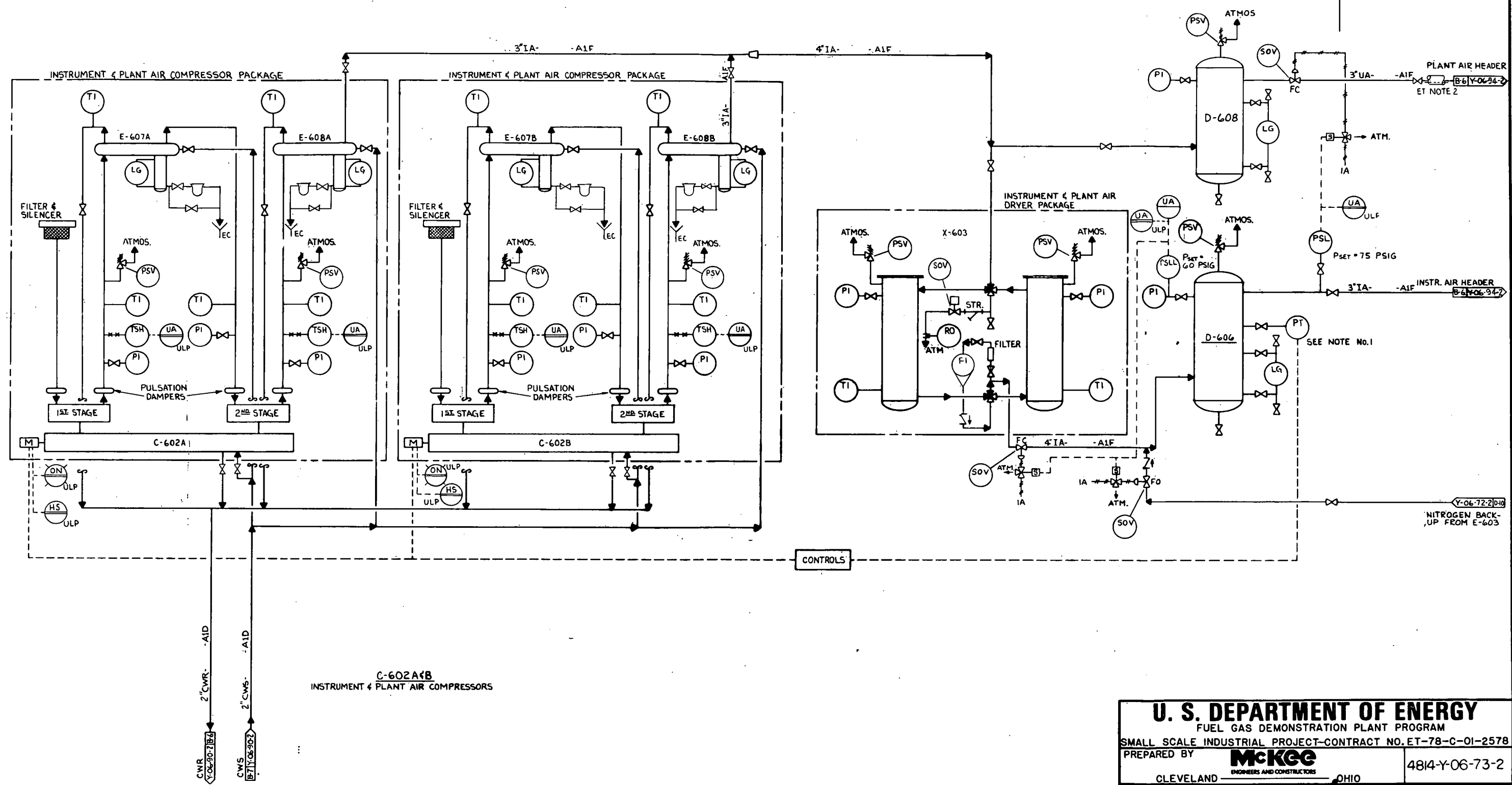
X-603
INSTRUMENT & PLANT AIR DRYER

D-608
PLANT AIR RECEIVER
SIZE : 3'-6"φ x 10'-0" T-T

D-606
INSTRUMENT AIR RECEIVER
SIZE : 3'-6"φ x 10'-0" T-T

NOTES

- THREE (3) STEP CAPACITY CONTROL FURNISHED BY COMPRESSOR VENDOR
- TRACE AND INSULATE SECTION OF PIPE RUN EXPOSED TO AMBIENT ENVIRONMENT.
- ULP-UTILITIES LOCAL PANEL.



CONTROLS

C-602A/B
INSTRUMENT & PLANT AIR COMPRESSORS

2" CWV - AID
2" CWS - AID

REVISION	DATE	BY	CHK	DESCRIPTION	APP.
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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
4814-Y-06-73-2

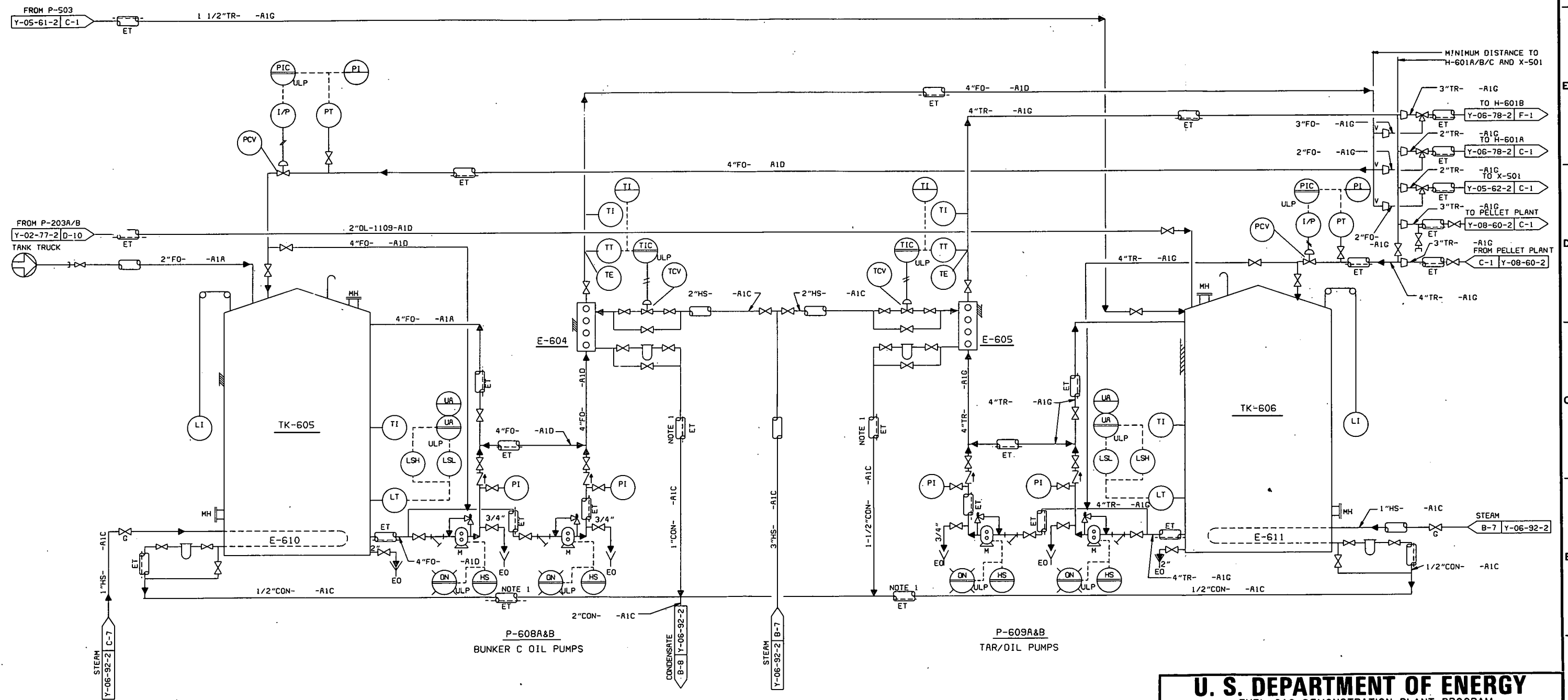
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
UTILITY AREA (P&ID)
COMMERCIAL UNIT
INSTRUMENT & PLANT AIR SYSTEM

PROJECT NO. P.E. NO. SCALE REVISION

10-27-78 B.B.W.B. ISSUED FOR APPROVAL.

NOTES
 1.) TRACE AND INSULATE SECTION OF PIPE RUN EXPOSED TO AMBIENT ENVIRONMENT.
 2.) ULP-UTILITIES LOCAL PANEL.

TK-605 BUNKER C OIL TANK 35'-0" DIA. X 24'-0" HIGH
 E-610 BUNKER C OIL TANK HEATER
 E-604 BUNKER C OIL HEATER
 E-605 TAR/OIL HEATER
 TK-606 TAR/OIL TANK 35'-0" DIA. X 24'-0" HIGH
 E-611 TAR/OIL TANK HEATER



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee**
ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO 4814-Y-06-74-2

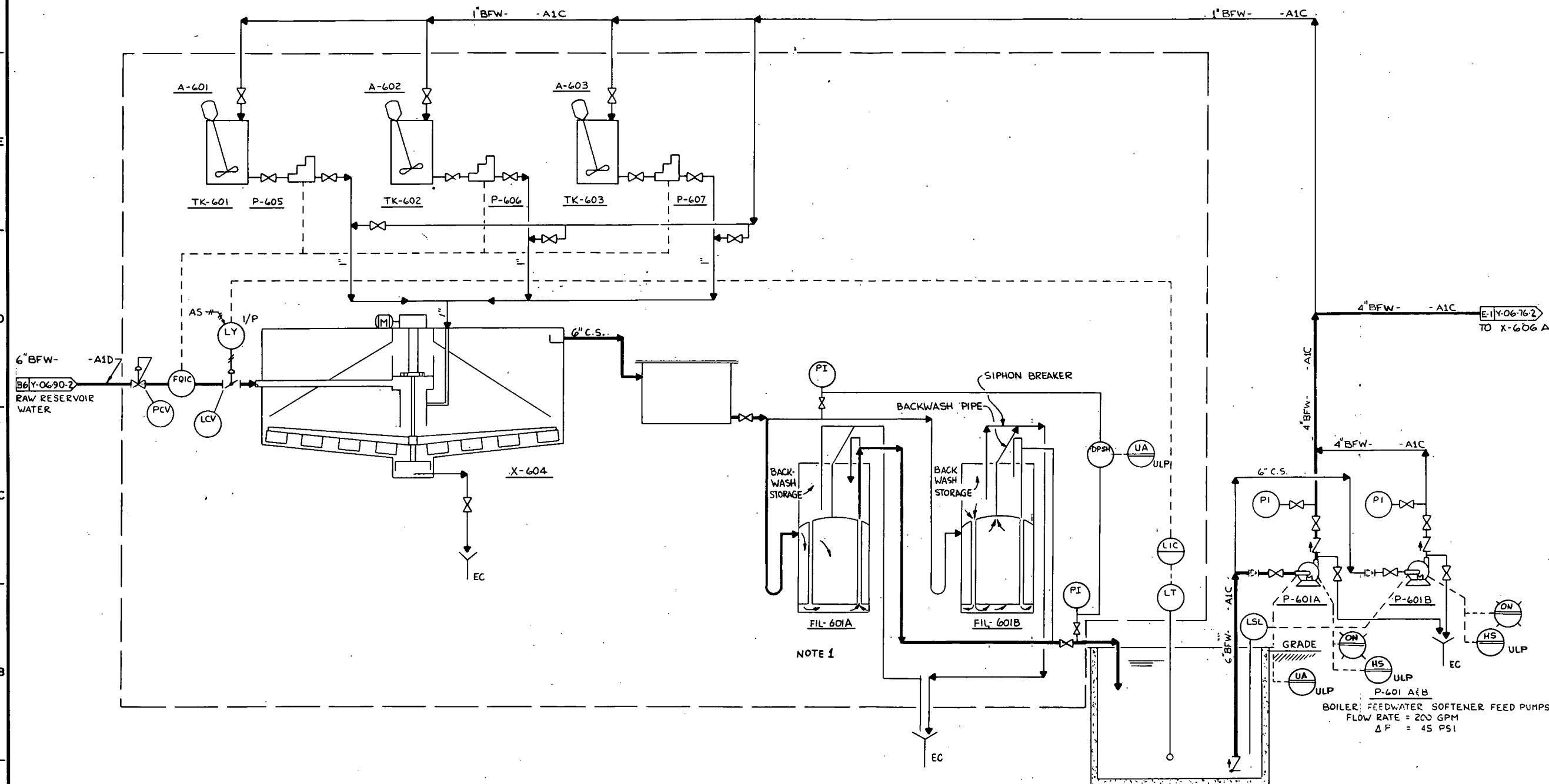
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 UTILITY AREA
 COMMERCIAL UNIT
 BUNKER C & TAR/OIL
 REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

10/19/78 FC ISSUED FOR APPROVAL

A-601 ALUM. FEED TANK AGITATOR
 X-604 CLARIFIER
 A-603 POLYMER FEED TANK AGITATOR
 FIL-601 A&B BOILER FEEDWATER FILTERS
 PIT-601 CLEARWELL 8'-0" WIDE x 10'-0" LONG x 8'-0" DEEP
 TK-601 ALUM. FEED TANK
 A-602 CHLORINE FEED TANK AGITATOR
 TK-602 CHLORINE FEED TANK
 A-603 POLYMER FEED TANK
 TK-603 POLYMER FEED TANK

NOTES:
 1. ARROWS INDICATE:
 FIL-601A IN OPERATING MODE
 FIL-601B IN BACKWASH MODE
 2. ULP-UTILITIES LOCAL PANEL

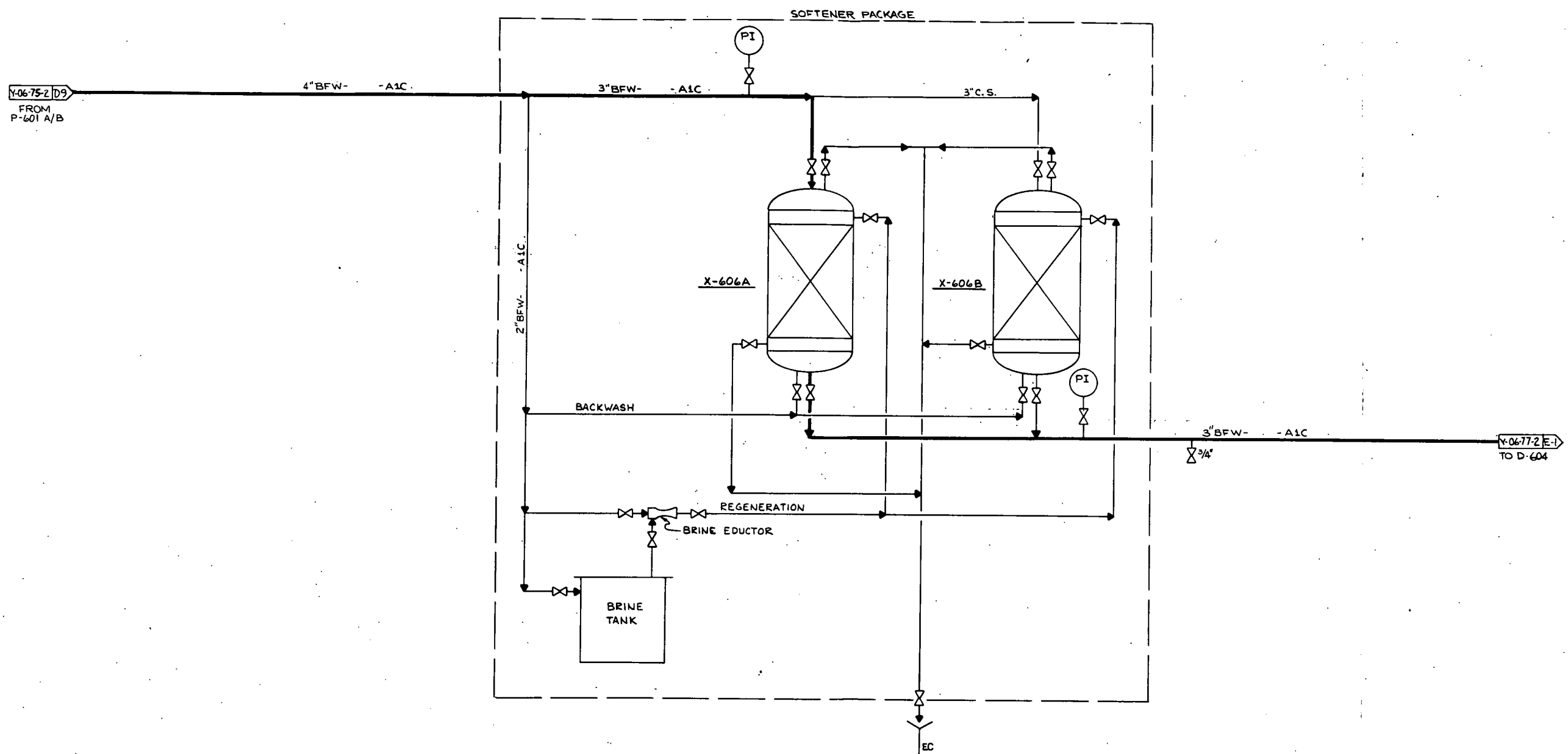


U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS OHIO
 4814-Y-06-75-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 UTILITIES
 COMMERCIAL UNIT
 BFW FILTRATION P&ID
 PROJECT NO. P.E. NO. SCALE REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

X-606 A & B
BOILER FEEDWATER SOFTENERS
APPROX. 6'-0" DIA. x 10'-0" T-T



U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee**
ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-06-76-2
P.E. NO. _____
SCALE _____

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

UTILITIES
COMMERCIAL UNIT
BFW SOFTENING P&ID

REVISION **0**

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
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DRAWING ON DRAWING

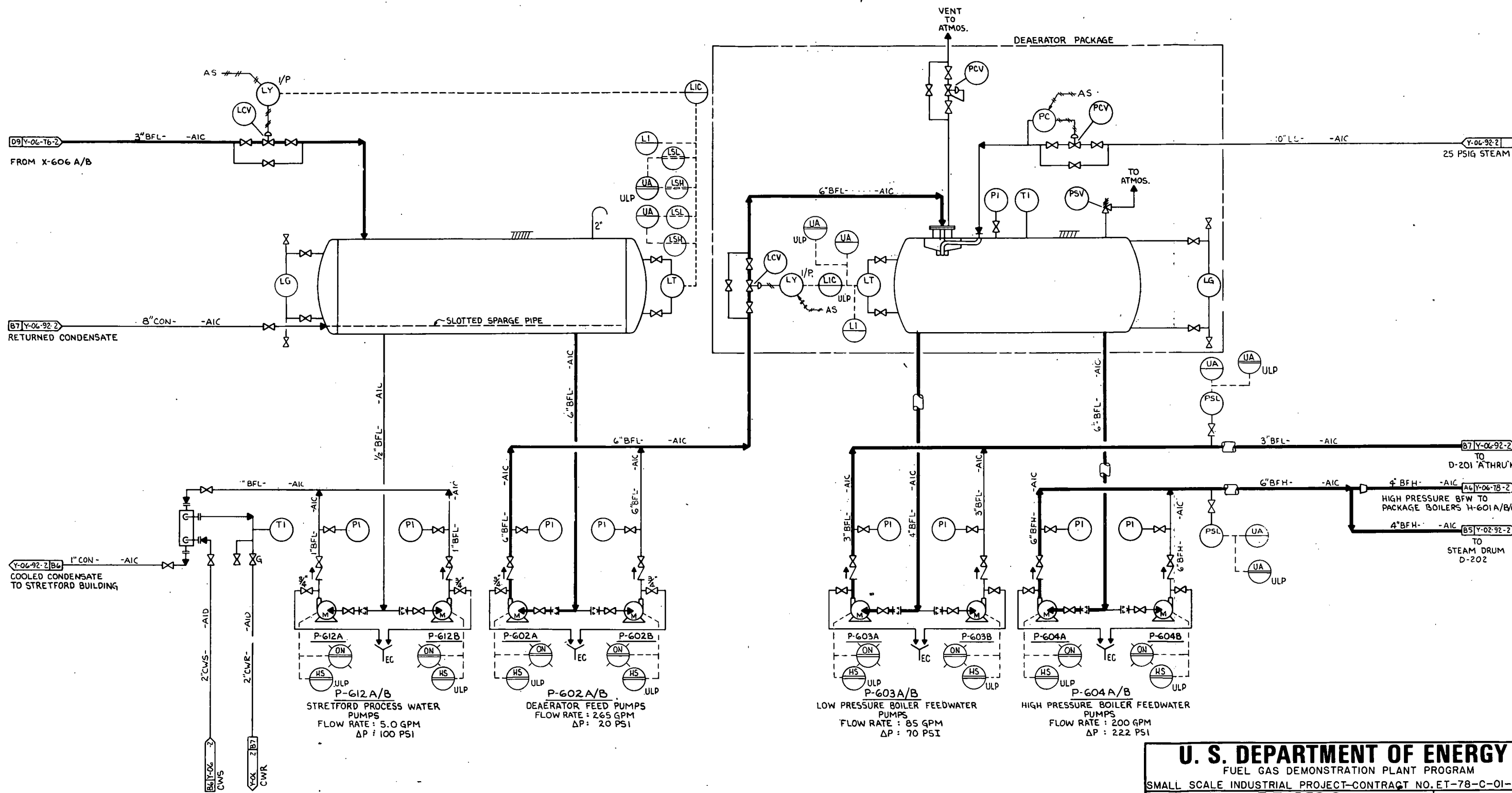
F
E
D
C
B
A

E-609
STRETFORD CONDENSATE COOLER
DUTY : 212,500 BTU/HR

D-604
DEAERATOR FEED SURGE TANK
6'-0" DIA × 18'-0" T-T

X-607
DEAERATOR
APPROX. 7'-0" DIA. × 15'-6" T-T

NOTES:
1.) ULP - UTILITIES LOCAL PANEL



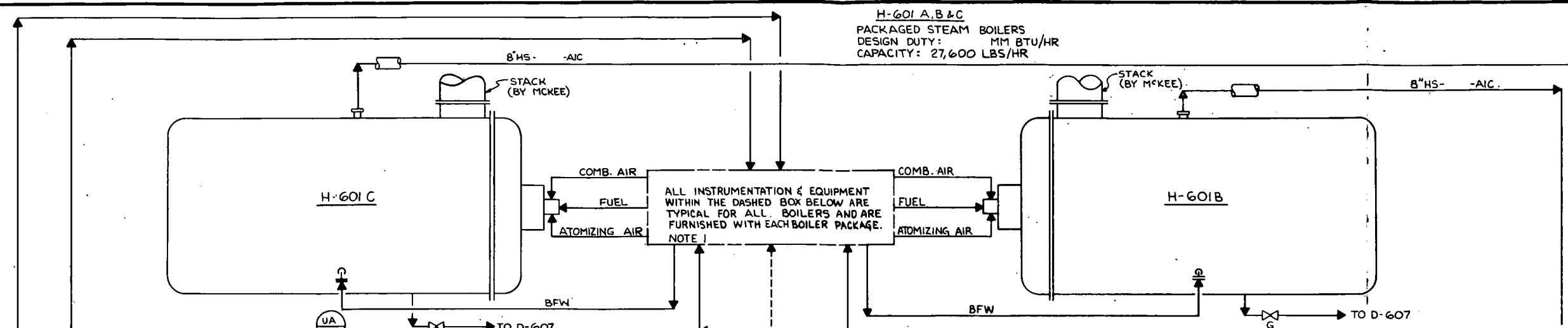
U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **McKEE** ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO 4814-Y-06-77-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

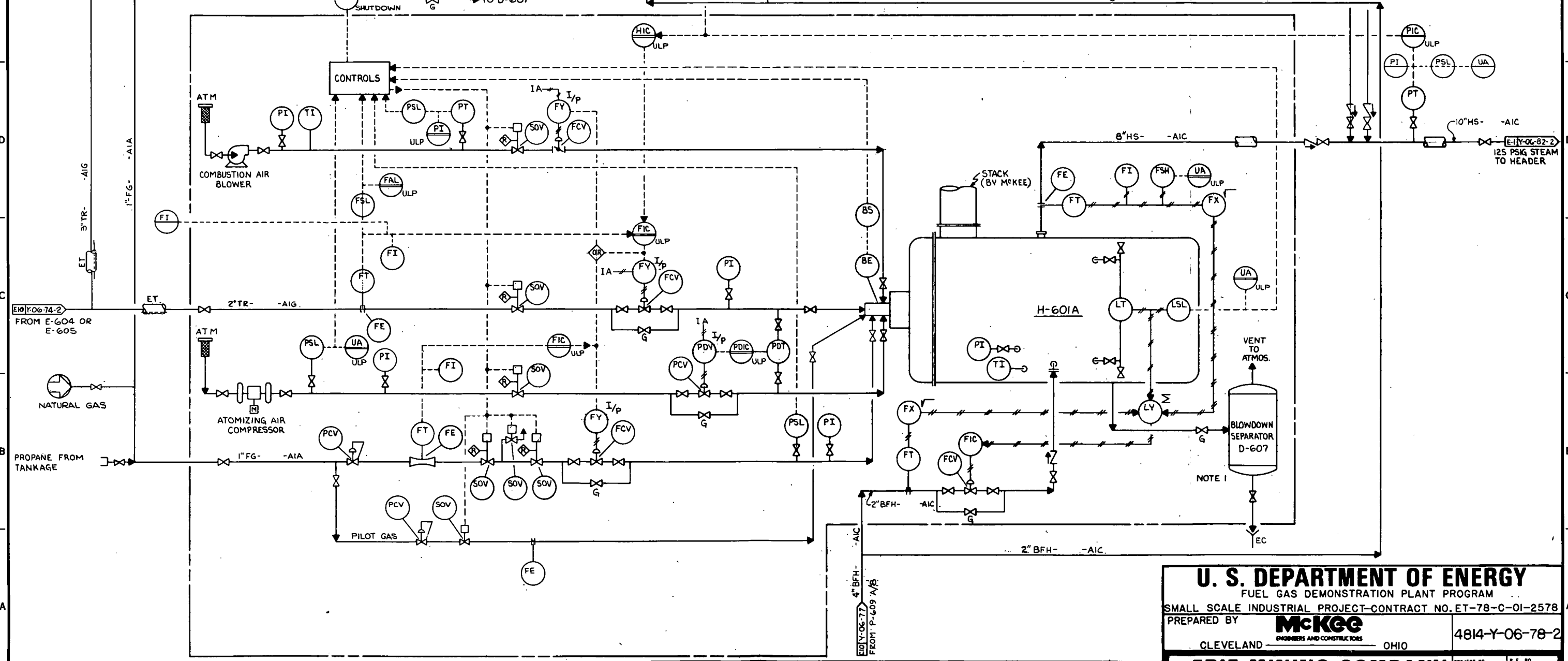
UTILITIES
COMMERCIAL UNIT
BFW DEAERATION AND PUMPS P&ID

PROJECT NO. P.E. NO.
SCALE
REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.
10-27-78	HUL	W.B.	ISSUED FOR APPROVAL	



NOTES:
 1. BLOWDOWN SEPARATOR D-607 IS COMMON TO THREE BOILERS.
 2. ULP - UTILITIES LOCAL PANEL OR PACKAGED BOILER PANEL.



REVISION	DATE	BY	CHK	DESCRIPTION	APP.
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REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.
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U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **MCKEE**
ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO 4814-Y-06-78-2

FOR ERIE MINING COMPANY
PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

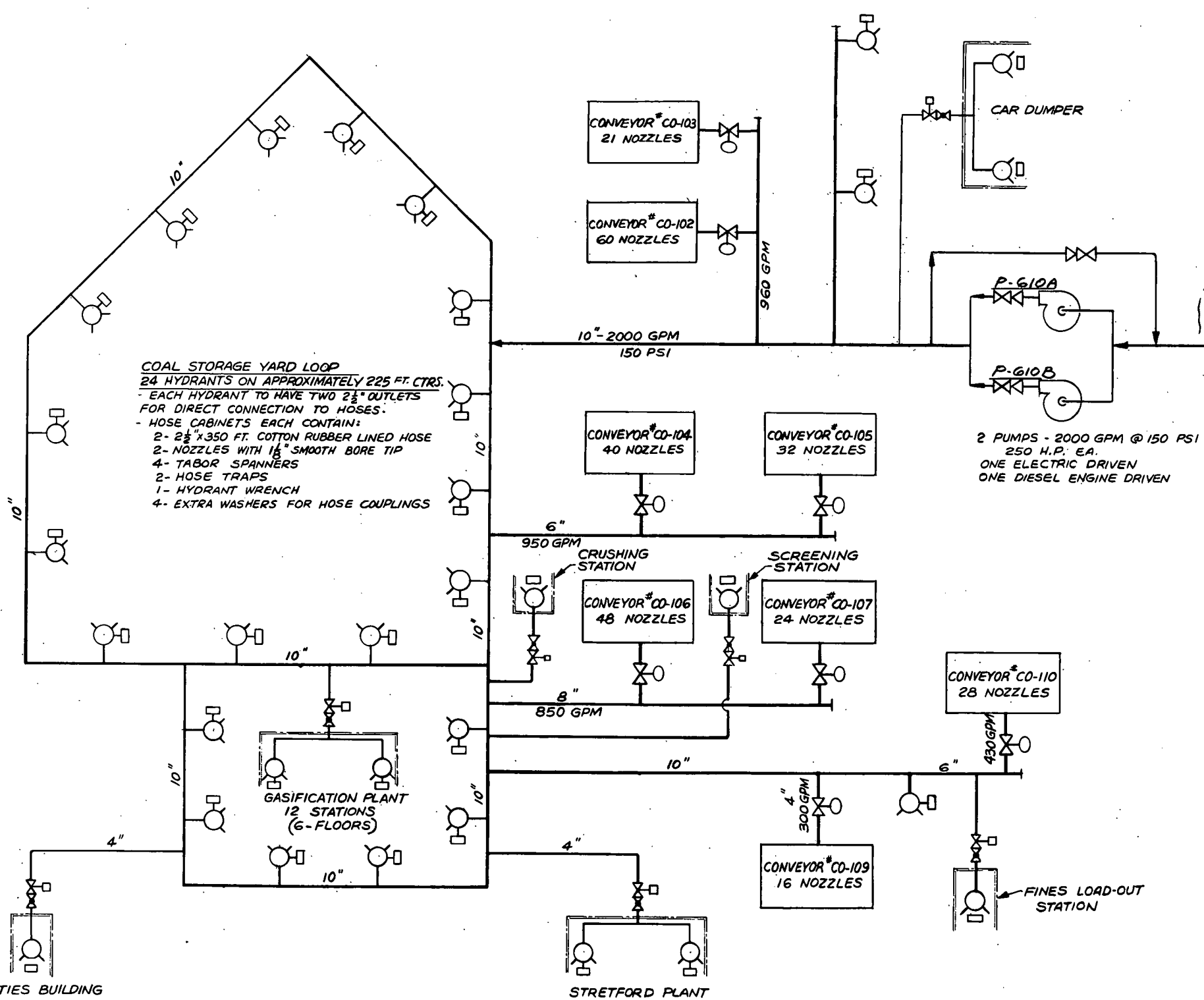
UTILITIES
 COMMERCIAL UNIT
 STEAM GENERATION P&ID

REVISION ▲

DRAWING NO.
4814Y06792

LEGEND

---	EXISTING SUPPLY LINE
—	NEW SUPPLY LINE
△	CHECK VALVE
⊗	GATE VALVE
⊗	SHUT OFF VALVE
⊗	PRESSURE REDUCING VALVE
⊗	DELUGE VALVE
⊗	FIRE HYDRANT - OUTSIDE
⊗	FIRE CABINET - INSIDE BUILDING



COAL STORAGE YARD LOOP
 24 HYDRANTS ON APPROXIMATELY 225 FT. CTRS.
 - EACH HYDRANT TO HAVE TWO 2 1/2" OUTLETS FOR DIRECT CONNECTION TO HOSES.
 - HOSE CABINETS EACH CONTAIN:
 2- 2 1/2" x 350 FT. COTTON RUBBER LINED HOSE
 2- NOZZLES WITH 1 1/8" SMOOTH BORE TIP
 4- TABOR SPANNERS
 2- HOSE TRAPS
 1- HYDRANT WRENCH
 4- EXTRA WASHERS FOR HOSE COUPLINGS

2 PUMPS - 2000 GPM @ 150 PSI
 250 H.P. EA.
 ONE ELECTRIC DRIVEN
 ONE DIESEL ENGINE DRIVEN

- NOTES:**
- PERIODIC TESTING OF COAL TEMPERATURES AND FLOODING OF HOT SPOTS WILL REQUIRE ADDITIONAL EQUIPMENT.
 - SPRAYS TO ALL CONVEYORS & GALLERIES TO BE DRY PIPE SYSTEMS WITH FUSED SPRINKLER HEADS, AIR CHARGED PIPES, AND AUTOMATIC ALARM DELUGE VALVES LOCATED IN HEATED AREAS AT GRADE LEVEL. EXPOSED WET PIPE TO BE THERMO STATIC CONTROLLED ELECTRIC HEATED. SPRAY HEADS SPACED 10'-0" APART AND DELIVER 10 GPM @ 10 PSI (MIN.).
 - FIRE CABINETS IN BUILDINGS CONTAIN:
 1 - 1 1/2" UNLINED LINEN HOSE x 150 FT. LONG.
 1 - NOZZLE WITH 1" SMOOTH BORE TIP.
 1 - HYDRANT WRENCH
 - ADDITIONAL EQUIPMENT IN BUILDING SHALL BE:
 DRY TYPE EXTINGUISHERS
 SODIUM BICARB - (ANSUL OR EQUAL)

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814Y06792

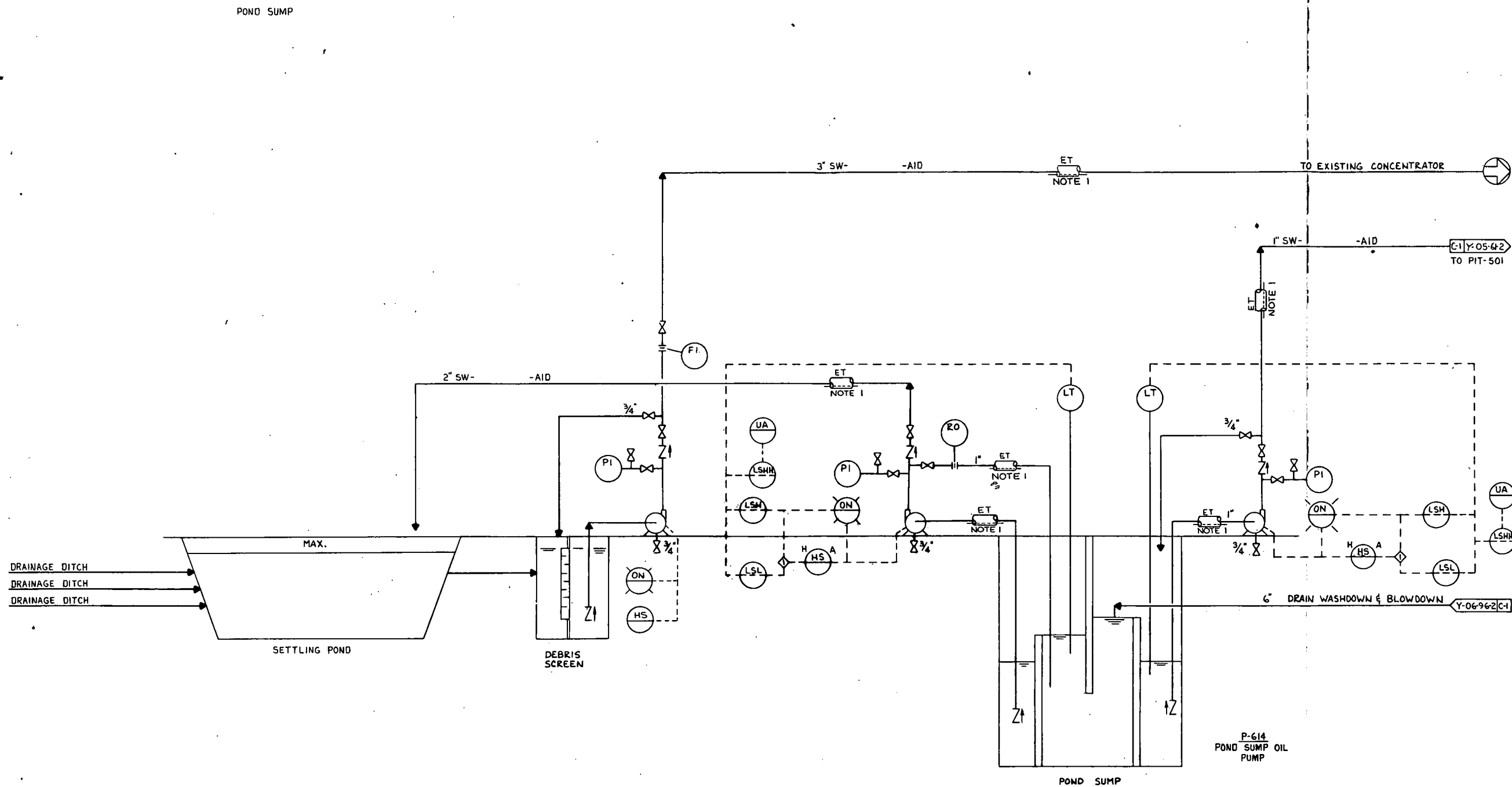
FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA

UTILITIES COMMERCIAL UNIT FIRE CONTROL DIAGRAM

REVISION 3

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10-16-78	MS	TG	CHANGES AS CIRCLED	MS
										9-25-78	MS		REMOVED FIRE HYDRANT	MS
										8-25-78	MS		LEGEND ADDED & NOTE CHANGED	MS
										8-11-78	NRS		ISSUED FOR ESTIMATING	NRS

NOTES:
1. TRACE AND INSULATE SECTION OF PIPE RUN EXPOSED TO AMBIENT ENVIRONMENT.



P-611 SETTLING POND OVERFLOW PUMP
P-613 POND SUMP WATER PUMP
PIT-602 POND SUMP

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO
 PROJECT NO. 4814-Y-06-80-2
 FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 UTILITY COMMERCIAL UNIT
 SETTLING POND WATER
 REVISION

DATE	BY	CHK	DESCRIPTION	APP.

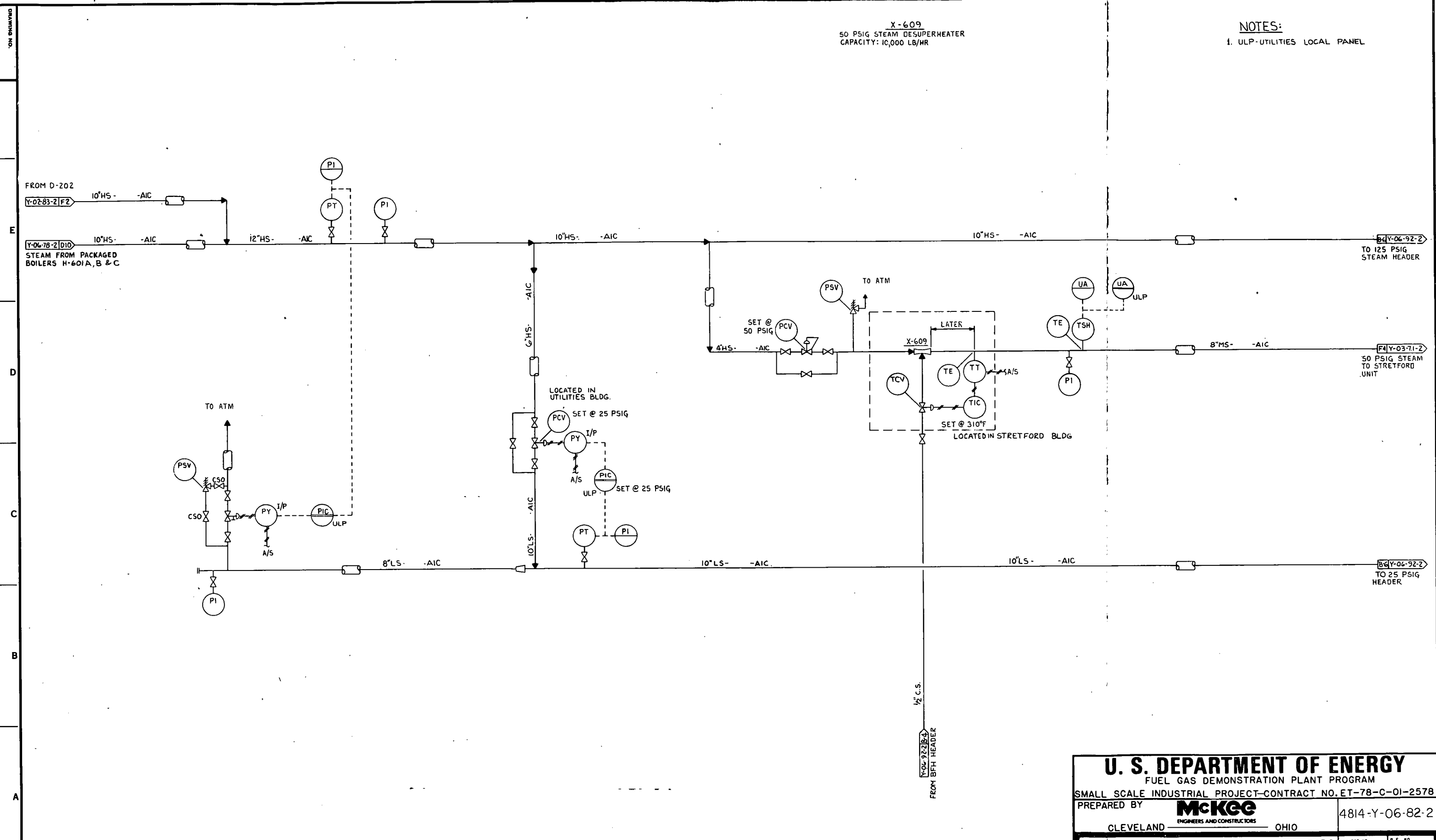
0-2778 GC W.B. ISSUED FOR APPROVAL

OH ENHAYVOC
F
D
C
B
A

F
E
D
C
B
A

X-609
 50 PSIG STEAM DESUPERHEATER
 CAPACITY: 10,000 LB/MR

NOTES:
 1. ULP-UTILITIES LOCAL PANEL



DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10-27-78	G.C.	W.B.	ISSUED FOR APPROVAL	SMB

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

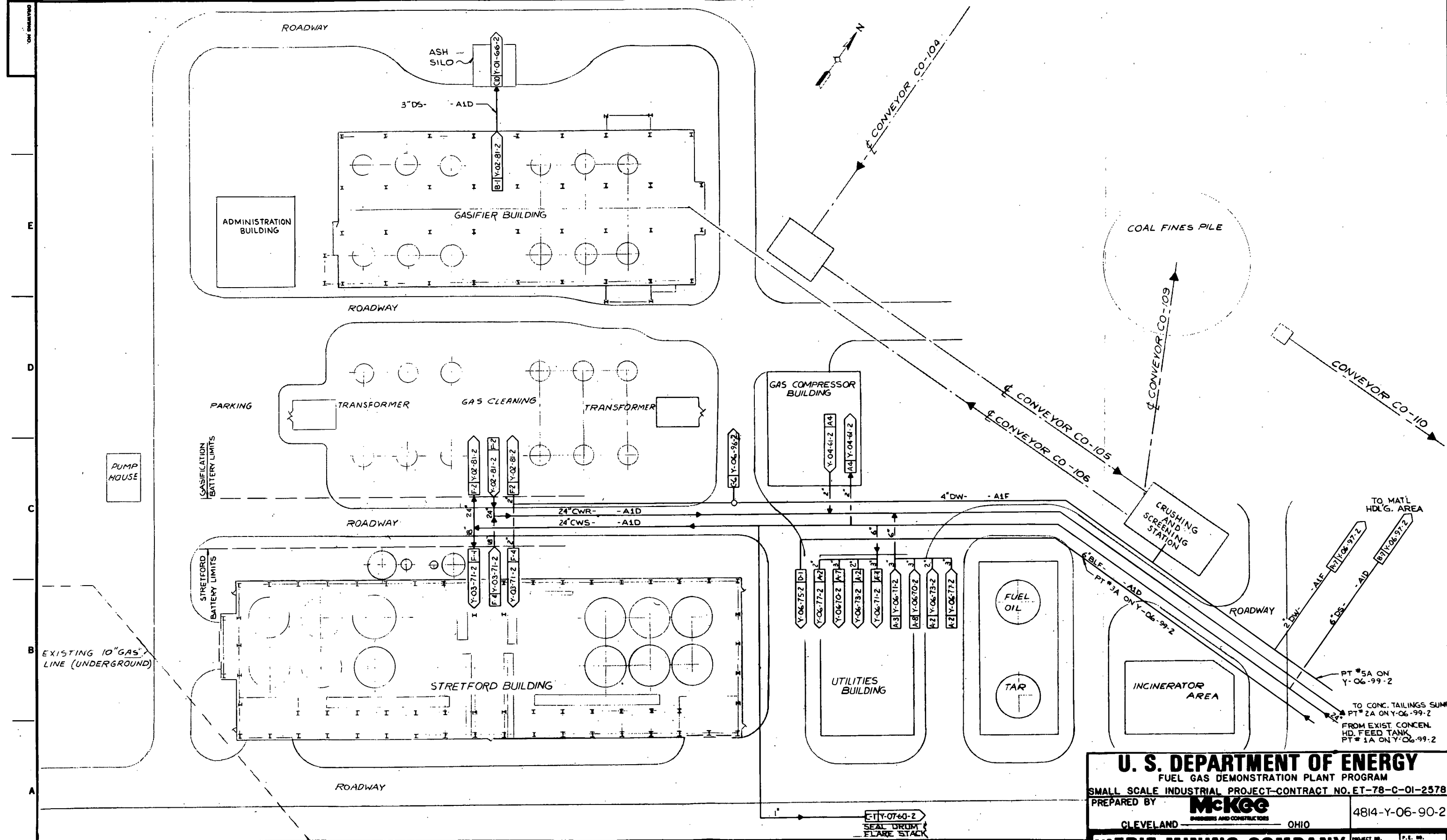
PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-06-82-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

UTILITIES
 COMMERCIAL UNIT
 STEAM REDUCING STATIONS (P&ID)

REVISION

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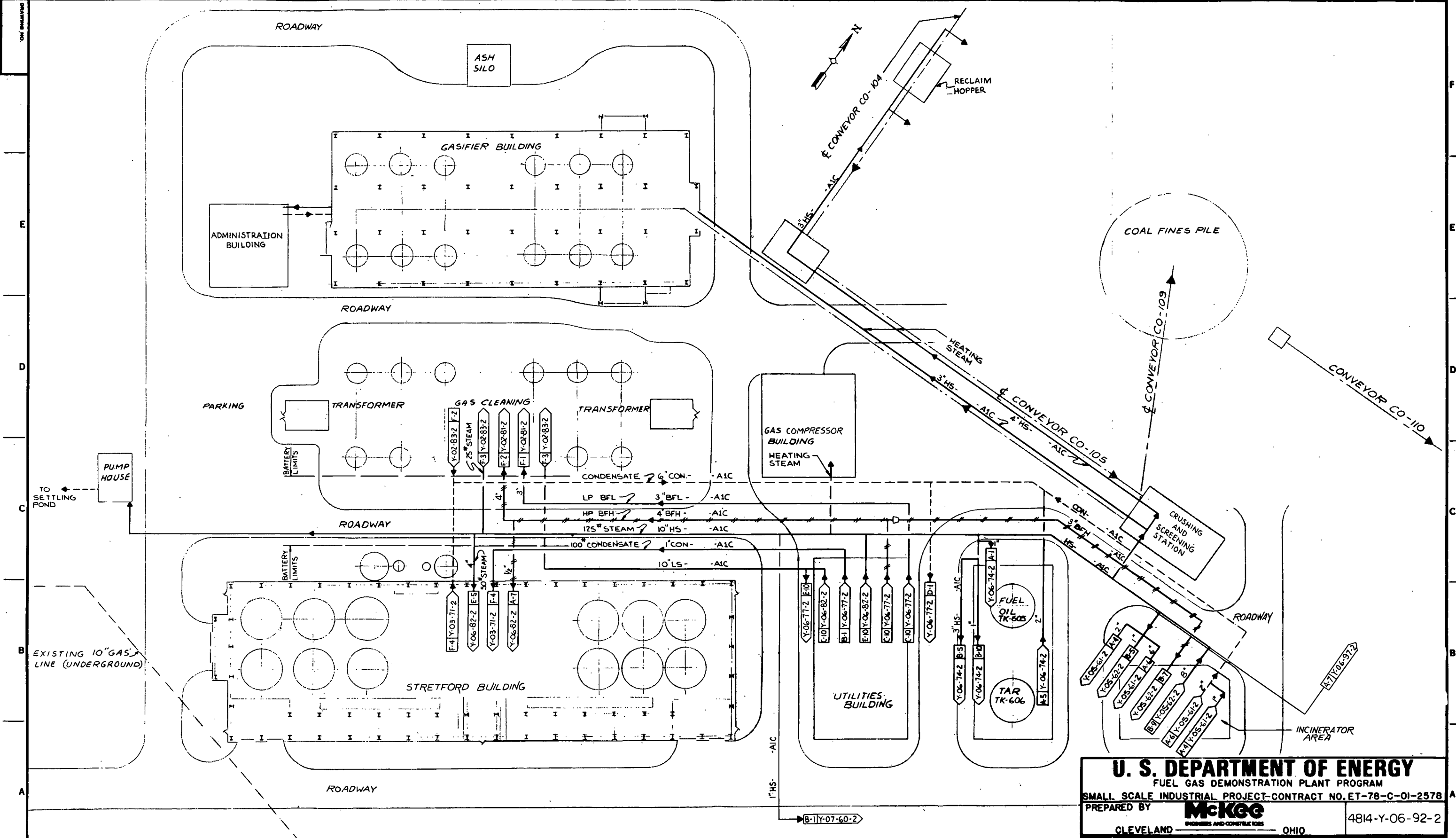
U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO

PROJECT NO. 4814-Y-06-90-2
 SCALE 1" = 30'-0"
FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA
 UTILITIES-ROUTING DIAGRAM
 COMMERCIAL UNIT
 COOLING AND POTABLE WATER

REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

ISSUED FOR APPROVAL



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 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-06-92-2

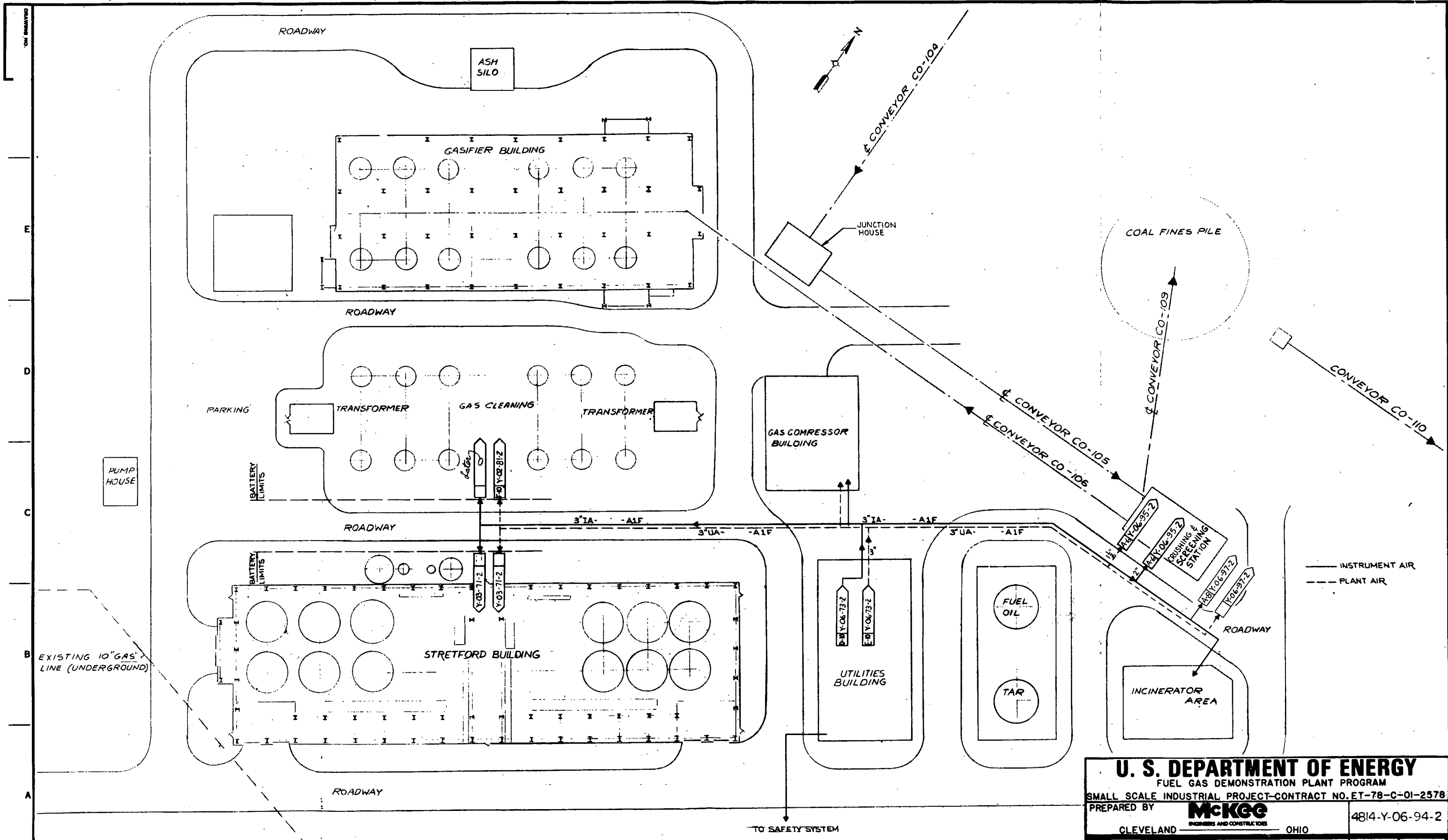
FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

UTILITIES - ROUTING
 COMMERCIAL UNIT
 STEAM, CONDENSATE & FEEDWATER

SHEET 1 REVISION 0

SCALE 1" = 30'-0"

DATE	BY	CHK	DESCRIPTION	APP.



U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578

PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-06-94-2

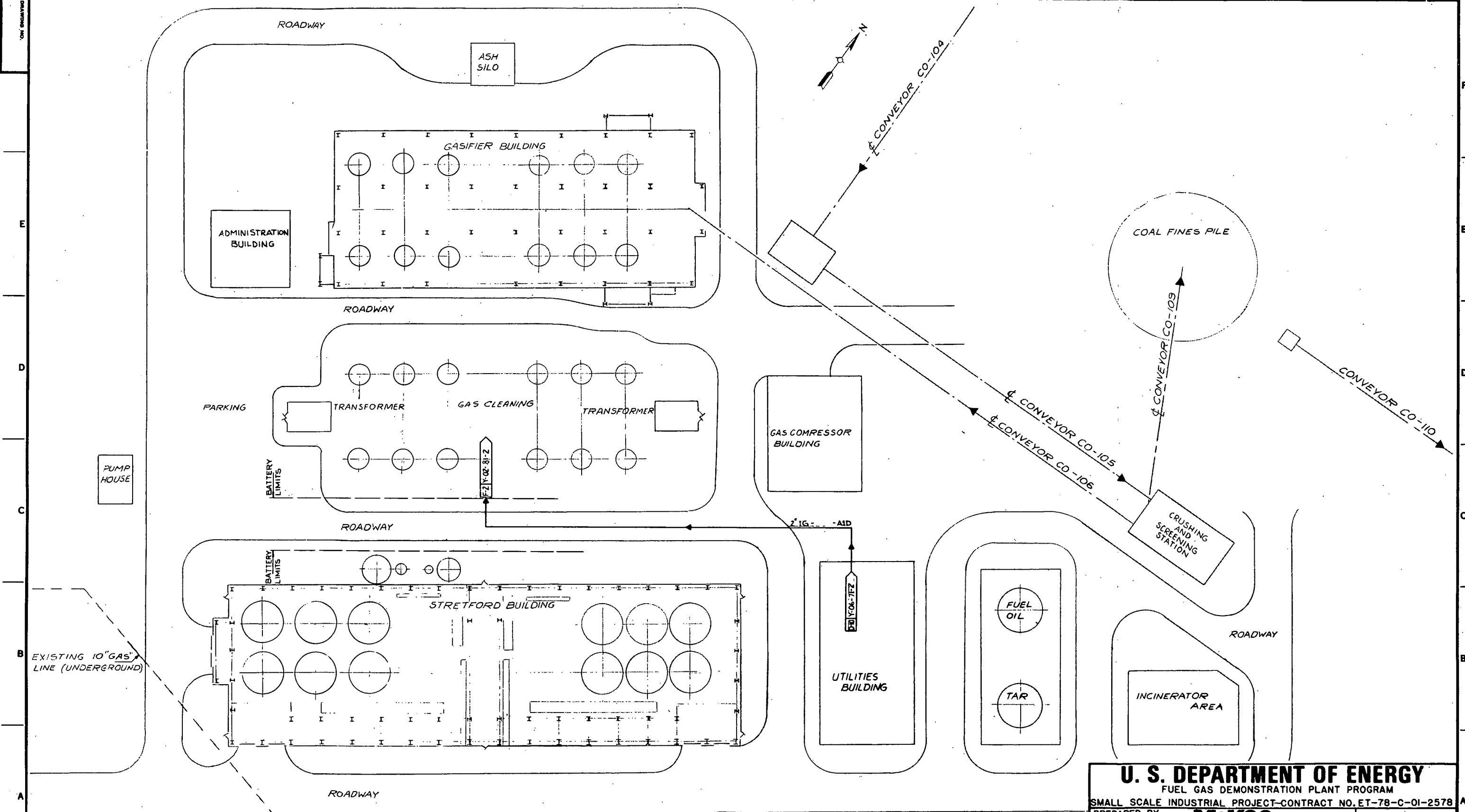
FOR **ERIE MINING COMPANY** PROJECT NO. P.E. NO.
 PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
 1" = 30'-0"

UTILITIES - ROUTING COMMERCIAL UNIT PLANT & INSTRUMENT AIR SHEET 1

REVISION

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 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **McKee**
 ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

PROJECT NO. 4814-Y-06-98-2

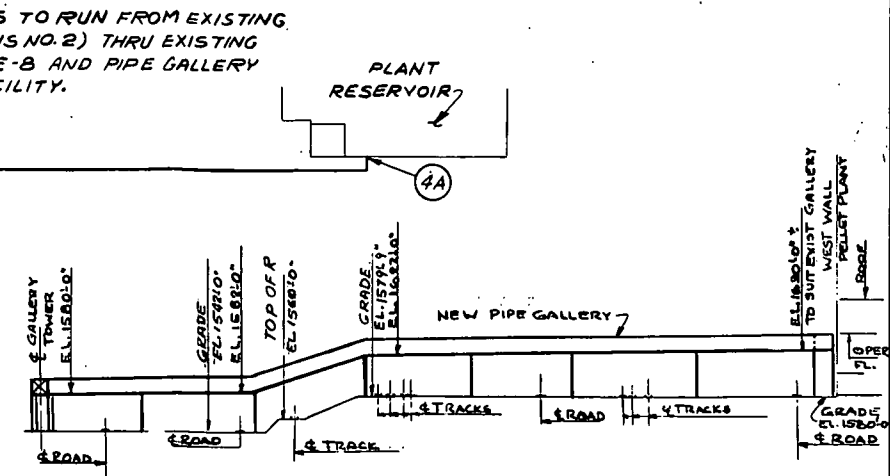
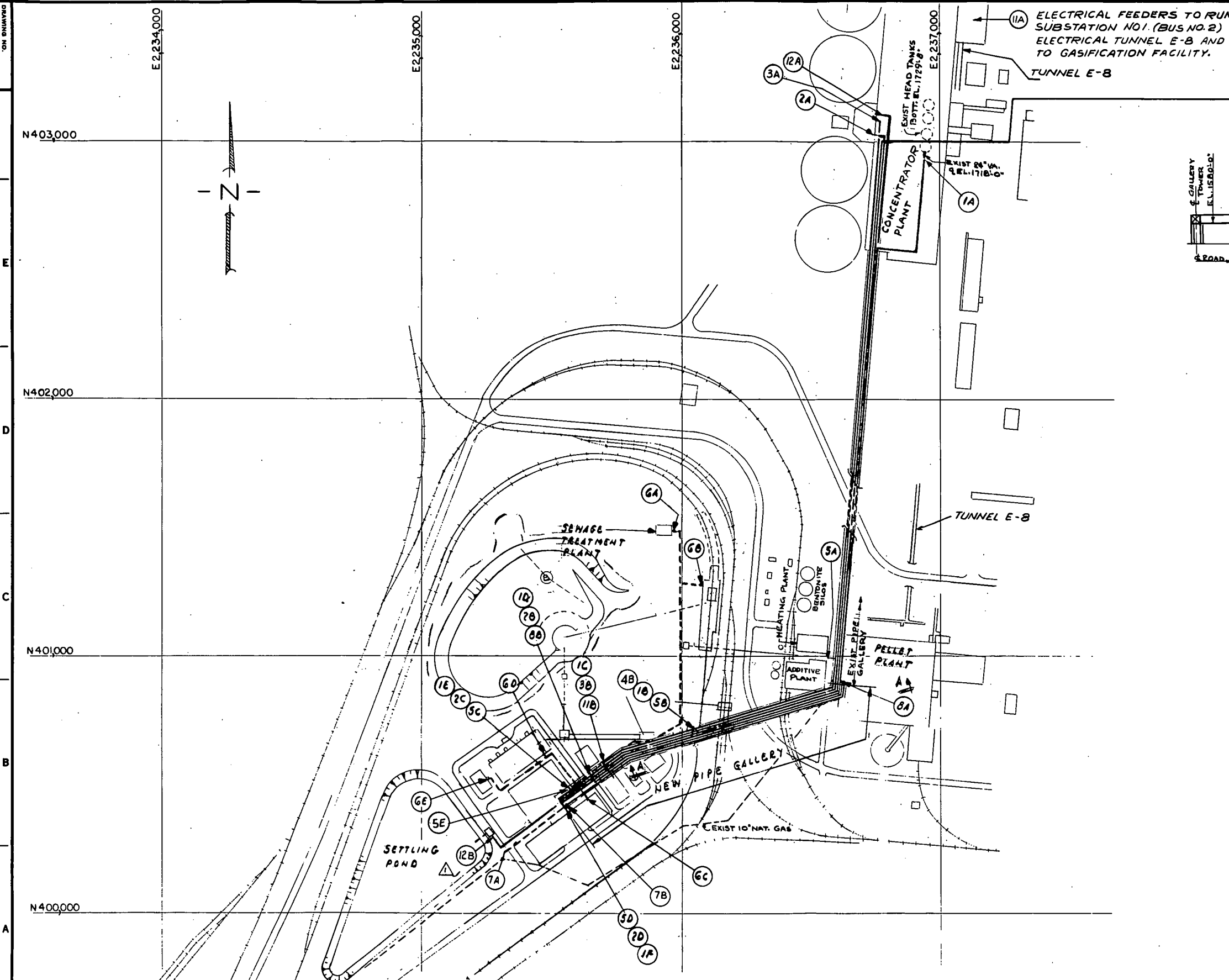
FOR **ERIE MINING COMPANY**
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

UTILITIES - ROUTING
 COMMERCIAL UNIT
 INERT GAS

SCALE: 1" = 30'-0"
 REVISION Δ

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

DRAWING NO. 4814-Y-06-99-2



SECTION 'A-A'
SCALE 1" = 100'

LEGEND:
 ABOVE GROUND PIPING ———
 UNDER GROUND PIPING - - - - -

SERVICES	EXIST. TIE-IN		DUMPER BLDG		UTILIT. BLDG		CONPR. BLDG		GASIF. BLDG		STRET. BLDG		EMPLOYE BLDG		PUMP HSE	
	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE	SYMB	SIZE
COOLING WTR SUP.	1A	24"	1B	4"	1C	3"	1D	6"	1E	10"	1F	12"				
COOLING WTR RET.	2A	24"					2B	6"	2C	10"	2D	12"				
BOILER FEED WTR	3A	6"			3B	6"										
FIRE WATER	4A	10"	4B	10"												
POTABLE WATER	5A	4"	5B	2"					5C	2"	5D	2"	5E	2"		
SANITARY SEWER	6A	4"	6B	4"					6D	4"	6C	4"	6E	4"		
RELOCATED GAS LINE	7A	10"									7B	10"				
PRODUCT GAS	8A	4"							8B	4"						
ELECTRIC	11A				11B											
DRAIN WATER	12A	4"														12B 4"

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT—CONTRACT NO. ET-78-C-01-2578 A

PREPARED BY **MCKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO

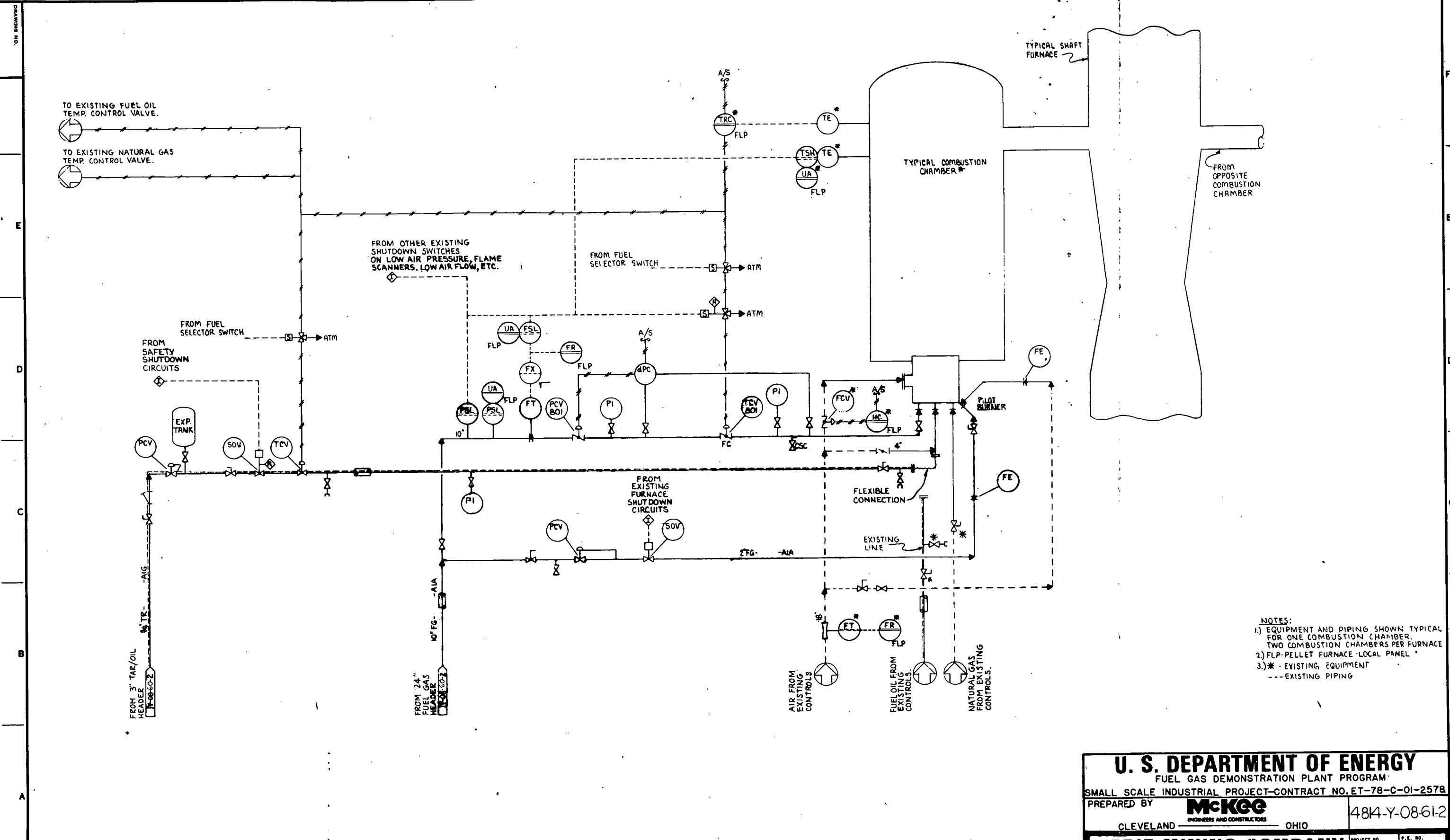
PROJECT NO. 4814-Y-06-99-2

FOR **ERIE MINING COMPANY**
 PICKANDS MATH AND CO. MANAGING AGENT. HOYT LAKES MINNESOTA

UTILITIES COMMERCIAL UNIT UTILITIES TIE-IN

REVISION **3**

DATE	BY	CHK	DESCRIPTION	APP.
10-13-78	MS	TK	BOILER FEED WATER TIE-IN 3MB WAS 4" P E	
			REVISED PILE CONFIGURATION	
9-15-78	MS		RELOCATED RUN 3, 4 & 7	
8-16-78	KH		RELOCATED RUN 4, 11 & 12	
8-3-78	JD		ISSUED FOR ESTIMATING	



NOTES:
 1) EQUIPMENT AND PIPING SHOWN TYPICAL FOR ONE COMBUSTION CHAMBER. TWO COMBUSTION CHAMBERS PER FURNACE.
 2) FLP- PELLET FURNACE LOCAL PANEL.
 3) * - EXISTING EQUIPMENT
 --- EXISTING PIPING

U. S. DEPARTMENT OF ENERGY
 FUEL GAS DEMONSTRATION PLANT PROGRAM
 SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
 PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
 CLEVELAND OHIO

4814-Y-0861-2

FOR ERIE MINING COMPANY
 PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

RETIROFIT
 COMMERCIAL UNIT
 DETAILS AT TYPICAL COMBUSTION CHAMBER

REVISION

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.

B.B. W.B. ISSUED FOR APPROVAL