ERIE MINING COMPANY

FUEL GAS

DEMONSTRATION PLANT

PROGRAM

SMALL-SCALE INDUSTRIAL PROJECT

DEMONSTRATION PLANT DESIGN

AND ECONOMIC EVALUATION

PHASE I

INTERIM REPORT

2 OF 2

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P.C. D
by C.P.D.
8/6/79

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DECEMBER, 1978

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

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C00--5066-T13(Vol. 2)

MASTER

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ENGINEERING REQUISITION

McKee

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

DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978UNIT 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> <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</p>		

ENGINEERING REQUISITION

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

DESCRIPTION GAS BOOSTER COMPRESSORSDATE JULY 24, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 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 Increasers Tag No.: CX-401 A&B		

ENGINEERING REQUISITION

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DESCRIPTION GAS BOOSTER COMPRESSORS DATE JULY 24, 1978UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p style="text-align: center;"><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

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		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.		

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 7/24/78	MADE BY TB	CHECKED BY	PAGE 5	OF	CONT. NO. 4814	E/R NO. 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	WESTERN			EASTERN	
	RATED	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, 60°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 ₀ -C _v		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 BHP					
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) (T-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 6 OF	CONT. NO.	B/M 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 ☒) (FLOW)
METHOD:
(CONSTANT SPEED) (INLET GUIDE VANES) (SUCTION THROTTLING ☒)
BY OTHERS
(VARIABLE SPEED) THROUGH (DRIVER) (HYDRAULIC CPLG.)
(MAGNETIC CPLG.) BY
ACTUATION: (MANUAL) (AUTOMATIC ☒)
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 ☒) FOR (COMPR ☒) (GEAR ☒) (DRIVER ☒)
CONSOLE: (YES ☒) (NO) BY
OIL RESERVOIR: (INTEGRAL ☒) (SEPARATE)
RETENTION TIME MINUTES. HEAT. COIL (YES ☒) (NO)
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 / /

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.: CM-401AEB
TYPE:
HP: RPM: ROTATION (CW) (CCW) °
ENCLOSURE: INSUL.: TEMP. RISE: °C
VOLT/PHASE/CYCLE: 4160/3/60, NEMA FRAME:
BEARINGS: LUBE:
EXCITER: (DIRECT CONN.) (M. G.) (RECTIFIER) BY
POWER FACTOR FOR DETAILS SEE
OTHER
(STM. 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 ☒) (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
CLASS I Group D DIV II

*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 COMPRESSORSDATE JULY 24, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																																													
		<p style="text-align: center;"><u>COAL GAS BOOSTER COMPRESSOR</u></p> <p style="text-align: center;"><u>C-401</u></p> <p style="text-align: center;"><u>GAS ANALYSIS</u></p> <table><tr><td></td><td style="text-align: center;">Western Coal Case 1</td><td style="text-align: center;">Eastern Coal Case 2</td></tr><tr><td><u>Component</u></td><td style="text-align: center;"><u>Mol %, "wet"</u></td><td style="text-align: center;"><u>Mol % "wet"</u></td></tr><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></table> <p>NOTES:</p> <p>1. Gas may contain up to .01 gr/scf of tar and .01 gr/scf solids.</p>		Western Coal Case 1	Eastern Coal Case 2	<u>Component</u>	<u>Mol %, "wet"</u>	<u>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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ENGINEERING REQUISITION

McKee

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

DESCRIPTION COAL GAS BURNERSDATE APRIL 4, 1978UNIT FUEL GAS GASIFICATION PROJECTCONTRACT 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</u> (to be provided later)</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>		

McKee

DESCRIPTION. COAL GAS BURNERS

DATE APRIL 4, 1978

UNIT FUEL GAS GASIFICATION PROJECT

CONTRACT_____4814

CL-308/12

MADE BY: JJC

CHECKED BY: HMc

PAGE 2 OF

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ENGINEERING REQUISITION

McKee

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

DESCRIPTION COAL GAS BURNERSDATE APRIL 4, 1978UNIT FUEL GAS GASIFICATION PROJECTCONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																														
		<p style="text-align: center;"><u>Design Notes</u></p> <p>1. Provide gas burners suitable for a fuel with the analysis listed below:</p> <p style="text-align: right;">% by Vol.</p> <table><tr><td>CO</td><td>=</td><td>27.65</td></tr><tr><td>CO₂</td><td>=</td><td>3.54</td></tr><tr><td>H₂</td><td>=</td><td>19.32</td></tr><tr><td>N₂</td><td>=</td><td>42.83</td></tr><tr><td>Ch₄</td><td>=</td><td>2.14</td></tr><tr><td>C₂h₆</td><td>=</td><td>0.07</td></tr><tr><td>COS</td><td>=</td><td>0.06</td></tr><tr><td>H₂O</td><td>=</td><td>4.37</td></tr><tr><td>NH₃</td><td>=</td><td>0.01</td></tr><tr><td>H₂S</td><td>=</td><td>Trace</td></tr></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>	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		
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		<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

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		<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> <p>a. #2 fuel oil</p> <p>b. #6 fuel oil heated to approximately 240°F</p> <p>c. Coal tar with the same viscosity as #6 fuel oil heated to 240°F.</p>		

ENGINEERING REQUISITION

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DESCRIPTION COAL GAS BURNERSDATE APRIL 4, 1978UNIT FUEL GAS GASIFICATION PROJECTCONTRACT 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

McKee

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

DESCRIPTION COAL GAS BURNERS DATE APRIL 4, 1978UNIT FUEL GAS GASIFICATION PROJECT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		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.		

ENGINEERING REQUISITION

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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>Furnish the packaged steam boilers specified herein and in accordance with the requirements of the following specifications:</p> <p><u>A. G. McKee Specifications</u></p> <p>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</p> <p><u>Industry Specifications</u></p> <p>ASME Boiler and Pressure Vessel Code ANSI Codes for Pressure Piping</p>		

ENGINEERING REQUISITION

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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-893 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.	<u>X</u>
		<u>X</u>
1.2	Preliminary outline and arrangement drawings.	<u>X</u>
1.3	Descriptive literature including cross sectional drawings.	<u>X</u>
1.4	Data sheet completed by supplier when included as a part of this E/R.	<u>X</u>
1.5	Material specifications.	<u>X</u>
1.6	Date for furnishing drawings.	<u>X</u>
1.7	Operating weights.	<u>X</u>
1.8	Shipping weights.	<u>X</u>
1.9	Hydrostatic Test Weights-- Vessels & Tanks	<u> </u>
1.10	Vendor shall complete data sheet (M-250 for Vessels, M-300 for Tanks) whichever is applicable.	<u> </u>
1.11	Performance Curves	<u>X</u>
1.12	Noise Data Sheet	<u>X</u>

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

ENGINEERING REQUISITION

McKee

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

DESCRIPTION PACKAGED STEAM BOILERS
ERIE MINING COMPANY
 UNIT COAL GASIFICATION PROJECT

DATE JULY 19, 1978CONTRACT 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																	
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																	

ENGINEERING REQUISITION

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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 for burner Viscosity, cp @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 for burner Viscosity, cp @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 1.4 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

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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
		1.9.1 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		

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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, 1978UNIT 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

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

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

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

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

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

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p><u>Design Notes</u></p> <ol style="list-style-type: none"> 1. The unit trains will be made up of 3 locomotives, 50 gondola coal cars, and a caboose. 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. 3. Each locomotive will be 15'-9" high and 10'-5" wide. For design purposes use a locomotive weight of 270 ton each. 4. Cars will be equipped with rotary couplers. 5. Cars will be equipped with interchangeable standard draftgears. 6. The car dumper shall rotate clockwise when viewed in the direction of a loaded train travel. 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. 8. The system shall be designed for continuous 24 hours per day heavy duty service and a cycle time of 2 minutes per car. 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. 		

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

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. 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-01-30-2 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>		

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

DESCRIPTION TRAIN POSITIONER/ROTARY DUMPER SYSTEM DATE JUNE 30, 1978UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

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

ENGINEERING REQUISITION

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DESCRIPTION COAL CRUSHERDATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 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>		

McKee

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

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

DESCRIPTION COAL CRUSHERDATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<p><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

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

DESCRIPTION COAL CRUSHERDATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																																	
		<p style="text-align: center;"><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><tr><td></td><td style="text-align: center;">Western</td><td style="text-align: center;">Eastern</td></tr><tr><td></td><td style="text-align: center;"><u>Sub-bituminous</u></td><td style="text-align: center;"><u>Bituminous</u></td></tr><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></table> <p>(1) Total moisture (inherent plus surface)</p> <p>4. <u>Operating Conditions:</u></p> <table><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></table> <p><u>Maximum Feed Size (inches)</u></p> <table><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></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	Eastern		<u>Sub-bituminous</u>	<u>Bituminous</u>	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		
	Western	Eastern																																			
	<u>Sub-bituminous</u>	<u>Bituminous</u>																																			
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ENGINEERING REQUISITION

McKee

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

DESCRIPTION COAL CRUSHERDATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 4814

ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		also be included to permit removal of the rotor without dismantling the crusher.		
		7. Renewable abrasion-resistant steel liners and components shall be furnished in all areas subject to excessive wear.		
		8. Provide a suitable mechanical adjustment mechanism for the cage frame.		
		9. Provide oil lubricated antifriction bearings with suitable seals and mounted on the outside of the crusher frame.		
		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.		
		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.		
		12. A direct coupled drive complete with motor, coupling and guard shall be provided for each crusher.		
		13. The rotor assembly shall be statically balanced.		

ENGINEERING REQUISITION

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

DESCRIPTION COAL CRUSHERDATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT 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

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

DESCRIPTION PRELIMINARY PLANT SITE SUBSURFACE EXPLORATION DATE NOVEMBER 11, 1977UNIT FUEL GAS DEMONSTRATION PLANTCONTRACT **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>		

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		<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>		

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		<p>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>8.0 PHASE II SCOPE OF WORK</p> <p>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>		

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		<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>		

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		<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:</p> <p>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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		<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>		

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		<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. 		

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		<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)		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.		
2)		<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 		

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		<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>		

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2)		<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 		

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		<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. 		
2)		<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 		
2				

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		<ul style="list-style-type: none">3. Steam requirement for grate cooling4. Pressure drop through gasifier and cyclonese. Identify product and by-product yields qualities and compositionf. Identify effluent streams, yields qualities, and composition, and provide "in-house" background environmental datag. Determine raw material feed quantitiesh. Operating Data<ul style="list-style-type: none">1. Manpower requirements, operating and maintenance2. Estimate of utilities and chemicals consumptions<ul style="list-style-type: none">a) Plant, utility and instrument airb) Steam, production and consumptionc) Boiler feedwater, quantity and qualityd) Cooling watere) Electrical powerf) Inert gasg) Chemicals quantity and costs2.4 Other subcontractor responsibilities, coordination		

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		<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>		

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		<p>packages which shall include, but not limited to, the following:</p> <p>2.8.1 General arrangement drawings showing the following:</p> <ul style="list-style-type: none">a. Major dimensions of vesselb. Nozzle locations and orientationc. Water jacket dimensionsd. Grate design and locatione. Poke hole design and locationf. Internal ash quench design and locationg. Stirrer and drive design and locationh. Coal lock hopper and valve design and locationi. Ash lock hopper design and locationj. Pneumatic ash handling system <p>2.8.2 Designs of the gasifier retorts shall include the following:</p> <ul style="list-style-type: none">a. Vessel design drawingsb. Refractory lining drawings with sufficient information for installation, including Bills of Materials. <p>2.8.3 Design of the ash level control system, including the following:</p>		

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		<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>		

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		<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 ($\pm 15\%$) 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>		

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		<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>		

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		will have bid on the fabrication and/or supply of major components of the gasifiers.		
		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.		
		2.19 During Phase I the subcontractor and McKee shall mutually develop a gasifier operating test program to be performed during Phase III.		
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.		
2)		2.21 Coal fines agglomeration system will be by others. Subcontractor shall advise test requirements. DELETED		
2,		3.0 <u>INSTRUCTION TO BIDDERS</u> DELETED all sections except 3.3		
		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		
		3.2 The proposal shall include the following: DELETED		
		3.2.1 The bidder shall provide the following information to be used in evaluating the bid: DELETED		
		a. A lump sum price to provide a complete process design specification package for the demonstration unit delineated under Paragraph 2.2. DELETED		
		b. A lump sum price to provide a complete		

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		<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>		

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		<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> <p>1. Plant, utility and instrument air DELETED</p> <p>2. Steam, production and consumption DELETED</p> <p>3. Boiler feedwater, quantity and quality DELETED</p>		

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		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		

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		<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>		

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		<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>		

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		<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> <p>a. Advise if there are any gasifier internals or appurtenances to the gasifiers that the bidder considers as proprietary information. DELETED</p> <p>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</p> <p>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</p> <p>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> <p>3.2.5 Cost control procedure DELETED</p> <p>3.2.6 Furnish and advise specific project requirements regarding the following: DELETED</p> <p>a. Secrecy Agreements DELETED</p>		

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		<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>		

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		<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>		

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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 descriptionb. Process flow diagramsc. Heat and material balancesd. Main process parameterse. Product and by-product yieldf. Effluent streamsg. Raw material feedh. 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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		<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>		

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		<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>		

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		<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>		

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		<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><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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GS-254	Site and Utility Data																											
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		<p>The subcontractor completion responsibilities are as listed in McKee Specification 789.</p> <p>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>		

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		<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>		

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		<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. <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>		

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		<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>		

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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	Sub-bituminous		Lignite*
Coal Seam	<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	Bituminous			
Coal Seam	<u>Brookville</u>	<u>Clarion</u>	<u>Davis-Dekoven</u>	<u>Kittanning</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.

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TABLE II

GUIDELINES FOR EQUIPMENT AND INSTRUMENTS NUMBERING

3)

- All coal gasification battery limits equipment will be numbered in the 200 series, starting 201.
- 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.

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APPENDIX A
 PHASE I
 BATTERY LIMITS FOR
 COAL GASIFICATION UNIT SUBCONTRACT

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REV. 0COAL GASIFICATION UNIT
SUBCONTRACT SCHEDULE FOR PHASE I

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

PROCESS FLOW DIA. TO McKEE

P & I'D TO McKEE

EQUIPMENT DATA SHEETS TO McKEE

ITEMS TO McKEE FOR REVIEW/APPROVAL

DATA FOR PROCESS PACKAGE COMPLETE

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. ^{Morton L. Markowitz} ~~Herbert D. Link~~,

~~whose resume is also included in Section 5.7 of this proposal.~~

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

While the majority of Mr. ^{Markowitz's} ~~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

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		<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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 Completely Pgs. 1,4,7,10,12, Pgs. 10,16A,22
 Revised as 13, 16, 17,19,21
 Purchased Added 16A

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		<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>Phase I</p> <p>1.5.1 Process and unit design and cost estimate 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</p>		

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		unit and cost estimate for Phase II and Phase III work.		
1)		The demonstration unit shall be designed to be expanded to provide the requirements for the commercial unit in an economical manner.		
		Phase II		
		The subcontractor shall furnish engineering, procurement, and construction consulting service for the demonstration unit sufficient to maintain the guarantees.		
1)		Phase III		
		The subcontractor shall furnish operator training, start-up, performance testing, and consulting services, for the demonstration unit.		
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.		
		1.7 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		

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		<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> <p>a. Sulfide loading of rich solution</p> <p>b. Reactor tank or drum and oxidizer residence times</p>		

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		c. Actual vs. theoretical air requirements.		
		2.2.3 Process Flow Diagrams which shall show major equipment items and principal process control loops.		
		2.2.4 A heat and material balance based on the design case and keyed to the Process Flow Diagram.		
		2.2.5 Piping & Instrument Diagrams showing the complete unit piping and instrumentation.		
		2.2.6 All equipment sized and specified in detail including internals.		
		2.2.7 Electrical single line diagrams.		
		2.2.8 Material specification for all process equipment and piping.		
		2.2.9 Plot plan and elevations drawn to scale showing all major equipment items.		
		2.2.10 Compositions and rates of purge streams.		
		2.2.11 Compositions and rates of gaseous vents.		
		2.2.12 Start-up and shutdown procedures in outline form.		
		2.2.13 Operating data		
1)		a. Manpower requirements, operations and maintenance		
1)		b. Estimate of utilities and chemical consumptions		

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		<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).		
		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 		

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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.		

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1)		<p>2.3.8 Cost estimate for the completion of the commercial unit <u>+20%</u>. Refer to 2.11.</p> <p>2.3.9 Material specification for all process equipment and piping.</p> <p>2.3.10 Plot plan and elevations drawn to scale showing all major equipment items.</p> <p>2.3.11 Compositions and rates of purge streams.</p> <p>2.3.12 Compositions and rates of gaseous vents.</p> <p>2.3.13 Start-up and shutdown procedures in outline form.</p> <p>2.3.14 Operating data</p> <p>a. Manpower requirements, operations and maintenance</p> <p>b. Estimate of utilities and chemical consumptions</p> <p>1. Plant and instrument air</p> <p>2. Steam consumption (summer and winter)</p> <p>3. Cooling water (summer and winter)</p> <p>4. Electrical power</p> <p>5. Chemical quantity and costs including initial charge, normal make up, design and operating</p> <p>2.3.15 Data sheets for all instruments required for control loops and indicating recording,</p>		

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		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:		
		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		

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		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		

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		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.		
1)		2.13 During Phase I the subcontractor shall make suggestions for wash stream clean-up.		
1)		3.0 <u>INSTRUCTION TO BIDDERS</u>		
		3.1 Coordination Procedure and Document Distribution		
		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.		
		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.		
		3.1.2 Subcontractor shall include the cost of reproduction and distribution of all documents in his bid.		
		4.0 <u>PROCESS DESIGN SPECIFICATION</u>		
		4.1. Scope of Specification		
		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.		

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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)				
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 PMV H₂S.</p>		
		<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>		

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		<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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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>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>		

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

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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.		

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																								
		<p>TABLE I</p> <p>STRETFORD UNIT</p> <p><u>FEED STREAM</u></p> <p><u>Battery Limits Conditions</u></p> <p>Temperature, °F 95 Pressure, Inches W.C. 15 Outlet Pressure, Inches W.C. 2 } Battery Limits to Battery Limits</p> <p><u>Design Feed Rate</u></p> <p>Demonstration Unit 1.89 x 10⁶ SCFH Commercial Unit 5.09 x 10⁶ SCFH</p> <p><u>Composition</u></p> <table><thead><tr><th>Component</th><th>MOL %</th></tr></thead><tbody><tr><td>CO</td><td>27.13</td></tr><tr><td>CO₂</td><td>3.50</td></tr><tr><td>H₂</td><td>18.90</td></tr><tr><td>N₂</td><td>41.90</td></tr><tr><td>CH₄</td><td>2.09</td></tr><tr><td>C₂H₆</td><td>0.07</td></tr><tr><td>H₂S</td><td>0.75</td></tr><tr><td>COS</td><td>0.08</td></tr><tr><td>H₂O</td><td>5.58</td></tr><tr><td>HCN</td><td>10 ppmv (est.)</td></tr><tr><td>NH₃</td><td>70 ppmv (est.)</td></tr></tbody></table>	Component	MOL %	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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		<p>TABLE III</p> <p>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 preceded 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>2) DELETED</p> <p>2)</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>		

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		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.		

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER																
		<p>TABLE IV - SEE GENERAL SPECIFICATION 254*</p> <p>STRETTFORD UNIT</p> <p><u>CHARACTERISTICS OF UTILITIES AND METEOROLOGICAL</u></p> <p><u>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><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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**TABLE V
STRETTFORD 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																	■															

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.

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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>		

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. 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 Data2. Environmental Ambient Data3. 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°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>		

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORD. NUMBER
		<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>		

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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 AND

UTILTIY COST DATA

GENERAL 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 specification contains basic engineering data including utility cost information for utilities presently at the site. This specification shall be referred 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>Temperture °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 CLOSES ON ACTUATING MEDIUM FAILURE FO - VALVE OPENS ON ACTUATING MEDIUM FAILURE FCL-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

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PIPING SYMBOLS

REVISIONS	1	5/5/78	3
	2	7/19/78	6
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EXHIBIT I

PIPING SYMBOLS

ORIGINAL

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

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 HIGH TEMPERATURE B (HT)

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

A. Process Equipment Letter Designations

Description	Equipment Designation
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

Description	Equipment Designation
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

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REVISIONS

1
2
3
45/5/78
7/7/78
10/11/785
6
7
8CONTRACT
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Exhibit 4

EQUIPMENT SYMBOLS

ORIGINAL VERTICAL CANNED
PUMP
(MOTOR DRIVEN) VERTICAL IN-LINE
PUMP
(MOTOR DRIVEN) CENTRIFUGAL PUMP
(MOTOR DRIVEN) CENTRIFUGAL PUMP
(TURBINE DRIVEN) SUMP PUMP
(MOTOR DRIVEN) SUMP PUMP
(TURBINE DRIVEN) METERING PUMP
DIAPHRAGM TYPE
(MOTOR DRIVEN) METERING PUMP
PISTON TYPE
(MOTOR DRIVEN)

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)

EQUIPMENT SYMBOLS

PROJECT NO. 4814

ORIGINAL

SHELL AND TUBE
HEAT EXCHANGER

DOUBLE PIPE
HEAT EXCHANGER
(2-PASS)

PLATE COIL
HEAT EXCHANGER

HEAT EXCHANGER
(KETTLE TYPE)

RECIPROCATING COMPRESSOR
2 CYLINDERS/STAGE
(MOTOR DRIVEN)

RECIPROCATING COMPRESSOR
2 CYLINDERS/STAGE
(TURBINE DRIVEN)

2 STAGE RECIPROCATING COMPRESSOR
2 CYLINDER/STAGE
(MOTOR DRIVEN)

2 STAGE RECIPROCATING COMPRESSOR
2 CYLINDER/STAGE
(TURBINE DRIVEN)

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EQUIPMENT SYMBOLS

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

EQUIPMENT SYMBOLS

PROJECT NO. 4814

ORIGINAL

EXCHANGER
AIR FIN
(INDUCED DRAFT)

EXCHANGER
AIR FIN
(FORCED DRAFT)

HORIZONTAL
DRUM

DRUM (LIQUID
DRAFF)

TANK,
CONE-ROOF

HOPPER

PACKAGED TOWER

TOWER TRAY

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

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EQUIPMENT SYMBOLS

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EXHIBIT 8

EQUIPMENT SYMBOLS

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

CONVEYOR (BUCKET TYPE)
AGITATOR

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EQUIPMENT SYMBOLS

PIPING AND INSTRUMENT DIAGRAM ABBREVIATIONSGENERAL

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.....	GPCC

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Piping and Instrument Diagram Abbrev.

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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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Piping and Instruments Abbrev.

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Exhibit 12

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.

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Exhibit 13

MISCELLANEOUS SYMBOLS

PROCESS START POINT		ELECTROMAGNETIC 4/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 SYMBOLSA. FURNISHED EQUIPMENT B. FURNISHED INSTRUMENTS C. FURNISHED PIPING

D. FUTURE PIPING

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MISCELLANEOUS SYMBOLS

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EXHIBIT 15

PROCESS PLANT DESIGN
GENERAL 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 DESIGN

1.0 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

	FIRE RESIST. CONSTRUCTION WITH NON-COMB. CONTENTS	NON-COMB. CONSTRUCTION WITH NON-COMB. CONTENTS	ORD. CONSTRUCTION, IC & SIC WITH NON-COMB. CONTENTS	FIRE RESIST. CONSTRUCTION WITH COMB. CONTENTS	NON-COMB. CONSTRUCTION WITH COMB. CONTENTS	ORD. CONSTRUCTION WITH COMB. CONTENTS
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

ORIGINAL

MINIMUM DISTANCE
IN FEET

	SERVICE BUILDINGS	PROCESS UNITS	BOILERS, UTILITY & ELECT. GEN. EQUIP., ETC.	FIRE PROCESS HEATERS	PROCESS VESSELS, FRACT. EQUIP., ETC.	GAS COMPRESSOR HOUSES	OIL LARGE PUMP HOUSES	CONTROL HOUSES	COOLING TOWERS	CONTROLS FOR DROPOUT STEAM SHUFF & SPRAY	BLOWDOWN DRUMS & FLARE STACKS	PRODUCT STORAGE TANKS	RUNDOWN TANKS	BLENDING TANKS	HAZARDOUS LDG. & UNLOAD. FACILITIES, INCL. DOCKS	FIRE PUMPS	TURRET NOZZLES	FIRE HYDRANTS	FIRE EQUIP. HOUSES
Service Buildings	See Bldg. Chart															50 ¹ to 250	50 ¹ to 250	50 ¹ to 100	
Process Units	100	50 ³ to 100														50 ¹ to 100	50 ¹ to 250	100	
Boilers, Utility & Elect. Generating Equipment, etc.	100	100	—													50 ¹ to 100	50 ¹ to 250	100	
Fired Process Heaters	2 100	50 ³	100 ²	25 ³												50 ¹ to 100	50 ¹ to 250	100	
Process Vessels, Fractionating Equipment, etc.	100	—	100	50 ²	—											50 ¹ to 100	50 ¹ to 250	100	
Gas Compressor Houses	100	—	100	100 ²	30	See Bldg. Chart										50 ¹ to 250	50 ¹ to 250	100	
Large Oil Pump Houses	100	—	100	100 ²	20	30	See Bldg. Chart									50 ¹ to 250	50 ¹ to 250	100	
Control Houses *		—	100	50 ²	50	50	30	See Bldg. Chart								50 ¹ to 250	50 ¹ to 250	100	
Cooling Towers	50 ¹ to 100	100	100	100 ²	100	50 ¹ to 100	50 ¹ to 100	50 ¹ to 100	25 ¹ to 50							50 ¹ to 100	50 ¹ to 250	100 ¹ to 200	
Dropout Controls, Steam Snuffing, & Water Spray Controls	—	—	—	50 ²	50	50	20	See Note	50	—						—	—	—	
Blowdown Drums & Flare Stacks	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	
Product Storage Tanks	200	250 ⁴	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	
Rundown Tanks	100	200 ³	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	
Blending Tanks	200	200	200	200 ²	200	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	
Hazardous Loading & Unloading Facilities, Including Docks	200	200	200	200 ²	200	200	200	200	200	200	200	200 ⁸ to 300	250 ⁴	250 ⁴	250 ⁴	50 ¹ to 100	50 ¹ to 250	250	
Fire Pumps	50 ¹ to 100	250	0	250	250	100	100	—	—	—	300	300	300	300	300	—	—	—	

- Special consideration should be given to the installation of fire hydrants and turret nozzles.
- Small open flame devices should be located not less than 100' from any vapor-hazardous area.
- Between battery limits.
- Tanks over 10,000 bbls. capacity—250'; tanks less than 10,000 bbls. capacity—150'.
- Tanks with capacities in excess of 5000 bbls.—200'; tanks less than 5000 bbls.—100'.
- 25' to 50', considering area.
- Controls may be installed adjacent to or inside, to serve as a shield.
- Flare stacks less than 75' in height should be 300' distance; with stacks over 75' in height 200' distance.
- 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.
- Service buildings include: offices, change houses, maint. whses., cafeterias, labs., hospitals, garages, except as specifically provided for as indicated.
- 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.

MINIMUM DISTANCE
IN FEET

MINIMUM DISTANCE IN FEET		DISTANCE TO TARGETS																50 - 100 to Center of Target		For 100' Flare that is 25' above Surrounding Equipment, Use 300'		50 to 250		50 to 100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		PROCESS UNIT—HH	PROCESS UNIT—LH	TANK FARMS—HH	TANK FARMS—LH	PRODUCT WAREHOUSE	SHIPPING & RECEIVING—HH	SHIPPING & RECEIVING—LH	SERVICE BUILDINGS	BOILER AREA	FIRE PUMPS	EMERGENCY CONTROLS	TURNOUT CONTROLS	EMERGENCY FLARES	PILOT PLANTS	LARGE COOLING TOWERS	FIRE HYDRANTS													FIRED PROCESS HEATERS																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
Process Unit—	HIGH HAZARD ^a	200										250	100	50 ^s								200	150																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								</

- 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. Experimentals 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

[illegible]

*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.

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.

General Specification 275
EXHIBIT 3

OIL INSURANCE ASSOCIATION

General Recommendations for Spacing in Gasoline Plants

MINIMUM DISTANCE
IN FEET

[illegible]

Service buildings include: offices, laboratories, change houses, gate houses, shops, maintenance whses., garages, cafeterias, & hospitals.

Utilities include: boilers, power houses and water treating.

1. Where equipment is housed because of cold climate, a standard firewall should separate compressor and process equipment.
2. Maximum of 300,000 gallons per group; 100' between groups, or other suitable arrangements.
3. 50' for handling nonflammables, 100' for handling flammables.

Fire water systems, with locations of hydrants and valves, require special consideration.

4. More spacing may be required in unattended plants or in high-valued attended plants with complex control systems.

ORIGINAL

*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
Public Utility Natural Gas Pumping StationsMINIMUM DISTANCE
IN FEET

	COMPRESSOR HOUSES	GENERATOR BUILDINGS	SHOP BUILDINGS	OFFICE BUILDINGS	BOILER HOUSES	OPEN FLAME DEVICES	GAS METER OR GAS REGULATOR HOUSES	INCOMBUSTIBLE OR FIN FAN COOLERS (GAS)	GAS COOLING TOWERS WOOD OR WOOD FRAME CONST.	JACKET WATER COOLING TOWERS	WAREHOUSES	MAIN-LINE VALVES	REMOTE CONTROL SHUTDOWN STATIONS	MAIN LINES	CAMP BUILDINGS, DWELLINGS, AUTOMOBILE GARAGES, ETC.	ALONG THE LINE PROPERTIES, P/L WISES, GAS DEMO, ETC.	ORDINARY ELECTRICAL EQUIPMENT	TURRET NOZZLES	FIRE EQUIPMENT HOUSES	FIRE HYDRANTS
Compressor Houses	— ⁴														100 ³		50 to 100	50 to 100		
Generator Buildings	100 ³	— ⁴													—		50 to 100	50 to 100		
Shop Buildings	100 ³	30 ⁴	— ⁴												—		50 to 100	50 to 100		
Office Buildings	100 ³	30 ⁴	30 ⁴	— ⁴											—		50 to 100	50 to 100		
Boiler Houses	100 ³	30 ⁴	30 ⁴	30 ⁴	— ⁴										—		50 to 100	50 to 100		
Open Flame Devices	SEE NOTE					NO. 5									—		50 to 100	50 to 100		
Gas Meter or Gas Regulator Houses	100	100	100	100	100	SEE NOTE NO. 5					— ⁴				100 ³		50 to 100	50 to 100		
Incombustible or Fin Fan Coolers (Gas)	100	100	100	100	100	SEE NOTE NO. 5					40 ⁴	—			100 ³		50 to 100	50 to 100		
Gas Cooling Towers Wood or Wood Frame Const.	100	100	100	100	100	SEE NOTE NO. 5					100	100	—		100 ³		50 to 100	50 to 100		
Jacket Water Cooling Towers	50 ⁴	30 ⁴	30 ⁴	30 ⁴	30 ⁴	50 ⁴	40 ⁴	40 ⁴	50	— ⁴					50		50 to 100	50 to 100		
Warehouses	100 ³	30 ⁴	30 ⁴	30 ⁴	30 ⁴	—	30 ⁴	30 ⁴	30 ⁴	30 ⁴	— ⁴				—		50 to 100	50 to 100		
Main-Line Valves	Main-Line Power Operated Valves with (RCS) Should be Located 350' from All Station Buildings										See Note No. 2				100 ³		100	100		
Remote Control Shutdown Stations	SEE NOTE NO. 1										—				— ³		—	—		
Main Lines	350 ³	350 ³	350 ³	350 ³	350 ³	See Note No. 3	350 ³	350 ³	350 ³	350 ³	350 ³	— ³	250 ¹	—	100 ³		100	100		
Product Storage Tanks	200	200	200	200	200	200	200	200	200	200	200	500 to 1000	500 to 1000	200	200	100	100	100		

1. There should be a minimum of two (2) remote control stations to actuate the main line power operated valves. One (RCS) should be located 250 feet or more from any gas pumping bldg., and 250 feet or more from any gas line. The 2nd (RCS) should be located 250 feet or more from the other (RCS) and/or any gas line or gas pumping bldg., or shielded by topography or structures so as to be accessible at all times.

2. Power operated valves with no remote control stations and manually operated valves on main suction and/or discharge lines should be located not less than 500 feet but not over 1000 feet from any station building.

3. Main lines when equipped with other than power operated valves with (RCS) should be located not less than 500 feet but not over 1000 feet from any station building.

4. Distances indicated are for buildings or structures of incombustible construction. If otherwise consult your Insurance Underwriters.

5. All open flame devices and/or ordinary elect. equip. should be located 100 feet from any gas vapor hazard area, gas line or gas pumping building.

6. Often elect. gen. equip., gas turbines, etc. are housed in the same building with gas compressors. In such instances, you should consult your Insurance Underwriters concerning the standards for the installation of this equipment.

OIL PUMP STATIONS,
OIL TERMINALS AND
OFF SHORE PROPERTIES

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

ORIGINAL

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

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/24/78

REV:

ORIGINAL
0

McKEE
ENGINEERS AND CONSTRUCTORS

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

DESIGN DATA SUMMARY

PUMPS

MAT'L HDLG.-01

[illegible]

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

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/24/78

REV: 010111A.

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

DESIGN DATA SUMMARY

PUMPS

SULFUR REMOVAL-03

[illegible]

COAL GASIFICATION PROJECT

DATE: 10/24/78

REV: ORIGINAL
0

McKee
ENGINEERS AND CONSTRUCTORS

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

DESIGN DATA SUMMARY

WASTE TREATMENT -05

PUMPS

WASTE TREATMENT 05

[illegible]

ORIGINAL

McKEE
ENGINEERS AND CONSTRUCTORS

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

DESIGN DATA SUMMARY

PUMPS

UTILITIES -06

[illegible]

McKee
ENGINEERS AND CONSTRUCTORS

LOCATION: HOYT LAKES, MINNESOTA
ERIE MINING COMPANY,
UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

REF.: 0 ORIG. 1

TANKS

[illegible]

ORIGINAL

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

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/25/78

REV: 0

McClure ENGINEERS AND CONSTRUCTORS		LOCATION: HOYT LAKES, MINNESOTA ERIE MINING COMPANY					DESIGN DATA SUMMARY			TANKS
		UNIT or PROJECT: DEMONSTRATION								REMARKS
ITEM NUMBER	SERVICE	SPEC. GRAV.	CAPACITY		DIAMETER FT.	HEIGHT FT.	CORR. ALLOW. IN.	MATERIAL	ROOF TYPE	
			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-313	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-332	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

ET-78-C-01-2578

COAL GASIFICATION PROJECT

CONTRACT NO.: NC-4814

DATE: 10/25/78

ORIGINAL

REV: 0

LOCATION:

HOYT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT:

DEMONSTRATION

DESIGN DATA SUMMARY

TANKS

[illegible]

ET-78-C-01-2578

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/25/78

REV.: 0 OK DAL

LOCATION: HOYT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

VESSELS

Gasification - 02

[illegible]

REV.: 0 ORIGINAL

VESSELS

Waste Treatment - 05

[illegible]

CRIMINAL

Utilities - 06

[illegible]

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/25/78

REV.: 5

LOCATION:

HOYT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

VESSELS

Safety System - 07

[illegible]

COAL GASIFICATION PROJECT

DATE: 10/25/78

LOCATION: HOYT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

EXCHANGER SUMMARY

Gasification - 02

ITEM NO.	SERVICE	POSITION	TYPE OF CONSTRUCTION	NO. OF SHELLS	ARRANGEMENT OF SHELLS	DUTY BTU/HR.	SURFACE SQ. FT.	CORRECTED MTD, °F.	OVERALL HEAT TRANSFER COEFF.	SIDE	FOULING FACTOR	DESIGN TEMP, °F.	PRESSURE, P.S.I.G.			NO. OF PASSES	MATERIALS	NOMINAL SHELL DIAMETER	TUBES					REMARKS		ITEM NO.
													OPERATING	DESIGN	TEST				O.D. & BWG	NO. PER SHELL	LENGTH	PITCH	STANDARD			
																							CODE			
E-201A thru E						5,220,000				SHELL		370	130-135	150		Carbon Steel		1.5' Min		10'-0"				E-20		
										TUBE		±1.6						10								
										SHELL																
										TUBE																
										SHELL																
										TUBE																
E-202A, B and C										SHELL						Carbon Steel		1"						E-20		
										TUBE						Carbon Steel		17			Sq.					
										SHELL																
										TUBE																
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										TUBE																

COAL GASIFICATION PROJECT

CONTRACT NO.: MC-4814

DATE: 10/25/78

REV: 0 ORIGINAL

McKee
ENGINEERS AND CONSTRUCTORS

LOCATION: HOTT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

EXCHANGER SUMMARY

Sulfur Removal - 03

[illegible]

REV: 06. 4AL
0[illegible]

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

COAL GASIFICATION PROJECT

CONTRACT NO.: NC-4814

DATE: 10/25/78

ORIGINAL

REV: 0

McKee
ENGINEERS AND CONSTRUCTORSLOCATION: HOYT LAKES, MINNESOTA
ERIE MINING COMPANY

UNIT or PROJECT: DEMONSTRATION

DESIGN DATA SUMMARY

EXCHANGER SUMMARY

Utilities - 06

ITEM NO.	SERVICE	POSITION	TYPE OF CONSTRUCTION	NO. OF SHELLS	ARRANGEMENT OF SHELLS	DUTY BTU/HR.	SURFACE SQ. FT.	CORRECTED MTD. °F.	OVERALL HEAT TRANSFER COEFF.	SIDE	FOULING FACTOR	PRESSURE, P.S.I.G.			NO. OF PASSES	MATERIALS	NOMINAL SHELL DIAMETER	O.D. & B.W.G.	NO. PER SHELL	LENGTH	PITCH	REMARKS		ITEM NO.
												OPERATING	DESIGN	TEST							STANDARD	CODE		
E-604	Bunker "C" Heater					848,750				SHELL	.0003	400	125	150		Car. Steel								
										TUBE	.005	300	250	275		Car. Steel								
E-605	Tar/Oil Heater					462,500				SHELL	.0003	400	125	150		Car. Steel							E-604	
										TUBE	.005	250	250	275		Car. Steel							E-605	
E-609	Stretford Cond. Cooler					212,500				SHELL	.003	150	80	100		Car. Steel							E-609	
										TUBE	.001	250	100	150		Car. Steel								
										SHELL														
										TUBE														
										SHELL														
E-601	Inert Gas Generator Aftercooler									SHELL														
										TUBE											By X-601 Vendor		E-601	
E-602	Inert Gas Compressor Aftercooler									SHELL											By C-601 Vendor		E-602	
										TUBE														
E-603	Liquified Nitrogen Vaporizer									SHELL											By X-608 Vendor		E-603	
E-606	Inert Gas Compressor Intercooler									SHELL											By C-601 Vendor		E-606	
										TUBE														
E-607	Instrument & Plant Air Intercoolers									SHELL											By C-602 Vendor		E-607	
A/B										TUBE														
E-608	Instrument & Plant Air Aftercoolers									SHELL											By C-602 Vendor		A/B	
A/B										TUBE														
E-610	Bunker C Tank Heater									SHELL											By TK-605 Vendor		E-608	
										TUBE													A/B	
E-611	Tar/Oil Tank Heater									SHELL											By TK-606 Vendor		E-610	
										TUBE														
										SHELL														
										TUBE														
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[illegible]

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

4814-Y
01-05-2

ASSUMED MATERIAL BALANCE

NOTE: QUANTITIES SHOWN ARE AVERAGE FLOW RATES

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-01-05-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. P.E. NO. SCALE NONE REVISION 1
MATERIALS HANDLING DEMONSTRATION UNIT BLOCK FLOW DIAGRAM- WESTERN COAL	

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

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814-Y-OI-06-2
CLEVELAND, OHIO	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES, MINNESOTA	PROJECT NO. _____ P. E. NO. _____ SCALE NONE
MATERIALS HANDLING P.F.D. DEMONSTRATION UNIT COAL HANDLING AND PREPARATION	REVISION 1

BN 201 A TO F COAL SURGE HOPPER CAPACITY 66 TONS C.S. LINED
D 201 A TO E LP STEAM DRUM 4'6" I.D. X 11'6" T.T. C.S.
MF 202 A TO E COAL FEEDER 83 TONS/HR.
MF 201 A TO E LOCK HOPPER CAPACITY 690* C.S.
A 201 A TO E STIRRER
R 201 A TO E GASIFIER 12'0" I.D. X 47' HT.
X 206 A TO C FLARE STACK
CY 201 A TO E DUST CYCLONE

DATE	BY	CHK	DESCRIPTION	APP.
12/21/78			ISSUE FOR CLIENT REVIEW	A. J. W.

- NOTES**
- 1. BAROMETRIC PRESSURE 13.9 PSIA
 - 2. LINE PRESSURE IS AT LINE ORIGIN
 - 3. PLANT OUTPUT 7.4 X 10⁹ BTU/DAY GAS WITH FOUR GASIFIERS IN OPERATION.
 - 4. ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 5. ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60°F
 - 6. STANDARD MOLAR GAS VOLUME IS 378.5 FT³

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P005 ISSUE NO. 0
FOR CLIENT REVIEW SIGNED *[Signature]* DATE 12/21/78

CRITERIA	1	2	3	4	5	6	7	8	9	10	31
STREAM IDENTIFICATION	COAL FEED	AIR	STM. PRODUCED	BLAST	BALANCE STM.	L.P. S.F.W.	CLEAR GAS	TOP GAS	DUST	ASH	LP BLOW DOWN
MOISTURE FREE COAL	32868										
ASH/CHAR/DUST									101	3975	
TAR/OIL											
CARBON MONOXIDE											
CARBON DIOXIDE											
HYDROGEN											
NITROGEN		57330	2048		57330	2048					
METHANE											
C ₂ TO C ₆											
HYDROGEN SULFIDE											
CARBONYL SULFIDE											
AMMONIA											
HYDROGEN CYANIDE											
OXYGEN		17435	545		17435	545					
CHLORIDE											
WATER	11310	747	41.5	13200	733	14592	810	647	35.9	14520	806.7
TOTAL	44178	75512	26345	13200	733	89357	3403	647	35.9	14520	806.7
MM SCFD											
USGPM											
PRESSURE PSIG OR * H ₂ O G.	0	23.8		25 PSIG	30.9	60	25 PSIG	25 PSIG	30.25	13.01	38.76
TEMPERATURE °F	60	60		267	147	60	267	210	1060	40	38.76
DENSITY LB./FT. ³		0.0718		0.0952	0.0692		0.0952	59	0.0200	0.0439	250
ENTHALPY MM BTU/HR.	388.0	0		15.0	17.6		0.735	2.17	92.4	285	0.71

COAL FEED ANALYSIS	
MOISTURE	25.60
C	50.74
H	3.53
N	0.87
Cl	0.01
S	0.87
O	10.11
ASH	8.27
HHV	8725 BTU
TAR/OIL ANALYSIS	
C	88.23
H	6.71
N	0.81
Cl	0.00
S	1.38
O	3.06
	100.00

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 **McKEE** ENGINEERS AND ARCHITECTS
CLEVELAND, OHIO
DATE 12/21/78
SHEET 1 OF 2
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
GASIFICATION DEMONSTRATION UNIT
P.F.D. WEST COAL
PROJECT NO. 3001
P.E. NO. 4814Y-02-05-2
REVISION *[Signature]*

STREAM IDENTIFICATION		1		2		3		4		5		6		7		8		9		10		11		31		COAL FEED ANALYSIS				
↓ CRITERIA →		COAL FEED		AIR		STM. PRODUCED		BLAST		BALANCE STM		L.P. B.F.W.		CLEAR GAS		TOP GAS		DUST		ASH		STRET FORD REC		LP BLOW DOWN						
		#/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		35024																										MOISTURE	4.3	
ASH/CHAR/DUST																		84		3818								C	71.21	
TAR/OIL																												H	5.05	
CARBON MONOXIDE								11.7	0.42														11.7	0.42				N	1.13	
CARBON DIOXIDE								102	2.32														102	2.32				Cl	0.07	
HYDROGEN								0.7	0.37														0.7	0.37				S	3.33	
NITROGEN				56042	2001.4			65873	2352.5														9831	351.1				O	5.30	
METHANE																												ASH	9.61	
C2 TO C8																													100.0	
HYDROGEN SULFIDE																												HHV	12.97	
CARBONYL SULFIDE																														
AMMONIA																														
HYDROGEN CYANIDE																														
OXYGEN				17025	532.0			19487	609.0														2462	77						
CHLORIDE																														
WATER		1574		731	40.6	13200	733	12794	710.4	1740	95.7	14520	807.0					842				603	33.5	1320	73.5				TAR/OIL ANALYSIS	
TOTAL		36598		73798	2574.0	98269	3675.0	1740	95.7	14520	807.0							926		3818		13010	464.7	1320	73.5				C	84.11
MM SCFD				2338		6.65		33.53		3.38		30.25	30.88		17.47							4.22		2.8					Cl	0.00
PRESSURE PSIG OR "H2O G		0		0		25PSIG		60"		25PSIG		25PSIG		40"		30"						80"		25PSIG					S	2.64
TEMPERATURE °F		60		60		267		140		267		210		1140		250		1202		140		60		267					O	2.90
DENSITY LB/FT³				0.0718		0.0719		0.0788		0.0719		59		0.0219		0.0485						0.0885		58.8						100.00
ENTHALPY MM BTU/HR		474.9		0.768		150		16.3		0.20		2.80		217.3		246.4		0.57		4.61			0.3							

DATE	BY	CHK	DESCRIPTION	APP
12/21/78			ISSUE FOR CLIENT REVIEW	

BN 108
STORAGE HOPPER
(BY OTHERS)

BN 203 A TO C
DUST BIN

TO ITEM
NO CY 202

TO ITEM NO. E 201

BN 108
(BY OTHERS)

CO 204

10

9

BABCOCK CONTRACTORS INC.

PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

PROJECT NO. 3001

DRAWING NO. P 007

ISSUE NO. 0

FOR CLIENT REVIEW

SIGNED

J. P. T. A.

DATE

12/21/78

DATE	BY	CHK	DESCRIPTION	APP
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 7.4 X 10⁹ BTU/DAY GAS WITH FOUR GASIFIERS IN OPERATION
 - 4 ALL EQUIPMENT CAPACITIES FOR ONE ITEM
 - 5 ENTHALPY IS HHV PLUS SENSIBLE HEAT ABOVE 60° F
 - 6 STANDARD MOLAR GAS VOLUME IS 378.5 FT³

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P008 ISSUE NO. 0
FOR CLIENT REVIEW SIGNED *[Signature]* DATE 12/21/78

CRITERIA	STREAM IDENTIFICATION		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	#/HR	MOL/HR
MOISTURE FREE COAL																										
ASH/CHAR/DUST																										
TAR/OIL																										
CARBON MONOXIDE																										
CARBON DIOXIDE																										
HYDROGEN																										
NITROGEN																										
METHANE																										
C ₂ TO C ₈																										
HYDROGEN SULFIDE																										
CARBONYL SULFIDE																										
AMMONIA																										
HYDROGEN CYANIDE																										
OXYGEN																										
CHLORIDE																										
WATER																										
TOTAL																										
MM SCFD	USGPM																									
PRESSURE	PSIG OR " H ₂ O G																									
TEMPERATURE	°F																									
DENSITY	LB/FT ³																									
ENTHALPY	MM BTU/HR																									

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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-02-08-2
SHEET 2 OF 2

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

PROJECT NO. 3001
PROCESS ENGINEERING
APPROVAL
BY: *[Signature]* DATE: 12/21/78

GASIFICATION
DEMONSTRATION UNIT
P.F.D. EAST COAL

REVISION *[Signature]*

STREAM COMPOSITION	1 AQUEOUS WASTE		2 VAPOR TO GAS PRODUCT LINE		3 LIQUID TO INCINERATOR		4 TAR/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														1.0	0.01			
TAR/OIL							546	—										
PHENOL	4.0	0.04	2.8	0.03	1.2	0.01												
CARBON DIOXIDE	43.7	0.99	43.7	0.99	—	—							1,648	37.5				
HYDROGEN SULFIDE	2.2	0.06	2.2	0.06	—	—												
AMMONIA	41.5	2.44	36.2	2.13	5.3	0.31												
HYDROGEN CYANIDE	3.2	0.12	3.2	0.12	—	—												
CHLORIDE	4.4	0.12	—	—	4.4	0.12							4.4	0.12				
WATER	11,507	639.3	9,221	512.3	2286	127.0			136	7.5	84.1	4.67	2,977	165.4	6,556	363.9	6,244	346.6
SULFUR DIOXIDE	3.4	0.05	—	—	3.4	0.05							7.8	0.12				
NITROGEN												6,554	234.1	6,559	234.2			
OXYGEN												1,978	61.8	395	12.34			
NO _x (AS NO ₂)													6.21	300.PPM				
TOTAL	11,609	643.1	9,309	515.6	2,300	127.5	546	—	136	7.5	8,616	300.6	11,598	449.8	6,556	363.9	6,244	346.6
US GPM / MMSCFD	23.3			4.69	4.9		1.0			0.07		2.73		4.09		13.7		3.16
PRESSURE, PSIG			12.2		250				125		-0.5		0				125	
TEMPERATURE, °F	95		250		250		175		353		70		650		220		353	
DENSITY, LB/FT ³	62.1		0.619		58.8		65.5		0.3106		0.0679		0.0301		59.6		0.3106	

REVISION /

[illegible]

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
TARSH													0.034	0.00				
TAR/OIL							85.2	—										
PHENOL																		
CARBON DIOXIDE	1.6	0.04	1.6	0.04									26.5	6.03				
HYDROGEN SULFIDE	9.0	0.26	9.0	0.26														
AMMONIA	17.0	1.00	3.5	0.21	13.5	0.79												
HYDROGEN CYANIDE																		
CHLORIDE	26.0	0.74			26	0.74							26	0.74				
WATER	1,572	87.3	1,257	69.8	315	17.5			21.2	1.18	15.4	0.86	460	23.5	1025	56.9	974	74.1
SULFUR DIOXIDE	3.4	0.05			3.4	0.05							5.1	0.08				
NITROGEN											1,196	42.7	1,207	43.1				
OXYGEN											361	11.3	72.2	2.26				
NO _x (AS NO ₂)													1.1	300 PPM				
TOTAL	1,629	89.4	1,271	70.3	358	19.1	85.2	—	21.2	1.18	1,572	54.9	2,036	77.7	1025	56.9	974	74.1
US GPM/MMSCFD	3.3			0.64	0.8		0.2			0.01		0.90		0.71	2.1			0.49
PRESSURE, PSIG			12.2						125		-0.5		0				125	
TEMPERATURE, °F	95		250		250		175		373		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:

1. ASSUMED FUEL OIL COMPOSITION IS AS FOLLOWS:

	WT. %
C	84.95
H	11.10
O	0.06
N	0.71
SI	1.00
ASH	0.04
MOISTURE	1.60
	<u>100.00</u>

HHV: 16,400 BTU/#

2. 6-302 MAY OR MAY NOT BE SUPPLIED BY THE INCINERATOR VENDOR.

3. ALL RATES LISTED ARE CONTINUOUS AVERAGES OF INTERMITTENT FLOWS. TO OBTAIN INTERMITTENT FLOW RATES, MULTIPLY ALL RATES ON THIS PAGE (EXCEPT PUMP DESIGN RATES) BY 6.425 (BASED ON 768 DAYS/YR OPERATION)

<h1 style="margin: 0;">U. S. DEPARTMENT OF ENERGY</h1> <h2 style="margin: 0;">FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>							
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578							
PREPARED BY <div style="text-align: center; font-weight: bold; font-size: 1.2em;">McKee</div> <small>ENGINEERS AND CONSTRUCTORS</small> CLEVELAND _____ OHIO	4814-Y-05-02-2 SHEET 2 OF 2						
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; padding: 2px;">PROJECT NO.</td> <td style="width: 50%; padding: 2px;">P. E. NO.</td> </tr> <tr> <td colspan="2" style="text-align: center; padding: 2px;">SCALE</td> </tr> <tr> <td colspan="2" style="height: 40px;"></td> </tr> </table>	PROJECT NO.	P. E. NO.	SCALE			
PROJECT NO.	P. E. NO.						
SCALE							
WASTE TREATMENT DEMONSTRATION UNIT WASTEWATER FACILITIES (PFD) EAST COAL							
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 80%; padding: 2px;">REVISION</td> <td style="width: 20%; text-align: center; padding: 2px;"> <div style="border: 1px solid black; width: 30px; height: 30px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 10px; height: 10px;"></div> </div> </td> </tr> </table>		REVISION	<div style="border: 1px solid black; width: 30px; height: 30px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 10px; height: 10px;"></div> </div>				
REVISION	<div style="border: 1px solid black; width: 30px; height: 30px; margin: 0 auto; display: flex; align-items: center; justify-content: center;"> <div style="border-top: 1px solid black; border-bottom: 1px solid black; width: 10px; height: 10px;"></div> </div>						

[illegible]

DRAWING NO.
4814-Y
06-01-2

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	
PREPARED BY	McKee ENGINEERS AND CONSTRUCTORS
CLEVELAND	OHIO
PROJECT NO.	4814-Y-06-01-2
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO.	MANAGING AGENT
HOYT LAKES	MINNESOTA
UTILITIES	SCALE
DEMONSTRATION UNIT	NONE
COOLING WATER FLOW DIAGRAM	REVISION 1

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

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

ALL FLOW RATES ARE APPROXIMATE BASED ON CURRENT BEST DATA

U. S. DEPARTMENT OF ENERGY			
FUEL GAS DEMONSTRATION PLANT PROGRAM			
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578			
PREPARED BY		McKee	
CLEVELAND		OHIO	
FOR ERIE MINING COMPANY		PROJECT NO. 4814-Y-06-02-2	
PICKANDS MATHER AND CO. HOYT LAKES		MANAGING AGENT MINNESOTA	
UTILITIES BLOCK FLOW DIAGRAM		REVISION 1	
DEMONSTRATION UNIT			
INERT GAS AND NITROGEN			

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

SCALING RULES

4814-Y-06-042

U. S. DEPARTMENT OF ENERGY			
FUEL GAS DEMONSTRATION PLANT PROGRAM			
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578			
PREPARED BY		McKee	
CLEVELAND		OHIO	
PROJECT NO.		4814-Y-06-042	
FOR ERIE MINING COMPANY		MANAGING AGENT	
PICKANDS MATHER AND CO.		HOYT LAKES MINNESOTA	
UTILITIES		REVISION 1	
DEMONSTRATION UNIT			
PLANT AND INSTRUMENT AIR FLOW			

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

ISSUED FOR ESTIMATING

DEMONSTRATION UNIT FLOW RATES

STREAM NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
STREAM NAME	RAW WATER TO TREATMENT	HIGH PRES. BFW	50 PSIG DESH PERHEATING NTE	BFW TO PACKAGED BOILERS	BFW TO WASTE HEAT BOILERS	BFW TO INCINERATOR	BLOWDOWN FROM PACK. BOILERS	BLOWDOWN FROM WASTE HT. BLR.	BLOWDOWN FROM INCINERATOR	125 PSIG STM FROM PACK. BOILERS	125 PSIG STM FROM WASTE HT. BOILERS	125 PSIG STM FROM INCINERATOR	STEAM TO 50 PSIG REDUCER	STEAM TO 25 PSIG REDUCER
NOTE 1 EAST COAL LB/HR	37,000	27,385	50	4,200	22,110	1,025	210	2010	55	3,990	20,100	970	4,950	1,000
NOTE 1 WEST COAL LB/HR	34,120	31,490	0	15,580	9,360	6,560	780	850	320	14,800	8,500	6,240	0	1,700
NOTE 2 MAX. OPER. LB/HR	71,320	71,440	0	42,770	22,110	6,560	2140	2010	320	40,620	20,100	6,240	0	5,600

(NOTE 2)

(NOTE 2)

STREAM NO.	15	16	17	18	19	20	21	22	23	24	25	26	27	28
STREAM NAME	AREAS 04-07 PROC. HEATING	GASIFIER RODDING STEAM	WASTE WATER EVAPORATOR STM	BUILDING HEATING STEAM	COND. FROM AREA 05	50 PSIG PROC. STEAM TO AREA 05	RETURNED CONDENSATE	LOW PRES. BFW TO GASIFIERS	STRETTFORD PROC. WATER	25 PSIG TO/FROM GASIFIERS	BLOWDOWN FROM GASIFIERS	25 PSIG STM TO DEAERATOR	WASTE FROM BFW TREATMENT	DEAERATOR VENT
NOTE 1 EAST COAL LB/HR	625	150	1,670	14,950	1,650	5000	15,725	14,520	1,500	(1870) EXPORT	726	1870	11,100	95
NOTE 1 WEST COAL LB/HR	625	150	12,120	14,950	12,100	0	21,175	14,520	0	650 IMPORT	726	1000	10,235	50
NOTE 2 MAX. OPER. LB/HR	1500	300	12,120	35,850	12,100	0	33,850	14,520	0	3300 IMPORT	726	2300	21,395	115

(NOTE 2)

(NOTE 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

CLEVELAND

OHIO

4814-Y-06-06-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. HOYT LAKES

MANAGING AGENT MINNESOTA

UTILITIES BLOCK FLOW DIAGRAM
DEMONSTRATION PLANT

STEAM, BOILER FEEDWATER, AND CONDENSATE

PROJECT NO. P.E. NO.

SCALE

REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.
11-15-78	M.R. W.B.		GENERAL REVISION	
7-27-78	D.M. RA		ISSUED FOR ESTIMATE

NOTE 2
NOTE 2
NOTE 1

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2> <h3>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578</h3>							
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-06-07-2						
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P.E. NO.</td> </tr> <tr> <td colspan="2">SCALE</td> </tr> <tr> <td colspan="2"> REVISION 2 </td> </tr> </table>	PROJECT NO.	P.E. NO.	SCALE		REVISION 2	
PROJECT NO.	P.E. NO.						
SCALE							
REVISION 2

<h1>U. S. DEPARTMENT OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</p>	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-06-09-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE _____
UTILITIES DEMONSTRATION UNIT SETTLING POND BLOCK FLOW DIAGRAM P&ID	REVISION 1

INSTRUMENT IDENTIFICATION					
	FIRST LETTER		SUGGESTED LETTERS		
	MEASURED/ INITIATING VARIABLE	MODIFIER	MEASUREMENT/ PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
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	GASING (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	RADIO ACTIVITY		RECORD/PRINT		
S	SPEED/ FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VISCOSITY			VALVE DAMPER/ LOWWER	
W	WEIGHT/FORCE		WELL		
X					
Y				RELAY/COMPUTE	
Z	POSITION			DRIVE ACTUATE/ UNCLASSIFIED FINAL CONTROL ELEMENT	

[illegible]

	DATE	DY	CORR.	DESCRIPTION	APP.		DATE	DY	CORR.	DESCRIPTION	APP.		DATE	DY	CORR.	DESCRIPTION	APP.					
REVISIONS: ▲ ▲ ▲ ▲ ▲ ▲						REVISIONS: ▲ ▲ ▲ ▲ ▲ ▲ ▲						REVISIONS: ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲										
													A-10-24-79 MS ISSUED FOR APPROVAL									

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY McKee BUSINESS AND CONSTRUCTORS	4814-Y-00-09-2
CLEVELAND OHIO	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ SCALE NONE
COAL GASIFICATION PLANT; DEMONSTRATION UNIT; P. & I. LEGEND	REVISION 0

DRAWING NO.
4814-X-00-01-2

a) 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 LOCOMOTIVE'S SPOTTING THE FIRST TWO CARS OF EACH TRAIN FOR DUMPING. AUTOMATIC DUMPER AND POSITIONER CYCLE TIME IS 2 MINUTES FOR ONE CAR.

- b.) 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

- C.) THAW AND UNLOAD FROZEN COAL AT A RATE OF 5 CARS PER HOUR CARS WITH ROTARY COUPLER OR RANDOM LENGTH AND RANDOM WIDTH.

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.

LEVEL TRACK T.R. EL. 1560' (5940' APPROX. LENGTH)

SCALE: HORIZONTAL $1'' = 600'$
VERTICAL $1'' = 20'$

TRAIN MOVEMENT DIAGRAM

UNIT TRAIN WITH ROTARY COUPLERS

PLAN
N° 200

WORK THIS DRAWING WITH ERIE
MINING CO. DNG. TH-5-001
(MODIFIED CURVE & GRADE)

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY	McKee
-------------	-------

MRKG

CLEVELAND	OHIO
-----------	------

508	ERIE MINING COMPANY.	PROJECT NO.	P. E. NO.
-----	----------------------	-------------	-----------

FOR THE LEBANON MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT AS NOTED

HOYT LAKES	MINNESOTA
------------	-----------

COAL GASIFICATION. REVISION

DEMONSTRATION UNIT

TRACK PLAN AND PROFILE	
------------------------	--

8 1 9 10

[illegible]

DRAWING NO.
4814-X-00-03-2

SECTION A-A (MCKEE DNG X-00- 2-2)
LOOKING SOUTH

~~SECTION A-B (MC REF DMS. X-00-02-2)~~
LOOKING WEST

GASIFICATION PLANT.
CUT - 582,200 CU.YD.
FILL - 681,200 CU.YD.

[illegible]

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-0-01-2678</p>	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814-X-00-03-2
CLEVELAND OHIO	PROJECT NO. _____ P.E. NO. _____ SCALE 1" = 100'-0" REVISION
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
COAL GASIFICATION DEMONSTRATION UNIT PLANT AREA PROFILES	

4814-X-00-05-2

E

D

C

B

A

F

E

D

C

B

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
11-29-78	SK	TG	REVISED AREAS AS NOTED		8-11-78	ER		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		PROJECT NO. 4814-X-00-05-2 P.E. NO.
PREPARED BY McKEE ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO		SCALE 1" = 30' 0"
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		REVISION 1
COAL GASIFICATION DEMONSTRATION UNIT PLAN OF PLANT

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

484-X-01-C6-2

PROJECT NO.

P.E. NO.

FOR

ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

MATERIAL HANDLING

DEMONSTRATION UNIT

CONVEYOR ELEVATIONS

SCALE

1"=30'-0"

REVISION

1

DATE	BY	CHK	DESCRIPTION	APP.
11-21-78	KH	TG	TRANSFER STATION WAS CRUSHER STATION. RELOCATED CRUSHER TO SCREENING STATION. BN-104 WAS A REQD. HEAD PULLEY W.P. ON CO-104 WAS 1518'-8". REMOVED HEATING AND INSULATION FROM CO-102 AND CO-103 ISSUED FOR ESTIMATING	

DATE	BY	CHK	DESCRIPTION	APP.

DATE	BY	CHK	DESCRIPTION	APP.

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

DRAWING NO.

2077096

BUILDING TO BE INSULATED AND HEATED

2 DELETED
OVERHEAD CRANE

GAS DISCHARGE
TYPE

MANUAL OPERATED
LOUVERS
(774)

RELIGION

[illegible]

4814-X-05-01-2

PLAN VIEW

SECTION A-A

SECTION B-B

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

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

U. S. DEPARTMENT OF ENERGY		PROJECT NO. 4814-X-05-01-2	
FUEL GAS DEMONSTRATION PLANT PROGRAM		P.E. NO.	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578		SCALE 1/8" = 1'-0"	
PREPARED BY McKee		REVISION 1	
ENGINEERS AND CONSTRUCTORS			
CLEVELAND OHIO			
FOR ERIE MINING COMPANY			
PICKANDS MATHER AND CO. MANAGING AGENT			
HOYT LAKES MINNESOTA			
WASTE TREATMENT DEMONSTRATION UNIT			
INCINERATOR BUILDING			

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

10-3-78 MS TG BOILER & INCINERATOR UNIT RELOCATED.
KH ISSUED FOR ESTIMATING

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814X-06-03-2
CLEVELAND OHIO	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE _____
UTILITIES DEMONSTRATION UNIT PUMP HOUSE & SETTLING POND	REVISION

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814-X-09-01-2
CLEVELAND _____ OHIO	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES _____ MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE $\frac{1}{8}'' = 12''$
<u>EMPLOYEE FACILITIES</u> <u>DEMONSTRATION UNIT</u> <u>ARRANGEMENT</u>	REVISION 1

4814-S-01-01-2

NOTE:
FOR EQUIPMENT DESIGN & FABRICATION REQUIREMENTS SEE A.G. MCKEE & CO. DUST & FUME COLLECTION GENERAL SPECIFICATION NO. 1000 SERIES.

WORK THIS DWG. WITH DWG. 4814-S-01-02-2

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-01-01-2
FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA
COAL GASIFICATION DEMONSTRATION COAL HANDLING UNIT DUST FLOW DIAGRAMS
REVISION 1

DATE	BY	CHK	DESCRIPTION	APP.
11/11/78	JK		GENERAL REVISION-ISSUED FOR ESTIMATE	
8/15/78	TJ		FOR ESTIMATE	
5/23/78	TJ		FOR APPROVAL	

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>									
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578									
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814-Y-01-10-2								
CLEVELAND OHIO	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P.E. NO.</td> </tr> <tr> <td colspan="2">SCALE</td> </tr> <tr> <td colspan="2">NONE</td> </tr> <tr> <td colspan="2"> REVISION 3 </td> </tr> </table>	PROJECT NO.	P.E. NO.	SCALE		NONE		REVISION 3	
PROJECT NO.	P.E. NO.								
SCALE									
NONE									
REVISION 3									
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA									
MATERIALS HANDLING P. & I. D. DEMO. UNIT COAL UNLOADING STATION									

FOR ERIE MINING COMPANY PICKLANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO.	P.E. NO.
	SCALE NONE	
MATERIALS HANDLING P. & I.D. DEMO UNIT COAL STORAGE	REVISION 2	

DRAWING NO.
4814-Y-01-12-2

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

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-01-12-2

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

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

REVISIONS

9-25-78 MS ~~MS~~ WAS CRUSHER STATION
8-7-78 KH ISSUED FOR ESTIMATING

CT

1

TC-101
TRIPPER CAR

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

WS-103
BELT SCALE

CO-107
GASIFIER FEED
TRIPPER CONVEYOR

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10-24-78	MS	TG	REVISED AS CIRCLED		10-24-78	MS	TG	REVISED AS CIRCLED		10-24-78	MS	TG	REVISED AS CIRCLED	
10-20-78	MS		REVISED AS CIRCLED		10-20-78	MS		REVISED AS CIRCLED		10-20-78	MS		REVISED AS CIRCLED	
9-21-78	KH		ADDED DRIBBLE CHUTE, TOTE BOX & SURGE HOPPER NOTE		9-21-78	KH		ADDED DRIBBLE CHUTE, TOTE BOX & SURGE HOPPER NOTE		9-21-78	KH		ADDED DRIBBLE CHUTE, TOTE BOX & SURGE HOPPER NOTE	
8-11-78	E.R.		DELETED UA MCP AT CO-107. "HOLD" REMOVED.		8-11-78	E.R.		DELETED UA MCP AT CO-107. "HOLD" REMOVED.		8-11-78	E.R.		DELETED UA MCP AT CO-107. "HOLD" REMOVED.	
6-7-78	KH		ISSUED FOR ESTIMATING		6-7-78	KH		ISSUED FOR ESTIMATING		6-7-78	KH		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	4814-Y-01-14-2
CLEVELAND	OHIO
McKee ENGINEERS AND CONSTRUCTORS	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
MATERIAL HANDLING P. & I. D.	
DEMO UNIT	
GASIFIER FEED CONVEYOR	
PROJECT NO.	P.E. NO.
NONE	NONE
REVISION 4	

4814-Y-01-15-2

BN-106
RECLAIM HOPPER
MP-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		PROJECT NO. 4814-Y-01-15-2
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO		P.E. NO. NONE
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		SCALE NONE
MATERIALS HANDLING P. & T.O. DEMO. UNIT COAL FINES RECLAIMING		REVISION 1

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

A

REVISION 1

[illegible]

INSTRUMENT IDENTIFICATION

I.S.A. STANDARD 5.1 - 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	MODIFIER
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)		
O					
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	

LINE IDENTIFICATION

LINE SIZE XX	UNIT DESIGNATION X	SERVICE CODE X	LINE NUMBER XXXX	LINE SPECIFICATION XXX	INSULATION CODE XXX		
SERVICE	LINE NO.	SPEC	CODE	SERVICE	LINE NO.	SPEC	CODE
COMBUSTION AIR	100-199	CIIE	CA	BLOWDOWN	1500-1599	CIIB	BD
ASH BLOWER AIR	200-299	CIIE	AA	AQUEOUS EFF.	1600-1699	CIIE	AE
INERT GAS	300-399	CIIE	IG	INST. AIR	1700-1799	G75A	IA
BOILER FEED H ₂ O	400-599	CIIB	BW	POTABLE WATER	1800-1899	B78 & G75	PW
L.P. STEAM	600-799	CIIB	LS	THERMOSYPHON	1900-1999	CAIJ	TS
H.P. STEAM	800-899	CIIB	HS	COMBINED GAS	2000-2099	CAIJ	MG
TOP GAS	900-999	CAIJ	TG	GREASE	2100-2199		GR
CLEAR GAS	1000-1099		CG	FLARE STACK GAS	2200-2299	CAIJ	FG
OIL	1100-1199	CIIE	OL	PLANT AIR	2300-2399	CIIE	PA
TAR	1200-1299	CIID	TR	CHEMICAL DRAIN	2400-2499	CIIE	CD
HYDRAULICS	1300-1399	CGIA	HY	PILOT GAS	2500-2599		
COOLING WATER	1400-1499	CIIE	CW	CONDENSATE	2600-2699	CIIB	CO

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)
GPS	GALLONS PER SECOND		AT 1 ATMOSPHERE AT SEA LEVEL
HP	HIGH PRESSURE	ST	STEAM TRAP
HP	HORSEPOWER	STR	STRAINER
HR	HOUR	TEMP	TEMPERATURE
IN	INCH	T	TEMPORARY SERVICE
ID	INSIDE DIAMETER	VISC	VISCOSITY
INT	INTERNAL	VI	VISCOSITY INDEX
KW	KILOWATT	W	WATT
KWH	KILOWATT HOUR	WT	WEIGHT

SAFETY

ATM	TO ATMOSPHERE	○	LOCALLY MOUNTED INSTR.
FLARE	TO FLARE	○	PANEL MOUNTED INSTR. (X-PANEL I.D.)
STACK	TO STACK	○	BACK PANEL MOUNTED INSTR. (X-PANEL I.D.)
		○	DUAL VARIABLE INSTR.

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	FCL-FC 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	CAP 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

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-02-09-2

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTAGASIFICATION
COMMERCIAL UNIT STAGE I & II
SYMBOLS AND LEGEND

PROJECT NO. 3001

P.E. NO.

SCALE

NONE

REVISION A

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

PROCESS ENGINEERING
APPROVAL
BY: DATE:

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001
PHASE 1
ESTIMATE
DRAWING NO. P-010
ISSUE NO. A
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-02-10-2

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

PROJECT NO. 3001
SCALE NONE
REVISION **A**

GASIFICATION
COMMERCIAL UNIT-STAGE I (DEMO)
P & I.D. GASIFIER MODULE

REVISION **A**

[illegible]

10

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

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

PROJECT NO. 3001
SCALE NONE
REVISION **A**

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

GASIFICATION
COMMERCIAL UNIT STAGE I (DEMO)
P&ID. GAS COOLING

REVISION **A**

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.

PROCESS ENGINEERING
APPROVAL

BARNETT CONTRACTORS INC.

A Division of Autodesk International Inc.

PHASE I

FOR **PHASE 2** **SIGNED** **DATE**
ESTIMATE

DESCRIPTION	APP
-------------	-----

[illegible]

[illegible]

[illegible]

7

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY	McKee
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4814-Y-02-31-2

ENGINEERS AND CONSTRUCTORS

CLEVELAND OHIO

FOR ERIE MINING COMPANY	PROJECT NO. 3001	P.E. NO.
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FOR	ERIE MINING COMPANY	3001	
		SCALE	

PICKANDS MATHER AND CO.	MANAGING AGENT	NONE
-------------------------	----------------	------

HOYT LAKES	MINNESOTA	NONE
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GASIFICATION	REVISION
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REVISION A

COMMERCIAL UNIT STAGE 1 (DEMO.)

P.&I.D. UTILITY	
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0 1 2 3 4 5 6 7 8 9 10

8	9	10
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Agency of Customs International Inc.

REVISION /

[illegible]

FUTURE CONNECTION
FOR COMMERCIAL UNIT
STAGE II (TYP 16 PLC'S)

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

THE RALPH M. PARSONS COMPANY 775ADENA, CALIFORNIA	
PARSONS DRAWING NUMBER	REV NO.
5840-1	0-10-MP-11
0	0

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SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-73-C-01-2578 A

McKee

4814-Y-03-21-2.

100

NONE

EVISION /

[illegible]

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
(DEMO)

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

- NOTES:
1. LOCAL FI-XXX AND 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 - 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-05-11-2

FOR **ERIE MINING COMPANY**
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
WASTEWATER TREATMENT
DEMONSTRATION UNIT.
WASTEWATER EVAPORATION P&ID

REVISION 2

DATE	BY	CHK	DESCRIPTION	APP.
2/10/78	MJA	WB	CHANGES AS CIRCLED	
9/22/78	DJS	WB	ADDED CROSS REFERENCES, SERVICE CODES & SPECIFICATIONS	
8/25/78	APD	WB	ISSUED FOR ESTIMATING	

<h1 style="text-align: center;">U. S. DEPARTMENT OF ENERGY</h1> <h2 style="text-align: center;">FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY <div style="text-align: center;"> McKee <small>ENGINEERS AND CONSTRUCTORS</small> </div>	4814-Y-05-12-2
CLEVELAND, OHIO	PROJECT NO. _____ P. E. NO. _____ SCALE _____
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	REVISION 2
WASTE WATER TREATMENT DEMONSTRATION UNIT INCINERATOR & STACK SYSTEM (P&ID)	

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

The diagram illustrates the process flow of the Fuel Gas Demonstration Plant Program. Key components and flow paths include:

- Fuel Gas Inlet:** Fuel gas from the compressor discharge (FE) enters the system, passing through a pressure control valve (PCV) and a flow transmitter (FT).
- Inert Gas Generator Package:** Inert gas (IG) is supplied to the system, passing through a pressure control valve (PCV) and a flow transmitter (FT).
- Control System:** The system is controlled by a central unit (CONTROLS) that receives signals from various sensors (PSL, PI, SOV, FI, FT, TI, RD, TSH, TE, TI, SC) and sends signals to actuators (SOV, PCV, FCV, PSV, UA).
- Process Vessels:** The fuel gas flows through a series of vessels, including a flame detector (BE), a heat exchanger (E-601), and a separator (X-601).
- Heat Recovery:** The fuel gas is preheated by a heat exchanger (E-601) before entering the main reactor (E-601).
- Flare System:** The reactor effluent is sent to a flare (E-601) where it is burned, with the heat being recovered by a heat exchanger (E-601).
- Safety Features:** The system includes several safety features, such as pressure relief valves (PSV), flame detectors (BE), and emergency shutdown (UA) buttons.
- Instrumentation:** The system is equipped with various instruments, including pressure sensors (PSL, PI), flow transmitters (FI, FT), temperature sensors (TI, TSH, TE), and a level sensor (RD).

Legend:

- B-601:** AIR BLOWER 500 SCFM
- E-601:** HEAT EXCHANGER
- X-601:** SEPARATOR

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

[illegible]

<h1>U. S. DEPARTMENT OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</p>							
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-06-20-2						
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P.E. NO.</td> </tr> <tr> <td colspan="2">SCALE</td> </tr> <tr> <td colspan="2"> REVISION 2 </td> </tr> </table>	PROJECT NO.	P.E. NO.	SCALE		REVISION 2	
PROJECT NO.	P.E. NO.						
SCALE							
REVISION 2							
UTILITIES DEMONSTRATION UNIT INERT GAS GENERATION P&ID

<h1 style="text-align: center;">U. S. DEPARTMENT OF ENERGY</h1> <h2 style="text-align: center;">FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
<h3 style="text-align: center;">SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</h3>	
PREPARED BY <div style="text-align: center;"> McKee ENGINEERS AND CONSTRUCTORS </div>	4814-Y-06-21-2
CLEVELAND _____ OHIO _____	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. _____ MANAGING AGENT HOYT LAKES _____ MINNESOTA _____	PROJECT NO. _____ P. E. NO. _____ SCALE _____
UTILITIES DEMONSTRATION UNIT INERT GAS COMPRESSION & DRYING (P&ID)	REVISION 2

• **Explain** the importance of the following:

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

LIQUEFIED NITROGEN PACKAGE

E-603
NITROGEN VAPORIZER
DUTY: ~~1.2~~ BTU/HR

NOTES :
1.) ULP - UTILITIES - LOCAL PANEL

REVISIONS					REVISIONS					REVISIONS				
DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
△					△					△				
△					△					△				
△					△					△				
△					△					△	10-16-78	1-JA	W.B	CHANGES AS CIRCLED
△					△					△	9/5/78	HK		ADDED CROSS REFERENCES, SERVICE CODES AND SPECIFICATIONS
△					△					△	8/24/78	DJS		ISSUED FOR ESTIMATING

<h1 style="text-align: center;">U. S. DEPARTMENT OF ENERGY</h1> <h2 style="text-align: center;">FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578	
PREPARED BY <div style="text-align: center;"> McKee <small>ENGINEERS AND CONSTRUCTORS</small> </div>	4814-Y-06-22-2
CLEVELAND OHIO	
FOR ERIE MINING COMPANY , PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE _____
UTILITIES DEMONSTRATION UNIT LIQUEFIED NITROGEN STORAGE & VAPORIZATION P&ID	REVISION 2

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" x 10'-0" T-T.)

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

NOTES

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

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10/24/78	MJA	WB	CHANGES AS CIRCLED		7/1/78	H.K.		ADDED CROSS REFERENCES, SERVICE CODES & SPECIFICATIONS		8/4/78	G.C.		TAG NUMBER CHANGES	
7/27/78	G.C.		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**

CLEVELAND, OHIO

4814-Y-06-23-2

PROJECT NO. P.E. NO.

SCALE

REVISION **3**

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

UTILITY AREA (P&ID)

DEMONSTRATION UNIT

INSTRUMENT & PLANT AIR SYSTEM

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 CLEVELAND ENGINEERS AND CONSTRUCTORS OHIO		4814-Y-06-24-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. P.E. NO. SCALE REVISION 2
UTILITY AREA DEMONSTRATION UNIT BUNKER C & TAR/OIL		

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

IGS A11433

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

REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.	REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.	REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.
△						△						△					
△						△						△					
△						△						△					
△						△						△	10-19-78	MJA	WB	CHANGES AS CIRCLED	JA
△						△						△	9-12-78	H.K.	W.B.	ADDED CROSS REFERENCES, SERVICE CODES AND SPECIFICATIONS	CH
△						△						△	8-29-78	DJS	WAL	ISSUED FOR ESTIMATING	

<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2>							
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578							
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS	4814-Y-06-26-2						
CLEVELAND _____ OHIO							
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES _____ MINNESOTA	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P. E. NO.</td> </tr> <tr> <td colspan="2">SCALE</td> </tr> <tr> <td colspan="2"> REVISION 2 </td> </tr> </table>	PROJECT NO.	P. E. NO.	SCALE		REVISION 2	
PROJECT NO.	P. E. NO.						
SCALE							
REVISION 2							

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

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

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

NOTES:
1.) ULP - UTILITIES LOCAL PANEL

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

CLEVELAND

ENGINEERS AND CONSTRUCTORS

OHIO

4814-Y-06-27-2

PROJECT NO.

P.E. NO.

FOR

ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

UTILITIES

DEMONSTRATION UNIT

BFW DEAERATION AND PUMPS P&ID

REVISION

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 OHIO 4814-Y-06-28-2

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

UTILITIES
DEMONSTRATION UNIT
STEAM GENERATION P&ID

REVISION 2

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

[illegible]

<h1>U. S. DEPARTMENT OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</p>							
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-06-30-2						
FOR ERIE MINING COMPANY 'PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P.E. NO.</td> </tr> <tr> <td colspan="2">SCALE</td> </tr> <tr> <td colspan="2"> REVISION 1 </td> </tr> </table>	PROJECT NO.	P.E. NO.	SCALE		REVISION 1	
PROJECT NO.	P.E. NO.						
SCALE							
REVISION 1							
UTILITY DEMONSTRATION UNIT SETTLING POND WATER							

<h1>U. S. DEPARTMENT OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</p>	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-06-32-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE _____
UTILITIES DEMONSTRATION UNIT STEAM REDUCING STATIONS (P&ID)	REVISION 2

[illegible]

DATE	BY	CHK	DESCRIPTION	APP.
10-23-78	MJA	W.B.	CHANGES AS CIRCLED	W.B.
9-18-78	HK		ISSUED FOR ESTIMATING	W.B.

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 PREPARED BY McKee CLEVELAND, OHIO		4814-Y-06-44-2 PROJECT NO. 4814-Y-06-44-2 P.E. NO.
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES, MINNESOTA UTILITIES ROUTING DEMONSTRATION UNIT PLANT & INSTRUMENT AIR. SHEET 1		SCALE 1" = 30'-0" REVISION 1

<h1 style="text-align: center;">U. S. DEPARTMENT OF ENERGY</h1> <h2 style="text-align: center;">FUEL GAS DEMONSTRATION PLANT PROGRAM</h2> <p style="text-align: center;">SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578</p>							
PREPARED BY <div style="text-align: center;"> McKee ENGINEERS AND CONSTRUCTORS </div>	4814-Y-06-45-2						
CLEVELAND ————— OHIO							
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	<table border="1" style="width: 100%;"> <tr> <td style="width: 50%;">PROJECT NO. _____</td> <td style="width: 50%;">P. E. NO. _____</td> </tr> <tr> <td colspan="2" style="text-align: center;">SCALE</td> </tr> <tr> <td colspan="2" style="text-align: center;">1" = 60'-0"</td> </tr> </table>	PROJECT NO. _____	P. E. NO. _____	SCALE		1" = 60'-0"	
PROJECT NO. _____	P. E. NO. _____						
SCALE							
1" = 60'-0"							
UTILITIES - ROUTING DEMONSTRATION UNIT PLANT & INSTRUMENT AIR . SHEET 2	<table border="1" style="width: 100%;"> <tr> <td style="width: 80%;">REVISION _____</td> <td style="width: 20%; text-align: center;"> </td> </tr> </table>	REVISION _____
REVISION _____

SYMBOL	DESCRIPTION
—	OILY & CHEMICAL WATER
BD—BD	BLOW DOWN, WASH DOWN & CLEAN WATER SEWERS (EC)
F—F—F	FIRE LOOP WATER
* * *	SANITARY WATER
—	POTABLE WATER
—	COOLING WATER

SYMBOL	DESCRIPTION
Ø	FLOOR DRAIN
●	FLOOR HUBS 2, 4, OR 6" SIZES
□	CLEAN OUT 4" OR 6" SIZES
⊗	PRESSURE REDUCING VALVE
⊗	SHUT OFF VALVE
⊗	FIRE HYDRANT AND HOSE STATION- OUTSIDE
⊗	FIRE CABINET INSIDE BLDG

TYPICAL DRAINAGE SLOPES:
0.0052 FT/FT (1/16" PER FT)
0.0104 FT/FT (1/8" PER FT)

NOTE:
ALL GASIFIER BLOW DOWNS ARE ROUTED ABOVE GROUND TO A FLASH TANK. ONE DRAIN FROM FLASH TANK WILL BE ABOVE GROUND AND PUMPED TO DILY WATER PIT - 501.

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLAN1 PROGRAM

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

PREPARED BY

ENGINEERS AND CONSTRUCTORS

CLEVELAND

OHIO

4814-Y-06-46-2

PROJECT NO.

P.E. NO.

FOR

ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

UTILITIES

DEMONSTRATION UNIT

UNDERGROUND PIPING SHEET 1 OF 2

1"

30'-0"

SCALE

REVISION 1

A

FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. _____ P.E. NO. _____ SCALE 1" = 60' 0"
UTILITIES DEMONSTRATION UNIT UNDERGROUND PIPING SHEET 2 OF 2		REVISION 1

[illegible]

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. 1414-Y-06-48-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
UTILITIES ROUTING DEMONSTRATION UNIT INERT GAS	
SCALE 1" = 30'-0" REVISION 1	

DATE	BY	CHK	DESCRIPTION	APP.

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DATE	BY	CHK	DESCRIPTION	APP.

11-1-78 MJA M.B. CHANGES AS CIRCLED
 11-12-78 HK ISSUED FOR ESTIMATING

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10-13-78	MS	TZ	BOILER FEED WATER TIE-IN 3A WAS 4" @ 6"		10-13-78	MS	TZ	REVISED PILE CONFIGURATION		10-13-78	MS	TZ	RELOCATED RUN 3, 4 & 7	
9-15-78	MS				9-15-78	MS				9-15-78	MS			
8-17-78	MS				8-17-78	MS				8-17-78	MS			

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2978 A

PREPARED BY **McKee**
CLEVELAND OHIO

4814-Y-06-49-2

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

UTILITIES DEMONSTRATION UNIT
UTILITIES TIE-IN

REVISION 2

SCALING RULES

D-701
FLARE SEAL DRUM
8'-0" DIA., 14'-0" TAN TO TAN
CARBON STEEL

X-701
SAFETY SYSTEM
FLARE TIP

IGS A11436

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-CONF: ACT NO. ET-78-C-01-2578 PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO		4814-Y-07-10-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. P.E. NO. SCALE REVISION 2
SAFETY SYSTEM P & ID DEMONSTRATION UNIT SEAL DRUM AND FLARE STACK		

HEADER NO: 4

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