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ERIE MINING COMPANY

FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL-SCALE INDUSTRIAL PROJECT

COMMERCIAL PLANT DESIGN MANUAL

PHASE I VOLUME I

JANUARY, 1979

CONTRACT ET-78-C-01-2578

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FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL-SCALE INDUSTRIAL PROJECT

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Prepared for the

U.S. DEPARTMENT OF ENERGY

Assistant Secretary for Energy Technology
Office of Fossil Fuels

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

U.S. DEPARTMENT OF ENERGY

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Organization

Department of Energy, Chicago Operations Office

Signature

Date

4-14-80

C00-5066-T14 (Vol.1) (12)

February 9, 1979

MASTER

Mr. J. H. Fatum
Project Director
Erie Mining Company
Pickands Mather & Company, Managing Agent
1100 Superior Avenue
Cleveland, Ohio 44114

SUBJECT: Erie Mining Company
Coal Gasification Project
D.O.E. Contract ET-78-C-01-2578
McKee Contract MC-4814A
Letter No. MEL-685

DESIGN MANUAL FOR COMMERCIAL PLANT

Dear Mr. Fatum:

Attached for your information are fifteen copies of the Design Manual for the Commercial Plant.

By means of this letter, we are transmitting to D.O.E., twenty copies of the Design Manual for the Commercial Plant. These twenty copies for D.O.E. have been sanitized. They contain sanitized drawings from BCI and all the drawings provided by Parsons have been removed.

Yours truly,

ARTHUR G. McKEE & COMPANY

Irwin Hess
Project Manager

Attachment (15)
IHHamh

cc: P. L. Rader
w/atts. (20)

COMMERCIAL PLANT DESIGN MANUAL
 ERIE MINING COMPANY
 COAL GASIFICATION PROJECT
 D.O.E. CONTRACT ET-78-C-01-2578
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THE FOLLOWING DRAWINGS HAVE BEEN DELETED FROM THE COMMERCIAL
 PLANT DESIGN MANUAL, VOLUME I, AND REPLACED WITH THE FOLLOWING
 DESIGNATED DRAWINGS.

<u>DRAWING</u>	<u>REPLACED BY</u>	<u>DESCRIPTION</u>
Y-02-51-2	Y-02-85-2	Western Coal Sheet 1
Y-02-52-2	Y-02-86-2	Western Coal Sheet 2
Y-02-53-2	Y-02-87-2	Eastern Coal Sheet 1
Y-02-54-2	Y-02-88-2	Eastern Coal Sheet 2

THE FOLLOWING DRAWINGS HAVE BEEN DELETED FROM THE COMMERCIAL PLANT
 DESIGN MANUAL, VOLUME I BECAUSE THEY ARE PROPRIETARY DATA.

N-03-52-2	Electrical Area Classification
Y-03-51-2	Process Flow Diagram
Y-03-52-2	Process Flow Diagram
Y-03-53-2	Process Flow Diagram
Y-03-54-2	Process Flow Diagram

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ERIE MINING COMPANY

FUEL GAS
DEMONSTRATION PLANT
PROGRAM

SMALL-SCALE INDUSTRIAL PROJECT

COMMERCIAL PLANT DESIGN MANUAL

PHASE I

JANUARY, 1979

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

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COMMERCIAL PLANT
DESIGN MANUAL

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1.0

PROJECT DESCRIPTION

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1.0 PROJECT DESCRIPTION

1.01 PROJECT OVERVIEW

The Fuel Gas Demonstration Plant Program envisions a coal gasification facility to produce low Btu fuel gas. The facility will provide low Btu gas to the Erie Mining Company taconite pelletizing operations at Hoyt Lakes, Minnesota. Initially, it will consist of a Demonstration Plant which will be sized to supply 7.4 billion Btu (HHV) of fuel energy per day, which is approximately 37 percent of Erie Mining Company's daily energy requirement for the induration of pellets. The Demonstration Plant will be designed to permit ultimate expansion to a Commercial Plant capable of supplying the entire fuel gas requirement of the pellet plant.

Erie Mining Company is one of the largest producers of iron ore pellets in the United States. Its plant consists of 27 shaft furnaces with an annual production capacity of 10.3 million tons. The furnaces now operate on natural gas and use fuel oil as a backup energy supply. Fuel consumption is normally equivalent to 20 billion Btu per day.

The contract arrangement between the Department of Energy and Erie Mining Company provides mutually advantageous opportunity and means for:

- Employing coal gasification technology and equipment which is now commercially available, for production and use of low Btu gas in an industrial environment under actual operating conditions.
- Identifying, defining and resolving problems and operational unknowns that have heretofore retarded industrial use of synthetic gas.
- Establishing parameters for retrofitting existing industrial furnaces for use of low Btu gas.
- Determining and demonstrating the technical and economic feasibility of the proposed scheme.

The Demonstration Plant will be designed as the initial module of a Commercial Plant sized to supply the entire energy requirement of the pellet plant. Expansion of the Demonstration Plant to the ultimately desired capacity will require only the installation of additional processing units. Detail design of the full scale Commercial Plant is not a part of the present contract.

1.0 PROJECT DESCRIPTION (continued)1.02 OVERALL SCOPE OF WORK

The Demonstration Plant Program is divided into three phases:

- Phase I - Program Development and Conceptual Design

This phase includes selection of a gasifier process to be used, development of the conceptual design for both a commercial scale plant and a Demonstration Plant.

The Demonstration Plant design will be carried to the point of completion corresponding to a "front end design package" suitable for use in the detailed engineering of Phase II.

Both plants will operate with high sulfur high caking Eastern coals as well as Western coals.

- Phase II - Demonstration Plant Final Design, Procurement and Construction

This phase includes all of the detailed engineering, procurement and construction of the Demonstration Plant.

- Phase III - Demonstration Plant Operation

This phase covers the operating portion of the program, includes training of personnel, shakedown testing with both low sulfur non-caking coal, and high sulfur, high caking coal, and testing of various practices and optimization schemes.

Each Phase of the overall Program comprises a series of Tasks which are identified and defined. The Tasks to be completed in Phase I are:

- Conceptual Design and Evaluation of Commercial Scale Plant
- Demonstration Plant Process and Mechanical Design
- Current Working Estimates for Phases II and III
- Site Evaluation and Agreements
- Demonstration Plant Environmental Analysis
- Materials, Licenses and Agreements
- Proposed Methods and Plans for Phases II and III Accomplishments

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1.02 OVERALL SCOPE OF WORK (continued)

- Economic Reassessment
- Technical Support Plan
- Project Management Plan and Project Manual
- Long Lead Time Item Procurement

1.0 PROJECT DESCRIPTION (continued)

1.03 COMMERCIAL PLANT DESIGN MANUAL SCOPE

1.03.1 This Commercial Plant Design Manual contains the required data to sufficiently define the plant requirement for Detailed Engineering, Procurement and Construction.

1.03.2 The Design Manual contains the following information and/or data:

- Process Description
- Plot Arrangement Drawings
- Process Flow Diagrams
- Heat and Material Balances involving:
 - Product and By-product yield and quality
 - Effluent stream yield and quality
 - Raw Material Requirements
- Utility Summary
- Electrical Single Line and Area Classification Drawings
- For each major process area, the following are included:
 - Piping and Instrument drawings
 - Equipment List
 - Equipment Data Sheets for all equipment items
 - Major In Line instrument data sheets
- Building Drawings
- Site Preparation Drawings
- Utility Routing Diagrams
- Underground sewage and drainage layouts
- Firewater system layouts

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1.03 COMMERCIAL PLANT DESIGN MANUAL SCOPE (continued)

- Safety System (Flare)
- Pellet Plant Retrofit
- The appropriate Engineering Requisitions for "long lead" and special equipment items.

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1.0 PROJECT DESCRIPTION (continued)

1.04 BASIS FOR DESIGN OF COMMERCIAL PLANT

The process design for the Commercial Plant is stated in detail in Section 2.0 of this report. The general provisions of that statement are as follows:

- The plant shall be designed to convert approximately 1500 tons of coal per day to 20 billion Btu of clean fuel gas suitable for use in Erie Mining Company's pelletizing plant shaft furnaces. The fuel gas product shall have a nominal heating value including sensible heat, prior to sulfur removal of 160 to 180 Btu per cubic foot.
- Capability shall be provided for processing both Western coals, and high caking Eastern coals with sulfur contents of 2.5% and greater, and free swelling indices greater than 5.0. Stretford sulfur removal technology shall be employed.
- The plant shall be designed, incorporating the Demonstration Plant into the Commercial Scale Plant.
- The fuel burning facilities of the pellet plant shaft furnaces shall be modified to permit the use of low Btu gas as fuel to the combustion chambers. It is intended that the program shall provide definition of problems and operational unknowns associated with the retrofitting of existing industrial facilities for utilization of low Btu gas in energy intensive industries.
- As a minimum, the facilities to be provided will include those required for Materials Handling, Coal Gasification, Sulfur Removal, Gas Transmission, Waste Treatment and Disposal, Utilities, Safety, and Shaft Furnace Retrofit.
- Air quality shall be controlled to meet or exceed all applicable federal, state and local standards.
- The materials handling systems, gas transmission facilities and utilities for the Demonstration Plant are sized to satisfy the operating requirements of the Commercial Scale Plant.
- There will be no discharge of contaminated process waste waters to the environment. Contaminated process waters will be reused in the gasifier or disposed of in an environmentally acceptable manner. Warmed cooling water will be utilized in the existing pellet plant facilities.

1.04 BASIS FOR DESIGN OF COMMERCIAL PLANT (continued)

- The gasification complex will produce tar and oil as by-products and ash and sulfur as solid wastes.

The tar and oil shall be used as fuel for boilers or for process applications.

Ash will be disposed of in existing ash disposal areas on the Erie Mining Company property. Sulfur will be disposed of on site in a manner that will permit reclamation if markets become available. Ground disposal of solid wastes will be accomplished in a manner meeting all applicable environmental standards respecting leaching and ground water pollution.

- The total gasification facility shall be so designed as to maximize energy conservation and reuse, e.g., recycling of warmed cooling water to the pellet plant, injection of carbon bearing dusts removed from gas streams, energy conserving design and construction methods and energy efficient lighting.
- The gasification complex will be independent of the existing Erie Mining Company facilities to the extent practical.

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1.0 PROJECT DESCRIPTION (continued)

1.05 COAL BASIS

The plant is designed to handle a range of coals encompassing high sulfur, high swelling bituminous Eastern coals, a suitably sized or briquetted sub-bituminous Western coals. A wide range of coals can be accepted including those indicated on Page 30 of Engineering Requisition W-20, in Section 6.0 of this report.

Samples of Rosebud-McKay coals and of a Brookville-Clarion-Kittanning mix were analyzed. The analyses were adjusted for use as the bases for material and energy balances for the gasification unit. These coal analyses are indicated in Section 2.01.3, "Bases for Process Design". Throughout this report the coal described as "Western" refers to the Rosebud-McKay material and the coal described as "Eastern" refers to the Brookville-Clarion-Kittanning mix. After initiation of the project, it was learned that available Western sub-bituminous coals would contain excessive amounts of fines which could not be processed in the gasifier retort. For these design studies, it is assumed that the Western sub-bituminous coal can be suitably briquetted.

The designs derived with the above limitations are a reasonable representation for the coal gasification plant described in this report.

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1.0 PROJECT DESCRIPTION (continued)

1.06 SITE LOCATION

1.06.1 Location

Erie Mining Company is located 60 miles north of Duluth, Minnesota, on the eastern end of the Mesabi Iron Range. The existing plant and the proposed coal gasification facility are within the boundary of the city of Hoyt Lakes, Minnesota, in the east-central portion of the St. Louis County at latitude 47° 35' 44" N and longitude 92° 08' 42" W. Regional and local maps are presented in Figures 1-1 and 1-2, respectively.

The coal gasification plant is located adjacent to the plant's processing buildings and surrounded by other lands owned and used by Erie Mining Company. It is important to note that the entire site was cleared and leveled in the mid-1950s during construction of the pelletizing plant.

A ditch conveying the sewage treatment plant effluent to Second Creek bisects the site. Eight acres east of this ditch are presently used for coal storage and will continue to be used for this purpose. The legal description of the area is a portion of sec. 17, T. 59 N., R. 14 W., fourth principal meridian, Minnesota.

The nearest land not controlled by the company is 1 mile away, while the closest dwelling is located 3-3/4 mile from the proposed site. The developed portion of Hoyt Lakes is 4-1/2 mile south of the coal gasification plant site.

1.06.2 Gasification Site

The coal gasification plant, along with the solid waste disposal area, will occupy a total of approximately 115 acres. The area required for the process unit is approximately 15 acres and includes a coal handling system, coal gasification plant, sulfur removal plant, gas compression plant, wastewater treatment plant, and utilities. The gasification plant area is part of a 52-acre site bounded on the west by a surfaced road (extension of County Road 110), on the north by a gravel road to the sewage treatment plant, and on the south and west by a railroad. The layout of the gasification complex is shown in Drawing X-00-52-2, "General Arrangement".

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1.06.2 Gasification Site (continued)

The land is owned by Erie Mining Company and was completely cleared and leveled in the mid-1950s during construction of the pelletizing plant.

The solid waste disposal area is located immediately to the west of the gasification plant, as shown in Figure 1-3. The disposal areas, including haulage roads and collection pond, will be approximately 100 acres. Gasifier bottom ash and elemental sulfur from the Stretford facility will be the major items stockpiled. These two by-products will be placed in separate areas to allow easy removal of sulfur should a market become available.

ERIE MINING COMPANY

Figure 1-1 Regional Map

Figure 1-2 Local Map

Figure 1-3 Gasification Plant Site and Solid Waste Disposal Area Locations

1.0 PROJECT DESCRIPTION (continued)

1.07 METEOROLOGY

Since 1958, a weather station affiliated with the National Oceanic and Atmospheric Administration (NOAA) has been in operation at the Erie Mining Company plant site. Data accumulated at this station have been published and are available through NOAA. A review of the climatological data shows that the Hoyt Lakes area, as well as most of northeastern Minnesota, is subject to extremes of temperature and precipitation. The summers have warm days and cool nights; winters are very cold with moderate to heavy snowfall. Summer maximum daily temperatures average in the upper 70s ($^{\circ}$ F) with only 36 days per year exceeding 80° F. Winter minimum daily temperatures of -30° F or less occur on an average of twice per month during December, January, and February. Temperatures of -40° F or less occur once every other year.

Precipitation at Hoyt Lakes averages 28.33 inches per year. Nearly 40% comes from summer showers and thunderstorms during June through August. Heaviest normal precipitation occurs during June with a mean of 4.04 inches. A monthly extreme of 8.25 inches occurred in September, 1961, and the highest 24-hour rainfall of 3.35 inches occurred in October 1978, (U.S. Department of Commerce, 1975). Average annual lake evaporation, derived from measurements at Hoyt Lakes, is approximately 25.8 inches (E.A. Hickok & Associates, 1977).

Mean monthly temperatures range from an average of 2.4° F in January to 64.2° F in July. The months of November through March have average temperatures below freezing. Freezing weather usually begins by mid-September and continues into late May, although freezing temperatures have occurred in every month of the year.

Snow cover typically exists from mid-November through late-March, but may occur during early November and persist as late as the second week of April. Total yearly snowfall averages 50.3 inches with snow cover of 1 inch or more occurring on 130 days. Light snowfalls can occur as early in the season as September and as late as May. Table 1-1 shows monthly averages and extremes of temperature and precipitation measured at the Erie Mining Company plant site.

Upper winds are relatively constant and vary only slightly in speed and direction. Mean yearly wind speed generally varies from 12 mph at approximately 5,000 feet to 45 mph at an altitude of 30,000 to 40,000 feet.

1.07 METEOROLOGY (continued)

TABLE 1-1

TEMPERATURE AND PRECIPITATION
MONTHLY AVERAGES AND EXTREMES

<u>Month</u>	<u>Temperature (^oF)</u>			<u>Precipitation (Inches)</u> <u>(Water Equivalent)</u>		
	<u>Average</u> <u>Daily</u> <u>Maximum</u>	<u>Average</u> <u>Daily</u> <u>Minimum</u>	<u>Average</u>	<u>Average</u>	<u>Monthly</u> <u>Maximum</u>	<u>Monthly</u> <u>Minimum</u>
Jan.	13.9	-9.1	2.4	.98	3.84	0.21
Feb.	21.4	-4.5	8.4	.59	1.85	0.08
Mar.	34.1	10.7	22.4	1.20	2.48	0.16
Apr.	49.7	25.1	37.4	2.34	6.50	0.68
May	63.5	36.7	50.1	3.32	5.84	0.73
June	72.5	45.7	59.1	4.04	6.77	0.86
July	77.3	51.1	64.2	3.69	6.94	1.03
Aug.	74.7	48.0	61.3	3.71	7.94	0.47
Sept.	64.0	39.8	51.9	3.39	8.25	0.89
Oct.	53.0	31.1	42.0	2.73	7.20	0.50
Nov.	34.0	16.1	25.0	1.35	3.28	0.24
Dec.	19.3	-0.7	9.3	1.04	2.34	0.41

Note: These data based on record for the 1958-1977 period.

The mean direction from which the wind blows shows a relatively small variance of 9 degrees between 279^o and 288^o. The variance during any one year from the mean wind speed and direction is insignificant. A summary of the upper wind speed and direction is presented on the following page.

1.07 METEOROLOGY (continued)

UPPER WIND STATISTICS FOR NORTHEASTERN MINNESOTA

<u>Elevation in Standard Atmospheres (millibar)</u>	<u>Elevation (ft)</u>	<u>Mean Yearly Wind Speed (mph)</u>	<u>Vector Mean Direction (degrees clockwise from north)</u>
850	4,800	12	283
700	9,900	20	288
500	18,400	32	285
300	30,200	45	280
200	38,800	45	279
100	53,500	32	284

Source: (MDNR, MPCA, 1976).

Surface winds have been monitored since 1966 on the Erie Mining Company plant site. Although prevailing winds are from the northwest quadrant during the colder, winter months, winds from the southeast quadrant occur during the warmer, summer months. The least frequent wind directions are from the southwest and northeast.

Mixing heights, which denote the elevation above the surface of the earth within which the vertical mixing of the atmosphere is relatively vigorous, have been determined for the plant site area. Mixing heights are significant for their relation to vertical diffusion of pollutants emitted to the atmosphere. Mixing heights for a locality show large variations during a day and are typically given for morning and afternoon periods.

The morning mixing height at the plant site averages approximately 1,580 feet and ranges from about 1,050 feet during the summer to about 1,800 feet during the fall. Wind speeds within the morning mixing layer average 11.2 mph and range from about 10 mph during the summer to about 13.4 mph during the winter (Holzworth, 1972).

The afternoon mixing height averages approximately 3,940 feet and ranges from about 2,130 feet during the winter to about 5,410 feet during the summer. Wind speeds within the afternoon mixing layer average 17.5 mph and range from almost 15 mph during the summer to approximately the annual mean during the rest of the year (Holzworth, 1972).

1.0 PROJECT DESCRIPTION (continued)

1.08 ENVIRONMENTAL

1.08.1 Air

The application of technological and procedural mitigation measures to the coal gasification process and waste handling programs has substantially reduced the potential atmospheric emissions of the facility. The product gas, which will be utilized in the pellet shaft furnaces, will have passed through a system of cyclones to remove particulates, precipitators to remove oils and tars, and a Stretford unit to remove hydrogen sulfide. The resulting product gas will be of high purity and should not produce quantities of sulfur dioxide or particulates that are of concern upon combustion.

Gases from the Stretford oxidizer tanks will be returned to the gasifier for incineration.

During start-up and shutdown periods and during emergencies, gases produced by the gasification units will be flared when released to the atmosphere. This flaring will prevent the direct release of environmentally-important gases and will transform most of them into their respective oxides.

Dust control hardware will be widely applied in all aspects of coal delivery and handling. Enclosed conveyors, vacuum systems, and baghouses will be used to prevent coal dust release to the environment. Coal stored in the reserve stockpile will be sprayed with a dust-suppressant material if dust entrainment by the wind appears to be a significant concern.

Dust suppression at the solid waste disposal site will be attained by utilizing two procedures. First, the site will be operated in a manner that minimizes the exposure of wind-entrainable ash to the atmosphere. Ash will be regularly covered with soil material to prevent loss by the wind. In addition, a biodegradable, water soluble surface binding spray for dust suppression, will be utilized if dust proves to be a problem. Once a portion of the solid waste disposal site has been filled, it will be covered with soil and

1.08.1 Air (continued)

vegetated. The reclamation program will be similar to that utilized by Erie Mining Company to reclaim sites at their mining operation. Proven reclamation practices and plant species will be employed in this mitigation measure.

1.08.2 Water

Unless seepage from material stockpiles or waste storage areas is carefully controlled, chemicals can enter the underlying aquifer and degrade the quality of the groundwater. Realizing the potential for this environmental impact, measures will be taken to prevent contamination of groundwater resources. At each site where a materials stockpile (coal pile) or waste storage area (landfill and settling pond) is to be located, soil borings will be made. If a natural soil or rock layer, which is at least 10 feet thick and has a permeability of less than 4 in./sec, is found under the site, this natural barrier will prevent seepage of contaminants into groundwaters. If such a natural barrier does not exist, a leachate collection system will be constructed at the site. Leachate collection systems will include installation of an impervious bottom liner graded such that leachate is drained to a sealed collection pond (landfill leachate) or settling pond (coal pile leachate). If the capacity of the collection pond is exceeded, flow will be directed to the settling pond. When the capacity of the settling pond is exceeded, effluent will be pumped to the tailings basin at the pellet plant.

To ensure that the adopted leachate control system is preventing contamination of groundwaters, water quality from monitoring wells will be determined during project operation. If monitoring indicates that groundwater is being contaminated, wells will be pumped to form groundwater "cones of depression". Hydraulic gradients around these "cones" will cause groundwater to flow toward, rather than away from, the contamination zones. Therefore, the dispersion of contaminated water will be prevented while measures are being taken to stop seepage of contaminants to groundwaters.

The efficient utilization and recycling of process water in the gasification facility can be considered a mitigation measure. This includes the incorporation of waste heat recovery. These measures reduce water consumption.

1.08.3 Biology

All of the emission and effluent controls which are being employed in the gasification facility are designed to mitigate biological effects. The engineering design objective of producing a zero discharge of process and runoff waters into the area's surface water system is a major element in mitigating potential biological impacts of the facility.

Potential biological effects attributable to atmospheric emissions will be minimized by the application of control technologies designed to produce a clean product gas. Oils, tars, particulates, and hydrogen sulfide will be removed from the gas prior to its combustion. The by-products generated by these gas-cleaning processes will be handled and disposed of in a manner also designed to minimize their potential environmental impacts.

1.08.4 Noise

Erie Mining Company presently has an intensive hearing conservation program in their taconite plant. This program will be incorporated into the gasification facility.

Erie Mining Company will incorporate an equipment maintenance program including equipment care, oiling/greasing, and parts replacement at the gasification facility. An important aspect of this maintenance program will be directing close attention to valves, junctions and fittings associated with the steam system. Steam leaks will be sealed as soon as practical. If a leak cannot be immediately sealed, hearing protection gear will be required in that particular area.

When practical, noise reduction/suppression methods will be incorporated including: special equipment mounting procedures (shock absorbers) to reduce vibrations, isolation of particularly noisy equipment, sound baffling, and the purchasing of equipment which produces lowest noise levels.

1.0 PROJECT DESCRIPTION (continued)

1.09 ITEMS TO BE RESOLVED

1.09.1 Early in the Phase II design period for the Demonstration Plant, the following outstanding items will be resolved and applied to the Commercial Plant Design:

- Materials Disposition
 - Cyclone char
 - Dust collection system dust
 - Excess water from the waste disposal area collection pond
 - Excess water (overflow) from the settling pond
 - Settling pond lining
 - Wet cake sulfur disposition vs. flaked, cast or liquid sulfur
 - High sulfur tars/oils in the event they cannot be used as a fuel on site
 - Coal fines (high sulfur)
- Additional site borings for design data
- Coal selection and means of transportation to Hoyt Lakes including modification to Taconite Harbor
- Coal agglomeration for Western coal and/or coal fines
- Materials Handling
 - Stacking conveyor vs. lowering tubes
 - Pneumatic vs. conveyors for ash handling
 - Steep rise vs. conventional conveyors
- Waste treatment area resolution based on selected coal
- Building design
 - Need for cranes
 - Heating of gasifier building
- Inert gas system and liquid nitrogen backup vs. installation of an on-site nitrogen plant with waste oxygen enrichment of gasifier plant air.
- Coal receipt during warm weather only or year round (thaw shed)
- Review of existing Erie Mining Company utilities toward increasing capacity rather than install separate facilities in the gasification area complex.
- Review of proposed design with Erie Mining Company's insurance carrier

1.09 ITEMS TO BE RESOLVED (continued)

- Determine number of stirred vs. unstirred gasifiers to be installed initially during Phase II
- Integrate Gasifier and Sulfur Removal Subcontract final Phase I design into overall plant design and determine whether or not the Sulfur Removal Unit process design should be revised
- Resize compressed air system as dust collection units; include their own air compressors
- Determine and evaluate means of feeding 10% fines into gasifier and feed system
- Gasifier ashbed level detection system
- Resolve effects of ammonia, cyanide and chlorides in gasifier effluent gas in the Stretford unit
- Review gasifier flare system for improvements
- Review combining gasifier heat exchangers and precipitators into single trains. The impact on overall plant service factor must be evaluated
- Add a small fuel gas line to provide purge gas for precipitator insulators
- Review condensate return and steam heating system

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1.0 PROJECT DESCRIPTION (continued)

1.10 REFERENCE DOCUMENTS

- 1.10.1 The following documentation supplements this design manual.

Management Plan Phase I dated January 4, 1978

Project Manual dated December, 1977

Specification Manual dated January, 1979

Commercial Plant Design and Economic Evaluation -
Phase I - Interim Report dated December 8, 1978

Environmental Assessment Draft Report dated November, 1978

DRAWING NO. 4814-H-00-51-2

HEATING & VENTILATING UNITS									
TAG NO	AREA	CFM	% O.A.	HEATING CAPACITY (MBH)	STEAM 50 PSIG (LB/HR)	MOTOR		REMARKS	
						RPM	HP		
HV-101	SWITCHGEAR RM. POSITIONER BLDG.	7500	50-100	350	385				
HV-102	POSITIONER BLDG. PUMPHOUSE	3500	50-100	250	275				
HV-103	COAL RECLAIM AREA	8400	100	880	970				
HV-104	CONV. CO-104	2000	100	210	232				
HV-105	CRUSHING STATION	1900	100	200	220				
HV-106	CONV. CO-105	4500	100	475	522				
HV-107	CONV. CO-106	6000	100	630	692				
HV-108	SCREENING STA.	17,000	100	1780	1958				
HV-111	CRUSH. STA. MOTOR RM.	2000	15-100	31.8	35				
HV-201	GASIFICATION PLANT	6000	100	600	692				
HV-210	GASIFICATION	7000	15-100	110	33 KW ELEC COIL				
HV-301 THRU 306	STRETTFORD BUILDING	16,000 EA.	50-100	1210 EA.	1330 EA.				
HV-307 & 308		32,000 EA.	50-100 EA.	2420 EA.	2659 EA.				
HV-501	INCIN. BLDG.	6000	50-100	350	404				
HV-601	UTILITIES BLDG.	14,000	100	1470	1615				
HV-901	EMPLOYEE FAC.	6500	100%	820	900				

AIR-CONDITIONING UNITS									
TAG NO	AREA	CFM	FAN MOTOR RPM	COIL FAN HP	COIL FAN RPM	COOLING CAPACITY (TON)	HEATING CAPACITY (MBH)	STEAM 25 PSIG (LB/HR)	COMPR. MOTOR RPM
AC-201	GASIF.	4000				12 TON	110	120	
AC-101	C. UN-LOAD	1200				5 TON	50	55	
AC-102	F. LOAD-OUT	800				2.5 TON	30	6 KW ELEC COIL	

UNIT HEATERS				
TAG NO	AREA	HEATING CAPACITY (MBH)	STEAM 50 PSIG (LB/HR)	REMARKS
UH-201 THRU 203	GASIF. BLDG.	2@120	330	
UH-101 THRU 107	SCREEN. STA.	4@30	265	
UH-108 THRU 110	COAL CRUSH.	2@30	165	
UH-401 THRU 406	COMPR. BLDG.	6@50	330	
UH-609 & 610	PUMPHOUSE	2@70	155	
UH-601 THRU 608	UTILITIES BLDG.	8@50	440	

EXHAUST FANS				
TAG NO	AREA	CFM	MOTOR RPM	REMARKS
EF-101	COAL UNLOADING	5500		
EF-201	GASIFICATION PLANT	40,000/20,000		
EF-202		30,000/15,000		
EF-203 THRU 216		58,500 EA.		
EF-401 & 402	COMPR. BLDG.	50,000 EA.		
EF-604 & 605	PUMPHOUSE	15,000 EA.		
EF-301 THRU 308	STRETTFORD	40,000 EA.		
EF-601 THRU 603	UTILITIES BLDG.	25,000 EA.		
EF-501	INCIN. BLDG.	3000/6000		

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-H-00-51-2

FOR

ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

GASIFICATION PLANT

COMMERCIAL UNIT

HVAC PLOT PLAN & EQUIPMENT LIST

PROJECT NO.

P.E. NO.

SCALE

NONE

REVISION

11-7-78

ISSUED FOR ESTIMATES

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

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

U. S. DEPARTMENT OF ENERGY	
FUEL GAS DEMONSTRATION PLANT PROGRAM	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578	
PREPARED BY	McKee
CLEVELAND	OHIO
ENGINEERS AND CONSTRUCTORS	
4814-X-00-52-2	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO.	MANAGING AGENT
HOYT LAKES	MINNESOTA
COAL GASIFICATION COMMERCIAL UNIT	
GENERAL ARRANGEMENT	
PROJECT NO.	P.E. NO.
SCALE	1" = 200' 0"
REVISION E	

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
9-18-78	KH		ITEM 4 WAS CRUSHING STATION, ADDED CRUSHER TO		9-18-78	KH		ITEM 5, DELETED OFFICE FROM ITEM 21, ADDED ITEM 23 & 38		8/14/78	KH		DELETED OIL TANK. COAL STORAGE WAS 516,000 TON	
										7/27/78	RVK		ADDED ITEMS 37 AND 38. RELOCATED ITEMS 9 & 10	
													ISSUED FOR ESTIMATING

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2.0

PROCESS DESCRIPTION

INDEX

- 2.01 Bases For Process Design
- 2.02 Coal Handling and Preparation
- 2.03 Gasification and Gas Clean-Up
- 2.04 Sulfur Removal
- 2.05 Gas Compression, Transmission and Retrofit
- 2.06 Utilities
- 2.07 Waste Water Incinerator
- 2.08 Safety Systems
- 2.09 Environmental Consideration
- 2.10 Process Flow Diagrams*

*Contains Proprietary Drawings

2.0

COMMERCIAL PLANT PROCESS DESCRIPTION

2.01 BASES FOR PROCESS DESIGN

The Process Design Bases take into account factors which involve both the Demonstration Plant and the Commercial Plant. The bases as outlined below pertain to both plants and factors specific to one plant or the other are so indicated.

2.01.1 General

- A. The Demonstration Plant coal gasification facility shall be designed to produce fuel gas from coal that, upon combustion, will yield 7.4 billion Btu/day (HHV) of energy. This fuel gas will be used in Erie Mining Company's pellet plant as a replacement fuel for the natural gas now being used for induration of iron ore pellets.
- B. The Commercial Plant shall be designed to produce fuel gas that, upon combustion, will yield 20 billion Btu/day (HHV) of energy.
- C. Total plant onstream availability (operating hours per year divided by 8760) shall be at least 95%.

2.01.2 Coal Handling and Preparation

- A. The coal handling facilities shall be designed to unload run of the mine sub-bituminous Western coal at the rate of 1433 tons/day and sized bituminous Eastern coal at the rate of 1349 tons/day. Coal analyses are given in Section 2.01.3 below. The Western coal design rate assumes future provision for briquetting the high percentage of coal fines contained in Western coal. The briquetting plant does not fall within the scope of the present study.
- B. The coal storage area shall provide sufficient capacity for storage of a 180 day supply of coal feedstock, based on the Commercial Plant coal usage rates.

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- C. Coal will be delivered in unit trains consisting of 100 cars of 100 ton capacity each. Fifty cars at a time will be delivered to the gasification plant for unloading. Provision shall be made for receiving coal at Hoyt Lakes via commercial railroad or from Taconite Harbor on Erie Mining's own rail systems.
- D. The coal handling facilities shall include coal fines loadout facilities. Fines loadout capacities will be based on commercial scale operations, using sized Eastern coal, generating 12% fines during handling.

2.01.3 Coal Gasification

- A. The coal gasification facilities shall consist of multiple two-stage, fixed bed, dry grate gasifiers with associated equipment including cyclones, coolers, tar and oil precipitators and waste heat recovery systems.
- B. Two process designs shall be made: one for the Commercial Plant and one for the Demonstration Plant. The Demonstration Plant will be a module of the Commercial Plant. The fuel gas heating value outputs for the plants, after desulfurization, will be as follows:

DEMONSTRATION PLANT

Five gasifiers - four operating, one spare, producing 7.4×10^9 Btu/day (HHV)

COMMERCIAL PLANT

Twelve gasifiers - Eleven operating, one spare, producing 20×10^9 Btu/day (HHV)

- C. The gasifiers shall be designed for use with non-caking sub-bituminous coal feedstocks, as well as highly caking coal feedstocks with free swelling indices greater than 5.0.

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- D. Heat and material balances for the coal gasification section are based on a Western sub-bituminous coal (Rosebud-McKay) and an Eastern bituminous coal (Brookville-Clarion-Kittanning mix) with these analyses:

<u>Component</u>	<u>Western Coal</u> <u>Wt. %</u>	<u>Eastern Coal</u> <u>Wt. %</u>
Moisture, as received	25.6	4.3
Proximate Analysis:		
Volatile Matter	32.6	39.4
Fixed Carbon	33.5	46.7
Ash	8.3	9.6
TOTAL	100.0	100.0
Free Swelling Index	0	8.0
Hardgrove Grind, Index 50@20.32% H_2O	46.8@ 1.33% H_2O	
HHV, Btu/lb	8775	12997
Ash Softening Temperatures $^{\circ}F$: ($^{\circ}F$ - degrees F)		
Reducing Conditions		
Initial Deformation	2140	2000
Sperhical	2150	2080
Hemispherical	2165	2310
Fluid	2175	2490

The above analyses are based on two coal samples sent to Babcock Contractors, Inc. by Pickands Mather. They were analyzed by Commercial Testing and Engineering on May 22, 1978, and May 3, 1978. The water content of the Western coal was adjusted from the reported value of 22.8 wt. % to 25.6 wt. % and that of the Eastern coal from 5.5 wt. % to 4.3 wt. %. The equipment in the gasification section shall be sized to handle the range of moisture bracketted by these two adjusted coal analyses.

- E. The gasifier ash removal system shall be designed to handle the ash from coal with 16.6% ash by weight. The ash shall be transported via pneumatic or belt conveyors to silo storage. Storage capacity shall be provided for a four day accumulation, based on commercial level operations using coal with 16.6% ash. Ash shall be moved by mobile equipment from storage to landfill.

2.01.4 Gas Cleanup and Waste Heat Recovery

- A. Gasifier dust shall be removed via gas cyclones and disposed of in a safe and environmentally acceptable manner.
- B. Waste heat recovery shall generate 125 psig saturated steam in process gas coolers on the hot bottom gas outlet.
- C. Precipitated tar and oil shall be combined and pumped to new storage facilities for use as an alternate fuel for iron ore pellet induration and/or firing of the packaged boilers and the waste water incinerator.
- D. The product fuel gas will be tar and particulate free (not more than 0.01 gr/scf of tar and 0.01 gr/scf of particulate at the coal gasification battery limits) as it exits the gas cleaning/waste heat recovery units. The gas shall be cooled to a temperature of 95°F for processing through an H₂S removal system.
- E. Temperature and pressure design conditions at the outlet from the electrostatic precipitator (de-oiler) shall be 95°F and 20" H₂O gauge respectively.

2.01.5 Hydrogen Sulfide Removal

- A. Two process designs of a Stretford H₂S removal system shall be made: one for the Demonstration Plant and a second one which, when added to the Demonstration Plant unit, will provide sufficient capacity for the Commercial Plant unit. The two designs shall be based on use of a high sulfur coal feedstock to the gasifiers (Eastern bituminous coal with a sulfur content of 4.1% by weight), and the following inlet gas composition and flow rates:

Composition		Flow Rates
Component	Vol.%	
H ₂ O	5.58	Demonstration Plant 1.89 x 10 ⁶ scfh
CO	27.13	Commercial Plant 5.09 x 10 ⁶ scfh
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	

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<u>Component</u>	<u>Vol. %</u>
COS	0.08
HCN	10 ppmv
NH ₃	70 ppmv
	100.0

Since the Stretford and Gasifier process designs were developed concurrently, the above gas composition and rates are based on a preliminary gasifier heat and material balance. The effects of the change in gas composition from the above to the final gasifier Eastern coal heat and material balance figures must be evaluated.

- B. Stretford unit oxidizer off-gas shall be discharged to the suction of the gasifier air blowers.
- C. The battery limits design conditions are as follows:
 - Inlet gas: temperature 95°F
 - pressure 20" H₂O gauge
 - Outlet gas: pressure 5" H₂O gauge
- D. The process designs shall not include Stretford solution purge facilities. Liquid purge shall be disposed of to the landfill.
- E. The Commercial and Demonstration plants shall incorporate centrifuges, and a backup system of sulfur melters and decanters. The melters and decanters will be sized to process sulfur froth from the froth tank when the centrifuges are inoperative.
- F. Sulfur shall be disposed of to a landfill site provided by Erie Mining Company.

2.01.6 Gas Compression, Gas Transmission, Retrofit

- A. Two compression process designs shall be made: one for the Demonstration Plant and one for the Commercial Plant. The Demonstration Plant design shall utilize equipment that can readily become part of the Commercial Plant design.

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- B. The fuel gas temperature to the compressors shall be a nominal 100°F. The fuel gas shall be compressed from 5" H₂O gauge to a nominal 12 psig for transmission to the pellet plant.
- C. The fuel gas product pipeline shall be sized for the commercial scale plant.
- D. A new gas distribution system shall be designed for the shaft furnace retrofit application.
- E. For the Demonstration Plant, twelve shaft furnaces shall be retrofitted to accept fuel gas. Of these twelve, three shall be designed to accept tar as well as fuel gas.
- F. For the Commercial Plant, all 27 shaft furnaces shall be retrofitted to accept fuel gas. Six of these furnaces shall be designed to accept tar also.

2.01.7 Waste Water Treatment

- A. As much as possible of the waste water effluent from the gasification plant shall be evaporated and the vapor fed into the fuel gas main to the pellet plant. The waste water remaining after evaporation shall be incinerated.
- B. Sanitary waste shall be handled through the existing pellet plant sewer system.

2.01.8 Gas Effluent Treatment

- A. The Stretford unit off-gas shall be fed to the suction of the gasifier air blowers. The off-gas composition used as the basis for the Eastern coal gasifier heat and material balance is as follows:

<u>Component</u>	<u>Vol. %</u>
CO ₂	0.5
CO	0.1
H ₂	0.1
N ₂	75.5
H ₂ O	7.2
O ₂	16.6
	100.0

Traces of ammonia and methane will also be present.

- B. Minor differences between the above off-gas composition and the final figures from the Stretford heat and material balance will have no significant effect on the gasifier heat and material balance.
- C. Provisions shall be made to flare the coal gas produced during start up, shutdown and emergency situations. Flares shall be located at the gasifiers proper and also on the suction line to the fuel gas compressors.

2.01.9 Utilities, Buildings and Enclosures

- A. Electric power shall be supplied through an existing substation located on the east side of the pellet plant concentrator. The source voltage will be 13.8kv. New transformers, as required, shall be provided for the coal gasification plant. An emergency electrical back up system shall be installed.
- B. An inert gas generation system with dryers shall be installed. The generator shall be fired with low Btu fuel gas. A liquid nitrogen system shall be installed as a backup to the inert gas generator.
- C. Packaged steam boilers shall be utilized for start up and supplemental use. They will be fired with product tar and/or fuel oil.
- D. Plant and instrument air, including driers for the instrument air, shall be supplied from a new air compressor installation independent of existing facilities. Plant air shall not be dried.
- E. Cooling water shall be supplied through a tie-in to an existing line below the concentrator head tanks. Cooling water shall be returned to the concentrator tailings sump.
- F. Boiler feedwater shall be supplied by treating water from the existing freshwater source in the pellet plant concentrator building.

Potable water will be supplied from the existing pellet plant system.

The firewater system shall tie into the existing plant reservoir and will include new firewater pumps and piping.

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- G. A control room suitable for controlling the facilities for coal gasification, Stretford H₂S removal and gas compression shall be included in one main control center. The coal handling, utility, and waste water incinerator control centers shall be located in their three respective areas.
- H. Wash and change rooms, laboratory facilities and limited work shop facilities shall be provided in the plant area.
- I. Conveyor galleries, coal crushing and screening stations, coal gasification facilities, gas and air compression, pumps, and utility service facilities shall all be enclosed. The Stretford unit shall also be enclosed, with the exception of the venturi scrubbers and knockout drums.

.....

A process description of the Demonstration Plant which has been designed in accordance with the foregoing criteria is presented in the subsequent parts of this section.

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.02 COAL HANDLING AND PREPARATION

2.02.1 General

The coal handling and preparation system is sized to support operations of the Commercial Plant, and includes all facilities required for unloading, stacking, reclaiming, crushing, screening, fines loadout and delivery of feed to the gasifiers.

The system is designed for handling unsized sub-bituminous Western coal. It will also handle sized Eastern coal to the extent required.

At normal operation the gasifiers will require delivery of plus 1/2" to minus 1-1/2" coal feed or plus 1" to minus 3".

Coal is shipped to the plant in unit trains of 100 cars, each car of 100 tons capacity. On arriving at the south end of the plant a unit train is cut into two strings of 50 cars each for movement to the coal unloading station.

No incoming shipments are scheduled for the four winter months. Train arrivals are scheduled at the rate of about six per month over the other eight months.

An area provided for coal storage has capacity for a 6 month supply.

The flow of materials through the system is shown on flow diagram drawing Y-01-56-2 and is further described under the area headings which follow.

2.02.2 Unloading, Weighing and Stacking

Normally, all unit trains consist of gondola cars equipped with rotary couplers, but there may be an occasional train made up with cars of random lengths and widths and not equipped with rotating couplers. The unloading facilities are capable of handling both types.

A thaw shed is provided for heating any cars arriving with frozen loads. Cars are moved through it at the rate of 5 per hour.

2.02.2 Unloading, Weighing, Stacking (continued)

Gondolas are positioned by the car positioner (CP-101) in the rotary car dumper (DU-101) which discharges the coal into the dumper hopper (BN-101) at the rate of approximately 17 cars per hour.

Random cars are positioned in the rotary dumper, manually uncoupled, and dumped at the rate of approximately 14 cars per hour.

Coal is discharged from the dumper hopper onto three vibrating feeders (MF-101) to collecting conveyor CO-101, which discharges to transfer conveyor CO-102. The transfer is equipped with a weigh scale (WS-101) which monitors and records the quantity of incoming coal.

Transfer conveyor CO-102 discharges to the active storage pile through a lowering pipe (X-101) which minimizes dust generation. The lowering pipe is equipped with ports covered with rubber flaps. As coal builds up in the pipe, it pours out of the ports nearest to the high point of the pile.

When the active storage pile is filled to its capacity of 5000 tons, or when coal of a different quality arrives, the flow is diverted to conveyor CO-103. From this conveyor the coal is discharged through lowering pipe X-103 to the bypass pile.

Coal is transferred by mobile equipment from the bypass pile to the 180 day storage supply pile, where it is layered, compacted and sealed for protective storage.

2.02.3 Reclaiming

Coal reclaiming is a two shift per day, seven days per week operation.

The daily coal requirement for gasifier feed is supplied from active storage. The active storage pile stands above two reclaim hoppers (BN-102). Two additional reclaim hoppers (BN-103) located outside the storage area, are provided for emergency use.

2.02.3 Reclaiming (continued)

Coal is drawn from the reclaim hoppers by actuation of vibrating feeders (MF-102) or (MF-103) and is discharged on collecting conveyor CO-104. This conveyor is equipped with two tramp metal detectors (X-105), a tramp iron pickup magnet (X-102) and a belt scale (WS-102). Upon detection of ferrous or non-ferrous metal passed by the tramp iron magnet, the protection system automatically shuts down the upstream material supply equipment and marks the location of the tramp metal on the bed of material.

Coal from conveyor CO-104 is normally discharged through a chute to conveyor CO-105 and then to a 1-1/2" x 1-1/2" grizzly for scalping off the plus 1-1/2" material for subsequent crushing by the coal crusher (X-104). If delivered coal sized to plus 1/2" to minus 1 1/2" is being handled, the grizzly is removed manually and the entire flow is delivered through a chute to surge bin BN-104 bypassing the coal crusher.

Coal is removed from the surge bin by two feeders (MF-104) discharging on two single deck screens (VS-101) where the minus 1/2" material is diverted as fines and the plus 1/2" to minus 1-1/2" material is discharged on conveyor CO-106.

Conveyor CO-106 is equipped with a belt (WS-103) scale which monitors and records the amount of coal supplied to the gasification plant. This conveyor discharges the sized coal to the gasifier feed tripper conveyor (CO-107) which automatically controls discharges into 12 gasifier feed surge hoppers. These bins are capable of holding a 12 hour supply of coal to the gasifiers.

2.02.4 Fines Handling

The fines handling system operates two shift per day and seven days per week.

The minus 1/2" fines flow through chutes from the vibrating screens (VS-101), to collecting conveyor CO-108, then to transfer conveyor CO-109 and then through lowering pipe X-106 to the active fines storage pile. Fines from active storage are moved by mobile equipment to either the fines storage pile in the case of Western coal or to a loading hopper (BN-106) in the case of Eastern coal.

2.02.4 Fines Handling (continued)

Eastern coal fines from loading hopper BN-106 flow to a vibrating feeder (MF-105) to conveyor CO-110 and then into a storage bin (BN-107). Conveyor CO-110 is equipped with a weigh scale (WS-104) which monitors and records the weight of fines being sent to the storage bin. These fines are shipped by rail to Taconite Harbor as trains become available, except that no shipments are made during the months of severe winter weather.

On Western coal fines, the briquetting facilities are not included within the scope of the equipment requirements for this plant, although an allowance for these facilities is included.

2.02.5 Unloading (Alternate)

At the request of Erie Mining Company, an alternate method for unloading incoming coal is shown on drawing 4814X-SK-0001-2, included in Section 5.0 of this Design Manual.

Flow of coal from the Rotary Car Dumper to conveyor CO-102 is the same as that described under Item 2.02.2, but instead of discharging into a lowering pipe it is discharged into a coal unloading radial stacker. The stacker discharges into two separate coal storage piles, one live and one for coals of different quality. Reclaiming from either pile is essentially the same as that described under Item 2.02.3.

Installation of this stacker deletes tag numbers X-101 and X-103 (lowering pipes) and CO-103 (conveyor) together with their related appurtenances and also shortens the length of CO-102 (conveyor).

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.03 GASIFICATION AND GAS CLEAN UP

2.03.1 General

In this area of the plant coal is processed with steam and air, in gasifier retorts, to form low Btu synthesis gas and condensable by-products. This raw gas is then processed through cyclones, coolers, and electrostatic precipitators to remove solids, tar and oils before being sent to the Sulfur Removal area of the plant. The basic reaction of coal and steam is $C + H_2O \rightleftharpoons H_2 + CO$. This reaction is highly endothermic and requires the addition of oxygen to provide the necessary high temperature and heat by reacting with the carbon, hydrogen and carbon monoxide. In practice several reactions are simultaneous and an equilibrium mixture results. The main reactions can be summarized as follows:

In addition to the above the resultant gas mixture contains nitrogen from the air used to supply the oxygen plus tar and oil vapors contained in the coals. The presence of sulfur and other trace elements in the coal will also result in their presence in various chemical combinations in the synthesis gas. Depending on the coals used, typical top gas mixtures would be:

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2.03.1 General (continued)

<u>Component</u>	<u>Western Coal</u>		<u>Eastern Coal</u>	
	<u>Feed</u>	<u>Vol. %</u>	<u>Feed</u>	<u>Vol. %</u>
CO		20.4		22.4
CO ₂		5.5		5.5
H ₂		18.0		17.6
N ₂		34.3		41.56
CH ₄		0.7		1.8
H ₂ O		20.7		9.4
C ₂ to C ₅		0.2		0.8
H ₂ S		0.1		0.8
COS		0.04		0.08
Ammonia		0.06		0.06
HCN		40 ppm		59 ppm
Chloride		14 ppm		130

Virtually all the coal is converted to gas with the exception of a slight amount of unburned carbon and coal ash. A typical ash composition would be:

<u>Component</u>	<u>Wt. %</u>
SiO ₂	37.2
Al ₂ O ₃	21.5
Fe ₂ O ₃	5.3
TiO ₂	0.8
P ₂ O ₅	0.4
CaO	13.4
MgO	4.6
Na ₂ O	2.8
K ₂ O	0.7
SO ₃	13.3
TOTAL	100.0

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2.03.1 General (continued)

The typical analyses of tar produced using the Western and Eastern coals specified for this plant, will be as follows:

Specific gravity at 60°F	1.0855
Viscosity at 122°F	555.4 centistokes
210°F	21.25
250°F	9.40

ASTM Dist, correct to atmospheric pressure from test made at 1.2-1.4 mm Hg absolute:

Pour Point	80°F
Flash Point	315°F
Carbon Residue (Rambottom)	4.10 wt. %
Sediment by Extration:	
with Benzene	0.78 wt. %
with Carbon Tet	4.16 wt. %

<u>Ultimate Analysis of Tar</u>	<u>Wt. %</u>
C	82.18
H	9.37
O	7.40
N	0.46
S	0.40
Ash	0.19
	100.0

Heating Value	16,400 Btu/lb.
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The properties of the oil produced will be similar to those of a light aromatic hydrocarbon mixture.

2.03 GASIFICATION AND GAS CLEAN UP (continued)

2.03.2 Gasifiers

The plant will utilize fixed bed, stirred, two stage gasifiers. The lower stage will be a standard gasifier configuration. The upper stage will be an undivided distillation section containing a slowly rotating stirrer which will move vertically through the bed. The bottom of the gasifier will contain a standard dry grate and will have lock hoppers to discharge the ash.

This type of gasifier provides high coal utilization. It also distills the tars and oils from the coal in the upper zone at minimum temperatures, thereby providing minimum viscosity liquid fuels which can be used for the induration of iron ore pellets. The very hot bottom gases leaving the combustion zone, after passing through a cyclone to remove coal and ash dust can be used to generate steam. This steam is in addition to the steam generated in the water jacket of the lower zone which is used in the steam air blast to the bottom of the gasifier retort.

A typical gasifier is shown in Figure 1.

A disadvantage of this type of gasifier is the limited size range of feed stock it can accept. Coal fed to the unit must not exceed the size span of 3 to 1. It can handle a maximum of 10% fines. This means only coal ranging from minus 3" to plus 1" or from minus 1-1/2" to plus 1/2", containing no more than 10% fines smaller than these respective minimum size, can be used in the plant. Excess fines must be disposed of or agglomerated for recycling. For purposes of the design studies it is assumed that agglomerated Western coal feed will be made available, but McKee's design scope of work did not include agglomerating facilities.

2.03.3 Gasification Retort Area

Coal is fed to the gasifiers from an overhead surge hopper which provides a 12 hour supply. It is fed into the top of each gasifier with a coal feed system comprised of belt feeders, lock hoppers, level sensors, and feed chambers. Fluctuations in the coal level are handled in the feed chamber which maintains a constant level in the gasifier, never permitting coal to drop into the gasifier and generate fines. The coal level is allowed to fluctuate in the feed chamber between two levels. The low level sensor serves to start the lock hopper cycle and operate the feeder.

The Commercial Plant will utilize 12 two-stage gasifiers. Coal is introduced in to the top of each gasifier and gravitates through the gasifier in counter flow to the rising gas. The gas is produced by combustion with the air and steam fed into the bottom of each gasifier. As the coal moves down through the upper section of the gasifier, the retort section, it is gradually heated by the rising gas. Volatile matter and moisture are slowly driven off and carried out in the top gas stream. The devolatilized coal travelling down through the gasifier retort zone reacts with the up flowing gas until it reaches the combustion zone. Here the remaining carbon is burned with the incoming air and steam blast, producing gas and the heat for the gasification reactions as well as the devolatilization in the upper stage. The ash forms a bed which supports the combustion zone, protects the grate and preheats the steam/air blast. The condition of the ash is controlled by varying the ratio of steam to air in the blast. The ash is discharged from the bottom of the gasifier, crushed between a revolving ash grate and fixed breaker ring and dropped into the ash lock hopper. From there it is mechanically conveyed to a storage silo prior to disposal to landfill. The quantities of ash produced in the Commercial Plant range from 120 to 150 tons per day, depending on the coal feedstock being used. With a carbon conversion in the gasifier of 98% by weight and an ash content of 9.6 by weight, the carbon content of the ash would be approximately 15% by weight.

2.03.3 Gasification Retort Area (continued)

Air for the gasifiers is supplied at a pressure of 80 inches water gauge by a centrifugal blower. Five blowers are installed, four operating and one spare. Part of the air, about 15 wt. %, will come from the Stretford oxidizer off gas when the Stretford unit is operating. This stream, slightly lower in oxygen content than atmospheric air, is then mixed with the steam produced in the water jackets surrounding the combustion zones of the gasifiers. The steam/air mixture enters the gasifier through the rotating grate and is preheated as it passes through the ash bed. The gasification reactions take place just above the combustion zone, producing the low Btu gas consisting mainly of carbon monoxide, carbon dioxide, hydrogen, water vapor and nitrogen.

At a point just above the gasification zone, a portion of the bottom gas is withdrawn from the gasifier at a temperature in the range of 900°-1200°F. This stream, the "clear gas", exits at the side of the gasifier. The remainder of the gas travels through the upper portion of the gasifier drying and devolatilizing the descending coal. This stream, the "top gas", leaves the gasifier at about 250°F. The flow split between the top gas and the clear gas is controlled to achieve proper coal devolatilization while maintaining a gentle distillation of the coal tars.

2.03.4 Gas Cooling and Waste Heat Recovery

The top gas, containing tar, oil and vaporized water, is collected in a header and passes first through electrostatic precipitators (de-tarrers) where tar mist is coalesced and separated from the gas stream. Six electrostatic precipitators in parallel are provided for this service. After tar removal the gas is combined with cooled clear gas and the mixed gases pass to the final gas coolers. These are shell and tube heat exchangers where the gas is cooled with water to about 95°F. Here water vapor and oil are condensed. The cooled gas flows to a second bank of six electrostatic precipitators (de-oilers). The oil and water condensed in the final gas coolers is separated from the gas stream and flows by gravity to a decanter tank.

2.03.4 Gas Cooling and Waste Heat Recovery

The clear gas exits the lower zone of the gasifiers at a temperature of about 1200°F and passes through refractory lined cyclones where the slight amount of entrained char is removed. The char consists mainly of carbon and ash. It may be wetted down and conveyed with the ash to the ash storage silo and from there disposed of to a controlled landfill, or the wetted char may be sent to the coal fines area for mixing with coal fines. Plans for disposition of this char have not been finalized.

The clear gas passes next through a process gas cooler where most of the sensible heat in the gas is recovered in the form of steam. The process gas cooler generates 125 psig steam which is used for general plant heating and other process uses. The clear gas is then combined with the top gas as discussed above. The clean cool gas exiting the precipitators is suitable for introduction into the Stretford hydrogen sulfide removal unit.

When operating with low moisture Eastern coal a small water spray is added to the gas stream prior to the final gas coolers. This is done since, without the spray, there would be no water condensation in the final gas coolers and chlorides in the gas would pass through to the Stretford unit. By adding a spray of sufficient quantity to cause a small amount of condensation, these chlorides as well as some ammonia and cyanide can be removed from the gas stream.

2.03.5 Tar and Oil

Oil and water from the coolers and de-oilers are separated in a decanter tank. The oil is then combined with the tar from the de-tarrers and stored for use as supplemental fuel for the pellet furnaces, for steam generation, or for incineration of liquid wastes. The yield of tar and oil is a function of the volatile matter in the coal. Production of tars and oils will amount to approximately 7,722 lbs/hr with use of Western coal and approximately 18,724 lbs/hr. with Eastern coal.

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2.03.6 Waste Water

The waste water condensed in the gasifier section is pumped from the oil/water decanter tank to a waste water storage tank. The quantity of water can vary greatly depending on the moisture content of the coal feedstock. It can range from near zero with use of a low moisture Eastern coal to about 90,000 gallons per day with a high moisture Western coal.

FIGURE 1

TWO STAGE GASIFIER

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.04 SULFUR REMOVAL

In the Stretford process, the Stretford solution absorbs H_2S , converts it to sulfur and is reoxidized by air. The process is based on the ability of vanadium, when in a five-valent state, to react with the bisulfide in an alkaline solution and oxidize it to elemental sulfur. In this reaction, the vanadium is reduced to a four-valent state. Oxidation of the solution with air oxidizes the ADA, which is a component of the solution, which in turn oxidizes the vanadium back to the five-valent state for reuse in H_2S removal.

In the Stretford unit the fuel gas first enters the venturi scrubber where it is contacted with lean Stretford solution. This gas/liquid mixture is discharged into the Stretford knock-out drum. The overhead product gas from the knockout drum contains less than 10 ppm H_2S . The Stretford solution from the bottom of the absorber flows to the reaction tank. Residence time for the sulfur reaction to go to completion takes place in the reaction tank. The overall reaction is:

The solution flows by gravity from the reaction tank through three oxidizers in series, where turbine aerators are used to disperse air supplied by the air blower. The oxidizer tanks perform the dual function of floating off elemental sulfur froth and converting the Stretford solution to the oxidized state. Sulfur froth is collected in the last oxidizer by a launder and flows by gravity to the froth tank. The oxidized solution flows from the last oxidizer to the balance tank, where it is circulated through jacketed pipe and a cooler for maintaining heat and water balance. Stretford solution from the balance tank is pumped back to the venturi scrubber to complete the cycle.

The sulfur froth which has flowed to the froth tank is agitated gently, deaerated, and kept in suspension prior to being pumped to the centrifuge. The centrifuge produces a 40-50% sulfur slurry which is then pumped to the decanter after passing through a heat exchanger with indirect steam heat. The steam melts the sulfur crystals by increasing the slurry temperature. The sulfur is removed from the decanter under level control through a steam jacketed line to the molten sulfur storage tank. Upon sufficient accumulation, molten sulfur is pumped to the flaker for more

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convenient storage and handling. Decanted Stretford solution flows out the top of the decanter and returns to the balance tank on back pressure control.

Auxiliary equipment necessary for the performance of the unit consists of a make-up pit for preparing fresh Stretford solution and adding make-up chemicals; and an additive injection package for adding diesel oil to the solution to aid in the floatations sulfur crystals in the oxidizer tanks.

Several side reactions take place in this circulated Stretford solution producing soluble sulfate salts. When these salts have built up to about 25 weight percent total dissolved salt concentration, a continuous side stream from the circulated solution is drawn off to a purge tank for further disposal.

For the Commercial Plant gas flow, a second Stretford unit is added to the Demonstration Plant unit with essentially twice the capacity. The process steps for both units are identical and as described above.

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2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.05 GAS COMPRESSION, TRANSMISSION AND RETROFIT

2.05.1 Gas Compression

From the Stretford hydrogen sulfide removal unit, the gas passes next to the main gas compressors. It should be noted that when operating on low-sulfur Western Coal the Stretford unit is by-passed and the gas passes directly from the gas clean up section to the compressors.

Compression is necessary because the pellet furnace combustion chambers, where the product gas is burned, operate at pressures of 4 to 6 psig. In addition to this a pressure drop allowance must be made for frictional losses in piping, in control valves at the burners, and in the burners themselves. Including contingency, the total required discharge pressure is about 12 psig. The suction pressure of the compressor is virtually atmospheric since most of the pressure available at the gasifier is taken up in the gas clean up and Stretford sections.

Multistage centrifugal compressors are used for this service. Overall plant design criteria call for easy and economical scale up from the Demonstration Plant to the Commercial Plant. For this reason the gas compressors are sized for 50 percent of the Commercial Plant gas rate. Two units are provided for the Demonstration Plant, one operating and one spare. Thus, with the addition of a third identical unit, the required Commercial Plant gas capacity will be achieved. In this case two units will be operating with one unit as a common spare.

There are two major control loops at the compressors. The first is the discharge pressure control loop in which the pressure in the product gas transmission line is controlled by throttling the suction of the compressors. The second controls the compressor suction pressure upstream of the above throttle valve. The pressure here is controlled by resetting the flow control of combustion air to the gasifiers. The two control loops work together to modulate gasifier output in proportion to gas demand.

2.05.2 Gas Transmission

From the compressors the gas is transmitted approximately 1200 feet to the Pellet Plant furnaces. The transmission line sized for the Commercial Plant requirement, is 48 inches in diameter. The gas is distributed within the pellet plant through two 24 inch headers.

The low Btu gas transfer lines are insulated but are not heat traced. The heat of compression is sufficient to maintain the temperature of the gas above its dew point in cold weather. Low point drains are provided for any condensation that might occur during start up.

2.05.3 Retrofit

With use of new burners, the low Btu gas can readily replace natural gas as fuel in the pellet plant shaft furnaces. New burners are required because the volume of low Btu gas required for a given heat output is much higher than that of natural gas. The new burners specified are capable of firing low Btu gas, natural gas, No. 2 fuel oil, No. 6 fuel oil and the tar/oil by product produced in the gasification plant. The low Btu gas pressure drop required for the new burners under normal flow conditions is 1 to 2 psi.

In the existing pellet plant there are two combustion chambers per shaft furnace, each with its own combustion chamber temperature control and combustion controls for natural gas and fuel oil. For the retrofit, a new burner is fitted to the existing combustion chamber and the existing valving and instrumentation for natural gas and fuel oil are utilized. New lines and new combustion control valving are added for low Btu gas and for gasifier tar/oil. These controls tie into the existing combustion chamber temperature control loop and the furnace shutdown system.

The low Btu gas lines to the combustion chambers are 10 inches in diameter. A temperature control valve, a pressure control valve, and a manual shut off valve are provided for each burner train. The basic control functions provided in the low Btu gas burner trains are identical to those provided in the existing natural gas controls. However, since the operating pressure of the low Btu gas header is much closer to the combustion chamber operating pressure, an additional safety measure is included. A flow sensing device coupled with a low flow shutdown switch is provided at each burner to detect and stop any backflow of air from the combustion chamber should an upset occur.

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2.05.3 Retrofit (continued)

All of the pellet plant's twenty-seven (27) shaft furnaces are retrofitted for use on low Btu gas, and six of them are additionally equipped for use of gasifier tar/oil. The fuel output from the Commercial Plant will supply 100 percent of the pellet plant requirements.

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.06 UTILITIES

2.06.1 Inert Gas

The Commercial Plant inert gas requirements are approximately 250 scfm. The generating system is designed to produce 333 scfm.

There are three primary uses of inert gas in the plant, namely:

- For pressurizing the gasifier lock hoppers to minimize coal gas leakage at the coal feed mechanism. This accounts for most of the total requirement.
- For purging the gasifier flare lines to prevent entry of air.
- For purging of instrumentation.

Inert gas is supplied by a system consisting of a generator, an aftercooler, a compressor and a dryer. The aftercooler, in which gas from the combustion chamber is cooled, is a shell and tube heat exchanger as opposed to the direct cooling type with a water spray. This choice was made to minimize waste water effluent from the unit.

The generator produces inert gas by precise metering of low Btu fuel gas and air to the combustion chamber in proportions ensuring that complete combustion occurs. The combustion product contains N_2 , CO_2 , water vapor and traces of SO_2 , NH_3 and oxygen.

On leaving the combustion chamber the gas enters the water cooled shell and tube exchanger, in which most of the SO_2 and NH_3 is absorbed by condensing water vapor. Saturated with water vapor, the gas leaves the exchanger at 100°F and 0.3 psig and flows to the compressor.

2.06.1 Inert Gas (continued)

The compressor is a two-stage reciprocating type. Because of the corrosive nature of a liquid water-carbon dioxide mixture, all pipe containing inert gas saturated with water vapor is steam traced and insulated to maintain the gas at or above its dew point. The saturated gas leaves the compressor aftercooler at 100°F and 110 psig.

The gas then flows to a desiccant dryer where it is dried to a dew point of -50°F. The composition of the final inert gas product is approximately 20.3% CO₂ and 79.7% N₂.

A liquified nitrogen storage tank and an electric vaporizer are provided as backup to supply inert gas at startup and during periods when the generating system is not operating.

2.06.2 Steam

Steam Requirements - A steam balance, based on operation during the winter season with Western coal feed to the gasifier, indicates a maximum steam demand of about 124,000 per hour for the Commercial Plant.

Steam supply - The steam demand is met by contributions from four sources, as follows:

- The process gas coolers, each of which is designed to produce 125 psig steam at the rate of 6040 lb/hr when operating on Eastern coal. The steam balance requires a combined total steam production by the process gas coolers of 23,000 lb/hr for the Commercial Plant when operating on Western coal.
- The Waste Water Incinerator produces 125 psig steam at a rate of approximately 16,900 lb/hr for the Demonstration Plant. A detailed description of the incinerator is given in Section 2.07 below.

The amounts of steam produced by the process gas coolers and the incinerator are fairly constant and are not controlled. The production rates are a function of the level of plant output and the coal being gasified.

2.06.2 Steam (continued)

- Each "Packaged" boiler is designed to produce 27,600 lbs/hr of 125 psig steam. The duty of the packaged boilers is twofold: during normal operations they supply the difference between the amount of steam produced by the process gas coolers and the incinerator, and the total 125 psig steam requirement; and when the process is shut down they supply the entire requirement for area heating and the steam required for startup.

Two packaged boilers are to be installed for the Demonstration Plant, with provision for addition of a third unit for the Commercial Plant. During normal operation of the Commercial Plant one or two boilers will be base loaded, furnishing steam at a constant rate; the other is swing loaded, maintaining pressure in the 125 psig header in the event of surges in demand. The rate at which the base loaded boiler supplies steam is established by the type of coal being gasified (which determines the amount of steam produced by the waste heat boilers and incinerator), by the amount of the requirement for process heat, and by the building heat requirement which varies with the seasons.

- The gasifier jackets, producing 25 psig steam, all of which is consumed in the gasification process.

The pressure levels and approximate quantities of steam required for winter operation on Western coal are as follows:

Steam Requirements - Pounds per Hour (Winter Operation - Western Coal)

<u>Grade</u>	<u>Commercial Plant</u>
125 psig, saturated	92,420
50 psig, saturated (not reqd.w/West.)	0
25 psig 353°F	7,440
15 psig gasifier process steam	37,240
TOTAL	137,100

The 125 psig steam from the process gas coolers, the incinerator and the package boilers is sent to a single header, from which the requirements for building heat and for other users are taken. Steam from the single header is also sent to reducing stations for production of 50 psig and 25 psig steam. The 50 psig steam is used in the sulfur melter in the Stretford unit, when the plant is operating on Eastern coal, and must be desuperheated because of the temperature-viscosity relationship of liquid sulfur.

2.06.2 Steam (continued)

The 25 psig steam is used for deaerating boiler feedwater, and as process steam for the gasifiers at startup. De-superheating is not required for these uses.

Condensate System

The condensate from approximately half of the above steam is returned to the deaerator for reuse as boiler feedwater. The condensate first enters a deaerator feed surge tank through a sparge nozzle and is mixed with treated makeup water, thereby preheating the makeup. The mixture is pumped to the deaerator and is then ready for vaporization.

Boiler Feed Water

Approximately 150 gpm of treated makeup must be supplied to the steam generating equipment. Production of this much treated water requires a maximum of about 200 gpm of raw water, which allows for blowdown, backwashing of filters and regeneration of softeners. The raw water is brought from the 18 inch Colby Lake Reservoir water line at Erie Mining Company's Pellet Plant concentrator to the boiler feedwater treatment system. Boiler feedwater treatment consists of the following sequence of processes:

- Clarification, the purpose of which is to remove dissolved matter and turbidity by adding various flocculating agents to the raw water. The clarifier basin provides for addition and mixing of these agents with the raw water, settling of the floc and removal of the coagulated matter. The clarifier underflow is sent to the evaporation pond.
- Filtration, where suspended matter not settled out in the clarifier basin is removed mechanically by passing the water through porous media. The development of excessive pressure drop across the filter bed signals a bed condition nearing saturation with contaminants and the need for backwashing. This is accomplished by passing filtered water through the bed in the direction opposite of normal, at a rate sufficient to lift and expand it, thus dislodging the impurities. Backwash effluent goes to the evaporation pond. Filtered effluent goes to the Clearwell sump, which provides surge capacity for filtered water. Its level is controlled by throttling the flow of raw water into the clarifier.

2.06.2 Steam (continued)

- Softening, to remove the calcium and magnesium ions which form scale on hot surfaces of steam generating equipment. This is done by passing the water through a bed of ion exchange resin which adsorbs the hard calcium and magnesium ions and replaces them with soft sodium ions. In due course the ion exchange medium becomes saturated with hard ions and loses effectiveness. At this point the softener is regenerated by passing through it a strong brine solution rich in sodium ions, which strips off the adsorbed calcium and magnesium ions. The hard ions and the excess salt solution are sent to the evaporation pond. The softened water goes to the deaerator surge tank where it is mixed with returned condensate.
- Deaeration. The feed surge tank operates at atmospheric pressure and at temperatures of 150°F to 180°F. A level control valve in the line between the softener and the tank controls the rate at which the softened makeup is admitted. The makeup-condensate mixture is next pumped to the deaerator, which operates at 5 psig and 225°F, where it is heated to saturation temperature by injection of steam at 25 psig and 353°F. At this temperature all of the carbon dioxide which was dissolved in the makeup water, and most of the oxygen, is released. The final oxygen content is about 0.005 cc/liter. The water is then ready to be pumped to the steam generating equipment.
- Two boiler feedwater pumps are provided, one low pressure and the other high pressure. The low pressure pump, which has a design capacity of 85 gpm, sends water to the gasifier jackets for production of the 25 psig steam required in the gasification process. The high pressure pump, which has a design capacity of 200 gpm, sends water to the generators of 125 psig steam, i.e., the process gas coolers, the waste water incinerator, and the packaged boilers.

2.06.3 Cooling Water

The design requirements for cooling water are 3800 gpm for the Demonstration Plant and 6700 gpm for the Commercial Plant.

The cooling system is the "once through" design in which the water is passed through heat exchange equipment and is then discharged to waste. The water flows by gravity from a line below the existing Concentrator Head Tanks at the pellet plant to the gasification plant, and returns by gravity to the Tailings Sump in the Concentrator building.

2.06.3 Cooling Water (continued)

A hydrostatic head of 25 to 30 psi is available for getting the water from the concentrator head tanks, through the gasification plant cooling equipment and back to the tailings sump. The allowable pressure drop through the cooling equipment is specified as 10 psi, which leaves 15 to 20 psi for frictional pressure loss through the piping. Because of the length of the water supply and return lines (approximately 6200 feet of straight pipe plus fittings) a 24-inch diameter pipe is required for both lines based on the Commercial Plant requirements.

No treatment is necessary because no evaporation occurs in the system, and thus there is no concentration of impurities in the water. Erie Mining Company has long used tailings pond water in this manner for cooling and has encountered no corrosion or fouling problems.

2.06.4 Instrument and Plant Air

Total instrument air and plant air requirements are furnished by two identical 500 scfm compressors operating simultaneously. The discharge pressure from the compressors is 110 psig.

On leaving the compressor aftercooler the air flow is split. Plant air goes directly to a receiver and thence to the plant air header. Instrument air goes first through a desiccant dryer where it is dried to a dew point of -500°F , and then to an instrument air receiver.

Without safeguards, an abnormally heavy demand for plant air would cause a pressure drop in the instrument air header. Occurrence of this condition is prevented by a low pressure switch in the instrument air header which activates a valve to cut off the flow to the plant air header.

2.06.4 Instrument and Plant Air (continued)

To maintain instrument controls in the event of an air compression system failure, provision has been made for supplying nitrogen from the backup nitrogen system described in Paragraph 2.06.1 below. When the pressure in the instrument air receiver drops below a set point, an automatically activated control valve admits nitrogen to the system. At the same time, a valve in the discharge line from the air dryers is closed to prevent air from entering the inert gas system.

2.06.5 Electrical Power

Distribution

As shown on the single line diagram, Drawing No. N-00-01-2, electrical power for the fuel gas plant is supplied through Erie Mining Company's existing Substation No. 1 located on the east side of the pellet plant concentrator. The source voltage is 13.8 kv.

It being desired to centralize the electrical equipment so far as practical, the greater part of it is installed in a main electrical room located adjacent to the gasifiers. However, because of the large loads in the car dumper area and the long distance between that area and the main electrical room, a second load center is located at the car dumper electrical room. Also, because of the long runs between the various buildings and conveyors, the motor control centers are located centrally with respect to the loads they feed.

Two 13.8 kv feeders run from the substation to the main electrical room of the gasification plant. One is sized to handle the maximum load capacity of the 7500/8400/10,500 kva transformer at the main electrical room, plus that of the 7500/8400 kva transformer at the car dumper electrical room. A secondary feeder, tapped into the main feeder, runs to the car dumper electrical room. The second 13.8 kv feeder is sized to handle the second 7500/8400/10,500 kva transformer to be installed at the main electrical room.

The major items of electrical equipment, and their locations, are as follows:

Main Electrical Room: 2 - 7500/8400/10,500 kva transformer
2 - 1500/1725 kva transformer
1 - 4.16 kv switchgear
1 - 480 V switchgear
1 - 4000 V motor control center
3 - 460 V motor control center

2.06.5 Electrical Power (continued)

Car Dumper Electrical Room: 1-7500/8400 kva transformer
1-4000V motor control center
1-500 kva transformer
1-460 V motor control center

Sulfur Removal Building: 1 - 460 V motor control center

Screening Station: 1 - 460 V motor control center

Utilities Building: 2 - 460 V motor control centers

Incinerator Building: 1 - 460 V motor control center

The 13.8 kv feeder voltage is transformed to 4.16 kv at the 7500 kva transformers and the plant power distribution begins at the 4.16 kv switchgear.

The 4.16 kv switchgear feeds the 4000 hp motors, 4000 V motor control centers and the 1500 kva transformers.

The 1500 kva transformers change the 4.16 kv to 480 V and feed the 480 V loads through 480 V switchgear and 460 V motor control centers.

Instrumentation

The instrumentation provided is of the latest proven designs. In general the instruments are electronic. Any required transformation of control signals from electric to pneumatic, etc. are made at the final control device.

The gasifiers and Stretford unit are controlled from a main control room located at the gasifier building. Local control panels are provided in the utilities, waste water treatment and compressor areas.

A distributed instrument control and monitoring system with conventional analog field instruments has been included for this project. The process and control signals will be interfaced at remote locations and linked to centralized operator's displays and control consoles via a highway system. A number of operator's stations grouped together form the operations center, located in the Control Center.

2.06.5 Electrical Power (continued)

The operations center will include the following:

- a. Microprocessor controller
- b. C.R.T.'s for overview, group and alarm displays
- c. Trend recorders
- d. Printer
- e. Keyboards for operator system communication and control
- f. Trend memory

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2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.07 WASTE WATER INCINERATION

Process waste water is generated by condensation from the process gas stream when it is cooled. This effluent contains contaminants (such as phenols, cyanide, and chlorides) which must be dealt with to avoid pollution of natural waterways. To dispose of this stream, along with two other minor effluent streams, a system of evaporation followed by incineration is used. The other two streams, both less than one gallon per minute, are effluent from the inert gas generating system and water from the flare seal drum.

The major components of the evaporation/incineration system are a dirty water sump, a waste water storage tank, a waste water evaporator and the incinerator. A second evaporator, roughly twice the size of the first, will be added for the Commercial Plant. The other components are sized for the Commercial Plant. Operation on Western coal, with its high moisture content, sets the sizing requirements for all components in this system. For operation on Eastern coal, this entire system is run intermittently to dispose of the relatively small quantity of aqueous waste produced. The waste water incinerator package consists of an incinerator, a waste heat recovery unit, a steam drum, two combustion air compressors, and associated instrumentation.

The contaminated waste water streams flow to the dirty water sump where the aqueous and hydrocarbon phases are separated. Levels in the sump are maintained by on-off control of the sump pumps. The hydrocarbon phase is pumped to the tar and oil storage tanks. The aqueous phase is pumped to the waste water storage tank, which is sized for three days' capacity at the Commercial Plant rate. Because of its outdoor location, the storage tank is insulated and heated with an internal steam coil to prevent freezing.

Waste water is pumped from the storage tank to the evaporator, a kettle-type exchanger using 125 psig saturated steam as the heating medium. Its purpose is to evaporate as much of the water as possible, to minimize the amount remaining to be incinerated. Experience with similar applications indicates that a practical evaporation rate could be about 80% of the feed rate. During operation of the Demonstration Plant, efforts will be made to determine the maximum practical evaporation rate.

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Operation of the evaporator is controlled by the ratio of vapor generated to water entering. This ratio is controlled by adjusting the steam rate to the exchanger so that a given amount of vapor is produced from a given amount of influent. Vapor leaves the exchanger at approximately 15 psig and 250 degrees F. Its pressure is reduced to about 12 psig as the gas is fed to the product gas transmission line.

Water from the evaporator flows to a surge drum, whence it is pumped to the incinerator. The level of the surge drum is controlled by throttling the incinerator feed pump discharge. Water flows from the surge drum to the incinerator at rates ranging from a minimum of 5 gpm to a maximum of 25 gpm. Its approximate composition for Western coal is:

pH	7.9
Total Dissolved Solids	1800 ppm
Sulfide (as H ₂ S)	330 ppm
Total Sulfur	380 ppm
Fatty Acids (as Acetic)	370 ppm
Ammonia (free)	6000 ppm
(fixed)	300 ppm
Carbonate (as CO ₂)	7500 ppm
Cyanide (as CN)	10 ppm
Thiocyanate (CNS)	100 ppm
Chloride (as Cl)	150 ppm

The incinerator is fired with a mixture of by-product tar and oil from the gasification process, or with Bunker "C" fuel oil as backup. The waste water is sprayed into the combustion chamber where it is vaporized and combustible components are bulk oxidized. These, together with the combustion products from the fuel, are vented to the stack.

As mentioned earlier, a waste heat recovery unit is incorporated in the design of the incinerator to recover part of the heat from the hot stack gas. Boiler feedwater is circulated through the tubes of this heat exchanger and steam is exported from the steam drum. The system is designed to produce 15,000 to 20,000 lb/hr of 125 psig steam.

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.08 SAFETY SYSTEM

To provide for safe operation during certain upsets and also for ease of startup, the plant design includes a flare system which is independent of those provided at the gasifiers. It is tied into the gas circuit upstream of the gas compressors.

The primary function of this system is to provide pressure relief during any upset which causes an overpressure condition on the suction side of the compressor. This condition could occur in the event of a trip of the gas compressor and subsequent failure of the check valves on the compressor discharge.

A second function of the system is to provide an alternate means of gas disposal during start up. The flare is located downstream of the gas clean up and hydrogen sulfide removal facilities. Thus, during start up, gas flow can be initiated through those units and vented to the flare without starting up the compressor and burning the gas in the pellet furnaces. Venting in this manner would also be of value in the event of a compressor failure, since the gasifiers, gas clean up and the hydrogen sulfide removal sections could stay on line during commissioning of the spare compressor.

The flare itself is essentially a 20 inch diameter carbon steel pipe with a stainless steel flare tip. The tip is equipped with pilots and a pilot ignition system. The flare is tied into the gas compressor suction through a water seal drum which acts as the pressure relief seal and vents gas to the flare when the gas pressure exceeds 30 inches w.g. A second leg in the seal drum is set at a lower pressure. This leg is tied into the gas compressor suction through a pressure control valve and is provided as the alternate vent for startup. In this case the seal drum serves to prevent flashbacks when the system is in use. The flare stack is sized to handle 25 percent of the normal flow of the Commercial Plant, with a short term maximum of 100 percent.

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2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.09 ENVIRONMENTAL CONSIDERATION

The Commercial Plant, by virtue of process and equipment selection, safeguards, monitoring and use of available technology, controls environmental pollutants at less than maximum levels allowed by regulatory agencies.

An Environmental Impact Assessment for the Commercial Plant is being prepared by Erie Mining Company. This EIA will cover the activities associated with the Demonstration Plant. The EIA for the Commercial Plant will contain data necessary to insure compliance with Federal, Minnesota State and local regulations.

2.0 COMMERCIAL PLANT PROCESS DESCRIPTION (continued)

2.10 PROCESS FLOW DIAGRAMS

Flow diagrams relating to Demonstration Plant processes are listed below by plant area, drawing number and title. The flow diagrams will be found by reference to the Drawing Index in Section 9.0, Volume 2 of this report.

<u>DRAWING NUMBER</u>	<u>TITLE</u>
<u>General - Area 00</u>	
Y-00-51-2	Conceptual Block Flow Diagram
Y-00-52-2	Conceptual Flow Diagram
<u>Material Handling - Area 01</u>	
Y-01-54-2	Block Flow Diagram - Eastern Coal
Y-01-55-2	Block Flow Diagram - Western Coal
Y-01-56-2	Coal Handling and Preparation
<u>Gasification - Area 02</u>	
*Y-02-51-2	Process Flow Diagram Western Coal, Sheet 1
*Y-02-52-2	Process Flow Diagram Western Coal, Sheet 2
*Y-02-53-2	Process Flow Diagram Eastern Coal, Sheet 1
*Y-02-54-2	Process Flow Diagram Eastern Coal, Sheet 2
<u>Sulfur Removal - Area 03</u>	
*Y-03-51-2	Process Flow Diagram - Stage I
*Y-03-52-2	Process Flow Diagram - Stage I
*Y-03-53-2	Process Flow Diagram - Stage II
*Y-03-54-2	Process Flow Diagram - Stage II
<u>Gas Transmission - Area 04</u>	
Y-04-51-2	Gas Compression (PFD)
<u>Waste Treatment - Area 05</u>	
Y-05-51-2	Wastewater Facilities - Western Coal (PFD)
Y-05-52-2	Wastewater Facilities - Eastern Coal (PFD)

* Proprietary Data

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DRAWING NUMBERTITLEUtilities - Area 06

Y-06-51-2	Cooling Water
Y-06-52-2	Inert Gas and Nitrogen
Y-06-54-2	Plant and Instrument Air Flow
Y-06-55-2	Potable Water and Sanitary Sewer
Y-06-56-2	Steam, Boiler Feedwater and Condensate
Y-06-57-2	Boiler Feedwater Treatment
Y-06-59-2	Settling Pond Block Flow Diagram

4814-Y-01-54-2

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**
CLEVELAND, OHIO

4814-Y-01-54-2

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

MATERIALS HANDLING
COMMERCIAL UNIT
BLOCK FLOW DIAGRAM — EASTERN COAL

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

REVISIONS
10-13-78 MS 74 REDRAWN GENERAL REVISION
9-19-78 AEG 75 ISSUED FOR REVIEW

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

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**

CLEVELAND, OHIO

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

SCALE NONE

REVISION 1

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

MATERIALS HANDLING

COMMERCIAL UNIT

BLOCK FLOW DIAGRAM — WESTERN COAL

NOTES:

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

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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	4814-Y-02-86-2
CLEVELAND	OHIO	SHEET 2 OF 2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. 3001	P.E. NO.
	PROCESS ENGINEERING APPROVAL	
	BY: <i>T. H. [Signature]</i> DATE: 12/21/78	
GASIFICATION COMMERCIAL UNIT P.F.D. WEST COAL	REVISION	0

SCALING RULES

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

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

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

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

CY 202 A TO M
TAR CYCLONEE 201 A TO M
PROCESS GAS COOLER
5,22MM BTU/HRD 202 A & B
H-F STEAM DRUM
4'-6" I.D. 15'-6" T.T.X 201 A TO F
TAR PRECIPITATOR
13'-9" I.D. 24' T.T.E 202 A TO E
COMBINED GAS
COOLER
13,56MM BTU/HRTK 201 A & B
OIL/WATER SEPARATOR
4'-0" H X 20'-0" L X 7'-0" WX 202 A TO F
OIL PRECIPITATOR
13'-9" I.D. 24' T.T.

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

NOTES

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

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

BABCOCK CONTRACTORS INC.

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

↓ CRITERIA	STREAM IDENTIFICATION		7		E		12		13		14		15		16		17		18		19		20		21		
	CLEAR GAS		TOF GAS		H.F. BFW.		H.P. STEAM		DETARRED GAS		CCCLD GAS		CIL/WATER		TAR		AQUEOUS EFFLUENT		TAR/OIL		HP-BLOW DOWN		SPRAY WATER				
	#/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													54	0.5	5573	55.7	13132	131.4	1.0		19						
CARBON DIOXIDE													95884	3423.8							18704	187.1					
HYDROGEN													36217	822.8	16	0.35			16	0.35							
NITROGEN													5362	2660.5													
METHANE													178834	6386.8													
C ₂ TO C ₄													1524	95.0													
HYDROGEN SULFIDE													1757	40.0													
CARBONYL SULFIDE													2481	72.8	24	0.73			24	0.73							
AMMONIA													752	12.6													
HYDROGEN CYANIDE													106	6.24	46	2.70			46	2.70							
OXYGEN													12.4	0.44	13	0.51			13	0.51							
CHLORIDE																											
WATER								54762	30422	49783	2765.7		14474	803.6	3010	167.32		70	2.00	3008	167.21	2	0.11	4978	276.5	5405	300.3
TOTAL								54762	30422	49783	2765.7		337457	14325.1	8752	229.3	13151	131.4	3178	173.5	18725	187.2	4978	276.5	5405	300.3	
MM SCFD USGPM	83.5		47.2		30"		115.68		251		46		128.55		17.5		25.97		6.35		37.57		9.95		10.8		
PRESSURE PSIG OR" H ₂ O		40"		30"	125PSIG		125PSIG		25" H ₂ O		207BL		95		95		250		25PSIG		204				60		
TEMPERATURE °F	1140		250		210		352		250		95		95		95		250		95		204				60		
DENSITY LB/FT ³	0.0219		0.0485		59		0.308		0.0464		0.0581		61.7		63.24		62.0		62.0		62.1				62		
ENTHALPY MM BTU/HR	587.3		666		8.22		57.9		436		850.1		95.5		95.5		230.1		0.03		326		1.6		0		

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U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2573 A

PREPARED BY

McKee

CLEVELAND

OHIO

4814-Y-02-88-2
SHEET 2 OF 2

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

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

PROJECT NO. 3001
PROCESS ENGINEER
APPROVAL
DATE 12/21/78
REVISION 0

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

NOTES:

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

WESTERN COAL CASE

COMPOSITION		1		2		3		4	
		COOLED GAS FROM GASIFICATION UNIT		COMPRESSOR DISCHARGE		VAPOR FROM WASTE-WATER EVAPORATOR		COAL GAS TO PELLET PLANT	
		#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
TAR/OIL		23.2	0.24	23.2	0.24			23.2	0.2
CARBON MONOXIDE		93,449	3336	93,449	3336			93,449	3336
CARBON DIOXIDE		38,222	868.7	38,222	868.7	118.1	2.66	38,340	871.4
HYDROGEN		5,747.3	2,851	5,747.3	2,851			5,747.3	2,851
NITROGEN		155,530	5,553	155,530	5,553			155,530	5,553
METHANE		1,316.8	82.08	1,316.8	82.08			1,316.8	82.0
C ₂ TO C ₅		1,027.3	25.68	1,027.3	25.68			1,027.3	25.6
HYDROGEN SULFIDE		730.8	21.43	730.8	21.43	5.9	0.17	736.7	21.6
CARBONYL SULFIDE		378.4	6.30	378.4	6.30			378.4	6.3
AMMONIA		904.9	53.14	904.9	53.14	97.8	5.75	1,002.7	58.8
HYDROGEN CYANIDE		8.6	0.32	8.6	0.32	8.6	0.32	17.2	0.6
WATER		13,681	759.5	13,681	759.5	24,789	1,377.2	38,470	2,136.7
PHENOL						7.6	0.08	7.6	0.0
CHLORIDE									
TOTAL		311,019	13,557.4	311,019	13,557.4	25,027	1,386.2	336,046	14,943.6
USGPM	MMSCFD		123.32		123.32		12.61		135.93
PRESSURE, PSIG ("H ₂ O)	(20")			12.2		12.2		12.2	
TEMPERATURE, °F				220		250		223	
DENSITY, LB/FT ³		0.0563		0.0821		0.0619		0.0801	

EASTERN COAL CASE

EASTERN COAL CASE									
STREAM COMPOSITION		①		②		③ NOTE (1)		④	
		COOLED GAS FROM STRETTFORD UNIT		COMPRESSOR DISCHARGE		VAPOR FROM WASTE- WATER EVAPORATOR		COAL GAS TO PELLET PLANT	
		#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR	#/HR	MOL/HR
TAR/OIL									
CARBON MONOXIDE		95,716	3,416	95,716	3,416			95,716	3,416
CARBON DIOXIDE		36,232	823.2	36,232	823.2	4.4	0.10	36,236	823.3
HYDROGEN		5,254	2,606	5,254	2,606			5,254	2,606
NITROGEN		178,500	6,370	178,500	6,370			178,500	6,370
METHANE		1,523	94.9	1,523	94.9			1,523	94.9
C ₂ TO C ₅		1,758	39.9	1,758	39.9			1,758	39.9
HYDROGEN SULFIDE		24.5	50 PPMV	24.5	50 PPMV	24.3	0.71	48.8	100 PPMV
CARBONVL SULFIDE		639.2	10.65	639.2	10.65			639.2	10.65
AMMONIA		763.5	44.84	763.5	44.84	7.1	0.42	770.6	45.22
HYDROGEN CYANIDE		25.7	0.95	25.7	0.95			25.7	0.95
WATER		17,451	968.6	17,451	968.6	2,614	145.2	20,065	1113.8
PHENOL									
CHLORIDE		70	2.03	70	2.03			70	2.03
TOTAL		337,957	14,377.1	337,957	14,377.1	2,650	146.4	340,607	14,523.3
US GPM MMSCFD			130.94		130.94		1.33		132.2
PRESSURE, PSIG (H ₂ O)		(5")		12.2		12.2		12.2	
TEMPERATURE, °F		100		235		250		235	
DENSITY, LB/FT ³		0.0551		0.0823		0.0620		0.0821	

[illegible][illegible]

REVISIONS	DATE	BY	CHK	DESCRIPTION	APP.
	△				
	△				
	△				
	△				
	△	11-15-78	R.M.	W.B.	UP DATE FLOWS FOR EASTERN CASE
				CONF. FOR 10-11-78	

<h1>U. S. DEMONSTRATION OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578</p>	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	4814-Y-04-51-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P. E. NO. _____ SCALE _____
GAS TRANSMISSION COMMERCIAL UNIT GAS COMPRESSION (PFD)	REVISION

FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO.	P.E. NO.
	SCALE	
WASTE TREATMENT COMMERCIAL UNIT WASTEWATER FACILITIES (PFD) WEST COAL	REVISION 1	

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1	2	3	4	5	6	7	8	9	10
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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.

<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 ENGINEERS AND CONSTRUCTORS </div>	4814-Y-06-56-2						
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" style="text-align: center;">SCALE</td> </tr> <tr> <td colspan="2" style="text-align: center;"> REVISION 0 </td> </tr> </table>	PROJECT NO.	P.E. NO.	SCALE		REVISION 0	
PROJECT NO.	P.E. NO.						
SCALE							
REVISION 0							
UTILITIES BLOCK FLOW DIAGRAM COMMERCIAL PLANT STEAM, BOILER FEEDWATER, AND CONDENSATE							

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

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

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U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A
PREPARED BY **McKee**
CLEVELAND OHIO
4814-Y-08-57-2

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

UTILITIES-BLOCK FLOW DIAGRAM
COMMERCIAL UNIT
BOILER FEEDWATER TREATMENT

REVISION **C**

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

U. S. DEPARTMENT OF ENERGY
FUEL GAS DEMONSTRATION PLANT PROGRAM
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578
PREPARED BY **McKEE** ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO 4814-Y-06-59-2

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

REVISION 0

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COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKee CONTRACT 4814
JANUARY, 1979

3.0

MATERIALS SUMMARY

INDEX

- 3.01 General
- 3.02 Raw Materials
- 3.03 Products
- 3.04 By-products
- 3.05 Waste Products
- 3.06 Chemicals
- 3.07 Utilities

3.0

MATERIALS SUMMARY

- 3.01 This section identifies the various materials associated with operating the Commercial Plant.

The Commercial Plant is a new design. The various materials, their compositions and quantities associated with this design are summarized in this section. They include:

- The composition and quantities of feed, yields, products and by-products.
- The composition and quantities of waste products.
- Utility requirements.
- Chemicals.

3.02 Raw Materials

3.02.1 Coal

The basic raw material for the plant is coal of the kinds, sizes and analyses specified in Engineering Requisition W-20 in Section 6.0 of this Design Manual.

The design coals are a Western sub-bituminous coal (Rosebud McKay) and an Eastern bituminous coal (Brookville-Clarion-Kittanning mix) and adjusted as described in Section 2.0 of this Design Manual.

The coal feed requirements are:

	<u>Eastern Coal</u>	<u>Western Coal</u>
Deliveries to Plant Site		
Tons per Year	468,103	497,251
Feed to Gasifiers		
Tons per Stream Day	1,187	1,433
Tons per Year	411,889	497,182

3.0 MATERIALS SUMMARY (continued)

3.03 PRODUCT GAS

3.03.1 The product gas to the Pellet Plant will have the following composition:

	Western		Eastern	
	Mole/ Hour	Mole %	Mole Hour	Mole/ %
Tar/Oil	0.24	trace	-	-
CO	3336.0	22.3	3416.0	23.52
CO ₂	871.4	5.83	823.3	5.67
H ₂	2851.0	19.08	2606.0	17.94
N ₂	5553.0	37.16	6370.0	43.87
CH ₄	82.08	0.55	94.9	0.65
C ₂ -C ₅	25.68	0.17	39.9	0.27
H ₂ S	21.60	0.14	100 ppmv	trace
COS	6.30	0.04	10.65	.07
NH ₃	58.89	0.39	45.26	.31
HCN	0.64	trace	0.95	.01
H ₂ O	2136.7	14.34	1113.8	7.68
Phenol	0.08	trace	-	-
Chloride	-		2.03	.01
TOTAL	14,943.61	100.0	14,523.5	100.00
Flow Rate (MMSCFD)		135.93		132.27
Btu/ft ³		151 Btu/scf		156 Btu/scf
Btu/day including sensible heat		20.52 x 10 ⁹ Btu/day		20.63 x 10 ⁹ Btu/day

3.0 MATERIALS SUMMARY (continued)

3.04 BY PRODUCTS

3.04.1 Fines

A. Western Coal

The gasification process using Western coal requires 1433 tons per day feed.

For this project, it was assumed that Western coal fines will be agglomerated as a suitable gasifier feed stock. The agglomerating facilities are not included in the project scope.

Run of mine Western coal will generate approximately 80% fines or 1146 tons/day which will be agglomerated for use as gasifier feed. Therefore, there will be no by-product fines.

B. Eastern Coal

This gasification process using Eastern coal requires 1187 tons per day. The Eastern coal will be screened at Taconite Harbor to remove fines ($-1/2''$). The subsequent handling between Taconite Harbor and Hoyt Lakes to storage and feed to the gasifier will generate approximately 12% fines. The coal feed rate prior to screening is 1349 tons per day resulting in 60 tons per day of fines. This 162 tons/day of fines will be delivered to Taconite Harbor for use in the boiler plant.

It should be noted that the gasifier can accommodate 10% fines. If the screened fines are properly metered into the coal feed stream, the input coal can be reduced to 1211 tons per day resulting in 24 tons per day that must be delivered to Taconite Harbor.

Stirred gasifier operating tests may show that the gasifier can accommodate more than 10% fines. If so, there will be no fines by-products when handling Eastern coal.

3.0 MATERIALS SUMMARY (continued)

3.04.2 Tar and Oil

Significant quantities of these by-products will be produced. Their properties are similar to those of No. 5 and No. 6 fuel oil. Plans are to mix the tar and oil and use them as fuel in the gasification plant, and as a supplemental fuel in the pellet plant.

It is possible that the tar/oil mix produced from operation on high sulfur Eastern coal will have a sulfur content in excess of the 2% by weight sulfur limitation currently set by environmental regulations. The actual tar/oil sulfur content is presently uncertain. It is assumed that if the tar/oil sulfur content exceeds 2%, it can be blended prior to combustion with a low sulfur fuel to utilize its value as a fuel.

A portion of the tar/oil is burned captively at the gasification plant as fuel for the packaged boilers and waste water incinerator. The demand for this fuel varies seasonally according to steam requirements and according to the quantity of water to be incinerated. For Western coal, the demand for tar/oil will exceed the quantity produced during winter operation and supplemental No. 6 fuel oil must be purchased during these periods. For Eastern coal, the quantity produced always exceeds the captive demand.

NET TAR/OIL

	<u>Western Coal</u>	<u>Eastern Coal</u>
<u>Production</u>		
Tar/Oil produced, lbs/hr.	7,722	18,724
<u>Demand</u>		
Tar/oil or fuel oil required for packaged boilers-annualized average lbs/hr.	1,214	219
Tar/oil or fuel oil required for waste water incinerator - annualized average lbs/hr.	1,559	182
TOTAL DEMAND	2,773	401
<u>Net Tar/Oil By-Product</u>		
Pounds per hour	4,949	18,323

3.0 MATERIALS SUMMARY (continued)

3.05 WASTE PRODUCTS

3.05.1 Gasifier Ash

Gasifier ash will be disposed of by trucking to the land fill disposal area.

	<u>#/Hr.</u>	<u>Tons/Day</u>
Western Coal	10,743	129
Eastern Coal	10,319	124

3.05.2 Cyclone Char

	<u>#/Hr.</u>	<u>Tons/Day</u>
Western Coal	273	3.3
Eastern Coal	228	2.7

3.05.3 Tar/Oil Decanter Sludge

The tar/oil decanter sludge will be disposed of in the land-fill area.

The sludge quantity and composition is not available at this time.

3.05.4 Stretford Purge

The Stretford sulfur removal unit will be operated only when gasifying Eastern coal. It is estimated that if operated continuously, the Stretford unit will not require purging for first year of operation. There will be two (2) Stretford units in operation.

When purging is required, the purge stream will have the following composition:

	<u>#/Hr.</u>	<u>Wt. %</u>
ADA	1.3	0.17
NaVO ₃	3.2	.41
Na ₂ CO ₃	8.0	1.03
NaCNS	9.3	1.20
Na ₂ SO ₄	50.8	6.57
Na ₂ S ₂ O ₃	117.2	15.15
H ₂ O	584.0	75.47
TOTAL	773.8	100.00

3.05 WASTE PRODUCTS (continued)

Specific gravity 1.25

GPM 1.29 or 1858 gal. per day

3.05.5 Sulfur

Sulfur will be removed only when gasifying Eastern coal at the design rate of 13,477 lbs/hr. or 162 tons/day.

Sulfur will be disposed of to landfill.

3.05.6 Liquid Effluents to Settling Pond

	Avg. GPM
a) Wash down water and Materials Handling area sump	2
b) Rainwater run off	52.5
c) Packaged boiler blowdown	1.3
d) Gasifier waste heat boiler blowdown	2.2
e) Incinerator heat recovery system blowdown	0.3
f) Gasifier steam jacket blowdown	1.4
g) Clarifier underflow	0.2
h) Filter backwash effluent	0.3
i) Softener backwash effluent	0.3
 TOTAL AVERAGE LIQUID EFFLUENT DISCHARGE TO SETTLING POND	 60.5
 Average Settling Pond Evaporation Rate	 6.0
 Average "overflow" rate for discharge to Tailings Basin	 54.5

Note: The above rates do not include any "pump-in" from the Waste Disposal Area Collection Pond.

3.05.7 Sanitary Waste

Sanitary waste from the various facilities will be treated in the Erie Mining Company existing sewage treatment facilities in the amount of 2,450 gallons per day.

3.0 MATERIALS SUMMARY (continued)

3.06 CHEMICALS

The following chemicals are required by the gasification facilities:

3.06.1 Materials Handling - Area 01

Dust Suppressants - one gallon/5000 gallon H_2O
use 2-1/2 gallon of mixture per ton per handling

3.06.2 Gasification Unit - Area 02

None

3.06.3 Sulfur Removal Unit - Area 03

	#/Hr
ADA	3.8
Vanasol	10.0
Caustic (50%)	212.0
Diesel Oil	

3.06.4 Gas Transmission - Area 04

None

3.06.5 Waste Water Treatment - Area 05

None

3.06.6 Utilities - Area 06

Sodium Chloride
Hypochloride
Alum
Flocculant

3.06.7 Safety Systems - Area 07

None

3.06.8 Retrofit - Area 08

None

3.0 MATERIALS SUMMARY (continued)

3.07 UTILITIES

Utility requirement for the Demonstration Unit are summarized as follows:

Item	Area	Unit	Requirements	
			Western Coal	Eastern Coal
Cooling Water	01	gpm	15	15
	02	gpm	2714	1350
	03	gpm	0	1990
	04	gpm	75	75
	06	gpm	177.5	222.5
	07	gpm	0.5	0.5
		TOTAL	2982.0	3653.0
Boiler Feed-water	02	mlb/hr.	64.5	99.0
	03	mlb/hr.	0	4.5
	05	mlb/hr.	17.7	2.18
	06	mlb/hr.	15.2	0.94
	07	mlb/hr.	0	0
		TOTAL	97.4	106.62
		Less returned condensate	49.98	26.91
		Required makeup	47.42	79.71
Inert Gas	02	scfm	240	240
	All(1)	scfm	10	10
		TOTAL	250	250
Back Up Nitrogen	06(2)	scfm	17	17
		TOTAL	17	17
Electric Power	01	kw.	871	871
	02	kw.	1141	1139
	03	kw.	0	1620
	04	kw.	4510	4510
	05	kw.	113	113
	06	kw.	460	439
		TOTAL	7095	8692

(1) Inert gas used in all areas for purging instrumentation

(2) Back up for inert gas system and instrument air

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4.0

ELECTRICAL

AND

SINGLE LINE DRAWINGS

INDEX

- 4.01 Area Classifications Drawings
- 4.02 Single Line Drawings

4.0 ELECTRICAL AREA CLASSIFICATIONS AND SINGLE LINE DRAWINGS

4.01 AREA CLASSIFICATIONS DRAWINGS

GENERAL

N-00-52-2	Area Classification - Material Handling
N-00-53-2	Area Classification - Process Units

GASIFICATION AREA

N-02-56-2	Plan at Elevation 1656' and 1623'
N-02-57-2	Plan at Elevation 1656' and 1623'
N-02-58-2	Plan at Elevation 1613' and 1601'
N-02-59-2	Plan at Elevation 1613' and 1601'
N-02-60-2	Plan at Elevation 1589'
N-02-61-2	Plan at Elevation 1589'
N-02-62-2	Plan at Elevation 1573' and 1580'
N-02-63-2	Plan at Elevation 1573' and 1580'
N-02-64-2	Plan at Elevation 1543'
N-02-65-2	Plan at Elevation 1543'
N-02-66-2	Gas Clean Up Area
N-02-67-2	Gas Clean Up Area
N-02-68-2	Gasifier Structure Elevation

*N-03-52-2	Sulfur Removal Area Classification
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*Proprietary

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4.0 ELECTRICAL AREA CLASSIFICATIONS AND SINGLE LINE DRAWINGS

4.02 ELECTRICAL SINGLE LINE DRAWINGS

N-00-51-2	Main Power Distribution Single Line
N-02-51-2	Combustion Air Blowers Sh. #1
N-02-52-2	Gasifier & Tar Precipitators Sh. #2
N-02-53-2	Oil Precipitators & Ash Removal Sh. #3
N-02-54-2	Gasifier & Tar Precipitators Sh. #4
N-02-55-2	Oil Precipitators & Miscellaneous Sh. #5
N-03-50-2	Sulfur Removal Unit Single Line
N-03-51-2	Sulfur Removal Unit Single Line
N-06-51-2	13.8 kv. Electrical Feeder Plan

DRAWING NO. E D C B A

- M.C.C. #1 MATERIAL HANDLING (LOCATED IN MAIN ELECT. RM.)
- M.C.C. #2 ASH SILC. COMPRESSOR BLDG., & GASIFICATION (PART.) (LOCATED IN MAIN ELECT. RM.)
- M.C.C. #3 GASIFICATION (PART.) (LOCATED IN MAIN ELECT. RM.)
- M.C.C. #4 SULFUR REMOVAL (LOCATED IN OR NEAR SULFUR REMOVAL BLDG.)
- M.C.C. #5 SCREENING STATION, COAL FINES PILE, FINES LOAD-OUT (LOCATED IN SCREEN. STA.)
- M.C.C. #6 UTILITIES (LOCATED IN UTILITIES BLDG.)
- M.C.C. #7 UTILITIES (LOCATED IN UTILITIES BLDG.)
- M.C.C. #8 WASTE TREATMENT (LOCATED IN INCINERATOR BLDG.)

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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-N-00-51-2

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SCALE

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FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

COAL GASIFICATION

COMMERCIAL UNIT

MAIN POWER DISTRIBUTION SINGLE LINE

11-10-78

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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-N-00-52-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. _____ P.E. NO. _____ SCALE 1" = 60' 0"
COAL GASIFICATION COMMERCIAL UNIT AREA CLASSIFICATION		REVISION 0

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4814-N-00-53-2

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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**

CLEVELAND OHIO

4814-N-00-53-2

PROJECT NO. P.E. NO.

SCALE

1" = 30'-0"

REVISION Δ

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

COAL GASIFICATION

COMMERCIAL UNIT

AREA CLASSIFICATION

10/10/78 FR ISSUED FOR ESTIMATING

10/11/78

 

COMBUSTION AIR BLOWERS

LEGEND:

CP-1 MAIN CONTROL
PANEL

TOR TEST-OFF-REMOTE SWITCH

START-STOP SWITCH

TOA TEST-OFF-AUTO
SWITCH

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U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKEE

CLEVELAND — ENGINEERS AND CONSTRUCTORS — OHIO

4814-N-02-51-2

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FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

GASIFICATION
COMMERCIAL UNIT-STAGE 2
SINGLE LINE DIAGRAM-SHEET NO. 1

PROJECT NO.	P.E. NO.
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PROJECT NO.	3001
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SCALE

NCNE

REVISION

REVISION

1. *Journal of Management Studies*, 1997, 34, 1, 1-14.

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CONTINUED FROM DWG
4814-N-02-54-2

NOTES:
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CLEVELAND OHIO

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HOYT LAKES MINNESOTA

GASIFICATION
COMMERCIAL UNIT-STAGE 2
SINGLE LINE DIAGRAM-SHEET NO. 5

PROJECT NO. 3001

P.E. NO.

SCALE

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ON ENLARGING

18 SQ. REMOVABLE GRATING (TYP)
FEEDER (TYP) (FE-202A to E)
COAL SURGE HOPPER (TYP) (BN-201 A to F)

PLAN @ ELEV. 1656'-0" & 1623'-0"

LEGEND:

- AREA ABOVE EL. 1656'-0" (COAL HANDLING) TO BE CLASSIFIED CLASS II, GROUP F, DIVISION I.
- AREA ABOVE EL. 1623'-0" TO UNDERSIDE OF EL. 1656'-0" TO BE CLASSIFIED CLASS I, GROUP D, DIVISION II.

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SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY	4814-N-02-56-2
McKee ENGINEERS AND CONSTRUCTORS	
CLEVELAND OHIO	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. HOYT LAKES MINNESOTA	MANAGING AGENT
GASIFICATION COMMERCIAL UNIT-STAGE 2 AREA CLASSIFICATION-SHEET NO. 1	
PROJECT NO. 3001	P.E. NO.
SCALE 1/8" = 1'-0"	REVISION 0

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

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A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. E-021 ISSUE NO. 0
FOR FINAL REVIEW SIGNED *J. L. Hall* DATE 10/1/91

4814-N-02-59-2

REVISION $\triangle$ 0

1	2	3	4	5	6	7	8	9	10
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ONE INCH = 100 FEET

MATCH LINE - SEE DWG. 4814-N-02-61-2

PLAN @ ELEV. 1589'-0"

LEGEND:

AREA ABOVE EL. 1589'-0" TO UNDERSIDE OF EL. 1601'-0" TO BE CLASSIFIED CLASS I, GROUP D, DIVISION II.

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BABCOCK CONTRACTORS INC.

PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

PROJECT NO. 3001 DRAWING NO. E-006 ISSUE NO. 0

FOR FINAL REVIEW SIGNED *[Signature]* DATE 10/1/78

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-N-02-60-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

GASIFICATION
COMMERCIAL UNIT-STAGE 2
AREA CLASSIFICATION - SHEET NO. 5

PROJECT NO. 3001 P.E. NO.

SCALE 1/8" = 1'-0"

REVISION *[Mark]*

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

DRAWING NO.

E

D

C

B

A

36'-0" TO 4' TAR PRECIPITATOR

35'-0"

100'-0"

35'-0"

35'-0"

35'-0"

36'-0" TO 4' GASIFIER R201-B,D,F,H,K & M

8

7

6

5

210'-0" TO 4' COL. #1

30'-0" 15'-0" 15'-0" 15'-0" 15'-0" 15'-0" 15'-0"

GASIFIER R201-L & M GASIFIER R201-J & K GASIFIER R201-G & H

PLAN @ ELEV. 1589'-0"

MATCH LINE - SEE DWG. 4814-N-02-60-2

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.

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
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PROJECT NO. 3001 DRAWING NO. E-022 ISSUE NO. 0
FOR FINAL REVIEW SIGNED *[Signature]* DATE 10/1/78

U. S. DEPARTMENT OF ENERGY	
FUEL GAS DEMONSTRATION PLANT PROGRAM	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY	McKee ENGINEERS AND CONSTRUCTORS
CLEVELAND	OHIO
PROJECT NO.	4814-N-02-61-2
P.E. NO.	3001
SCALE	1/8" = 1'-0"
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. HOYT LAKES	MANAGING AGENT MINNESOTA
GASIFICATION COMMERCIAL UNIT-STAGE 2 AREA CLASSIFICATION-SHEET NO. 6	
REVISION <i>[Triangle]</i>	

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

PLAN @ ELEV. 1543'-0"

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PROJECT NO. 3001

DRAWING NO. E-024

ISSUE NO. 0

FOR FINAL REVIEW

SIGNED *[Signature]* DATE 10/1/78

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-N-02-65-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

GASIFICATION
COMMERCIAL UNIT-STAGE 2
AREA CLASSIFICATION - SHEET NO. 10

PROJECT NO. 3001

P.E. NO.

SCALE 1/8" = 1'-0"

REVISION *[Mark]*

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

MATCH LINE - SEE DWG. 4814-N-02-67-2

- LEGEND:**
- TRANSFORMER-RECTIFIER ROOM TO BE CLASSIFIED "NON-CLASSIFIED".
 - GAS CLEANING AREA TO BE CLASSIFIED CLASS I, GROUP D, DIVISION II.

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.

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
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PROJECT NO. 3001 DRAWING NO. E-009 ISSUE NO. 0
FOR FINAL REVIEW SIGNED *[Signature]* DATE 10/1/78

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-N-02-66-2

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

GASIFICATION
COMMERCIAL UNIT-STAGE 2
AREA CLASSIFICATION-SHEET NO. 11

PROJECT NO. 3001
SCALE 1/8" = 1'-0"
REVISION 0

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
										10/1/78	D.C. H.B.		FINAL REVIEW	B.A.

1

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FOR FINAL REVIEW SIGNED *[Signature]* DATE 10/1

GASIFICATION
COMMERCIAL UNIT-STAGE 2
AREA CLASSIFICATION-SHEET NO. 13

5.0

MATERIALS HANDLING - AREA 01

INDEX

- 5.01 Summary Description
- 5.02 Design Comments
- 5.03 Equipment List
- 5.04 Piping and Instrument Diagrams
- 5.05 Equipment Summary Sheets
- 5.06 Equipment Data Sheets
- 5.07 Major Inline Instrument Data Sheets
- 5.08 General Drawing List

5.0MATERIALS HANDLING - AREA 015.01 SUMMARY DESCRIPTION

The Materials Handling area is located to the north of the Gasification Area. This area, which has already been completely described in Section 2.0, Process Description, can be divided into four units. These units are:

Coal Receiving and Storage
Coal Preparation
Coal Fines
Ash Storage and Removal

All material transfer points are designed for either dust collection or dust suppression; see drawings S-01-51-2 and S-01-52-2. All water runoff in this area is collected and is sent to the settling pond.

The required alterations to Erie Mining Company's existing coal unloading station is shown on Drawing X-01-58-2.

5.01.1 Coal Receiving and Storage

Located in this area are the thaw shed, rotary dumper, train positioner, live coal pile, 180-day coal storage pile, and related belt conveyors. These are shown on Drawings X-01-51-2, X-01-52-2, and X-01-56-2.

Because there are no incoming coal shipments for the four winter months, buildings and conveyor galleries are not heated or insulated. The only exception to this is the fire protection pump room.

5.01.2 Coal Preparation

As shown on drawings X-01-54-2 and X-01-56-2, coal is removed from either pile, is sized, screened, and conveyed by conveyors to the gasifier feed surge hoppers. These buildings and galleries are heated and insulated.

5.01.3 Coal Fines

Due to limits of gasifiers to handle all the coal fines, a proportion of the fines are removed from the feed coal.

5.01 SUMMARY DESCRIPTION (continued)

5.01.3 Coal Fines (continued)

For the Eastern coal, this amounts to 60 tons a day of fines. These coal fines are shipped by rail to the Taconite Harbor Power Plant. Eastern coal fines storage, reclaim, and loadout are shown on drawings X-01-55-2 and X-01-56-2.

Western coal fines, because of the high percent of fines to sized coal, assumes future provision for briquetting. The briquetting plant does not fall within the scope of the present study.

5.01.4 Ash Storage and Removal

Ash removed from the Gasification Area is conveyed to the Ash Silo, drawing X-01-57-2. The Ash Silo is sized for a three-day Commercial Plant storage capacity. The ash is removed, is wetted for dust control, and is loaded into mine trucks for disposal in a landfill.

5.02 DESIGN COMMENTS

Early in Phase II, "Detailed Engineering" for the Demonstration Plant, the following comments should be addressed and applied to the Commercial Plant:

- 5.02.1 Can the 180-day coal storage pile be reduced? The 180 days is based on a four-month winter plus two months for any outside delays for incoming coal. Since this plant is designed for both Eastern and Western coal, an outside two-month delay period may not be completely needed.
- 5.02.2 Should all of the rising conveyors be replaced with fast rising (plus fifty degrees) conveyors? There would be a saving in land, concrete, steel and heating energy.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKee CONTRACT 4814
JANUARY, 1979

5.03

EQUIPMENT LIST

MATERIALS HANDLING - AREA 01

MCKEE CORPORATION

EQUIPMENT LIST

CONTRACT MC-4814

DATE OCTOBER 26, 1978

CLIENT ERIE MINING COMPANY

UNIT COMMERCIAL

AREA MATERIAL HANDLING 01

DOE CONTRACT ET-78-C-01-2578

ORIGINAL

CONTRACT NUMBER MC-4814		AREA Comm. 01
REVISION (0)		
PAGE 1	OF 8	

EQUIPMENT LIST
McKee
 Form M-514-2

TAG	E/R	P & I NO.	DESCRIPTION
BN-101	U-1	Y-01-60-2	Bin (Dumper Hopper)
BN-102A/B		Y-01-61-2	Bin (Live Storage Reclaim)
BN-103A/B		Y-01-62-2	Bin (Auxiliary Reclaim)
BN-104		Y-01-63-2	Bin (Vibrating Screen Surge Hopper)
BN-106		Y-01-65-2	Bin (Fines Storage Reclaim)
BN-107		Y-01-65-2	Bin (Fine Loadout)
BN-108		Y-01-66-2	Ash Silo
C-101		Y-01-66-2	Air Slide Blower, Ash Silo

ORIGINAL

EQUIPMENT LIST

McKee

Form M-514-2

CONTRACT NUMBER MC-4814		AREA 01	Comm.
REVISION (0)			
PAGE 2	OF 8		

TAG	E/R	P & I NO.	DESCRIPTION	
CO-101		Y-01-60-2	Track Hopper Collecting Conveyor	
CO-102		Y-01-60-2 Y-01-61-2	Raw Coal Transport Conveyor	
CO-103		Y-01-61-2	Raw Coal to Test Pile Conveyor	
CO-104		Y-01-61-2 Y-01-62-2	Reclaim Collecting Conveyor	
CO-105		Y-01-62-2 Y-01-63-2	Coal Transporting Conveyor	
CO-106		Y-01-63-2 Y-01-64-2	Screened Coal Collecting Conveyor	
CO-107		Y-01-64-2	Gasifier Feed Tripper Conveyor	
CO-108		Y-01-63-2	Coal Fines Collecting Conveyor	
CO-109		Y-01-63-2	Fines Transporting Conveyor	
CO-110		Y-01-65-2	Reclaim Fines Transporting Conveyor	
CO-111		X-01-58-2	Raw Coal Transporting Conveyor	Modification of Existing Unloading Station
				for Existing Heating Plant
COV-112		X-00-51-2 X-01-58-2	Extension to Existing Conv. H-4	Modification of Existing Unloading Station
				for Existing Heating Plant
CP-101	U-1	Y-01-60-2	Train Positioner	

EQUIPMENT LIST

McKee

Form M-514-2

CONTRACT NUMBER	AREA Comm.
MC-4814	01
REVISION	
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PAGE	OF
3	8

TAG	E/R	P & I NO.	DESCRIPTION
DC-101		S-01-51-2 Y-01-63-2	Dust Collector (Crushing & Screening Station)
DC-102		S-01-51-2 Y-01-62-2	Dust Collector (Junction House)
DC-103		S-01-51-2 Y-01-64-2	Dust Collector (Surge Bin)
DC-104		S-01-51-2 Y-01-61-2	Dust Collector (Conveyor CO-102 & 103)
DC-105		S-01-52-2 Y-01-66-2	Dust Suppression (Ash Silo)
DC-106		S-01-52-2 Y-01-60-2	Dust Suppression (Car Dumper Area)
DC-107		S-01-52-2 Y-01-61-2 Y-01-62-2	Dust Collector (Live Storage Area)
DC-108		S-01-52-2 Y-01-65-2	Dust Suppression (Fines Loadout)
DC-109		S-01-52-2 Y-01-63-2 Y-01-65-2	Dust Suppression (Conveyor CO-109, BN-106, & CO-110)
DC-110		S-01-51-2 Y-01-11-2	Dust Collector (Conveyor CO-103)
DC-111			Vacuum Cleaning System for Conveyor CO-102 Gallery
DC-112			Vacuum Cleaning System for Conveyor CO-104 Gallery & Transfer Station
DC-113			Vacuum Cleaning System for Conveyor CO-105 & CO-106 Galleries

EQUIPMENT LIST

McKee

Form M-514-2

CONTRACT NUMBER MC-4814		AREA Comm. 01
REVISION (0)		
PAGE 4	OF 8	

TAG	E/R	P & I NO.	DESCRIPTION
DC-114			Vacuum Cleaning System for Conveyor
			CO-109 Gallery, Crushing & Screening
			Station
DC-115			Vacuum Cleaning System for Conveyor
			CO-107 Gallery
DU-101	U-1	Y-01-60-2	Rotary Car Dumper
H-101		Y-01-60-2	Thaw Shed Heaters

OR AL

CONTRACT NUMBER	AREA Comm.
MC-4814	01
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PAGE	OF
5	8

EQUIPMENT LIST

McKee

Form M-514-2

TAG	E/R	P & I NO.	DESCRIPTION
ME-101			Car Dumper Dozer
ME-102A/B			Raw Coal Dozer
ME-103A/B			Raw Coal Stockpile Scrapers
ME-104			Coal Fines Wheel Loader
ME-101A/B/C		Y-01-60-2	Dumper Hopper Reclaim Vibrating Feeders
ME-102A/B		Y-01-61-2	Storage Pile Reclaim Vibrating Feeders
ME-103A/B		Y-01-62-2	Storage Pile Emergency Reclaim
			Vibrating Feeders
ME-104A/B		Y-01-63-2	Vibrating Screen Vibrating Feeders
ME-105		Y-01-65-2	Fine Storage Reclaim Vibrating Feeder
ME-106		Y-01-66-2	Ash Silo Star Feeder
ME-107		Y-01-66-2	Rotary Wetter/Unloader Feeder

EQUIPMENT LIST
McKee
Form M-514-2

CONTRACT NUMBER	AREA	Comm.
MC-4814	01	
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6	8	

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CONTRACT NUMBER

MC-4814

AREA Comm.

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REVISION

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OF

8

EQUIPMENT LIST

McKee

Form M-514-2

TAG	E/R	P & I NO.	DESCRIPTION
WS-101		Y-01-60-2	Belt Scale - Conveyor CO-102
WS-102		Y-01-62-2	Belt Scale - Conveyor CO-104
WS-103		Y-01-64-2	Belt Scale - Conveyor CO-106
WS-104		Y-01-65-2	Belt Scale - Conveyor CO-110
X-101		Y-01-61-2	Lowering Pipe
X-102		Y-01-62-2	Tramp Iron Pick-Up Magnet - CO-104
X-103		Y-01-61-2	Lowering Pipe
X-104	U-2	Y-01-63-2	Gasifier Feed Preparation Crusher
X-105A/B		Y-01-62-2	Metal Detector - CO-104
X-106		Y-01-63-2	Lowering Pipe - Fines
X-110			Trolley Hoist - Crushing & Screening Station

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EQUIPMENT LIST

McKee

Form M-514-2

CONTRACT NUMBER

MC-4814

AREA	Comm.
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REVISION

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PAGE

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OF

8

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5.0 MATERIALS HANDLING - AREA 01

5.04 PIPING AND INSTRUMENT DIAGRAMS

INDEX

<u>Drawing Number</u>	<u>Description</u>	<u>Revision</u>
4814-Y-01-60-2	Coal Unloading Station	2
4814-Y-01-61-2	Coal Storage	2
4814-Y-01-62-2	Auxiliary Hopper and Transfer Station	1
4814-Y-01-63-2	Coal Screening and Crushing	1
4814-Y-01-64-2	Gasifier Feed Conveyor	4
4814-8-01-65-2	Coal Fines Reclaiming	1
4814-Y-01-66-2	Ash Handling	1

4814-Y-01-60-2

H-101
THAW SHED HEATERS

DU-101
ROTARY CAR DUMPER

CP-101
CAR POSITIONER

WS-101
BELT SCALE

BN-101
DUMPER HOPPER

CO-102
TRANSPORT CONVEYOR

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

OPERATOR'S ROOM

DUMPER CONTROL PANEL (DCP)

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

MF-101A,B & C
VIBRATING FEEDERS

P-101 A & B
SUMP PUMPS

CO-101
COLLECTING CONVEYOR

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

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

CHANGES AS CIRCLED.
P-101A/B WAS VERTICAL SUMP PUMPS & ADDED REF DWGS
ISSUED FOR ESTIMATING

SCALING RULES

4814-Y-01-61-2

P-102 A & B
 SUMP PUMPS
BN-102 A, B,
 RECLAIM HOPPER
MF-102 A, B,
 VIBRATING FEEDERS
 DELETED BN-102C & BN-102D
 DELETED MF-102C & MF-102D

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

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

4814-Y-01-61-2

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

MATERIALS HANDLING P. & I. D.
 COMMERCIAL UNIT
 COAL STORAGE

REVISION 2

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

BN-103A, 103B
AUXILIARY RECLAIM
HOPPERS.

X-105A
METAL
DETECTOR

X-102
TRAMP IRON
MAGNET.

X-105B
METAL
DETECTOR

WS-102
BELT SCALE

MF 103 A & B
STORAGE PILE EMERGENCY
RECLAIM HOPPER FEEDERS

CO-104
RECLAIM COLLECTING
CONVEYOR.

DELETED.
X-104 A/B

CO 105
COAL COLLECTING CONVEYOR

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	PROJECT NO. 4814-Y-01-62-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA MATERIAL HANDLING P. & I.D. COMMERCIAL UNIT AUXILIARY HOPPER & TRANSFER STATION	SCALE NONE REVISION

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

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DRAWING NO.
4814-Y-01-64-2TC-102
TRIPPER CARTC-101
TRIPPER CAR

TO DC-103

S-01-51-2 B-9

20 1/2" ϕ DA -1002

EL. 1542.00'

TOTE BOX

EL. 1542.00'

WS-103
BELT SCALECO-107
GASIFIER FEED
TRIPPER CONVEYOR

Y-02-10-2 C-1

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKee
ENGINEERS AND CONSTRUCTORS

CLEVELAND OHIO

4814-Y-01-64-2

FOR **ERIE MINING COMPANY**PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTAMATERIAL HANDLING P. & I. D.
COMMERCIAL UNIT
GASIFIER FEED CONVEYORS

PROJECT NO.

P.E. NO.

SCALE

NONE

REVISION 4

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
10-24-78	MS	TC	REVISED AS CIRCLED		10-24-78	MS	TC	REVISED AS CIRCLED		10-24-78	MS	TC	REVISED AS CIRCLED	
10-20-78	MS	TC	REVISED AS CIRCLED		9-22-78	KH	TC	ADDED DRIBBLE CHUTE, TOTE BOX & SURGE HOPPER NOTE		8-11-78	HRS	TC	HOLD REMOVED	
8-11-78	HRS	TC	HOLD REMOVED		7-18-78	KH	TC	ISSUED FOR ESTIMATING						

4814-Y-01-65-2

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△						△						△	9-22-78	KH	JP	ADDED DUST CONTROL TO BN -106 & REFERENCE NO.	ASB
△						△						△	8-17-78	E.R.		ISSUED FOR ESTIMATING	
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<h1>U. S. DEPARTMENT OF ENERGY</h1> <h2>FUEL GAS DEMONSTRATION PLANT PROGRAM</h2> <p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-OI-2578</p>							
PREPARED BY McKee <small>ENGINEERS AND CONSTRUCTORS</small>	4814-Y-01-65-2						
CLEVELAND OHIO	<table border="1"> <tr> <td>PROJECT NO.</td> <td>P.E. NO.</td> </tr> <tr> <td colspan="2"> NAME NONE </td> </tr> <tr> <td colspan="2"> REVISION 1 </td> </tr> </table>	PROJECT NO.	P.E. NO.	NAME NONE		REVISION 1	
PROJECT NO.	P.E. NO.						
NAME NONE							
REVISION 1							
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA MATERIALS HANDLING P. O. B. COMMERCIAL UNIT COAL PILES RECLAIMING

4814-Y
01-66-2

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

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

U. S. DEPARTMENT OF ENERGY	
FUEL GAS DEMONSTRATION PLANT PROGRAM	
SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY	McKee ENGINEERS AND CONSTRUCTORS
CLEVELAND	OHIO
4814-Y-01-66-2	
FOR ERIE MINING COMPANY	
PICKANDS MATHER AND CO. HOYT LAKES	MANAGING AGENT MINNESOTA
MATERIALS HANDLING COMMERCIAL UNIT ASH HANDLING	P. & I. D.
REVISION 1	

5.0 MATERIALS HANDLING - AREA 01

5.05 EQUIPMENT SUMMARY SHEETS

Conveyors

Belt Scales

Bins

Dust Collectors

Dust Suppression

Feeders

Monorail Hoists

Pumps

COMMERCIAL

CONTRACT REF: ET-78-C-01-2578			COAL GASIFICATION PROJECT HOYT LAKES, MINNESOTA ERIE MINING COMPANY				CONTRACT NO. MC-4814				DATE		REV.	
DESIGN DATA SUMMARY										CONVEYORS				
TAG NO.	SIZE IN.	BULK DENS. LB/CF	CAPACITY TPH*		% BELT DESIGN CAPACT.	BELT WIDTH IN.	BELT SPEED FPM	LENGTH FT.	RISE FT.	HORSEPOWER		TAKE UP TYPE	REMARKS	
			RATED	DESIGN						CALC.	MOTOR			
CO-101	-6	45	3000 3000	3000	84	66	700	65	0	36	40	Gravity	Skirited Full Lgt	
CO-102	-6	45	3000 3000	3000	84	66	700	600	134	520	600	Gravity	WS-101 Belt Scale	
CO-103	-6	45	3000 3000	3000	84	66	700	215	10	78	100	Gravity		
CO-104	-6	45	117 113	140	68	24	350	385	49	16	20	Gravity	X-102 Tramp Iron Magnet X-105A/B Metal - Detector WS-102 Belt Scale	
CO-105	-6	45	117 113	140	68	24	350	320	68	15	20	Gravity		
CO-106	-1½	45	117 99	140	79	24	300	480	24	22	25	Gravity	WS-103 Belt Scale	
CO-107	-1½	45	117 99	140	54	30	250	240	11	12	15	Gravity	With Tripper Car TC-101	
CO-108	-½	45	94 14	112	63	24	300	42	0	5	7.5	Adjust. Screw		
CO-109	-½	45	94 14	112	63	24	300	160	52	10	15	Gravity		
CO-110	-½	45	200 200	240	72	30	325	280	80	26	30	Gravity	WS-104 Belt Scale	
CO-111		50	225 225	225	84	24	450	144	6	8.2	10	Gravity	Modification of existing unloading sta. for existing heating plant	

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CUSTOMER REF. ET-78-C-01-2578		COAL GASIFICATION PROJECT HOYT LAKES, MINNESOTA ERIE MINING COMPANY		CONTRACT NO. MC-4814		DATE	REV.
				DESIGN DATA SUMMARY		BELT SCALES	
TAG NO.	SERVICE	FLOW RATE MAX(STPH)	BELT WIDTH IN.	TROUGH ANGLE	REMARKS		
WS-101	Flow Indication	3000	90	35	Mounted on Conveyor CO-102		
WS-102	Flow Indication	285	30	35	Mounted on Conveyor CO-104		
WS-103	Flow Indication	140	24	20	Mounted on Conveyor CO-106		
WS-104	Flow Indication	500	42	35	Mounted on Conveyor CO-110		
<p>NOTES: For All Scales</p> <p>1. Flow Indicator will be included on data logger.</p> <p>2. Remote readout logic will indicate rate of flow, speed and weight.</p> <p>3. Supplied with Built-in Automatic Calibration.</p>							

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CUSTOMER REF:		COAL GASIFICATION PROJECT		CONTRACT NO. MC-4814		DATE		REV.	
ET-78-C-01-2578		HOYT LAKES, MINNESOTA							
		ERIE MINING COMPANY		DESIGN DATA SUMMARY		BINS			
TAG NO.	GENL. TYPE	TOP OPENING - FT.	STR SIDE HT. - FT.	TAPER HT. - FT.	NET CAPACITY ST	MAX. OUTLET RATE - STPH	MAX. INLET RATE - STPH	CONSTRUCTION MATERIALS	REMARKS
BN-101									See E/R U-1
BN-102 A/B	Square, Rect. Outlet	10x10	1.5	8	9	80	Flood	CS With SS Liner	
BN-103 A/B	Square, Rect. Outlet	10x10	1.5	8	10	145	Flood	CS With SS Liner	
BN-104	Rect., Rect Outlet	6x7	7	11	24	188ea.out.	285	CS With SS Liner	
BN-106	Rect., Rect Outlet	Top 10Sq. Out.1.5Sq.	2	8	10 6(cu.yd)	240	Flood	CS With SS Liner	
BN-107	Square	Top19x19 Out 2x2	4	18	50	Flood	240	CS With SS Liner	
BN-108	Cylind.	25 I.D.	52	NA	490	10	50	Walls-Hollow Tile With Internal Glaze Roof-Rein. Concr. Bottom-Rein. Concr	

NOTES

1. BN-108 is for the storage of coal ash, all other bins are for coal handling.
2. Bulk density of coal in lb/cf is 45 loose and 50 packed.
3. Angle of repose for coal is 40 degrees.

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CUSTOMER REF:		COAL GASIFICATION PROJECT		CONTRACT NO. MC-4814		DATE		REV.	
ET-78-C-01-2578		ERIE MINING COMPANY		DESIGN DATA SUMMARY		DUST COLLECTORS			
HOYT LAKES, MINNESOTA									
Tag No.	Type	Air Temp.	Construction	Installation	Loading	Efficiency	Vol. (acfm)	Pressure Drop "H ₂ O	Remarks
DC-101	Reverse Jet Cont. Duty Fabric Coll.	Amb. -25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft. above sea level	coal dust 3-5 gr/scf	99.9	26200	3-6	
DC-102	Reverse Jet Cont. Duty Fabric Coll.	Amb. -25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft. above sea level	coal dust 3-5 gr/scf	99.9	8500	3-6	
DC-103	Reverse Jet Cont. Duty Fabric Coll.	Amb. - 25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft. abv. sea level	coal dust 3-5 gr/scf	99.9	9250	3-6	
DC-104	Reverse Jet Cont. Duty Fabric-Coll.	Amb. - 25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft. abv. sea level	coal dust 3-5 gr/scf	99.9	6500	3-6	
DC-107	Reverse Jet Cont. Duty Fabric Coll.	Amb. - 25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft. abv. sea level	coal dust 3-5 gr/scf	99.9	17250	3-6	
DC-110	Reverse Jet Cont. Duty Fabric Coll.	Amb. - 25°F to 83°F	Hazardous + 3 psig	Outdoors @ 1600 ft abv. sea level	coal dust 3-5 gr/scf	99.9	2750	3-6	

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CUSTOMER REF: ET-78-C-01-2578		COAL GASIFICATION PROJECT HOYT LAKES, MINNESOTA ERIE MINING COMPANY		CONTRACT NO. MC-4814		DATE		REV.	
					DESIGN DATA SUMMARY		DUST SUPPRESSION		
Tag No.	Type	Material Handled	Qty. Hndl. TPH	System Spray Control	Compound H ₂ O Proportioning	Oper. Conditions, of	Service Hrs/Day	Remarks	
DC-106	Water & Suppresant Spray	Coal	3000 4" max. 75%-1½"	Automatic Interlocked With DU-101 and MF-101	Automatic	Ambient	4		
DC-108	Water & Suppresant Compound Spray	Coal ½"x0"	200	Automatic Interlocked With CO-110	Automatic	Ambient	8		
DC-109	Water & Suppresant Compound Spray	Coal ½"x0"	121	Automatic Interlocked With CO-107	Automatic	Ambient	16		

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CUSTOMER REF:		COAL GASIFICATION PROJECT				CONTRACT NO. MC-4814				DATE		REV.			
ET-78-C-01-2578		HOYT LAKES, MINNESOTA				ERIE MINING COMPANY				DESIGN DATA SUMMARY		FEEDERS			
Tag No.	Type	Matl. Hdd.	Size In.	Bulk Dens. lb/cf	Angle of Repose	Lgth Ft.	Width In.	Design Capac. STPH	Feeder Down Slope°	Liner Matl.	Matl. Temp. OF	Matl. Size Rg. In.	Matl. Norm. Sz. In.	Oper.	Remark
MF-101 A/B/C	Mech. Vibra. Pan	Coal	6	45	40	10	84	1000	10	S.S.	Amb				
MF-102 A/B	Mech. Vibra. Pan	Coal	6	45	40	5	24	80	10	S.S.	Amb.				
MF-103 A/B	Mech. Vibra. Pan	Coal	6	45	40	5	42	145	10	S.S.	Amb.				
MF-104 A/B	Mech. Vibra. Pan	Coal	2	45	40	5	30	188	10	S.S.	Amb.				
MF-105	Mech. Vibra. Pan	Coal	½	45		5	36	240	10	S.S.	Amb.				
MF-106	Rotr. Vane	Coal Ash		40				50			Amb. to 250	50Micr. to 1½ dia.	½ dia. to 1 dia.	Intermittent	
MF-107	Rotr. Wetter Unloader	Coal Ash		40				50			Amb. to 250	50Micr. to 1½ dia.	½ dia. to 1 dia.	Intermittent	
Note: Liner material for mech. vibrating feeders will be stainless steel with 3/8" thickness for sides and 1/2" for bottom.															

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3

CUSTOMER REF:		COAL GASIFICATION PROJECT				CONTRACT NO. MC-4814			DATE		REV.	
ET-78-C-01-2578		HOYT LAKES, MINNESOTA										
		ERIE MINING COMPANY				DESIGN DATA SUMMARY			MONORAIL HOISTS			
Tag No.	Type	Hoists				Trolley						Remark
		Capacity Tons	Lift Ft.	Speed FPM	Motor HP	Type	Speed FPM	Motor HP	Min. Rad. Ft.	Min. Monorail Beam Sz. In.	Conductors	
X-110	Elec. Cable	2	60	22	3	Motor Driven	65	1/3	6	8	Safety Covered Bar	
X-111	Elec. Cable	1	25	40	3	Motor Driven	65	1/3	Strght. Track	8	40' Flex. Cable	
X-112	Elec. Cable	10	50	22	15	Motor Driven	75	2@1/2	Strght. Track	10	100' Flex. Cable	
X-113	Elec. Cable	1	75	60	5	Motor Driven	100	2@1/3	Strght. Track	8	50' Flex. Cable	
X-114	Elec. Cable	1	130	60	5	Motor Driven	100	2@1/3	6	8	200' Flex. Cable	
X-115	Elec. Cable	1	60	40	3	Motor Driven	100	1/3	Strght. Track	8	50' Flex. Cable	
X-116	Elec. Cable	1½	110	60	5	Motor Driven	100	2@1/3	Strght. Track	8	40' Flex. Cable	
X-117	Elec. Cable	1½	40	30	3	Motor Driven	100	1/3	Strght. Track	8	50' Flex. Cable	
X-118	Elec. Cable	1	110	60	5	Motor Driven	100	2@1/3	Strght. Track	8	50' Flex. Cable	
X-119	Elec. Cable	1	110	60	5	Motor Driven	100	2@1/3	Strght. Track	8	50' Flex. Cable	
NOTES: All motors 440/3/60 Controls 110volt AC 4 button P.B. Pendant												

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COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKEE CONTRACT 4814
JANUARY, 1979

5.0 MATERIALS HANDLING - AREA 01

5.06 EQUIPMENT DATA SHEETS

- 5.06.1 Bins or Hoppers
- 5.06.2 Coal Crusher
- 5.06.3 Compressors/Blowers
- 5.06.4 Conveyors
- 5.06.5 Dust Collection/Suppression
- 5.06.6 Feeders
- 5.06.7 Heaters
- 5.06.8 Mobil Equipment
- 5.06.9 Pumps
- 5.06.10 Scales
- 5.06.11 Screens
- 5.06.12 Train Positioner/Dumper
- 5.06.13 Tripper Car
- 5.06.14 Special Equipment

5.06.1

BINS OR HOPPERS

PROCESS EQUIPMENT SPECIFICATIONS

DESIGN NOTES

BN-101	Dumper Hopper
BN-102A/B	Live Storage Reclaim Hopper
BN-103A/B	Emergency Reclaim Hopper
BN-104	Vibrating Screen Surge Hopper
BN-106	Fines Storage Reclaim Hopper
BN-107	Fines Loadout Bin
BN-108	Ash Silo

BINDESIGN NOTES

1. Bins shall be designed for mass flow.
2. For feeder maintenance or removal, the bin shall be provided with a means of stopping the discharge of material from the bin.
3. All controls shall be interlocked so that the upstream material supplying equipment cannot be started before the downstream equipment has been started and is running at design speed/capacity. Stopping any conveyor shall also automatically stop all upstream conveyors and feeders. A stop-run manual selector switch with lock unit shall be provided within sight of each drive motor for maintenance purposes. Design of the interlock system shall consider the length of conveyors and the inertia of successive conveyors.
4. Equipment sequential shutdown interlock system shall have a first out feature indicating the equipment that tripped first.
5. Access shall be provided to bins for personnel and equipment as required for inspection. Material sampling, flow observation and repairs.
6. All outdoor equipment shall be designed for winter operation in Northern Minnesota.

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ERIE MINING COMPANY
COAL GASIFICATION PROJECT
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BN-101

DUMPER HOPPER

Refer to DU-101 Rotary Dumper Engineering Requisition U-1

BN-102A/BLive Storage Reclaim Hopper

General Type	Square, rectangular outlet
Material Reclaimed	Coal
Material Bulk Density	
+ Loose (lb/cf)	45
+ Packed (lb/cf)	50
Angle of Repose (DEG)	40
Top Opening (ft)	10 x 10
Straight Side Height (ft)	1.5
Taper Height (ft)	8
Net Capacity (ST)	9
Maximum Outlet Rate (STPH)	80
Maximum Inlet Rate (STPH)	Flood
Design Temperature (°F)	Ambient
Material	CS with SS Liner
Remarks	
	+ Equipment notes No. 2, 5 and 6 apply
	+ Hopper top shall be equipped with grizzly screen.
	Opening shall be 6" square
	+ Hopper angle = 55° min. to horizontal
	+ Liners shall be replaceable
	+ One (1) outlet each for MF-102A and B, vibrating feeders

BN-103A/B

EMERGENCY RECLAIM HOPPER

General Type	Square, rectangular outlet
Material Reclaimed	Coal
Material Bulk Density	
+ Loose (lb/cf)	45
+ Packed (lb/cf)	50
Angle of Repose (DEG)	40
Top Opening (ft)	10 x 10
Stright Side Height (ft)	1.5
Taper Height (ft)	8
Net Capacity (ST)	10
Maximum Outlet Rate (STPH)	145
Maximum Inlet Rate (STPH)	Flood
Design Temperature (°F)	Ambient
Material	CS with SS Liner

Remarks

- + Equipment notes 2, 5 and 6 apply
- + Hopper top shall be equipped with grizzly screen
 Opening shall be 6" square
- + Hopper angle = 55° min. to horizontal
- + Liners shall be replaceable
- + Single outlet for MF-106A/B vibrating feeders

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BN-104Vibrating Screen Surge Hopper

General Type	Rectangular, Rectangular outlet (2)
Material Reclaimed	Coal
Material Bulk Density	
+ Loose (lb/cf)	45
+ Packed (lb/cf)	50
Angle of Repose (DEG)	40
Top Opening (ft)	6 x 7
Straight Side Height (ft)	7
Taper Height (ft)	11
Net Capacity (ST)	24
Outlet Rate (STPH)	188 each outlet
Inlet Rate (STPH)	285
Design Temperature (°F)	Ambient
Material	CS with SS Liner

Remarks

- + Equipment notes No. 2, 3, 4, 5 and 6 apply
- + A level probe shall be installed stopping CO-105 and preventing over-filling and spillage
- + Hopper wall angle = 55° min. to horizontal
- + Liners shall be replaceable
- + Surge hopper shall have two (2) outlets for MF-104A and B, vibrating feeders.

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ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
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BN-106

FINES STORAGE RECLAIM HOPPER

General Type	Rectangular, rectangular outlet
Material Reclaimed	Coal
Material Bulk Density	
+ Loose (lb/cf)	45
+ Packed (lb/cf)	50
Angle of Repose (DEG)	40
Top Opening (ft)	10 square
Outlet Opening (ft)	1.5 square
Straight Side Height (ft)	2
Taper Height (ft)	8
Net Capacity (ST)	6 (10 cu. yd.)
Maximum Outlet Rate (STPH)	240
Maximum Inlet Rate (STPH)	Flood
Design Temperature (^o F)	Ambient
Material	CS with SS Liner

Remarks

- + Equipment notes No. 2, 5, and 6 apply
- + Hopper top shall be equipped with grizzly screen.
Opening shall be 6" square
- + Hopper angle = 55^o min. to horizontal
- + Liners shall be replaceable
- + One (1) outlet for MF-105

COMMERCIAL PLANT DESIGN MANUAL
 ERIE MINING COMPANY
 COAL GASIFICATION PROJECT
 D.O.E. CONTRACT ET-78-C-01-2578
 McKEE CONTRACT 4814
 JANUARY, 1979

BN-107

FINES LOADOUT BIN

General Type	Square
Material Handled	Coal
Material Bulk Density	
+ Loose (lb/cf)	45
+ Packed (lb/cf)	50
Top Opening (ft)	19 x 19
Outlet Opening (ft)	2 x 2
Straight Side Height (ft)	4
Taper Height (ft)	18
Net Cap (ST)	50
Maximum Outlet Rate (STPH)	Flood
Maximum Inlet Rate	240
Design Temperature (°F)	Ambient
Material	CS with SS Liner

Remarks

- + Equipment notes No. 5 and 6 apply
- + Liners shall be replaceable
- + Hopper angle = 55° min. to horizontal
- + Design with single outlet and quadrant type shutoff gate.

BN-108ASH SILO

General Shape	Cylindrical
Material Stored	Coal Ash
Material Bulk Density	
+ Loose (lb/cf)	--
+ Packed (lb/cf)	40
Length (ft)	52
Width (ft)	25 I.D.
Straight Side Height (ft)	52
Taper Height (ft)	N/A
Net Cap (ST)	490
Maximum Inlet Rate (STPH)	10
Maximum Outlet Rate (STPH)	50
Material Temperature (°F)	100 to 1000
Material of Construction	
Walls	Hollow tile with internal glaze
Roof	Reinforced concrete
Bottom	Reinforced concrete
Remarks	
+ Silo bottom equipped with fluidizer (aerated air slide type)	
+ Reference Drawing 4814-X-01-07-2	

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKee CONTRACT 4814
JANUARY, 1979

5.06.2

COAL CRUSHER

ENGINEERING REQUISITION U-2

X-104

Coal Crusher

ENGINEERING REQUISITION

McKee

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

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

CONTRACT

4814

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

Rev. 1) 1/2/79
AST
Page 2

McKee

DESCRIPTION COAL CRUSHER

DATE AUGUST 7, 1978.

UNIT FUEL GAS DEMONSTRATION PLANT

CONTRACT 4814

CL-325/14

MADE BY: WOW

CHECKED BY:

PAGE 2 OF

E/R U-2

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. ORC 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

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																											
		<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>Western</td><td>Eastern</td></tr><tr><td></td><td><u>Sub-bituminous</u></td><td><u>Bituminous</u></td></tr><tr><td>Bulk Density (lb/cf)</td><td>45</td><td>45</td></tr><tr><td>Grindability (Hardgrove Index)</td><td>44-51</td><td>46-60</td></tr><tr><td>Moisture Content (wt %) as received</td><td>16-26 (1)</td><td>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>Minus 1-1/2 x plus 1/2</td></tr><tr><td>Discharged Fines Size (inches)</td><td>Minus 1/2 x 0</td></tr><tr><td>Maximum Fines Generation (wt %)</td><td>15</td></tr><tr><td>Crushing Capacity Range (tph)</td><td>14-58</td></tr></table> <p><u>Maximum Feed Size (inches)</u></p> <table><tr><td>Normal (assumed)</td><td>2-3</td></tr><tr><td>Frozen (assumed)</td><td>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	Frozen (assumed)	6		
	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																														
Frozen (assumed)	6																														

ENGINEERING REQUISITION

McKEE

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

DESCRIPTION COAL CRUSHER DATE AUGUST 7, 1978UNIT FUEL GAS DEMONSTRATION PLANT CONTRACT 4814

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

ENGINEERING REQUISITION

McKee

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

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

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

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5.06.3

BLOWERS

PROCESS EQUIPMENT SPECIFICATIONS

C-101

Ash Silo Air Slide Blower

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C-101ASH SILO AIR SLIDE BLOWER

1. Type: Horizontal
Gas Handled: Ambient Air
Flow: lb/hr.
SCFM
Driver: Electric Motor
2. Inlet Conditions:
Temperature OF - 40 to 100
Pressure, psia 13.9
Design acfm
3. Discharge Conditions:
Pressure, psia
Temperature OF
4. Notes:
 - 4.1 Blower shall be supplied with an air intake filter.
 - 4.2 Blower shall supply transport air to air slide X-102.
 - 4.3 Blower requirements shall be specified by air slide supplier.
 - 4.4 Electric power available - 460/3/60

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5.06.4CONVEYOR PROCESS SPECIFICATIONS

CO-101	Track Hopper Collection Conveyor
CO-102	Raw Coal Transport Conveyor
CO-103	Raw Coal Bypass Conveyor
CO-104	Reclaim Collecting Conveyor
CO-105	Crushed Coal Collecting Conveyor
CO-106	Screened Coal Collecting Conveyor
CO-107	Gasifier Feed Tripper Conveyor
CO-108	Coal Fines Collecting Conveyor
CO-109	Fines Transport Conveyor
CO-110	Reclaimed Fines Conveyor
CO-111	Raw Coal Transporting Conveyor
CO-112	Extension to Existing Conveyor H-4

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CONVEYOR

EQUIPMENT NOTES

1. All transfer points shall be designed to minimize dusting. Skirt boards with covers shall be provided for transfers from feeders to conveyors.
2. Chutes provided at transfer points shall be equipped with "plugged chute" indicators capable of shutting down the upstream material supplying equipment. Chutes shall be of carbon steel construction with wear plates as required at wear points.
3. All controls shall be interlocked so that the upstream material supplying equipment cannot be started before the downstream equipment has been started and is running at design speed/capacity. Stopping any conveyor shall also automatically stop all upstream conveyors and feeders. A stop-run manual selector switch with lock unit shall be provided within sight of each drive motor for maintenance purposes. Design of the interlock system shall consider the length of conveyors and the inertia of successive conveyors.
4. Equipment sequential shutdown interlock system shall have a first out feature to indicate the equipment that tripped first.
5. Conveyors to have enclosed galleries. Conveyor galleries are to have walkways on one side. Galleries are to have a means of ventilation and are to be equipped with heaters, fire protection, and washdowns.
6. Conveyor lengths and rises are approximate and shall be verified at time of final design.
7. Conveyors shall be provided with emergency stop cords.
8. All discharge chutes shall be covered and supplied with inspection doors.
9. All outdoor equipment shall be designed for winter operation in northern Minnesota.

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CO-101TRACK HOPPER COLLECTION CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	65
Rise (ft)	0
Width (in)	90
Trough Angle (degrees)	35
Design Capacity (STPH)	3000
Speed at Design Capacity (FPM)	440
Material Design Temperature (°F)	Ambient
Take-up Type	Gravity

Remarks

- + Design for 3 point filling
- + Conveyor to be skirted full length
- + Equipment notes No. 1, 2, 3, 4, 6, 7, 8, & 9 apply

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CO-102RAW COAL TRANSPORT CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft)	600
Rise (ft)	134
Width (in)	66
Trough Angle (degrees)	35
Design Capacity (STPH)	3000
Speed at Design Capacity (FPM)	700
Material Design Temperature (^o F)	Ambient
Take-up Type	Gravity

Remarks

- + Contains belt scale WS-101 (by others)
- + Discharges to lowering pipe with flop gate diverter to conveyor CO-103
- + Angle in horizontal plane from conveyor CO-101 at point of transfer is approximately 90^o
- + Equipment notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply

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CO-103RAW COAL BYPASS CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	215
Rise (ft)	10
Width (in)	66
Trough Angle (degrees)	35
Design Capacity (STPH)	3000
Speed at Design Capacity (FPM)	700
Material Design Temperature (^o F)	Ambient
Take-up Type	Gravity
Remarks	

+ Equipment notes 1,2,3,4,5,6,7,8&9 apply

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CO-104

RECLAIM COLLECTING CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	400
Rise (ft)	49
Width (in)	30
Trough Angle (degrees)	20
Design Capacity (STPH)	285
Speed at Design Capacity (FPM)	350
Material Design Temperature (^o F)	Ambient
Take-up Type	Gravity

Remarks

- + Contains tramp iron magnet X-102, metal detector X-105A & B and belt scale WS-102 (by others).
- + Conveyor has four (4) point filling
- + Equipment notes 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply
- + To discharge on Conveyor C-105.

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CO-105COAL TRANSPORTING CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1 1/2
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	320
Rise (ft)	57
Width (in)	30
Trough Angle (degrees)	20
Design Capacity (STPH)	285
Speed at Design Capacity (FPM)	350
Material Design Temperature (^o F)	Ambient
Take-up Type	Gravity

Remarks

- + Conveyor has one (1) point filling
- + Equipment notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply

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CO-106SCREENED COAL COLLECTING CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1 1/2
Material Bulk Density (lb/cf)	45
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	480
Rise (ft)	103
Width (in)	24
Trough Angle (degrees)	20
Design Capacity (STPH)	140
Speed at Design Capacity (FPM)	300
Material Design Temperature	Ambient
Take-up Type	Screw

Remarks

- + Contains belt scale WS-103 (by others)
- + Equipment notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply
- + Conveyor has two (2) point filling

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CO-107GASIFIER FEED TRIPPER CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1 1/2
Material Bulk Density (lb/cf)	45
Length (ft) c/c Pulleys	240
Rise (ft)	(later)
Width (in)	30
Trough Angle (degrees)	20
Design Capacity (STPH)	140
Speed at Design Capacity (FPM)	250
Material Design Temperature (°F)	Ambient
Take-up Type	Gravity

Remarks

- + Conveyor has one (1) traveling tripper. Tripper shall be equipped with diverter chute for left & right hand discharge and shall have approximately 60' of travel
- + Equipment notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply

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CO-108

COAL FINES COLLECTING CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1/2
Material Bulk Density (lb/cf)	45
Length (ft) c/c Pulleys	42
Rise (ft)	0
Width (in)	24
Trough Angle (degrees)	20
Design Capacity (STPH)	145
Speed at Design Capacity (FPM)	300
Material Design Temperature (°F)	Ambient
Take-up Type	Adjustable Screw

Remarks

- + Conveyor has two (2) point filling
- + Equipment notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply

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CO-109

FINES TRANSPORT CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1/2
Material Bulk Density (lb/cf)	45
Length (ft) c/c Pulleys	160
Rise (ft)	52
Width (in)	24
Trough Angle (degrees)	20
Design Capacity (STPH)	145
Speed at Design Capacity (FPM)	300
Material Design Temperature (^o F)	Ambient
Take-up Type	Gravity
Remarks	

+ Equipment notes 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply

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CO-110

RECLAIMED FINES CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	1/2
Material Bulk Density (lb/cf)	45
Length (ft)	280
Rise (ft)	79
Width (in)	30
Trough Angle (degrees)	20
Design Capacity (STPH)	240
Speed at Design Capacity (FPM)	300
Material Design Temperature (°F)	Ambient
Take-up Type	Gravity

Remarks

- + Conveyor notes No. 1, 2, 3, 4, 5, 6, 7, 8 & 9 apply
- + Contains belt scale WS-104 (by others)

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CO-111COAL TRANSPORT CONVEYOR

General Type	Belt
Material Handled	Coal
Material Size (in.) Max.	
Material Bulk Density (lb/cf)	50
Angle of Repose (DEG.)	40
Length (ft) c/c Pulleys	144
Rise (ft)	6
Width (in)	24
Trough Angle (DEG.)	20
Design Capacity (STPH)	225
Speed at Design Capacity (FPM)	450
Material Design Temperature ($^{\circ}$ F)	Ambient
Take-up Type	Gravity

Remarks

- + To discharge on to stacker conveyor
- + All transfer points shall be designed to minimize dusting.
Skirt boards with covers shall be provided for transfers from
feeders to conveyors.

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CO-112EXISTING COAL RECLAIM FEEDER H-2F REVAMP

General Type	Belt
Material Handled	Coal
Material Size (in) Max.	
Material Bulk Density (lb/cf)	50
Angle of Repose (DEG)	40
Length (ft) c/c Pulleys	60 (was 8'-10")
Rise (ft)	0
Width (in)	60
Trough Angle (degrees)	20
Design Capacity (STPH)	170
Speed at Design Capacity (FPM)	66
Material Design Temperature (^o F)	Ambient
Take-up Type	Screw

Remarks

1. To discharge on to transfer conveyor
2. Use existing transfer chute
3. Provide new belt drive at 5HP (was 3HP)

5.06.5DUST COLLECTION/SUPPRESSIONEQUIPMENT PROCESS SPECIFICATIONS

DC-101	Screening Station Dust Collector
DC-102	Transfer House Dust Collector
DC-103	Conveyor CO-103 Dust Collector
DC-104	Conveyor CO-104 Dust Collector
DC-106	Car Dumper Dust Suppression
DC-107	Live Storage Area Dust Suppression
DC-108	Conveyor CO-110 Dust Suppression
DC-109	Conveyor CO-109 & BN-106 Dust Suppression
DC-110	Coal Surge Bin Dust Collector
DC-111	Conveyor CO-102 Vacuum Cleaning System
DC-112	Conveyor CO-104 & Transfer Station Vacuum Cleaning System
DC-113	Conveyor CO-105 & 106 Vacuum Cleaning System
DC-114	Conveyor CO-109, Crushing & Screening Station Vacuum Cleaning System
DC-115	Conveyor CO-107 Vacuum Cleaning System

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DUST COLLECTION/SUPPRESSION

SYSTEM DESIGN NOTES

1. Each dust collector shall be designed for an inlet and discharge dust loading as follows:

Inlet Dust Loading	3-5 grams/scf
Discharge Dust Loading	0.005 grams/scf (dry) max.
2. Dust particle size distribution for all collectors shall be assumed to be as follows:

20% less than 10 microns
20% 10-50 microns
60% 50-500 microns
3. Each dust collector shall be of a pressure jet, continuous-duty, fabric collector design. High pressure (80-100 psig) compressed air shall be used for reconditioning of dust tubes.
4. Each collector shall be equipped with dust hoppers. A motor driven rotary valve airlock shall be installed on each dust hopper.
5. A dried, filtered, and compressed air system shall be furnished with each collector.
6. Each collector shall be designed to meet all of the requirements of McKee Specification 1003.

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DC-101

SCREENING STATION DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature ($^{\circ}\text{F}$)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	26,200
Pressure Drop ($"\text{H}_2\text{O}$)	3-6

Ref. Dwg. 4814-S-01-51-2

4814-X-01-56-2

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DC-102

CRUSHING STATION DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature ($^{\circ}\text{F}$)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	8,500
Pressure Drop ($"\text{H}_2\text{O}$)	3-6

Ref. Dwg. 4814-S-01-51-2

4814-X-01-56-2

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DC-103

COAL SURGE BIN DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature ($^{\circ}\text{F}$)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	9,250
Pressure Drop ($"\text{H}_2\text{O}$)	3-6

Ref. Dwg. 4814-S-01-51-2

4814-X-01-56-2

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DC-104

CONVEYOR CO-102 DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature (°F)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	6,500
Pressure Drop ("H ₂ O)	3-6

Ref. Dwg. 4814-S-01-51-2

4814-X-01-56-2

DC-105

ASH SILO DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature (^o F)	Ambient (-25 ^o F to 83 ^o F)
Construction	Hazardous <u>+3</u> psig
Installation	Outdoors at 1542 ft. above sea level
Efficiency	99.9%
Volume (acfm)	2,500
Pressure Drop (H ₂ O)	3-6
Ref Drawing	4814-S-01-52-2 4814-X-01-57-2 4814-Y-01-66-2

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DC-106

CAR DUMP AREA DUST SUPPRESSOR

Type	Water & Suppressant Spray
Material Handled	Coal
Quantity Handled (TPH)	3000 (4" max, 75% - 1 1/2")
System Spray Control	Automatic, interlocked w/DU-101 & MF-101
Compound H ₂ O Proportioning	Automatic
Operating Conditions (°F)	Ambient
Service/(hrs/day)	8

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DC-107

LIVE STORAGE AREA DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature ($^{\circ}\text{F}$)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	17,250
Pressure Drop ($"\text{H}_2\text{O}$)	3-6

Ref. Dwg. 4814-S-01-52-2

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DC-108

FINES LOADOUT AREA DUST SUPPRESSOR

Type	Water & Suppressant Compound Spray
Material Handled	Coal (1/2" x 0")
Quantity Handled (TPH)	200
System Spray Control	Automatic, interlocked w/CO-110
Compound, H ₂ O Proportioning	Automatic
Operating Conditions (°F)	Ambient
Service (hrs/day)	8

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DC-109

CONVEYOR CO-109 DUST SUPPRESSOR

Type	Water & Suppressant Compound Spray
Material Handled	Coal (1/2" x 0")
Quantity Handled (TPH)	121
System Spray Control	Automatic, interlocked w/CO-107
Compound, H ₂ O Proportioning	Automatic
Operating Conditions (°F)	Ambient
Service (hrs/day)	8

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DC-110

CONVEYOR CO-103 DUST COLLECTOR

Type	Reverse Jet, Continuous-Duty Fabric Collector
Air Temperature ($^{\circ}\text{F}$)	Ambient (-25°F to 83°F)
Construction	Hazardous ± 3 psig
Installation	Outdoors at 1542 ft above sea level
Efficiency	99.9%
Volume (acfm)	2,750
Pressure Drop ($"\text{H}_2\text{O}$)	3-6

Ref. Dwg. 4814-S-01-52-2

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DC-111, DC-112, DC-113, DC-114 & DC-115

VACUUM CLEANING SYSTEMS

1. High velocity central vacuum cleaning and conveying systems shall be installed for:

<u>Tag</u>	<u>Unit</u>
DC-111	CO-102 Conveyor Gallery
DC-112	CO-104 Conveyor Gallery and Transfer Station
DC-113	CO-105 and CO-106 Conveyor Galleries
DC-114	CO-109 Conveyor Gallery, Crushing and Screening Station
DC-115	CO-107 Tripper Conveyor Gallery

2. Each system shall be designed to allow simultaneous operation of two (2) inlet valves, each with a 25 ft. length of 1 1/2" vacuum cleaning hose and cleaning tool.
3. Each system shall be complete and include, but not limited to, a motor driven exhaustor interconnected with one or two separators, the required lengths of pipe extending throughout the system area with inlet valves placed approximately every 45 ft., hoses, cleaning tools and accessories.
4. Each system shall conform to the requirements of applicable NFPA, Federal, State and Local codes.
5. Reference Drawing 4814-X-01-56-2.

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5.06.6FEEDERSEQUIPMENT PROCESS DATA SHEETS

MF-101A-C	Track Hopper Reclaim Feeders
MF-102A/B	Storage Pile Reclaim Feeders
MF-103A/B	Storage Pile Emergency Reclaim Feeders
MF-104A/B	Feeders For Vibrating Screens
MF-105	Fines Storage Reclaim Feeder
MF-106	Ash Silo Discharge Feeder
MF-107	Rotary Unloader/Wetter

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MF-101-A, B, & C

TRACK HOPPER RECLAIM FEEDERS

1. Each feeder shall be furnished as follows:

- A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient

- B. Mechanical Design

Type: Electromechanical Vibrating Feeder
Trough Size: 84 inches wide by 120 inches long
Trough Bottom: Flat
Angle of Trough to Horizontal: 10°
Mounting: Cable Suspended
Design Capacity: 1000 short tons per hour
Liner Material: Stainless steel
Liner Thickness: Bottom, 1/2 inch
Sides, 3/8 inch

- C. Design Notes

Installation: Outdoors
Available Power Supply: 460/3/60

Impact Loading for 6" maximum lump size shall be assumed.

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MF-102-A/B

STORAGE PILE RECLAIM FEEDERS

1. Each feeder shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient

B. Mechanical Design

Type: Electromechanical Vibrating Feeder
Trough Size: 24 inches wide by 60 inches long
Trough Bottom: Flat
Angle of Trough to Horizontal: 10°
Mounting: Cable Suspended
Design Capacity: 80 short tons per hour
Liner Material: Stainless steel
Liner Thickness: Bottom, 1/2 inch
Sides, 3/8 inch

C. Design Notes

Installation: Outdoors
Available Power Supply: 460/3/60
Impact loading for 6" maximum lump size shall be assumed.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKee CONTRACT 4814
JANUARY, 1979

MF-103 A & B

STORAGE PILE EMERGENCY RECLAIM FEEDERS

1. Each feeder shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient

B. Mechanical Design

Type: Electromechanical Vibrating Feeder
Trough Size: 42 inches wide by 60 inches long
Trough Bottom: Flat
Angle of Trough to Horizontal: 10°
Mounting: Cable Suspended
Design Capacity: 145 short tons per hour
Liner Material: Stainless steel
Liner Thickness: Bottom, 1/2 inch
Sides, 3/8 inch

C. Design Notes

Installation: Outdoors
Available Power Supply: 460/3/60
Impact loading for 6" maximum lump size shall be assumed

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
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JANUARY, 1979

MF-104-A & B

FEEDERS FOR VIBRATING SCREENS

1. Each feeder shall be furnished as follows:

- A. Operating Conditions

Material Handled: Coal
Material Size: 2 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient

- B. Mechanical Design

Type: Electromechanical Vibrating Feeder
Trough Size: 30 inches wide by 60 inches long
Trough Bottom: Flat
Angle of Trough to Horizontal: 10°
Mounting: Cable Suspended
Design Capacity: 188 short tons per hour
Liner Material: Stainless steel
Liner Thickness: Bottom, 1/2 inch
Sides, 3/8 inch

- C. Design Notes

Available Power Supply: 460/3/60
Two feeders shall be operating at 119 stph

Impact loading for 2" maximum lump size shall be assumed.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
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MF-105

FINES STORAGE RECLAIM FEEDER

1. Each feeder shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient

B. Mechanical Design

Type: Electromechanical Vibrating Feeder
Trough Size: 36 inches wide by 60 inches long
Trough Bottom: Flat
Angle of Trough to Horizontal: 10°
Mounting: Cable Suspended
Design Capacity: 250 short tons per hour
Liner Material: Stainless steel
Liner Thickness: Bottom, 1/2 inch
Sides, 3/8 inch

C. Design Notes

Available Power Supply: 460/3/60
Impact loading for 6" maximum lump size shall be assumed.

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MF-106

ASH SILO DISCHARGE FEEDER

1. The feeder shall be furnished as follows:

- A. Operating Conditions

Material Handled: Coal ash
Material Size: 1 1/2 inch maximum
Bulk Density: 40 pounds per cubic foot
Angle of repose:
Temperature F: Ambient

- B. Mechanical Design

Type: Rotary Vane
Inlet Size:
Outlet Size:
Design Capacity: 50 tons per hour
Operation: Intermittent

- C. Design Notes

Installation: Outdoors
Available Power: 460/3/60
Used as an air lock and to be included with rotary wetter/
unloader MF-107.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
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MF-107

ROTARY UNLOADER/WETTER

1. The unloader/wetter shall be furnished as follows:

- A. Operating Conditions

Material Handled: Coal ash
Material Size: 50 micron to 1 1/2 inch diameter
Bulk Density: 40 pounds per cubic foot
Temperature °F: Ambient to 250

- B. Mechanical Design

Type: Rotary Drum - Continuous Wetter/Mixer
Wetting Agent: Water
Internal Conveyor: Double Flight
Feed Controller: Rotary Star Feeder MF-106
Design Capacity: 50 tons per hour
Operation: Intermittent
Mounting Type: Suspension

- C. Design Notes

Installation: Outdoors
Available Power Supply: 460/3/60
Manual cut-off gate to be provided at inlet before the
Rotary Star Feeder MF-106

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ERIE MINING COMPANY
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5.06.7

HEATERS

H-101

Thaw Shed Heaters

COMMERCIAL PLANT DESIGN MANUAL
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H-101THAW SHED HEATERPROCESS SPECIFICATION

Service	Raw Coal Thawing
General Type	Electric Infrared
Thawing Rate	5 Cars per Hour
Car Contents	Coal 6" Max. Lump
Type and Size of Cars	Unit Train Gondola Cars - 100 Ton 53'-1" length over coupler 10'-8" width 12'9" height
Type of Dumping	Rotary Dump
Dumping Design Temperature	Ambient
Length of Thawing Shed	Two Car Length
Length of Soaking Area	One Car Length

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5.06.8

MOBIL EQUIPMENT

PROCESS SPECIFICATIONS

ME-101	Car Dumper Dozer
ME-102A/B	Raw Coal Dozers
ME-103A/B	Raw Coal Stockpile Scrapers
ME-104	Coal Fines Wheel Loader

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JANUARY, 1979

ME-101

CAR DUMPER DOZER

Type: Track type tractor with coal bulldozer blade. Caterpillar type D4D or equivalent. 5'1" approx. width over shoes.

Operating Duty:

- a. The tractors travel occasionally on the grizzly of the car dumper hopper to break up lumps of frozen coal. Six inches square grate bar openings.
- b. Standby for raw coal and coal fines handling.

ME-102A/B

RAW COAL DOZER

Type: Track type tractor with coal bulldozer blade. Caterpillar D8 or equivalent.

Operating Duty:

- a. Spread conical raw coal bypass pile for scraper loading. 4300 ton in one 8 hour shift after each 100 car coal train. Average 75 feet dozing distance. 10% grades.
- b. Replenish and prepare raw coal live pile in winter time or in case of train delays. 2857 tons in one 8 hour shift every 24 hours.
- c. Grading raw coal storage pile.
- d. To be used for coal fines handling.
- e. One operating and one standby.

ME-103A/B

RAW COAL STOCKPILE SCRAPER

Type: Wheel tractor scraper. Caterpillar 627B or equivalent.
Capacities 14 cu. yd. struck; 20 cu. yd. heaped.

Operating Duty:

- a. Reclaiming raw coal from the conical bypass pile and spreading on the flat top storage pile. 4300 ton in one 8 hour shift after each 100 car coal train. 300 feet average haul distance one way. Nominal level run.
- b. Reclaiming raw coal from the storage pile and dumping in the live pile area. 2857 ton on one 8 hour shift every 24 hours. In winter time only when no coal trains are arriving. 300 feet average haul distance one way.
- c. To be used for coal fines handling.
- d. One operating and one standby.

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ME-104

COAL FINES WHEEL LOADER

Type: Wheel Loader. 10 cu. yd. coal bucket, Caterpillar
992B or equivalent.

Operating Duty:

Reclaim 200 tph coal fines from a conical pile. Haul
approximately 100 feet on a 10% grade and dump in an
elevated conveyor feed hopper.

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5.06.9

PUMPS

PROCESS SPECIFICATIONS

P-101A/B	Track Hopper Sump Pumps
P-102A/B	Coal Reclaim Sump Pumps

CENTRIFUGAL PUMP DATA SHEET

McKee

FORM M-604

REVISION BY DATE	1.	2.	3.	4.	5.	6.	7.	8.
SERVICE <u>Car Dumper Pit - Pump</u>					MOTORS REQ'D <u>Two (2)</u>		TURBINES REQ'D _____	
NO. REQ'D <u>Two (2)</u> TAG NO. <u>P-101A/B</u>					TAG NO. <u>PM-101A/B</u>		TAG NO. _____	
<u>Horizontal Sump Pump</u>								
MPR _____					PROVIDED BY _____		PROVIDED BY _____	
SIZE & TYPE _____ SERIAL NO. _____					MOUNTED BY _____		MOUNTED BY _____	
OPERATING CONDITIONS, EACH PUMP					PERFORMANCE			
LIQUID <u>Dirty Water</u>		U.S. GPM. at PT. NOR _____		RATED <u>50</u>		PROPOSAL CURVE NO. _____		
		DISCH. PRESS., PSIG <u>30</u>				RPM _____ NPSHR (WATER) _____		
PT. F. NOR <u>Ambient</u> MAX <u>150</u>		SUCT. PRESS., PSIG MAX _____		RATED _____		EFF. _____ BHP RATED _____		
SP. GR. at PT. <u>1.01</u>		DIFF. PRESS., PSI _____				MAX. BHP RATED IMP. _____		
VAP. PRESS. at PT. PSIA _____		DIFF. HEAD, FT. _____				MAX. HEAD RATED IMP. _____		
VIS. at PT. Sio _____ CP _____		NPSHA, FT. _____				MIN. CONTINUOUS GPM. _____		
CORR/EROS. CAUSED BY <u>Coal - 1/2" Max.</u>				HYD. HP _____		ROTATION (VIEWED FROM CPLG END) _____		
CONSTRUCTION					SHOP TESTS			
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF. ☐ WIT. PERF ☐ NON-WIT. HYDRO ☐ WIT. HYDRO ☐ NPSH REQ'D. ☐ WIT. NPSH ☐ SHOP INSPECTION ☐ DISMANT. & INSP. AFTER TEST ☐ OTHER _____			
SUCTION								
DISCHARGE								
CASE MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____ -SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SQL ☐ DBL ☐ DIFFUSER -PRESS ☐ MAX. ALLOW. _____ PSIG _____ "F; ☐ HYDRO TEST _____ PSIG -CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE IMPELLER DIA.: ☐ RATED _____ ☐ MAX. _____ ☐ TYPE: _____ MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG BEARINGS-TYPE: ☐ RADIAL _____ ☐ THRUST _____ LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE COUPLING: ☐ MFR _____ ☐ MODEL _____ DRIVER HALF MTD BY: ☐ PUMP MFG ☐ DRIVER MFR ☐ PURCHASER PACKING: ☐ MFR & TYPE _____ ☐ SIZE/NO. OF RINGS _____ MECH. SEAL: ☐ MFR & MODEL _____ API CLASS. CODE _____ ☐ MFR CODE _____								
AUXILIARY PIPING					MATERIALS			
☐ C.W. PIPE PLAN _____ ☐ CU; ☐ S.S.; ☐ TUBING; ☐ PIPE ☐ TOTAL COOLING WATER REQ'D, GPM _____ ☐ SIGHT F.I. REQ'D _____ ☐ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG ☐ SEAL FLUSH PIPE PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE ☐ EXTERNAL SEAL FLUSH FLUID _____ ☐ GPM _____ ☐ PSIG ☐ AUXILIARY SEAL PLAN _____ ☐ C.S. ☐ S.S. ☐ TUBING ☐ PIPE ☐ AUX. SEAL QUENCH FLUID _____					PUMP: CASE/TRIM CLASS ☐ _____ <u>C.I./STD</u> BASEPLATE: ☐ _____			
MOTOR DRIVER					SUMP PUMPS			
HP _____ RPM _____ FRAME _____ VOLTS/PHASE/CYCLES _____ MFR _____ BEARINGS _____ LUBE _____ TYPE _____ INSUL _____ FULL LOAD AMPS _____ ENC _____ TEMP RISE, C _____ LOCKED ROTOR AMPS _____ ☐ VHS ☐ VSS VERT. THRUST CAP., LB. _____					PIT OR SUMP DEPTH ☐ _____ MIN. SUBMERGENCE REQ'D. ☒ <u>8'</u> (suction pipe) COLUMN PIPE: ☐ FLANGED ☐ THREADED LINE SHAFT: ☐ OPEN ☐ ENCLOSED BRG: ☐ BOWL _____ ☐ LINE SHAFT _____ BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE FLOAT & ROD ☐ C.S. ☐ S.S. ☐ BRZ ☐ NONE FLOAT SWITCH ☐ _____ PUMP THRUST, LB ☐ UP _____ ☐ DOWN _____			
APPROX. WT, PUMP & BASE _____ MOTOR _____ TURBINE _____								

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

One Pump StandbyPumps Located Above SumpPriming Tank Required

CENTRIFUGAL PUMP DATA SHEET

McKee

FORM M-604

REVISION BY DATE	1.	2.	3.	4.	5.	6.	7.	8.
SERVICE <u>Coal Reclaim Pit Pump</u>				MOTORS REQ'D <u>Two (2)</u>		TURBINES REQ'D _____		
NO. REQ'D <u>Two (2)</u>		TAG NO. <u>P-102A/B</u>		TAG NO. <u>PM-102A/B</u>		TAG NO. _____		
<u>Horizontal Sump Pump</u>								
MFR. _____				PROVIDED BY _____		PROVIDED BY _____		
SIZE & TYPE _____				SERIAL NO. _____		MOUNTED BY _____		MOUNTED BY _____
OPERATING CONDITIONS, EACH PUMP					PERFORMANCE			
LIQUID <u>Dirty Water</u>		U.S. GPM. at PT. NOR _____		RATED <u>50</u>		PROPOSAL CURVE NO. _____		
		DISCH. PRESS., PSIG <u>30</u>				RPM _____ NPSHR (WATER) _____		
PT. F. NOR <u>Ambient</u> MAX. <u>150</u>		SUCT. PRESS., PSIG MAX _____		RATED _____		EFF. _____ BHP RATED _____		
SP. GR. at PT. <u>1.01</u>		DIFF. PRESS., PSI _____				MAX. BHP RATED IMP _____		
VAP. PRESS. at PT. PSIA _____		DIFF. HEAD, FT. _____				MAX. HEAD RATED IMP _____		
VIS. at PT. <u>Std</u> CP _____		NPSHA, FT. _____				MIN. CONTINUOUS GPM. _____		
CORR/EROS. CAUSED BY <u>Coal - 1/2" Max.</u>				HYD. HP _____		ROTATION (VIEWED FROM CPLG END) _____		
CONSTRUCTION					SHOP TESTS			
NOZZLES	SIZE	RATING	FACING	LOCATION	☐ NON-WIT. PERF. ☐ WIT. PERF ☐ NON-WIT. HYDRO ☐ WIT. HYDRO ☐ NPSH REQ'D. ☐ WIT. NPSH ☐ SHOP INSPECTION ☐ DISMANT. & INSP. AFTER TEST ☐ OTHER _____			
SUCTION								
DISCHARGE								
CASE-MOUNT: ☐ CENTERLINE ☐ FOOT ☐ BRACKET ☐ VERT. (TYPE) _____ -SPLIT: ☐ AXIAL ☐ RAD; TYPE VOLUTE ☐ SQL ☐ DBL ☐ DIFFUSER -PRESS ☐ MAX. ALLOW. _____ PSIG _____ °F; ☐ HYDRO TEST _____ PSIG -CONNECT: ☐ VENT ☐ DRAIN ☐ GAGE IMPELLER DIA.: ☐ RATED _____ ☐ MAX _____ ☐ TYPE: _____ MOUNT: ☐ BETWEEN BRGS ☐ OVERHUNG BEARINGS-TYPE: ☐ RADIAL _____ ☐ THRUST _____ LUBE: ☐ RING OIL ☐ FLOOD ☐ OIL MIST ☐ FLINGER ☐ PRESSURE COUPLING: ☐ MFR _____ ☐ MODEL _____ DRIVER HALF MTD BY: ☐ PUMP MFG ☐ DRIVER MFR ☐ PURCHASER PACKING: ☐ MFR & TYPE _____ ☐ SIZE/NO. OF RINGS _____ MECH. SEAL: ☐ MFR & MODEL _____ API CLASS. CODE _____ ☐ MFR CODE _____								
AUXILIARY PIPING					MATERIALS			
☐ O.C.W. PIPE PLAN _____ ☐ O.C.U. ☐ O.S.S. ☐ O TUBING; ☐ O PIPE ☐ TOTAL COOLING WATER REQ'D, GPM _____ ☐ O SIGHT F.I. REQ'D _____ ☐ PACKING COOLING INJECTION REQ'D: ☐ TOTAL GPM ☐ PSIG ☐ SEAL FLUSH PIPE PLAN _____ ☐ O.C.S. ☐ O.S.S. ☐ O TUBING ☐ O PIPE ☐ EXTERNAL SEAL FLUSH FLUID _____ ☐ GPM _____ ☐ PSIG ☐ AUXILIARY SEAL PLAN _____ ☐ O.C.S. ☐ O.S.S. ☐ O TUBING ☐ O PIPE ☐ O AUX. SEAL QUENCH FLUID _____					PUMP: CASE/TRIM CLASS ☐ _____ <u>C.I./STD</u> BASEPLATE: ☐ _____			
MOTOR DRIVER					SUMP PUMPS			
HP _____ RPM _____ FRAME _____ VOLTS/PHASE/CYCLES _____ MFR _____ BEARINGS _____ LUBE _____ TYPE _____ INSUL _____ FULL LOAD AMPS _____ ENC _____ TEMP RISE, C _____ LOCKED ROTOR AMPS _____ ☐ VHS ☐ VSS. VERT. THRUST CAP., LB. _____					PIT OR SUMP DEPTH ☐ _____ MIN. SUBMERGENCE REQ'D. ☒ <u>8'</u> (Suction Pipe) COLUMN PIPE: ☐ FLANGED ☐ THREADED LINE SHAFT: ☐ OPEN ☐ ENCLOSED BRG: ☐ BOWL _____ ☐ LINE SHAFT _____ BRG. LUBE ☐ WATER ☐ OIL ☐ GREASE FLOAT & ROD ☐ O.C.S. ☐ O.S.S. ☐ O BRZ ☐ O NONE FLOAT SWITCH ☐ _____ PUMP THRUST, LB ☐ UP _____ ☐ DOWN _____			
APPROX. WT. PUMP & BASE _____					MOTOR _____ TURBINE _____			

API STANDARD 610 GOVERNS UNLESS OTHERWISE NOTED.

One Pump Standby
 Pumps Located Above Sump
 Priming Tank Required

McKee

Form M-1082

VESSEL SERVICE Oil/Water Separator Sump

TAG No. PIT-501

NO. REQUIRED 1

UNIT _____

PREPARED BY IHH **APPROVED BY** _____ **CONTRACT No.** MC-4814 **SHEET No.** 1

DATE 8/4/78 **DATE** _____ **WN No.** _____ **OF** 2

1	TEMPERATURE °F	DESIGN	OPER.	TOP	100°F	7	PRESSURE	OPERATING:		REFERENCES:					
				FEED	100°F			ATM.		TRAY DATA SHEET No.					
				BOTTOM	100°F			RELIEF VALVE		P & I FLOW DIAGRAM No.					
		DESIGN	OPER.	TOP	200°F	8	PRESSURE	SET:		REVISION	1	2	3	4	5
				FEED	200°F			WIND, P.S.F.:	BY						
				BOTTOM	200°F				DATE						

10 **OPER. HYDROSTATIC HEAD** 6'

11 **SPECIFIC GRAVITY** 62.4 lbs/Ft³

12 **DESIGN AND CONSTRUCTION** **CORR. ALL.-SHELL & HD, IN.** _____

13 **CORR. ALL.-INTERNALS, IN.** _____

14 **McKee SPECS.** _____

15 **CUST. SPECS.** _____

16 **CONST. CODE** _____

17 **STRESS RELIEVED** _____

18 **RADIOGRAPHED** _____

19 **EARTHQUAKE COMP.** _____

20 **HEAD TYPE** _____

21 **PLATFORM No. & TYPE** _____

22 **INSULATION SERVICE** _____

23 **MATERIALS** **SHELL & HEAD** _____

24 **INTERNAL STRUCT.** _____

25 **INTERNAL BOLTING** _____

26 **EXTERNAL BOLTING** _____

27 **EXTERNAL GASKET** _____

CONNECTIONS

No.	SERIES	SIZE	SERVICE
-----	--------	------	---------

28 A _____ Pump Mt. for P-504

29 B _____ Pump Mt. for P-503

30 C Sewer 4" Inlet Pipe

31 D Pipe 4" Inlet Pipe

32 _____

33 _____

34 _____

35 _____

36 _____

37 _____

38 _____

39 _____

40 _____

41 _____

42 _____

43 _____

44 _____

45 _____

46 _____

47 _____

48 _____

49 _____

See Sketch on Page 2

ALL WALLS AND DIVIDERS ARE 4" THICK
REINFORCED CONCRETE.
▽=NORMAL LIQUID LEVEL.

GRATING AS REQUIRED PER PROJECT SPEC'S. OR
AS NECESSARY TO SUPPORT SUMP PUMPS.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
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5.06.10SCALESPROCESS EQUIPMENT SPECIFICATIONS

WS-101	Raw Coal Transport Conveyor CO-102 Belt Scale
WS-102	Reclaim Collecting Conveyor CO-104 Belt Scale
WS-103	Screened Coal Collecting Conveyor CO-106 Belt Scale
WS-104	Reclaimed Fines Transporting Conveyor CO-110 Belt Scale

WS-101

BELT CONVEYOR SCALE FOR RAW COAL TRANSPORT CONVEYOR CO-102

1. The belt scale shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient, minus 42°F to 102°F
Duty: 8 hours per day, 365 days per year

B. Mechanical Design

Scale Weigh Bridge: Two idler design
Conveyor Capacity: 3000 short tons per hour
Belt Speed: 700 feet per minute
Belt Width: 66 inches
Throughing Angle: 35°
Conveyor Incline: 15°
Tension Takeup: Gravity

C. Design Notes

Installation: Outdoors
Power Available: 120/1/60
Calibration: Test chain or test weights
Weigh System Accuracy: $\pm 1/2\%$
Integrator Enclosure: NEMA 4
Output Signals for Remote Instrumentation:
1. 4-20 ma DC for Flow Rate Recorder
2. 4-20 ma DC for Belt Speed Indicator
3. Dry Relay Contact (Pulse) for Totalizer
Remote instrumentation will be furnished by others.
The integrator shall be furnished with weight
totalizer display, rate meter, and belt speed compensation.
A storage and handling device shall be furnished for the
calibration chain or weights.

WS-102

BELT CONVEYOR SCALE FOR RECLAIMED FINES TRANSPORTING CONVEYOR CO-104

1. The belt scale shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient, minus 42°F to 102°F
Duty: 8 hours per day, 365 days per year

B. Mechanical Design

Scale Weigh Bridge: Two idler design
Conveyor Capacity: 285 short tons per hour
Belt Speed: 350 feet per minute
Belt Width: 30 inches
Troughing Angle: 20°
Conveyor Incline: 7°
Tension Takeup: Gravity

C. Design Notes

Power Available: 120/1/60
Calibration: Test chain or test weights
Weigh System Accuracy: $\pm 1/2\%$
Integrator Enclosure: NEMA 4
Output Signals for Remote Instrumentation:
1. 4-20 ma DC for Flow Rate Recorder
2. 4-20 ma DC for Belt Speed Indicator
3. Dry relay Contact (Pulse) for Totalizer
Remote instrumentation will be furnished by others.
The integrator shall be furnished with weight
totalizer display, rate meter, and belt speed compensation.
A storage and handling device shall be furnished for the
calibration chains or weights.

WS-103

BELT CONVEYOR SCALE FOR SCREENED COAL COLLECTING CONVEYOR CO-106

1. The belt scale shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal
Material Size: 1 1/2 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient, minus 42°F to 102°F
Duty: 8 hours per day, 365 days per year

B. Mechanical Design

Scale Weigh Bridge: Two idler design
Conveyor Capacity: 117 short tons per hour
Belt Speed: 300 feet per minute
Belt Width: 24 inches
Troughing Angle: 20°
Conveyor Incline: 3°
Tension Takeup: Screw

C. Design Notes

Installation: Outdoors
Power Available: 120/1/60
Calibration: Test chain or test weights
Weigh System Accuracy: $\pm 1/2\%$
Integrator Enclosure: NEMA 4
Output Signals for Remote Instrumentation:
1. 4-20 ma DC for Flow Rate Recorder
2. 4-20 ma DC for Belt Speed Indicator
3. Dry Relay Contact (Pulse) for Totalizer
Remote instrumentation will be furnished by others.
The integrator shall be furnished with weight
totalizer display, rate meter, and belt speed compensation.
A storage and handling device shall be furnished for the
calibration chains or weights.

WS-104

BELT CONVEYOR SCALE FOR RECLAIMED FINES TRANSPORTING CONVEYOR - CO-110

1. The belt scale shall be furnished as follows:

A. Operating Conditions

Material Handled: Coal Fines
Material Size: 1/2 inch maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient
Duty: 8 hours per day, 365 days per year

B. Mechanical Design

Scale Weigh Bridge: Two idler design
Conveyor Capacity: 200 short tons per hour
Belt Speed: 325 feet per minute
Belt Width: 30 inches
Troughing Angle: 35°
Conveyor Incline: 16°
Tension Takeup: Gravity

C. Design Notes

Installation: Outdoors
Power Available: 120/1/60
Calibration: Test chain or test weights
Weigh System Accuracy: $\pm 1/2\%$

Integrator Enclosure: NEMA 4

Output Signals for Remote Instrumentation:

1. 4-20 ma DC for Flow Rate Recorder
2. 4-20 ma DC for Belt Speed Indicator
3. Dry Relay Contact (Pulse) for Totalizer

Remote instrumentation will be furnished by others.

The integrator shall be furnished with weight totalizer display, rate meter, and belt speed compensation.

A storage and handling device shall be furnished for the calibration chains or weights.

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5.06.11

VIBRATING SCREENS

VS-101A/B

Gasifier Feed Stock Sizing

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VS-101A/B

VIBRATING SCREENS FOR GASIFIER FEEDSTOCK SIZING

1. Each screen shall be furnished as follows:

- A. Operating Conditions

Material Handled: Western Coal and Eastern Coal
Size Distribution: (later)
Maximum Particle Size: 1 1/2 inches
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient, minus 42°F to 105°F
Duty: 8 hours per day, 365 days per year

- B. Mechanical Design

Type: Vibrating Single Deck Screen
Screen Size: 60 inches wide by 144 inches long
Screen Function: Sizing
Screen Circuit: Open
Screening: Dry
Design Capacity:
 Western Coal, 145 short tons per hour containing
 50% undersize
 Eastern Coal, 188 short tons per hour, containing
 12% undersize
Required Separation Size:
 Over, 1/2 inch and larger
 Under, minus 1/2 inch
Screening Efficiency: 92%

- C. Design Notes

Available Power Supply: 460/3/60
Both screens shall be designed for the most severe conditions.
When screening Western coal, two screens will be operating.
When screening Eastern coal, one screen will be operating
and one screen will be on standby.

5.06.12

TRAIN POSITIONER/CAR DUMPER

ENGINEERING REQUISITION U-1

BN-101	Coal Hopper
CP-101	Train Positioner
DU-101	Rotary Car Dumper

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

McKee

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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

McKee

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

ENGINEERING REQUISITION

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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-01-51-2 shows the typical arrangement of the system.</p> <p>14. Drawings Y-01-10-2 and Y-01-11-2 shows the instrumentation.</p> <p>15. Ambient temperature range is -20F to 100F.</p> <p>16. The design for the rotary dumper shall include sufficient structural and mechanical integrity to allow for starting and stopping a locomotive when the locomotive is on the dumper platen.</p>		

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ITEM NO.	NO. PIECES	DESCRIPTION	DISTRIBUTION ITEM NO.	PUR. ORC NUMBER
		<p style="text-align: center;"><u>BINS</u></p> <p>Tag Number BN-101</p> <p><u>Service</u> <u>Dumper Hopper</u></p> <p>General Type Rectangular, rectangular outlet</p> <p>Material Handled Coal</p> <p>Material Bulk Density</p> <p style="padding-left: 20px;">+ Loose (lb/cf) 45</p> <p style="padding-left: 20px;">+ Packed (lb/cf) 50</p> <p>Angle of Repose (DEG) 40</p> <p>Top Opening (ft) As required for the system dumping rate</p> <p>Taper Height (ft) As required for the system</p> <p>Net Capacity (ST) As required for the system</p> <p>Design Temperature (°F) Ambient</p> <p>Material CS with SS Liner</p> <p><u>Remarks:</u></p> <ol style="list-style-type: none"> 1. All bins shall be designed to be self-emptying. 2. All bins and hoppers shall be equipped with a means of stopping flow to allow removal of feeder equipment for maintenance. 3. Hopper top shall be equipped with a grizzly screen suitable for occasional bulldozer operation. 4. Opening shall be 6" square. 5. Hopper angle = 55 degree min. to horizontal. 6. Liners shall be replaceable. 		

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TRIPPER CAR

PROCESS EQUIPMENT SPECIFICATIONS

TC-101	Gasifier Feed Tripper Car
TC-102	Gasifier Feed Tripper Car

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FOR TC-101

EQUIPMENT NOTES JANUARY, 1979

1. All transfer points shall be designed to minimize dusting. Skirt boards with covers shall be provided for transfers from feeders to conveyors.
2. Chutes provided at transfer points shall be equipped with "plugged chute" indicators capable of shutting down the upstream material supplying equipment. Chutes shall be of carbon steel construction with wear plates as required at wear points.
3. All controls shall be interlocked so that the upstream equipment has been started and is running at design speed/capacity. Stopping any conveyor shall also automatically stop all upstream conveyors and feeders. A stop-run manual selector switch with lock unit shall be provided within sight of each drive motor for maintenance purposes. Design of the interlock system shall consider the length of conveyors and the inertia of successive conveyors.
4. Equipment sequential shutdown interlock system shall have a first out feature to indicate the equipment that tripped first.
5. Conveyors to have enclosed galleries. Conveyor galleries are to have walkways on one side. Galleries are to have a means of ventilation and are to be equipped with heaters, fire protection and washdowns.
6. Conveyors shall be provided with emergency stop cords.
7. All discharge chutes shall be covered and supplied with inspection doors.
8. All outdoor equipment shall be designed for winter operation in Northern Minnesota.

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TC-101TRIPPER CAR GASIFIER FEED

General Type:	Motor Propelled
Material Handled	Coal
Material Size (inch) Max.	1 1/2
Material Bulk Density (lb/cf)	45
Belt Width (inch)	30
Belt Speed (FPM)	250
Trough Angle (degrees)	20
Design Capacity (STPH)	140
Design Temperature	Ambient
Traverse Speed (FPM)	50

Remarks

- + Two way discharge to either right or left side of belt.
Remote operated power diverter gates.
- + Chutes with stainless steel liner.
- + Operates with conveyor CO-107.
- + Equipment Design Notes - see attached.

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TC-102

TRIPPER CAR GASIFIER FEED

General Type	Motor Propelled
Material Handled	Coal
Material Size (inch) Max.	1 1/2
Material Bulk Density (lb/cf)	45
Belt Width (inch)	30
Belt Speed (FPM)	250
Trough Angle (degrees)	20
Design Capacity (STPH)	140
Design Temperature	Ambient
Traverse Speed (FPM)	50

Remarks

- + Three-way discharge to either right or left side of belt or straight. Remote operated power diverter gates.
- + Chutes with stainless steel liner.
- + Operates with conveyor CO-107
- + Equipment notes 3, 4, 5, 6, 7, 9, 10, 11 & 12 apply.

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SPECIAL EQUIPMENT

PROCESS SPECIFICATIONS

X-101	Live Storage Pile Lowering Pipe
X-102	Tramp Iron Pickup Magnet for CO-104
X-103	Coal Lowering Pipe
X-105A/B	Metal Detector for CO-104
X-106	Coal Fines Lowering Pipe
X-110	Trolley Hoist - Crushing and Screening Station
X-111	Trolley Hoist - Transfer Station
X-112	Trolley Hoist - Crushing and Screening Station
X-113	Trolley Hoist - Crushing and Screening Station
X-114	Trolley Hoist - Tripper Conveyor CO-107
X-115	Trolley Hoist - Fines Loadout Bin
X-116	Trolley Hoist - Ash Silo
X-117	Trolley Hoist - Ash Silo
X-118	Trolley Hoist - Conveyor CO-102 Head Pulley
X-119	Trolley Hoist - Conveyor CO-103 Head Pulley
X-120	Ash Silo - Air Slide

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X-101LIVE STORAGE PILE LOWERING PIPE

General Type	Circular
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (Deg.)	40
Height (from Base of Pile to Centerline Discharge Pulley) (feet)	100
Inside Diameter (inch) Nominal	84
Design Capacity (STPH)	3000
Design Temperature	Ambient
Material	Stainless Steel (1/2" thick wall)

Remarks:

1. The lowering pipe shall minimize dust degradation of the coal.
2. The discharge openings in the lowering pipe shall be equipped with gravity doors to feed the conical live pile.
3. The galleries of conveyor CO-102 and conveyor CO-103 will be used to laterally support the lowering pipe at the top.
4. Provide powered diverter gate and chute to conveyor CO-103.
5. Access shall be provided to bins and hoppers for personnel and equipment as required for inspection, material sampling, flow observation and repairs.
6. All outdoor equipment shall be designed for winter operation in northern Minnesota.

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X-102

TRAMP IRON MAGNET FOR CONVEYOR CO-104

1. The tramp iron magnet shall be furnished as follows:

A. Operating Conditions:

Material Handled: Coal
Material Size: 6 inches maximum
Bulk Density: 45 pounds per cubic foot
Angle of Repose: 40°
Temperature: Ambient, Minus 42°F to 105°F
Duty: 8 hours per day, 365 days per year
Tramp Iron Size: 1 inch minimum
 24 inch maximum
Tramp Iron Weight: 2 ounces minimum
 50 pounds maximum

B. Mechanical Design

Type: Automatically self-cleaning, electromagnetic, suspended separation magnet
Installation: Cross-belt
Belt Width: 30 inches
Belt Speed: 350 feet per minute
Belt Incline: 7°
Troughing Angle: 20°
Belt Design Capacity: 285 short tons per hour

C. Design Notes

The tramp iron magnet will be activated by a signal transmitted from a metal detector located upstream of the magnet. The metal detector, control timer, and motor starter will be supplied by others.

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X-103BY PASS PILE LOWERING PIPE

General Type	Circular
Material Handled	Coal
Material Size (in) Max.	6
Material Bulk Density (lb/cf)	45
Angle of Repose (Deg)	40
Height (from Base of Pile to Centerline Discharge Pulley) (feet)	100
Inside Diameter (inch) Nominal	84
Design Capacity (STPH)	3000
Design Temperature	Ambient
Material	Stainless Steel (1/2" thick wall)

Remarks:

1. The lowering pipe shall minimize dust and degradation of the coal.
2. The discharge openings shall be equipped with gravity doors to feed the conical storage pile.
3. Support is to be provided laterally by the gallery of conveyor CO-103 at the top
4. Access shall be provided to bins and hoppers for personnel and equipment as required for inspection, material sampling, flow observation and repairs.
5. All outdoor equipment shall be designed for winter operation in northern Minnesota.

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X-105 A&B

METAL DETECTORS

- 1.0 Furnish two (2) metal detectors of an electromagnetic design to perform the duties required.
 - 1.1 Metal detector shall detect ferrous and nonferrous tramp metal on conveyor CO-104.
 - 1.2 Upon detection of material the metal detector X-105B shall shut down upstream material supply equipment.
 - 1.3 Upon detection of material the metal detector X-105A shall initiate the start of the tramp iron magnet X-102.
 - 1.4 Metal detector X-105B shall "mark" on the bed of material the location of the tramp material and shut down conveyor.
- 2.0 Each detector's solid state electronic system shall be enclosed in a housing which conforms to a Class II, Group F, Division 2 hazardous area.
- 3.0 The output from each unit shall be from isolated contacts.
(2 - SPDT contacts rated 10 amp at 120 volt A.C.)
- 4.0 Optional features shall include, but not be limited to, tramp metal marker for X-105B and conveyor belt clip detector for each unit.

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X-106FINES STORAGE PILE LOWERING PIPE

General Type	Circular
Material Handled	Coal
Material Size (in) Max.	1/2
Material Bulk Density (lb/cf)	45
Angle of Repose (Deg)	40
Height (from Base of Pile to Centerline Discharge Pulley) (ft)	58
Inside Diameter (inch) Nominal	48
Design Capacity (STPH)	145
Design Temperature	Ambient
Material	Stainless Steel (1/2" thick wall)

Remarks:

1. The lowering pipe shall minimize dust and degradation of the coal.
2. The discharge openings shall be equipped with gravity doors to feed the storage pile.
3. Support is to be provided laterally by the gallery of conveyor CO-109 at the top.
4. Access shall be provided to bins and hoppers for personnel and equipment as required for inspection, material sampling, flow observation and repairs.
5. All outdoor equipment shall be designed for winter operation in northern Minnesota.

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X-110CRUSHING STATION MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	2
Service	Intermittent (Maint.)
Lift, Ft.	20
Speed, FPM	22
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Station
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	65
Control, Volts	110
Min. Radius, Ft.	6
Min. Monorail Beam Size, In.	8
Conductors	Safety Covered Bar

Remarks:

1. Pushbutton pendant from hoist shall be approximately 8 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-111

TRANSFER STATION MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	40
Speed, FPM	40
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	65
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	40 Ft. Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 6 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-112SCREENING STATION MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	10
Service	Intermittent (Maint.)
Lift, Ft.	50
Speed, FPM	22
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	75
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	10
Conductors	100' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 22 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-113SCREENING STATION MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	70
Speed, FPM	60
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	50' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 10 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-114TRIPPER CONVEYOR CO-107 MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	130
Speed, FPM	60
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	6
Min. Monorail Beam Size, In.	8
Conductors	200' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 16 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-115

FINES LOADOUT BIN MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	60
Speed, FPM	40
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	50' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 12 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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X-116ASH SILO MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1-1/2
Service	Intermittent (Maint.)
Lift, Ft.	110
Speed, FPM	60
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient
Trolley:	
Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	40' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 10 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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D.O.E. CONTRACT ET-78-C-01-2578
McKEE CONTRACT 4814
JANUARY, 1979

X-117ASH SILO MONORAIL HOIST

General Type:

Electric Cable

Hoist:

Capacity, tons	1-1/2
Service	Intermittent (Maint.)
Lift, Ft.	40
Speed, FPM	30
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions ^o F	Ambient

Trolley:

Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	50' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 12 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

P/R-37

COMMERCIAL PLANT DESIGN MANUAL
 ERIE MINING COMPANY
 COAL GASIFICATION PROJECT
 D.O.E. CONTRACT ET-78-C-01-2578
 McKEE CONTRACT 4814
 JANUARY, 1979

X-118

HEAD PULLEY CO-102 MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	110
Speed, FPM	60
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient

Trolley:

Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	50' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 10 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

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COMMERCIAL PLANT DESIGN MANUAL
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X-119

HEAD PULLEY CO-103 MONORAIL HOIST

General Type:	Electric Cable
Hoist:	
Capacity, tons	1
Service	Intermittent (Maint.)
Lift, Ft.	110
Speed, FPM	60
Headroom	Standard
Motors	440/3/60
Control, Volts	110 Volt, 4 Button P.B. Pendant
Reeving	By Manufacturer
Operating Conditions °F	Ambient

Trolley:

Type:	Motor Driven
Speed, FPM	100
Control, Volts	110
Min. Radius, Ft.	Straight Track
Min. Monorail Beam Size, In.	8
Conductors	50' Flexible Cable

Remarks:

1. Pushbutton pendant from hoist shall be approximately 10 feet long.
2. Stationary electrical power on-off control to be furnished by others.
3. All motors and controls are to be explosion-proof.

P/R-37

COMMERCIAL PLANT DESIGN MANUAL
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X-120

ASH SILO AIRSLIDE

General Type

Number Required

Conveying Capacity Each, CFM

Length, Ft.

Downslope, Degree

Conveyor Width

Lower Compartment Height, In.

Operating Air Each:

SCFM

PSIG

Remarks:

1. Coal ash is to be discharged into Rotary Star Feeder MF-106.
2. The Airslide shall be furnished with MF-107 - Rotary Wetter/Unloader Feeder.
3. Data shall be furnished by Airslide supplier.

P/R-30

5.0 MATERIALS HANDLING - AREA 01

5.07 MAJOR INLINE INSTRUMENT DATA SHEETS

There are no major inline instruments in the Materials Handling Area - 01.

5.0 MATERIALS HANDLING - AREA 015.08 GENERAL DRAWING LIST

<u>Drawing Number</u>	<u>Title</u>	<u>Revision</u>
4814-S-01-51-2	Dust Flow Diagrams	0
4814-S-01-52-2	Dust Flow Diagrams	0
4814-X-01-51-2	Coal Unloading Station	1
4814-X-01-52-2	Coal Thaw Shed	1
4814-X-01-54-2	Crushing and Screening Station	2
4814-X-01-55-2	Coal Fines Reclaim and Loadout	1
4814-X-01-56-2	Conveyor Elevations	1
4814-X-01-57-2	Ash Silo	2'
4814-X-01-58-2	Existing Coal Unloading Station	0

CRUSHING & SCREENING STATION DUST COLLECTION

COAL GASIFICATION SURGE BIN DUST COLLECTION SYSTEM

LOWERING PIPE DUST COLLECTION SYSTEM

CONVEYORS CO-104 & CO-105 JUNCTION
HOUSE DUST COLLECTION SYSTEM

COAL BY-PASS PILE
DUST COLLECTION

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

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

SMALL SCALE
PREPARED BY

McKEE
ENGINEERS AND CONSTRUCTORS

CLEVELAND ENGINEERS AND CONSTRUCTORS OHIO

4814-S-
01-51-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

COAL GASIFICATION
COMMERCIAL COAL HANDLING UNIT
DUST FLOW DIAGRAMS

PROJECT NO.	P.E. NO.
-------------	----------

SCALE
NONE

REVISION $\triangle O$

SECTION B-B

DATE	BY	CHK	DESCRIPTION	APP.

ELEVATION

DATE	BY	CHK	DESCRIPTION	APP.

REVISIONS

DATE	BY	CHK	DESCRIPTION	APP.
9-25-78	KH		ADDED DIESEL OIL TANK	
8-24-78	E.L.		ADDED SWITCH GEAR ROOM, RELOCATED TRANSFORMERS	
8-11-78	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 A
PREPARED BY **McKee** ENGINEERS AND CONSTRUCTORS
CLEVELAND OHIO
4814-X-01-51-2

FOR ERIE MINING COMPANY
PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA
MATERIAL HANDLING
COMMERCIAL UNIT
COAL UNLOADING STATION

PROJECT NO. P.E. NO.
SCALE: 1" = 20'-0"
REVISION: 2

4814-X
01-21-2

SECTION A-A

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY **McKee**

CLEVELAND OHIO

4814-X-01-52-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTA

MATERIAL HANDLING
COMMERCIAL UNIT
COAL THAW SHED

PROJECT NO. _____ P.E. NO. _____

SCALE
3" = 1'-0"

REVISION **1**

8-24-78 E.R. ADDED HEATER NOTES
8-11-78 V.B. ISSUED FOR ESTIMATING

A

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
REVISIONS					REVISIONS					REVISIONS				
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△					△					△	8-11-78	A.D.		ISSUED FOR ESTIMATING

<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 <div> </div> <p>CLEVELAND OHIO</p>	48J4X-01-55-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____ SCALE 1" = 10'0" @ 20'0"
MATERIAL HANDLING COMMERCIAL UNIT COAL FINES RECLAIM & LOAD-OUT	REVISION

4814 X
01-58-2

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 X 01-58-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA MATERIALS HANDLING ALTERATIONS COMMERCIAL UNIT EXISTING COAL UNLOADING STATION		PROJECT NO. _____ P.E. NO. _____ SCALE 1" = 20'-0" REVISION 0

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

7-7-78 EN 74 ISSUED FOR ESTIMATING

6.0

GASIFICATION - AREA 02

INDEX

- 6.01 Summary Description
- 6.02 Design Comments
- 6.03 Equipment List
- 6.04 Piping and Instrument Diagrams
- 6.05 Equipment Summary Sheets
- 6.06 Equipment Data Sheets
- 6.07 Major Inline Instrument Data Sheets
- 6.08 General Drawings

6.0

COAL GASIFICATION UNIT - AREA 02

6.01 SUMMARY DESCRIPTION

- 6.01.1 The Coal Gasification Process, as described in Section 2.0 is presented in detail in this Section 6.0.

Each equipment item required in the Coal Gasification Process is itemized by tag numbers in the equipment list under 6.03 of this section.

The process flow diagrams included in Section 2.0 are expanded showing design details in the form of "Piping and Instrument" diagrams under 6.04 of this section.

Design requirements for each equipment item are further expanded in the form of equipment data sheets and/or drawings in 6.06 of this section.

- 6.01.2 The Coal Gasification area is located to the south of the Materials Handling area as shown on drawing 4814-X-00-52-2 in section 1 of this Design Manual. This area, which has already been described in Section 2.0, Process Description can be divided into four principal areas:

Coal Feed and Gasification
Detarring
Deoiling and Gas Cooling
Ash Disposal

- 6.01.3 The Coal Gasifiers, Coal Feed System, Waste Heat Recovery and Ash Removal Systems are housed in an unheated, insulated and ventilated building, 210' long by 100' wide and 135' high. The building is equipped with a personnel and freight elevator.

Attached to the Gasification Building is the Control Room facilities which includes offices, laboratory, maintenance facilities and the electrical equipment room.

Two (2) travelling overhead cranes are included for maintenance purposes.

The Gasifier Building Arrangement is shown on drawing 4814-X-02-51-2 included in 6.08 of this section.

6.01 SUMMARY DESCRIPTION (continued)

6.01.3 (continued)

The Gas Cleaning facilities are located outdoors. This includes the electrostatic precipitators for detarring and deoiling as well as the gas cooling exchangers.

The Gasification Area arrangement relative to the other plant areas is shown on drawings 4814-X-00-52-2 and 4814-X-00-55-2 included in Section 1.0 of this design manual.

- 6.01.4 As shown on drawing 4814-X-00-55-2, "Plan of Plant", adequate space has been allotted for expansion to a Commercial sized coal gasification unit, including expansion of the building. The cranes installed in the Demonstration Unit Building will also service the add-on Commercial Unit in the building extension.

- 6.01.5 The gasifier design is based on the Woodall-Duckham, dry grate design as selected for this application.

The gasification process must demonstrate that high FSI, high sulfur coals can be successfully gasified. In this case, an FSI of 5 or greater is considered high FSI. Current low pressure, air blower, two stage gasifiers requires an FSI of 2.5 or less. In order to gasify high FSI coal the distillation sections of the two stage gasifier has been modified to accommodate a stirrer to insure that the high swelling coal does not accumulate in the distillation zone and plug the retort.

Full details of the stirred gasifier design will be included in a separate design manual.

6.02 DESIGN COMMENTS

6.02.1 Early in Phase II, "Details of Engineering," the following should be more fully evaluated before including in the final design, and applied to the Commercial Plant.

- a. Materials Disposition for the cyclone char.
- b. Pneumatic versus conveyors for ash handling.
- c. Gasifier ash bed level detection systems.
- d. Requirement for automatic "poking".
- e. Process design review and equipment sizing should be evaluated based on the coal or coal ranges selected for operational use.
- f. Evaluate building and layout to possibly locate the tar precipitators and gas coolers at elevated locations within the Gasifier Building.

6.0 GASIFICATION - AREA 02 (continued)

6.03 EQUIPMENT LIST

MCKEE CORPORATION

EQUIPMENT LIST

CONTRACT MC-4814

DATE August 14, 1978

CLIENT Erie Mining Company

UNIT Commercial

AREA Gasification - 02

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

1 11/10/78 - General Revision
REV. 0 8/14/78 RHB(IMCP. BCI 7-26

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TAG	E/R	P & I NO.	DESCRIPTION
B-201A		Y-02-74-2	Comb. Air Blower
B-201B		Y-02-74-2	Comb. Air Blower
B-201C		Y-02-74-2	Comb. Air Blower
B-201D		Y-02-75-2	Comb. Air Blower
B-201E		Y-02-75-2	Comb. Air Blower
B-202		Y-02-80-2	Ash Cooling Blower
B-203A		Y-02-80-2	Aeration Blower
B-203B		Y-02-80-2	Aeration Blower
B-203C		Y-02-81-2	Aeration Blower
B-203D		Y-02-81-2	Aeration Blower

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TAG	E/R	P & I NO.	DESCRIPTION
BN-201A		Y-02-56-2	Coal Surge Hopper
BN-201B		Y-02-57-2	Coal Surge Hopper
BN-201C		Y-02-58-2	Coal Surge Hopper
BN-201D		Y-02-59-2	Coal Surge Hopper
BN-201E		Y-02-60-2	Coal Surge Hopper
BN-201F		Y-02-61-2	Coal Surge Hopper
BN-201G		Y-02-62-2	Coal Surge Hopper
BN-201H		Y-02-63-2	Coal Surge Hopper
BN-201J		Y-02-64-2	Coal Surge Hopper
BN-201K		Y-02-65-2	Coal Surge Hopper
BN-201L		Y-02-66-2	Coal Surge Hopper
BN-201M		Y-02-67-2	Coal Surge Hopper
BN-203A		Y-02-82-2	Cyclone Dust Bin
BN-203B		Y-02-82-2	Cyclone Dust Bin
BN-203C		Y-02-82-2	Cyclone Dust Bin
BN-203D		Y-02-83-2	Cyclone Dust Bin
BN-203E		Y-02-83-2	Cyclone Dust Bin

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TAG	E/R	P & I NO.	DESCRIPTION
BN-203F		Y-02-83-2	Cyclone Dust Bin
CO-201A		Y-02-80-2	Drag Link Conveyor
CO-201B		Y-02-81-2	Drag Link Conveyor
CO-202A		Y-02-80-2	Drag Link Conveyor
CO-202B		Y-02-81-2	Drag Link Conveyor
CO-203		Y-02-80-2	Drag Link Conveyor
CO-204		Y-02-80-2	Bucket Elevator

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TAG	E/R	P & I NO.	DESCRIPTION
D-201A		Y-02-56-2	L. P. Steam Drum
D-201B		Y-02-57-2	L. P. Steam Drum
D-201C		Y-02-58-2	L. P. Steam Drum
D-201D		Y-02-59-2	L. P. Steam Drum
D-201E		Y-02-60-2	L. P. Steam Drum
D-201F		Y-02-61-2	L. P. Steam Drum
D-201G		Y-02-62-2	L. P. Steam Drum
D-201H		Y-02-63-2	L. P. Steam Drum
D-201J		Y-02-64-2	L. P. Steam Drum
D-201K		Y-02-65-2	L. P. Steam Drum
D-201L		Y-02-66-2	L. P. Steam Drum
D-201M		Y-02-67-2	L. P. Steam Drum
D-202A		Y-02-70-2	HP Steam Drum
D-202B		Y-02-71-2	HP Steam Drum

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TAG	E/R	P & I NO.	DESCRIPTION	
D-203		Y-02-78-2	Flash Tank	BCI Tag No. TN203
E-201A		Y-02-56-2	Process Gas Cooler	
E-201B		Y-02-57-2	Process Gas Cooler	
E-201C		Y-02-58-2	Process Gas Cooler	
E-201D		Y-02-59-2	Process Gas Cooler	
E-201E		Y-02-60-2	Process Gas Cooler	
E-201F		Y-02-61-2	Process Gas Cooler	
E-201G		Y-02-62-2	Process Gas Cooler	
E-201H		Y-02-63-2	Process Gas Cooler	
E-201J		Y-02-64-2	Process Gas Cooler	
E-201K		Y-02-65-2	Process Gas Cooler	
E-201L		Y-02-66-2	Process Gas Cooler	
E-201M		Y-02-67-2	Process Gas Cooler	

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TAG	E/R	P & I NO.	DESCRIPTION	
E-202A		Y-02-72-2	Combined Gas Cooler	
E-202B		Y-02-72-2	Combined Gas Cooler	
E-202C		Y-02-72-2	Combined Gas Cooler	
E-202D		Y-02-73-2	Combined Gas Cooler	
E-202E		Y-02-73-2	Combined Gas Cooler	
F-201A		Y-02-74-2	Comb. Air Blower Filt. Silencer	
F-201B		Y-02-75-2	Comb. Air Blower Filt. Silencer	

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TAG	E/R	P & I NO.	DESCRIPTION
MF-203A		Y-02-80-2	Ash Lock Hopper Assembly
MF-203B		Y-02-80-2	Ash Lock Hopper Assembly
MF-203C		Y-02-80-2	Ash Lock Hopper Assembly
MF-203D		Y-02-80-2	Ash Lock Hopper Assembly
MF-203E		Y-02-80-2	Ash Lock Hopper Assembly
MF-203F		Y-02-80-2	Ash Lock Hopper Assembly
MF-203G		Y-02-80-2	Ash Lock Hopper Assembly
MF-203H		Y-02-80-2	Ash Lock Hopper Assembly
MF-203J		Y-02-80-2	Ash Lock Hopper Assembly
MF-203K		Y-02-80-2	Ash Lock Hopper Assembly
MF-203L		Y-02-80-2	Ash Lock Hopper Assembly
MF-203M		Y-02-80-2	Ash Lock Hopper Assembly
MF-203N		Y-02-81-2	Ash Lock Hopper Assembly
MF-203P		Y-02-81-2	Ash Lock Hopper Assembly
MF-203Q		Y-02-81-2	Ash Lock Hopper Assembly
MF-203R		Y-02-81-2	Ash Lock Hopper Assembly
MF-203S		Y-02-81-2	Ash Lock Hopper Assembly
MF-203T		Y-02-81-2	Ash Lock Hopper Assembly
MF-203U		Y-02-81-2	Ash Lock Hopper Assembly

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FARM MACHS

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FARM MACHINERY

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TAG	E/R	P & I NO.	DESCRIPTION
P-201A		Y-02-74-2	Tar Transfer Pump - Oper.
P-201B		Y-02-74-2	Tar Transfer Pump - Spare
P-202A		Y-02-74-2	Aqueous Eff. Pump
P-202B		Y-02-74-2	Aqueous Eff. Pump
P-202C		Y-02-75-2	Aqueous Eff. Pump
P-202D		Y-02-75-2	Aqueous Eff. Pump
P-203A		Y-02-74-2	Oil Transfer Pump
P-203B		Y-02-74-2	Oil Transfer Pump
P-203C		Y-02-75-2	Oil Transfer Pump
P-203D		Y-02-75-2	Oil Transfer Pump

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TAG	E/R	P & I NO.	DESCRIPTION
P-204A		Y-02-74-2	Sludge Pump
P-204B		Y-02-75-2	Sludge Pump
P-205		Y-02-78-2	Chemical Sump Pump
P-206A		Y-02-82-2	Hydro Ejector Pump
P-206B		Y-02-82-2	Hydro Ejector Pump
P-206C		Y-02-83-2	Hydro Ejector Pump
P-206D		Y-02-83-2	Hydro Ejector Pump
P-207A		Not Shown	Hydraulic Pump
P-207B		Not Shown	Hydraulic Pump
P-207C		Not Shown	Hydraulic Pump
P-207D		Not Shown	Hydraulic Pump
PIT-201		Y-02-82-2	Chemical Sump

BCI Tag No. TN-204

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TAG	E/R	P & I NO.	DESCRIPTION	
TK-201A		Y-02-74-2	Oil/Water Separator	BCI Tag No. TN-201A&B
TK-201B		Y-02-75-2	Oil/Water Separator	BCI Tag No. TN-201A&B
TK-202		Y-02-74-2	Tar Tank	BCI Tag No. TN-202
X-201A		Y-02-70-2	Tar Precipitator	BCI Tag No. M-201A
X-201B		Y-02-70-2	Tar Precipitator	BCI Tag No. M-201B
X-201C		Y-02-70-2	Tar Precipitator	BCI Tag No. M-201C
X-201D		Y-02-71-2	Tar Precipitator	BCI Tag No. M-201D
X-201E		Y-02-71-2	Tar Precipitator	BCI Tag No. M-201E
X-201F		Y-02-71-2	Tar Precipitator	BCI Tag No. M-201F

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TAG	E/R	P & I NO.	DESCRIPTION	
X-205A		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202A
X-205B		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202B
X-205C		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202C
X-205D		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202D
X-205E		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202E
X-205F		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202F
X-205G		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202G
X-205H		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202H
X-205J		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202J
X-205K		Y-02-72-2	Ash Grate Lube System	BCI Tag No. W-202K
X-205L		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202L
X-205M		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202M
X-205N		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202N
X-205P		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202P
X-205Q		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202Q
X-205R		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202R
X-205S		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202S
X-205T		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202T
X-205U		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202U

ORIGINAL

EQUIPMENT LIST

McKee

Form M-514-2

CONTRACT NUMBER	AREA
MC-4814	02 Comm.
REVISION	
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PAGE	OF
21	22

TAG	E/R	P & I NO.	DESCRIPTION	
X-205V		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202V
X-205W		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202W
X-202X		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202X
X-202Y		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202Y
X-202Z		Y-02-73-2	Ash Grate Lube System	BCI Tag No. W-202Z
X-206A		Y-02-74-2	Flare Stack	BCI Tag No. J-201A
X-206B		Y-02-74-2	Flare Stack	BCI Tag No. J-201B
X-206C		Y-02-74-2	Flare Stack	BCI Tag No. J-201C
X-206D		Y-02-75-2	Flare Stack	BCI Tag No. J-201D
X-206E		Y-02-75-2	Flare Stack	BCI Tag No. J-201E
X-206F		Y-02-75-2	Flare Stack	BCI Tag No. J-201F
X-207A		Y-02-72-2	Lock Hopper Lube System	BCI Tag No. W-203A
X-207B		Y-02-73-2	Lock Hopper Lube System	BCI Tag No. W-203B

[illegible]

6.0 GASIFICATION - AREA 02 (continued)

6.04 PIPING AND INSTRUMENT DIAGRAMS

<u>Drawing Number</u>	<u>Description</u>	<u>Revision</u>
4814-Y-02-55-2	Symbols and Legend	1
4814-Y-02-56-2	Gasifier R-201A	1
4814-Y-02-57-2	Gasifier R-201B	1
4814-Y-02-58-2	Gasifier R-201C	1
4814-Y-02-59-2	Gasifier R-201D	1
4814-Y-02-60-2	Gasifier R-201E	1
4814-Y-02-61-2	Gasifier R-201F	1
4814-Y-02-62-2	Gasifier R-201G	1
4814-Y-02-63-2	Gasifier R-201H	1
4814-Y-02-64-2	Gasifier R-201J	1
4814-Y-02-65-2	Gasifier R-201K	1
4814-Y-02-66-2	Gasifier R-201L	1
4814-Y-02-67-2	Gasifier R-201M	1
4814-Y-02-68-2	Process Interconnecting	1
4814-Y-02-69-2	Process Interconnecting	1
4814-Y-02-70-2	Detarring	1
4814-Y-02-71-2	Detarring	1
4814-Y-02-72-2	Deoiling and Gas Cooling	1
4814-Y-02-73-2	Deoiling and Gas Cooling	1
4814-Y-02-74-2	Oil Separation and Blowers	1
4814-Y-02-75-2	Oil Separation and Blowers	1
4814-Y-02-76-2	Utility - Water and Inert Gas	1
4814-Y-02-77-2	Utility - Water and Inert Gas	1
4814-Y-02-78-2	Utility - Steam and Condensate	1
4814-Y-02-79-2	Utility - Steam and Condensate	1
4814-Y-02-80-2	Ash Handling - Gasifier	1
4814-Y-02-81-2	Ash Handling - Gasifier	1
4814-Y-02-82-2	Ash Handling - Cyclone Dust	1
4814-Y-02-83-2	Ash Handling - Cyclone Dust	1

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					
O			ORIFICE (RESTRICTION)		
P	PRESSURE/ VACUUM		POINT (TEST CONNECTION)		
Q	QUANTITY/ EVENT	INTEGRATE/ TOTALIZE			
R	RADIOACTIVITY		RECORD/PRINT		
S	SPEED/ FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	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		CIIE	CA	BLOWDOWN		CIIB	BD
ASH BLOWER AIR		CIIE	AA	AQUEOUS EFF.		CIIE	AE
INERT GAS		CIIE	IG	INST. AIR		G75A	IA
BOILER FEED LOW		CIIB	BFL	DOMESTIC WATER		B75 & G75	DW
BOILER FEED HIGH		CIIB	BFH				
SLUDGE		CIIF	SL				
L.P. STEAM		CIIB	LS	THERMOSYPHON		CAIJ	TS
H.P. STEAM		CIIB	HS	COMBINED GAS		CAIJ	MG
TOP GAS		CAIJ	TG	GREASE		CAIJ	GR
CLEAR GAS			CG	FLARE STACK GAS		CAIJ	FG
OIL		CIIE	OL	UTILITY AIR		CIIE	UA
TAR		CIID	TR	CHEMICAL DRAIN		CIIE	CD
HYDRAULICS		CGIA	HY	PILOT GAS		CIIE	PG
COOLING W. SUP.		CIIE	CWS	CONDENSATE		CIIB	CO
COOLING W. RET.		CIIE	CWR				

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	B/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
FLARE	TO FLARE
STACK	TO STACK

UTILITIES

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

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	VALVE CLOSES ON ACTUATING MEDIUM FAILURE
GLOBE VALVE	VALVE OPENS ON ACTUATING MEDIUM FAILURE
NEEDLE VALVE	VALVE LOCKS IN LAST POSITION ON ACTUATING MEDIUM FAILURE
PLUG VALVE	BACK PRESSURE CONTROL VALVE
CHECK VALVE	PRESSURE REDUCING CONTROL VALVE
BUTTERFLY VALVE	THREE WAY VALVE
BUTTERFLY CONTROL VALVE	DIAPHRAGM OPERATED THREE WAY CONTROL VALVE
CONTROL VALVE WITH HANDWHEEL	PISTON OPERATED SLIDE VALVE
HAND OPERATED CONTROL VALVE	CAR SEAL CLOSED
SAFETY VALVE	ANGLE 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	
LOCATION FOR BLIND FLANGE	

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

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
BY H. J. [Signature] DATE 10/11/78

BABCOCK CONTRACTORS INC.

A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P-055 ISSUE NO. 1
FOR PER MCKEE COMMENTS SIGNED [Signature] DATE 10/11/78

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

4E14-Y-02-55-2

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO.
HOYT LAKESMANAGING AGENT
MINNESOTAGASIFICATION
COMMERCIAL UNIT STAGE II
SYMBOLS AND LEGENDPROJECT NO. 3001
SCALE NONE

REVISION 1

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PITTSBURGH, PA.
 A Subsidiary of Babcock International Inc.
 PROJECT NO. 3001 DRAWING NO. P-057 ISSUE NO. 1
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 FOR MCKEE COMMENTS SIGNED [Signature] DATE 11/11/78

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-02-57-2

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT
 HOYT LAKES MINNESOTA

GASIFICATION
 COMMERCIAL UNIT - STAGE II
 P&I.D. GASIFIER R201B

PROJECT NO. 3001

P.E. NO.

SCALE

NONE

REVISION 1

DATE BY CHK DESCRIPTION APP.

DATE BY CHK DESCRIPTION APP.

DATE BY CHK DESCRIPTION APP.

PROCESS ENGINEERING APPROVAL
BY *[Signature]* DATE 11/18/78

BABCOCK CONTRACTORS INC.
PITTSBURGH PA
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P-058
REVISED PER 100% MCKEE COMMENTS
DATE 11/1/78

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-02-58-2

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

GASIFICATION
COMMERCIAL UNIT - STAGE II
P & I.D. GASIFIER R201C

PROJECT NO. 3001
SCALE NONE
REVISION 1

NOTES

- 1 VALVES ON RODDING PORT ARE MECHANICALLY LINKED TO PORT
- 2 DISCHARGE TO LOCAL REMOVABLE DRUM

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BABCOCK CONTRACTORS INC.

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PROJECT NO. 3001 DRAWING NO. P-059 ISSUE NO. 1
REVISED PER MCKEE COMMENTS 7/2/80
DATE 11/18/78

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-02-59-2

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

GASIFICATION
COMMERCIAL UNIT - STAGE II
P&ID GASIFIER R201D

PROJECT NO. 3001
SCALE NONE
REVISION 1

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REVISIONS

1. [REDACTED]

2. [REDACTED]

3. [REDACTED]

4. [REDACTED]

5. [REDACTED]

6. [REDACTED]

7. [REDACTED]

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BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P-068 ISSUE NO. 1
BY P. MCKEE DATED 11/11/78

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

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

GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID PROCESS INTERCONNECTING

PROJECT NO. 3001 P.E. NO. NONE
SCALE NONE
REVISION 1

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<p>10</p>				<p>11</p>				<p>12</p>			

PROCESS ENGINEERING APPROVAL
BY *[Signature]* DATE 11/11/78

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P-069 ISSUE NO. 1
FOR PER MCKEE SIGNED *[Signature]* DATE 11/11/78

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

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

GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID PROCESS INTERCONNECTING

PROJECT NO. 3001 P.I. NO. 4814-Y-02-69-2
SCALE NONE
REVISION 1

X201A, B & C
TAR PRECIPITATORD202A
H.P. STEAM DRUM

NOTE:

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

PROCESS ENGINEERING
APPROVAL
BY *[Signature]* DATE 11/10/78

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. P070 ISSUE NO. 1
FOR PER MCKEE SIGNED *[Signature]* DATE 11/14/78

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKee

ENGINEERS AND CONSTRUCTORS

CLEVELAND OHIO

4814-Y-02-70-2

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

GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID. DETARRING

PROJECT NO. 3001

P.E. NO.

NONE

REVISION 1

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

SCALING RULES

X201D, E & F
TAR PRECIPITATOR

D202B
H.P. STEAM DRUM

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

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10						10						10					

PROCESS ENGINEERING
BY: [Signature]
DATE: 11/1/77
CHECKED BY: [Signature]
DATE: 11/1/77
PROJECT NO. 3001
SHEET NO. 2 OF 2
DATE 11/1/77

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**
CLEVELAND, OHIO

4814-Y-C2-71-2

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

GASIFICATION
COMMERCIAL UNIT STAGE II
P&ID DETARRING

PROJECT NO. 3001
P.E. NO. NONE
REVISION 1

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

DATE	BY	CHK	DESCRIPTION	APP.

PROCESS ENGINEERING
APPROVAL
DATE 10/1/77
BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001
DRAWING NO. P-097
ISSUE NO. 1
SIGNED [Signature] DATE 10/1/77

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A PREPARED BY McKEE ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO		PROJECT NO. 3001 P.E. NO. 4814-Y-02-77 -2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA GASIFICATION COMMERCIAL UNIT STAGE II P&ID UTILITY (WATER & GAS)		SCALE NONE REVISION 1

<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-02-78 -2				
CLEVELAND _____ OHIO _____					
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES _____ MINNESOTA _____	<table border="1"> <tr> <td>PROJECT NO. 3001</td> <td>P.I. NO.</td> </tr> <tr> <td colspan="2">SCALE NONE</td> </tr> </table>	PROJECT NO. 3001	P.I. NO.	SCALE NONE	
PROJECT NO. 3001	P.I. NO.				
SCALE NONE					
GASIFICATION COMMERCIAL UNIT STAGE II P & I.D. UTILITY (STEAM & CONDENSATE)	REVISION 1

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

MF 203 N TO Z
ASH LOCK
ASSEMBLY

REVISIONS	COMMENTS		
	DATE	BY	CHK
△			
△			
△			
△			
△	11/11/79		
△	11/20/79 J.V.	TP	REVISED PER MCKEE COMMENTS FINAL 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-YO2-81-2
CLEVELAND OHIO	
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. P. E. NO. SCALE NONE
GASIFICATION COMMERCIAL UNIT-STAGE II P&ID. ASH HANDLING	REVISION 1

MF 207 A TO F
DUST ROTARY FEEDER

BN 203 A TO C
DUST BIN

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

PROCESS ENGINEERING
APPROVAL
BY [Signature] DATE 10/1/78
BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
PROJECT NO. 3001 DRAWING NO. R083 ISSUE NO. 1
FOR PER MCKEE COMMENTS SIGNED [Signature] DATE 10/1/78

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 PREPARED BY MCKEE ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO		4814-Y-02-83-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. _____ P.E. NO. _____ SCALE NONE REVISION <u>1</u>
GASIFICATION COMMERCIAL UNIT-STAGE II P&I.D. ASH HANDLING		

6.0 GASIFICATION - AREA 02 (continued)

6.05 EQUIPMENT SUMMARY SHEETS

6.05.1 Exchangers

6.05.2 Pumps

6.05.3 Vessels

6.05.4 Tanks

6.0 GASIFICATION - AREA 02 (continued)

6.06 EQUIPMENT DATA SHEETS

- 6.06.1 Blowers
- 6.06.2 Bins
- 6.06.3 Cyclones
- 6.06.4 Drums
- 6.06.5 Exchangers
- 6.06.6 Feeders
- 6.06.7 Pumps
- 6.06.8 Gasifiers
- 6.06.9 Tanks
- 6.06.10 Miscellaneous Equipment

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKEE CONTRACT 4814
JANUARY, 1979

6.06.1

BLOWER PROCESS SPECIFICATIONS

B-201 A/E

Gasifier Air Blower

CENTRIFUGAL FANS & LOW PRESSURE BLOWERS

Babcock

Contractors Inc.

REVISION DATE:

DATE: 11/29/78

SERVICE Air Supply to Gasifier Plant, One Spare

ITEM NO B201 A thru E

MFR. NO REQ'D. 5 X MOTOR TURBINE TAG NO

SIZE: MODEL ARROT. NO. ☐ SWSI ☐ DWDI CLASS NOPOWER TRANSMISSION ☐ DIRECT ☐ GEAR ☐ HYDRAULIC COUPLING ☐ TYPE BELT ☐ TYPE CHAINOUTLET ☐ CLOCKWISE ☐ COUNTER CLOCKWISE ☐ UP ☐ DOWN ☐ TOP ☐ BOTTOM ☐ ANGLE ☐ HORIZONTALINLET BOXES ☐ UP ☐ DOWN ☐ RIGHT ☐ LEFT ☐ ANGLE WITH HORIZONTALBLADE FORM ☐ RADIAL ☐ AIRFOIL ☐ FORWARD CURVED ☐ BACKWARD CURVED ☐ FORWARD INCLINE RADIAL TIP ☐ NON-OVERLOADING

FLUID DATA		PERFORMANCE		CONSTRUCTION DETAILS																						
FLUID: ☒ AIR ☐ GAS DRY GAS ANALYSIS % BY VOL. Design Wet Bulb 71°F.		PERFORMANCE CURVE NO. STATIC PRESS. DESIGN VOL. "WC EXIT VELOCITY FPS EXIT GAS TEMP. °F % MECH. EFF. BHP RPM STATIC PRESSURE % DESIGN VOL. "WC MAX. RATE TEMP. CHANGE °F/MIN 1ST. CRITICAL SPEED RPM RESONANCE SPEED RPM VIB. LB-FT ² /START. TORQ. FT/LB COOLING WATER REQ'D. GPM COMP. AIR REQ'D. PSIG CFM CONTROL OPER. SHAFT INLET OUTLET DIAM. INCHES ANGLE OF ROT. DEG. ROTATION TO OPEN MAX. TORQUE. IN.-LB		GENERAL ☐ CORROSION RESIST ☐ ABRASION RESIST ☐ HIGH TEMP. ☐ WIDE TEMP. VARIATIONS ☐ GAS TIGHT ☐ NON-SPARK HOUSING ☐ FLANGED ☐ SPLIT FOR WHEEL REMOVAL ☐ SOUND TRAP ☐ WEAR LINERS ☐ INLET SCREEN ☐ FIXED INLET VANES ☐ INSULATION CLIPS ☐ ACCESS DOOR ☐ WEATHER PROTECTED INLET FT ² /OUTLET FT ² SHAFT SEALS ☒ STD. ☐ CARBON RING ☐ LABYRINTH ☐ PRESSURIZED Packed Gland WHEEL ☐ BLADES ☐ SHROUDED ☐ WEAR STRIP ☐ FULL LINER DIAM. IN. WIDTH IN. TIPS IN. SHAFT BEARINGS DIAM. # BEARINGS IN. DIAM. # HUB IN. DISTANCE BETWEEN BRG. 1 IN. BEARINGS ☐ BALL ☐ ROLLER ☐ SLEEVE ☐ THRUST COLLAR ☐ FORCED LUB. ☐ RING OILED ☐ GREASED ☐ AIR COOLED ☐ WATER COOLED ☐ HEAT SLINGER ☐ BRACKETED OFF HOUSING ☐ PEDESTAL ☐ SOLE PLATES ☐ SUN SHIELD SHAFT C.O.G. MFR. ☐ RIGID ☒ FLEXIBLE ☒ G.P.L.G. GUARD ☐ REQ'D. ☐ NOT REQ'D. RECOVERY, % OF DES. S.P. LENGTH FT. OUTLET AREA FT ² EVASE PURPOSE: ☐ REGULATION ☐ SHUT-OFF BEARINGS: ☐ ANTI-FRICTION ☐ BALL ☐ OPER. LEVER & LOCKING QUADRANT ☐ OPER. SHAFT EXT. FOR CONT. LINKAGE INLET LOUVER VANE PURPOSE: ☐ REGULATION ☐ SHUT-OFF BEARINGS: ☐ ANTI-FRICTION ☐ BALL ☐ OPER. LEVER & LOCKING QUADRANT ☐ OPER. SHAFT EXT. FOR CONT. LINKAGE OUTLET CAMBER HOUSING LB. COMPLETE ROTOR LB. TOTAL OPERATING LB. SHIPPING LB.																						
MOISTURE CONTENT GR/SCF SPECIFIC GRAVITY (WET) MOLECULAR WEIGHT (WET) DUST CONTENT GR/SCF PARTICULATE SIZE:		MATERIALS SCROLL C.S. SCROLL LINERS END LINERS INLET BOXES C.S. BLADES C.S. WHEEL END PLATES C.S. WHEEL CENTER PLATE C.S. WHEEL LINER CTR & END PLATE LINERS HUB SHAFT C.S.		PROCESS SPECIFICATIONS <table border="1"> <thead> <tr> <th></th> <th>NORMAL</th> <th>DESIGN</th> </tr> </thead> <tbody> <tr> <td>INLET VOL., CFM/INLET SCFM</td> <td>51805</td> <td>56985</td> </tr> <tr> <td>1000 LBS/HR</td> <td></td> <td></td> </tr> <tr> <td>INLET TEMP., °F</td> <td>60</td> <td>102</td> </tr> <tr> <td>INLET PRESS., "WC</td> <td>13.9PSIG</td> <td>13.9PSIG</td> </tr> <tr> <td>OUTLET PRESS., "WC</td> <td>80</td> <td>80</td> </tr> <tr> <td>ELEV. ABOVE S.L., FT.</td> <td></td> <td>1541</td> </tr> </tbody> </table> CONTROL: ☐ MANUAL ☐ REMOTE MANUAL ☐ AUTOMATIC ☐ OUTLET DAMPER ☐ INLET LOUVER ☐ INLET VANE ☐ HYD. C.P.L.G. TURNING GEAR REQ'D. ☐ YES ☐ NO COOLING WATER PSIG. & °F MAX. S.P. // 1.15 X DESIGN S.P. N.A.F.M. NOISE LEVEL DB MAX. ALLOWABLE TIP SPEED FPM 1ST CRITICAL SPEED // 1.2 X OPER. RPM RESONANCE SPEED // 1.15 X OPER. RPM RATE OF TEMP. CHANGE // °F/MIN.			NORMAL	DESIGN	INLET VOL., CFM/INLET SCFM	51805	56985	1000 LBS/HR			INLET TEMP., °F	60	102	INLET PRESS., "WC	13.9PSIG	13.9PSIG	OUTLET PRESS., "WC	80	80	ELEV. ABOVE S.L., FT.		1541
	NORMAL	DESIGN																								
INLET VOL., CFM/INLET SCFM	51805	56985																								
1000 LBS/HR																										
INLET TEMP., °F	60	102																								
INLET PRESS., "WC	13.9PSIG	13.9PSIG																								
OUTLET PRESS., "WC	80	80																								
ELEV. ABOVE S.L., FT.		1541																								
REMARKS: Design Basis: 20x10 ⁹ BTU/day plus 10% overcapacity, above specified capacity is for 4 units (one unit will be spare) Vendor to advise thrupt at minimum conditions: -40°F., 13.9PSIG inlet; 50" W.C. outlet. Motor: 4160V. 3 phase, 60 Hz. Class I, Div. II, Group D. Ambient Temp.: -42°F. min., 102°F. Max. *Two 50% capacity units.		(X) CHECK ITEMS FURNISHED WITH FAN ☐ INLET LOUVER ☐ RED. GEAR ☐ INLET VANES ☐ HYD. COUPLING ☐ OUTLET DAMPER ☐ DRIVER ☐ WEATHER HOOD ☐ COUPLING ☐ BRG. P.L.T. ☐ SOLE P.L.T. ☐ TURNING GEAR ☒ FAN C.P.L.G. ☒ MTD ☐ BASE P.L.T. ☐ DRIVE ☒ DRIVER C.P.L.G. ☒ MTD ☐ DRIVER ☒ COM'N ☐ EVASE ☐ DES ONLY *Inlet Filter ☐ BRG. SUN SHIELD *Inlet Silencer ☐ INLET CHAIN GUARD																								

MADE BY

M.JH

CHECKED BY

PAGE

1

CONT. NO.

3001

ENGINEERING REQUISITION NO.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKEE CONTRACT 4814
JANUARY, 1979

6.06.2

BIN PROCESS SPECIFICATIONS

BN-201 A/M

Coal Surge Hoppers

GENERAL NOTES

1. SPECIFICATIONS PER THE BILL OF MATERIAL.
2. THIS DRAWING IS A SCHEMATIC OUTLINE ONLY FOR ELEVATION & ORIENTATION OF ATTACHMENTS, REFER TO
3. FOR ESTIMATING PURPOSES, VESSEL FABRICATOR SHALL INCLUDE THE FOLLOWING CLIPS:

4. Capacity (each bin) 66 tons coal
size range 1/2" thru 1-1/2" -
Bulk density 50#/cu. ft.

5. Bins shall be lined with non-sparking materials such as Poly-Hi Inc. "Tivar 88" or approved equal.
6. Internal chute shall be provided in each bin to minimize coal degradation.
7. One bin required per gasifier (twelve shown).
8. Design Basis: 1.85×10^9 Btu/day per gasifier - Western Coal - 12 hour storage

[illegible]

NOZZLE SCHEDULE

No. 671, - 4

REVISIONS

DESIGN DATA

DESIGN PRESSURE	0	°C, °F
OPER. PRESSURE	0	°C, °F
VACUUM DESIGN	0	°C, °F
OPER. VAC. COND.	0	°C, °F
OPER. HYDROSTATIC HEAD		
SP. CR. OPER. LIQUID		
CORROSION ALLOWANCE	NONE	
RADIOGRAPHY	(FULL)	(PARTIAL) (SPOT)
JOINT EFFICIENCY		
HEAD TYPE		
STRESS RELIEF	(REQ'D)	(PER CODE)
CODE:	ASME SECTION VIII, DIV.	
	API 650	
	API 620	
	X AISI	
CODE STAMP	(REQ'D)	(NOT REQ'D)
EARTHQUAKE:	CODE	ZONE
WIND DESIGN BASIS:		
MATERIALS OF CONSTRUCTION		
SHELL:	ASTM A36	HEADS:
SUPPORT:	By Others	EXT. CLIPS:
INTERNAL:	See Notes 5 & 6	VESSEL FAB. X
TRAYS:	BY OTHERS	
BOLTS: EXT.	NUTS: EXT.	
INT.	INT.	
PIPE: EXT.	INT.	
WELDINGS:		
PACKING:	BY OTHERS	
GASKETS:		
REFERENCES		
SUPPORT:	SKIRT TYPE A	LEGS LUGS
SADDLES PER STD.		
INSUL. SUPPTS PER STD.		
FOR THK. INSULATION		
SUPPORTING SUPPTS PER STD.		
REQ'D (1.5) (0.5) OF SKIRT		
RAILWAY DAVITS/HINGES PER STD.		
VESSEL DAVIT PER		
STRUCTURAL CLIPS PER SPEC. EXH.		
SEE GEN. NOTE 3		
PAINT PER SPEC.		
LIFTING LUGS (REQ'D) (NOT REQ'D)		
CONTRACT		
B.N. No.	ITEM NO.	
EQUIP. TAG No.	BN201 A/M	No. REQ'D 12
SERVICE	Coal feed for casifiers	
COAL SURGE HOPPERS		
DRAWN	Babcock	
CHECKED	Contractors Inc.	
DATE		
Q.C. NO.	BN201 A/M	REV.
		0

6.06.3 .

CYCLONE PROCESS SPECIFICATIONS

CY-201 A/M	Dust Cyclones	Pgs. 1 & 2
CY-202 A/M	Tar Cyclones	Pg. 1

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.	PROCESS SPECIFICATION FOR DUST CYCLONES		PS - CY201 A/M	
			REVISION 0 PAGE 1 OF 2	
ORIGINAL 0 For Est.	BY I.W.	DATE 9/29/78	APPD. M.J.H.	DATE
REVISION	BY	DATE	APPD.	DATE
CLIENT: McKee			PROJECT NO. 3001	

No. Off: 12 (1 per gasifier)

Duty: Removal of dust (coke and ash particles) from "clear gas".

Gas Analysis:	Vol. %	Range	Typical
Dry Gas	CO	25 - 27	25.61
	CO ₂	5.5 - 6.5	6.10
	H ₂	19 - 23	19.75
	N ₂	43 - 50	47.63
	CH ₄	0.06 - 0.12	0.08
	H ₂ S	0.1 - 0.5	0.38
	COS	0.02 - 0.12	0.09
	NH ₃	0.2 - 0.6	0.34
	HCN	100 ppm	0.01
	Cl	200	0.01

100.00

Molecular Wt. 23.9

H₂O lbs./1000 SCF 1.0-1.5 1.07

Dust grains/100 SCF approx. 50-100

Dust Size Range - Vendor shall provide performance curve

Operating Conditions	Normal	Maximum
Temperature: °F	1202	1250
Pressure: inches WG.	45	50

Note: Atmospheric pressure = 13.85 psia

Gas viscosity: micropoises 380 400

Capacity:

Coal source:		Western	Eastern
Dry Gas:	SCFH	132,100	314,600
H ₂ O:	SCFH	3,600	7,100
Total:	SCFH	135,700	321,700

Actual flow at
operating
conditions: CFH 413,000 979,000

PROCESS SPECIFICATION
FOR
DUST CYCLONES

PS - CY201 A/11

REVISION 0

PAGE 2 OF 2

Performance Required:

Dust removal: 95%

Pressure drop: Not more than 3 inches WG.

Materials of Construction:

Carbon steel refractory lined

Shell thickness 15/64"

Refractory

Inner layer 3" AP Green Low Abrade 2400F - Vitrified

Backing layer 3" VSL 50 Insulating Castable

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR TAR CYCLONE		PS- CY 202 A/M REVISION 0 PAGE 1 OF 1	
ORIGINAL 0	BY Hemingway	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Design Basis: 20×10^9 Btu/day from eleven gasifiers. Western coal, 10% overcapacity.

No. Required: Twelve (one per gasifier)

Function: To remove tar droplets from top gas.

Duty: (for each unit)

	<u>Normal</u>	<u>Max. Process Design</u>
Gas flow SCFM	6,710	7,381
Gas flow ACFM	9.162	10,078
Gas temperature °F	250	250
Gas pressure, psia	14.62	14.62
Atmospheric pressure, psia	13.9	13.9
Gas density #/ft. ³	0.044	0.044
Gas viscosity Cp	0.0185	0.0185
Gas pressure drop "w.g.	1.5	1.7
Tar loading #/min.	15	70
Tar viscosity @ 250°F Cp		
Tar S.G.	1.01	1.08

Mechanical Design:

Design temperature: 450°F
 Design pressure: 5 psig
 Material: C.S.
 Corrosion allowance: 1/16"min.
 Insulation and tracing: Cyclone will be steam traced and insulated with 2" insulation by others.

Typical Size: Cyclone will be similar to Fisher Klosterman Model No. XQ36.

Guarantees: Vendor to provide guarantee of pressure drop for the duties listed in this specification.

6.06.4

DRUM PROCESS SPECIFICATIONS

D-201 A/M

L.P. Steam Drum

D-202 A/B

H.P. Steam Drum

D-203

Flash Tank

FOUR 4" ϕ HOLES SPACED 90°

GENERAL NOTES

- SPECIFICATIONS PER THE BILL OF MATERIAL.
- THIS DRAWING IS A SCHEMATIC OUTLINE ONLY FOR ELEVATION & ORIENTATION OF ATTACHMENTS. REFER TO
- FOR ESTIMATING PURPOSES, VESSEL FABRICATOR SHALL INCLUDE THE FOLLOWING CLIPS:

- Design Basis: One per gasifier
- Twelve identical units are required.
- Capacity each unit: 750 U.S. gallons at normal liquid level.

DESIGN DATA

DESIGN PRESSURE	45 psig F.W.	°C, °F
OPER. PRESSURE	25 psig	°C, °F
VACUUM DESIGN	Full	°C, °F
OPER. VAC. COND.		°C, °F
OPER. HYDROSTATIC HEAD		
SP. GR. OPER. LIQUID	0.936	
CORROSION ALLOWANCE	1/8"	
RADIOGRAPHY	(FULL) (PARTIAL) (SPOT)	
JOINT EFFICIENCY		
HEAD TYPE		
STRESS RELIEF	(REQ'D) (PER CODE)	
CODE:	ASME SECTION VIII, DIV.	
	API 650	
	API 620	
	X ASME Section I	
CODE STAMP	(REQ'D) X (NOT REQ'D)	
EARTHQUAKE:	CODE ZONE	
KIND DESIGN BASIS:		
MATERIALS OF CONSTRUCTION		
SHELL:	HEADS:	
SUPPORT:	EXT. CLIPS:	
INTERIALS:	BY VESSEL FAB.	
TRAYS:	BY OTHERS	
BOLTS: EXT. INT.	NUTS: EXT. INT.	
PIPE: EXT. INT.		
FORGINGS:		
PACKING:	BY OTHERS	
GASKETS:		

REFERENCES

SUPPORT: SKIRT TYPE 6	LEGS	LOGS
SADDLES X PER STD.		
INSUL. SUPP'TS PER STD.		
FOR 4" THK. INSULATION Calcium Silicate		
FIREPROOFING SUPP'TS PER STD.		
REQ'D (I.S.) (O.S.) OF SKIRT		
HANWAY DAVITS/HINGES PER STD.		
VESSEL DAVIT PER		
STRUCTURAL CLIPS PER SPEC.	EXH.	
SEE GEN. NOTE 3		
PAINT PER SPEC.		
LIFTING LUGS	(REQ'D) X (NOT REQ'D)	

CONTRACT

S.M. No.	ITEM No.
EQUIP. TAG No.	D201 A/M No. REQ'D. 12
SERVICE	

L. P. STEAM DRUM

DRAWN	Babcock
CHECKED	Contractors Inc.
DATE	
DWG. NO.	REV.

D201 A/M

1

A	1	6"		Steam Outlet		L ₁ L ₂	4	1-1/2"		Level Gage	
B	1	8"		Circulation-Out		M ₁ M ₂	2	1-1/2"		Level Control	
C	1	10"		Circulation-Return		N	1	3/4"		Temperature	
D	1	1"		Boiler Feed Water Dip Pipe							
E	1	4"		Nozzle for D							
F	1	1"		Blowdown Drain							
G	1	6"		Relief Valve							
H	1	1"		Pressure Vent							
J	1	3/4"		Pressure Control							
K	1	1-1/2"		Spare							
MARK	NO. REQ'D.	SIZE	RATING	SERVICE	REMARKS	MARK	NO. REQ'D.	SIZE	RATING	SERVICE	REMARKS
NOZZLE SCHEDULE											

No. BY DATE REVISIONS

GENERAL NOTES

- SPECIFICATIONS PER THE BILL OF MATERIAL.
- THIS DRAWING IS A SCHEMATIC OUTLINE ONLY FOR ELEVATION & ORIENTATION OF ATTACHMENTS. REFER TO
- FOR ESTIMATING PURPOSES, VESSEL FABRICATOR SHALL INCLUDE THE FOLLOWING CLIPS:
- Nozzles D₁-D₂ must be on vertical centerline of drum.
- Nozzles C₁-C₆ may be up to 12" either side of vertical centerline to suit layout.
- Design Basis - Six gasifiers operating at 1.35×10^9 Btu/da each - Eastern Coal.
- Two identical units are required.
- Capacity each unit: 1100 U.S. gallons at normal liquid level.

FOUR 2½" Ø HOLES SPACED 90°

RISER DETAIL SHOWN FOR NOZZLE D₁ ALSO REQ'D FOR NOZZLES D₂ THRU D₆

A	1	3"		Boiler Feed Water-In	M ₁ M ₂	2	1-1/2"	Level Controller	
B	1	4"		Nozzle for A					
C1-6	6	4"		Circulation-Out					
D1-6	6	6"		Circulation-Return					
E	1	6"		Steam-Out					
F	1	6"		Relief Valve					
G	1	3"		Vent					
J	1	1"		Intermittent Blowdown					
K	1	3"		Spare					
L1L2	4	1-1/2"		Level Gage					
MARK	NO. REQ'D	SIZE	RATING	SERVICE	REMARKS	MARK	NO. REQ'D	SIZE	RATING

NOZZLE SCHEDULE

NO. BY DATE

REVISIONS

DESIGN DATA

DESIGN PRESSURE	150	°	366	°C, °F
OPER. PRESSURE	125	°	353	°C, °F
VACUUM DESIGN	Full	°	--	°C, °F
OPER. VAC. COND.		°		°C, °F
OPER. HYDROSTATIC HEAD				
SP. GR. OPER. LIQUID	0.89			
CORROSION ALLOWANCE	1/8"			

RADIOGRAPHY	(FULL)	(PARTIAL)	(SPOT)
JOINT EFFICIENCY			
HEAD TYPE			
STRESS RELIEF	(REQ'D)	(PER CODE)	

CODE:	ASME SECTION VIII, DIV.
	API 650
	API 620
X	ASME Section I

CODE STAMP	(REQ'D)	X	(NOT REQ'D)
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EARTHQUAKE: CODE	ZONE
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WIND DESIGN BASIS:	
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MATERIALS OF CONSTRUCTION	
---------------------------	--

SHELL:	HEADS:
--------	--------

SUPPORT:	EXT. CLIPS:
----------	-------------

INTERNALS:	BY VESSEL FAB.
------------	----------------

TRAYS:	BY OTHERS
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BOLTS: EXT.	NUTS: EXT.
-------------	------------

INT.	INT.
------	------

PIPE: EXT.	INT.
------------	------

FORGINGS:	
-----------	--

PACKING:	BY OTHERS
----------	-----------

GASKETS:	
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SUPPORT: SKIRT	TYPE A	LEGS	LUGS
----------------	--------	------	------

SADDLES	PER STD.
---------	----------

INSUL. SUPP'TS PER STD.	
-------------------------	--

FOR 4" THK. INSULATION	Calcium Silicate
------------------------	------------------

FIREPROOFING SUPP'TS PER STD.	
-------------------------------	--

REQ'D (1.S)	(O.S) OF SKIRT
-------------	----------------

MANWAY DAVITS/HINGES PER STD.	
-------------------------------	--

VESSEL DAVIT PER	
------------------	--

STRUCTURAL CLIPS PER SPEC.	EXH.
----------------------------	------

SEE GEN. NOTE 3	
-----------------	--

PAINT PER SPEC.	
-----------------	--

LIFTING LUGS	(REQ'D)	X	(NOT REQ'D)
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CONTRACT	
----------	--

B. M. No.	ITEM No.
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EQUIP. TAG No.	D202 A&B	No. REQ'D.	2
----------------	----------	------------	---

SERVICE	
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--	--

HIGH PRESSURE STEAM DRUM	
--------------------------	--

--	--

DRAWN	Babcock
-------	---------

CHECKED	Contractors Inc.
---------	------------------

DATE	
------	--

DWG. No.		REV.
----------	--	------

D202 A/B

1

GENERAL NOTES

- SPECIFICATIONS PER THE BILL OF MATERIAL.
- THIS DRAWING IS A SCHEMATIC OUTLINE ONLY FOR ELEVATION & ORIENTATION OF ATTACHMENTS, REFER TO
- FOR ESTIMATING PURPOSES, VESSEL FABRICATOR SHALL INCLUDE THE FOLLOWING CLIPS:

- Flow Rate (lb./hr.) from 125 psig system:

Flash Steam: 301
Liquid Blowdown: 1709
Total: 2010

- Flow Rate (lb./hr.) from 25 psig system:

Flash Steam: 78
Liquid Blowdown: 1242
Total: 1320

A	1	24"	150FF	Manhole							
B	1	3"	150RF	125 PSIG Blowdown							
C	1	2"	"	25 PSIG Blowdown							
D	1	6"	"	Vent							
E	1	2"	"	Blowdown Drain							
F	1	2"	"	Spare							
G	1	3"	"	Spare							
MARK	NO. REQ'D.	SIZE	RATING	SERVICE	REMARKS	MARK	NO. REQ'D.	SIZE	RATING	SERVICE	REMARKS

NOZZLE SCHEDULE

No. BY DATE

REVISIONS

DESIGN DATA

DESIGN PRESSURE 5 psig 4 400 °C, °F
OPER. PRESSURE 2 psig 2 218 °C, °F
VACUUM DESIGN Full 0 - °C, °F
OPER. VAC. COND. 0 °C, °F

OPER. HYDROSTATIC HEAD

SP. GR. OPER. LIQUID

CORROSION ALLOWANCE 1/8"

RADIOGRAPHY (FULL) (PARTIAL) (SPOT)

JOINT EFFICIENCY

HEAD TYPE

STRESS RELIEF (REQ'D) (PER CODE)

CODE: X ASME SECTION VIII, DIV.

API 650

API 620

CODE STAMP (REQ'D) X (NOT REQ'D)

EARTHQUAKE: CODE ZONE

WIND DESIGN BASIS:

MATERIALS OF CONSTRUCTION

SHELL: HEADS:

SUPPORT: EXT. CLIPS:

INTERNAL: BY VESSEL FAB.

TRAYS: BY OTHERS

BOLTS: EXT. INT. NUTS: EXT. INT.

PIPE: EXT. INT.

FORGINGS:

PACKING: BY OTHERS

GASKETS: 1/8" Compressed Asbestos

REFERENCES

SUPPORT: SKIRT TYPE 3 LEGS LUGS

SADDLES X PER STD.

INSUL. SUPPTS PER STD.

FOR 3" THK. INSULATION Calcium Silicate

FIREPROOFING SUPPTS PER STD.

REQ'D (1.5) (0.5) OF SKIRT

MANWAY DAVITS/HINGES PER STD.

VESSEL DAVIT PER

STRUCTURAL CLIPS PER SPEC. EXH.

SEE GEN. NOTE 3

PAINT PER SPEC.

LIFTING LUGS (REQ'D) X (NOT REQ'D)

CONTRACT

B/M No. ITEM No.

EQUIP. TAG No. D-203 No. REQ'D. 1

SERVICE 125 & 25 psig Flash Steam

Flash Tank

DRAWN: Babcock
CHECKED: Contractors Inc.
DATE:

ENG. NO.

D-203

REV.

0

6.06.5

EXCHANGER PROCESS SPECIFICATIONS

E-201 A/M	Process Gas Cooler (also refer X-204A)	
E-202 A/E	Combined Gas Cooler	Pgs. 1-3

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR EXCHANGER			PS - E201 A to M REVISION 1 PAGE 1 OF 1	
ORIGINAL 0	BY MJH	DATE 9/29/78	APPD. MJH	DATE		
REVISION 1	BY MJH	DATE 11/29/78	APPD.	DATE		

FUNCTION	Process gas cooler (component or W-204)																																																																																
	Cooling gas obtained by gasification of coal and generation of 125 PSIG steam.																																																																																
	Design Basis: Eastern Coal; gas in at 1202°F.																																																																																
OPERATION	Boiler will be fed by thermosyphon recycle from steam drum located approx. 15 ft. above the top end of the boiler.																																																																																
MATERIALS HANDLED	Gas analysis vol.% approx. CO 25.04, CO ₂ 5.97, H ₂ 19.31, N ₂ 46.58																																																																																
	CH ₄ 0.08, H ₂ S 0.37, COS 0.09, NH ₃ 0.33																																																																																
	H ₂ O 2.21, HCN + Cl Trace																																																																																
DESIGN DATA	HEAT EXCHANGED (BTU/HR) (East) 4,820,000 (West) 1,807,500 (MAXIMUM) 5,220,000 TRANSFER RATE (BTU/HR-SQ. FT.-°F) (SERVICE) (CLEAN) AREA (FT²) CORR. LMTD (°F) TYPE TUBES NO. OD (IN) 1.5 BWG 10 LENGTH (FT.) PITCH (IN.) BAFFLES NO. TYPE SHELL I.D. (IN.)																																																																																
	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 40%;">PERFORMANCE OF ONE UNIT (Design)</th> <th style="width: 30%;">SHELLSIDE</th> <th style="width: 30%;">TUBESIDE</th> </tr> </thead> <tbody> <tr> <td>FLUID ENTERING</td> <td>Boiler Feed Water</td> <td>Gas</td> </tr> <tr> <td>CONDENSABLE VAPORS LB/HR</td> <td>-</td> <td>-</td> </tr> <tr> <td>NONCONDENSABLE VAPORS LB/HR</td> <td>-</td> <td>20,170</td> </tr> <tr> <td>LIQUID LB/HR</td> <td>Approx. 121,000</td> <td>-</td> </tr> <tr> <td>TOTAL FLUID ENTERING LB/HR</td> <td></td> <td></td> </tr> <tr> <td>FLUID VAPORIZED OR CONDENSED LB/HR</td> <td>5040</td> <td>-</td> </tr> <tr> <td>SPECIFIC GRAVITY - LIQUID</td> <td>0.89</td> <td></td> </tr> <tr> <td>VISCOSITY CP</td> <td></td> <td>Inlet 0.038</td> </tr> <tr> <td>MOLECULAR WEIGHT - VAPORS</td> <td>18.02</td> <td>23.72</td> </tr> <tr> <td>SPECIFIC HEAT</td> <td></td> <td></td> </tr> <tr> <td>LATENT HEAT - VAPORS BTU/LB</td> <td>864.5</td> <td></td> </tr> <tr> <td>THERMAL CONDUCTIVITY BTU/HR SQ.FT.°F/FT</td> <td></td> <td>Inlet 0.045</td> </tr> <tr> <td>FOULING RESISTANCE HR-SQ. FT.°F/BTU</td> <td>0.001</td> <td>0.002</td> </tr> <tr> <td>TEMPERATURE IN °</td> <td>358</td> <td>1202</td> </tr> <tr> <td>TEMPERATURE OUT °</td> <td>358</td> <td>400</td> </tr> <tr> <td>OPERATING PRESSURE PSIG</td> <td>130 - 135</td> <td>1.5</td> </tr> <tr> <td>NUMBER OF PASSES</td> <td>1</td> <td>1</td> </tr> <tr> <td>VELOCITY FT/SEC.</td> <td></td> <td></td> </tr> <tr> <td>PRESSURE DROP PSI</td> <td></td> <td>0.2</td> </tr> <tr> <td>DESIGN PRESSURE PSIG</td> <td>170</td> <td></td> </tr> <tr> <td>DESIGN TEMPERATURE</td> <td>375</td> <td></td> </tr> <tr> <td colspan="3">INSULATION</td> </tr> <tr> <td colspan="3">MATERIALS OF CONSTRUCTION: TUBES Refractory lined inlet, CS Tubes</td> </tr> <tr> <td colspan="3">SHELL CS</td> </tr> <tr> <td colspan="3">GASKETS</td> </tr> </tbody> </table>			PERFORMANCE OF ONE UNIT (Design)	SHELLSIDE	TUBESIDE	FLUID ENTERING	Boiler Feed Water	Gas	CONDENSABLE VAPORS LB/HR	-	-	NONCONDENSABLE VAPORS LB/HR	-	20,170	LIQUID LB/HR	Approx. 121,000	-	TOTAL FLUID ENTERING LB/HR			FLUID VAPORIZED OR CONDENSED LB/HR	5040	-	SPECIFIC GRAVITY - LIQUID	0.89		VISCOSITY CP		Inlet 0.038	MOLECULAR WEIGHT - VAPORS	18.02	23.72	SPECIFIC HEAT			LATENT HEAT - VAPORS BTU/LB	864.5		THERMAL CONDUCTIVITY BTU/HR SQ.FT.°F/FT		Inlet 0.045	FOULING RESISTANCE HR-SQ. FT.°F/BTU	0.001	0.002	TEMPERATURE IN °	358	1202	TEMPERATURE OUT °	358	400	OPERATING PRESSURE PSIG	130 - 135	1.5	NUMBER OF PASSES	1	1	VELOCITY FT/SEC.			PRESSURE DROP PSI		0.2	DESIGN PRESSURE PSIG	170		DESIGN TEMPERATURE	375		INSULATION			MATERIALS OF CONSTRUCTION: TUBES Refractory lined inlet, CS Tubes			SHELL CS			GASKETS		
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REMARKS: 1. Atmospheric Pressure = 13.85 psig																																																																																	
2. Boiler feed water flow will be by thermosyphon recycle from steam drum located above the boiler.																																																																																	

Boilers designed to minimize vibration at tube sheet may be accomplished by mounting unit at 90° to vertical.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR EXCHANGER			PS - E202 A to E REVISION 0 PAGE 1 OF 3	
ORIGINAL 0		BY HEMINGWAY	DATE 9/29/78	APPD.	DATE	
REVISION 1		BY MJH	DATE	APPD.	DATE	

FUNCTION	Combined Gas Exchanger To cool combined top gas and clear gas - Design Basis is 10×10^9 Btu/day Western coal - Three 50% Units					
	Four operating, one standby, each unit as specified, consists of two shells, alternate construction is one shell/unit with 28' long tubes. △					
MATERIALS HANDLED	Shell Side - Composition of non-condensable CO - 26.01 % v/v CO ₂ - 6.79 H ₂ - 22.41 N ₃ 43.29 CH ₄ - 0.64 C ₂ + 0.86 100.00					
DESIGN DATA	HEAT EXCHANGED (BTU/HR) 13.56 MM (NORMAL) per unit. (MAXIMUM) TRANSFER RATE (BTU/HR-SQ. FT-°F) (SERVICE) (CLEAN) AREA (FT ²) CORR. LMTD (°F) TYPE TUBES NO. OD (IN) 1-1/2" BWG 12 LENGTH (FT.) 14 PITCH (IN.) Square BAFFLES NO. 10 TYPE Single SHELL I.D. (IN.) 75					
	PERFORMANCE OF ONE UNIT		SHELLSIDE		TUBESIDE	
	FLUID ENTERING		Combined Gas		Cooling Water	
	CONDENSABLE VAPORS Water/Oil LB/HR		16131/586			
	NONCONDENSABLE VAPORS LB/HR		74.326			
	LIQUID LB/HR		0		1356 g.p.m.	
	TOTAL FLUID ENTERING LB/HR		86043			
	FLUID VAPORIZED OR CONDENSED Water/Oil LB/HR		7722/586			
	SPECIFIC GRAVITY - LIQUID Water/Oil		1.0/0.98			
	VISCOSITY Gas In/Out CP		0.020/0.016			
	MOLECULAR WEIGHT - VAPORS (Dry)		23.18			
	SPECIFIC HEAT Gas In/Out Btu/H °F.		0.316/0.305			
	LATENT HEAT - VAPORS BTU/LB		1025/120			
	THERMAL CONDUCTIVITY BTU/HR SQ.FT° F/FT		0.022/0.018			
	FOULING RESISTANCE HR-SQ. FT.°F/ BTU		0.003			
	TEMPERATURE IN °		287		75	
	TEMPERATURE OUT °		95		95	
	OPERATING PRESSURE PSIG		1.0			
	NUMBER OF PASSES					
	VELOCITY FT/SEC.					
	PRESSURE DROP PSI		0.15			
	DESIGN PRESSURE PSIG		5.0			
	DESIGN TEMPERATURE					
	INSULATION For personnel protection required.					
	MATERIALS OF CONSTRUCTION:		TUBES C.S.			
		SHELL C.S.				
		GASKETS				
REMARKS: 1. See page 3 for cooling curve △						
2. Unit horizontal - Slope 5°						

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>	PROCESS SPECIFICATION FOR EXCHANGER	PS - E202 A to E
		REVISION <u>0</u>
		PAGE <u>2</u> OF <u>3</u>

VENDOR	MANUFACTURER
PROPOSAL NO. <u> </u>	DATE <u> </u>

VENDOR TO PROVIDE EQUIPMENT ITEM(S), PLUS FOLLOWING AUXILIARIES:

Combined Gas Exchanger - Five Units required.

Each unit will consist of two shells in fries. Each shell specified below.

EQUIPMENT DESCRIPTION

MATERIALS OF CONSTRUCTION:

SHELL Carbon steel

TUBES Carbon steel

OUTSIDE AREA PROVIDED

TUBES	NO. 1150	O.D. 1-1/2" BWG 12	LENGTH 14'	PITCH 1.875" 90°
SHELL		I.D. 75" O.D. 76"	THICKNESS 1/2"	
SHELL COVER			FLOATING HEAD COVER	
CHANNEL			CHANNEL COVER	
TUBE SHEETS	☐ STATIONARY		☐ FLOATING	
BAFFLES - CROSS NO. 10	TYPE Single	15	% CUT THICKNESS	
BAFFLES - LONG NO. 110	TYPE		THICKNESS 0.375"	
BAFFLES - IMPINGEMENT				
TUBE FASTENING				
TUBE SUPPORTS		THICKNESS		
GASKETS				
CONNECTIONS - SHELL IN 8"	OUT 8"	SERIES		
CHANNEL IN 42"	OUT 42"	SERIES		
CORROSION ALLOWANCE	SHELLSIDE	TUBESIDE		
CODE REQUIREMENTS				
WEIGHTS EACH SHELL	BUNDLE	FULL OF WATER		
TEST PRESSURE				

Design to TEMA "C"
 TEMA Type A.E.L.

Note: Exchangers to be fitted with 2" nozzle at low point of head for continuous drain of condensate.

Note: Alternate construction for one unit is a single shell with 28' tubes.

Cooling Curve Data

Combined Gas Cooler

Temperature °F.	287	250	200	132	120	110	95
Heat to be Removed Btu/Hr.x10 ⁶	13.56	12.51	11.05	9.09	5.04	2.64	0
Steam Lb./Hr.	11,131	11,131	11,131	11,131	7,511	5,484	3,409
Water Lb./Hr.	-	-	-	-	3,620	5,647	7,722
Oil Vapor Lb./Hr.	586	586	397	140	95	57	0
Oil Liquid Lb./Hr.	-	-	189	446	491	529	586
Steam Dew Pt. 132°F.							
Oil Dew Pt. 250°F.							

6.06.6

FEEDER PROCESS SPECIFICATIONS

MF-201 A/M	Lockhopper - Coal Fed	Pgs. 1 & 2
MF-202 A/M	Coal Feeder	Pg. 1

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR LOCK HOPPER		PS-MF-201 A to M REVISION 0 PAGE 1 OF 2	
ORIGINAL 0	BY M.J.H.	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

No. Required: Twelve

Duty: To control the level in the gasifier to within + 6 ins. and to control the gasifier feed by stop/start of coal feeders MF 202 A to M.

Design Basis: 1.85×10^9 Btu/day per gasifier, Western coal, 25% overcapacity.

Material Handled: Coal within the size range $1/2"$ to $1\ 1/2"$. Bulk density 50 #/ft.³.

Flow Rate: Average design - 13,805 #/hr.

Operation:

System hold-up is to be sized so that at design flow rate given above operates once every 3 minutes. The hopper is to be sized to hold 690# of coal at normal operating level.

System valves and conveyors are to be designed so the complete cycle can operate once every minute.

Description of Operating Cycle:

- (a) As the level of coal in the gasifier falls, a level sensing device operates, closing a limit switch which initiates the cycle.
- (b) Outlet valve opens, lifting level sensor in gasifier and coal is discharged into gasifier.
- (c) Outlet valve closes, level sensor is lowered on to coal.
- (d) Vent valve is opened, N₂ purge is closed
- (e) Inlet valve is opened.
- (f) Feeder conveyor runs for approx. 15 seconds to load 690# measured by load cells.
- (g) Vent and inlet valves are closed, N₂ purge is opened.

The above cycle to take place in 60 seconds.

The lock hopper is now in the charged condition awaiting the next cycle.

Supply:

The extent of supply covered by this specification is as follows:

Level measurement
 Valve Actuators
 Plug Valves (18" nominal size)
 Lock Hopper
 Plug Valve
 Load cells and weight integrator/control

All associated electrical/pneumatic/hydraulic control gear.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR LOCK HOPPER		PS-MF 201 A to E REVISION <u>1</u> PAGE <u>2</u> OF <u>2</u>	
ORIGINAL	BY <u>M.J.H.</u>	DATE <u>6/8/78</u>	APPD.	DATE	
REVISION <u>1</u>	BY <u>M.J.H.</u>	DATE <u>11/29/78</u>	APPD.	DATE	
CLIENT: <u>McKee</u>				PROJECT NO. <u>3001</u>

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR COAL FEEDER		PS- MF 202 A to M REVISION 0 PAGE 1 OF 1	
ORIGINAL	0	BY	MJH	DATE	9/29/78
REVISION	1	BY		DATE	
CLIENT: McKee				PROJECT NO. 3001	

No. Required: Twelve.

Duty: To convey coal from the base of the coal surge hopper BN 201A to M to the lock hopper MF 201A to M.

Design Basis: 1.85×10^9 Btu/day, Western coal, 25% overcapacity.
Fill lock hopper in 15 seconds.

Flow Rate: Design: 690#/15 sec.
165,600 #/hr.
83 tons/hr.

Average Design Rate: 13,805 #/hr.

Material Handled: Coal within the size range 1/2" to 1-1/2".
Max. temperature of coal - 200°F.
Bulk density - 50 #/ft.³.

Dimensions: To suit layout.

Motor: Class II, Div. I, Group F.
Electric supply: 480V, 3 ph., 60 Hz.

Control: Feeder stop/starts in sequence with MF 201A to M.

Type of Feeder: May be vibratory or belt type.

6.06.7

PUMP PROCESS SPECIFICATIONS

P-201 A/B	Tar Pumps	Pg. 1
P-202 A/B	refer TK-201A Oil/water Separator	
P-203 A/B	refer TK-201A Oil/water Separator	
P-204A	refer TK-201A Oil/water Separator	
P-205	Chemical Sump Pump	Pgs. 1 & 2

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		PROCESS SPECIFICATION FOR TAR PUMPS		PS-P201 A & B REVISION 0 PAGE 1 OF 1	
ORIGINAL 0	BY J. Garvin	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Number of Units: Two (2)

No. Operating: One

Duty: Transfer tar from pump tank to off-site equipment.

Type: Positive displacement.

Operating Conditions:

Tar Temperature:	250 F ⁰ (300 max.)
Flow Rate:	13,151 #/hr.
Density:	63.24 #ft. ³
Viscosity:	Equivalent #6 fuel oil
Vapour press p.s.i.a.	Less than 1 p.s.i.
N.P.S.H. available	greater than 25 ft.
Head:	40 ft. TDH
Ambient Temperature:	Minus 42 to 102°F

Pump Description:

1. Each pump capable of 150% design rate at design TDH. No copper, brass or aluminum pump parts.
2. Pumps will be electric traced & insulated (by others).

Power:

Driver Type: Electric, Class I, Group D, Div. 2, 440V, 60 cycles, 3 phase.

Atmospheric pressure: 13.9 p.s.i.a.

Ambient temperature: °F Min/Max -42, + 102

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR CHEMICAL SUMP PUMP		PS - P 205 REVISION <u>0</u> PAGE <u>1</u> OF <u>2</u>	
ORIGINAL <u>0</u>	BY J. Garvin	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

No. of Units: One

No. Operating: One

No. Spare: Zero

Type: Vertical Sump P-205

Liquid: Water containing up to 10% tar or oil and up to 5000 mg/l coal fines.

Operation: Intermittent Hours Per Day: 0 to 8

<u>Operating Conditions:</u>	<u>Normal</u>	<u>Maximum</u>
Capacity/Pump GPM	150	----
Temperature °F	60	95
S.G.	8.3 lb./gal.	----
Viscosity cP at above temperature	1.0	20.0
Vap. Press. psia	0.25	7.0
Total suction head	See Pit Sketch	
NPSH Available - Normal Temp. ft.	*	
Max. Temp. ft.	*	
Discharge Head (abs) psi	30	30

Power:

Driver Type: Electric, Class I, Group D, Div. 2

Hydraulic Power	* HP	----
Shaft Input at estimated efficiency of % *	* HP	
	440 volts, 60 cycles,	
	3 phase	

Atmospheric Pressure: 13.9 psia

Maximum Particle Size: 1/2"

Ambient Temp. °F Min./Max. -42, +102

Pump output controlled by vendor's float switch.

REMARKS - Alkaline water containing oil, tar, ammonia, and cyanide. Iron, steel and stainless acceptable. Brass, copper and aluminum not suitable. Furnish vendor's standard base plate * " x ".

* Vendor to complete.

TK204 sump for P205 Chemical Sump Pump.

Concrete construction.

NOTES:

1. Number of steady bearings * _____
2. Lubricant (prefer water, vendor cyclone)
* _____
3. Bearing material * _____
4. Steel pit cover to support pump base plate and with pit access plate. (Not by pump Vendor.) 2" vent to 10' height.

*Information by Vendor.

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKee CONTRACT 4814
JANUARY, 1979

6.06.8

GASIFIER PROCESS SPECIFICATIONS

R-201 A/M

Gasifier

Pgs. 1-7

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR REACTOR		PS-R201 A to M REVISION <u>0</u> PAGE <u>1</u> OF <u>7</u>	
ORIGINAL <u>0</u>	BY MJH	DATE <u>9/29/78</u>	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

1. Type:

Two stage, dry grate gasifier.

The gasifiers are to be capable of modification so they can operate in either of two modes:

- 1.1 As a conventional two stage gasifier.
- 1.2 As a developmental two stage gasifier, fitted with a stirrer (Item No. A 201).
- 1.3 The two types of gasifier will be identical, except for the refractory lining (see Section and the stirrer. The stirrer is covered under a separate specification.
- 1.4 The demonstration plant will consist of four conventional gasifiers, and one stirred gasifier.

2. Nominal Size: 12 ft. I.D. or 3.6 M.

3. Duty:

To gasify coal to a low Btu gas leaving an ash residue. The gasifier produces two product gas streams - a top gas at approximately 250°F, and a clear gas at approximately 1200°F.

- 3.1 The design basis coal feed to the conventional gasifiers has the following properties:

Analysis:

	<u>% W/W</u>
Moisture	25.60
C	50.74
H	3.53
N	0.87
Cl	0.01
S	0.87
O	10.11
Ash	<u>8.27</u>

100.00

F.S.I.
HHV

Non-agglomerating
8775 Btu/#

Design thruput of specified coal 5.52 tons/hr.

3. Duty (Continued):

3.2 The design basis coal feed to the stirred gasifier has the following properties:

Analysis:

	<u>% W/W</u>
Moisture	4.3
C	71.21
H	5.05
N	1.13
Cl	0.07
S	3.33
O	5.30
Ash	9.61
	<u>100.00</u>
F.S.I.	7
HHV	12,977 Btu/#

Design thruput of specified coal 4.57 tons/hr.

4. Construction:

BCI Drawing No. 3001-M300 Ref. A is an overall view of the gasifier, showing general arrangement and nozzles and this drawing should be used as a reference drawing in conjunction with this specification. The gasifier is composed of the following main components:

Blast Inlet Assembly	Ref. A
Grate Support Base	Ref. B
Grate Support Casing	Ref. C
Water Jacket	Ref. D
Gasifier Shell and Details	Ref. E
Gasifier Lower Cone and Distributor	Ref. F
Gasifier Upper Cone	Ref. G

5. Blast Inlet Assembly (Ref. A on Drawing 3001 -- M300):

5.1 Duty: Inlet box for air/steam blast, and to permit removal of any ash which falls thru the grate.

5.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Design</u>
Temperature °F	160°	650
Pressure p.s.i.g.	2.16	4.32

5. Blast Inlet Assembly (Continued):

5.3 Nozzles: The following nozzle sizes are minimums for process requirements. Larger nozzles may be installed if recommended by mechanical department.

1. Blast inlet	24" O.D.
2. Pyrometer	4" (check with instruments)
3. Drain	2"
4. Ash port	8" x 12"
5. Spare	3"
6. Not required	

Connection to gasifier grate to be 24" minimum.

5.4 Material: Carbon steel - to include a 1/4" corrosion allowance.

5.5 Insulation: The blast inlet box will be insulated with 3" calcium silicate.

6. Water Jacket (Ref. D on Drawing 3001 - M300):

6.1 Duty: To generate the steam required for gasification and provide cooling for the gasification reaction.

The water jacket operates in conjunction with the steam drum D201 A to E; they are connected by a thermosyphon. The water jacket, steam drum, and thermosyphon piping must be considered as a complete system for design and coding purposes.

Design production of steam = 3300 #/hr.

Dimensions: Inside height 76 7/8", inside width, 16 5/8".
Diameter of inside wall is 141 3/4" (3.6 M).

6.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Proc. Design</u>	<u>Mech. Design</u>
Steam drum temp. °F	207	300	350
Steam drum pressure, psig	25	30 + F.V.	30 + F.V.
Temp. in water jacket °F	268	300	350
Pressure in water jacket, incl. liquid head, psig	25	40 + F.V.	40 + F.V.
Pressure in gasifier, psig	2.16	4.32	4.32
Temp. of gasification zone	2200	2600	----
Max. furnace wall temp. °F	500	600	700

6. Water Jacket (Continued):

6.3 Nozzles: The following nozzles are the minimum for process requirements. Additional inspection ports or manholes may be added by mechanical department to meet code requirements.

(17)	Thermosyphon inlet	two x 6"
(18)	Thermosyphon outlet	two x 8"
(19)	Nozzle for blowdown	two x 4"
(20)	Blowdown dip pipe	two x 1 1/2"
(21)	Drain plug	two x 2"
(22)	Inspection	eight x 10"

6.4 Material: Carbon steel - to include 1/16" corrosion allowance for the waterside, 1/8" corrosion allowance for the reaction side.

6.5 Insulation: The outside wall of the shell will be insulated with 4" of calcium silicate.

7. Gasifier Shell (Ref. E & F on Drawing 3001 - M300):

7.1 Duty: Shell for refractory lined distillation retort.
Total ht. of sections E & F to be 26 ft.

7.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Mech. Design</u>
Temperature °F	200	300
Pressure p.s.i.g.	2.16	4.32

7.3 Nozzles: The following nozzles are the minimum for process requirements. Additional manholes may be added by mechanical department to facilitate maintenance.

(23)	Pyrometer port	two x 3"
(24)	Lower access	one x 1'-0" x 1'-2"
(25)	Lower rodding ports	fifteen x 3"
(26)	Inspection port	four x 1'-0" x 1'-0"
(27)	Access port	five x 1' x 2'6"
(28)	Clear gas	one x 4'6" O.D.

7. Gasifier Shell (Continued):

7.4 Carbon steel - to include 1/16" corrosion allowance.

7.5 Insulation: No insulation will be provided on the outside of this section of the vessel. A guard may be required around the outside of the vessel for personnel protection.

8. Gasifier Lower Cone & Distributor (Ref. F on Drawing 3001 - M300)

8.1 Duty: To connect the shell with the upper cone, and to provide an even distribution of the coal over the top of the retort.

8.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Mech. Design</u>
Temperature °F	200	300
Pressure p.s.i.g.	2.16	4.32

8.3 Nozzles: The following nozzles are the minimum for process requirements. Additional manholes may be added by mechanical department to facilitate maintenance.

(29)	Manhole	one x 30"
(30)	Top gas	two x 18" (two used)
(31)	Stirrer shaft port	one x 24"
(32)	Coal distributor	five x 24"
(33)	Upper rodding ports	five x 3"

The coal distributor nozzles No. 32 are lined with refractory concrete. The lining has an I.D. of 18" at the top and 20" at the bottom.

8.4 Construction: Carbon steel to include 1/16" corrosion allowance. Distributor to be lined with refractory concrete.

9. Coal Distributor & Level Hopper (Ref. G. on Drawing 3001 - M300):

8.1 Duty: To provide a space for the coal level to fluctuate, and to provide a constant supply of coal to the retort. Unit is sized so that level fluctuages +3", equivalent to a coal charge of 1000#.

9. Coal Distributor & Level Hopper (Continued):

9.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Design</u>
Temperature °F	250	400
Pressure p.s.i.g.	2.16	4.32

9.3 Nozzles:

(34) Manhole	one - 30"
(35) Coal inlet	one - 18"
(36) Rodding port	five - 3"
(37) Level alarm	one - 6"
(38) Stirrer port	one - 24"
(39) Level sensor	two - 3"

9.4 Construction:

Carbon steel - to include 1/8" corrosion allowance. Section of hopper below level 6'0" above center discharge of nozzle 32 is to be lined with refractory concrete.

10. Gasifier Grate Castings:

10.1 Duty: To remove ash from the gasifier, and to distribute air/steam blast thru the gasification zone.

10.2 Operating & Design Conditions:

	<u>Operating</u>	<u>Design</u>
Temperature °F	300	650
Pressure p.s.i.g.	2.16	4.32

Grate is to rotate at a maximum speed of one revolution every 2 hours. For details of grate drive unit and hydraulic cylinders, see Spec. W201.

11. Gasifier Refractory:

11.1 Unstirred Gasifiers:

Refractory material Spec.	SP-R201/SR3
Refractory installation Spec.	SP-R201/SR2

11. Gasifier Refractory (Continued):

11.2 Stirred Gasifiers

Refractory material Spec.
Refractory installation Spec.

SP-R201/SR5
SP-R201/SR4

NOZZLE SCHEDULE

REF.	SIZE	QTY.	SERVICE	FLANGES
20	1 1/2" SCH. 40	2	BLOW DOWN	150" SUPON
21	2"	2	DRAIN	2" SQUADRIE
22	10" R.F. FLANGE	8	INSPECTION PORTS	
(B)	GASIFIER	SHELL	ASSEMBLY	DWG. M-304
23	3" SCH. 40	2	PYROMETER PORT	0-6 1/2" SQ.
24	1-2 x 1-10	1	ACCESS PORT	1-6 1/2 x 2-2 1/2
25	3" SCH. 40	15	RODDING PORT	0-6 1/2" SQ.
26	1-0 SQ.	4	ACCESS PORT	1-4 SQ.
27	1-0 x 2-6	5	ACCESS PORT	1-4 x 2-10
28	4-6" Ø	1	CLEAR GAS	5-0 O.D.
(F)	GASIFIER	LOWER CONE AND DISTRIBUTOR	DWG. M-305	
29	30" STD.	1	MAN HOLE	3-0 O.D.
30	18" STD.	3	TOP GAS	125" FF. S.O.
31	24" X.S.	1	STIRRER PORT	2-4 O.D.
32	24" Ø	5	COAL DISTRIBUTION	
33	3" SCH. 40	5	RODDING PORT	0-6 1/2" SQ.
(C)	GASIFIER	UPPER CONE	DWG. M-306	
34	36" STD.	1	MAN HOLE	3-0 O.D.
35	18" SCH. 40	1	COAL INLET	150" R.F. S.O.
36	3" SCH. 40	5	RODDING PORT	0-6 1/2" SQ.
37	6" SCH. 40	1	COAL LEVEL ALARM	150" R.F. S.O.
38	24" X.S.	1	STIRRER SHAFT PORT	2-4 O.D.

REF	SIZE	QTY	SERVICE	FLANGES
39	3" SCH. 40	2	LEVEL SENSOR	150" R.F. S.O.
(H)	GASIFIER STEAM DRUM			DWG. M-310
(I)	GASIFIER STIRRER			DWG. M-315
(K)	GASIFIER RODDING PORT COVER			DWG. M-336

UNSTIRRED GASIFIER MAXIMUM OPERATING WT. = 264 TONS
STIRRED GASIFIER MAXIMUM OPERATING WT. =
FOR GASIFIER GENERAL ARRANGEMENT SEE DRAWINGS:
M-302 UNSTIRRED
M-303 STIRRED

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of Babcock International Inc.
DRAWING NO. M300 ISSUE NO. 0
DATE 11/1/78

<h1>U. S. DEPARTMENT OF ENERGY</h1> <p>FUEL GAS DEMONSTRATION PLANT PROGRAM</p>		
<p>SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578</p>		A
<p>PREPARED BY</p> <p>McKee</p> <p>ENGINEERS AND CONSTRUCTORS</p>	<p>4514-D-02-01-2</p>	
<p>CLEVELAND</p>	<p>OHIO</p>	
<p>FOR ERIE MINING COMPANY</p> <p>PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA</p>		<p>PROJECT NO. _____ P.E. NO. _____</p>
<p>COAL GASIFICATION GASIFIER - COMMON EXTERIOR VIEW</p>		<p>SCALE $\frac{1}{4}'' = 1'-0''$</p> <p>REVISION </p>

REVISION 0

FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES ————— MINNESOTA	PROJECT NO. _____	P. E. NO. _____
	SCALE $\frac{1"}{4} = 1'-0"$	
COAL GASIFICATION GASIFIER-STIRRED GENERAL ARRANGEMENT-ELEVATION	REVISION

PLAN AT ELEVATION 1610'-0"

PLAN AT ELEVATION 1619'-0"

FOR ARRANGEMENT & ELEVATION SEE DWG. M-345

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.

BABCOCK CONTRACTORS INC.

PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

PROJECT NO. 3001

DRAWING NO. M-346

ISSUE NO.

FOR

SIGNED

DATE

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKee

CLEVELAND OHIO

4814-D-02-04-2

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. HOYT LAKES

MANAGING AGENT MINNESOTA

COAL GASIFICATION

GASIFIER - STIRRED

GENERAL ARR'G'T - PLANS

PROJECT NO.

P.E. NO.

SCALE

1/4" = 1'-0"

REVISION

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

10/28/78 ISSUED FOR APPROVAL

COMMERCIAL PLANT DESIGN MANUAL
ERIE MINING COMPANY
COAL GASIFICATION PROJECT
D.O.E. CONTRACT ET-78-C-01-2578
McKEE CONTRACT 4814
JANUARY, 1979

6.06.9

TANK PROCESS SPECIFICATION

TK-201A

Oil/water Separator

Pgs. 1 & 2

TK-202

Tar Tank

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>	PROCESS SPECIFICATION FOR OIL/WATER SEPARATOR		PS-TK 201A&B REVISION <u>0</u> PAGE <u>1</u> OF <u>2</u>	
ORIGINAL <u>0</u>	BY <u>J. Garvin</u>	DATE <u>9/29/78</u>	APPD. _____	DATE _____
REVISION _____	BY _____	DATE _____	APPD. _____	DATE _____
CLIENT: <u>McKee</u>			PROJECT NO. <u>3001</u>	

Number of Units: Two 2)

Duty: Separation of Oil and Condensate (water).

Ambient Conditions: Outdoor installation in a heavy industrial environment. Ambient temperature range minus 42° to 102°F. Barometric pressure 13.85 psia.

Service Requirements: Continuous, un-attended operation.

Liquid Flow Rates:

Material	#/hr.	#/ft. ³
Condensate	10,048	62.00
Oil	<u>2,340</u> (3,000 max.)	60.76
Total flow to separate	12,388	---

Small amounts of fine solids are present.

Liquid Temperature: 95° F (110 max).

Separation Requirements:

The unit shall function as a primary separator to remove most of the free oil. Secondary treatment shall be by others.

The separated water stream shall contain 100 ppm oil or less.

Design:

The separator shall contain the following functional parts :

1. A gravity separation compartment.
2. An oil skimming device (wier, pipe, etc.).
3. An oil sump, or compartment to receive skimmed oil.
4. Two (2) oil pumps, P203 A to D (one operating, one standby). Each pump shall have a capacity of 150% design maximum oil flow at 40 ft. TDH. If the pumps are mounted on the separator, they shall be self priming.
5. A condensate sump or compartment to receive oil-free condensate.
6. Two (2) condensate pumps, P202 A to D (one operating, one standby). Each pump shall have a

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR OIL/WATER SEPARATOR		PS- TK 201 A REVISION <u>0</u> PAGE <u>2</u> OF <u>2</u>	
ORIGINAL <u>0</u>	BY <u>J. Garvin</u>	DATE <u>9/29/78</u>	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT <u>McKee</u>				PROJECT NO. <u>3001</u>	

Design:
(Con't.)

capacity of 150% of design condensate flow at 40 ft. TDH.

7. A solids removal device capable of continuous or intermittent operation. Solids may be removed by a sludge pump P 204 A & B.
8. Immersion heaters for freeze protection.
9. Controls - All controls needed for operation.
10. Steel is preferred as a material of construction. Copper, brass or aluminum shall not be used.

Electrical
Classification:

1. The area is classified Class I, Group D, Division 2.
2. Motors over 1/2 HP shall be 480V 3 phase, 60 cycle, TEFC.

Installation:

The unit will be installed outdoors, on-grade on a concrete pad. A skid mounted unit shall be furnished. Vendor shall provide access ladders and platforms to top of unit. (Installation by others.)

Data
Sheet:

Bidder shall complete attached data sheet.

GENERAL NOTES

- SPECIFICATIONS PER THE BILL OF MATERIAL.
- THIS DRAWING IS A SCHEMATIC OUTLINE ONLY FOR ELEVATION & ORIENTATION OF ATTACHMENTS, REFER TO
- FOR ESTIMATING PURPOSES, VESSEL FABRICATOR SHALL INCLUDE THE FOLLOWING CLIPS:

4. Flow Rate: 13151 lb./hr.

DESIGN DATA

DESIGN PRESSURE Atmos.	0	300	°C, °F
OPER. PRESSURE Atmos.	3	250	°C, °F
VACUUM DESIGN	0		°C, °F
OPER. VAC. COND.	0		°C, °F
OPER. HYDROSTATIC HEAD			
SP. GR. OPER. LIQUID	1.01		
CORROSION ALLOWANCE	1/8"		
RADIOGRAPHY	(FULL)	(PARTIAL)	(SPOT)
JOINT EFFICIENCY			
HEAD TYPE			
STRESS RELIEF (REQ'D) PER CODE			
CODE:	ASME SECTION VIII, DIV.		
X	API 650		
	API 620		
CODE STAMP	(REQ'D)	X	(NOT REQ'D)
EARTHQUAKE: CODE	ZONE		
WIND DESIGN BASIS:			
MATERIALS OF CONSTRUCTION			
SHELL: Carbon Steel HEAD: Carbon Steel			
SUPPORT: EXT. CL. 15'			
INTERIALS: Carbon Steel VESSEL FAB. X			
TRAYS: OTHERS			
BOLTS: EXT.	NUTS: EXT.		
INT.	INT.		
PIPE: EXT.	INT.		
FORGINGS:			
PACKING: OTHERS			
GASKETS:			
REFERENCES			
SUPPORT: SKIRT	TYPE 6	LEGS	LUGS
SADDLES PER STD.			
INSUL. SUPPTS PER STD.			
FOR 3" THX. INSULATION Calcium Silicate			
FIREPROOFING SUPPTS PER STD.			
REQ'D (L.S.) (O.S.) OF SKIRT			
MANWAY DAVITS/HINGES PER STD.			
VESSEL DAVIT PER			
STRUCTURAL CLIPS PER SPEC. EXH.			
SEE GEN. NOTE 3			
PAINT PER SPEC.			
LIFTING LUGS (REQ'D) X (NOT REQ'D)			
CONTRACT			
B.M. No. ITEM No.			
EQUIP. TAG No. TN202 No. REQ'D. 1			
SERVICE Tar Collection by Gravity			
Tar Tank			
DRAWN _____ Babcock			
CHECKED _____ Contractors Inc.			
DATE _____			
DWG. NO. 1K202			
REV. 0			

A	1	24"		Manhole							
B	1	2"		Tar Inlet							
C	1	2"		Tar Outlet (Pump Suction)							
D	1	4"		Vent							
E	1	2"		Drain							
F	1	2"		Level Gage							
G	1	3"		Heater							
H	1	3/4"		Temperature Controller							
J	1	3/4"		Temperature Indicator							
MARK	No. REQ'D.	SIZE	RATING	SERVICE	REMARKS	MARK	No. REQ'D.	SIZE	RATING	SERVICE	REMARKS

NOZZLE SCHEDULE

No. BY DATE

REVISIONS

0/1/1/1

6.06.10

MISCELLANEOUS EQUIPMENT PROCESS SPECIFICATIONS

X-201 A/F	Tar Precipitator	Pgs. 1 & 2
X-202 A/F	Oil Precipitator	Pgs. 1 & 2
X-203	Gasifier Hydraulic System	Pg. 1
X-204 A/B	Steam Drum and Process Gas Cooler Package	Pgs.1-3
X-205	Ash System	Pgs. 1-4
X-206 A/J	Flare Stacks	Pgs. 1 & 2
-	Eductor	Pg. 1

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR TAR PRECIPITATOR		PS-X201 A to F REVISION 0 PAGE 1 OF 2	
ORIGINAL 0	BY I.W.	DATE 9/29/78	APPD. M.J.H.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Design Basis: 20 billion Btu/day, 10% overcapacity. No standby.

No. Req'd: 6

Duty: Removal of tar droplets from coal gas (top gas).

Gas Analysis:	Vol. %	Range	Typical
	CO	24.5 - 26.0	25.93
	CO ₂	5.5 - 7.5	7.02
	H ₂	19 - 23	22.28
	N ₂	42 - 47	42.96
	CH ₄	0.8 - 2.0	0.87
	C ₂ +	0.2 - 1.0	0.24
	H ₂ S	0.1 - 1.0	0.18
	COS	0.05	0.05
	NH ₃	0.5	0.46
	HCN	0.01	0.01
			100.00
	Molecular Wt.		23.2

Tar Content: lbs./1000 SCF 1.5 - 10.0
of dry gas

Moisture Content: lbs./1000 SCF 3-15
of dry gas

Gas will also contain Phenols and Chlorides.

<u>Operating Conditions:</u>	<u>Normal</u>	<u>Maximum</u>
Temperature: °F	250	300
Pressure: inches WG.	29	32

Note: Atmospheric Pressure = 13.85 psia.

Tar Properties:

SG.: 1.01 - 1.08

Viscosity: Approx. 8.6° Engler at 122°F

Tar will be free flowing at operating conditions.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		PROCESS SPECIFICATION FOR TAR PRECIPITATOR		PS-X 201 A to F REVISION 0 PAGE 2 OF 2	
ORIGINAL 0	BY I.W.	DATE 9/29/78	APPD. M.J.H.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Capacity:

Coal Source:		<u>Western</u>	<u>Eastern</u>	<u>Design</u>
Dry Gas:	SCFH	3,466,000	1,720,000	
Moisture:	SCFH	898,000	178,000	
Total:	SCFH	4,364,000	1,898,000	4,800,000
Actual flow at operating conditions	CFH	5,892,000	2,562,000	6,480,000

Note: These are the total flowrates through all the precipitators operating in parallel flow.

Performance Required:

Tar removal efficiency: *not less than 99%.

Pressure drop: *not more than 1.0 inches WG.

Vendor is required to specify the performance that will be obtained in items of tar removal efficiency and pressure drop at the design flowrate when one unit is off line.

Power Source: 460 volts 60 Hertz 3 Phase

Area Hazard Classification: Class I, Div. II, Group D

Purge Gas: Vendor to design unit for minimum continuous purge gas at electrodes. Vendor to advise purge requirements.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR OIL PRECIPITATOR		PS-X 202 A, to F REVISION <u>0</u> PAGE <u>1</u> OF <u>2</u>	
ORIGINAL <u>0</u>	BY <u>I.W.</u>	DATE <u>9/29/78</u>	APPD. <u>M.J.H.</u>	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: <u>McKee</u>				PROJECT NO. <u>3001</u>	

Design Basis: 20 billion Btu/day, 10% overcapacity. No standby.

No. Req'd: 6

Duty: Removal of oil droplets and dust from coal gas (combined gas).

<u>Gas Analysis:</u>	<u>Vol. %</u>	<u>Range</u>	<u>Typical</u>
CO		25.0 - 26.5	25.36
CO ₂		5.5 - 7.5	6.08
H ₂		19.0 - 23.0	19.68
N ₂		42 - 49	47.26
CH ₄		0.5 - 1.0	0.70
C ₂ +		0.1 - 0.4	0.29
H ₂ S		0.1 - 1.0	0.64
COS		0.05	
NH ₃		0.5	
HCN		0.01	
			100.00
	Molecular Wt.		23.83

Oil and Dust Content: lbs./1000 SCF of dry gas expected to be less than 0.15

Moisture Content: lbs./1000 SCF of dry gas 2.3 - 2.81 (i.e. saturated at operating conditions)

Gas will also contain Phenols and Chlorides.

<u>Operating Conditions:</u>	<u>Normal</u>	<u>Maximum</u>
Temperature: °F	95	105
Pressure: inches WG.	22	25

Note: Atmospheric Pressure = 13.85 psia.

Oil Properties:

SG.: 0.93 - 0.98

Viscosity: Approx. 3.0° Engler at 68°F

Oil will be free flowing at operating conditions.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR HYDRAULIC SYSTEM		PS- X203 REVISION 0 PAGE 1 OF 1	
ORIGINAL	BY MJH	DATE 9/29/78	APPD.	DATE	
REVISION 0	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO: 3001	

No. Required: Two

Duty: Each system provides the power necessary to drive the grates of six gasifiers.

Description: Each system will include hydraulic storage tank (1), hydraulic pumps (2), and hydraulic cylinders for the gasifier. Each gasifier is fitted with two cylinders, which will operate at the same time. Twelve cylinders are required to six gasifiers.

Each cylinder, when connected to the hydraulic system, must be capable of developing in excess of 65,000 # force, and should have a stroke of 8".

Fluid: The system is to be designed on a water based hydraulic fluid. During abnormal conditions (a total plant shutdown) the temperature of the hydraulic fluid may drop to minus 40°F. Vendor is to confirm that the fluid will not freeze.

Reference Drawing: BCI Drawing No. 3001-M-326 - Hydraulic Circuit for six gasifiers.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR STEAM DRUM AND PROCESS GAS COOLER PACKAGE		PS- X²04A&B (System) REVISION 0 PAGE 1 OF 3	
ORIGINAL 0	BY I.W.	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Duty: Cooling of "clear gas" streams from five coal gasifiers by generation of 125 psig saturated steam.

Scope: The package will consist of:

1. 12 waste heat boilers - (Process Spec. E201 A to M).
2. 2 steam drum with appropriate fittings and instrumentation (Process Spec. D202A & B.)
3. Thermosyphon piping system from steam drum to each waste heat boiler.

Provision is to be made in the design of the steam drum, piping, etc. for the future installation of a sixth waste heat boiler.

Process Data:

1. Waste Heat Boilers: (E201 A to M).

The Design process duty of each waste heat boiler is specified on the attached process data sheet. This design duty is based on Eastern coal, & a gas inlet temperature of 1202°F. Note that the circulating water flowrate entering each boiler is specified on the basis of a 20/1 ratio of water flow/steam generated. The vendor is free to alter this ratio if he considers a different ratio to be more suitable.

Normal operating condition for Eastern coal will be gas in at 1140°F, heat exchanged 4.82 MM Btu/lb per exchange. Normal operating condition for Western coal will be gas in at 1060°F, heat exchanged 1.8. MM Btu/lb per exchange.

2. Steam Drum: (D202 A&B).

Boiler feed water make-up:

Temperature: 200°F

Pressure: 150 psig (vendor to advise if this is insufficient)

Quality: to be advised

Steam conditions in drum:

125 psig, 353°F

Note: atmospheric pressure - 13.85 psia

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		PROCESS SPECIFICATION FOR STEAM DRUM AND PROCESS GAS COOLER PACKAGE		PS-X204A&B (System) REVISION 0 PAGE 2 OF 3	
ORIGINAL 0	BY I.W.	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

Process Data (Continued):

2. Steam Drum (Continued):

Heat balance:

Steam (saturated) at 353°F	1193.7 Btu/lb.
BFW at 200°F	168.1 Btu/lb.
	<u>1025.6 Btu/lb.</u>

Waste heat boilers:

Gas cooling duty per boiler	5.22 x 10 ⁶ Btu/h
For 6 boilers	31.32 x 10 ⁶ Btu/h

Assume 2% heat loss.

Steam generation = $\frac{31.32 \times 10^6}{1025.6 \times 1.02} = 29,940 \text{ lb./h}$

Turndown to 20% required.

i.e. minimum steam generation 6,000 lb./h with
3 boilers operating.

3. Piping System:

The steam drum will be located at an elevation approx. 15 ft. above the top of the waste heat boilers which will be in an upright position, possibly at an angle to the verticle. (Vendor to advise.) A preliminary estimate of the total length of pipe run from the steam drum to the boilers and the number of fittings is as follows:

Steam drum D 202A to:

Boilers A, B, E, & F	Pipe length	75'-0"
	Fittings	6-90° Els.
Boilers C, D	Pipe length	45'-0"
	Fittings	4-90° Els.

Steam Drum D 202B to:

Boilers G, H, L, M	Pipe length	75'-0"
	Fittings	6-90° Els.
Boilers J, K	Pipe length	45'-0"
	Fittings	4-90° Els.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR STEAM DRUM AND PROCESS GAS COOLER PACKAGE		PS- X204A&B (System) REVISION 0 PAGE 3 OF 3	
ORIGINAL 0	BY I.W.	DATE 9/29/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

3. Piping System (Continued):

Each feed water supply and steam return line will also be fitted with 2 shutoff valves so that boilers may be individually isolated from the steam drum if required. Each waste heat boiler should be protected by a relief valve (or valves) in the steam return line. The final determination of elevations, length of pipe runs, numbers of fittings, etc. will be made during the detailed design stage after discussions between the vendor and the purchaser.

MECHANICAL REQUIREMENTS:

1. The waste heat boilers, steam drum and piping shall be designed to the appropriate ASME code and stamped with maker's name.
2. The steam drum shall be designed to produce steam of a quality suitable for general heating purposes.
3. The steam drum will include as a minimum the following fittings:
 - 1 boiler feed water nozzle 2"
 - 1 steam outlet nozzle 8"
 - 6 circulation outlet nozzles
 - 6 circulation return nozzles
 - Relief valves as required by the code
 - 1 vent
 - 1 intermittent blowdown nozzle
 - 1 spare nozzle 3"
 - Level guage
 - Level controller and feedwater control valve
 - High alarm, low alarm and low low alarm
 - Pressure guage

The vendor should specify any other fittings and internals required to ensure satisfactory operation and steam quality.

4. In the event of a complete failure of boiler feed water supply, the steam drum should provide the following holdup times when generating steam at 29,940 lb./h:
 - Normal level to low alarm: 1 minutes
 - Low alarm to low low alarm: 4 minutes
 - Low low alarm to empty: 10 minutes

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		PROCESS SPECIFICATION FOR ASH SYSTEM		PS- X205 REVISION 1 PAGE 1 OF 4	
ORIGINAL	BY M.J.H.	DATE 6/6/78	APPD.	DATE	
REVISION 1	BY M.J.H.	DATE 11/29/78	APPD.	DATE	
CLIENT: McKEE				PROJECT NO. 3001	

Basis: System - 10×10^9 Btu/day, Western Coal, 25% over capacity.

Duty: To collect ash from 12 gasifiers and transport ash to ash collection hopper BN 202.

Also, to collect dust from the dust cyclones, and transport to a collection point.

Capacity: Ash - design average: 5,300#/hr.

Dust - design average: 500#/hr.

Collection Points:

Each gasifier discharges ash at two points - total of 12 discharge points.

Design average rate at each discharge point: 500#/hr.

Dust is discharged at each dust cyclone (6 in total).

Design average rate at each discharge point: 50#/hr.

Ash Characteristics:

Temperature range: 100°F to 1000°F
 Size range: 50 micron to 6" dia.
 Normal size: 1/2" dia. to 1" dia.

Ash may be cooled by water sprays. Provision must be made to observe the size of the ash produced approximately once per hour.

Dust Characteristics:

Temperature range: 100°F to 1000°F
 Size range: 5 micron to 1/32"
 Carbon content: Approximately 50%

NOTE: Dust must not be cooled by air as it may self ignite.
 Ash must be cooled by water or inert gas.

System Equipment Items:

B 202 Ash cooling blower
B 203 A/B Aeration blower

BN 203 A/C Dust bin

CO 201 A Drag link conveyor
CO 202 A Drag link conveyor
CO 203 Drag link conveyor
CO 204 Bucket elevator

MF 203 A/K Ash lock

MF 207 A/E Rotary feeder

P 206 A/B Hydro-ejector pump

Cyclone Ash Disposal:

The cyclone ash will be taken from the five cyclones by means of 8" rotary feeder, (MF 207 A/E), an 8" slide pipe into three sand tanks (BN 203 A/C). The sand tank will be water impounded and will have an overflow louver to eliminate water as the ash displaces it. The ash will be removed from the sand tanks by three 3" x 4" x 45° tangential hydro-ejectors. Each hydro-ejector will require 550 GPM @ 175 psig provided by pump P 206 A/B rated at 700 GPM @ 125 psig.

The sand tanks will require emptying approximately once every six hours. The sequence will be started manually, and then an automatic sequencer will direct the water to each hydro-ejector in sequence. The emptying cycle will take approximately 10 minutes.

Bottom Ash System

The ash will be removed from the gasifier by a drag link conveyor system.

Each gasifier will discharge thru two locking arrangements (MF 203 A/K).

The ash locks will consist of three chambers connected by slide valves. The top chamber will collect the ash discharged from the gasifier, the middle chamber will act as a cooling chamber, where the ash will be cooled by air supplied by the aeration blowers B 203 A/B. Air discharges from the center hopper thru a filter. The third hopper provides a hold up before discharging to the conveyors. Two drag link conveyors, (CO 201 A & 202 A) collect ash from the bottom of the gasifiers. These conveyors are

Bottom Ash System (Continued)

insulated. A cross conveyor (CO 203) collects the ash from these two conveyors. The ash is further cooled in this conveyor by air from the ash cooling blower, B 202.

The ash is lifted from the cross conveyor to the ash silo by a bucket elevator, CO 204.

The ash silo, (BN 202), has a capacity of 8500 ft.³ (approximately 250 tons or 5 days storage of ash). Ash is discharged from the silo in an ash grinder (MF 204), a silo rotary feeder (MF 205), thru a continuous loader (MF 206) where the ash is conditioned with water to prevent dusting, prior to loading into trucks.

Also provided will be a cooling system for the cross conveyor which will consist of a fan with a motor which will vent to the silo. The purpose of this will be to try to cool the material before it reaches the silo. We propose to introduce ash into the angular space between the top and bottom flight of this conveyor. The velocity of the air will be low enough as not to entrain the ash in the air.

The central control panel for this system for both the bottom ash and the cyclone ash will be of sufficient size and have all controls and programmers mounted within it to facilitate the addition of the other seven gasifiers when and if they are added.

Silo

We propose to furnish an 8500 cubic foot storage silo for holding the bottom ash for the system. The silo is sized for all twelve gasifiers. The silo will be constructed of carbon steel plate with a cone bottom as shown on our drawing.

We will provide for the silo all structural steel supports for truck clearance as shown. Also provided will be the stairway from the grate to the unloader floor, and a ladder and cage to the roof of the silo. On the roof of the silo we will provide an invent filter sufficient for removing the displacement air from the silo of both the cooling system and the displacement ash. Under the silo we will provide a two foot standard clicker grinder which will grind the large pieces which we understand can be 6" in diameter during upset, to an acceptable size to feed into our C-30 unloader. The unloader will be complete with an 18" rotary feeder and a water spray nozzle inside the conditioner.

We will also provide a discharge chute as shown on our drawing for discharge into the customer's truck.

Silo (Continued)

The silo control panel will sequence all operations of the unloading cycle automatically. We have not furnished any water piping to the C-30 unloader, this requires approximately 50 GPM @ 100 psig. This water can be taken from the hydro-ejector pump which we are providing, although no provision has been made at this time for doing so.

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PROCESS SPECIFICATION
FOR
FLARE STACKS

PS-X 206 A to J

REVISION 0

PAGE 1 OF 2

ORIGINAL 0	BY Hemingway	DATE 9/29/78	APPD.	DATE
REVISION	BY	DATE	APPD.	DATE
CLIENT: McKee			PROJECT NO. 3001	

No. Required: Six

Design Basis: One stack per two gasifiers. Flare to be able to handle total gas production from one gasifier.

Duty: To burn off specification gas produced by a coal gasification unit during start up, shutdown and under emergency conditions.

Type: May be elevated flare stack, or enclosed cabin type ground flare.

<u>Gas Analysis:</u>	<u>Vol. %</u>	<u>Max. Range</u>	<u>Typical</u>	<u>Min.</u>
CO		24.5 - 26.0	25.93	0
CO2		5.5 - 7.5	7.02	21
H2		19 - 23	22.28	0
N2		42 - 47	42.96	79
CH4		0.8 - 2.0	0.87	0
C2+		0.2 - 1.0	0.24	0
H2S		0.1 - 1.0	0.18	0
COS		0.05	0.05	0
NH3		0.5	0.46	0
HCN		0.01	0.01	0

100.00

Molecular Wt.

23.2

Tar Content: lbs./1000 SCF of dry gas 0 - 5

Moisture Content: lbs./1000 SCF of dry gas 3 - 15

Dust Content (coal or ash): lbs./1000 SCF of dry gas 0 - 0.05

Gas will also contain Phenols and Chlorides.

Gas Heating Value:

The maximum heating value on a dry, tar free basis is 170 Btu/dry SCF.

The effective maximum heating value, including tar is 250 Btu/dry SCF.

During start up and shutdown, the HHV of the gas to the flare will vary between 0 Btu/dry SCF and the maximum value.

Gas Flow Rate:

The gas flow rate, at any composition between the maximum, and a minimum value equivalent to 50 Btu/SCF can vary between:

	<u>Maximum</u>	<u>Minimum</u>
SCFH dry gas	451,800	112,950
SCFH	86,620	21,655

Supplementary Firing:

Vendor shall include provision for supplementary firing of the flare with natural gas if the gas HHV falls below 50 Btu/SCF. This supplementary firing will be manually initiated.

During supplementary firing, the maximum gas flow rate to the flare will be:

SCFH dry gas	225,900
SCFH water vapor	43,310

Temperature:

For any flow rate or composition given above, the temperature of the gas can vary between 1200°F and 230°F.

Pressure:

Maximum	60" w.g.
Normal	30" w.g.
Minimum	12" w.g.

Vendor is to design flare to operate at maximum flow rate, with 20" w.g. pressure drop.

Ignition & Pilot:

Natural gas or propane will be available for use. Vendor is to recommend if natural gas is required to ensure satisfactory combustion of low heating fuels.

Purging:

Nitrogen or carbon dioxide will be available for purging the line to the burner. Vendor is to include a seal, such as a fluidic seal to minimize the amount of purge gas required. Vendor is to advise BCI of the purge gas required.

Overall Height: The overall height from the base of the flare to the discharge of the stack is to be 70 ft.

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ORIGINAL 0	BY MJH	DATE 9/29/78	APPD.	DATE	
REVISION	BY MJH	DATE	APPD.	DATE	
CLIENT: McKee				PROJECT NO. 3001	

No. Required: Twelve

Function: To mix steam and air during normal operation. To function as a steam jet blower during emergency conditions.

<u>Duty:</u>	<u>Normal</u>	<u>Emergency</u>
Air inlet pressure p.s.i.a.	16.06	13.9
Air inlet temperature	120°F	100
Air differential pressure "w.g.	To be supplied by vendor	3"
Air flow SCFM	4740	1185
Air flow CFM	4848	1212
Steam pressure p.s.i.g.	20	15
Steam flow #/hr.	3461	900

Note: No pressure boost is required during normal operation. The unit may operate at a pressure loss during normal operation. Vendor is to advise pressure boost or loss with quotation.

6.0 GASIFICATION - AREA 02 (continued)

6.07 MAJOR INLINE INSTRUMENT DATA SHEETS

Instrument Index Pages 2A, 3A, 5A, 6A, 7A, 10A, 11A, 20A, 21A

<u>Loop Number</u>	<u>Description</u>	<u>Primary Spec</u>
21101	Coal Surge Hopper - Level Control	8542
21102	Gasifier Coal Charge Control	8527
21103	Gasifier Coal Charge Control	8820
21104	Low Pressure Boiler Level Control	8522
21109	Combustion Steam Flow Ratio Control	8424
21110	Blast Temperature and Pressure Recorder	8216
21111	Combustion Air Flow Ratio Control	8424
21114	Top Gas Temperature Control	8216
21124	Gasifier Bed Temperature Recorder and Grate Speed Control	8216
21125	Dust Cyclone Emergency Relief	8141
21126	Tar Cyclone Blowdown Control	8141
21127	Gasifier Emergency Relief	8141
21130	Emergency Draft Control	8141
21800	Combustion Air From Blowers - Pressure Control	8311
21804	High Pressure Steam Drum - Level Control	8522

INSTRUMENT INDEX

PAGE 2 A OF

DATE _____

PROJECT NO. 3001 Ø II

[illegible]

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INSTRUMENT INDEX

SP. 8001

REVISION

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ORIGINAL	BY R. MOYTA	DATE 8/31/78	APPD.	DATE
REVISION	BY	DATE	APPD.	DATE

CLIENT: ERIE MINING COMPANY PROJECT NO. 3001 Ø II

TAG NUMBER	DESCRIPTION	MANUFACTURER AND MODEL NUMBER	SPECIFICATION NUMBER
	Loop No. 21112		
	Clean Gas-Temperature & Pressure Indication		
PI-21112	Pressure Gauge		8202
TI-21112	Indicating Pyrometer		8206
	Loop No. 21113		
	Top Gas-Temperature & Pressure Indication		
TI-21113A	Dial Thermometer (Bi-Metal)		8201
TI-21113B	Dial Thermometer (Bi-Metal)		8201
PI-21113	Pressure Gauge w/Seal		8301
	Loop No. 21114		
	Top Gas-Temperature Control		
TE-21114	Thermocouple Assembly		8216
TT-21114	Temperature Transmitter		8236
TS-21114	Current Switch		8030
TAH-21114	Ann. Alarm Point		8150
TR-21114	Recorder		8111
TIC-21114	Controller		8142
I/P-21114	I/P Signal Converter		8041
TV-21114	Control Valve (Butterfly)		8610
TI-21114	Dial Thermometer (Bi-Metal)		8201

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		<h1>INSTRUMENT INDEX</h1>		SP- 8001 REVISION PAGE 10 A OF	
ORIGINAL	BY R. MOYTA	DATE 8/31/78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING COMPANY				PROJECT NO. 3001 Ø II	
TAG NUMBER	DESCRIPTION	MANUFACTURER AND MODEL NUMBER	SPECIFICATION NUMBER		
	LOOP NO. 21124				
	Gasifier Bed Temperature Record & Grate Speed Control				
TE-21124	Thermocouple Assembly		8210		
TT-21124	Temperature Transmitter		8236		
EQ-21124	Timer		8161		
TR-21124	Recorder		8111		
HS-21124	Selector Switch		8180		
SC-21124	Pulser		8021		
SY-21124	Solenoid Valve				
	Loop No. 21125				
	Dust Cyclone Emergency Relief				
HC-21125	Manual Loader		8141		
I/P-21125	I/P signal Converter		8041		
FV-21125	Control Valve (Butterfly)		8610		
	w/FY-21125 Solenoid Valve				
	Loop No. 21126				
	Tar Cyclone Blowdown Control				
HC-21126	Manual Loader		8141		
I/P-21126	I/P Signal Converter		8041		
FV-21126	Control Valve (Butterfly)		8610		
	w/FY-21126 Solenoid Valve				

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INSTRUMENT INDEX

SP. 8001

REVISION

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ORIGINAL	BY R. MOYTA	DATE 8/31/78	APPD.	DATE
REVISION	BY	DATE	APPD	DATE
CLIENT: ERIE MINING COMPANY				PROJECT NO. 3001 Ø II

TAG NUMBER	DESCRIPTION	MANUFACTURER AND MODEL NUMBER	SPECIFICATION NUMBER
	Loop No. 21127		
	Gasifier Emergency Relief		
HC-21127	Manual Loader		
I/P-21127	I/P Signal Converter		
PV-21127	Control Valve (Butterfly)		
	Loop No. 21128		
	Dust Cyclone Level Alarm		
LE-21128	w/LS-21128		
LS-21128	Level Switch (Capacitance Type)		8542
LAH-21128	Ann. Alarm Point		8150
	Loop No. 21129		
	Tar Cyclone Level Alarm		
LE-21129	W/LS-21129		
LS-21129	Level Switch (Capacitance Type)		8542
LAH-21129	Ann. Alarm Point		8150
	Loop No. 21130		
	Emergency Draft Control		
HC-21130	Manual Loader		8141
I/P-21130	I/P Signal Converter		8041
PV-21130	Control Valve (Butterfly)		8610
	w/FY-21130 Solenoid Valve		

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. <i>A Subsidiary of</i> <i>Babcock International Inc.</i>		<h1>INSTRUMENT INDEX</h1>		SP: 8001 REVISION PAGE 21 A OF	
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ORIGINAL	BY R. MOYTA	DATE 8/31/78	APPD	DATE
REVISION	BY	DATE	APPD	DATE

CLIENT: ERIE MINING COMPANY	PROJECT NO. 3001 Ø II
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TAG NUMBER	DESCRIPTION	MANUFACTURER AND MODEL NUMBER	SPECIFICATION NUMBER
	Loop No. 21804		
	High Pressure Steam Drum-Level Control		
LT-21804	Level Transmitter (Displacement Type)		8522
LSH-21804	Current Switch		8030
LSL-21804	Current Switch		8030
LAH-21804	Annunciator Alarm Point		8150
LAL-21804	Annunciator Alarm Point		8150
LIC-21804	Controller		8142
I/P-21804	I/P Signal Converter		8041
LV-21804	control Valve (Globe)		8612
	Loop No. 12805		
	High Pressure Steam Drum Level & Temperature Indication		
LG-21805	Gauge Glass		8400
TI-21805	Dial Thermometer (Bi-Metal)		8201
	Loop No. 21806		
	High Pressure Steam Drum Pressure Record and Alarm		
PT-21806	Pressure Transmitter		8311
PI-21806	Pressure Gauge w/Syphon		8301
PSH-21806	Current Switch		8030
PSL-21806	Current Switch		8030
PAH-21806	Annunciator Alarm Point		8150
PAL-21806	Annunciator alarm Point		8150
PR-21806	Recorder		8111

LOOP NUMBERING SYSTEM

BABCOCK CONTRACTORS INC.

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DR MOYTA	DATE 8-28-78	SECT. MGR. APPD.	DATE	SCALE:	PROJECT NO. Ø II 3001	SKETCH NO. 0	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE	NONE

BABCOCK CONTRACTORS INC.
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DR. MOYTA	DATE 8-15-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 1	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE

BABCOCK CONTRACTORS INC.
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DR. MOYTA	DATE 8-15-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 2	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE

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LOOP 21103
THRU 22603

DR. MOYTA	DATE 8-15-78	SECT. MGR. APPD.	DATE	SCALE:	PROJECT NO. Φ II 3001	SKETCH NO. 3	REV
CH.	DATE	PROJ. MGR. APPD.	DATE	NONE			

CP-1 FRONT

ES 24VDC

CP-1 REAR

FIELD

LOW PRESSURE BOILER LEVEL CONTROL

LOOP 21104
THRU 22604BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

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DR. MOYTA	DATE 8-16-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 4	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE				

CP-1 FRONT

FIELD

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

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(ENG-106-0278)

DR. MOYTA	DATE 8-16-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 9	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE

BLAST TEMP & PRESS. RECORD

LOOP 21110
THRU 22610

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

DR. MOYTA	DATE 8-16-78	SECT. MGR. APPD.	DATE	SCALE:	PROJECT NO. Φ II 3001	SKETCH NO.	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE	NONE		10	

ENG-106-0278)

UP-1 FRONT

FIELD

COMBUSTION AIR FLOW RATIO CONTROL

LOOP 21111
THRU 22611

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

DR. MOYTA	DATE 8-17-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 11	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE				

(ENG-108-0278)

CP-1 FRONT

CP-1 REAR

FIELD

TOP GAS TEMP. CONTROL

LOOP 21114
THRU 22614

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

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ENG-106-0278

DR. MOYTA	DATE 8-17-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO. 14	REV
CH.	DATE	PROJ. MGR. APPD.	DATE

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

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(ENG-106-0778)

DR	MOYTA	DATE	5-18-78	SECT MGR	APPD	DATE	SCALE:	PROJECT NO.	SKETCH NO.	REV.
CH		DATE		PROJ. MGR.	APPD	DATE	NONE	Φ II 3001

DUST CYCLONE EMERGENCY RELIEF

LOOP 21125
THRU 22625

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
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(ENG-106-0278)

DR. MOYTA	DATE 8-18-78	SECT. MGR. APPD.	DATE	SCALE:	PROJECT NO. Φ II 3001	SKETCH NO.	REV
CH.	DATE	PROJ. MGR. APPD.	DATE	NONE			

CP-1 FRONT

ES24 VDC

CP-1 REAR

FIELD

TAR CYCLONE BLOWDOWN CONTROL

LOOP 21126
THRU 22626

BABCOCK CONTRACTORS INC.

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DR. MOYTA	DATE 3-18-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO.	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE				

CP-1 FRONT

FIELD

GASIFIER EMERGENCY RELIEF

LOOP 21127
THRU 22627

BABCOCK CONTRACTORS INC.

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ENG-106-0278

DR	MOYTA	DATE	8-21-78	SECT. MGR.	APPD.	DATE	SCALE:	PROJECT NO.	SKETCH NO.	REV.
CH.		DATE		PROJ. MGR.	APPD.	DATE	NONE	3001

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

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(ENG-106-0278)

DR. MOYTA	DATE 8-23-76	REVIEW MGR. APPD.	DATE	SCALE	PROJECT NO. Φ II 3001	SKETCH NO.	REV
CH	DATE	PROJ. MGR. APPD.	DATE	NONE			

CP-1 FRONT

CP-1 REAR

FIELD

COMBUSTION AIR FROM BLOWERS PRESS CONTROL LOOP 22800
LOOP 21800

BABCOCK CONTRACTORS INC.

PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

DR. MOYTA	DATE 8-25-78	SECT. MGR. APPD.	DATE	SCALE: NONE	PROJECT NO. Φ II 3001	SKETCH NO.	REV.
CH.	DATE	PROJ. MGR. APPD.	DATE

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.

A Subsidiary of Babcock International Inc.

DR	MOYTA	DATE	8-25-78	SECT. MGR.	APPD.	DATE	SCALE:	PROJECT NO.	SKETCH NO.	REV.
CH.		DATE		PROJ. MGR.	APPD.	DATE	NONE	φ II 3001		

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		MINIATURE MANUAL LOADING STATION SPECIFICATION		SP- 8141 REVISION PAGE 1 OF 1	
ORIGINAL	BY R.M. OYTA	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.				PROJECT NO. 3001ΦII	

DESIGN CRITERIA FOR MINIATURE MANUAL LOADING STATION

Case shall be manufacturer's standard dust and moisture resistant, suitable for flush panel mounting. Mounting brackets shall be provided.

Indicator shall preferably be vertical scale with minimum visible scale length of 3".

Chassis shall plug in and pull out from front of case. Field connections shall be integral with case.

Loading stations shall at all times indicate the output or final control element position.

The set-point adjustment for all control stations shall be manual, unless otherwise specified and readily accessible from the front of the case.

Accuracy shall be within 0.5% range span.

Unit shall be furnished with a durable tag or label marked with the tag number as listed on the data sheet.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		MANUAL LOADER DATA SHEET		SP- 8141 REVISION PAGE 1 OF 2	
ORIGINAL	BY LMW	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
ERIE MINING CO.			PROJECT NO. 3001ΦII		

TAG NO.	SEE NOTE #1	SEE NOTE #2	SEE NOTE #3
REVISION			
QUANTITY	12	12	12
MANUFACTURER	FOXBORO	→	→
MODEL NO.	MODEL 67HTG OR EQUAL	→	→
SERVICE	DUST CYCLONE EMER. RELIEF	TAR CYCLONE BLOW DOWN CONTROL	EMERGENCY DRAFT VENT
NOMINAL SIZE	3"X6"	→	→
INPUT - SOURCE	MANUAL KNOB	→	→
↓ - RANGE	0-100	→	→
↓ - GAUGE	-	-	-
OUTPUT - RANGE	4-20 MA	→	→
↓ - GAUGE	0-100	→	→
SET POINT	MANUAL	→	→
SWITCH - TYPE	-	-	-
↓ - NAMEPLATE	-	-	-
SUPPLY	+24V D.C.	→	→
MOUNTING	FLUSH PANEL	→	→
N.E.C. AREA CLASS	GEN PURP.	→	→
ENCLOSURE	↓ ↓	→	→

NOTE #1) FOR TAG NO. HC-21125, HC-21225, HC-21325, HC-21425, HC-21525, HC-21625,
 HC-22125, HC-22225, HC-22325, HC-22425, HC-22525, HC-22625

#2) HC-21126, HC-21226, HC-21326, HC-21426, HC-21526, HC-21626,
 HC-22126, HC-22226, HC-22326, HC-22426, HC-22526, HC-22626

#3) HC-21130, HC-21230, HC-21326, HC-21426, HC-21526, HC-21626,
 HC-22130, HC-22230, HC-22326, HC-22426, HC-22526, HC-22626

LOCATION	CP-1	CP-1	CP-1
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BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		INSTRUMENT DATA SHEET MANUAL LOADER		SP. <u>814-1</u> REVISION _____ PAGE <u>2</u> OF <u>2</u>	
ORIGINAL	BY <u>R. MOYTA</u>	DATE <u>8-10-78</u>	APPD. _____	DATE _____	
REVISION	BY _____	DATE _____	APPD. _____	DATE _____	
CLIENT: <u>ERIE MINING CO.</u>				PROJECT NO <u>3001-0 II</u>	

TAG NO.	#1 BELOW		
REVISION			
QUANTITY	12		
MANUFACTURER	FOXBORO OREGON		
MODEL NO.	67HTG OR EQUAL		
SERVICE	AIR INTAKE TO EDUCTOR		
NOMINAL SIZE	3" X 6"		
INPUT - SOURCE	MANUAL KNOB		
↓ - RANGE	0-100		
↓ - GAUGE	—		
OUTPUT - RANGE	4-20MA		
↓ - GAUGE	0-100		
SET POINT	MANUAL		
SWITCH - TYPE	—		
↓ - NAMEPLATE	—		
SUPPLY	+ 24VDC		
MOUNTING	FLUSH PANEL		
N.E.C. AREA CLASS	GEN PURPOSE		
ENCLOSURE	Y V		

#1) HC-21127, HC-21227, HC-21327, HC-21427, HC-21527,
 HC-21627, HC-22127, HC-22227, HC-22327, HC-22427, HC-22527,
 HC-22627

LOCATION

CP-1

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		THERMOCOUPLE ASSEMBLIES SPECIFICATION		SP. 8216 REVISION PAGE 1 OF 1	
ORIGINAL	BY R. MOYTA	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.				PROJECT NO 3001ΦII	

DESIGN CRITERIA FOR THERMOCOUPLE ASSEMBLIES

Thermocouple assemblies shall be complete including terminal block, thermocouple element with insulation, extension, head and protecting well or tube, as required.

Recommended practice as described in ISA-RPI, as approved September, 1958, shall be met for calibration accuracy and color coding.

Heads shall be universal type, cast iron, complete with threaded chained, gasketed cover, integral single pair screw type terminal block with polarity indicated, a 1/2" NPT well, and 3/4" NPT conduit connection unless otherwise specified.

Extensions, when required, shall be of 1/2" steel pipe with length as specified on data sheets.

When required, protective wells shall be solid bored type with process connection and length as specified on data sheets.

Protective tubes shall be straight type, single or double construction, complete with pressure-tight mounting bushing or pressure-tight mounting flange, as specified.

Thermocouple wire shall be ISA standard types. Wire gage shall be as recommended in ISA recommended practice RP1.3.

The unit shall be identified by a metal tag attached with corrosion resistance wire, and stamped with the tag number from the data sheet.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		INSTRUMENT DATA SHEET THERMOCOUPLE ASSEMBLIES		SP. <u>8216</u> REVISION _____ PAGE <u>1</u> OF <u>2</u>	
ORIGINAL	BY LMW	DATE 8-7-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: <u>ERIE MINING CO.</u>				PROJECT NO. <u>30014 II</u>	

TAG NO.	SEE NOTE #2	SEE NOTE #3	SEE NOTE #4
REVISION			
QUANTITY	12	12	
MANUFACTURER			
MODEL NO.			
SERVICE	BLAST TEMP.	DUST CYCLONE OUTLET TEMP.	GASIFIER GRATE TEMP.
PROCESS FLUID	AIR	COAL GASIFIER TOP GAS	STEAM & AIR
THERMOCOUPLE TYPE	"J"	—————>	DUAL "J"
WIRE GAGE	14 AWG	—————>	—————>
ELEMENT LENGTH	SEE NOTE #1	—————>	13'-9"
ELEMENT DIAMETER	*	*	*
SHEATH	3/16 ST. ST.	—————>	SEE NOTE #5
GROUNDING	REQ'D	—————>	WELD TO TOP PIPE CAP
HEAD - TYPE	WEATHER PROOF	—————>	—————>
HEAD - PROCESS CONNECTION	1/2" NPT	—————>	—————>
HEAD - EXTENSION	3"	—————>	4" WITH UNION
WELL - MATERIAL	3/16 ST. ST.	—————>	3/4" SCH 40 PIPE
WELL - BORE	*	*	—
WELL - "U" DIMENSION	9"	—————>	SEE NOTE 5
WELL - PROCESS CONNECTION	3/4"	—————>	1 1/2" 150# RF
WELL - WALL THICKNESS-MIN.	*	*	—
WELL - LAG LENGTH	3"	—————>	—
ELEMENT INSULATION	—	—	CERAMIC

NOTE #1) SPRING LOADED TO CONTACT WELL BOTTOM.

- # 2) TE-21110, TE-21210, TE-21310, TE-21410, TE-21510, TE-21610, TE-22110, TE-22210, TE-22310, TE-22410, TE-22510, TE-22610
- # 3) TE-21114, TE-21214, TE-21314, TE-21414, TE-21514, TE-21614, TE-22114, TE-22214, TE-22314, TE-22414, TE-22514, TE-22614
- # 4) TE-21124, TE-21224, TE-21324, TE-21424, TE-21524, TE-21624, TE-22124, TE-22224, TE-22324, TE-22424, TE-22524, TE-22624
- # 5) WELL IS 3/4" SCH 40 PIPE IN THREE SECTIONS "U" = 13'-2" TOP SEC = 3'-6" OTHER TWO SEC = 4'-10" EACH. FOR FIELD ASSEMBLY WITH PIPE COUPLINGS.

* INFO BY VENDOR

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		INSTRUMENT DATA SHEET THERMOCOUPLE ASSEMBLIES		SP- <u>8216</u> REVISION _____ PAGE <u>2</u> OF <u>2</u>	
ORIGINAL	BY LMW	DATE 8-7-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.			HOYT LAKES, MN.		PROJECT NO. 30017II

TAG NO.	SEE NOTE #2	TE-21740/ TE-21740	TE-21741/ TE-22741
REVISION			
QUANTITY	5	7	
MANUFACTURER			
MODEL NO.			
SERVICE	GAS COOLER OUTPUT	MIXED GAS TO COOLERS	MIXED GAS OUT OF COOLERS
PROCESS FLUID	COAL GAS	→	→
THERMOCOUPLE TYPE	"J"	→	→
WIRE GAGE	14 AWG	→	→
ELEMENT LENGTH	SEE NOTE #1	→	→
ELEMENT DIAMETER	* 316 ST. ST.	* →	* →
SHEATH	REQ'D	→	→
GROUNDING	WEATHERPROOF	→	→
HEAD - TYPE	1/2" NPT	→	→
HEAD - PROCESS CONNECTION	3"	→	→
HEAD - EXTENSION	316 ST. ST.	→	→
WELL - MATERIAL	*	*	*
WELL - BORE	9"	→	→
WELL - "U" DIMENSION	3/4"	→	→
WELL - PROCESS CONNECTION	*	*	*
WELL - WALL THICKNESS-MIN.	3"	→	→
WELL LAG LENGTH			

NOTE #1) SPRING LOADED TO CONTACT WELL BOTTOM.

#2) TAG NO. TE-21711, TE-21721, TE-21731, TE-22711, TE-22721

* INFO BY VENDOR

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of
Babcock International Inc.

PRESSURE TRANSMITTER
SPECIFICATION

SP 8311
REVISION
PAGE 1 OF 2

ORIGINAL	BY R. MOYTA	DATE 3-1-78	APPD.	DATE
REVISION	BY	DATE	APPD.	DATE
CLIENT: ERIE MINING CO. HOYT LAKES, MIN.			PROJECT NO. 3001ΦII	

1.0 SCOPE

This specification shall define the physical and performance characteristics of field mounted, electric or pneumatic, force balance type pressure transmitters as further defined in the attached data sheets. The required documentation for this equipment is also defined.

2.0 EQUIPMENT DESCRIPTION

- 2.1 Transmitter shall be enclosed in gasketed dust-tight and moisture-proof case, unless otherwise specified on the data sheet.
- 2.2 Pressure transmitter shall be complete with integral direct reading indicator or an output meter, when specified.
- 2.3 Accuracy and repeatability shall be within 0.5% of span.
- 2.4 Overrange protection shall be provided so that neither accuracy nor zero calibration will be affected by a pressure of 150% of scale span.
- 2.5 Chemical seals shall be provided only when specified on the data sheets.
- 2.6 Transmitter shall be equipped with a universal bracket for 2" pipe mounting.
- 2.7 When specified, vendor shall furnish a filter-regulator complete with gage. The air set shall be pre-piped to the unit and set at pressure as indicated on data sheet.
- 2.8 Each transmitter shall be supplied with a permanently attached corrosion resistant tag showing the manufacturer's name, model and serial number, and the instrument tag number. The instrument tag number shall be as shown on the data sheet.

3.0 DOCUMENTATION

- 3.1 The following certified documents shall be submitted to the buyer in quantities and terms as specified in the purchase order.

1. Drawing and Manual Index
2. General Arrangement Drawings
3. Electrical & Piping Drawings
(Schematic and interconnection)
4. Operation & Installation Manuals
5. Maintenance Manual & Parts List
6. Recommended Spare Parts for _____ Years Operation

3.2 Each document shall be marked with the following indentifying date:

1. BCI Job Number
2. Customer Job Number
3. BCI Instrument Specification Number
4. Instrument Tag No. (from data sheet)
5. Exact Instrument Identification as furnished
(i.e. detailed model number or list of furnished options)

BABCOCK CONTRACTORS INC.

PITTSBURGH, PA.

A Subsidiary of
Babcock International Inc.PRESSURE TRANSMITTER
DATA SHEET

SP. 8311

REVISION

PAGE 1 OF 2

ORIGINAL

BY R. MOYTA

DATE 8-2-78

APPD.

DATE

REVISION

BY

DATE

APPD.

DATE

CLIENT: ERIE MINING CO.

PROJECT NO 3001 #II

TAG NO.

#1 BELOW

#2 BELOW

PT-21710/
PT-22710

REVISION

QUANTITY

12

12

MANUFACTURER

MODEL NO.

SERVICE

D201 ATRU E
STEAM DRUMBLAST FROM
EDUCTORCOMBINED GAS
TO BAT. LIMITS

PROCESS FLUID

STEAM

STEAM & AIR

COOL GAS

FLUID - PRESSURE - MAX.

- - - OPER.

- - - TEMPERATURE

25 PSI
267°F60" H₂O
147°F20" H₂O
95°F

ELEMENT - TYPE

*

*

- MATERIAL

*

*

- RANGE LIMITS

15-60 PSI

25"-100"

7.5-30"

- CALIBRATION

BODY - MATERIAL

C. STEEL

- RATING

150#

- CONNECTION

1/2" NPT

OUTPUT SIGNAL

4-20 MA

SUPPLY

24 VDC

AREA CLASS

CLASS I DIV II

MOUNTING

2" PIPE BRKT

(1) PT-21106, PT-21206, PT-21306, PT-21406, PT-21506, PT-21606,
PT-21706, PT-21806, PT-21906, PT-22106, PT-22206, PT-22306, PT-22406, PT-22506, PT-22606,
PT-21110, PT-21210, PT-21310, PT-21410, PT-21510, PT-21610,
PT-21710, PT-21810, PT-21910, PT-22110, PT-22210, PT-22310, PT-22410, PT-22510, PT-22610

* BY VENDOR

LOCATION

FIELD

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		ANNUBAR SPECIFICATION		SP- 8424 REVISION _____ PAGE 1 OF 1	
ORIGINAL	BY R. MOYTA	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.				PROJECT NO. 3001ΦII	

4.0 DESIGN CRITERIA FOR ANNUBARS

This primary flow rate sensing element shall be a combined reverse pitot tube design based on the Manufacturer's standard design.

The output of this flow element shall be a differential pressure proportional to average flow velocity squared.

When installed with the straight run requirement specified on the data sheets, accuracy shall be $\pm 1.5\%$ or better.

A calculation report confirming maximum flow rate differential pressure shall be furnished, based on data sheet specified conditions.

The unit shall be supplied with a permanently attached corrosion resistant tag showing the manufacturer's name, model and serial number, and the instrument tag number. The instrument tag number shall be as shown on the data sheet.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		ANNUBAR DATA SHEET		SP. 8424 REVISION _____ PAGE 1 OF 1	
ORIGINAL	BY LMW	DATE 8-9-78	APPD. _____	DATE _____	
REVISION	BY _____	DATE _____	APPD. _____	DATE _____	
CLIENT: ERIE MINING CO. HOYT LAKES, MN.				PROJECT NO 3001 JIL	

TAG NO.	SEE NOTE #1	SEE NOTE #2	SEE NOTE #3
REVISION			
QUANTITY	12	12	1
MANUFACTURER			
MODEL NO.	ACCUTUBE MODEL 6600	—————>	—————>
SERVICE	STEAM FLOW FROM L.P. BOILER	STEAM FLOW TO EDUCTOR	COMBUSTION AIR TO EDUCTOR
PROCESS FLUID	SAT. STEAM	—————>	AIR
FLUID TEMP	267°F	—————>	80°F
PRESS	25 PSIG	—————>	80" W.C.
SP. GRAVITY @ OPER. COND.	1.29	—————>	
VISCOSITY	—	—	—
SUPERHEAT	—	—	
BASE TEMP./PRESS.	—	—	
FLOW RATE - OPER.	13,200 LB/HR	14,335 LB/HR	3791 SCFM
↓ ↓ - SIZING	Later		5000 SCFM
METER DIFFERENTIAL (DRY)	*	*	*
LINE SIZE / SCHEDULE	6" SCH. 40	6" SCH. 40	14" STD. WT.
LINE I.D.	6.07"	6.07"	
METER MAT'L.	316 ST. ST.	—————>	316 ST. ST.
COUPLING SIZE/MAT'L.	*	*	*
PRESS. CONNECTIONS	1/2" NPT	—————>	—————>
HOT TAP FITTINGS	REQ'D	—————>	NOT REQ'D
STRAIGHT RUN APPROACH	9 PIPE DIAM	—————>	—————>
STRAIGHT RUN DEPART	3 ↓ ↓	—————>	—————>

NOTE #1) TAG No. FE-21108, FE-21208, FE-21308, FE-21408, FE-21508, FE-21608, FE-22108, FE-22208, FE-22308, FE-22408, FE-22508, FE-22608

#2) TAG No. FE-21109, FE-21209, FE-21309, FE-21409, FE-21509, FE-21609, FE-22109, FE-22209, FE-22309, FE-22409, FE-22509, FE-22609

#3) TAG No. FE-21111, FE-21211, FE-21311, FE-21411, FE-21511, FE-21611, FE-22111, FE-22211, FE-22311, FE-22411, FE-22511, FE-22611

* BY VENDOR

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		LEVEL TRANSMITTER (DISPLACEMENT TYPE) SPECIFICATION		SP. 8522 REVISION PAGE 1 OF 1	
ORIGINAL	BY R. M. YTA	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.				PROJECT NO. 3001 Φ II	

DESIGN CRITERIA FOR LEVEL TRANSMITTER (Displacer Type)

Transmitter shall operate on the principle of force sensing on a variable displacement displacer suspended in the liquid to be monitored.

The displacer and fluid shall be completely isolated from the transmitter mechanism by a torque tube or equivalent packless seal.

The output signals shall be standard pneumatic or electronic as specified on the data sheet.

A float chamber shall mount to the vessel with the configuration and connection specified on the data sheets.

The unit shall be furnished with a metal tag fastened with corrosion resistant wire and stamped with the tag number as specified on the data sheet.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		INSTRUMENT DATA SHEET		SP. <u>8522</u>	
LEVEL TRANSMITTER - DISPLACEMENT		REVISION _____		PAGE <u>1</u> OF <u>1</u>	
ORIGINAL	BY <u>R MOYTA</u>	DATE <u>8-4-78</u>	APPD. _____	DATE _____	
REVISION	BY _____	DATE _____	APPD. _____	DATE _____	
CLIENT: <u>ERIE MINING CO</u>				PROJECT NO. <u>3001ΦII</u>	

TAG NO.	#1 BELOW	LT-21804/ LT-22804
REVISION		
QUANTITY	12	2
MANUFACTURER	MASONELION	→
MODEL NO.	1212.0 OR EQUAL	→
SERVICE	LOW PRESS. STEAM DRUM	H1 PRESS. STEAM DRUM
UPPER FLUID	STEAM	STEAM
LOWER FLUID	WATER	WATER
FLUID - PRESS. MAX/OPER.	/ 25PSI	/ 125PSI
↓ - SP. G. UP/LOW	1.25 1.0	4.0 1.0
↓ - TEMP. MAX/OPER.	267°F	352°F
CHAMBER - TYPE	C. STEEL	→
CONNECTION - TYPE & SIZE	2" NPT	→
TOP CONNECTION - LOCATION	SIDE	→
BOTTOM CONNECTION -	END	→
DISPLACER - DIA/LENGTH	* 1 1/4"	* 1 1/4"
↓ - MATERIAL	ST. STEEL	ST. STEEL
SEAL - TYPE	*	*
↓ - MATERIAL	*	*
OUTPUT	4-20MA	→
SUPPLY	24VDC	→

#1) LT-21104, LT-21204, LT-21304, LT-21404, LT-21504,
LT-21604, LT-22104, LT-22204, LT-22304, LT-22404,
LT-22504, LT-22604

* BY VENDOR

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		LEVEL TRANSMITTER (CAPACITANCE TYPE) SPECIFICATION		SP. 8527	
ORIGINAL		BY R. MOYTA	DATE 3-1-78	APPD.	DATE
REVISION		BY	DATE	APPD.	DATE
CLIENT: ERIE MINING CO.				PROJECT NO. 30010II	

DESIGN CRITERIA FOR LEVEL TRANSMITTER - CAPACITANCE TYPE

Level Transmitter - Capacitance Type shall be manufacturer's standard assembly complying with this specification and the accompanying data sheet.

The transmitter shall measure the level of the process media by sensing the capacitave coupling between a sensing probe and an adjacent grounded surface.

The transmitter output shall be continuous of the type and range shown on the data sheet. The magnitude of the output shall vary in direct proportion to the measured level.

The transmitter shall be complete with sensing element, interconnecting cable, connectors and suitable enclosure.

The transmitter shall be suitable for service in industrial plant and outdoor environment with temperature range of -20 to 150° F.

Each transmitter shall be supplied with a permanently attached corrosion resistant tag showing the manufacturer's name, model and serial number, and the instrument tag number. The instrument tag number shall be as shown on the data sheet.

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of
Babcock International Inc.

INSTRUMENT DATA SHEET

SP. 8527
REVISION _____
PAGE 1 OF 1

LEVEL TRANSMITTER - CAPACITANCE TYPE

ORIGINAL	BY <u>R. MOYTA</u>	DATE <u>8-4-78</u>	APPD. _____	DATE _____
REVISION	BY _____	DATE _____	APPD. _____	DATE _____
CLIENT: <u>ERIE MINING CO</u>			PROJECT NO. <u>300111</u>	

TAG NO.	#1 BELOW	LIT-21707	
REVISION			
QUANTITY	12	1	
MANUFACTURER			
MODEL NO.			
SERVICE	COAL FEED	TN 202 TAR/OIL TANK	
PROCESS FLUID	COAL	TAR/OIL	
FLUID - PRESS/TEMP.	0/	0/250°F	
- VISCOSITY			
ELEMENT - TYPE			
- MATERIAL			
- SHIELD			
- DIA. & LENGTH			
- CONNECTION			
TRANSMITTER			
OUTPUT	4-20 MA	4-20 MA	
FLOW RANGE - MIN/MAX			
WATER LEVEL - MIN/MAX			
LOCATION	VESSEL TOP	→	
POWER SUPPLY	24VDC	24VDC	
CABLE LENGTH (HEAD-TRANSM.)			
INDICATION			
N.E.C AREA CLASS	CLASS I DIV II GROUP D	→	
ENCLOSURE	NEMA 4	→	
AMBIENT TEMPERATURE			

#1) LS-21102, LS-21202, LS-21302, LS-21402, LS-21502
LS-21602, LS-22102, LS-22202, LS-22302, LS-22402,
LS-22502, LS-22602

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		LEVEL SWITCH (CAPACITANCE TYPE) SPECIFICATION		SP- 8542 REVISION _____ PAGE 1 OF 1	
ORIGINAL	BY R. MOYTA	DATE 8-1-78	APPD.	DATE	
REVISION	BY	DATE	APPD.	DATE	
CLIENT: ERIE MINING CO.				PROJECT NO 30014II	

DESIGN CRITERIA FOR CAPACITANCE TYPE LEVEL SWITCH

Switch shall detect level by sensing the change of capacitance between probe and either or both the liquid and tank.

The sensing probe shall not have any moving parts and it shall be constructed of materials satisfactory for the service conditions specified on the data sheets.

The electronics and probe shall be in weather proof housings unless specified otherwise on the data sheets.

Operation shall be satisfactory over the ambient temperature range of -20°F to 160°F.

Electrical switch construction shall be SPDT snap action type. Minimum contact rating shall be five (5) amps at 120 V.A.C., 60 Hz, unless otherwise indicated on the data sheet.

The unit shall be identified by a metal tag attached with corrosion resistance wire, and stamped with the tag number from the data sheet.

BABCOCK CONTRACTORS INC. PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		INSTRUMENT DATA SHEET LEVEL SWITCH - CAPACITANCE TYPE		SP. <u>8542</u> REVISION _____ PAGE <u>1</u> OF <u>1</u>	
DESIGN	BY <u>R. MOYTA</u>	DATE <u>8-4-78</u>	APPD. _____	DATE _____	
REVISION	BY _____	DATE _____	APPD. _____	DATE _____	
CLIENT: <u>ERIE MINING CO.</u>				PROJECT NO. <u>3001ΦII</u>	

TAG NO.	#1 BELOW	#2 BELOW	#3 BELOW
REVISION			
QUANTITY	<u>12</u>	<u>12</u>	<u>12</u>
MANUFACTURER			
MODEL NO.			
SERVICE	<u>COAL SURGE HOPPER</u>	<u>DUST CYCLONE</u>	<u>TAR CYCLONE</u>
PROCESS FLUID	<u>COAL</u>	<u>DUST/GAS</u>	<u>TAR/GAS</u>
FLUID - PRESS/TEMP.	<u>0</u> <u>80°F</u>	<u>0</u> <u>120°F</u>	<u>0</u> <u>250°F</u>
↓ - VISCOSITY			
ELEMENT - TYPE			
↓ - MATERIAL			
↓ - SHIELD			
↓ - DIA. & LENGTH			
↓ - CONNECTION			
SWITCH - CONTACT FORM	<u>(2) SPDT</u>	<u>(1) SPDT</u>	<u>(1) SPDT</u>
↓ - RATING	<u>5 AMP @ 115VAC</u>	<u>→</u>	<u>→</u>
SETTING - TYPE	<u> </u>	<u> </u>	<u> </u>
↓ - SET PT/DIFF.			
ELECTRONICS - LOCATION	<u>IN HEAD</u>	<u>→</u>	<u>→</u>
↓ - POWER	<u>24VDC</u>	<u>→</u>	<u>→</u>
CABLE - TYPE			
↓ - LENGTH			
N.E.C. AREA CLASS	<u>CLASS I DIV II</u> <u>GROUP D</u>	<u>→</u>	<u>→</u>
ENCLOSURE	<u>NEMA 4</u>	<u>→</u>	<u>→</u>

- #1) LS-21101, LS-21201, LS-21301, LS-21401, LS-21501, LS-21601, LS-22101, LS-22201, LS-22301, LS-22401, LS-22501, LS-22601
- #2) LS-21128, LS-21228, LS-21328, LS-21428, LS-21528, LS-21628, LS-22128, LS-22228, LS-22328, LS-22428, LS-22528, LS-22628
- #3) LS-21129, LS-21229, LS-21329, LS-21429, LS-21529, LS-21629, LS-22129, LS-22229, LS-22329, LS-22429, LS-22529, LS-22629

LOCATION	FIELD	→	→
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PITTSBURGH, PA. A Subsidiary of Babcock International Inc.		WEIGH SYSTEM SPECIFICATION		SF- 8820 REVISION PAGE 1 OF 2	
ORIGINAL	BY LMW	DATE 9-27-78	APPD	DATE	
REVISION	BY	DATE	APPD	DATE	
CLIENT: ERIE MINING CO.			HOYT LAKES, MN.		PROJECT NO. 3001 Φ II

1.0 SCOPE

This specification shall define the physical and performance characteristics of an automatic batch weighing system for use with a batch hopper. Documentation requirements are also specified.

2.0 EQUIPMENT DESCRIPTION

- 2.1 Load cells shall be the electronic type with strain gage force sensors. The material of construction shall be stainless steel or as specified in the Data Sheet.
- 2.2 Load cells shall be temperature compensated over a range of 0 to 150°F.
- 2.3 Linearity of the load cell shall be $\pm 0.05\%$ of full scale or better.
- 2.4 Load cells shall be fully protected against humidity and water and shall be suitable for the NEC classification specified in the Data Sheets.
- 2.5 The weight indicator/controller shall be compatible with the load cells and shall provide the readouts and control features as specified in the Data Sheet.
- 2.6 The weigh system shall include all hardware required to provide a working system, including signal cable, connectors, and any required signal summers or signal conditioners.
- 2.7 Each load cell and receiver instrument shall be supplied with a permanently attached corrosion resistant tag showing the manufacturer's name, model number, serial number and the instrument tag number as shown on the Data Sheet.

3.0 DOCUMENTATION

- 3.1 The following certified documents shall be submitted to the buyer in quantities and terms as specified in the purchase order.
 - A. Drawing and Manual Index
 - B. General Arrangement Drawings
 - C. Electrical & Piping Drawings
(schematic and interconnection)
 - D. Operation and Installation Manuals
 - E. Maintenance Manual & Parts List
 - F. Recommended Spare Parts for _____ Years Operation

3.2 Each document shall be marked with the following identifying data:

- A. BCI Job Number
- B. Customer Job Number
- C. BCI Instrument Specification Number
- D. Instrument Tag No. (from Data Sheet)
- E. Exact Instrument Identification as furnished
(i.e., detailed model number or list of furnished options)

BABCOCK CONTRACTORS INC.
PITTSBURGH, PA.
A Subsidiary of
Babcock International Inc.

WEIGH SYSTEM
DATA SHEET

SP. 8820

REVISION

PAGE 1 OF 1

ORIGINAL	BY LMW	DATE 9-27-78	APPD.	DATE
REVISION	BY	DATE	APPD.	DATE
CLIENT: ERIE MINING CO. HOYT LAKES, MN.			PROJECT NO. 3001 + II	

TAG NO.	SEE NOTE #1		
REVISION			
QUANTITY	12		
MANUFACTURER			
MODEL NO.			
SERVICE	LOCK HOPPER		
LOAD CELL - TYPE	ELECTRONIC		
- NUMBER	4		
- MATERIAL	ST. STEEL		
- CAPACITY (EACH)	2000 LB.		
- RESISTANCE	*		
NEC CLASSIFICATION	CL I DIV II G. D		
ENCLOSURE	EXPLOSION PROOF		
HOPPER WEIGHT - EMPTY	5800 LB.		
- FULL	6700 LB.		
WEIGHT PROCESSOR			
APPLICATION	AUTO. BATCH CTL.		
READOUT - UNITS	TOTAL NET TONS		
- DIGITS	6		
- RESOLUTION	.1 TON		
CONTROL - INPUTS	RESET		
- OUTPUTS	TWO SPOT SET POINTS		
POWER SUPPLY	+ 24 V. DC		
MOUNTING	FLUSH PANEL		
NEC CLASSIFICATION	GEN. PURP.		
TYPE	↓ ↓		
CABLE LENGTH	200 FT		

* INFO BY VENDOR

NOTE #1) PROCESSOR: QR-21103, QR-21203, QR-21303, QR-21403, QR-21503 QR-21603
QR-22103 QR-22203 QR-22303 QR-22403 QR-22503 QR-22603
LOAD CELL: QE-21103 QE-21203 QE-21303 QE-21403 QE-21503 QE-21603
QE-22103 QE-22203 QE-22303 QE-22403 QE-22503 QE-22603

LOCATION			
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6.0 GASIFICATION - AREA 02 (continued)

6.08 GENERAL DRAWINGS

<u>Drawing Number</u>	<u>Description</u>	<u>Revision</u>
4814-X-02-51-2	Gasifier Building Arrangement	4
4814-X-02-52-2	Plan and Elevation at 1656' and 1623'	0
4814-X-02-53-2	Plan and Elevation at 1656' and 1623'	0
4814-X-02-54-2	Plan and Elevation at 1613' and 1601'	0
4814-X-02-55-2	Plan and Elevation at 1613' and 1601'	0
4814-X-02-56-2	Plan and Elevation at 1589'	0
4814-X-02-57-2	Plan and Elevation at 1589'	0
4814-X-02-58-2	Plan and Elevation at 1573' and 1580'	0
4814-X-02-59-2	Plan and Elevation at 1573' and 1580'	0
4814-X-02-60-2	Plan and Elevation at 1543'	0
4814-X-02-61-2	Plan and Elevation at 1543'	0
4814-X-02-62-2	General Arrangement Section "A-A"	0
4814-X-02-63-2	General Arrangement Section "B-B"	0
4814-X-02-64-2	General Arrangement Section "B-B"	0
4814-X-02-65-2	Gas Cleaning Plant - Plan and Elevation	0
4814-X-02-66-2	Gas Cleaning Plant - Plan and Elevation	0

4814-X-0251-2

BLODG. & TRIPPER CONV.

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKEE
ENGINEERS AND CONSTRUCTORS

CLEVELAND

OHIO

4814-X-02-51-2

FOR **ERIE MINING COMPANY**PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTAGASIFICATION
COMMERCIAL UNIT
GASIFIER BUILDING ARRANGEMENT

PROJECT NO.

P.E. NO.

SCALE
1" = 30'-0"

REVISION 4

DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.	DATE	BY	CHK	DESCRIPTION	APP.
8-25-78	KH	TG	REVISED NOTE. BUILDING WAS INSULATED & HEATED		10-26-78	MS	TG	CHANGES AS CIRCLED		8-25-78	KH	TG	REVISED NOTE. BUILDING WAS INSULATED & HEATED	
			ADDED ELECTRICAL EQUIPMENT ROOM, ELEVATOR										ADDED ELECTRICAL EQUIPMENT ROOM, ELEVATOR	
			SECTION F-F										SECTION F-F	
			STACKS, PLAT., BLOWERS, PIPING, DUST COLL., &										STACKS, PLAT., BLOWERS, PIPING, DUST COLL., &	
			TAG HTS ADDED; TRUCK DOOR DELETED										TAG HTS ADDED; TRUCK DOOR DELETED	
			ISSUED FOR ESTIMATING										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-X-02-53-2
CLEVELAND OHIO	PROJECT NO. P.E. NO.
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	SCALE 1/8" = 1'-0"
GASIFICATION COMMERCIAL UNIT-STAGE 2 GEN. ARRGT. PLAN-SHEET N°1	REVISION 3

SCALING RULES

PLAN & ELEV. 1613'-0" & 1601'-0"

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY **McKee**

CLEVELAND, OHIO

4814-X-02-54-2

PROJECT NO. P.C. NO.

SCALE 1/8" = 1'-0"

REVISION

FOR **ERIE MINING COMPANY**

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

GASIFICATION

COMMERCIAL UNIT-STAGE 2

GEN. ARRGT. PLAN-SHEET NO. 2A

SCALING RULES

1/8"

1/4"

3/8"

1/2"

3/4"

1"

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

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A PREPARED BY McKee CLEVELAND OHIO		4814-X-02-55-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. P.E. NO. SCALE 1/4" = 1'-0"
GASIFICATION COMMERCIAL UNIT-STAGE 2 GEN. ARGT. PLAN-SHEET N°2		REVISION

SCALING RULES

1/8"

1/4"

3/8"

1/2"

PLAN @ ELEV. 1589'-0"

MATCH LINE
SEE DWG. N8 01-57

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

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY **McKee**

CLEVELAND, OHIO

4814-X-0256-2

PROJECT NO. P.E. NO.

SCALE 1/8" = 1'-0"

REVISION

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES, MINNESOTA

GASIFICATION

COMMERCIAL UNIT - STAGE 2

GEN. ARRGT. PLAN - SHEET NO 3A

PLAN @ EL. 1573'94 & 1580'0"

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 CLEVELAND OHIO		4814-X-02-58-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA		PROJECT NO. P.E. NO.
GASIFICATION COMMERCIAL UNIT STAGE 2 GEN. ARRGT. PLAN-SHEET N°4A		SCALE 1/8" = 1'-0" REVISION O

PLAN @ EL. 1573'9 3/4" & 1580'0"

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**

CLEVELAND OHIO

4814-X-02-59-2

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT. HOYT LAKES MINNESOTA

GASIFICATION COMMERCIAL UNIT - STAGE 2

GEN. ARRGT. PLAN - SHEET N04

PROJECT NO. 4814-X-02-59-2

P.E. NO. 1/8" = 1'-0"

REVISION

SCALING RULES

PLAN @ ELEV. 1543'-0"

SARCOB CONTRACTORS INC.
 1700 W. 10th St.
 Minneapolis, MN 55408
 PHONE 800-828-1111
 FAX 612-338-1111

U. S. DEPARTMENT OF ENERGY FUEL GAS DEMONSTRATION PLANT PROGRAM SMALL SCALE INDUSTRIAL PROJECT-CONTRACT NO. ET-78-C-01-2578 A	
PREPARED BY McKee ENGINEERS AND CONSTRUCTORS CLEVELAND OHIO	PROJECT NO. 4814-X-02-60-2
FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	
GASIFICATION COMMERCIAL UNIT-STAGE 2 GEN. ARRGT. PLAN SHEET N ^o 5A	
SCALE 1/8" = 1'-0" REVISION	

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

REVISION	DATE	BY	CHK	DESCRIPTION	APP.	REVISION	DATE	BY	CHK	DESCRIPTION	APP.	REVISION	DATE	BY	CHK	DESCRIPTION	APP.
1						1						1					
2						2						2					
3						3						3					
4						4						4					
5						5						5					
6						6						6					
7						7						7					
8						8						8					
9						9						9					
10						10						10					

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

4814X-0261-2

PROJECT NO.

P.E. NO.

SCALE

1/8" = 1'-0"

REVISION

0

FOR

ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT

HOYT LAKES MINNESOTA

GASIFICATION

COMMERCIAL UNIT - STAGE 2

GEN. ARRGT. PLAN-SHEET. N° 5

	DATE	BY	CHR	DESCRIPTION	APP
REVISIONS	01/20/78	JN	DS	FINAL REVIEW	
▲					
▲					
▲					
▲					
▲					

REVISION /

FLARE STACK
J-201-FMATCH LINE
SEE DWG. NO. 02-64T/STL
EL. 1654'-0"T/STL
EL. 1623'-0"T/STL
EL. 1601'-0"T/STL
EL. 1589'-0"T/STL
EL. 1580'-0"T/STL
EL. 1573'-9 1/4"T/STL
EL. 1543'-0"T/STL
EL. 1543'-0"SECTION B
02-52, 54, 56, 58 & 60

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKee
ENGINEERS AND CONSTRUCTORS

CLEVELAND OHIO

4814-X-02-63-2

FOR ERIE MINING COMPANY

PICKANDS MATHER AND CO. MANAGING AGENT
HOYT LAKES MINNESOTAGASIFICATION
COMMERCIAL UNIT - STAGE 2
GEN. ARRGT. SECTION "R-B" SHT. N-1

REVISION

10

SCALING RULES

1/8" = 1' 0"

1/4" = 1' 0"

3/8" = 1' 0"

1/2" = 1' 0"

SECTION B
02. ET, 55, 57, 59, 61

U. S. DEPARTMENT OF ENERGY

FUEL GAS DEMONSTRATION PLANT PROGRAM

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

PREPARED BY

McKee
ENGINEERS AND CONSTRUCTORS

CLEVELAND OHIO

4814-X-02-64-2

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

GASIFICATION
COMMERCIAL UNIT - STAGE 2
GEN. ARRGT. SECTION "B-B" SHT. NO. 2

PROJECT NO.

P.E. NO.

SCALE
1/8" = 1' 0"

REVISION

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

1	2	3	4	5	6	7	8	9	10
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FOR ERIE MINING COMPANY PICKANDS MATHER AND CO. MANAGING AGENT HOYT LAKES MINNESOTA	PROJECT NO. _____ P.E. NO. _____
	SCALE $\frac{1}{8}'' = 1' - 0''$
GASIFICATION COMMERCIAL UNIT - STAGE 2 GAS CL. PLANT PLAN & ELEV. SHT. NO. 2	
REVISION

[illegible]