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DELIVERABLE 14B

PROCESS ENGINEERING AND MECHANICAL DESIGN REPORTS

VOLUME II OF IV

DOE/ET/14759--T1-Vol.2-14B

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AUGUST 1982

PRELIMINARY DESIGN AND ASSESSMENT OF A 12,500 BPD COAL-TO-GASOLINE-TO-METHANOL PLANT

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R. M. Stewart

GRACE PROJECT DIRECTOR

SEP 2 1982

DATE

PREPARED FOR THE UNITED STATES
DEPARTMENT OF ENERGY
UNDER COOPERATIVE AGREEMENT NO. DE-FC01-80ET-14759

United States
Department of Energy

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Keith A. Tinkler
PARSONS PROJECT DIRECTOR

August 17, 1982
DATE

PARSONS

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PROCESS ENGINEERING
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VOLUME II OF IV

AUGUST 1982

THE RALPH M. PARSONS COMPANY
100 WEST WALNUT STREET
PASADENA, CALIFORNIA 91124

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ACRONYMS

ACI	American Concrete Institute
AGMA	American Gear Manufacturers Association
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
BACT	Best Available Control Technology
BOD	Biochemical Oxygen Demand
BREC	Big Rivers Electric Corporation
BSRP	Beavon Sulfur Removal Process
CAAS	Construct Across or Along Streams
CACS	Construct an Air Contaminant Source
CEMA	Conveyor Equipment Manufacturers Association
CHWL	Construct a Hazardous Waste Landfill
COD	Chemical Oxygen Demand
CRL	Construct a Residuals Landfill
DOE	Department of Energy
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FGD	Flue Gas Desulfurization
GRADD	Green River Area Development District
HGT	Heavy Gasoline Treating
LAER	Lowest Achievable Emission Rate
LPG	Liquefied Petroleum Gas
MRDC	Mobil Research and Development Corporation

ACRONYMS (Contd)

MTG	Methanol-to-Gasoline
NEC	National Electric Code
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PCB	Power Control Building
PFCD	Process Flow and Control Diagrams
PSA	Pressure Swing Adsorption
PSD	Prevention of Significant Deterioration
RVP	Reid vapor pressure
SGDPP	Synthesis Gas Demonstration Plant Program
SRU	Sulfur Recovery Unit
TCGP	Texaco Coal Gasification Process
TDC	Texaco Development Corporation
TEMA	Tube Exchanger Manufacturers Association
UBC	Uniform Building Code

SECTION 1

FACILITIES DESIGN

1.1 GENERAL CONSTRAINTS

1.1.1 CODES AND STANDARDS

All national, state, and local codes and standards that apply to the construction and operation of the Gasoline Plant have been adhered to, as well as the standards of the industry deemed necessary for the safe design, fabrication, assembly, erection, inspection, and testing of the completed system. The latest editions of the following codes have been used:

Item	Regulation
Buildings	Uniform Building Code
Compressors	API Standard 617, 618, OSHA
Conveyor Components	CEMA
Drive Gears	AGMA
Electrical	NEMA, NEC
Exchangers	ASME Section VIII, Division 1 and TEMA B, C and R
Furnaces	API 530, ASME Section 1, ANSI B31.3
Navigational Hazards	FAA
Pipeline	ANSI B31.4
Plumbing	Uniform Building Code and Local Code
Pressure Vessels, Unfired	ASME Section VIII, Division I
Pumps	API Standard 610
Refinery Piping	ANSI B31.3
Safety	OSHA
Steam Generators	ASME Section I

Storage Tanks:	
Atmospheric	API Standard 620 and 650
Pressure	API Standard 620 and 650
Pressure Spheres	ASME Section VIII
Structures:	
Concrete	Uniform Building Code, ACI
Steel	AISC and UBC, ANSI AS 8.1
Turbines	API Standard 611 and 612

1.1.2 REGULATORY STANDARDS AND REQUIREMENTS

The key applications for permits and licenses to be filed as described in this section during the preliminary design phase of the project will relate to the 50,000-bpd Gasoline Plant. Should the decision be made to reduce the size of the plant to 12,500 bpd, the permit applications will be amended as required to reflect the lower plant capacity.

The construction and operation of the Gasoline Plant will require compliance with applicable local, state, and federal laws, codes, ordinances, and regulations. Key permits will be prosecuted as part of the Gasoline Plant project work. The key permits to be issued by federal agencies include:

(1) Permit to Construct on a Navigable Waterway, Section 10 permit, by the Corps of Engineers

(2) Permit to Discharge Dredged or Fill Material, Section 404 permit, by the Corps of Engineers

(3) National Pollution Discharge Elimination System (NPDES) notification to the Environmental Protection Agency

The NPDES notification is filed in lieu of an application for a NPDES permit which is not required since the Gasoline Plant has been designed to have no discharge of wastes to a navigable stream. The Environmental

Protection Agency (EPA) is in the process of delegating to the Commonwealth of Kentucky the authority to administer the NPDES program and close contact with the Commonwealth of Kentucky will be maintained.

The project must comply with state and federal regulations for protection of air quality, water quality, and solid waste disposal. The responsibility for the administration of these regulations is to be delegated to the Commonwealth of Kentucky by EPA in accordance with federal law. For those regulations administered by Kentucky, EPA will retain review responsibility and, in some cases, notifications still must be issued to EPA by the applicant. For those regulations administered by EPA, application will be made to EPA, with the Commonwealth of Kentucky in an advisory or review role.

The permits for which application will have to be submitted to the Commonwealth of Kentucky include:

(1) Prevention of Significant Deterioration (PSD) permit
(2) Permit to Construct an Air Contaminant Source (CACS)
(3) Permit to Construct a Residuals Landfill (CRL)
(4) Permit to Construct a Hazardous Waste Landfill (CHWL)
(5) Water Withdrawal Permit
(6) Permit to Construct Across or Along Streams (CAAS)

These permits will be issued and administered by the Kentucky Department of Natural Resources and Environmental Protection. Items 1 and 2 are permits issued under authority delegated by EPA under the Clean Air Act. Items 3 and 4 are delegated by EPA under provisions of the Resource Conservation and Recovery Act.

The Corps of Engineers cannot issue its permits until the provisions of the National Environmental Policy Act (NEPA) have been met. NEPA requires that an Environmental Impact Statement (EIS) be prepared by the lead federal agency, the Corps of Engineers in this case, before a decision can be made as to whether permits can be issued.

There are other permits by state and local authorities that will have to be obtained in connection with the Gasoline Plant construction. These are:

(1) Department of Transportation, Federal Aviation Administration, Notice of Proposed Construction or Alteration.

(2) Department of Interior: compliance with

(a) National and historic Preservation Act
(b) Wilderness Act of 1964
(c) Forest and Rangeland Renewable Resources Act
(d) Wild and Scenic Rivers Act
(e) Endangered Species Act
(f) Fish and Wildlife Coordination Act
(g) Protection of Bald and Golden Eagles

Deliverable 27B, "Materials and License Report," includes a master schedule and staffing plan for their preparation, submittal, and prosecution. These permits will be obtained as an early action during the detailed design phase of this project.

1.1.3 SPARING CRITERIA

In the interest of continuous onstream operation of the Gasoline Plant, all major rotating equipment will be spared. In some instances, complete trains will be spared so that if an entire train of equipment is down, another can pick up its function without affecting the plant output. In other cases, trains of equipment will have design capacity to make up for the lost capacity of similar equipment that is down. Also, intermediate storage facilities are included to enable continuous plant operation for scheduled interruptions.

1.1.4 SPECIAL METALLURGICAL REQUIREMENTS

Unit 21 will have a high concentration of chlorides combined with CO_2 and H_2S in both the process water and the cooling water, presenting a difficult materials problem. To prevent stress corrosion cracking and pitting of the heat exchanger tubes and piping handling these waters, materials were selected that are suitable for the processing conditions specified.

In general, the materials of construction for the plant is carbon steel with the exception of some equipment and related piping where alloy, lined or nonferrous metals will be used to control corrosive or erosive process fluids.

SECTION 1

FACILITIES DESIGN

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In general, the materials of construction for the plant is carbon steel with the exception of some equipment and related piping where alloy, lined or nonferrous metals will be used to control corrosive or erosive process fluids.

1.2 PROCESS UNITS DESIGN

The Gasoline Plant is designed to produce a nominal 12,500 bpd of gasoline by gasifying high-sulfur agglomerating coal, synthesizing methanol from the coal-derived gas, and converting the methanol to gasoline.

The overall process configuration for the Gasoline Plant is shown in Process Block Flow Diagram D-01-FS-101 in Volume I, subsection 1.1.1.

Raw Kentucky No. 9 coal is delivered at Coal Receiving and Unloading - Unit 11 by railroad and barge. Coal unloaded at the railcar unloading station and the barge unloading stations is sampled and transported to storage. Then the coal is conveyed to Coal Grinding and Slurry Preparation - Unit 24, where a coal-water slurry is prepared to a specified grind size distribution and slurry concentration.

Coal-water slurry pumped from the slurry preparation unit is fed with high-purity oxygen from Unit 22 to the Texaco gasifiers in Gasification - Unit 21. Partial oxidation of the coal-water slurry occurs at 900-psig pressure and temperatures ranging from 2,200 to 2,800°F, producing a raw gas consisting mainly of CO, H_2, CO_2, and steam with a small amount of H_2S, COS, methane, inerts, and some unconverted carbon. The ash content of the feed coal leaves the gasifiers in the form of molten slag.

The raw gas is cooled by generating steam. Then it is quenched and scrubbed with water for particulate material removal before entering CO Shift - Unit 23.

About 62% of the raw gas is processed through a CO shift unit containing a cobalt/molybdenum catalyst. The remaining portion of the raw gas bypasses the shift reactor. This processing results in the correct H_2:CO ratio for methanol synthesis. Heat is recovered from both of the streams before flowing to Acid Gas Removal - Unit 34.

An integrated heat recovery scheme has been designed to recover the useful energy for heating shift feed gas, high-pressure boiler feedwater, process condensate, and vacuum condensate. Process condensate from cooled shift effluent and bypass gas is reheated and returned to the Gasification Unit.

The shifted and unshifted gases are treated in Acid Gas Removal - Unit 34. The Acid Gas Removal Unit employs Lotepro Corporation's Rectisol Process, which produces a synthesis gas suitable for methanol synthesis, an H_2S-rich gas for sulfur recovery in Sulfur Recovery (Claus) - Unit 36, and a CO-rich gas for further treating in the Torvex and washing system before venting of an environmentally acceptable tail gas.

Following compression, a low-pressure methanol synthesis loop is employed to convert the purified syngas into methanol. Part of the purge gas from the synthesis loop is fed to a Pressure Swing Adsorption (PSA) train, which provides high-purity hydrogen for Heavy Gasoline Treating - Unit 38. The remainder of the purge gas from the synthesis loop and the tail gas from the PSA Unit are sent to the fuel gas system.

Crude methanol is converted to hydrocarbons and water in the Methanol-to-Gasoline - Unit 31. The hydrocarbons are separated in Gas Fractionation - Unit 32 to produce fuel gas, HF Alkylation Unit feed, LPG, light gasoline, and a heavy gasoline feedstream. The process water from Unit 31 is biotreated to remove impurities before recycling and disposal. Fuel gas from the Gas Fractionation Unit is sent to the fuel gas system.

HF Alkylation - Unit 33 converts the alkylation feed, which includes butylenes, amylenes, and isobutane, to alkylate, a gasoline blending component, n-butane, used to adjust gasoline vapor pressure, and isobutane, which is used to adjust gasoline vapor pressure with the excess to sales.

Heavy Gasoline Treating - Unit 38 reduces the durene content in the heavy gasoline from the Gas Fractionation Unit to meet finished gasoline specification requirements. The PSA Unit provides the required hydrogen for

this catalytic hydrogenation. Treated heavy gasoline is sent to heavy gasoline storage in Unit 57 for product blending. Gas produced in this processing step is sent to the fuel gas system.

Alkylate, isobutane, and n-butane from HF Alkylation - Unit 33; light gasoline from Gas Fractionation - Unit 33; and treated heavy gasoline from heavy gasoline storage in Unit 57 are combined in Gasoline Blending - Unit 55 to make product gasoline.

Sulfur Removal (BSRP) - Unit 37 removes sulfur compounds from the tail gas of Sulfur Recovery (Claus) - Unit 36 before the tail gas is vented to the atmosphere. Sulfur product is recovered mainly from the Claus Unit and partly from the BSRP Unit.

Details of the process systems and offsite facilities are presented in Volumes II, III, and IV of this report.

1.2.1 COAL RECEIVING AND UNLOADING - UNIT 11

A. Basis of Design

The coal receiving and unloading systems employ commercially proven technologies currently in use at plants of similar size. The systems and equipment were selected to handle a nominal 9,000 stpd of coal for 330 days per year up to a total annual requirement of approximately 3 million short tons. The general design philosophy of the systems and the design bases are described in CRT-01-MH-1 included in Volume I, Section 9.

The design of the coal receiving and unloading systems is based on the premise of receiving the total annual requirement of coal by river barges, or up to a maximum of 60% of the annual requirement by railcars. The systems are capable of operating one at a time or simultaneously. The design basis for each of the two systems are described individually.

1. Barge Unloading. The barge unloading system is designed to handle 6 barges per day of 1,500-short-ton capacity each. These barges will be brought to the unloading dock in tows of four barges via the Green River. Any shipments via the Ohio River will be broken down from larger tows prior to placement.

The barge unloader is sized to unload 9,000 short tons of coal in two 8-hour shifts per day, working 7 days per week, at an average nominal rate of 900 stph. The unloading dock and conveyors are designed to operate at river water levels of 342 feet (minimum) to 375.5 feet (maximum). All electrical equipment and motors are above 385 feet in elevation. The 100-year flood level at the site is 380 feet, and the 500-year flood level is 382 feet.

2. Train Unloading. The train unloading system is designed to handle a maximum of 6,000 tons of coal per day via 100-ton standard bottom dump coal cars. Each train is unloaded in 6 to 8 hours from the time the train is brought to the plant's track loop. The unloading operation is

carried out manually. The coal cars are spotted on the unloading hopper by means of a yard switch engine. A gas-fired thaw shed is provided for winter use as required. The train unloading operation may be performed in all three shifts of the day, 7 days of the week.

B. System Selection Rationale

Barge transport is the preferred mode of delivery for coal both by the suppliers as well as the consumers in the region since it is more economical and convenient than shipment by rail. The barge unloading facilities are designed to unload the total daily requirement of the plant. It is a standard practice to move barges only during daylight hours, so the unloaders have adequate capacity to unload the total requirement in two 8-hour shifts.

The location of the barge unloading equipment on the southern bank of the Green River with the shoreline slightly cut back was determined after discussions with the U.S. Army Corps of Engineers, the Kentucky Department for Natural Resources and Environmental Protection, and barge operating companies. The location of the dock on the recessed river bank avoids any interference in the river barge traffic.

A choice was required between a continuous chain bucket-type unloader or a grab bucket-type unloader. One grab bucket unloader was found suitable for coal unloading rates up to 1,000 stph. Since the Gasoline Plant average daily unloading rate is within that capacity, one grab bucket type unloader was selected for this scheme. Although the availability (reliability) of this machine is not compatible with the belt conveying system, it is considered more reliable than chain bucket-type unloaders. This unloader is ideally suitable for the variance of the river water level without the need of a luffing conveyor. The above-noted selection was also based on the flexibility of operation and turndown capability, lower maintenance requirements, and lowest capital and operating cost as well as acceptable environmental conditions.

A detailed study was performed to select a train unloading system based on Parsons experience and standard engineering practices in related industries of comparable size. Having generally considered different alternatives, the scheme with the covered station and under-the-track hoppers using railway standard bottom dump cars was considered best suited for the project.

In conclusion, the equipment type and size selected for unloading coal from barges and trains are of proven technology, have no unusual break-in feature requirements, and can be purchased for delivery within the established schedule for the project.

C. System Description

1. Barge Unloading. The barge unloaders is the grab bucket type mounted on a stationary style structure installed on caissons along the river bank. A fixed receiving hopper at the unloader is connected to the land conveyor by a fixed cross conveyor above the river high-flood water level. Winches are provided to move the barge being unloaded under the unloading structure. One small harbor boat is to tow coal and product barges to and from the loading/unloading stations.

2. Train Unloading. The train unloading system is designed to unload coal from railway standard bottom dump coal cars. The bottom dump car train is pulled through a thaw shed (operating during winter months only) to the train unloading station; and the switch engine spots two cars at a time on the track hoppers. A car shaker is lowered on the car if required while the doors of the second car are being opened manually. After both cars are empty, the train is moved to advance the next two cars onto the unloading hoppers. The hoppers discharge coal by belt feeders onto a collecting belt to convey the coal to the yard stockpiles.

D. Risk Assessment

The philosophy used in the selection of the coal unloading systems for this project was to utilize a commercially proven, environmentally acceptable, and economical system. Furthermore, the basis of selection and design of individual equipment ensures efficient use of the equipment capacities, flexibility of operation, and built-in reserve capacities for momentary surges in the coal unloading rates. This philosophy was maintained in the determination of the number of trains, modules, and spare equipment. The system startup, turndown capability, maintenance, availability, and interchangeability of parts were considered in the risk assessment.

All manufacturer-furnished equipment was specified for maximum operating rates at 25% over and above the plant's designed operating conditions. The conveyors were designed for a maximum of 75% loading for capacities required by the Plant Design Operating Conditions. Individual components of the system have a minimum service factor of 1.25 or more in general conformity with the latest editions of applicable codes, standards, and practices of federal, state, and local authorities. In case of conflict in standards, the more conservative standard was used in the design or selection of the equipment/system.

The operation of the coal receiving and unloading systems is affected by five significant factors.

1. Reliability of Coal Supply and Transport Systems. To provide flexibility of supply and the most competitive prices, coal supply contracts will be entered into with three to five coal suppliers. The option to buy the coal in the spot market whenever it is advantageous to the purchaser will be available. The reliability of delivery is increased by providing two independent modes of coal receiving; i.e., by river barges as well as railcars. The provision of as much as a 60-day coal supply stockpile at the plantsite is a safeguard against a prolonged interruption of coal deliveries.

2. Availability and Occupancy of Coal Receiving and Unloading Systems. The coal unloader at the barge docks is commercially proved, standard design with all applicable safety features. Its availability (reliability) will be over 90% for the design period. The single train conveyor belts from the unloading system have a higher availability (reliability) than the barge unloader.

The train unloading station similarly has two unloading hoppers, each capable of handling the total design capacity. Similarly, there are two dust collectors at this station, of which any one can operate and maintain the area dustfree preventing the formation of a potentially explosive air/coal dust mixture.

3. Continuity of Coal Requirement by Process Units. In case of unexpected failure of the process units or the utility boilers, the demand for coal from the plant may suddenly reduce or totally stop. The loaded coal barges in the dock and those en route to the plant and the railcars within the plant area cannot be withheld from unloading without incurring demurrage charges. Coal stockpiles are provided so that the unloading operation can be sustained. Also, the availability of stockpiled coal reduces the risk of a forced plant shutdown in the event of a stoppage or slowdown in coal supply.

4. Effect on Equipment Performance Caused by Maloperation or Machine Parts Breakdown. The equipment and system are designed to perform at the maximum plant design operating conditions. Although all safeguards and protective devices are provided, mechanical failures may be caused by maloperation, fire and accident, or extended wear. Dual operating and monitoring devices are provided in each system to eliminate or minimize failures. Additionally, the coal unloading systems are each controlled by individual operators as well as monitored by their supervisors in a remote central control room. Additional operators (deck hands and conveyor walkers) will spot any abnormality in the operation and avert a breakdown.

E. Process Flow and Control Diagrams (Including Material Balances)

Process Flow and Control Diagrams for Coal Receiving and Unloading Unit 11 are as follows:

Drawing No.	Title
D-10-MP-101NP	Material Balance Coal Area
D-11-MP-101NP	PFCD Coal Area Units 11 and 12 - Barge Unloading, Conveying and Sampling
D-11-MP-102NP	PFCD Coal Area Units 11 and 12 - Train Unloading, Conveying and Sampling

FLOW SHEET DRAWING NUMBER D-11-MP-101 NP

FLOW IDENTIFICATION		① DISCHARGE FROM BARGE UNLOADERS	② FEED TO STORAGE PILES	③ PRIMARY SAMPLE CUT FROM BARGES
MATERIAL		COAL	COAL	COAL
SIZE	(INCHES) (MESH)	(-2)	(-2)	(-2)
MOISTURE	% (MAX.)	9.4	9.4	9.4
TEMPERATURE	°F	AMB.	AMB.	AMB.
BULK DENSITY		(45/55)	(45/55)	(45/55)
OPERATING RATE	STPH (LBS./HR.)	900	897.4	(5250)
DESIGN RATE NOMINAL	STPH (LBS./HR.)	900	897.4	(5250)
DESIGN FACTOR EQUIPMENT		1.25	1.25	1.25
WATER FLOW RATE	GPM			
WATER FLOW PRESSURE	PSIG			
AIR FLOW RATE	SCFM			
AIR FLOW PRESSURE	PSIG			

FLOW SHEET DRAWING NUMBER D-11-MP-102 NP

FLOW IDENTIFICATION		① AS RECEIVED FROM TRAIN U/L FEEDERS	② AS RECEIVED FROM TRAIN U/L STATION	③ PRIMARY SAMPLE CUT FROM BARGES	③ PRIMARY SAMPLE CUT FROM RAILCARS	④ FEED TO STORAGE PILES FROM RAILCARS	⑤ FEED TO STORAGE PILES FROM BARGES	⑥ PRIMARY SAMPLE CUT FROM BARGES	⑦ REJECTS FROM SECONDARY SAMPLE FROM RAIL CARS	REJECTS FROM SECONDARY SAMPLE FROM
MATERIAL		COAL	COAL	COAL	COAL	COAL	COAL	COAL	COAL	
SIZE	(INCHES) (MESH)	(-2)	(-2)	(-2)	(-2)	(-2)	(-2)	(-2)	(-2)	
MOISTURE	% (MAX.)	9.4	9.4	9.4	9.4	9.4	9.4	9.4	9.4	
TEMPERATURE	°F	AMB.	AMB.	AMB.	AMB.	AMB.	AMB.	AMB.	AMB.	
BULK DENSITY	(LBS./FT.³)	(45/55)	(45/55)	(45/55)	(45/55)	(45/55)	(45/55)	(45/55)	(45/55)	
OPERATING RATE	STPH (LBS./HR.)	450	900	(5250)	(6750)	896.62	897.4	(5250)	(6743)	
DESIGN RATE NOMINAL	STPH (LBS./HR.)	450	900	(5250)	(6750)	896.62	897.4	(5250)	(6743)	
DESIGN FACTOR EQUIPMENT		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
WATER FLOW RATE	GPM									
WATER FLOW PRESSURE	PSIG									
AIR FLOW RATE	SCFM									
AIR FLOW PRESSURE	PSIG									

FLOW SHEET DRAWING NUMBER D-12-MP-101 NP

FLOW IDENTIFICATION		① FEED FROM STORAGE PILES	② FEED FROM DAY STORAGE SILOS	③ FEED FROM BOILER COAL BUNKERS	④ LIMESTONE FEED TO FGD PLANT	⑤ FEED TO SLURRY PREP MILLS
MATERIAL		COAL	COAL	COAL	LIME STONE	COAL
SIZE	(INCHES) (MESH)	(-2)	(-2)	(-2)	(2)	(-2)
MOISTURE	% (MAX.)	9.4	9.4	9.4		9.4
TEMPERATURE	°F	AMB.	AMB.	AMB.	AMB.	AMB.
BULK DENSITY	(LBS./FT.³)	(45/55)	(45/55)	(45/55)	(85)	(45/55)
OPERATING RATE	STPH (LBS./HR.)	1250	75.5	6.29	1250	118/151
DESIGN RATE NOMINAL	STPH (LBS./HR.)	1250	100	6.29	1250	① 200
DESIGN FACTOR EQUIPMENT		1.25	1.25	1.25	1.25	② 1.25
WATER FLOW RATE	GPM					
WATER FLOW PRESSURE	PSIG					
AIR FLOW RATE	SCFM					
AIR FLOW PRESSURE	PSIG					

FLOW SHEET DRAWING NUMBER D-13-MP-101 NP

FLOW IDENTIFICATION		① FEED FROM UNLOADING STATIONS	② RECLAIM FROM STORAGE PILES	③ FEED TO SILOS & BUNKERS	④ RECLAIM FROM EMERGENCY STORAGE PILE
MATERIAL		COAL	COAL ⑤	COAL	COAL ⑤
SIZE	(INCHES) (MESH)	(-2)	(-2)	(-2)	(-2)
MOISTURE	% (MAX.)	9.4	9.4	9.4	9.4
TEMPERATURE	°F	AMB.	AMB.	AMB.	AMB.
BULK DENSITY	(LBS./FT.³)	(45/55)	(45/55)	(45/55)	(45/55)
OPERATING RATE	STPH (LBS./HR.)	MAX 1,800	1,250	⑤ 1,250	⑤ 600
DESIGN RATE NOMINAL	STPH (LBS./HR.)	MAX 1,800	1,250	⑤ 1,250	⑤ 600
DESIGN FACTOR EQUIPMENT		1.25	1.25	1.25	1.25
WATER FLOW RATE	GPM				
WATER FLOW PRESSURE	PSIG				
AIR FLOW RATE	SCFM				
AIR FLOW PRESSURE	PSIG				

REFERENCES

DRAWING NO.	DESCRIPTION

REFERENCES

DRAWING NO.	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT
B	7/13/83	R.S.	SHR			FOR
A	7/7/83	R.S.	SHR			FOR

ENGINEERED 12/79

NOTES:
1. THESE ARE THE RANGE OF OPERATING CONDITIONS.
2. THIS IS A NOMINAL DESIGN RATE OF MATERIAL HANDLING EQUIPMENT.
3. LIMESTONE FEED TO F.G.D. REMOVAL PLANT WILL HAVE TP SAME RATES (OTHER DATA NOT INDICATED)
4. WORK THIS DRAWING WITH DRAWINGS D-11-MP-101 NP, D-11-MP-102 NP, D-12-MP-101 NP & D-13-MP-101 NP.

1 REJECTS FROM SECONDARY SAMPLE FROM RAIL CARS	7 REJECTS FROM SECONDARY SAMPLE FROM BARGES	8 FINAL CRUSHED SAMPLE FROM BARGES	8 FINAL CRUSHED SAMPLE FROM RAILCARS	9 10 FEED TO STORAGE PILES FROM BARGES OR RAILCARS	11 AIR DISCHARGE FROM COLLECTOR
COAL	COAL	COAL	COAL	COAL	
(-2)	(-1/4)	(-1/4)	(-2)	(-2)	
9.4	9.4	9.4	9.4	9.4	
AMB.	AMB.	AMB.	AMB.	AMB.	AMB.
(45/55)	(45/55)	(45/55)	(45/55)	(45/55)	
(6743)	(5246)	(4)	(6.6)	MAX 1,800	
(6743)	(5246)	(4)	(6.6)	MAX 1,800	
1.25	1.25	1.25	1.25	1.25	
					40,000 ea.

DIOMPIDIN. DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE	SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
MATERIAL BALANCE COAL AREA - UNIT 10	NONE	2000	6182	B
	DOCUMENT NUMBER: D-10-MP-101 NP			

		FOR	
		DRAWN	
		CHECKED	
101	FOR DESIGN REPORT	APVD SECT MD	
	FOR CLIENT APPROVAL	APVD PROJ MGR	
PROJ CLIENT	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

11-02-3501
CLAMSHELL TYPE BARGE UNLOADER
NOMINAL CAPACITY: 900 TPH EACH

11-02-2201
TRAMP IRON MAGNET

12-02-2007
RIP PROTECTOR

12-02-2901
DUST COLLECTOR
TRANSFER HOUSE #1

12-02-4402
METAL DETECTOR

12-02-3601
BARGE UNLOADING
42" WEIGH SCALE

12-02-2002
42" WIDE 1ST TRANSFER
BELT CONVEYOR

42" W

11-02-2003
54" BARGE UNLOADING
BELT FEEDER

11-02-2902
BARGE UNLOADING
DUST COLLECTOR
FAN

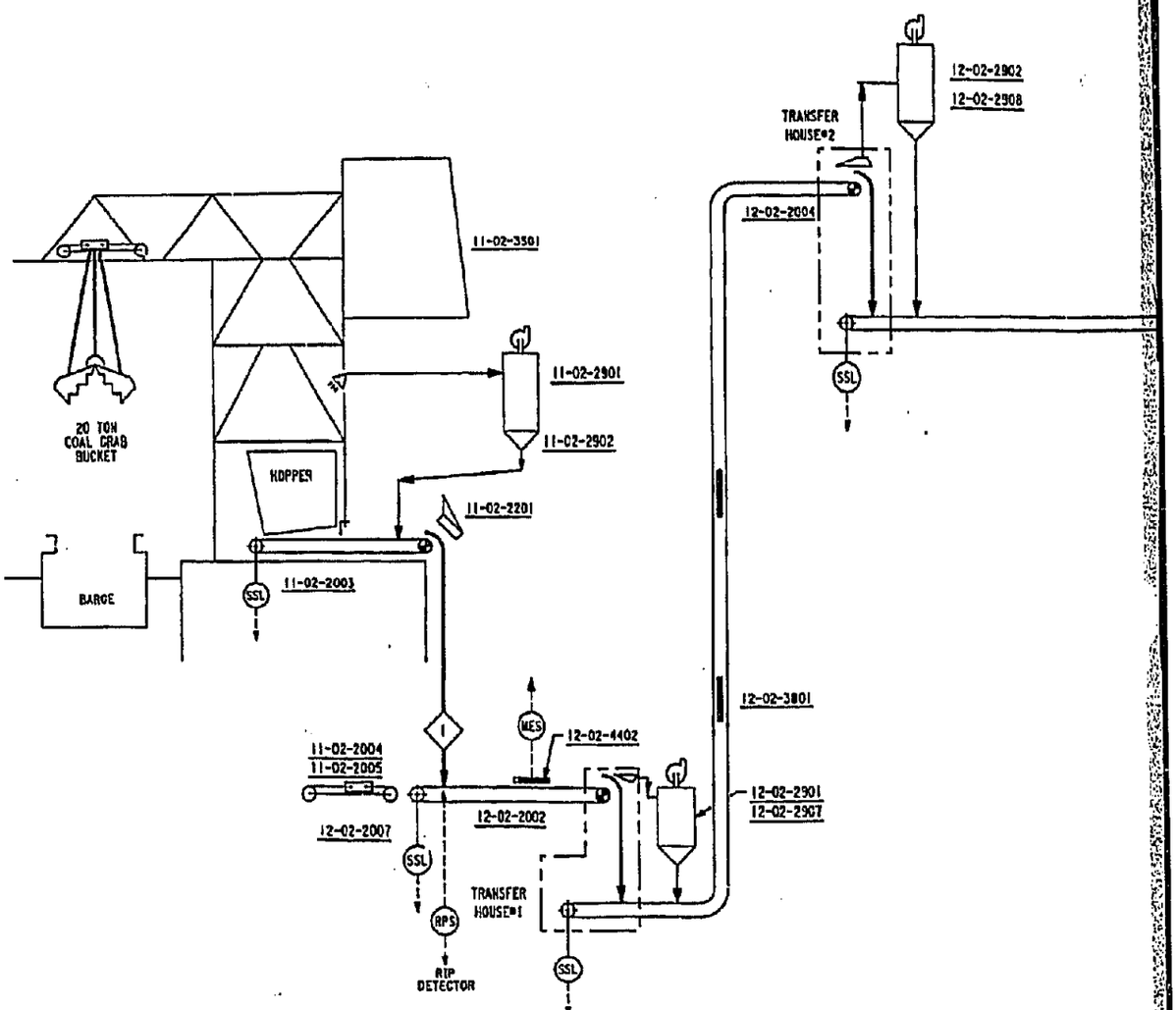
11-02-2901
BARGE UNLOADING
DUST COLLECTOR

12-02-2901
DUST COLLECTOR
TRANSFER HSE#1

12-02-2907
FAN TRANS. HSE#1

12-02-2902
DUST COLLECTOR
TRANS. HSE#2

12-02-2908
FAN TRANS. HSE#2



11-02-2004
11-02-2005
BARGE PULLER

REFERENCES		REFERENCES		REVISIONS								REVISIONS								
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
												B	3/16/82	RS					FOR
												A	6/17/82	RS	DWL		SHP		FOR

NG-GE-22 (12/78)

12-02-2004
42" WIDE 2ND TRANSFER
BELT CONVEYOR

12-01-2005
42" WIDE 3RD TRANSFER
BELT CONVEYOR

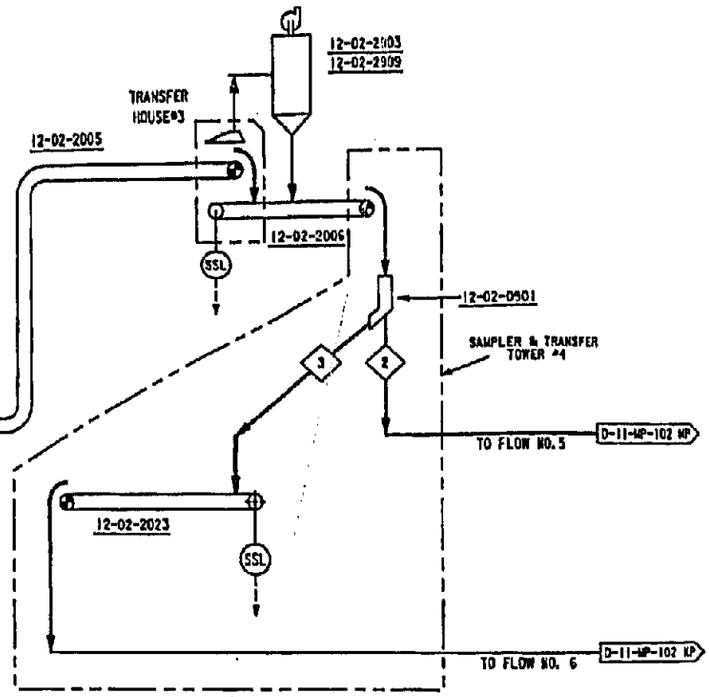
12-02-0901
PRIMARY SAMPLER CUTTER

12-02-2903
DUST COLLECTOR
TRANSFER HOUSE #3

12-02-2909
FAN TRANS. HSE#3

12-02-2006
42" WIDE 4TH TRANSFER
BELT CONVEYOR

NOTES:
1. BARGES TO BE UNLOADED IN 12 HOURS.
MAX. FEED RATE 9000 TPD/10 HOURS=900 TPH.
2. ITEMS MARKED THUS (D) ARE DRIVE PULLEYS.
3. ITEMS MARKED THUS (T) ARE PULLEYS WHERE
MOTION DETECTOR SWITCHES ARE TO BE LOCATED.
4. WORK THIS DRAWING WITH DRAWINGS D-11-MP-102 MP,
D-13-MP-101MP, D-12-MP-101MP, & D-10-MP-101MP.
5. ALL BELT CONVEYORS SHALL HAVE A 10 SEC.
DELAY START TIED IN TO A LOCALLY PLACED
ALARM.
6. ALL BELT CONVEYORS SHALL HAVE EMERGENCY
PULL CORD SWITCHES.
7. RAILROAD CARS TO BE UNLOADED IN 6 HOURS .
FEED RATE 5400/6 HR=900 TPH



12-02-2023
12" WIDE PRIMARY CUT
BELT CONVEYOR

			FOR	
			DRAWN	D. DAVIS
			CHECKED	
			APVD SECT MD	
			APVD PROJ MGR	
			APVD CLIENT	
		FOR DESIGN REPORT		
		FOR CLIENT APPROVAL		
		DESCRIPTION		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

DI IMPIOIN. DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

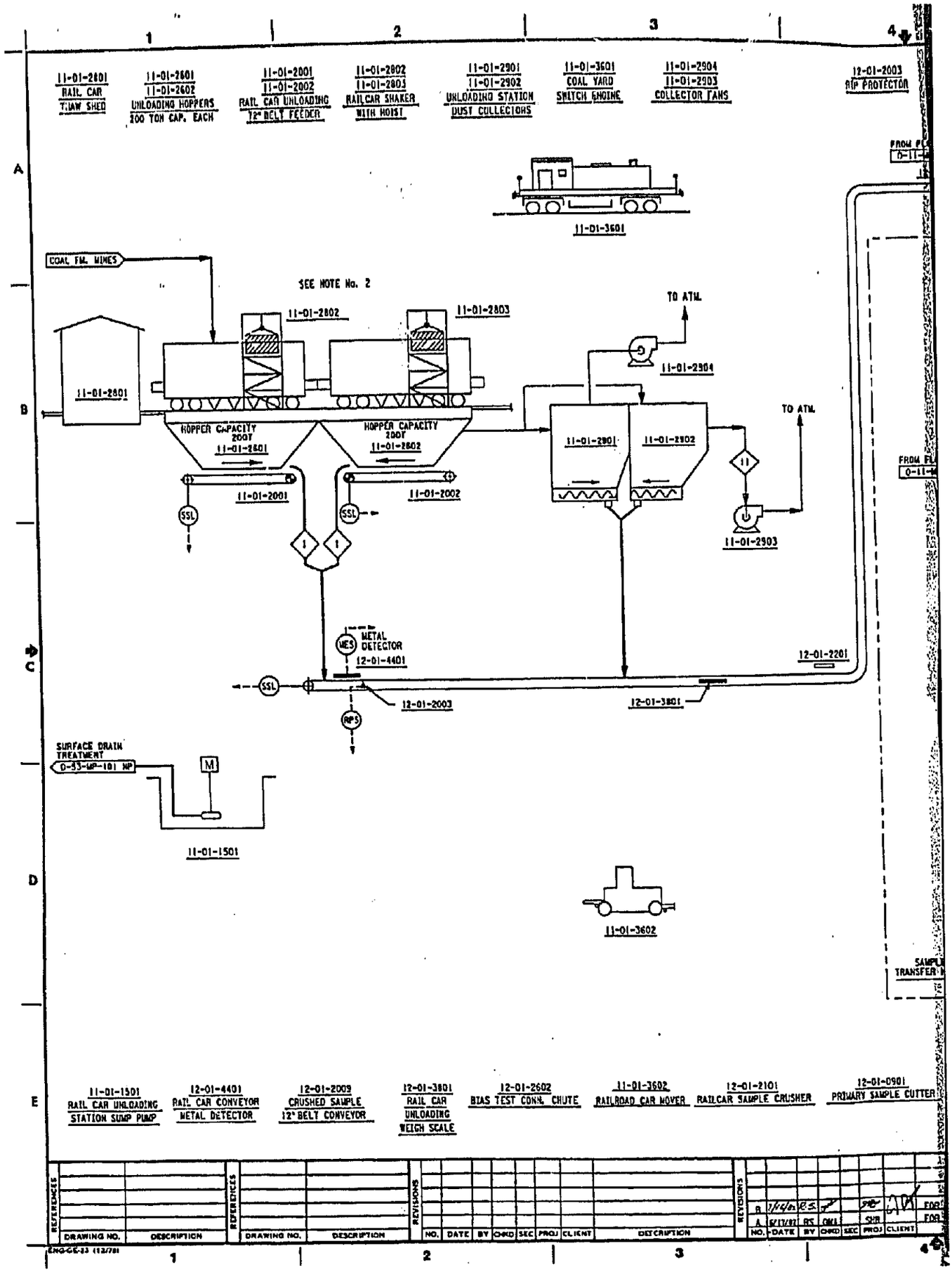
COAL - TO - METHANOL - TO - GASOLINE PLANT

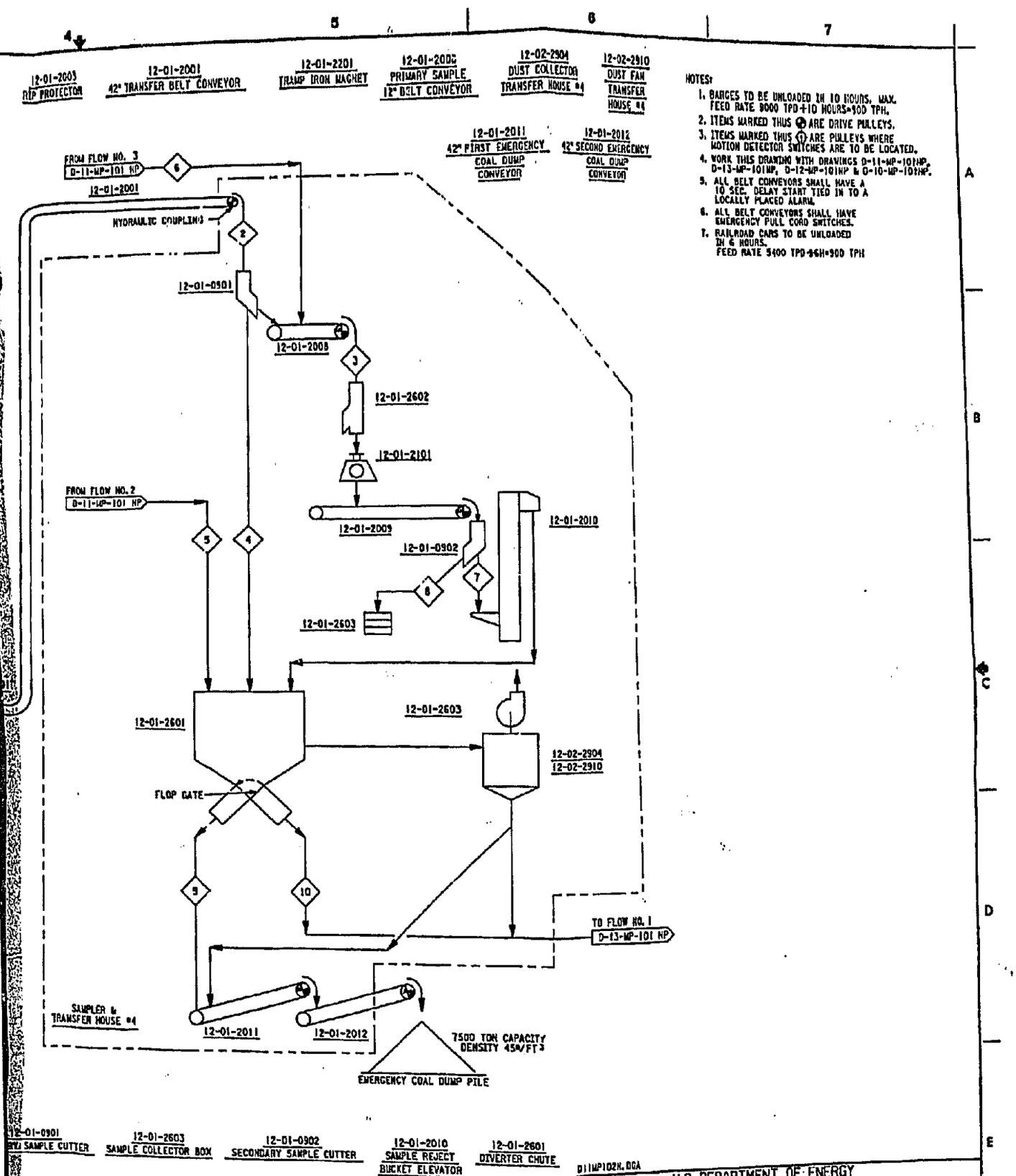
TITLE: PROCESS FLOW & CONTROL DIAGRAM
COAL AREA - UNITS 11 & 12
BARGE UNLOADING, CONVEYING & SAMPLING

SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
NONE	2009	5182	B

DRAWING NUMBER: D-11-MP-101 MP

DT.

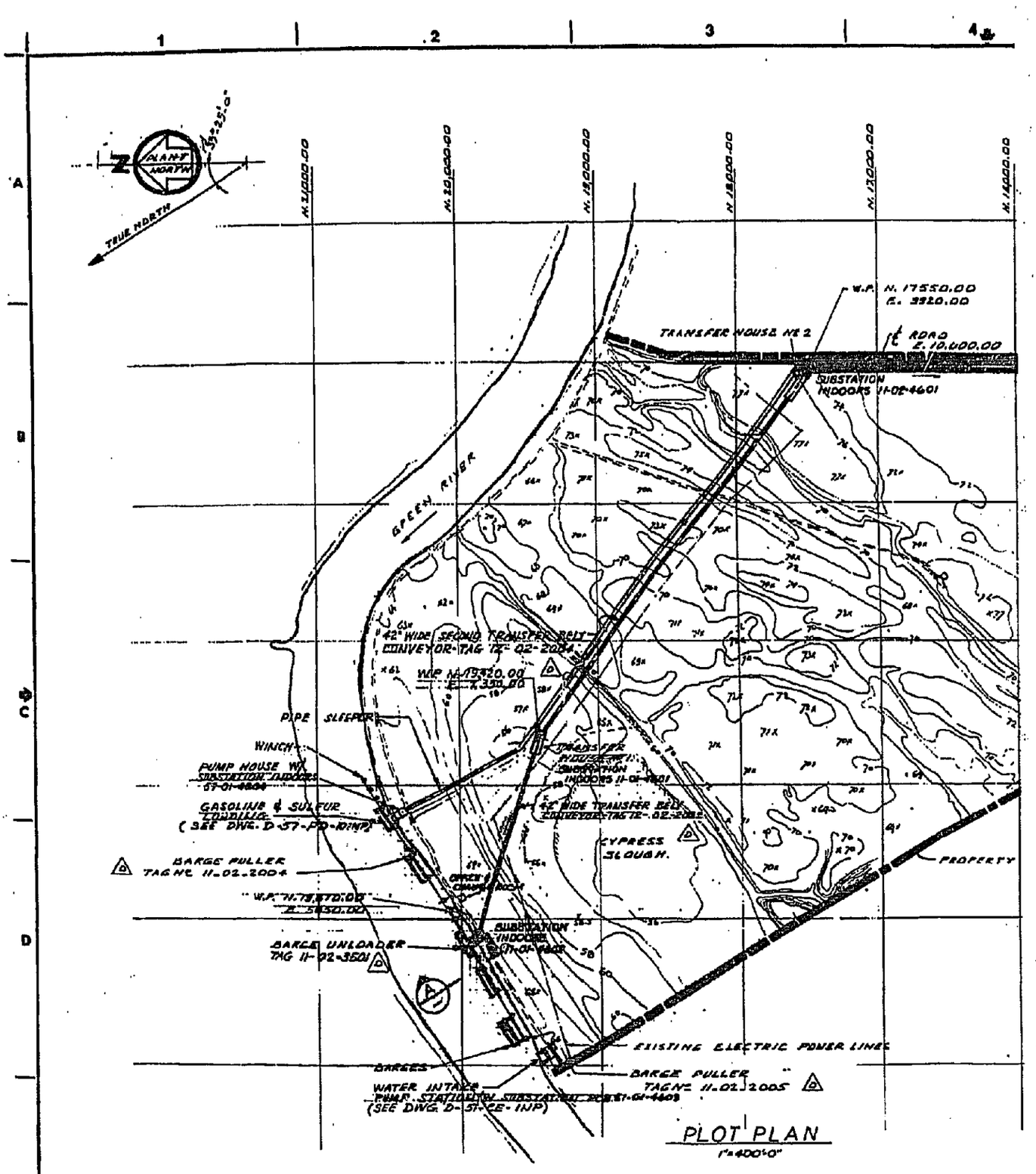

11-01-2801
RAIL CAR THAW SHED
11-01-2601
11-01-2602
UNLOADING HOPPERS 200 TON CAP. EACH
11-01-2001
11-01-2002
RAIL CAR UNLOADING 72" BELT FEEDER
11-01-2802
11-01-2803
RAILCAR SHAKER WITH HOIST
11-01-2901
11-01-2902
UNLOADING STATION DUST COLLECTIONS
11-01-3601
COAL YARD SWITCH ENGINE
11-01-2904
11-01-2903
COLLECTOR FANS
12-01-2003
RP PROTECTOR
11-01-3601
COAL FM. MINES
SEE NOTE No. 2
11-01-2802
11-01-2803
TO ATM.
11-01-2904
11-01-2801
HOPPER CAPACITY 200T
11-01-2601
HOPPER CAPACITY 200T
11-01-2602
11-01-2901
11-01-2902
TO ATM.
11-01-2001
11-01-2002
11-01-2903
METAL DETECTOR
12-01-4401
12-01-2201
12-01-2003
12-01-3801
SURFACE DRAIN TREATMENT
11-01-1501
11-01-3602
11-01-1501
RAIL CAR UNLOADING STATION SUMP PUMP
12-01-4401
RAIL CAR CONVEYOR METAL DETECTOR
12-01-2009
CRUSHED SAMPLE 12" BELT CONVEYOR
12-01-3801
RAIL CAR UNLOADING WEIGH SCALE
12-01-2602
BIAS TEST CONN. CHUTE
11-01-3602
RAILROAD CAR MOVER
12-01-2101
RAILCAR SAMPLE CRUSHER
12-01-0901
PRIMARY SAMPLE CUTTER
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
FOR
FOR


12-01-2003 RIP PROTECTOR
12-01-2001 42" TRANSFER BELT CONVEYOR
12-01-2201 TRAMP IRON MAGNET
12-01-2005 PRIMARY SAMPLE 12" BELT CONVEYOR
12-02-2904 DUST COLLECTOR TRANSFER HOUSE #4
12-02-2910 DUST FAN TRANSFER HOUSE #4
12-01-2011 42" FIRST EMERGENCY COAL DUMP CONVEYOR
12-01-2012 42" SECOND EMERGENCY COAL DUMP CONVEYOR
NOTES:
1. BARGES TO BE UNLOADED IN 10 HOURS, MAX. FEED RATE 8000 TPD÷10 HOURS=800 TPH.
2. ITEMS MARKED THUS ⊕ ARE DRIVE PULLEYS.
3. ITEMS MARKED THUS ⊙ ARE PULLEYS WHERE MOTION DETECTOR SWITCHES ARE TO BE LOCATED.
4. WORK THIS DRAWING WITH DRAWINGS D-11-MP-101NP, D-13-MP-101NP, D-12-MP-101NP & D-10-MP-101NP.
5. ALL BELT CONVEYORS SHALL HAVE A 10 SEC. DELAY START TIED IN TO A LOCALLY PLACED ALARM.
6. ALL BELT CONVEYORS SHALL HAVE EMERGENCY PULL CORD SWITCHES.
7. RAILROAD CARS TO BE UNLOADED IN 6 HOURS. FEED RATE 5400 TPD÷6H=900 TPH
FROM FLOW NO. 3 D-11-MP-101 NP
12-01-2001
HYDRAULIC COUPLING
12-01-0901
12-01-2008
12-01-2602
12-01-2101
FROM FLOW NO. 2 D-11-MP-101 NP
12-01-2009
12-01-2010
12-01-0902
12-01-2603
12-01-2601
12-01-2603
12-02-2904 12-02-2910
FLOP GATE
TO FLOW NO. 1 D-13-MP-101 NP
SAMPLER & TRANSFER HOUSE #4
12-01-2011
12-01-2012
7500 TON CAPACITY DENSITY 45#/FT³
EMERGENCY COAL DUMP PILE
12-01-0901 SAMPLE CUTTER
12-01-2603 SAMPLE COLLECTOR BOX
12-01-0902 SECONDARY SAMPLE CUTTER
12-01-2010 SAMPLE REJECT BUCKET ELEVATOR
12-01-2601 DIVERTER CHUTE
D11MP102N.DGA
U.S. DEPARTMENT OF ENERGY
BASKETT
W.R. GRACE & CO.
KENTUCKY
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT
PROCESS FLOW & CONTROL DIAGRAM
COAL AREA -UNITS 11 & 12
TRAIN UNLOADING, CONVEYING & SAMPLING
SCALE NONE
ACCOUNT NUMBER 2000
JOB NUMBER 6182
DOCUMENT NUMBER D-11-MP-102 NP
REVISION B
FOR DESIGN REPORT
FOR CLIENT APPROVAL
DESCRIPTION
DRAWN
CHECKED
APVD DSGT MG
APVD PROJ MGR
APVD CLIENT
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

F. Plot Plan/General Arrangement Drawings

Plot Plan/General Arrangement Drawings for Coal Receiving and Unloading Unit 11 are as follows:

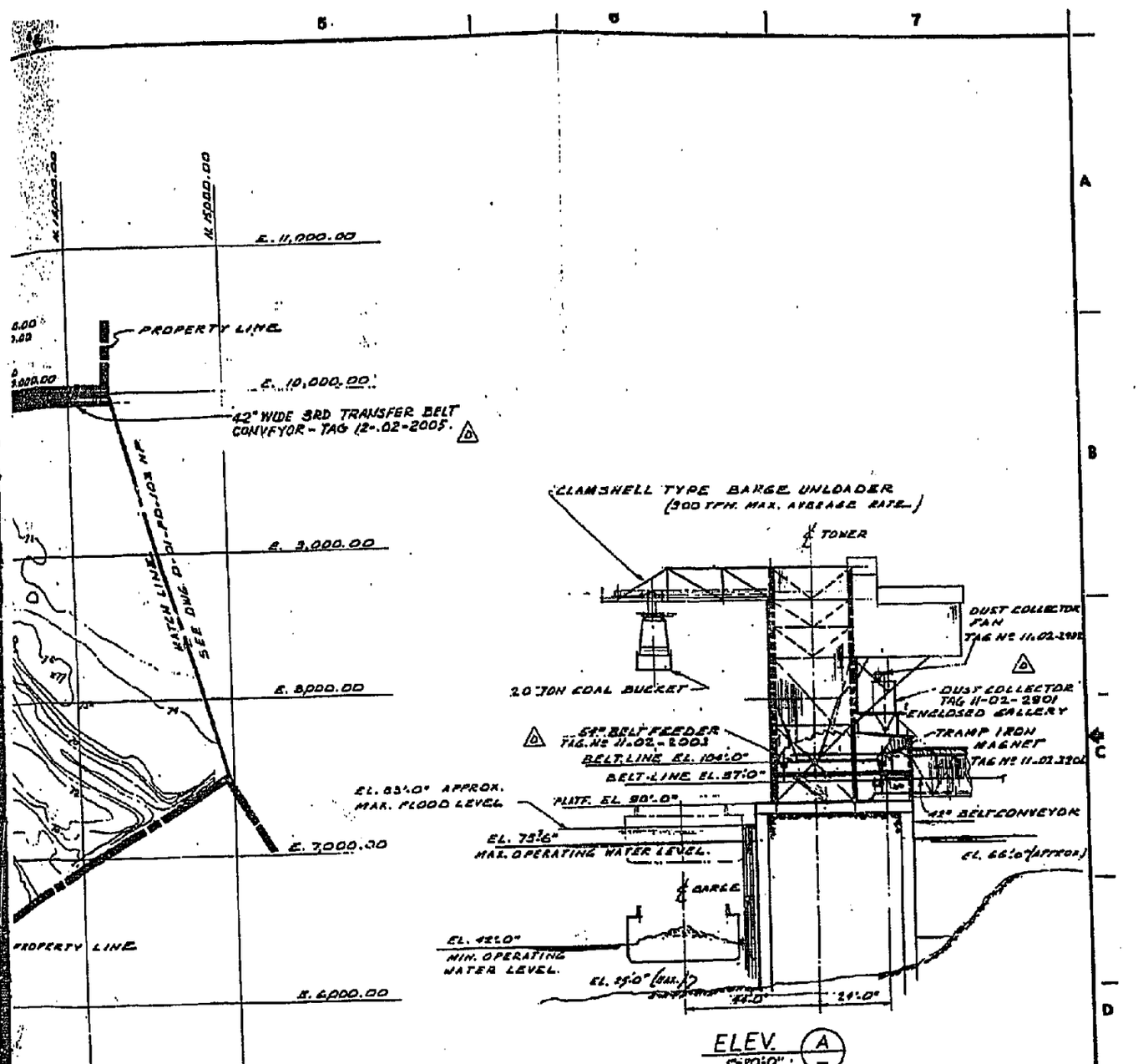
Drawing No.	Title
D-11-MH-101NP	General Arrangement - Receiving and Unloading - Unit 11 Barge Unloading - Plan and Elevations
D-11-MH-103NP	General Arrangement - Receiving and Unloading - Unit 11 Rail Unloading - Plan
D-11-MH-104NP	General Arrangement - Receiving and Unloading - Unit 11 Rail Unloading - Elevations



PLOT PLAN
1"=400'-0"

REFERENCES			
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION

REVISIONS								
NO.	DATE	BY	CHKD	ENG	PROJ	CLIENT	DESCRIPTION	
E	7/1/03	AS					ADDED	RE-ISSUED
D	7/1/03	AS					ADDED	REVISED
C	5/1/03	Ed	PDPE				ADDED	REVISED PE
B	3/1/03							REVISED PE
A	2/28/03	AS						CLIENT



ELEV. A
1"=20'-0"

NOTES:

1/ DATUM EL. 100'-0" ACTUAL EL. 400.0" (M.S.L.)

2/ COAL BARGE SIZE 195'-LG x 35' WIDE.

3/ TUG BOAT SIZE 80' LG x 30' WIDE.

4/ CAPACITY PER COAL BARGE 1500 TONS. 5 COAL BARGES PER DAY REQUIRED.

0 200 400 800 1200 1600 FT.
GRAPHIC SCALE 1"= 400 FT

U.S. DEPARTMENT OF ENERGY

BARKETT — W.R. GRACE & CO. — KENTUCKY

18,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

GENERAL ARRANGEMENT

RECEIVING & UNLOADING — UNIT 11

BARGE UNLOADING - PLAN & ELEVATION

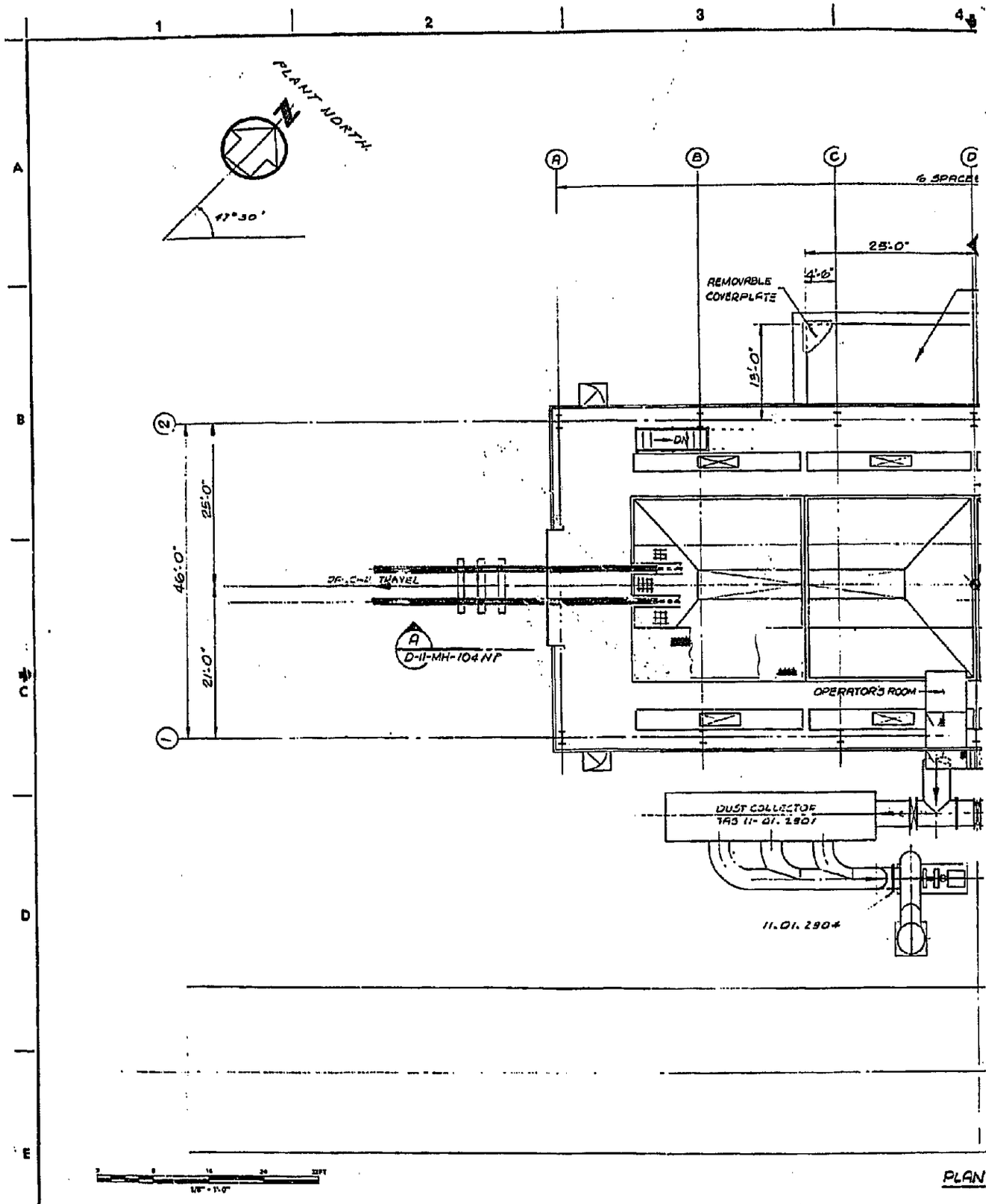
AS NOTED | 2000 | 4/82

D-11-MH-101 NP

E

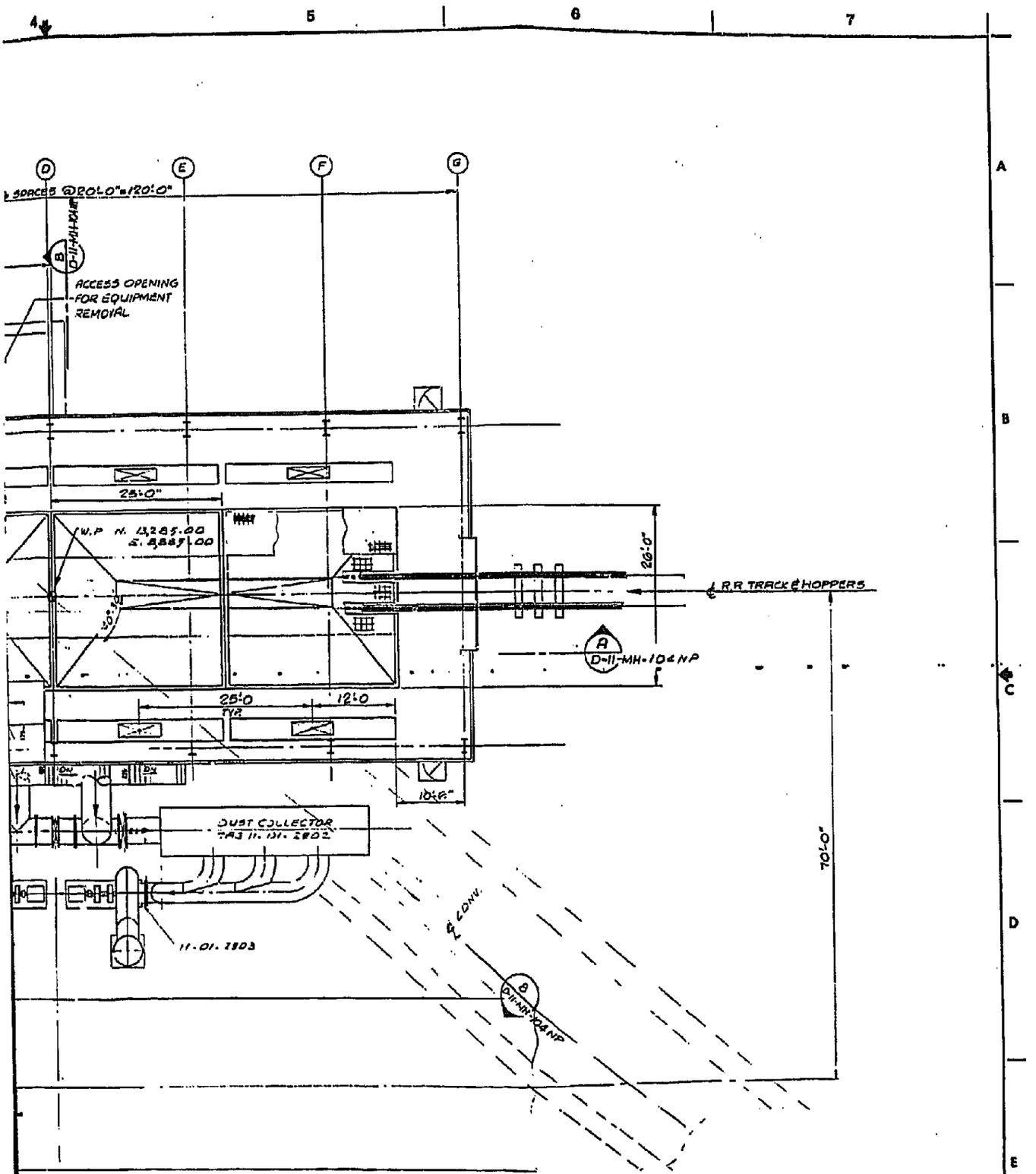
NO.	DESCRIPTION	DRAWN	CHECKED	APVD ENGR MGR	APVD PROJ MGR	APVD CLIENT
201	REISSUED FOR DESIGN REPORT					
	REVISED FOR CLIENT APPROVAL					
	ISSUED FOR DESIGN REPORT					
	ISSUED FOR CLIENT APPROVAL					
	CLIENT ISSUED PRELIMINARY					

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA



REFERENCES			REFERENCES			REVISIONS									REVISIONS									
DRAWING NO.	DESCRIPTION		DRAWING NO.	DESCRIPTION		NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION		NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION		
															B	5-26-82	L.K.	R.S.		SW	KAS	ISSUED		
															A	5-5-82	L.K.	R.S.		SW		ISSUED		

ENG-GE-23 (12/78)



PLAN

		DRAWN	LBK 5-4-82
		CHECKED	RS 5-5-82
3/5	ISSUED FOR DESIGN REPORT	APVD. DEPT HD	5-5-82
	ISSUED FOR CLIENT APPROVAL	APVD PROJ MGR	5-5-82
IENT	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

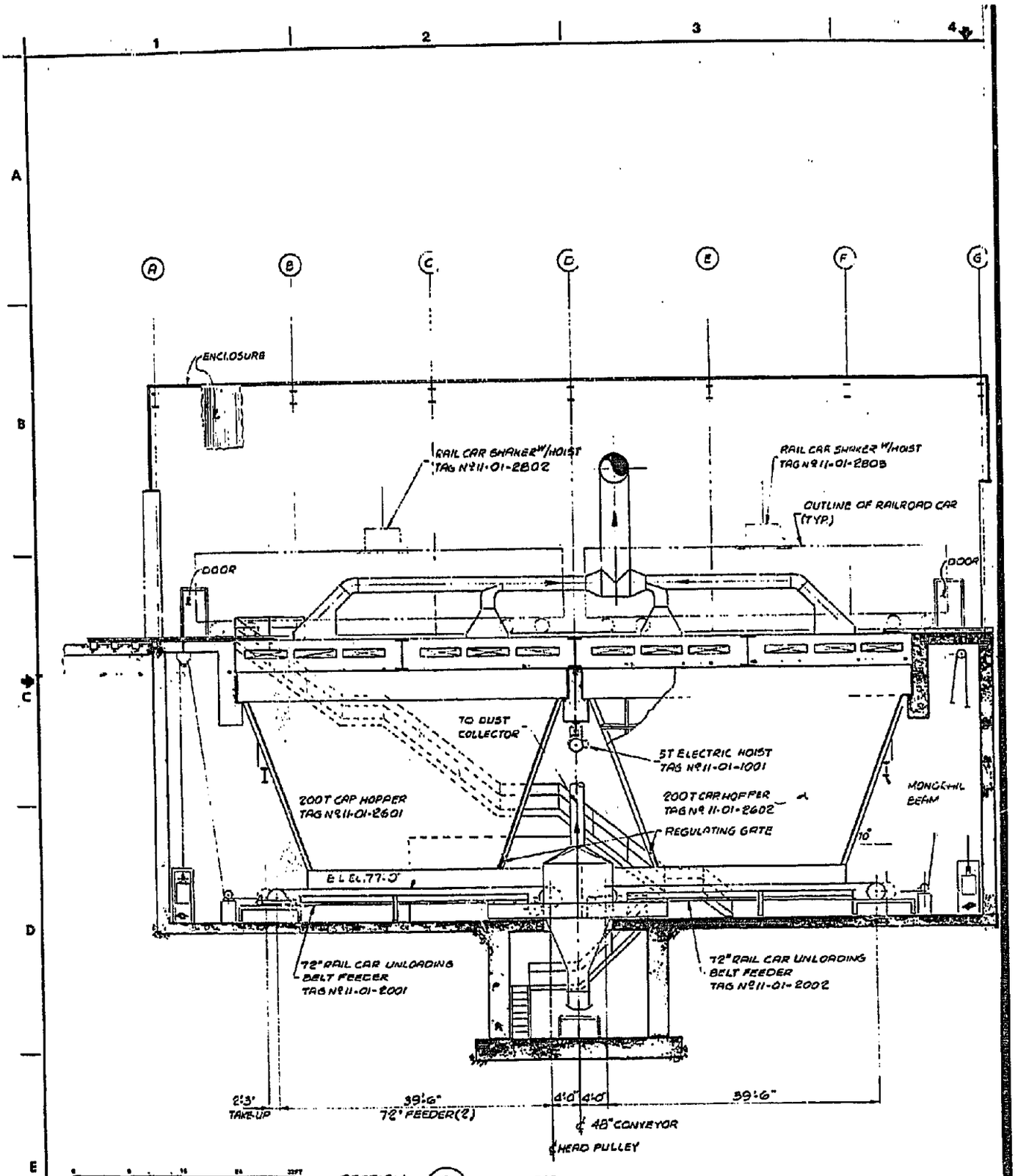
BASKETT — W.R. GRACE & CO. — KENTUCKY

12500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE	SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
GENERAL ARRANGEMENT RECEIVING & UNLOADING - UNIT 11 RAIL UNLOADING - PLAN	1/8"=1'-0"	2000	6182	A

DOCUMENT NUMBER: D-11-MH-103 N.P.



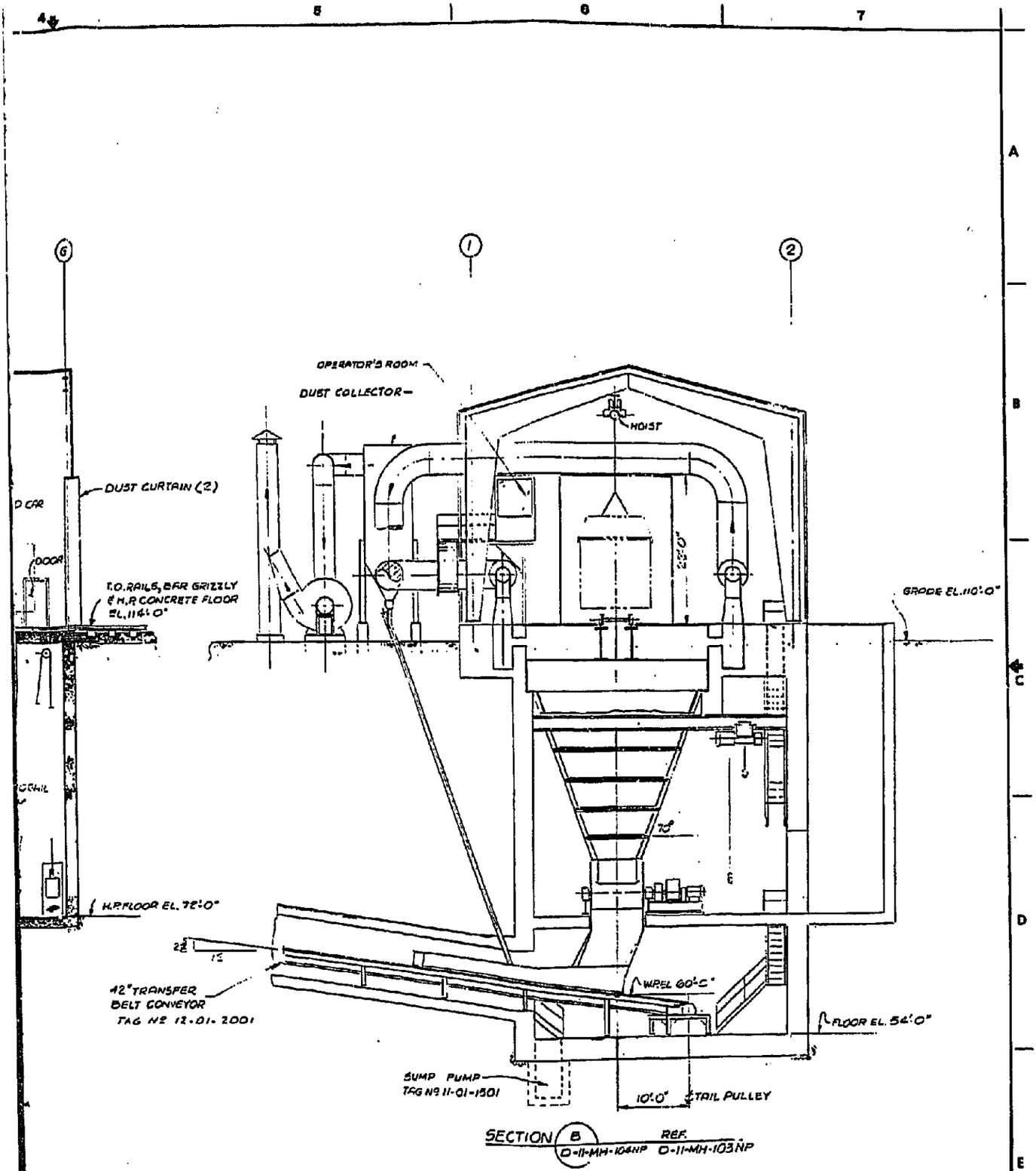
REFERENCES	DRAWING NO.	DESCRIPTION
	D-11-MH-103NP	"A" LINE SECTION

REFERENCES	DRAWING NO.	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT
	B	5-28-82						ISSUED
	A	5-5-82						ISSUED

ENG-GE-33 (12/79)



ISSUE	DESCRIPTION	BY	DATE
	ISSUED FOR DESIGN REVIEW		
	ISSUED FOR CLIENT APPROVAL		

DRAWN LC 5-4-82
ENGR'D RG 5-6-82
APVD SECT MGR [illegible] 5-5-82
APVD PROJ MGR [illegible] 5-5-82
APVD CLIENT

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: GENERAL ARRANGEMENT RECEIVING & UNLOADING - UNIT 11 RAIL UNLOADING - SECTIONS

SCALE: 1/8"=1'-0" | ASSIGNMENT NUMBER: 2000 | JOB NUMBER: 6182

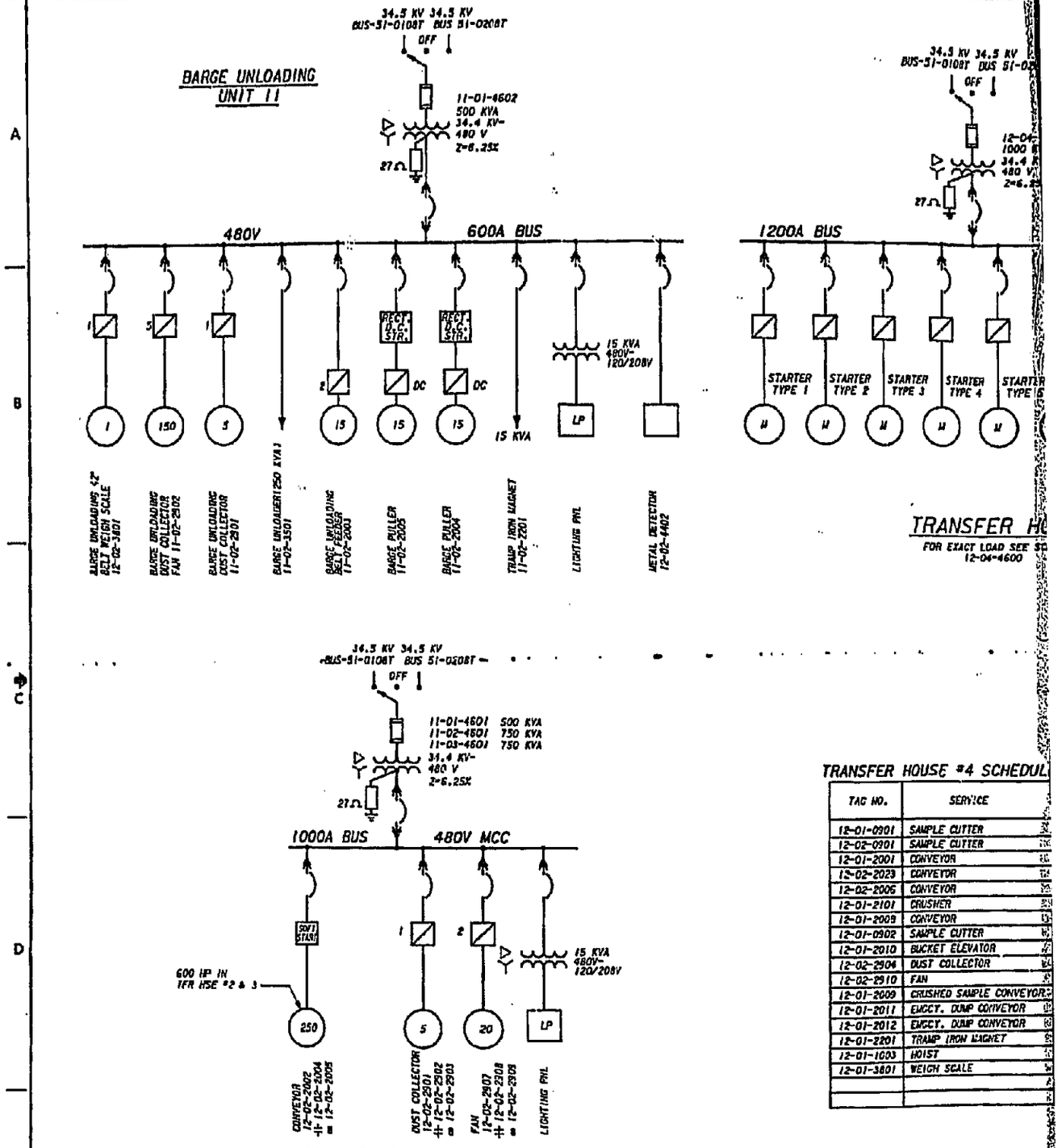
DOCUMENT NUMBER: D-11-MH-104NP

REVISION: 2

G. Single-Line Diagrams

Single-Line Diagrams for Coal Receiving and Unloading Unit 11 are as follows:

Drawing No.	Title
D-51-EE-102NP Sheet 1	Single-Line Diagram - Units 11, 12, 13 and 14
D-51-EE-102NP Sheet 2	Single-Line Diagram - Units 11, 12, 13 and 14
D-51-EE-102NP Sheet 3	Single-Line Diagram - Units 11, 12, 13 and 14

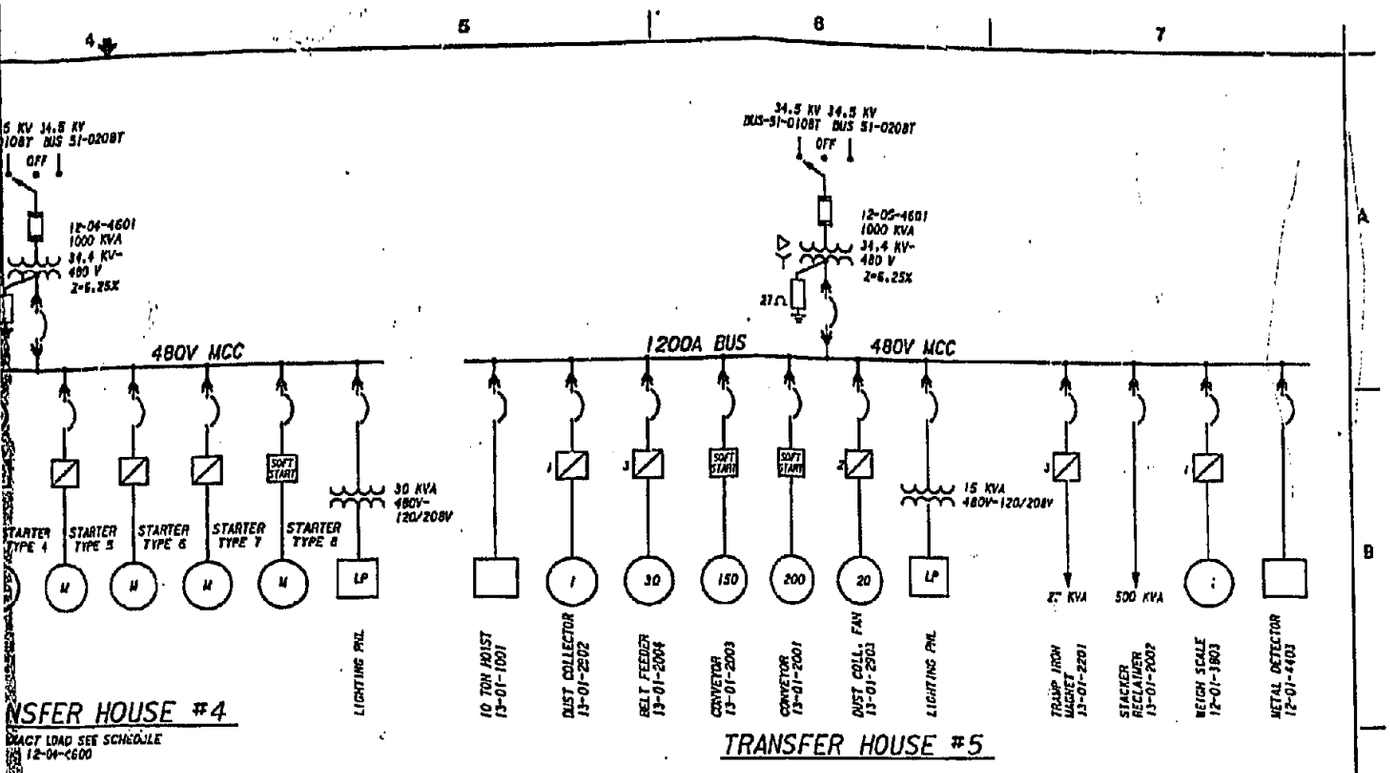


TRANSFER HOUSE #4 SCHEDUL

TAG NO.	SERVICE
12-01-0901	SAMPLE CUTTER
12-02-0901	SAMPLE CUTTER
12-01-2001	CONVEYOR
12-02-2023	CONVEYOR
12-02-2005	CONVEYOR
12-01-2101	CRUSHER
12-01-2009	CONVEYOR
12-01-0902	SAMPLE CUTTER
12-01-2010	BUCKET ELEVATOR
12-02-2904	DUST COLLECTOR
12-02-2910	FAN
12-01-2009	CRUSHED SAMPLE CONVEYOR
12-01-2011	EMRGCY. DUMP CONVEYOR
12-01-2012	EMRGCY. DUMP CONVEYOR
12-01-2201	TRAMP IRON MAGNET
12-01-1003	HOIST
12-01-3801	WEIGH SCALE

REFERENCES			REVISIONS															
DRAWING NO.	DESCRIPTION	REFERENCES	DRAWING NO.	DESCRIPTION	REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
						B	7-1-82	LS	T.L.	ATR	AWJ		FOR									
						A	6/16	LS	TS	RTB	AWJ		ISSU									

ENG-06-43 (12/79)



NSFER HOUSE #4

EXACT LOAD SEE SCHEDULE 12-04-4600

TRANSFER HOUSE #5

SCHEDULE 12-04-4600

SERVICE	STR FOR TYPE	MOTOR HP	STR SIZE
LITTER	1	3/4	1
LITTER	1	1/2	1
	8	250	6
	1	2	1
	8	250	6
	1	10	1
	1	1	1
LITTER	1	3/4	1
LEVATOR	1	5	1
LECTOR	1	5	2
	2	20	2
SAMPLE CONVEYOR	2	20	2
AMP. CONVEYOR	8	200	5
AMP. CONVEYOR	8	200	5
NT MAGNET	1	15 KVA	1
	1	1	1
	1	3	1

		DSGN	
		DRAWN	
		CHECKED	
A1	FOR DESIGN REPORT	APVD DEPT MGR	
A0	ISSUED FOR CLIENT APPROVAL	APVD PROJ MGR	
NO.	CLIENT DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

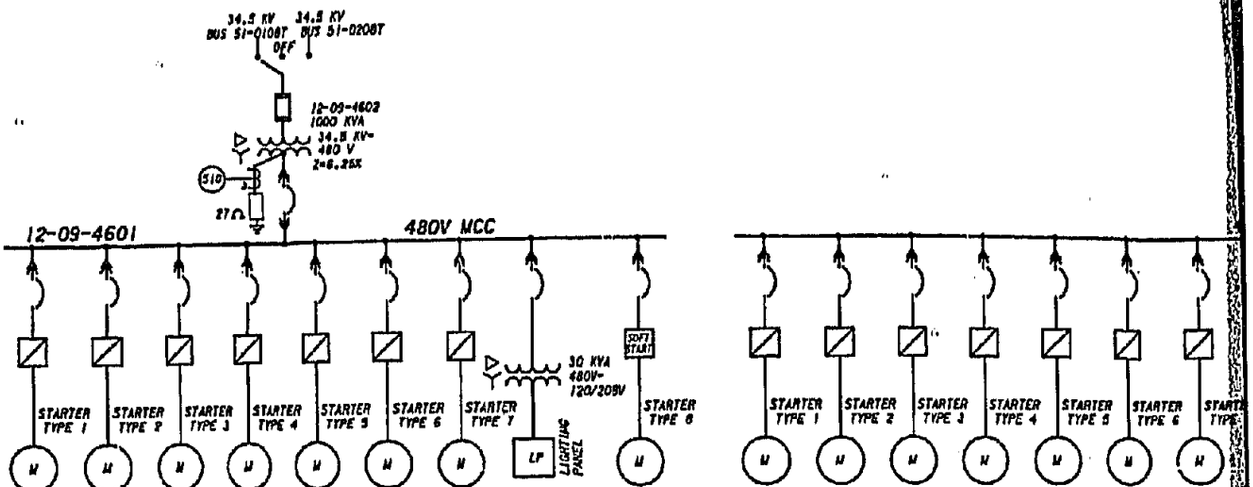
12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SINGLE LINE DIAGRAM RECEV. AND UNLOADING UNIT-11 CONV. AND STORAGE UNIT-12 STACKING AND RECLA. UNIT-13

SCALE: NONE | ACCOUNT NUMBER: 4600 | JOB NUMBER: 6182 | REVISION: B

DOCUMENT NUMBER: D-51-EE-102NP SHT. 1 OF 3



TRANSFER HOUSE #6

FOR EXACT LOAD SEE SCHEDULE

COAL BUNKER HOUSE

FOR EXACT LOAD SEE SCHEDULE

TRANSFER HOUSE #6 SCHD.

TAG NO.	SERVICE	STR FDR TYPE	MOTOR HP	STR SIZE	M. QTY
12-01-2014	CONVEYOR	8	150	5	1
12-02-2013	CONVEYOR	8	250	6	1
12-01-2911	FAN	2	20	2	1
12-01-1001	HOIST	1	1	1	1
12-01-5001	ELEVATOR	1	20	1	1
12-01-2914	FAN	2	20	2	
12-01-2015	BELT TRIPPER	1	5	1	1
12-01-0501	DISCH FEEDER	1	5	1	1
12-01-0502	DISCH FEEDER	1	5	1	1
12-01-2916	FAN	2	20	2	1
12-01-1501	SUMP PUMP	1	5	1	1
12-02-0501	DISCH FEEDER	1	5	1	1
12-02-0502	DISCH FEEDER	1	5	1	1
12-03-0501	DISCH FEEDER	1	5	1	1
12-03-0502	DISCH FEEDER	1	5	1	1
12-02-1501	SUMP PUMP	1	5	1	1
12-03-1501	SUMP PUMP	1	5	1	1
12-02-2914	FAN	2	20	2	1
12-03-2914	FAN	2	20	2	1
12-02-2916	FAN	2	20	2	1
12-03-2916	FAN	2	20	2	1
12-01-2905	DUST COLL	1	5	1	1
12-01-2912	DUST COLL FAN	2	20	2	1
12-01-2906	DUST COLL	1	5	1	1

COAL BUNKER HOUSE SCHD.

TAG NO.	SERVICE	STR FDR TYPE	MOTOR HP	STR SIZE	M. QTY
12-01-1002	HOIST	1	1	1	1
12-01-2016	BELT TRIPPER	1	5	1	1
12-02-2921	DUST COLLECTOR FAN	1	5	1	1
12-01-2921	DUST COLLECTOR FAN	2	20	2	1
12-01-2922	DUST COLLECTOR FAN	2	20	2	1
12-02-2922	DUST COLLECTOR FAN	2	20	2	1
12-03-2920	DUST COLLECTOR FAN	2	20	2	1
12-01-2020	SCREW FEEDER	1	1	1	3
12-01-2021	SCREW FEEDER	1	1	1	3
12-01-2022	SCREW FEEDER	1	1	1	3
12-03-2020	SCREW FEEDER	1	1	1	3
12-02-2020	SCREW FEEDER	1	1	1	3
12-02-2021	SCREW FEEDER	1	1	1	3
12-02-2022	SCREW FEEDER	1	1	1	3
12-03-2021	SCREW FEEDER	1	1	1	3
12-03-2921	DUST COLLECTOR FAN	2	20	2	1
12-03-2922	DUST COLLECTOR FAN	2	20	2	1
12-03-2022	SCREW FEEDER	1	1	1	1
12-02-2917	DUST COLLECTOR	1	5	1	1
12-02-2918	DUST COLLECTOR	1	5	1	1
12-02-2919	DUST COLLECTOR	1	5	1	1
12-03-2917	DUST COLLECTOR	1	5	1	1
12-03-2918	DUST COLLECTOR	1	5	1	1
12-03-2919	DUST COLLECTOR	1	5	1	1
12-01-2920	DUST COLLECTOR FAN	2	20	2	1
12-02-2920	DUST COLLECTOR FAN	2	20	2	1
12-01-2913	DUST COLLECTOR	1	5	1	1
12-02-2913	DUST COLLECTOR	1	5	1	1
12-03-2913	DUST COLLECTOR	1	5	1	1
12-01-2915	DUST COLLECTOR	1	5	1	1
12-02-2915	DUST COLLECTOR	1	5	1	1
12-03-2915	DUST COLLECTOR	1	5	1	1
12-01-2917	DUST COLLECTOR	1	5	1	1
12-01-2918	DUST COLLECTOR	1	5	1	1
12-01-2919	DUST COLLECTOR	1	5	1	1

RAIL CAR UNLOADING

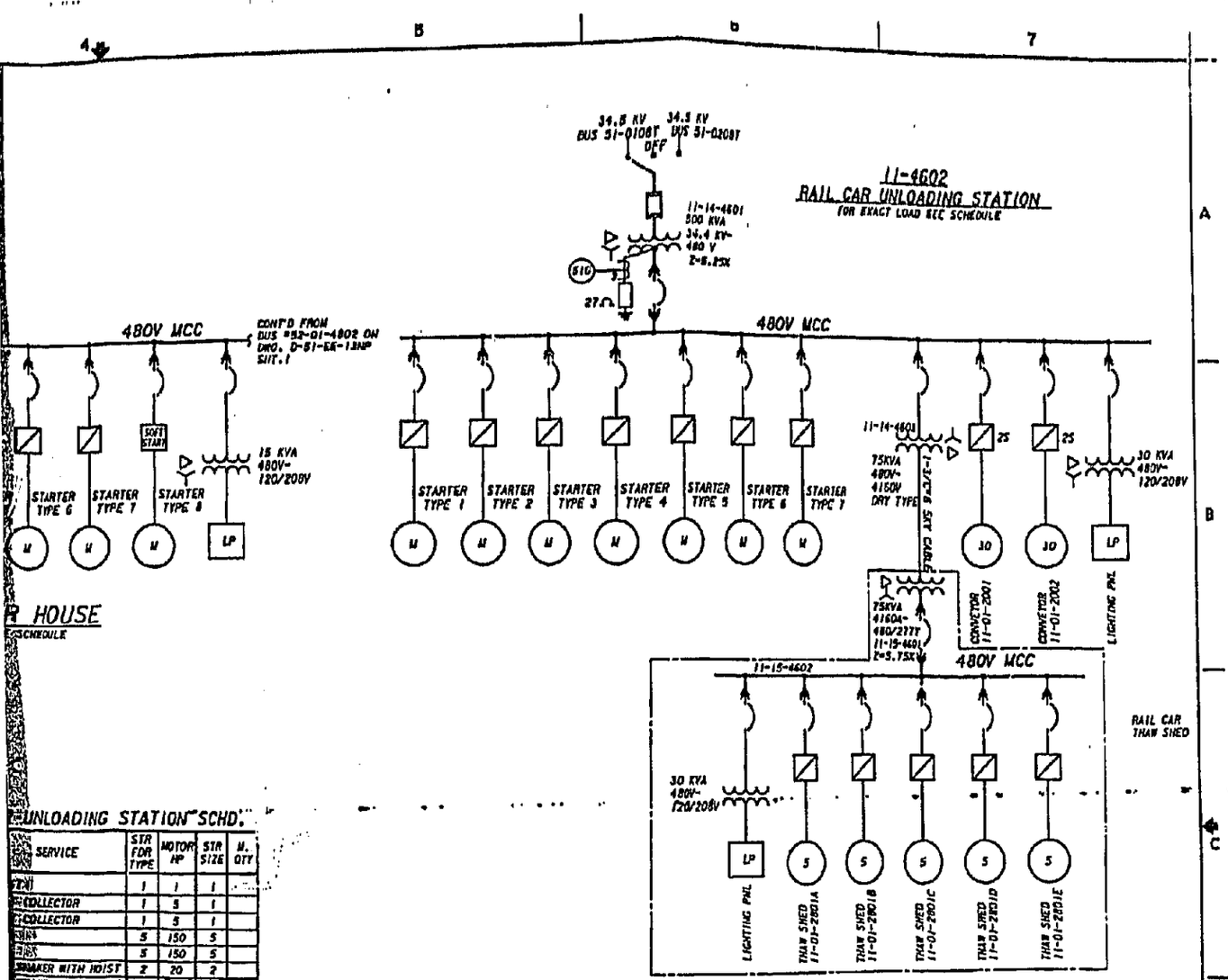
TAG NO.	SERVICE
11-01-1001	HOIST
11-01-2901	DUST COLLECTOR
11-01-2902	DUST COLLECTOR
11-01-2903	FAN
11-01-2904	FAN
11-01-2802	CAR SHAKER WITH HOIST
11-01-2803	CAR SHAKER WITH HOIST
11-01-1501	SUMP PUMP
11-01-3602	RAIL CAR MOVER
12-01-4401	METAL DETECTOR

REFERENCES — DRAWING NO. — DESCRIPTION

REVISIONS — NO. — DATE — BY — CHKD — SEC — PROJ — CLIENT — DESCRIPTION

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION
B	7-1-82	IS	T.J.	RTB	Pusky	JT	FOR BID
A	6-16-82	IS	TS	RTB	GS		ISSUED

ENG-GE-23 (12/79)



11-4602
RAIL CAR UNLOADING STATION
FOR EXACT LOAD SEE SCHEDULE

R HOUSE
SCHEDULE

UNLOADING STATION SCHD.

SERVICE	STR FOR TYPE	MOTOR HP	STR SIZE	M. QTY
[illegible]	1	1	1	
COLLECTOR	1	5	1	
COLLECTOR	1	5	1	
[illegible]	5	150	5	
[illegible]	5	150	5	
SHAKER WITH HOIST	2	20	2	
SHAKER WITH HOIST	2	20	2	
[illegible]	1	5	1	
LOAD MOVER	1	10	1	
DETECTOR	1	1	1	1

1	10/87	FOR DESIGN REPORT	
0		ISSUED FOR CLIENT APPROVAL	
	CLIENT	DESCRIPTION	

FOR	
DRAWN	LS
CHECKED	
APVD SECT MGR	
APVD PROJ MGR	
APVD CLIENT	

THE RALPH M. FARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

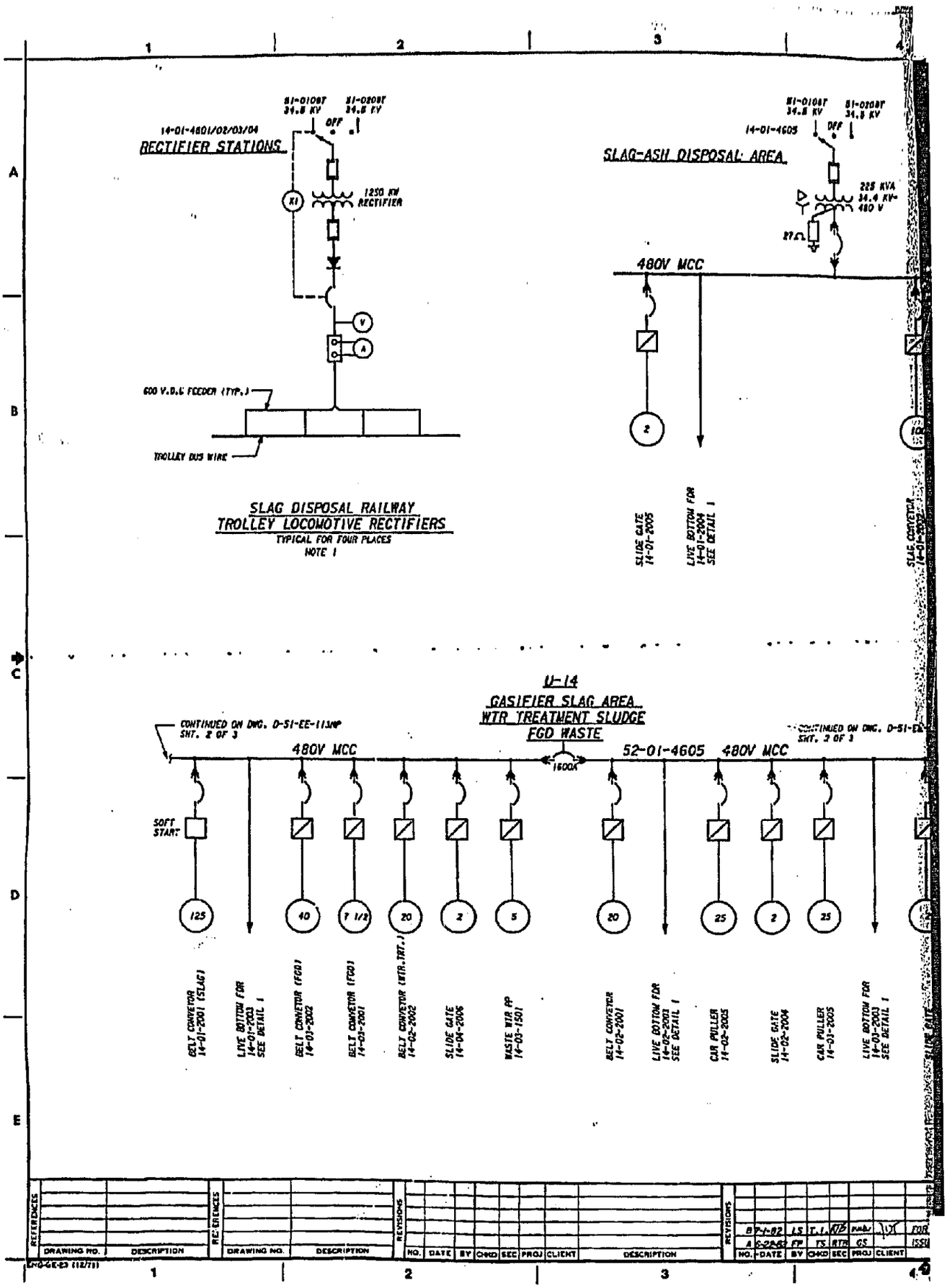
12,500 B.P.D.

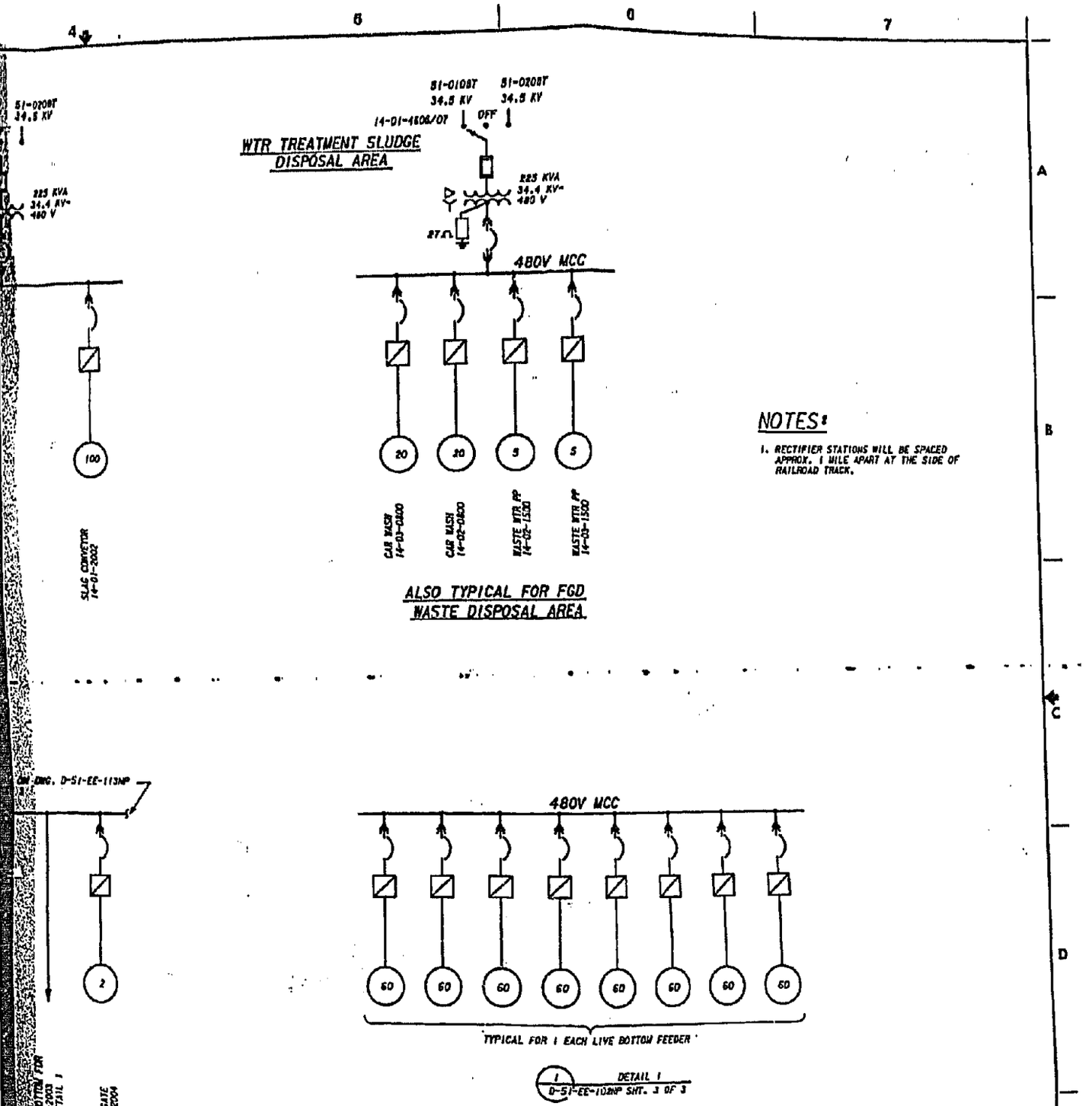
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SINGLE LINE DIAGRAM
RECEV. AND UNLOADING UNIT-11
CONV. AND STORAGE UNIT-12
STACKING AND RECLA. UNIT-13

SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
NONE	4600	6182	A

DOCUMENT NUMBER: D-51-EE-102NP SHT. 2 OF 3


51-0108T 34.5 KV
51-0208T 34.5 KV
OFF
14-01-4601/02/03/04
RECTIFIER STATIONS
X1
1250 KW RECTIFIER
V
A
600 V.D.C FEEDER (TYP.)
TROLLEY BUS WIRE
SLAG DISPOSAL RAILWAY
TROLLEY LOCOMOTIVE RECTIFIERS
TYPICAL FOR FOUR PLACES
NOTE 1
51-0108T 34.5 KV
51-0208T 34.5 KV
14-01-4605
OFF
SLAG-ASH DISPOSAL AREA
225 KVA 34.4 KV-480 V
27Ω
480V MCC
2
SLIDE GATE 14-01-2005
LIVE BOTTOM FOR 14-01-2004 SEE DETAIL 1
SLAG CONVEYOR
U-14
GASIFIER SLAG AREA
WTR TREATMENT SLUDGE
FGD WASTE
CONTINUED ON DWG. D-51-EE-113MP SHT. 2 OF 3
480V MCC
1600A
52-01-4605 480V MCC
CONTINUED ON DWG. D-51-EE SHT. 2 OF 3
SOFT START
125
40
7 1/2
20
2
5
20
25
2
25
BELT CONVEYOR 14-01-2001 (SLAG)
LIVE BOTTOM FOR 14-01-2003 SEE DETAIL 1
BELT CONVEYOR (FGD) 14-03-2002
BELT CONVEYOR (FGD) 14-03-2001
BELT CONVEYOR (WTR. TRT.) 14-02-2002
SLIDE GATE 14-04-2006
WASTE WTR PP 14-03-1501
BELT CONVEYOR 14-02-2001
LIVE BOTTOM FOR 14-02-2003 SEE DETAIL 1
CAR PULLER 14-02-2005
SLIDE GATE 14-02-2004
CAR PULLER 14-31-2005
LIVE BOTTOM FOR 14-03-2003 SEE DETAIL 1
SLIDE GATE
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
B 7-1-82 LS T.I. WB
A 6-28-82 FP TS RTR GS
FOR ISSUE
ENG-EE-E3 (12/79)



			FOR		
			DRAWN	FP	
			CHECKED		
			APVD DESV MG		
			APVD PROJ MGR		
			APVD CLIENT		
PROJ	CLIENT	DESCRIPTION			
		FOR DESIGN REPORT			
		ISSUED FOR CLIENT APPROVAL			

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — KENTUCKY

W.R. GRACE & CO.
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SINGLE LINE DIAGRAM
SLAG AND FGD DISPOSAL
UNIT-14

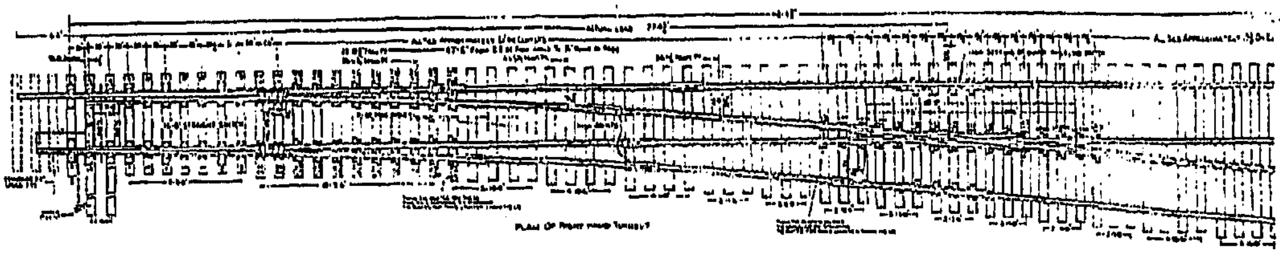
SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
NONE	4600	6182	8

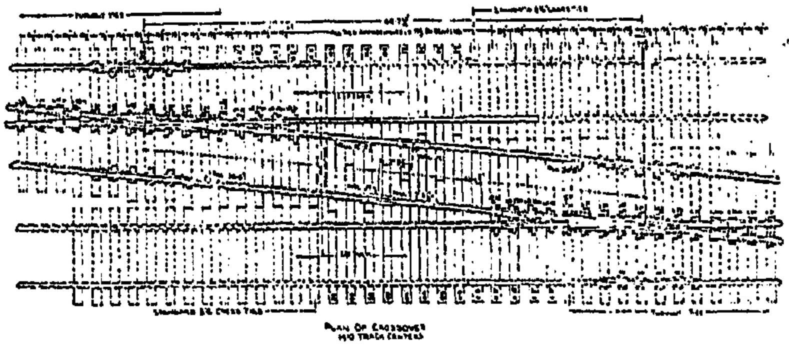
DOCUMENT NUMBER: D-51-EE-102NP
SHT 1 OF 3

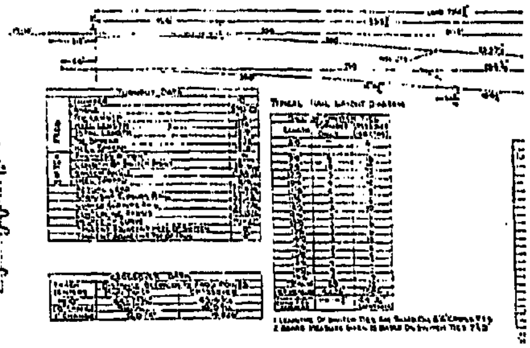
H. Civil Engineering Drawing

Civil Engineering Drawing for Coal Receiving and Unloading Unit 11 is as follows:

Drawing No.	Title
D-11-CE-101NP	Railroad - Sections and Details

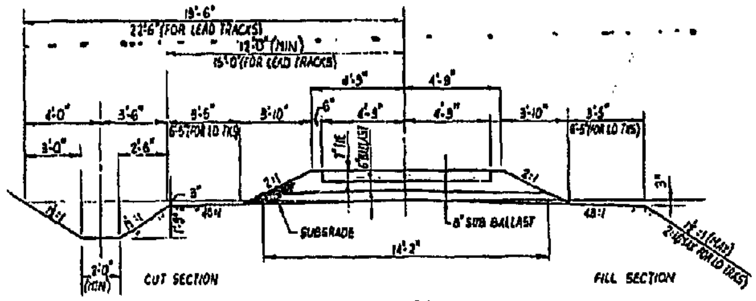




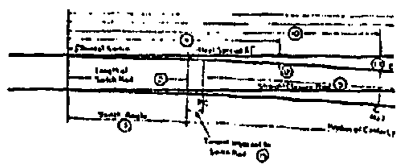


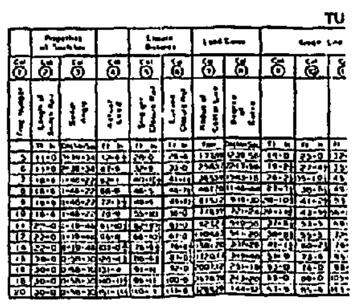
A.R.E.A. NO 10 TURNOUT & CROSSOVER

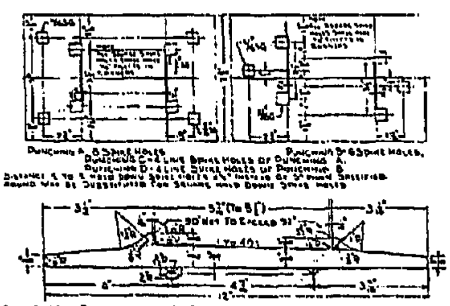
NTS



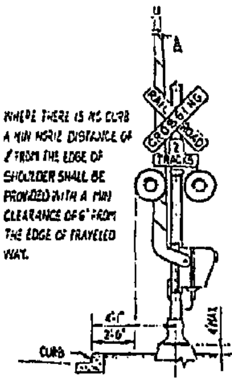
BALLAST SECTION







WHERE THERE IS NO CURB A MIN HORIZ DISTANCE OF [illegible] FROM THE EDGE OF SHOULDER SHALL BE PROVIDED WITH A MIN CLEARANCE OF 6' FROM THE EDGE OF TRAVELED WAY.



A.R.E.A. TURNOUT &

A.R.E.A. TIE PLATE

NTS

REFERENCES	DRAWING NO.	DESCRIPTION	REFERENCES	DRAWING NO.	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
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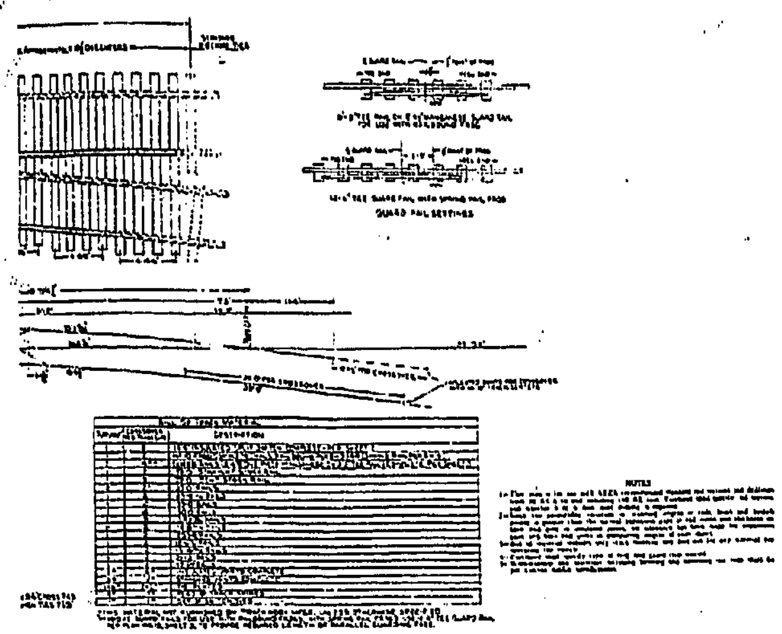
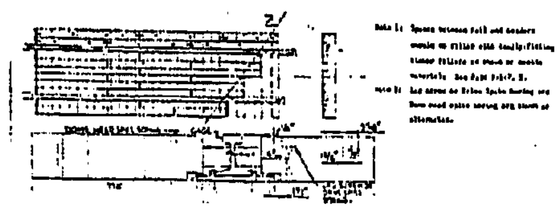
	A	5-14-82	THK					FOR

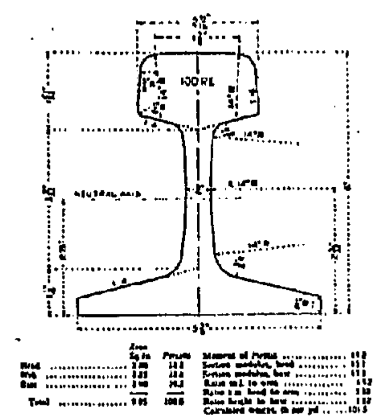
ENG-GE-23 (12/78)





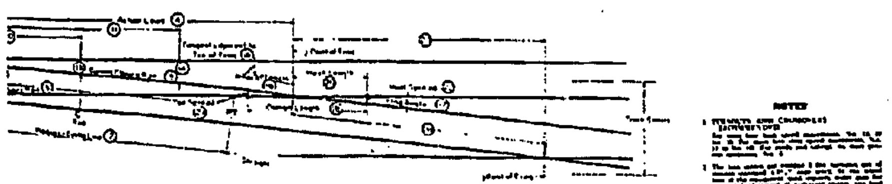
WOOD PLANK ROAD CROSSING

NTS

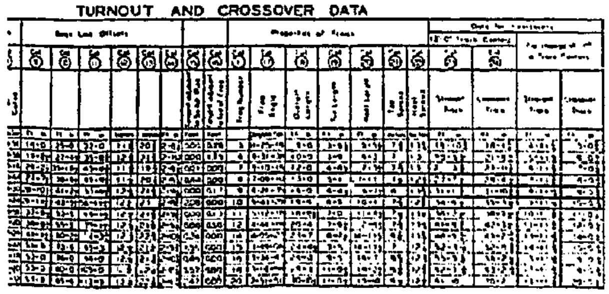


100 RE RAIL SECTION

NTS



TURNOUT AND CROSSOVER DATA



TURNOUT & CROSSOVER DATA FOR STRAIGHT SPLIT SWITCHES

NTS

NOTES:

1. THE MINIMUM SIZE TURNOUT FROM ALL MAIN TRACKS, LOOP & FAST LOAD TRACKS SHALL BE NO 10 PER L&N RAILROAD SPECIFICATIONS FOR COAL LOADING TRACKS.
2. THE MINIMUM SIZE OF ALL SECONDARY TURNOUTS FOR CONVENTIONAL LOAD TRACKS SHALL BE NO 8 PER L&N RAILROAD SPECIFICATIONS FOR COAL LOADING TRACKS.

		FOR		
		DRAWN	TYK	
		CHECKED	JA	
		APVD SECT MGR		5-14-82
	ISSUED FOR DESIGN REPORT FOR CLIENT APPROVAL	APVD PROJ MGR		5-14-82
CLIENT	DESCRIPTION	APVD CLIENT		

RMP
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 BPD

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: RAILROAD SECTIONS & DETAILS 12.5K BPD

SCALE: AS SHOWN — ACCOUNT NUMBER: 4800 — JOB NUMBER: 6182

DOCUMENT NUMBER: D-11-CE-101 NP — REVISION: 5

1.2.2 COAL CONVEYING AND STORAGE - UNIT 12

A. Basis of Design

The coal conveying and storage systems employ commercially known technology normally used in utility and mining industries of similar capacities. Belt conveyor malfunctions and/or failures are known to be relatively low when compared with their utilization. Barring accidents, an effective preventive maintenance program and availability of vital spares can prevent major plant shutdowns caused by conveyor failures.

All conveyors are designed to convey the coal at the rates shown on the Process Flow and Control Diagrams. Design requirements and standards are in accordance with industry standard engineering practices and as described in the Material Handling Design Criteria, CRT-01-MH-1, included in Volume I, Section 9.

Coal storage capacities are sized to provide sufficient quantities of surge at each intermediate location to overcome the interruptions in coal supplies or demand. The active surge capacities are sized based on the reliability of handling equipment and the probability of breakdowns. Since the plant operation cannot tolerate long unscheduled interruptions caused by equipment breakdown, the system has built-in redundancy provided by standby equipment to serve in emergencies where necessary.

B. System Selection Rationale

The coal conveying and storage system is designed for the plant annual requirement and standard engineering practices in related industries of comparable size. The conveyors connecting the barge and train unloading stations to the main yard coal storage area are in single trains. The breakdown of one unloading station does not affect the other unloading station; this allows the continuous use of one of the two unloading facilities. Conveyors connecting the main coal storage yard to the plant feed silos are provided in two parallel trains. This is a common practice in

continuous process operation facilities where intermediate surge storage at the plant is limited. The total storage capacity of the day storage bins is sufficient for 24 hours of operation. This storage capacity is replenished when the supply is less than 8 hours. In normal operation, both trains of the silo feed conveyors can be working at full capacity 12 hours a day. In case one train fails, the second train furnishes the total plant operating requirement for 24 hours.

Coal is stored in open-yard live stockpiles for a nominal 10-day plant requirement to ensure feed to the plant in case of transport delays and temporary failures in the unloading equipment. Dead storage of a 50-day supply of coal is provided in the stockpiles to safeguard against a prolonged interruption in coal receipts.

Though the main yard coal storage is a safeguard for a prolonged interruption of coal supply or plant breakdown, short-term storage is essential to provide a more homogeneous mixture of coal feed and better feed rate control to individual grinding mills. Furthermore, the short-term coal storage is protected from weather, providing more uniformity in quality of coal feed.

To achieve the above objective, a cluster of tall concrete silos is provided at the process area with two conveyors bringing coal feed from yard storage. There is a group of steel coal bunkers in the utility boiler area to feed the coal to the pulverizers. This day storage capacity is for a maximum requirement of 1 day of operation. The normal operating level in this system varies between one-third and two-thirds full.

C. System Description

The coal conveying and storage system consists of belt conveyors connecting barge and railroad unloading stations with the yard coal storage system and the yard coal storage system to the day storage silos and bunkers at the process and utilities areas, respectively.

The coal unloaded at the barge unloading stations is collected by a 42-inch-wide belt conveyor and conveyed to Transfer House No. 1. Three more 42-inch-wide belt conveyors convey the coal from Transfer House No. 1 through Transfer House Nos. 2 and 3 to the sampling station at Transfer House No. 4.

The coal unloaded at the train unloading station is conveyed to Transfer House No. 4 on a 42-inch-wide belt conveyor. All coal received at the barge and/or at the railroad unloading station is weighed by belt scales on their respective conveyor belts. There is an automatic sampling system at Transfer House No. 4 that takes samples of as-received coal separately for each unloading system. From the sample station, the coal is conveyed on a 42-inch-wide yard belt to the coal storage yard and stacked by an automatic stacker. The yard belt conveyor receives coal from the reclaimer and transfers it in two parallel trains to the plant day storage silos or the boiler feed bunkers. The two 42-inch-wide belts feeding the day storage silos and the boiler feed bunkers have traveling belt trippers that feed the silos/bunkers according to the plant feed demand automatically set by the coal levels in the silos. The coal conveyed to the plant and/or boilers is weighed on belt scales provided on the 42-inch-wide plant feed conveyors. Since the stacking/reclaiming system is a single-train unit, there is an emergency coal stack for as-received coal stacking and an emergency reclaim hopper to feed the plant.

All coal conveying and plant feed operations are remotely controlled from a coal area central control room. The plant feed is distributed automatically into the feed silos according to the process train demand. Instrumentation philosophy and details of the centralized control system are described in Volume V. Conveyor descriptions and the coal flow are shown in the process flow control diagrams included in this subsection.

D. Risk Assessment

The coal conveying and storage system uses the commercially proven and economically preferred system. No high-risk areas associated with this

system or equipment have been identified. The equipment selection and the conveyor design have a minimum service factor of 1.25 in conformity with the latest applicable editions of federal, state, and local codes.

In assessing operational risks involved, three significant factors are considered:

(1) Breakdown of coal supplies to the plant site.

(2) Unscheduled shutdown of the process plant.

(3) Breakdown of stacker/reclaimer and yard belt.

A coal stockpile is maintained at the project site to act as a buffer for the plant in case suppliers fail to deliver coal. Similarly, in case the plant shuts down unexpectedly, there is sufficient capacity available in the coal yard to receive the contracted amount of daily supply of all coal in transit. The reliability of the unloading operation is maintained by providing the emergency coal stockpile at the sampling station, which is used only when the yard belt or stacker/reclaimer breaks down. The reliability of feed to the plant is increased by providing an emergency reclaim hopper that bulldozers can fill with coal or limestone.

The risk of long unscheduled breakdowns of single-train conveyors is reduced further by providing a complete spare drive train assembly (drive pulley, shaft, bearings, couplings, reducer, and motor) in warehouse stores for quick replacement. All such conveyor drives are standardized to reduce the number of spare assemblies in the warehouse.

High reliability is maintained in the coal reclaim conveyor systems by providing two trains of reclaim conveyors. One conveyor can fulfill the total operational requirement of the plant working 24 hours a day should the other be out of service. In a normal operation, both conveyors work 12 hours, sharing the load and reducing the operating hours of the

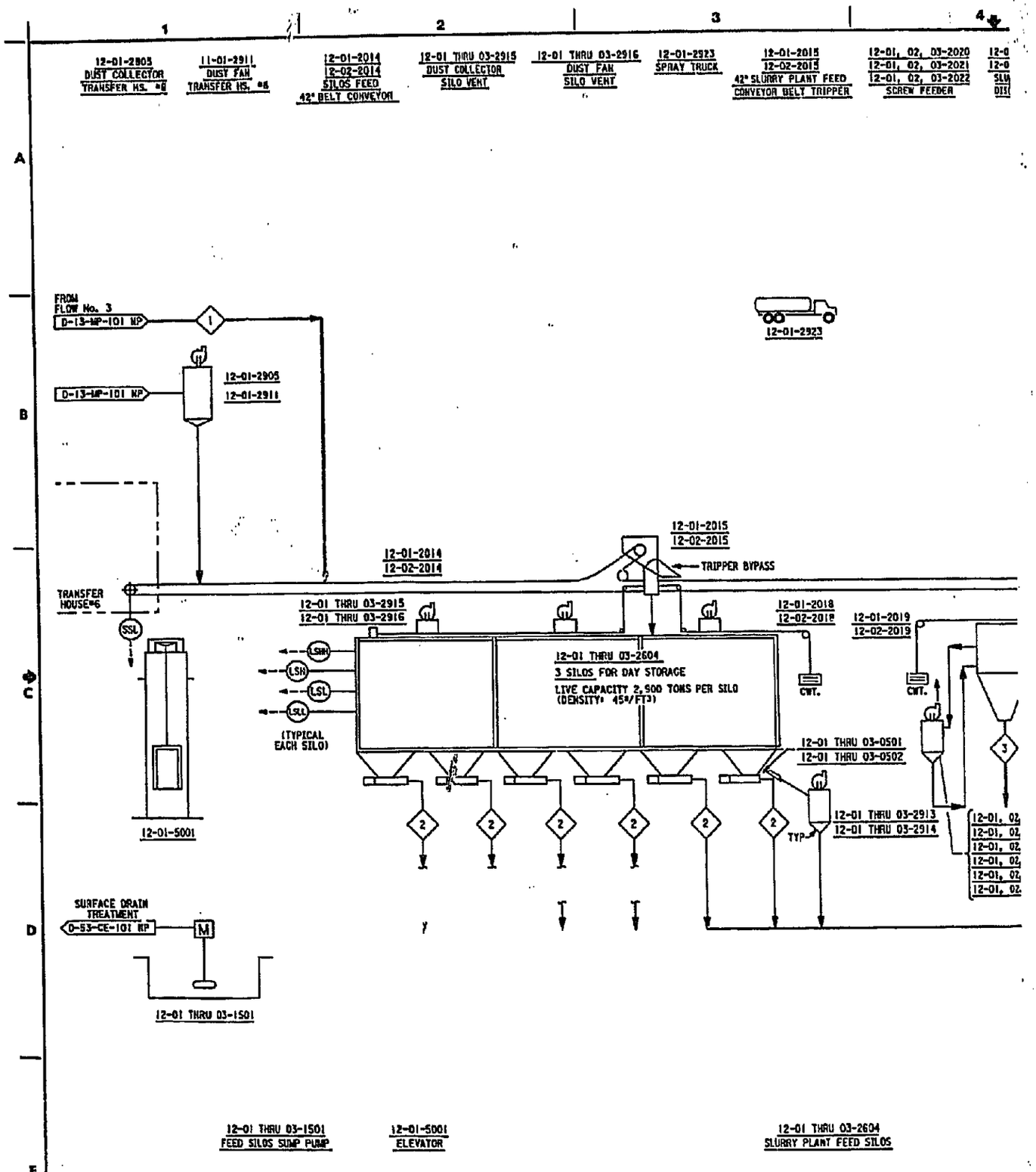
system. The reclaiming conveyor systems are provided with two belt trippers and silos dischargers. Thus, high reliability and flexibility in operations are maintained in the conveyor systems through redundancy to feed the plant while one train is inoperative.

Human errors are minimized by central control room monitoring and safety release controls operated from two independent positions. Fire safety is provided by a temperature sensing and fire alarm system along the length of the conveyors. Coal silos and bunkers have methane detection devices that automatically release a nitrogen purging system and warn the central control room of an incident. All enclosed conveyor transfers have dust collectors to reduce the chance of accumulating combustible coal dust in the chutes. The conveyor galleries have open grating to maintain air circulation and reduce the chimney effect in the elevated section of the conveyors. For other detailed safety features, refer to CRT-01-MH-1, CRT-01-EN-2, and CRT-01-FP-1.

E. Process Flow and Control Diagram (Including Material Balance)

Process Flow and Control Diagram for Coal Conveying and Storage Unit 12 is as follows:

Drawing No.	Title
D-10-MP-101NP	Coal Area Material Balance (see subsection II-1.2.1E for drawing)
D-12-MP-101NP	PFCD Coal Area Storage Silos and Bunkers Unit 12



REFERENCES		REFERENCES		REVISIONS								REVISIONS								
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												A	6/17/88	RS	DWA		SHR		FOR I	

ENG-GE-23 (12/78)

12-01 THRU 03-0501
12-01 THRU 03-0502
SLURRY FEED SILO DISCHARGE FEEDER

12-01- THRU 03-2913
SILO DISCHARGE DUST COLLECTOR

12-01- THRU 03-2914
SILO DUST FAN

12-01-2016
12-02-2016
42" BOILER HOUSE FEED CONVEYOR BELT TRIPPER

12-01-2912
DUST FAN

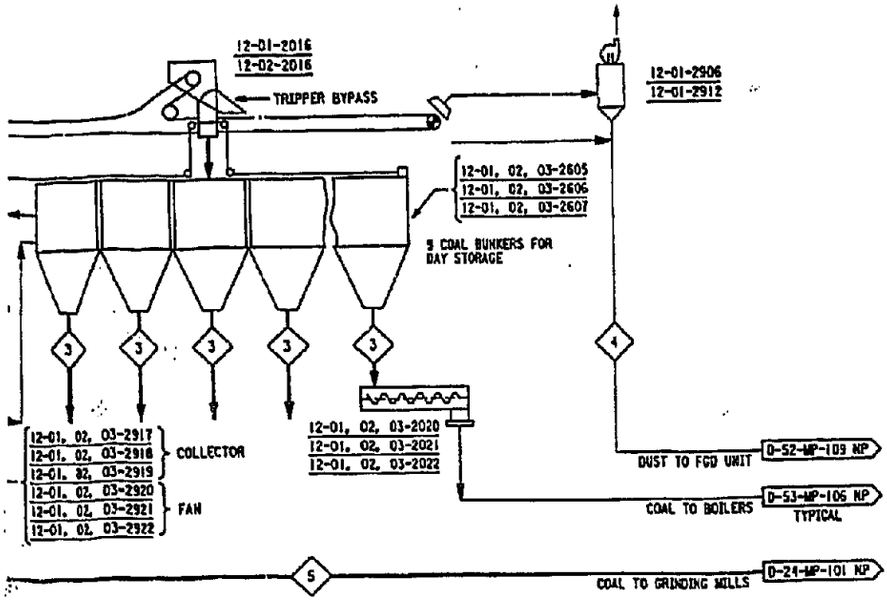
12-01-2906
DUST COLLECTOR

12-01, 02, 03 2920
12-01, 02, 03 2921
12-01, 02, 03 2922
DUST COLLECTORS FANS

12-01, 02, 03-2917
12-01, 02, 03-2918
12-01, 02, 03-2919
DUST COLLECTORS BUNKERS

12-01, 02, 03-2605
12-01, 02, 03-2606
12-01, 02, 03-2607
COAL BUNKER

NOTES:
1. BARGES TO BE UNLOADED IN 10 HOURS. MAX. FEED RATE 9000 TPD/10 HOURS=900 TPH.
2. ITEMS MARKED THUS ⊕ ARE DRIVE PULLEYS.
3. ITEMS MARKED THUS ⊕ ARE PULLEYS WHERE MOTION DETECTOR SWITCHES ARE TO BE LOCATED.
4. WORK THIS DRAWING WITH DRAWINGS D-11-MP-101NP, D-13-MP-101NP, D-12-MP-101NP, & D-10-MP-101NP.
5. ALL BELT CONVEYORS SHALL HAVE A 10 SEC. DELAY START TIED IN TO A LOCALLY PLACED ALARM.
6. ALL BELT CONVEYORS SHALL HAVE EMERGENCY PULL CORD SWITCHES.
7. RAILROAD CARS TO BE UNLOADED IN 6 HOURS FEED RATE 5400/6 HR=900 TPH



12-01-2018
12-02-2018
SEAL BELT SILO TRIPPER

12-01-2019
12-02-2019
SEAL BELT BUNKER TRIPPER

D12MP101N.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: PROCESS FLOW & CONTROL DIAGRAM COAL AREA - UNIT 12 ONE DAY STORAGE	SCALE: NONE	ACCOUNT NUMBER: 2000	JOB NUMBER: 6182
	DOCUMENT NUMBER: D-12-MP-101 NP		REVISION: A

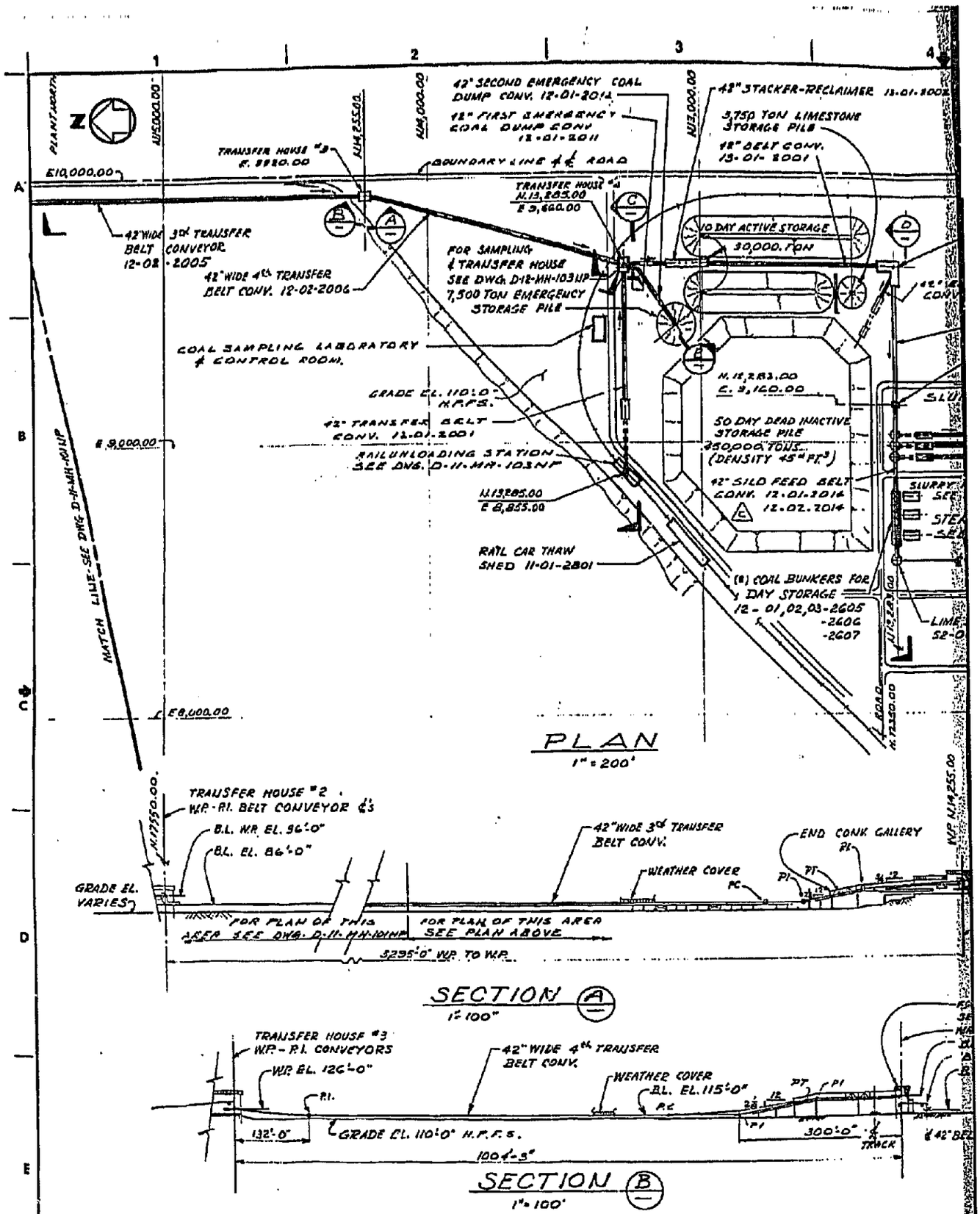
DESCRIPTION	DRWN	ENGRD	APVD SECT MGR	APVD PROJ MGR	APVD CLIENT
FOR DESIGN REPORT					
FOR CLIENT APPROVAL					

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

F. Plot Plan/General Arrangement Drawings

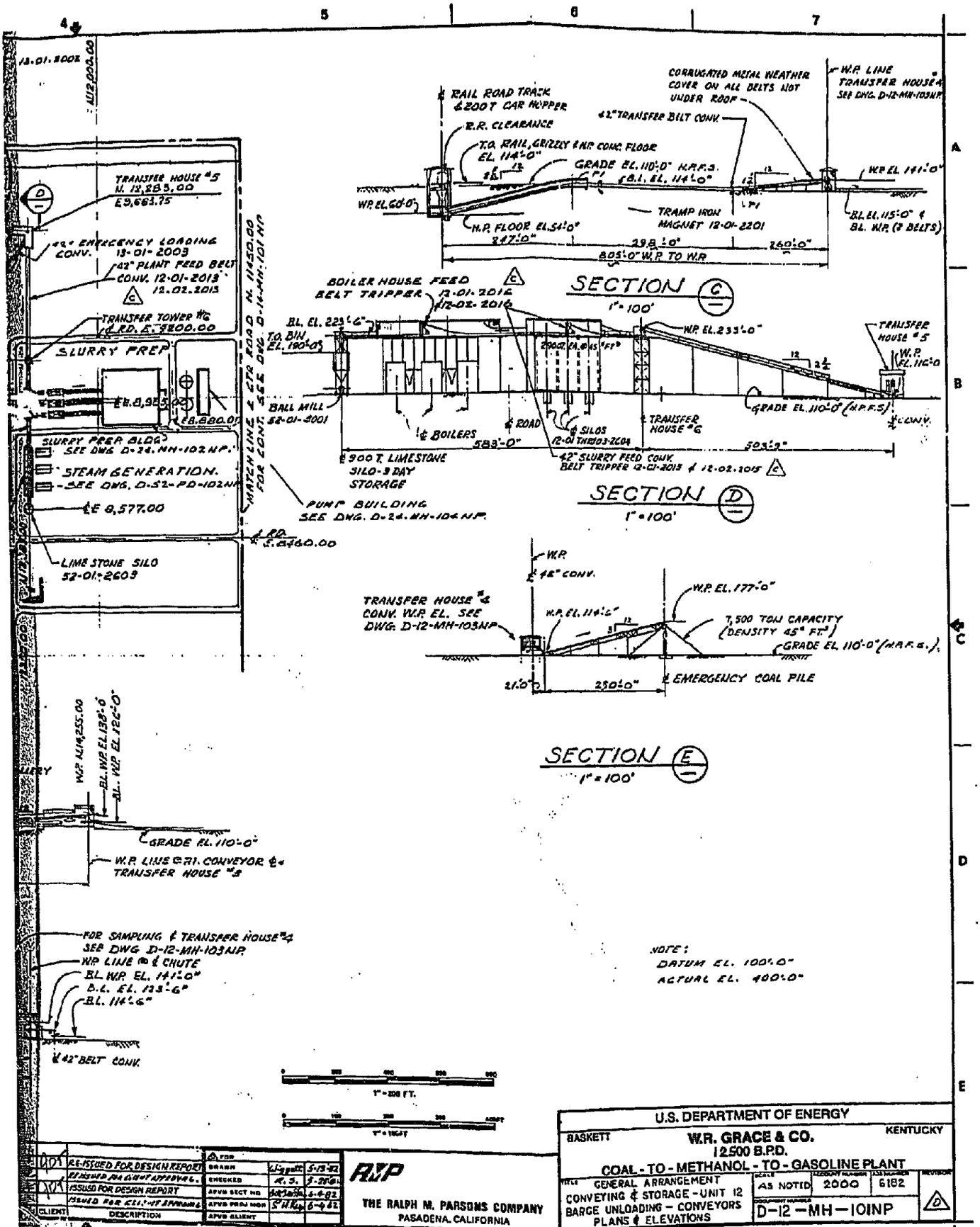
Plot Plan/General Arrangement Drawings for Coal Conveying and Storage Unit 12 are as follows:

Drawing No.	Title
D-12-MH-101NP	General Arrangement - Conveyors, Plans and Elevation - Unit 12
D-12-MH-103NP	General Arrangement - Sampler and Transfer Tower Elevation and Plans - Unit 12



REFERENCES:		REFERENCES		REVISIONS								REVISIONS									
D-01-PD-101 H/P	PLOT PLAN			NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	D	7-12-13	RS							
D-11-MH-101 H/P	STACKING & RECLAIMING											C	7-8-13	RS							
D-11-MH-103 H/P	STACKER & RECLAIMER BEDS											B	6-18-13	MH	RS						
D-11-MH-104 H/P	PUMP HOUSE											A	5-15-13	WP	RS						
D-12-PD-103 H/P	STEAM GENERATION											NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION		
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION																		

1 2 3 4



NO.	DESCRIPTION	BY	DATE
1	RE-ISSUED FOR DESIGN REPORT	Liggett	5-13-82
2	RE-ISSUED FOR CLIENT APPROVAL	K. S.	5-28-82
3	ISSUED FOR DESIGN REPORT	APVD SECT MGR	6-4-82
4	ISSUED FOR CLIENT APPROVAL	APVD PROJ MGR	6-4-82
CLIENT	DESCRIPTION	APVD CLIENT	

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12500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

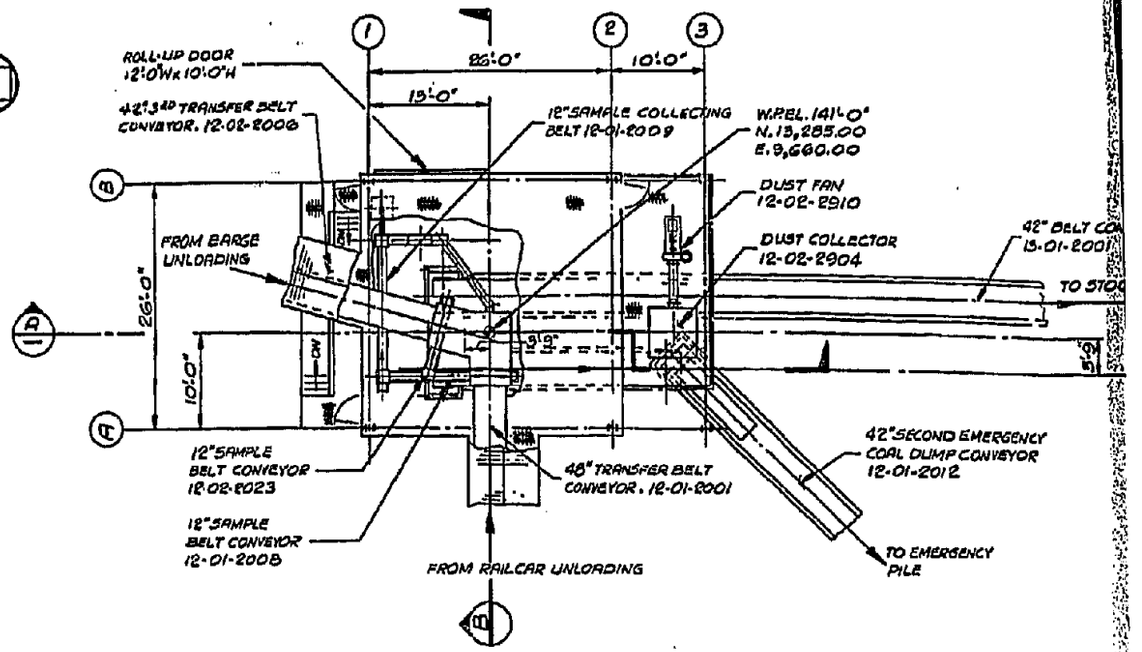
TITLE: GENERAL ARRANGEMENT CONVEYING & STORAGE - UNIT 12 BARGE UNLOADING - CONVEYORS PLANS & ELEVATIONS

SCALE: AS NOTED | ACCESSORY NUMBER: 2000 | JOB NUMBER: 6182

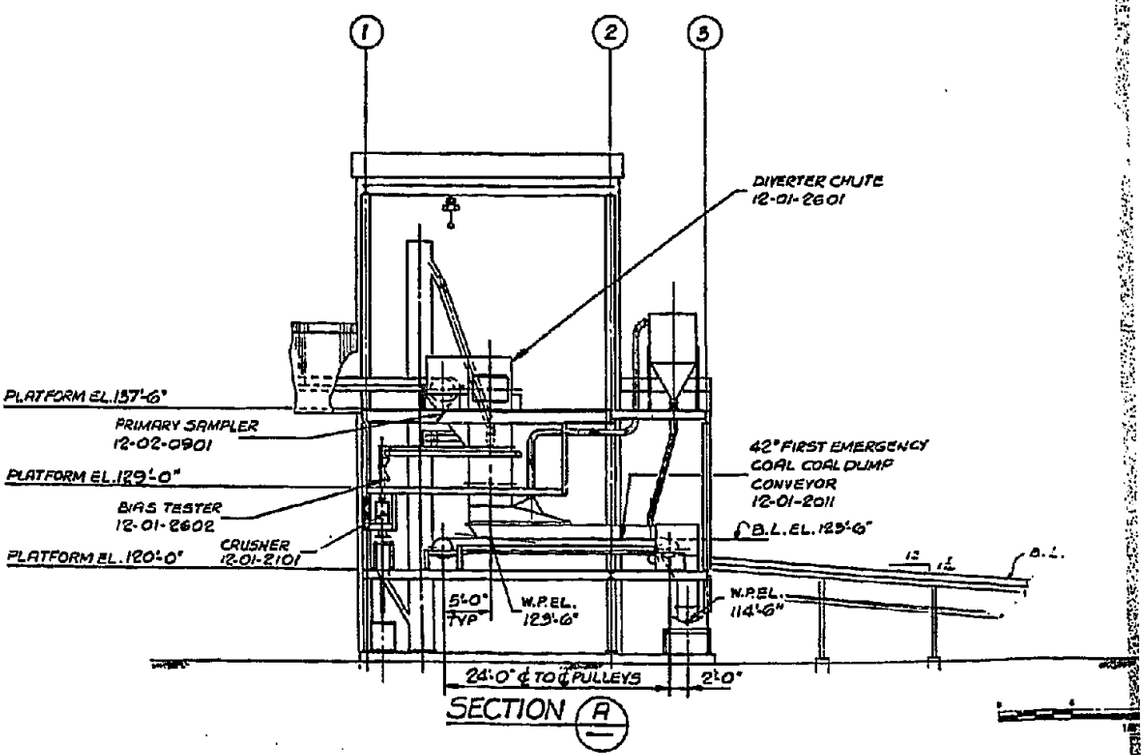
DRAWING NUMBER: D-12-MH-101NP

REVISION: 4

DC-MH 7



PLAN



SECTION A

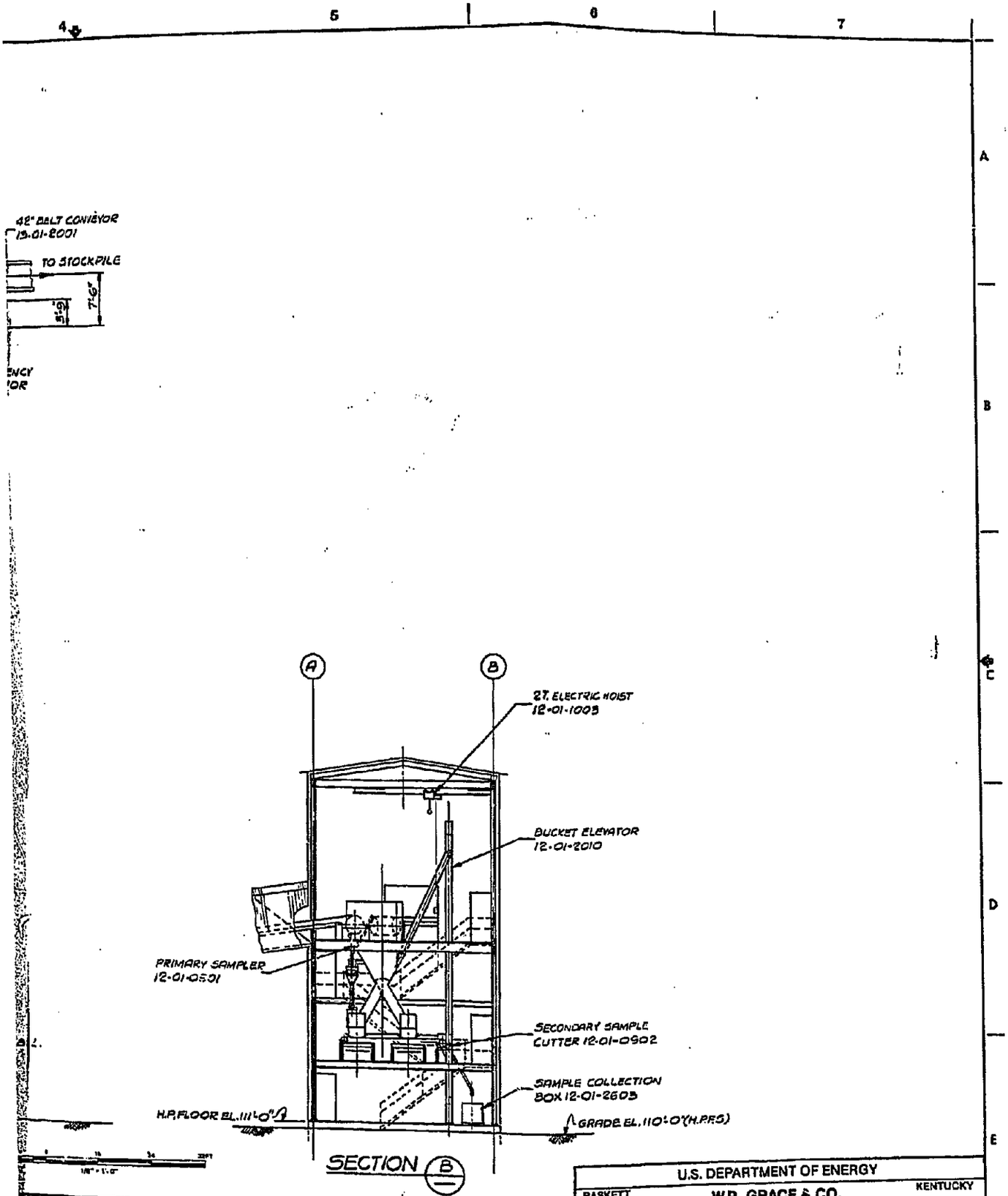
REFERENCES	DRAWING NO.	DESCRIPTION
	D-12-MH-101MD	BARGE UNLOAD. CONVR.

REFERENCES	DRAWING NO.	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT
	B	6-18-81	LBK	ABR	ABR	CM PWL	ISSUED FOR C
	A	5-11-81	LBK	R.S.	KHL		

ENG-CE-23 (12/78)



		DRAWN	LBK 5-17-82
		CHECKED	R.S. 5-19-82
		APVD SECT MGR	5-21-82
		APVD PROJ MGR	5-22-82
		APVD CLIENT	
	ISSUED FOR DESIGN REPORT		
	FOR CLIENT APPROVAL		
CLIENT	DESCRIPTION		

THE RALPH M. PARSONS COMPANY
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U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: GENERAL ARRANGEMENT
CONVEYING & STORAGE - UNIT 12
SAMPLING & TRANSFER TOWER N°4
PLAN & SECTIONS

SCALE: 1/8"=1'-0" | ACCOUNT NUMBER: 6182 | JOB NUMBER: 2000

DOCUMENT NUMBER: D-12-MH-103NP

REVISION: B

G. Single-Line Diagram

See Volume II, 1.2.1(G) for Coal Conveying and Storage Unit 12 Single-Line Diagram.

1.2.3 COAL STACKING AND RECLAIMING - UNIT 13

A. Basis of Design

The coal stacking and reclaiming system is matched with the feed and reclaim conveying systems, which are upstream and downstream of Unit 13. The system has machines capable of serving the live pile as well as building inactive storage without affecting the process plant normal operational requirement.

The stacking and reclaiming rates of equipment are determined by the required maximum coal unloading rate and the maximum coal demand rate from process and utility plants. The stacking boom length is established by the live coal stack height and the active reclaim reach of the boom. The machine linear travel is based on the total active quantity of coal to be stored so that one-third of the active pile length will always be available for coal unloading.

The total coal pile volume was determined by normal practices used in the area by plants of comparable sizes. The live pile size is based on the normal material handling practice of keeping a minimum of 10 days of coal space available in the active pile.

There is one stacker/reclaimer on a yard belt conveyor providing one-train availability. The single train, working 8 hours, is able to furnish the total feed required by the plant. However, to increase the availability of coal from the unloading stations and to provide continuous feed to the process plant, an emergency stockpile and a reclaiming hopper are provided in the yard system. Provision of these features increases the reliability of the combined systems to exceed 96% in a 24-hour working schedule.

At the downstream end of the coal yard conveyors, there are two parallel conveyor systems, complete with belt trippers and feeders. These plant feed conveyors are designed to serve the total plant capacity with only

one conveyor line working 8 hours a day. Thus, the reliability of the coal reclaim and plant feed systems is increased by the redundancy of the parallel spare conveyor system

B. System Selection Rationale

A detailed study was performed to select the coal yard stacking/reclaiming system, based on project general design criteria, barge/train unloading rates, and to satisfy plant feed requirements.

Various arrangements of coal storage belt conveyors stacking and reclaiming schemes were evaluated. The following three alternative arrangements were considered for this project.

1. Combination Stacker/Reclaimers, Using a Common Yard Conveyor for both Input and Output. The possibility of a circular bucket-wheel stacker/reclaimer with a kidney-shaped stockpile was investigated. The main disadvantage in this scheme is that a machine capable of handling the rates and capacity requirements would be a prototype. Although the circular "Stak-Rake" is in use in Europe, its flight belt boom will generate more coal dust in reclaiming than the bucket-wheel reclaimer. The enclosure to contain the dust for a kidney-shaped pile will be exorbitant. Additionally, the kidney-shaped stockpile would be limited in capacity by equipment rotation.

An alternative to this scheme is a bucket-wheel-type stacker/reclaimer operating on a straight track, forming two live coal piles on each side of the yard conveyor. This is considered as most practical, it uses standard equipment, and is least dust producing. This scheme is used for this project.

2. Separate Stackers and Reclaimers Using Common Input and Output Conveyors. This arrangement is basically the same as the bucket wheel on a straight track (noted above), except that it uses two separate

machines instead of one. A separate stacker (without a bucket wheel at the boom end) is less costly and gives the system greater reliability and flexibility of operation than a combined machine. However, a bucket-wheel reclaimer is still required. The capital and operating cost of two machines in comparison to one is very high.

3. Separate Stackers and Reclaimers Using Separate Input and Output Conveyors. In this arrangement there are three possible systems:

(1) Overhead traveling tripper on trestles with underground reclaim tunnel.

(2) Traveling stacker at grade-level track with drum reclaimer across the pile.

(3) Crawler-mounted reclaimer with a separate stacking tripper and a reclaiming belt with hopper car.

The first of the above three systems is very costly, requires extensive underground tunnel construction, and generates more dust than the selected luffing-boom-type stacker/reclaimer. The second system is higher in capital and operating costs than the arrangements noted earlier. The third system has greater breakdown and maintenance problems and generates more dust from the crawlers than with the bucket wheel on tracks. Though the above systems give flexibility of operation through possible simultaneous stacking and reclaiming, they have maintenance and operational complexities.

Considering the advantages and drawbacks of each arrangement, including environmental impact, system availability, and evaluation of capital and operating costs, it is concluded that the first arrangement with a common yard belt conveyor and combined stacker/reclaimer machine is the one best suited for this project.

C. System Description

There is one track-mounted, single 90-foot-long luffing boom, traveling bucket-wheel stacker/reclaimer. This stacker/reclaimer travels on its own 42-inch-wide yard belt conveyor for a length suitable to provide the required live storage. The machine has a nominal stacking rate of 2,500 stph and a nominal reclaiming rate of 1,250 stph.

There is an emergency stockpile available to stack the coal received from the unloading stations. This pile, operated with bulldozers, allows the barges at the dock and the railcars within the plant to be emptied when the stacker/reclaimer is down for repairs or maintenance. Similarly, to keep the plant feed going during the stacker/reclaimer shutdown, an underground reclaim hopper is provided to reclaim the coal with bulldozers and front-end loaders.

Both the stacking and reclaiming coal is weighed on automatic belt scales and a central integrator-printer gives the inventory of coal in the stockpiles.

A tramp iron magnet and metal detector ensures that no metallic pieces are picked up from the stockpile and taken to the coal feed preparation plant.

Mobile equipment (bulldozers and front-end loaders) is provided to move coal from the live stockpile to the dead stockpile and vice versa. Two bulldozers will also perform emergency stacking or reclaiming operations when required.

Typical parameters for the selection of combination stacker/reclaimer systems, including dozers for working adjacent dead piles, are as follows:

(1) One rail-mounted combination stacker/reclaimer, having a nominal average stacking rate of 2,500 stph and a nominal average reclaiming rate of 1,250 stph and two 400-horsepower tractor dozers.

(2) One 42-inch-wide yard belt conveyor, approximately 1,000 feet long, designed to carry coal at a combined maximum rate of train unloading and barge unloading of 1,800 stph.

(3) Coal yard storage in two stockpiles with the following capacities:

- Total active storage space for a maximum of 90,000 short tons (10 days of plant feed) accessible to stacker/reclaimers.

- Inactive storage piles, beyond the reach of stacker/reclaimers, capacity of 450,000 short tons (50 days of plant feed).

- Total yard stockpile capacity of 540,000 short tons (60 days of plant feed).

(4) Dust suppression systems on the stacker/reclaimer and a water tank truck equipped to spray coating on the inactive storage piles.

The coal yard belt conveyor receives the coal from the unloading stations and feed the stacker. The stacker/reclaimer has the capability of performing three functions:

(1) Stacking the coal on the live pile.

(2) Reclaiming the stacked coal from the live pile.

(3) Receiving the coal from the unloading stations, stacking part of it on the stockpile and feeding the remainder to the plant, bypassing the stockpile.

These functions will be performed by the stacker/reclaimer operator and monitored by the supervisor in the central control room. Detailed explanation of the controls is given in Volume IV.

D. Risk Assessment

The philosophy used in selection of the stacking/reclaiming systems has been to choose proven, environmentally acceptable, and economical equipment. Furthermore, the basis of selection and design of the system was established to ensure efficient use of the equipment, provide flexibility of operation, and supply built-in reserve capacities for surges in the coal unloading/loading rates. This philosophy was carried over in the determination of the number of trains, modules, and spare equipment. Equipment startup, turndown capability, maintenance, access to equipment, and interchangeability of parts were assessed for risk.

The bucket-wheel stacker/reclaimer selected for this project is designed with some overcapacity to provide additional reliability above the 80% onstream time normally assigned to such equipment. Similar machines have been in operation handling more abrasive ores and much larger lump-size material. The conveyor design will conform to the design factors detailed in CRT-01-MH-1.

In the assessment of operational risks, the following two factors have a significant effect on the system reliability:

(1) Stacker/reclaimer reliability (equipment and personnel).

(2) Systems reliability to match incoming and outgoing systems.

The stacker/reclaimer selected is of standard design and size. It is proved to have individual availability (reliability) of over 80%. The belt conveyor availability is 95% because the stacker/reclaimer trippers run on the yard belt. The two factors combined (in series) reduce the overall single-train availability (reliability) to 76%. Since there are emergency receiving stacking and reclaiming systems, the combined reliability of the overall arrangement is 94%.

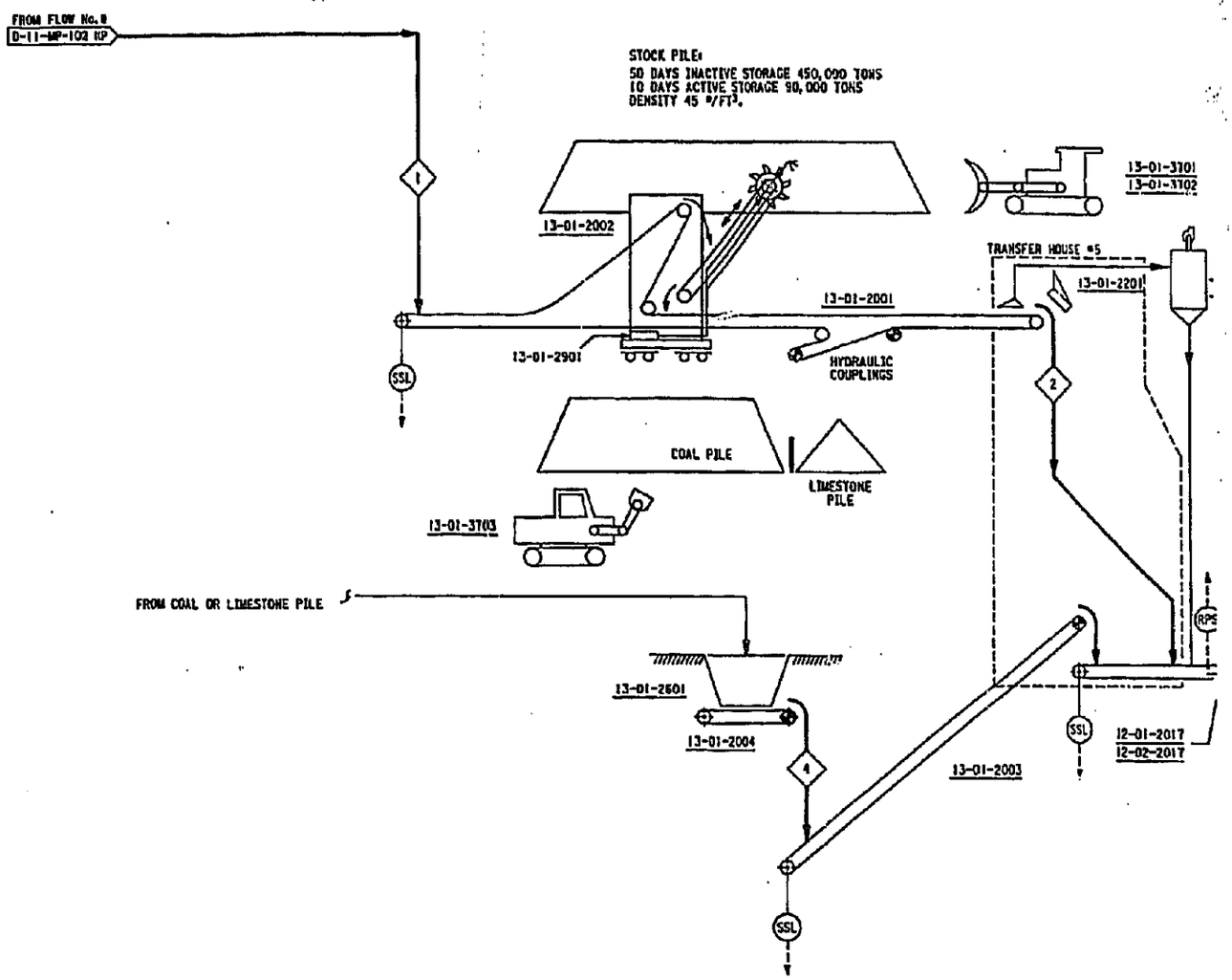
The stacking/reclaiming system is designed to operate the total plant capacity by working 16 hours a day. The nominal stacking rate of 2,500 stph was selected to handle the combined coal unloading rates of both barge and railroad stations working simultaneously. This higher stacking rate allows the machine to unload the daily average receipt of coal in less than 8 hours. The coal reclaiming rate of 1,250 stph allows the machine to feed the plant in approximately 8 hours. These high rates of stacking and reclaiming allow the stacker to be available to handle the limestone for the FGD removal system. Thus, the limestone can be received at the plant by railcars or barge once a week and be stored in the open stockpile at one end of the live stockpile (see Drawing D-13-MH-101NP). Similarly, there is sufficient free system time available in the reclaiming and conveying system to use one conveyor train to fill the lime storage bin every 48 hours of operation.

E. Process Flow and Control Diagram (Including Material Balance)

Process Flow and Control Diagram for the Coal Stacking and Reclaiming Unit 13 is as follows:

Drawing No.	Title
D-10-MP-101NP	Coal Area Material Balance (see subsection II-1.2.1E for drawing)
D-13-MP-101NP	PFCD Coal Area Unit 13 - Stacking and Reclaiming

13-01-2002 42" STACKER RECLAIMER 2,500 STPH/STACKING (MAX) 1,250 STPH/RECLAIMING (NOMINAL)	13-01-2901 DUST SUPPRESSION SYSTEM	13-01-2001 42" BELT CONVEYOR	13-01-3701 13-01-3702 CRAWLER DOZER	13-01-2601 EMERGENCY DUMP HOPPER	12-01-2017 12-02-2017 RIP PROTECTOR	12-01-2013 12-02-2013 PLANT FEED 42" BELT CONVEYOR	12-01-3802 12-02-3802 PLANT FEED 42" BELT SCALE



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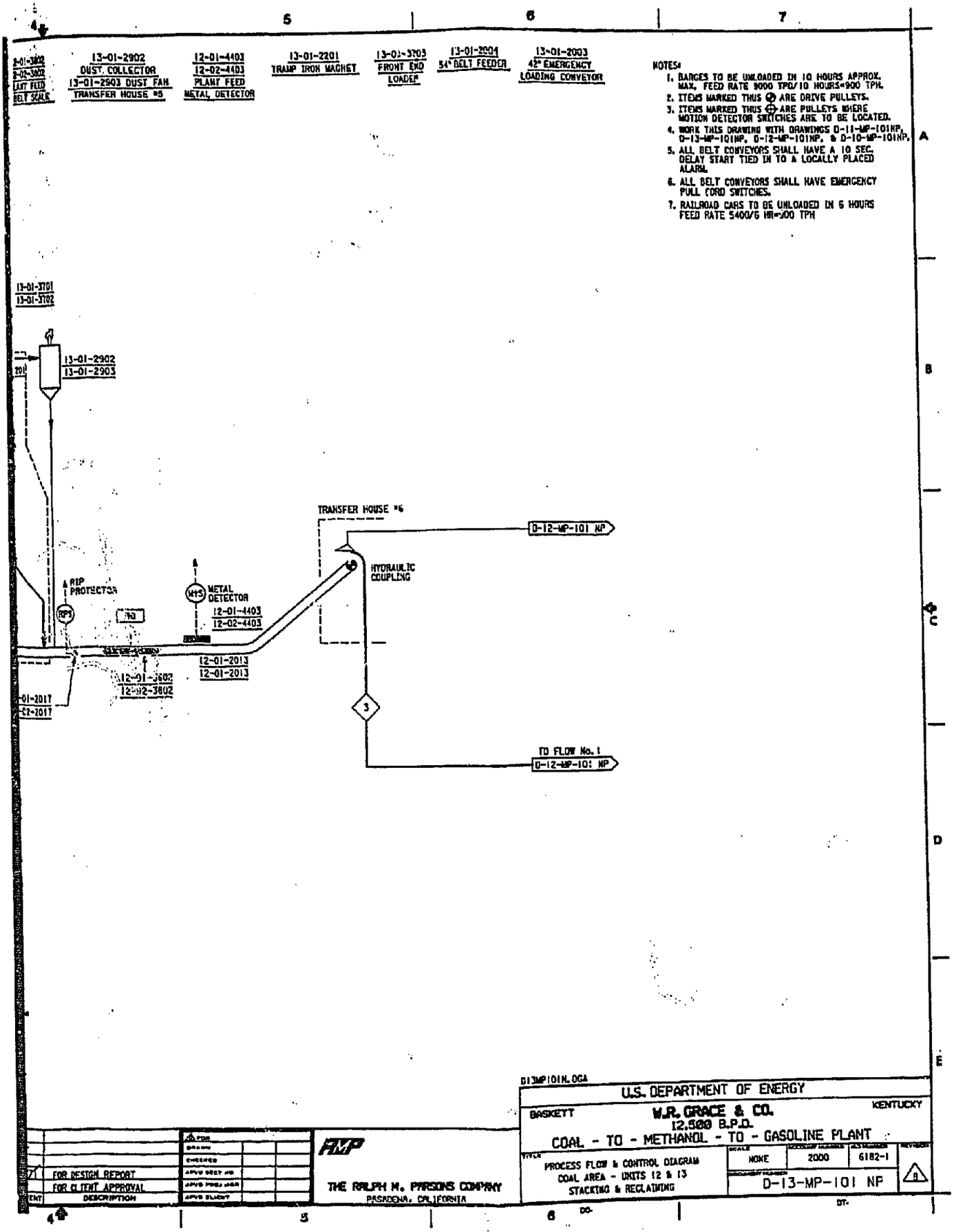
													B	1'						FOR QI
													A	6/21/91						FOR QI

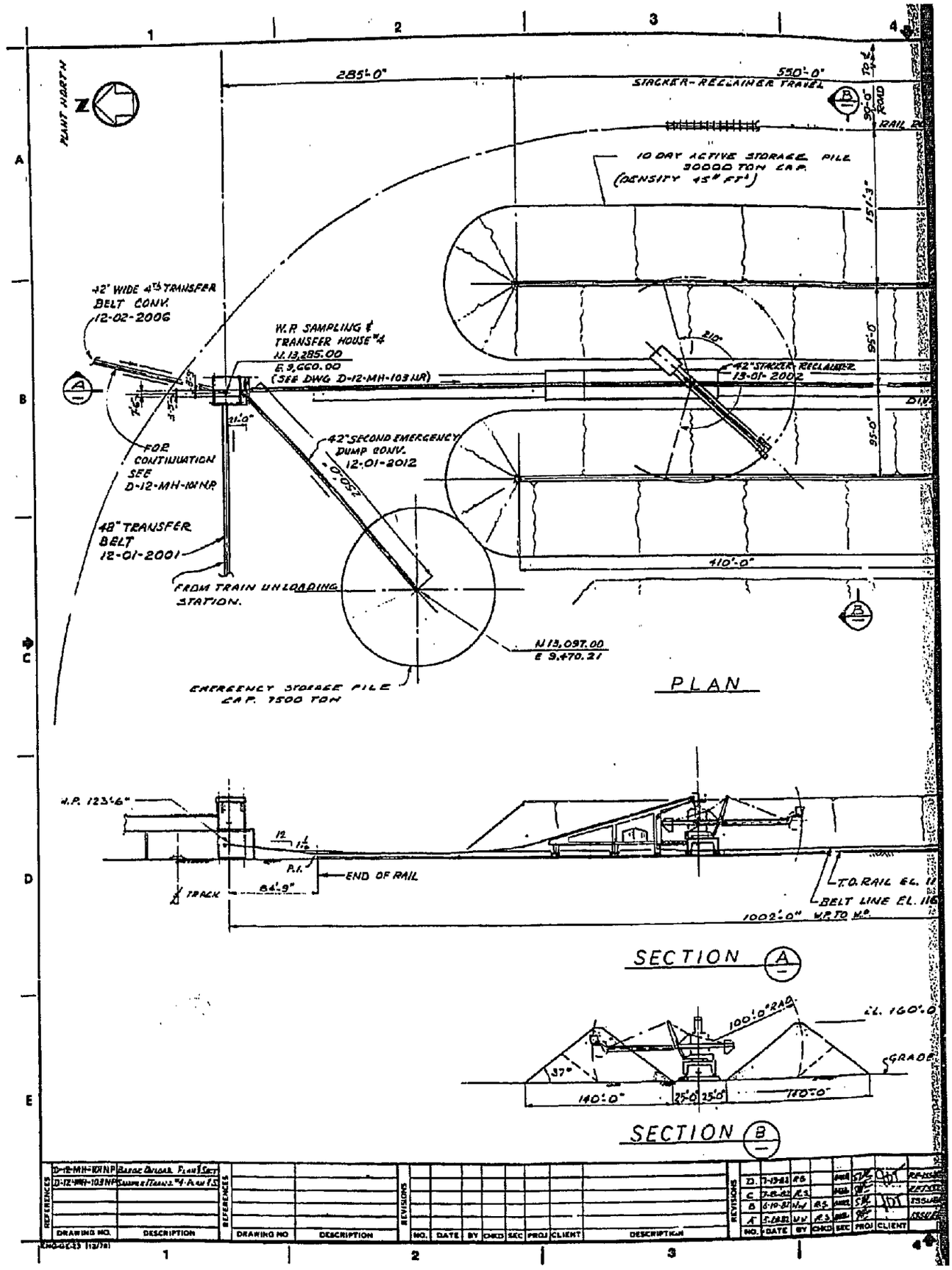
ENG-GE-03 (12/79)

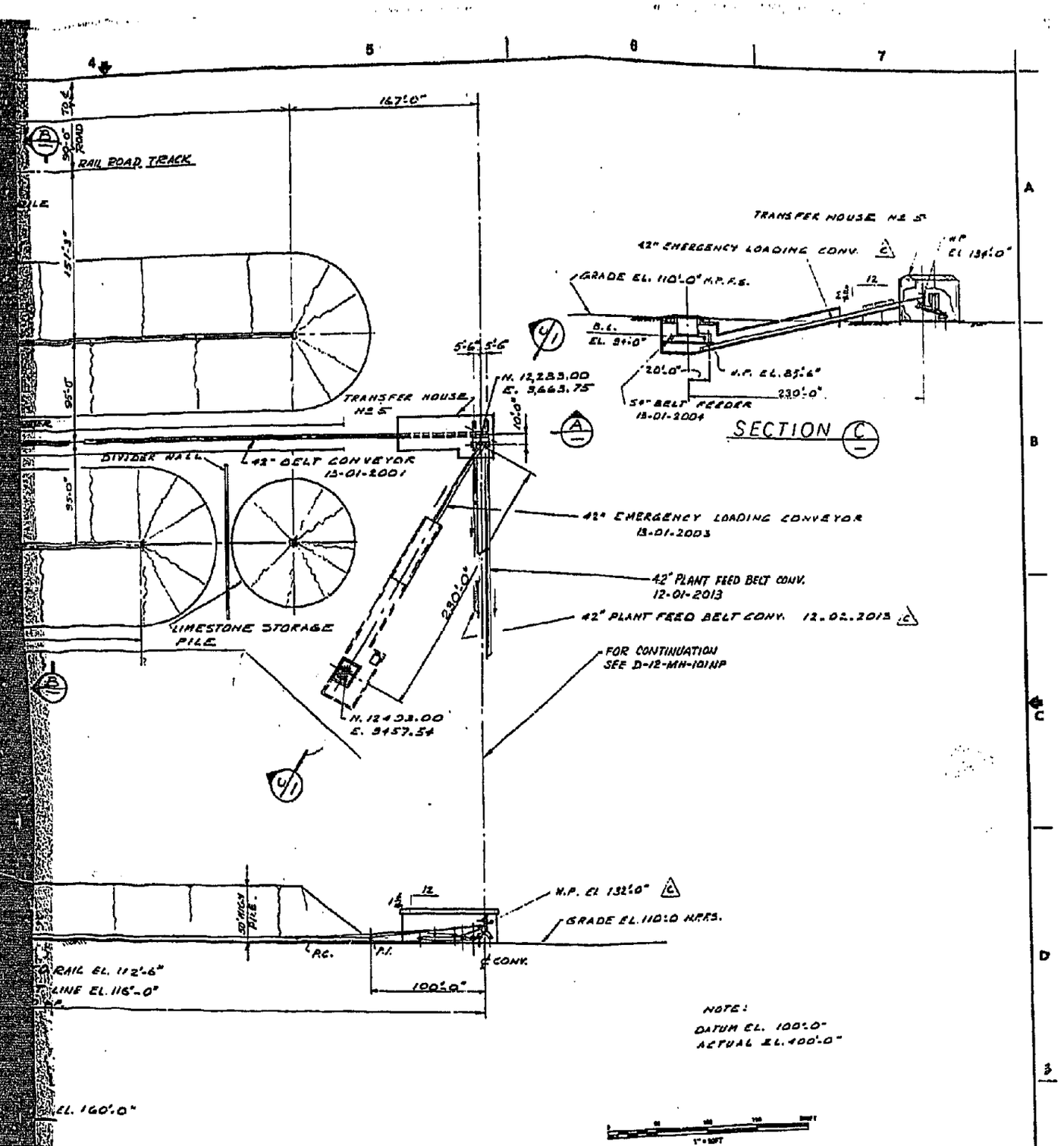

13-01-2902
DUST COLLECTOR
13-01-2903 DUST FAN
TRANSFER HOUSE #5
12-01-4403
12-02-4403
PLANT FEED
METAL DETECTOR
13-01-2201
TRAMP IRON MAGNET
13-01-3703
FRONT END
LOADER
13-01-2004
54" BELT FEEDER
13-01-2003
42" EMERGENCY
LOADING CONVEYOR
NOTES:
1. BARGES TO BE UNLOADED IN 10 HOURS APPROX. MAX. FEED RATE 9000 TPD/10 HOURS=900 TPH.
2. ITEMS MARKED THUS ⊕ ARE DRIVE PULLEYS.
3. ITEMS MARKED THUS ⊕ ARE PULLEYS WHERE MOTION DETECTOR SWITCHES ARE TO BE LOCATED.
4. WORK THIS DRAWING WITH DRAWINGS D-11-MP-101NP, D-13-MP-101NP, D-12-MP-101NP, & D-10-MP-101NP.
5. ALL BELT CONVEYORS SHALL HAVE A 10 SEC. DELAY START TIED IN TO A LOCALLY PLACED ALARM.
6. ALL BELT CONVEYORS SHALL HAVE EMERGENCY PULL CORD SWITCHES.
7. RAILROAD CARS TO BE UNLOADED IN 6 HOURS FEED RATE 5400/6 HR=900 TPH
13-01-3701
13-01-3702
13-01-2902
13-01-2903
TRANSFER HOUSE #6
D-12-MP-101 NP
HYDRAULIC COUPLING
RIP PROTECTOR
RPS
MTS
METAL DETECTOR
12-01-4403
12-02-4403
12-01-2013
12-01-2013
12-01-3602
12-02-3602
3
TO FLOW No. 1
D-12-MP-101 NP
D13MP101N.DGA
U.S. DEPARTMENT OF ENERGY
BASKETT
W.R. GRACE & CO.
12,500 B.P.D.
KENTUCKY
COAL - TO - METHANOL - TO - GASOLINE PLANT
PROCESS FLOW & CONTROL DIAGRAM
COAL AREA - UNITS 12 & 13
STACKING & RECLAIMING
NONE
2000
6182-1
D-13-MP-101 NP
FOR DESIGN REPORT
FOR CLIENT APPROVAL
DESCRIPTION
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

F. Plot Plan/General Arrangement Drawing

Plot Plan/General Arrangement Drawing for Coal Stacking and Reclaiming Unit 13 is as follows:

Drawing No.	Title
D-13-MH-101NP	General Arrangement - Stacking and Reclaiming - Unit 13 Stacking and Reclaiming - Plan and Elevations


PLANT NORTH
285'-0"
550'-0"
STACKER-RECLAIMER TRAVEL
90'-0" ROAD
RAIL RD
10 DAY ACTIVE STORAGE PILE
30000 TON CAP.
(DENSITY 45# FT³)
42" WIDE 4 PLY TRANSFER BELT CONV. 12-02-2006
W.P. SAMPLING & TRANSFER HOUSE #4
N 13,285.00
E 9,660.00
(SEE DWG D-12-MH-103 NP)
42" STACKER-RECLAIMER 13-01-2002
42" SECOND EMERGENCY DUMP CONV. 12-01-2012
FOR CONTINUATION SEE D-12-MH-101 NP
48" TRANSFER BELT 12-01-2001
FROM TRAIN UNLOADING STATION.
410'-0"
N 13,097.00
E 9,470.21
EMERGENCY STORAGE PILE CAP. 7500 TON
PLAN
W.P. 123'-6"
P.I.
END OF RAIL
TRACK
84'-9"
T.O. RAIL EL.
BELT LINE EL. 116
100'-0" W.P. TO M.P.
SECTION A
EL. 160'-0"
100'-0" RAD.
GRADE
37°
140'-0"
25'-0"
25'-0"
110'-0"
SECTION B



NO	BY	DESCRIPTION	DATE
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03		RE-ISSUED FOR CLIENT APPROVAL	
02		ISSUED FOR DESIGN REPORT	
01		ISSUED FOR CLIENT APPROVAL	

DRAWN	N.W.A.	5.25.82
ENGINEER	R.S.	5.26.82
APVD DEPT HD		6-2-82
APVD PROJ MGR		6-2-82
APVD CLIENT		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY
BASKETT — KENTUCKY
W.R. GRACE & CO.
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE	SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
GENERAL ARRANGEMENT STACKING & RECLAIMING - UNIT 13 STACKING & RECLAIMING PLANS & SECTIONS	1"=50'	2000	6182	04

DOCUMENT NUMBER: D-13-MH-101NP

G. Single-Line Diagrams

See Volume II, 1.2.1(G) for Coal Stacking and Reclaiming Unit 13 Single-Line Diagrams.

1.2.4 SOLID WASTE COLLECTION AND DISPOSAL - UNIT 14

A. Basis of Design

The solid waste collection and disposal system consists of the equipment needed to receive and carry the plant waste from where generated in the process and utility areas to selected waste disposal areas. The solid wastes are combined into three categories, depending on the source and potential toxicity of the material. Disposal areas for the three wastes are segregated and their leachate and rainwater runoff are treated separately. The free moisture of these wastes is reduced to the greatest practical degree, so that the leachate from each landfill area is minimized.

The design of the system takes into account environmental factors such as air and water quality, noise, public health and safety, land use, and aesthetics of the area. The disposal methods comply with applicable sections of Commonwealth of Kentucky regulations prepared by the Department of Natural Resources and Environmental Protection.

Since the largest amount of solid waste will be the gasifier slag, this quantity was a prime factor in establishing the method of collection and disposal. The gasifier slag and boiler bottom slag are collected at the base of the gasifiers and the boilers by a wet collection method. The wastes are dewatered and conveyed to a common railway load bin for transport by a dedicated string of railway cars. Since the gasifier slag and boiler bottom ash are of similar chemical and physical qualities, they are disposed of in the same landfill.

The solid waste generated in the Flue Gas Desulfurization (FGD) process is collected by wet scrubber, stablilized with lime, and mixed with fly ash to be transported by another dedicated string of railway cars.

The process water treatment solids are dewatered and stabilized for transportation by still another dedicated string of railway cars. These

wastes are considered hazardous and are to be disposed in a facility designed and operated according to the terms of a hazardous waste landfill permit.

The three types of railway cars will be distinguishable by their mode of loading and unloading and are designed so that the solid waste materials cannot be mixed at either end of the tracks or in transit. All conveying system components are designed in accordance with industry standard engineering practices and as described in Material Handling Design Criteria CRT-01-MH-01 in Volume I.

The number of trains plying between the plant and the disposal sites for the gasifier slag can be reduced by 50% and still dispose the slag without affecting the plant. All other transport and disposal trains will be single-train configuration and are designed to work during the daytime.

B. System Selection Rationale

The design of the solid waste collection and disposal system is based on material characteristics, the need to keep the three types of waste segregated, the disposal site topography, and waste quantities.

Various methods conveying the solid wastes to the disposal area were considered. Plant surveys were conducted, some site visitations were carried out, and equipment vendors were contacted to evaluate competing systems. The capital and operating cost for each practical system was estimated. The reliability and flexibility of operation for each scheme was studied. The study determined that a common railway system with dedicated railcars disposing waste to segregated areas is best suited for the project.

C. System Description

Solid waste collection and disposal systems are described in three parts: solid waste collection, solid waste transport, and solid waste disposal.

1. Solid Waste Collection. Solid waste material is collected from the units where generated by different methods. The largest amount of solid waste will be the gasifier slag (1,355 stpd). The slag material discharged from the gasifiers is crushed and screened. The oversize material from the screen is loaded onto one of two belt conveyors that takes the material to one of two train loadout bins.

The bottom slag from the utility boilers is discharged into wet bottom disposal hoppers. The slag is crushed into less than 2-inch nominal size to be transported by wet slurry eductors to a bottom ash settling basin, where two flight chain conveyors drag the slag from the bottom, dewater it, and load it onto the gasifier slag conveyor.

The sulfur components present in the flue gas from the utility boilers are removed by the Research-Cottrell double-loop limestone flue gas desulfurization (FGD) process. The gypsum product is conveyed as wet sludge to a Conversions Systems Incorporated fixation unit. Here the FGD solid waste is mixed with dry fly ash from the electrostatic precipitators and dry lime and converted into a stabilized solid waste. Since the stabilization process needs 2 to 5 days to allow completion of the reaction, an aging pile is provided prior to hauling the material to the waste disposal area. The area of the aging pile is paved and curbed to retain rainwater runoff and contain any leachate. FGD solid wastes are picked up from the aging pile by a front-end loader and transported to dedicated railcars.

The material from the raw water treatment area and the biosludge from the aerobic digesters are inert solid wastes suitable for landfill or as a soil conditioner for plant landscaping. These materials are dewatered by belt presses and conveyed by a separate belt conveyor to a bin at the railcar loading station. They are transported in dedicated railcars.

The solid waste materials from the process water treatment areas pass through filter presses and the solid cakes drop onto belt conveyors running below the filters. The cake will be conveyed to two loadout bins at the train unloading station.

2. Solid Waste Transport. The three different types of solid waste are loaded into segregated strings of railcars and transported on a common track to their respective destinations. The gasifier slag and boiler bottom slag are transported in bottom dump type cars. The FGD waste and the process water treatment wastes are loaded into side-dump cars designed for dumping the right side and left side, respectively.

The trains are pulled by electric locomotives on welded narrow gauge tracks to minimize noise pollution. Two 7-car trains of 10-ton nominal capacity cars each make one round trip every hour for the gasifier slag and bottom slag transport. The stacking of slag at the disposal area is performed 24 hours a day by noise-attenuated belt conveyor. A front-end loader picks up the waste from this stack during the daylight hours and dumps it into the disposal pit.

A 10-car train carrying the FGD and raw water treatment wastes and process water treatment wastes makes six trips during daylight hours. The railcars are coded to automatically change the track switches for spotting to their respective loading and unloading stations. Each locomotive is manned by an operator. In the event of human error or failure of the track switching mechanism, whereby a train could be directed to a wrong unloading/loading station, a secondary safety device is provided at these stations so that the loading and unloading trip mechanism does not trip the railcars not destined for that disposal area.

3. Solid Waste Disposal. There are three segregated disposal areas in the southeast section of the plantsite. The solid wastes brought to these areas are handled by two different methods.

The gasifiers and boiler bottoms slag are brought to the disposal site for those materials by two 7-car trains, each train making 15 trips in a 24-hour period. When driven over the unloading hoppers, the railcars' bottom doors open and discharge the material into a 100-ton

unloading bin. This bin discharges the waste onto a 36-inch-wide fixed belt conveyor. The fixed conveyor transports the waste about 160 feet to a stacking point 35 feet above the grade elevation. Though the trains bring the waste to the land reclaim area 24 hours a day and stack it into a pile, the bulldozers and front-end loaders spread the waste during daylight hours only to reduce the nighttime noise. Whenever the stacking conveyor is shut down for repair or maintenance, a second dump hopper receives the slag/ash, which can be dozed later into the adjacent valley by the bulldozers.

The wastes from the FGD and raw water treatment plants are brought by a separate train to the disposal site. Here, the side-dump railcars discharge the wastes at the unloading area. Bulldozers and front-end loaders place and compact the wastes into the surface depression for the first 6 years. After 6 to 8 years, when the disposal area close to the train unloading station is filled and covered with a 3-foot final cover, a set of light conveyors or dump trucks is used to carry the wastes across the filled area next to the unloading station to the new fill area.

The process water treatment solid wastes are transported by a third string of dedicated cars, which brings that waste to the third disposal area. The unloading station there is similar to the FGD and raw water wastes handling station, except that it will trip the cars meant only for this disposal area.

Rainwater runoff ponds collect the leachate and contaminated rainwater runoff from each of the three waste disposal sites. The ponds have floating pumps to transfer the accumulated water in two return water mains, taking the water to their respective treatment plants.

The topsoil scraped from the barge area is temporarily stacked along the perimeter of the existing valleys and used for the solid waste landfill cover. The topsoil will be planted with fast growing grasses to minimize windblown dust from the pile. The solid waste is spread as evenly as possible by the bulldozers to the elevations shown in Drawing D-14-CE-103NP.

The slag waste is disposed at the site by front-end loaders and dozers. The waste disposal valley is filled from one side of its ridge. In approximately 6 months, adequate area is filled to finished grade so that the stacked topsoil can be spread on the slag waste fill to a thickness that will be specified in the "Permit to Construct a Residual Landfill." The finished landfill is compacted, finish graded, cultivated, and revegetated with indigenous grasses.

The solid wastes quantities from the raw water treatment (64 stpd) and process water treatment (158 stpd) are far less than those from the gasifiers. Thus, this landfill operation needs to be performed during the daylight hours. In the case of process water treatment solid wastes, the reclaimed land is covered by a temporary cover of a minimum 6-inch thickness of topsoil at the end of the daily operations. At the end of a 6-month period, a portion of the valley that has reached the final grade is covered by topsoil, cultivated, and revegetated.

D. Risk Assessment

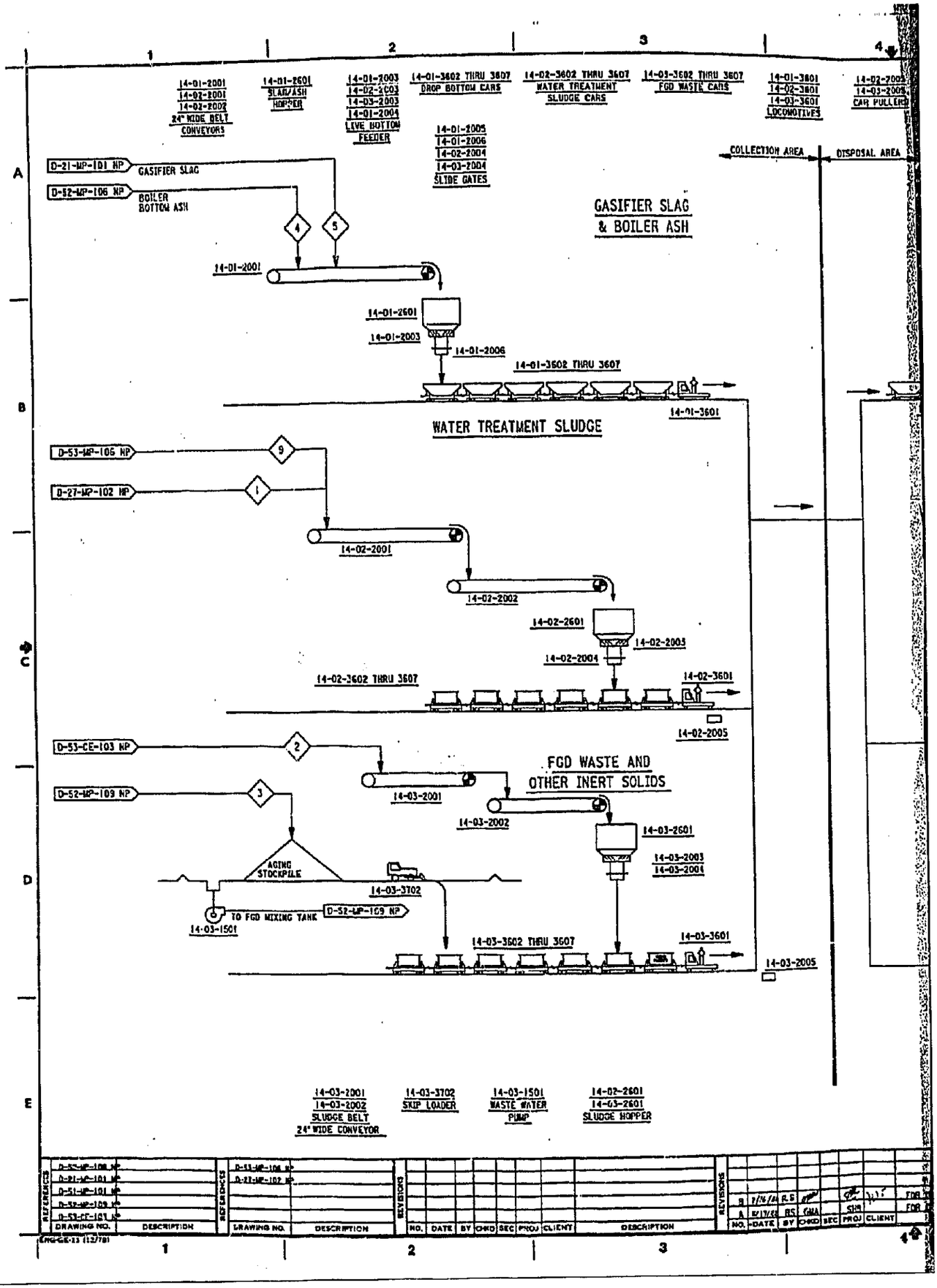
The solid waste collection, transportation, and disposal systems utilize standard and commercially proven equipment; no prototypes are to be employed. The transportation and discharge of wastes, although primarily automated, is backed up with manual controls. Segregation of the disposal areas is conducive to good environmental controls.

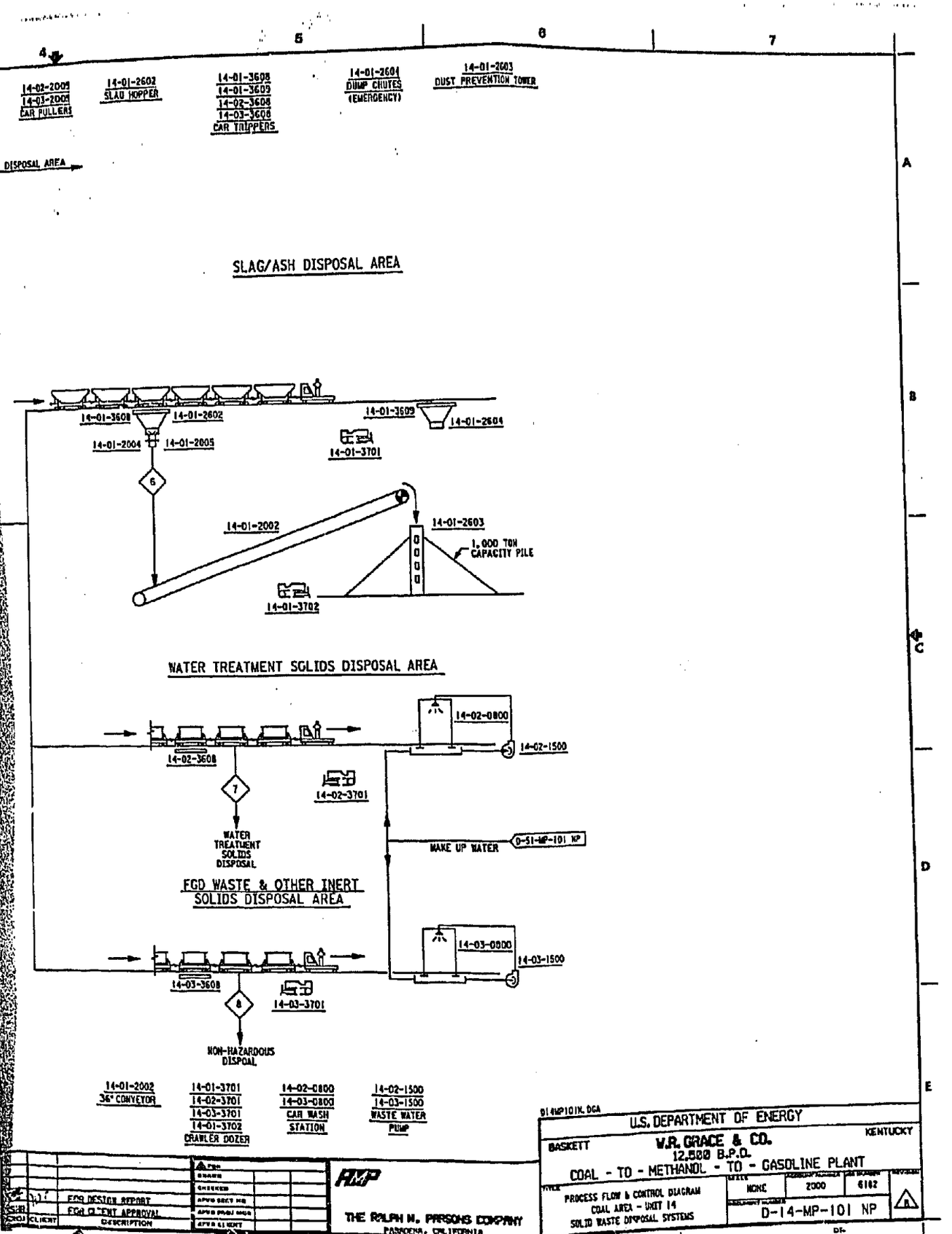
The risk involved of individual conveyor failure is minimized by nature of the design of the equipment and the safety features detailed in CRT-01-MH-1. The surge capacities in intermediate hoppers and bins permit the transfer of wastes from a continuous operating plant to the batch train loading and unloading facilities. The risk of the gasifier operation upset is reduced by providing two parallel waste slag collecting conveyors, each capable of carrying the total plant capacity. Similarly, the slag transport trains run in two strings, each able to carry the total plant waste by either increasing the load in the cars or increasing the trips of the train.

E. Process Flow and Control Diagrams (Including Material Balance)

Process Flow and Control Diagrams for Solid Waste Collection and Disposal Unit 14 are as follows:

Drawing No.	Title
D-14-MP-101NP	PFGD Coal Area - Unit 14 Solid Waste Disposal Systems
D-14-MP-102NP	Material Balance - Solid Waste Collection and Disposal System - Unit 14


14-01-2001
14-02-2001
14-02-2002
24" WIDE BELT CONVEYORS
14-01-2601
SLAG/ASH HOPPER
14-01-2003
14-02-2003
14-03-2003
14-01-2004
LIVE BOTTOM FEEDER
14-01-3602 THRU 3607
DROP BOTTOM CARS
14-02-3602 THRU 3607
WATER TREATMENT SLUDGE CARS
14-03-3602 THRU 3607
FGD WASTE CARS
14-01-3601
14-02-3601
14-03-3601
LOCOMOTIVES
14-02-2005
14-03-2005
CAR PULLER
14-01-2005
14-01-2006
14-02-2004
14-03-2004
SLIDE GATES
COLLECTION AREA
DISPOSAL AREA
D-21-MP-101 NP
GASIFIER SLAG
D-52-MP-106 NP
BOILER BOTTOM ASH
GASIFIER SLAG & BOILER ASH
14-01-2001
14-01-2601
14-01-2003
14-01-2006
14-01-3602 THRU 3607
14-01-3601
WATER TREATMENT SLUDGE
D-53-MP-105 NP
D-27-MP-102 NP
14-02-2001
14-02-2002
14-02-2601
14-02-2003
14-02-2004
14-02-3602 THRU 3607
14-02-3601
14-02-2005
D-53-CE-103 NP
D-52-MP-109 NP
FGD WASTE AND OTHER INERT SOLIDS
14-03-2001
14-03-2002
14-03-2601
14-03-2003
14-03-2004
AGING STOCKPILE
14-03-3702
TO FGD MIXING TANK
D-52-MP-109 NP
14-03-1501
14-03-3602 THRU 3607
14-03-3601
14-03-2005
14-03-2001
14-03-2002
SLUDGE BELT 24" WIDE CONVEYOR
14-03-3702
SKIP LOADER
14-03-1501
WASTE WATER PUMP
14-02-2601
14-03-2601
SLUDGE HOPPER
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION


14-02-2009
14-03-2009
CAR PULLERS
14-01-2602
SLAG HOPPER
14-01-3608
14-01-3609
14-02-3608
14-03-3608
CAR TRIPPERS
14-01-2604
DUMP CHUTES
(EMERGENCY)
14-01-2603
DUST PREVENTION TOWER
DISPOSAL AREA
SLAG/ASH DISPOSAL AREA
14-01-3608
14-01-2602
14-01-3609
14-01-2604
14-01-2004
14-01-2005
14-01-3701
6
14-01-2002
14-01-2603
1,600 TON
CAPACITY PILE
14-01-3702
WATER TREATMENT SOLIDS DISPOSAL AREA
14-02-0800
14-02-1500
14-02-3608
7
14-02-3701
WATER
TREATMENT
SOLIDS
DISPOSAL
MAKE UP WATER
D-51-MP-101 NP
FGD WASTE & OTHER INERT
SOLIDS DISPOSAL AREA
14-03-0800
14-03-1500
14-03-3608
8
14-03-3701
NON-HAZARDOUS
DISPOAL
14-01-2002
36" CONVEYOR
14-01-3701
14-02-3701
14-03-3701
14-01-3702
CRAWLER DOZER
14-02-0800
14-03-0800
CAR WASH
STATION
14-02-1500
14-03-1500
WASTE WATER
PUMP
U.S. DEPARTMENT OF ENERGY
BASKETT
W.R. GRACE & CO.
KENTUCKY
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT
PROCESS FLOW & CONTROL DIAGRAM
COAL AREA - UNIT 14
SOLID WASTE DISPOSAL SYSTEMS
NONE
2000
6102
D-14-MP-101 NP
FGD DESIGN REPORT
FGD CLIENT APPROVAL
DESCRIPTION
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

FLOW IDENTIFICATION	◇1 GAS. PROCESS WATER TREATMENT	◇2 FROM BELT PRESS	◇3 FROM PUG MILL	◇4 FROM BOTTOM BOILER ASH	◇5 FROM GASIFICATION UNIT
MATERIAL	WATER TREATMENT SOLIDS	INERT SOLIDS	STABLIZED F.G.D. SLUDGE	BOILER BOTTOM ASH	GASIFIER SLAG
SIZE (1) (INCHES) (MESH)	(±100)	(±100)	(±10)	(-1")	(-1")
MOISTURE X (MAX.)	45%	60%	15%	20%	20%
TEMPERATURE °F	AMBIENT	AMBIENT	AMBIENT	AMBIENT	AMBIENT
BULK DENSITY LBS. FT.3	80	60	120. 8	84. 7	84. 7
EQUIP. OPERATING RATE STPH	7	3	30	2	80
EQUIP. DESIGN RATE NOM. STPH	8.5	4	37	2.5	100
EQUIP. DESIGN FACTOR	1.25	1.25	1.25	1.25	1.25
TOTAL QUANTITY (NOC) TPD	95	64	486	26	1,329

REFERENCES

DRAWING NO.	DESCRIPTION
D-14-MP-1	MP

REFERENCES

DRAWING NO.	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
B	7/14/82	RS	SHR		SHR	WT	FOR
A	7/1/82	RS	SHR	DBA	SHR		FOR

ONG-CE-43 (12/79)

NOTES:
1. PARTICULATE SIZES ARE APPROXIMATE. THE SOLID MATERIAL HANDLED WILL BE IN THE SHAPE OF CAKE BOUND BY THE PRESENCE OF MOISTURE.

	5 FROM GASIFICATION UNIT	6 GAS. SLAG & BOILER ASH	7 WATER TREATMENT SLUDGE	8 F. G. D. SLUDGE & INERT SOLIDS	9 EVAPORATOR SOLIDS
	GASIFIER SLAG	GAS. SLAG & BOTTOM ASH	WATER TREATMENT SLUDGE	F. G. D. SLUDGE & INERT SOLIDS	WATER TREATMENT SOLIDS
1")	(-1")	(-1")	(±100)	(±10)	(±100)
20%	20%	20%	45%	25%	40%
ENT	AMBIENT	AMBIENT	AMBIENT	AMBIENT	AMBIENT
84.7	84.7	84.7	80	100	80
2	80	110	80	125	7
2.5	100	140	100	155	8
1.25	1.25	1.25	1.25	1.25	1.25
1,326	1,329	1,359	158	550	63

			CHK	
			DRAWN	
			ENGINEER	
KW		FOR DESIGN REPORT	APVD PROJ MGR	
		FOR CLIENT APPROVAL	APVD PROJ MGR	
PROJ	CLIENT	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

D14MP102A.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,588 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

STYLE: MATERIAL BALANCE SOLID WASTE COLLECTION & DISPOSAL SYSTEM UNIT 14

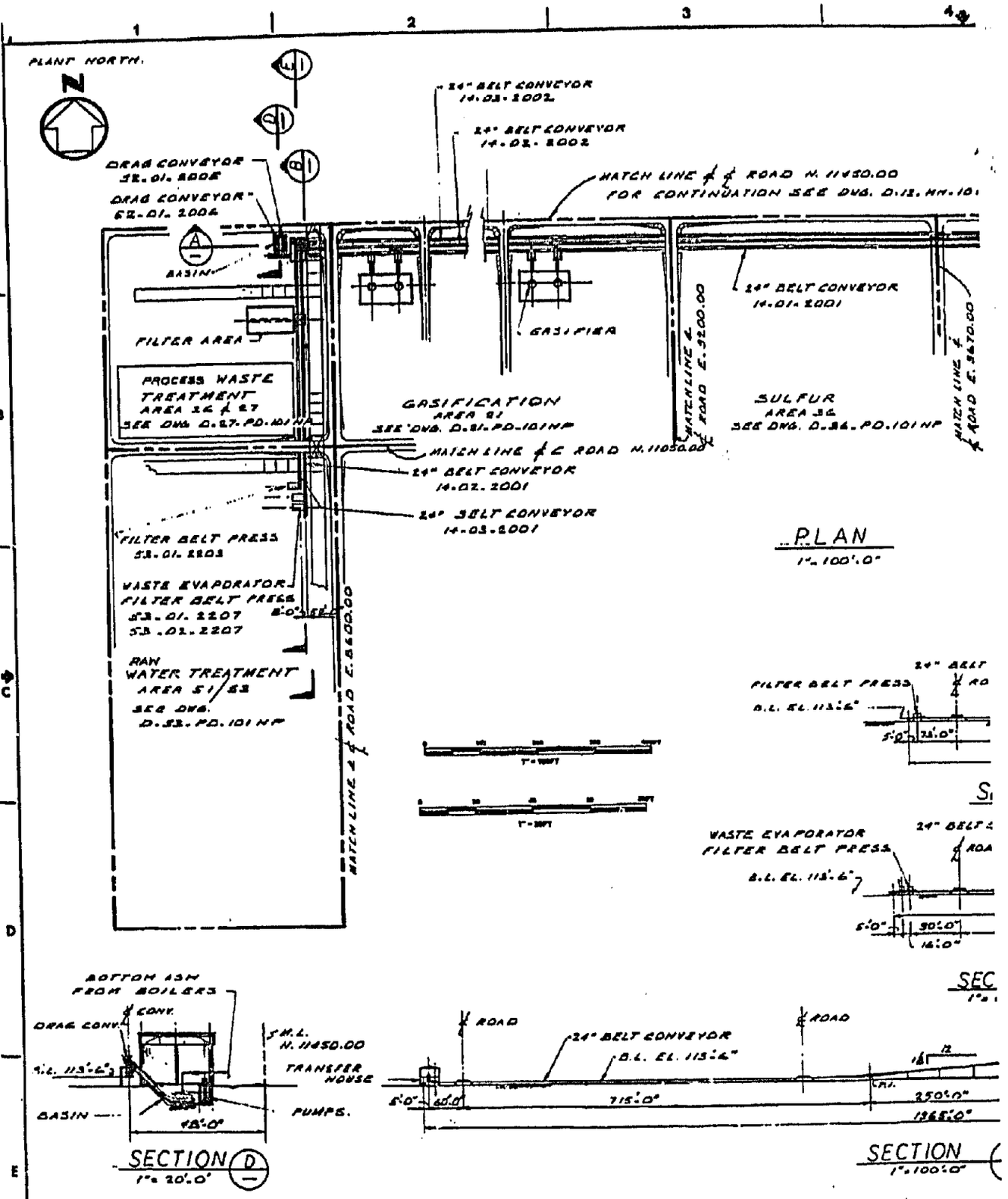
WBS	ACCOUNT NUMBER	CONTRACT NO.	REVISION
NONE	2000	6182	0

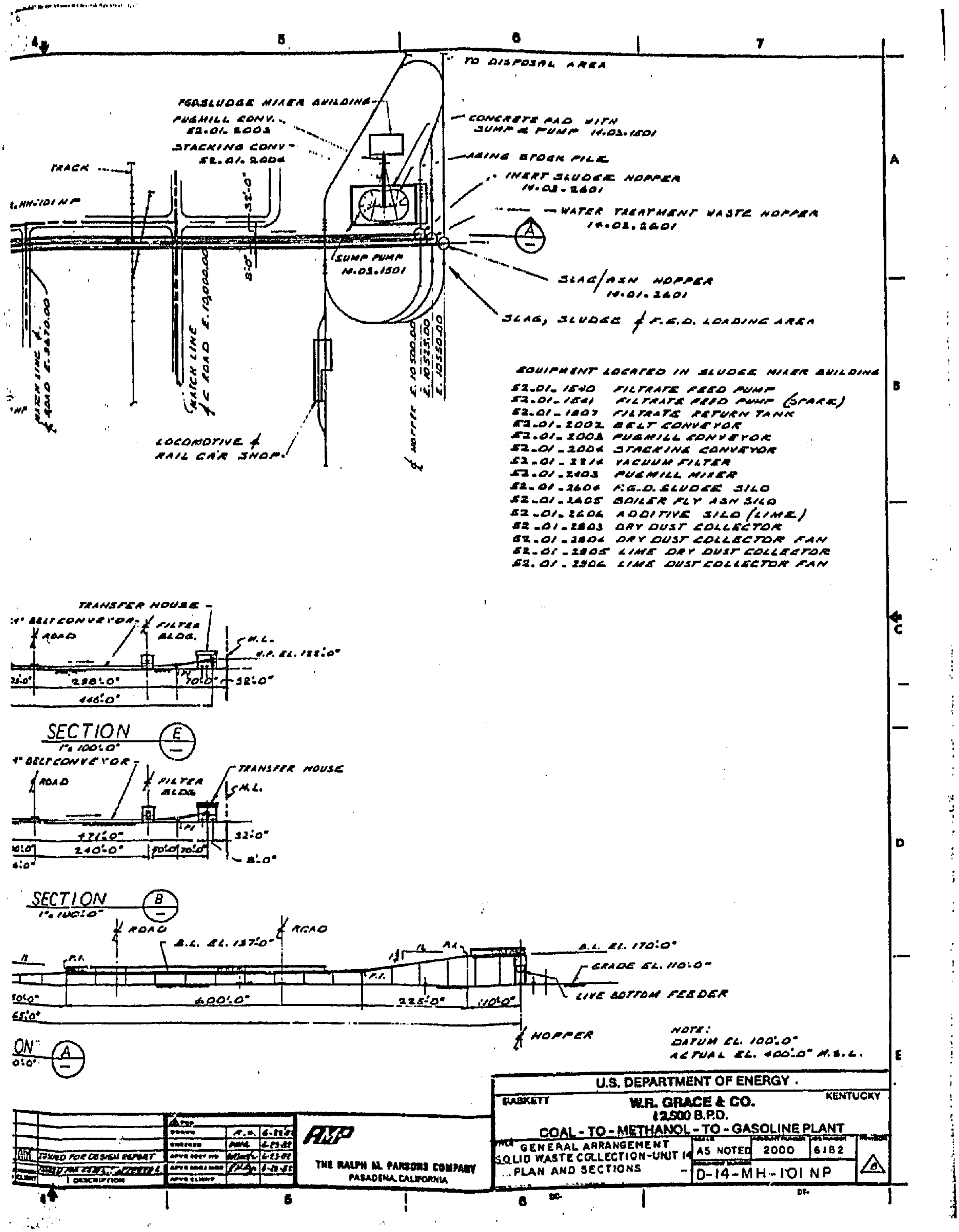
D-14-MP-102 NP

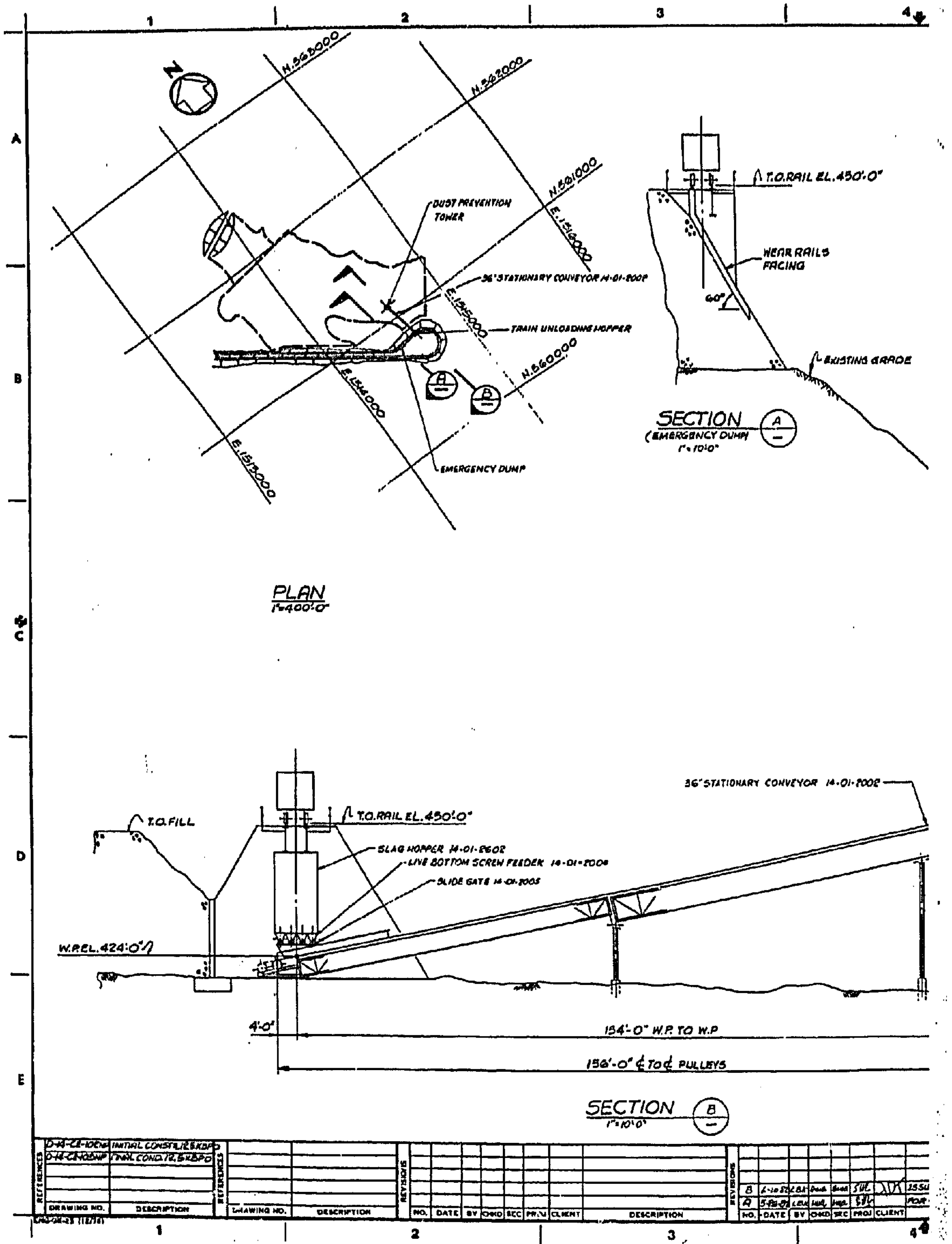
F. Plot Plan/General Arrangement Drawings

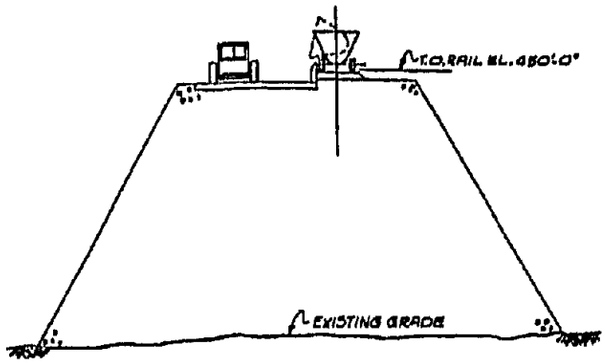
Plot Plan/General Arrangement Drawings for Solid Waste Collection and Disposal Unit 14 are as follows:

Drawing No.	Title
D-14-MH-101NP	General Arrangement - Solid Waste Disposal, Plans and Elevation - Unit 14
D-14-MH-102NP	General Arrangement - Solid Waste Disposal, Plans and Elevations - Unit 14

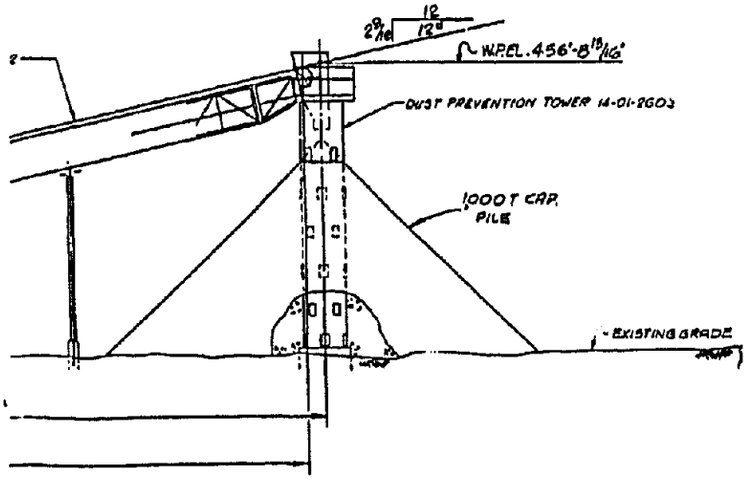

PLANT NORTH
N
24" BELT CONVEYOR 14.03-2002
24" BELT CONVEYOR 14.02-2002
DRAG CONVEYOR 52.01-2005
DRAG CONVEYOR 52.01-2004
MATCH LINE ℄ ROAD N. 11450.00 FOR CONTINUATION SEE DWG. D.12.HH-101
BASIN
FILTER AREA
PROCESS WASTE TREATMENT AREA 26 & 27 SEE DWG. D.27-PD.101 NP
GASIFIER
24" BELT CONVEYOR 14.01-2001
MATCH LINE ℄ ROAD E. 3200.00
GASIFICATION AREA 21 SEE DWG. D.21-PD-101 NP
SULFUR AREA 36 SEE DWG. D.36-PD.101 NP
MATCH LINE ℄ ROAD E. 3670.00
MAIN LINE ℄ ROAD N. 11050.00
24" BELT CONVEYOR 14.02-2001
24" BELT CONVEYOR 14.03-2001
FILTER BELT PRESS 53.01-2203
WASTE EVAPORATOR FILTER BELT PRESS 53.01-2207 53.01-2207
RAW WATER TREATMENT AREA 51/52 SEE DWG. D.52-PD.101 NP
MATCH LINE ℄ ROAD E. 3400.00
PLAN
1"=100'-0"
24" BELT
FILTER BELT PRESS
B.L. EL. 113'-6"
5'-0"
28'-0"
WASTE EVAPORATOR FILTER BELT PRESS
B.L. EL. 113'-6"
5'-0"
90'-0"
16'-0"
BOTTOM ASH FROM BOILERS
CONV.
DRAG CONV.
B.L. 113'-6"
C.L. N. 11450.00
TRANSFER HOUSE
BASIN
PUMPS.
48'-0"
SECTION D
1"=20'-0"
ROAD
24" BELT CONVEYOR
B.L. EL. 113'-6"
ROAD
5'-0"
60'-0"
715'-0"
250'-0"
1365'-0"
SECTION
1"=100'-0"
DRAWING NO.
DESCRIPTION
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION

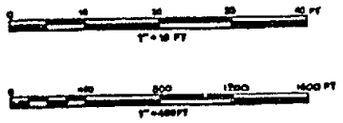

TO DISPOSAL AREA
FGD SLUDGE MIXER BUILDING
PUGMILL CONV. 52.01.2003
STACKING CONV. 52.01.2004
TRACK
CONCRETE PAD WITH SUMP & PUMP 14.03.1501
AGING STOCK PILE
INERT SLUDGE HOPPER 14.03.2401
WATER TREATMENT WASTE HOPPER 14.03.2601
SUMP PUMP 14.03.1501
SLAG/ASH HOPPER 14.01.2401
SLAG, SLUDGE & F.G.D. LOADING AREA
LOCOMOTIVE & RAIL CAR SHOP
MATCH LINE ℄ ROAD E.13000.00
℄ HOPPER E.10500.00
E.10525.00
E.10550.00
EQUIPMENT LOCATED IN SLUDGE MIXER BUILDING
52.01.1540 FILTRATE FEED PUMP
52.01.1541 FILTRATE FEED PUMP (SPARE)
52.01.1807 FILTRATE RETURN TANK
52.01.2002 BELT CONVEYOR
52.01.2003 PUGMILL CONVEYOR
52.01.2004 STACKING CONVEYOR
52.01.2214 VACUUM FILTER
52.01.2403 PUGMILL MIXER
52.01.2604 F.G.D. SLUDGE SILO
52.01.2605 BOILER FLY ASH SILO
52.01.2606 ADDITIVE SILO (LIME)
52.01.2803 DRY DUST COLLECTOR
52.01.2804 DRY DUST COLLECTOR FAN
52.01.2805 LIME DRY DUST COLLECTOR
52.01.2806 LIME DUST COLLECTOR FAN
TRANSFER HOUSE
BELT CONVEYOR
℄ ROAD
℄ FILTER BLDG.
H.L.
298'-0"
440'-0"
70'-0"
32'-0"
SECTION E
1" = 100'-0"
TRANSFER HOUSE
171'-0"
240'-0"
32'-0"
8'-0"
SECTION B
1" = 100'-0"
℄ ROAD
B.L. EL. 137'-0"
B.L. EL. 170'-0"
GRADE EL. 110'-0"
LIVE BOTTOM FEEDER
600'-0"
225'-0"
110'-0"
℄ HOPPER
NOTE:
DATUM EL. 100'-0"
ACTUAL EL. 400'-0" M.S.L.
SECTION A
U.S. DEPARTMENT OF ENERGY
BASKETT
KENTUCKY
W.R. GRACE & CO.
12,500 B.P.D.
COAL-TO-METHANOL-TO-GASOLINE PLANT
GENERAL ARRANGEMENT
SOLID WASTE COLLECTION-UNIT 14
PLAN AND SECTIONS
AS NOTED
2000
6182
D-14-MH-101 NP
ISSUED FOR DESIGN REPORT
DESCRIPTION
RMP
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA


N
N.563000
N.562000
N.561000
N.560000
E.1516000
E.1515000
E.1514000
E.1513000
DUST PREVENTION TOWER
36" STATIONARY CONVEYOR 14-01-2002
TRAIN UNLOADING HOPPER
EMERGENCY DUMP
PLAN
1"=400'-0"
T.O.RAIL EL.450'-0"
WEAR RAILS FACING
60°
EXISTING GRADE
SECTION A
(EMERGENCY DUMP)
1"=10'-0"
T.O.FILL
T.O.RAIL EL.450'-0"
SLAG HOPPER 14-01-2602
LIVE BOTTOM SCREW FEEDER 14-01-2004
SLIDE GATE 14-01-2005
36" STATIONARY CONVEYOR 14-01-2002
W.P.EL.424'-0"
4'-0"
154'-0" W.P. TO W.P
156'-0" ℄ TO ℄ PULLEYS
SECTION B
1"=10'-0"
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION



TYP. SIDE DUMP
1"=10'-0"





CLIENT	DESCRIPTION			
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		CHECKED	[illegible]	6-1-82
1	ISSUED FOR DESIGN REPORT	APVD SHEET NO	[illegible]	6-1-82
	FOR CLIENT APPROVAL	APVD PROJ MGR	[illegible]	6-2-82
		APVD CLIENT		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — **W.R. GRACE & CO.** — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE	SCALE	DRAWING NUMBER	JOB NUMBER	REVISION
GENERAL ARRANGEMENT SLAG & ASH COLLECTION & DISPOSAL-UNIT 14 SOLID WASTE DISPOSAL PLAN & SECTIONS	AS NOTED	6152	2000	B
	DOCUMENT NUMBER D-14-MH-102NP			

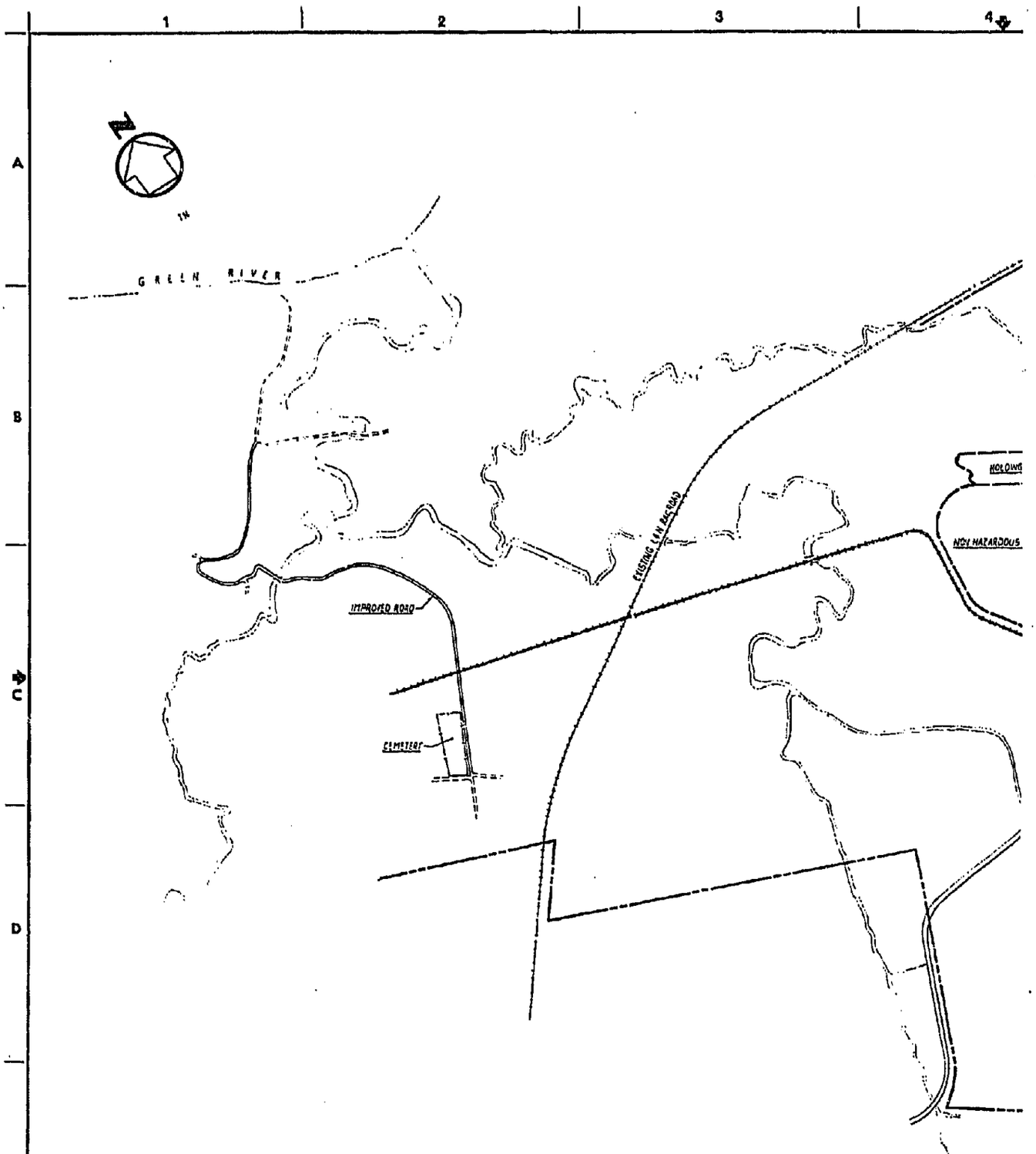
G. Single-Line Diagrams

See Volume II, 1.2.1(G) for Solid Waste Collection and Disposal Unit 14 Single-Line Diagrams.

H. Civil Engineering Drawings

Civil Engineering Drawings for Solid Waste Collection and Disposal Unit 14 are as follows:

Drawing No.	Title
D-01-CE-101NP	Solid Waste Disposal Area - Plot Plan
D-14-CE-101NP	Slag Conveyor Plan and Profile
D-14-CE-102NP	Slag Disposal Area - Initial Construction
D-14-CE-103NP	Slag Disposal Area - Final Condition
D-14-CE-104NP	Slag Railroad and Waste Disposal Area - Sections and Details



REFERENCES		REFERENCES		REVISIONS								REVISIONS								
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	
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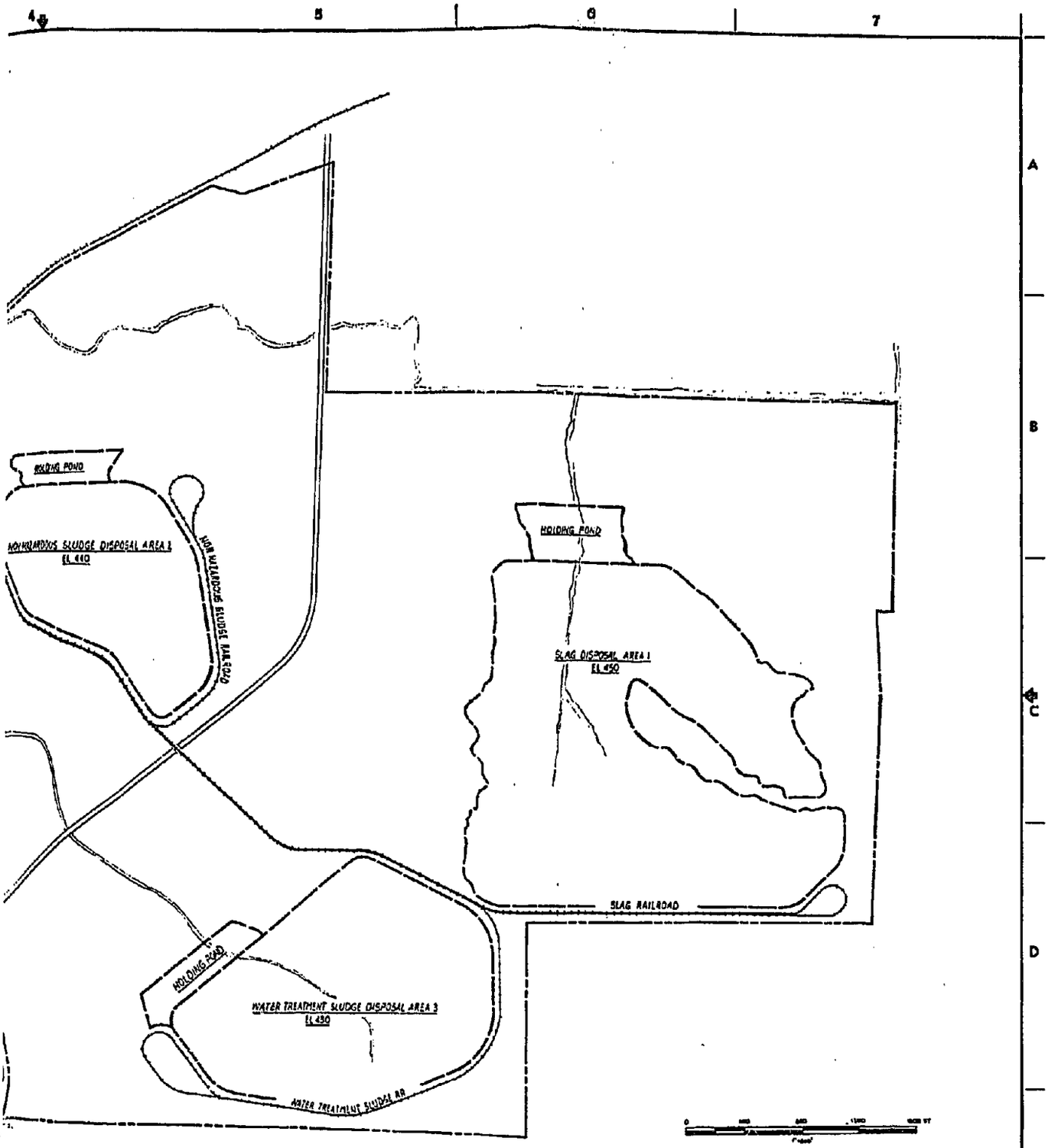
												A	5-14-82	TK					FOR C	
																			FOR	

ENG-GE-23 (12/78)



U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 BPD

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SOLID WASTE DISPOSAL AREA PLOT PLAN (FINAL CONDITION)

SIZE: D | 1"=400' | ACCOUNT NUMBER: 4800 | JOB NUMBER: 6182

DOCUMENT NUMBER: D-01-CE-101 NP

REVISION: B

	FOR		
	DRAWN	KELLY	
	CHECKED	jpd	
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FOR CLIENT APPROVAL	APVD PROJ MGR	[illegible]	[illegible]
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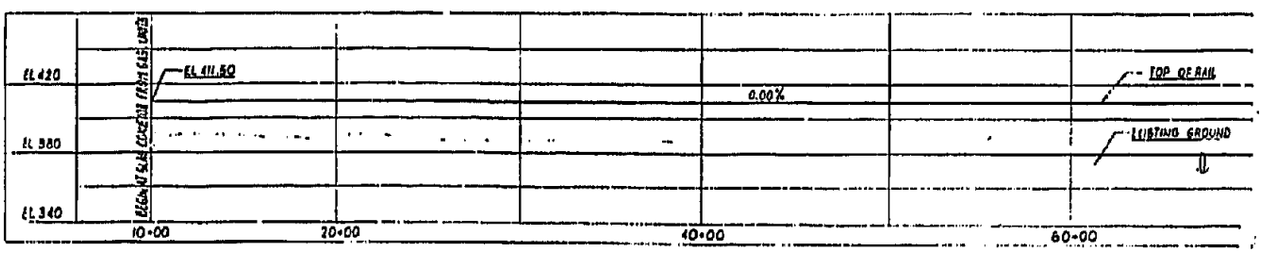

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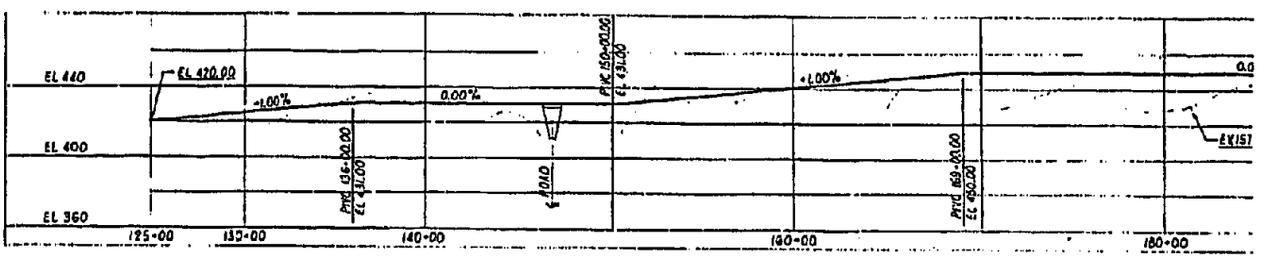
HORZ 1"=400'
VERT 1"=40'



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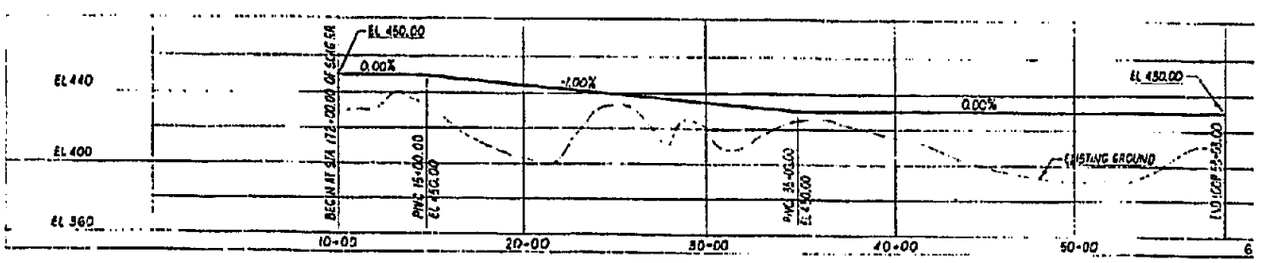

℄ WATER TREATMENT SLUDGE RAILROAD PROFILE AREA 3
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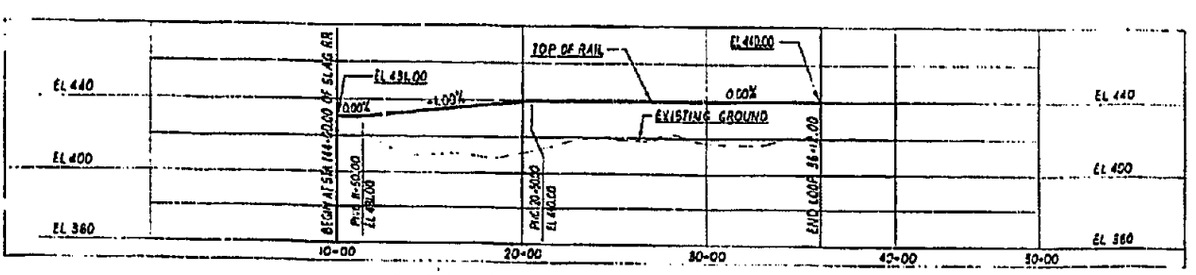

℄ NON-HAZARDOUS SLUDGE RAILROAD PROFILE AREA 2
HORZ : 1"= 400'
VERT : 1" = 40'

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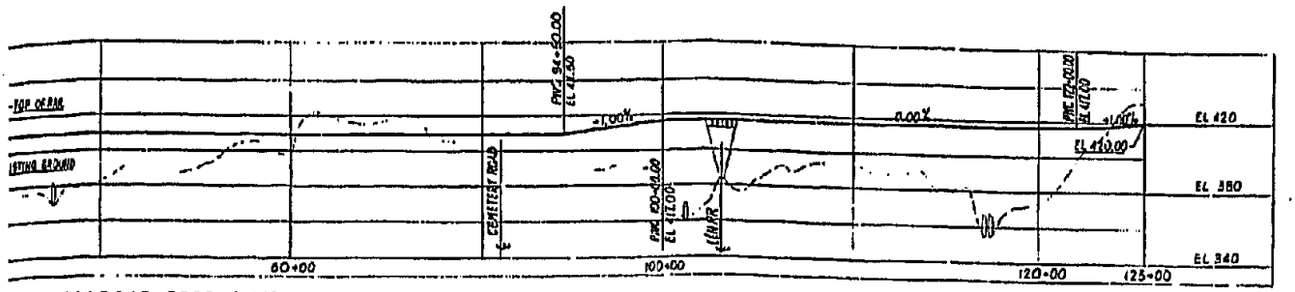
ENG-GE-33 (12/79)



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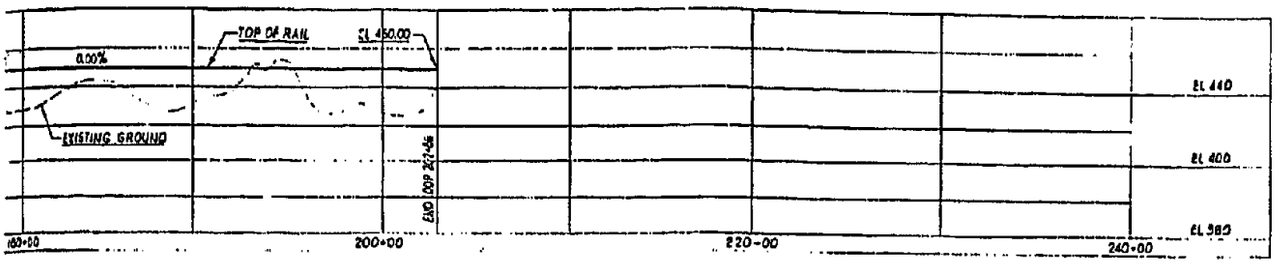

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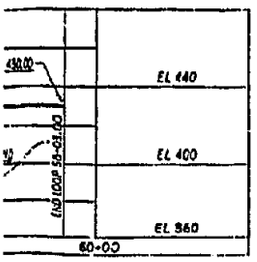

NOTES:

1. FOR PLAN SEE DWG NO D-14-CE-02 NP

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	FOR CLIENT APPROVAL	APVD PROJ MGR		5-16-82
CLIENT	DESCRIPTION	APVD CLIENT		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 BPD

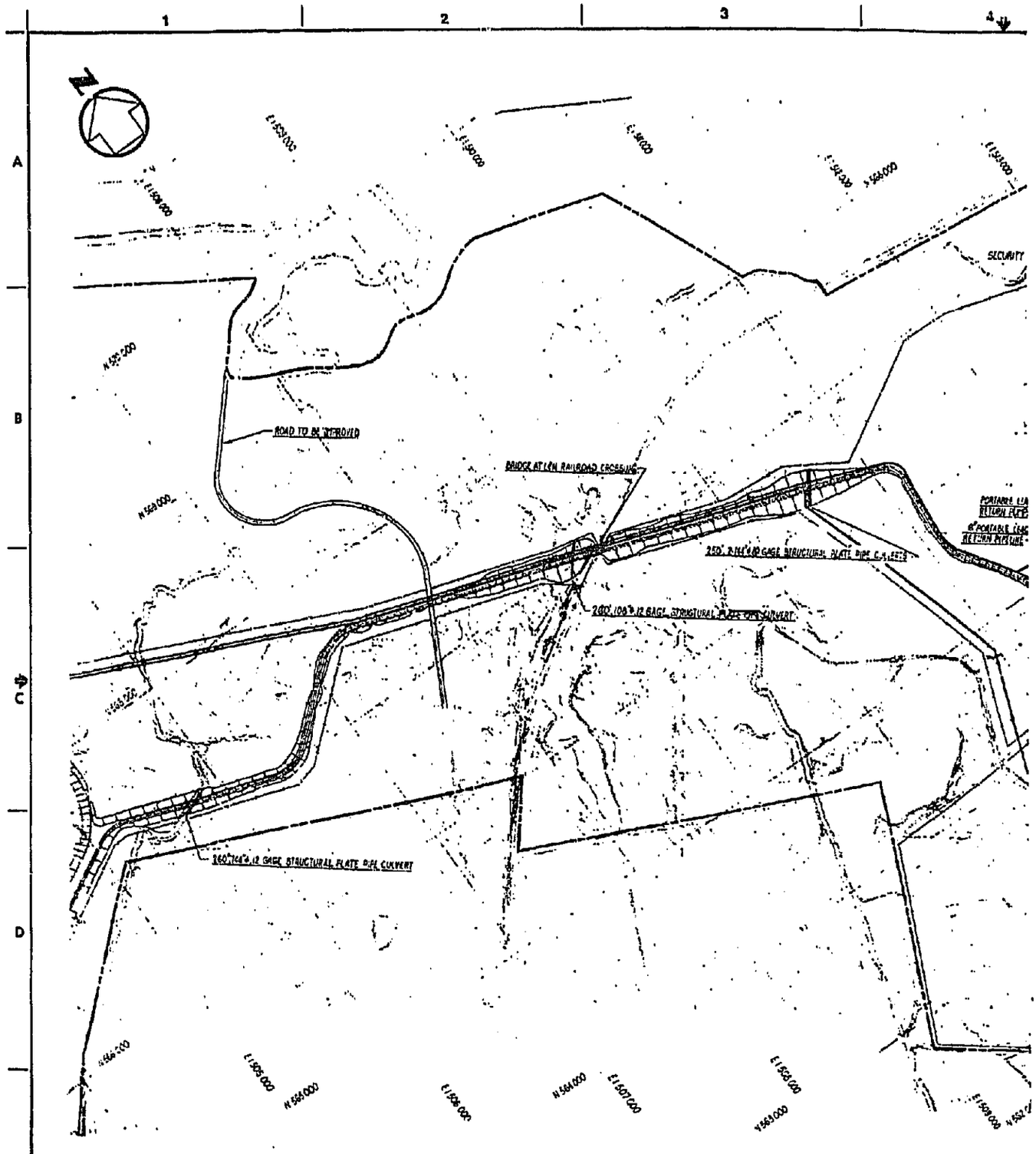
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: RAILROAD PROFILES

SCALE: AS SHOWN | ACCOUNT NUMBER: 4800 | JOB NUMBER: 6182

DOCUMENT NUMBER: D-14-CE-01 NP

REVISION: 6



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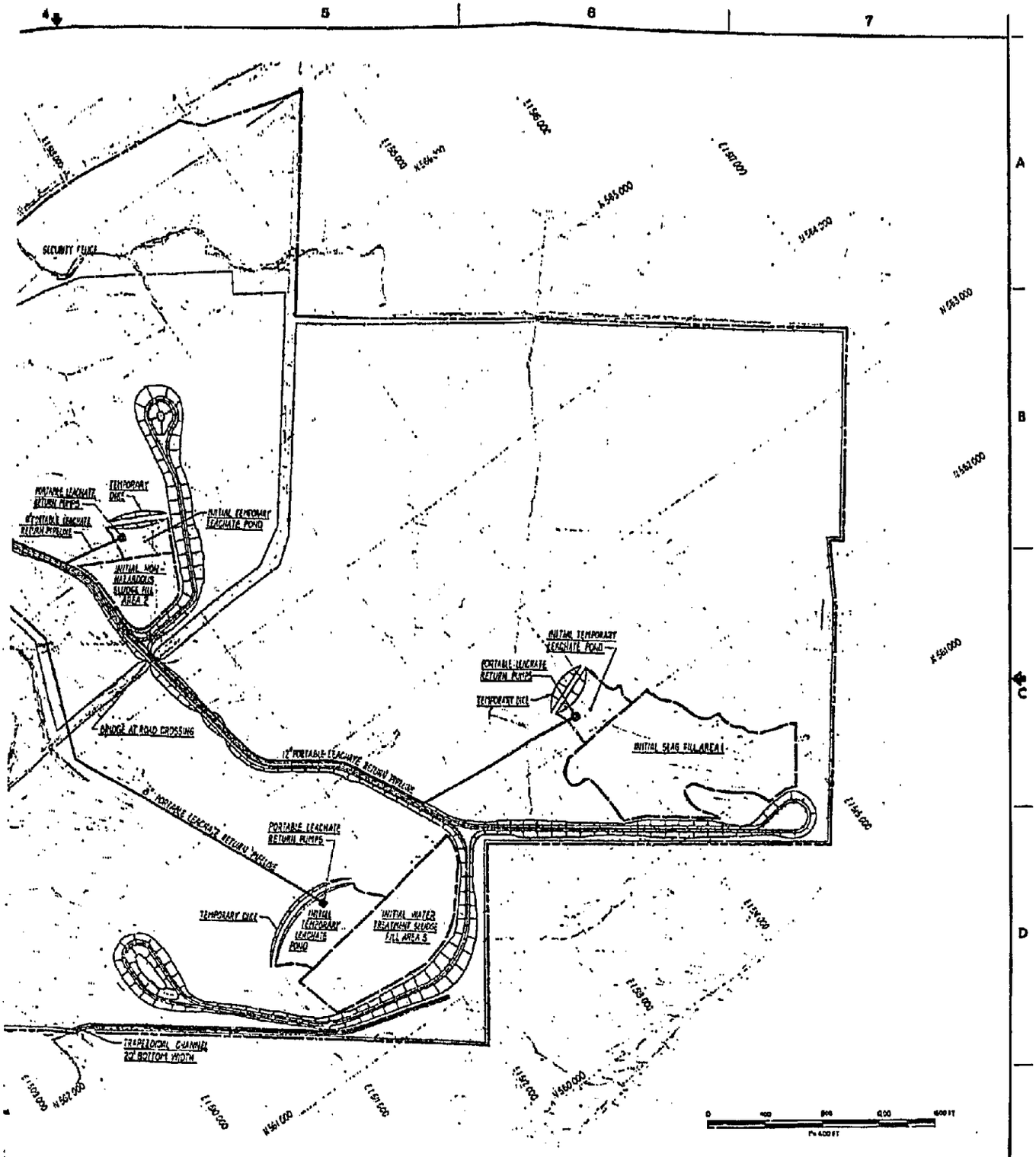
												A	5-14-82	TMK					FOR CL

ENG-GE-23 (12/79)



	APVD		
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	CHECKED	JGH	
1	ISSUED FOR DESIGN REPORT	APVD DSGT MGR	CCW 6-14-82
	FOR CLIENT APPROVAL	APVD PROJ MGR	5-26-82
CLIENT	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 BPD

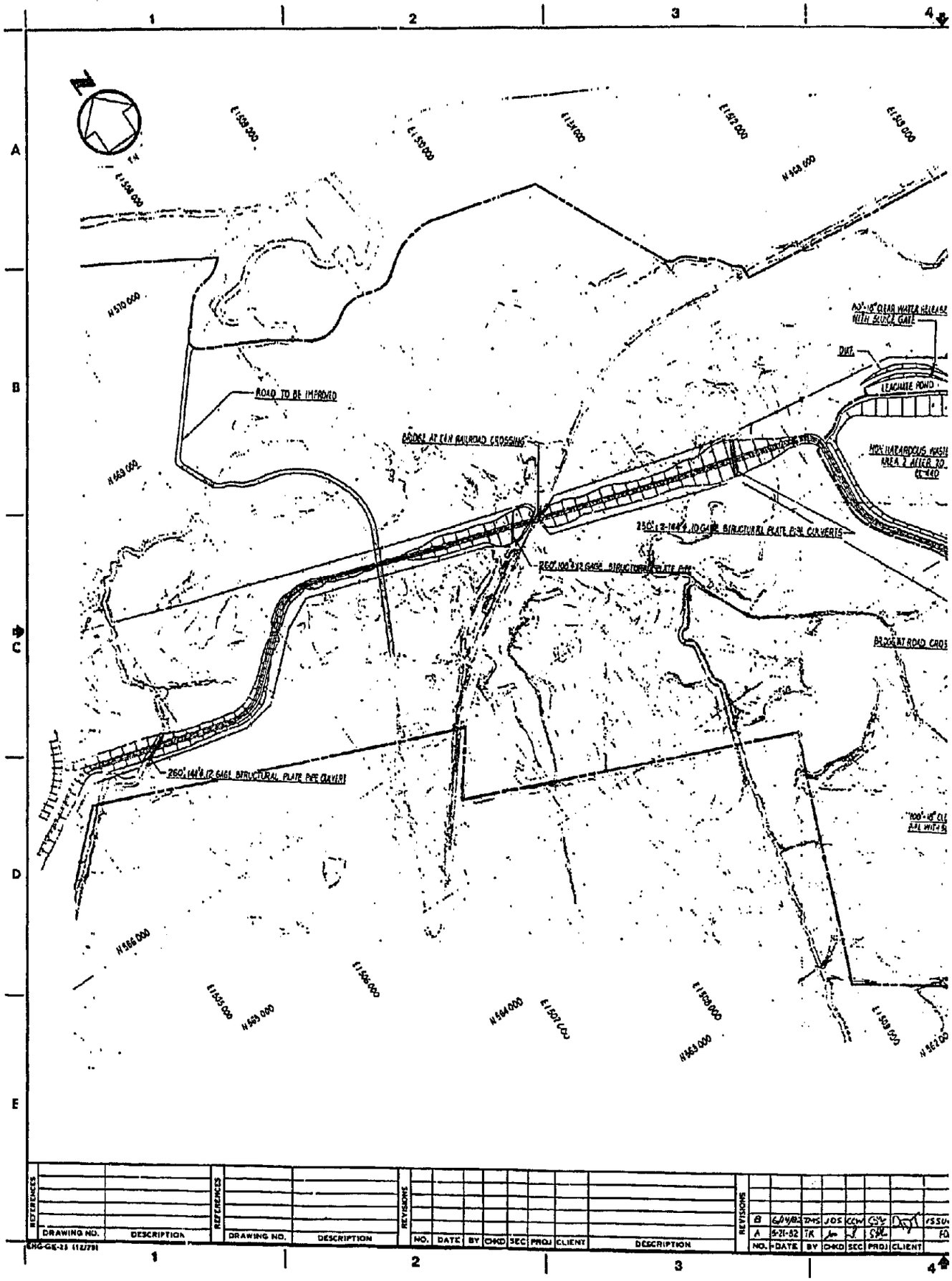
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SLAG DISPOSAL AREA INITIAL CONSTRUCTION 12.5KBPD

SCALE: 1"=400' | ACCOUNT NUMBER: 4800 | JOB NUMBER: 6182

DOCUMENT NUMBER: D-14-CE-102 NP

REV: 0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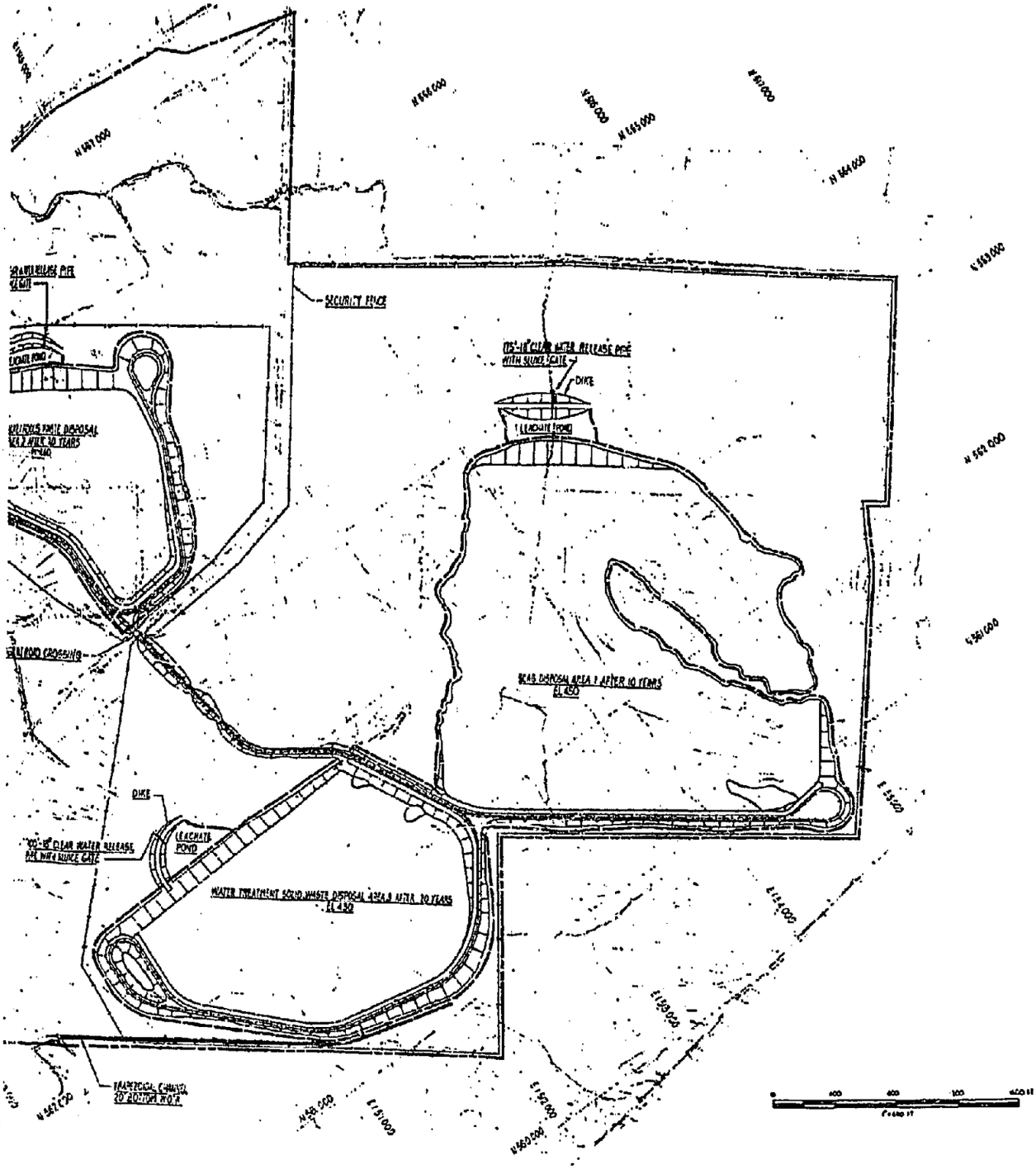
ROAD TO BE IMPROVED
BRIDGE AT C&N RAILROAD CROSSING
DIKE
LEACHATE POND
250'-12'-144"ø, 10 GAGE BIRUCTURAL PLATE PIPE CULVERTS
250'-108"ø 12 GAGE BIRUCTURAL PLATE PIPE
250'-144"ø 12 GAGE BIRUCTURAL PLATE PIPE CULVERT
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
B 6/04/82 TMS JDS CCW CSK ISSU
A 5-21-82 TK FQ
ENG-GE-25 (12/79)



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	FOR CLIENT APPROVAL	APVD PROJ MGR	EWB	12/1/82
CLIENT	DESCRIPTION	APVD CLIENT		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

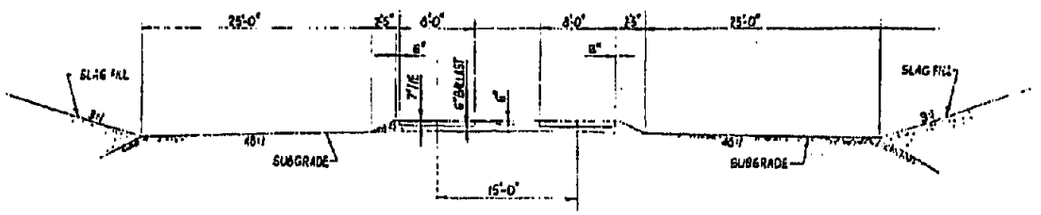
12,500 BPD
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SLAG DISPOSAL AREA
FINAL CONDITION 12.5KBPD

SCALE: 1"=400' | ACCOUNT NUMBER: 4800 | JOB NUMBER: 6182

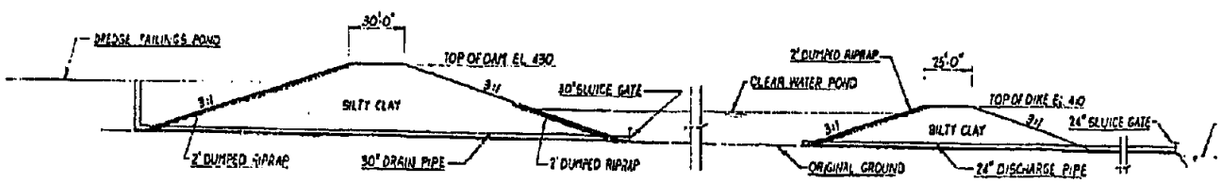
DOCUMENT NUMBER: D-14-CE-103 NP

REVISION: B



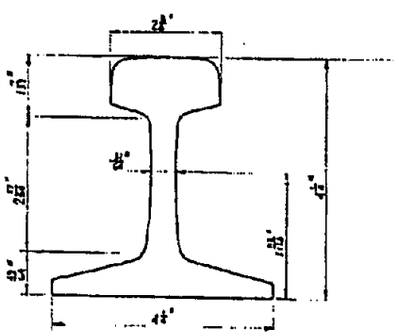
SLAG RAILROAD BALLAST SECTION AT SLAG FILL AREA

1" = 1'-0"



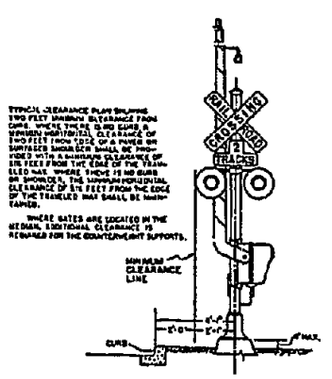
DREDGE TAILINGS DAM & CLEAR WATER POND DIKE SECTIONS

1" = 40'-0"



60 A.S.C.E. RAIL SECTION

NTS



RAILROAD CROSSING SIGNAL

NTS

REFERENCES		REFERENCES		REVISIONS								REVISIONS									
DRAWING NO	DESCRIPTION	DRAWING NO.	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION
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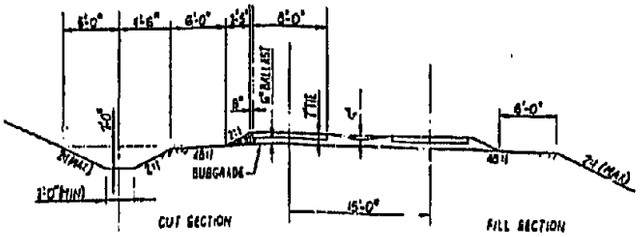
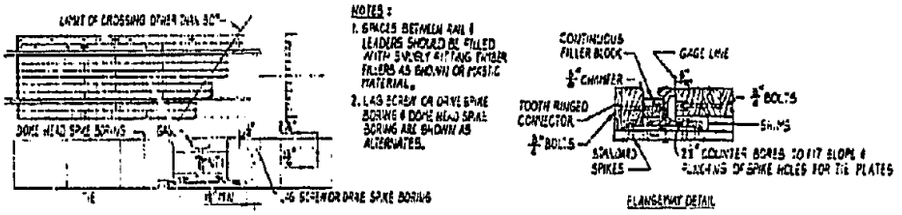
1 2 3 4



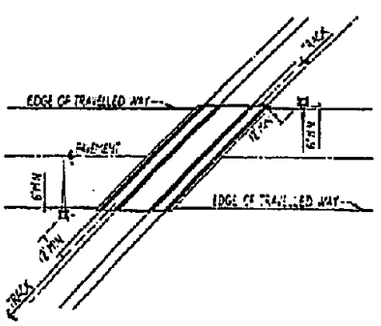
SLAG RAILROAD BALLAST SECTION

3/8" = 1'-0"



WOOD PLANK ROAD CROSSING

NTS



CROSSING SIGNAL LOCATION PLAN

NTS

NAL

		PQR			
		DRAWN	THK		
		CHECKED	bp		
	ISSUED FOR DESIGN REPORT	APVD DEPT HD	C+N		
	FOR CLIENT APPROVAL	APVD PROJ MGR	PM	5-14-82	
CLIENT	DESCRIPTION	APVD CLIENT			

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — **W.R. GRACE & CO.** — KENTUCKY

12,500 BPD

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: SLAG RAILROAD & WASTE DISPOSAL AREA SECTIONS & DETAILS 12.5KBPD

SCALE: AS SHOWN | ACCOUNT NUMBER: 4800 | JOB NUMBER: 6182

DOCUMENT NUMBER: D-14-CE-104 NP

REVISION: 2

1.2.5 GASIFICATION - UNIT 21

The Texaco Coal Gasification Process (TCGP), characterized as an entrained slagging downflow gasifier, is utilized in the design of the Gasoline Plant. The utilization of this technology was specified in the Cooperative Agreement Statement of Work with engineering design information obtained through Texaco Development Corporation.

A. Basis of Design

The quantity of synthesis gas generation capacity required by the size of the Gasoline Plant necessitated the incorporation of five operating coal gasifier trains and one spare into the design. The feed and product streams shown on the following two pages depict the design basis utilized in the design of this unit.

B. Process Selection Rationale

The design of the Gasoline Plant centers around the TCGP for combustion of Kentucky No. 9 high-sulfur, agglomerating coal specified in the Cooperative Agreement. This commercially available technology has been demonstrated as capable of efficiently gasifying high-sulfur content, high swelling index coals; operating at high pressure and affording an excellent heat recovery scheme to reduce operating cost; and producing an environmentally acceptable syngas and nonhazardous slag.

In the ensuing years, a commercially sized demonstration plant has been built and is operating at the Ruhrchemie Chemical Complex in Oberhausen-Holten, West Germany. The Ruhrchemie gasifier has been running successfully since early 1978. For these reasons, Texaco has licensed this process for other commercial installations and considers this process to be commercial.

Feed Streams

Component	Total Coal Slurry to Gasification (lb mol/hr)	Total Oxygen to Gasification (lb mol/hr)
H_2		-
CH_2		-
CO		-
CO_2		-
O_2		13,742.19
N_2		-
Ar		69.07
H_2S		-
COS		-
Total Dry, lb mol/hr	Proprietary	13,811.26
H_2O		-
Total Wet, lb mol/hr		13,811.26
Coal, lb/hr		-
Ash, lb/hr		-
Carbon		-
Total, lb/hr	Proprietary	442,510
Pressure, psia	1,200	1,015
Temperature, °F	200	200

Product Streams

Component	Total Raw Syngas (lb mol/hr)	(mol%)
H_2	15,645.27	36.19
CH_4	85.86	0.20
CO	18,940.21	43.81
CO_2	7,697.10	17.81
O_2	-	-
N_2	205.75	0.48
A	69.07	0.16
H_2S	550.29	1.27
COS	33.93	0.08
Total Dry, lb mol/hr	43,227.48	100.00
H_2O	30,792.69	
Total Wet, lb mol/hr	74,020.17	
Total, lb/hr	1,486,240.00	
Pressure, psia	874	
Temperature, °F	435	

C. Process Description

The equipment arrangement and material balance for this unit are shown on Process Flow and Control Diagram D-21-MP-101NP.

The coal-water slurry is pumped at high pressure through the slurry preheater into the gasifier. In the gasifier, the slurry is partially oxidized with oxygen at 900 psig and at high temperature. The hot synthesis gas and molten slag generated flow downward from the gasifier into the radiant boiler, where much of the heat of reaction is recovered by generating high-pressure saturated steam. The slag falls into the water sump and solidifies and shatters to glass-like granules. The synthesis gas is withdrawn from the radiant boiler for further processing.

The gas exiting the radiant waste heat boiler undergoes a succession of scrubbing stages to remove particulate material. At the final stage, the gas is washed with condensate before it flows to the CO Shift Unit.

A substantial portion of the ash and recycle slag in the gasifier feed agglomerates into coarse molten slag droplets. The slag is solidified and quenched in the radiant boiler. This slag settles through the water bath and is collected in a lock hopper. The contents of the lock hopper are discharged periodically.

The coarse slag is sent to slag disposal while water and slag fines passing through a screen are pumped to the clarification system.

Water streams from the radiant boiler, slag discharge, and the scrubber system contain suspended ash and char particles, which are routed to a clarification system. The fine slag and unconverted coal are formed in a concentrated underflow that is returned to the Coal Grinding and Slurry Preparation Unit. The clarified water overflows into a water holding tank for reuse in the gasification system.

D. Risk Assessment

The commercially available Texaco Coal Gasification Process offered through Texaco Development Corporation (TDC) is an expansion of the well-proven Texaco Synthesis Gas Generation Process. TDC, a wholly owned subsidiary of Texaco Inc., has been engaged in the development and licensing of the Texaco Synthesis Gas Generation Process since 1945. The synthesis gas generated by this technology is a mixture predominantly of hydrogen and carbon monoxide, which is used as a feedstock for the production of ammonia, methanol, hydrogen, oxo products, reducing gas, fuel gas, and Fischer-Tropsch liquid hydrocarbons.

Over 80 Texaco synthesis gas generation plants have been licensed since the early 1950s involving some 150 gasifiers. Early units were natural gas fired. Later, liquid fuels such as naphtha and heavy fuel oil were introduced. The majority of plants now in operation utilize heavy residual oils.

Generator size has increased steadily, with present units producing 20 times the output of the early commercial units. Operating pressure has risen from 350 psig in initial plants to 1,200 psig in one plant in operation since 1968. Commercial operation as low as 30 psig has also been demonstrated. Pilot unit commercial operation on residual fuels has been conducted at 2,500 psig. Syngas coolers have been used in 20 commercial plants, while the remainder have used direct quench.

The Texaco Coal Gasification Process is a modification of the Texaco Synthesis Gas Generation Process, producing generally the same type of synthesis gas for the same commercial applications. Development work on coal gasification, started in 1948, has involved large-scale pilot unit operation on many solid fuels including lignites, bituminous coals, anthracites, coal-liquefaction residues, and petroleum cokes.

A demonstration plant was erected at the Morgantown Ordnance Works in West Virginia in 1956. This unit charged 100 tons per day of an eastern bituminous coal in water slurry and was in operation for 2 years. This plant confirmed gasifier scale-up criteria and demonstrated the ash-handling system.

At the Montebello Research Laboratory, extensive facilities are available for the gasification of solid fuels. These include three 15- to 20-tpd coal gasification pilot units including one stand-alone pilot plant. Testing has included gas cooling, sulfur removal, and wastewater treatment. These pilot units have been operating on a wide range of coals at pressures ranging from 300 to 1,200 psi. Detailed environmental data have been accumulated on both eastern and western U.S. coal.

Ruhrchemie AG (RCH) and Ruhrkohle AG (RAG) completed a demonstration plant utilizing the Texaco Coal Gasification Process in 1977 at Oberhausen-Holten, Germany. The demonstration plant has been in operation more than 4 years. Over 10,000 hours of operation, with a total throughput of more than 50,000 tons of coal, have been achieved. Eleven different types of coal have been tested. Three of the coal grades used were supplied from the United States.

A number of variables that may affect the coal gasification process in the Gasoline Plant are:

(1) Gasifier thermal performance

(2) Effectiveness of ash removal and carbon recycle systems.

(3) Pumpability range of high solids content slurries.

(4) Assessment of unexpected corrosion, erosion, and refractory life.

The temperatures and pressures involved in the Gasoline Plant are within the range for which equipment has been supplied for petrochemical and process plants. Some key items in this process area are slurry charge pumps, slurry preheating, gasifier burner, and gasifier/waste heat boiler system.

The removal and handling of slag from the gasifier are particularly arduous applications for valving. Special attention was applied to the details of valve design. Safety interlocks on valves and instrumentation for sequencing prevent maloperation of the lock hopper system for slag collecting and dumping. The gasification units are provided with alarms to warn of abnormal conditions. The purpose of the alarm system is to allow operators to take corrective action before an automatic shutdown is initiated.

The efficiency of the process can be affected by three significant variables including slurry concentration, ash content of the coal, and melting point of the ash. The gasification facilities were designed for a range of coal analyses centered on the design coal used in the normal operating condition. An increase in ash content, a decrease in slurry concentration, or an increase in combustion zone temperature requires more coal and oxygen feed per Btu of heating value of gas produced. This results in higher operating costs than provided in the Operating Cost Summary.

Technical risk is related mainly to equipment life and maintenance requirements, which include the rate of wear of the refractory. Life of at least a year is expected. Two spare gasifier trains were included in the design so that replacement of refractory can be scheduled sequentially. The spare gasifier trains also allow an aggressive program of recognizing and solving problems to be carried out by periodic rotation of units for inspection, preventive maintenance, and maintenance.

The slurry charge pumps provided are commercially available proven equipment, and require no scale-up or extrapolation of design. The pumps are discussed in the section covering Coal Grinding and Slurry Preparation.

The gasifier design pressure of 900 psi and design basis (slurry concentration coal types, gasifier temperatures, etc.) are considered well within commercial use and conservatively set. Burner replacement is a simple matter and adequate spares are stocked. Gasifier lock hopper valves are critical items, but operating units have confirmed technical adequacy.

Reactions with high-purity oxygen produce large quantities of heat and require careful monitoring and control. As described herein, the gasifier system is highly instrumented to provide operators with information on the operating conditions. This information is integrated into a trip system that shuts down a train automatically if unsafe conditions arise.

The waste heat boiler system is a very critical item since it represents simultaneous gas cooling and recovery of a major portion of the heat (steam) utilized in plant drivers. The design is based on the successful operating experience in the Ruhrchemie demonstration plant at Oberhausen. Special soot blowing equipment is utilized in maintaining heat transfer surface coefficients and that source of technology is used for material selection.

The means by which slag is discharged from the gasifier requires special attention during operation to minimize the risk associated with the scale-up from existing units.

A significant risk results from the uncertainty relating to corrosion rates in the circulating water system, although information available at present suggests that this corrosion may not be unusually high.

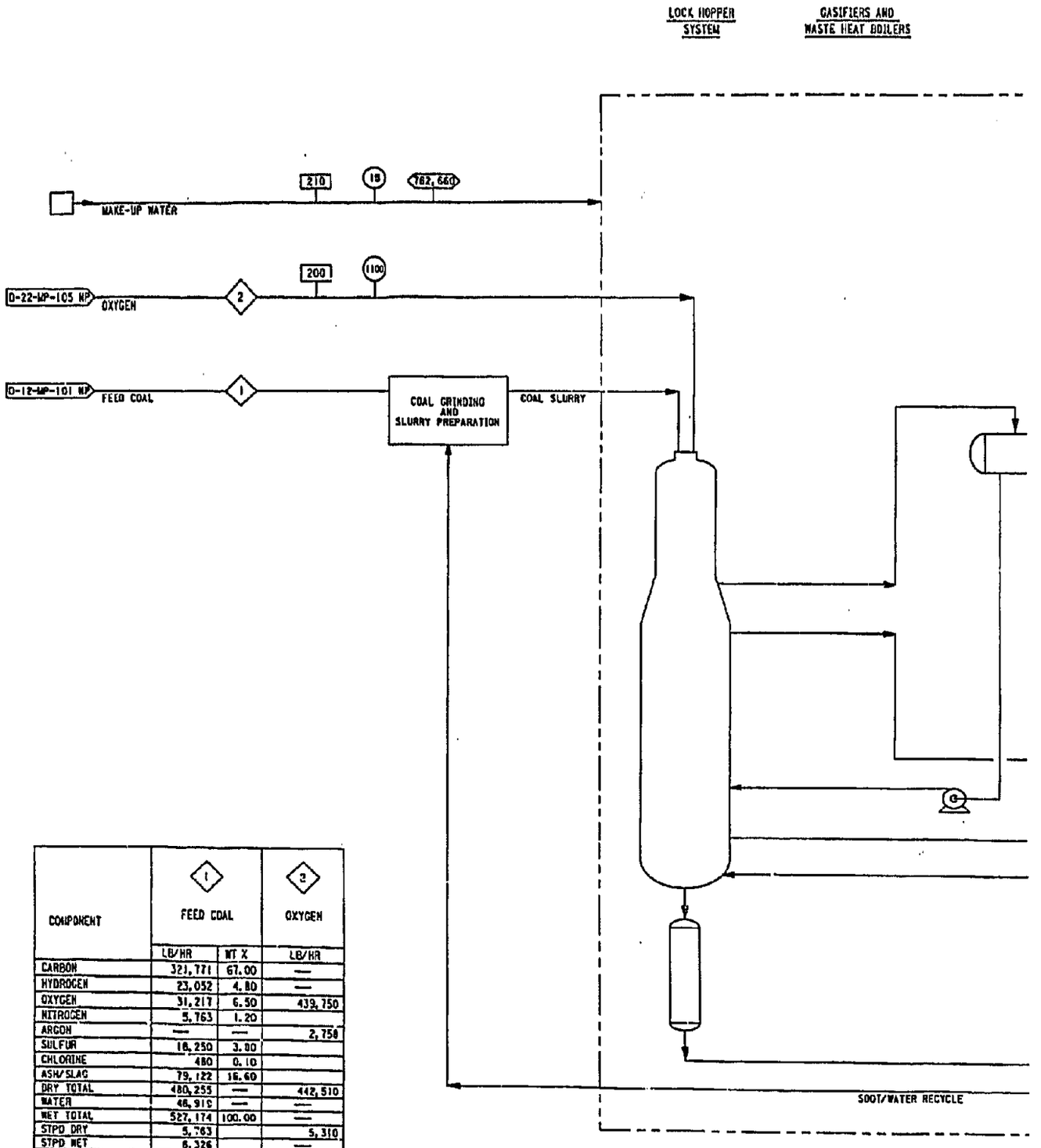
Uncertainties associated with the design and operation of coal slurry heaters do not pose serious risks as the plant can be operated satisfactorily without them.

In general, the gasification section contains certain equipment mentioned above that has relatively severe operating conditions; however, commercial operation has proven the adequacy of the process. In conjunction with conservative designs and adequate sparing, the technical risk is considered minimal.

E. Process Flow and Control Diagram (Including Material Balance)

The Process Flow and Control Diagram for Gasification Unit 21 is as follows:

Drawing No.	Title
D-21-MP-101NP	PFCD Gasification - Unit 21



COMPONENT	1 FEED COAL		2 OXYGEN
	LB/HR	WT %	LB/HR
CARBON	321,771	67.00	—
HYDROGEN	23,052	4.80	—
OXYGEN	31,217	6.50	439,750
NITROGEN	5,763	1.20	
ARGON	—	—	2,758
SULFUR	18,250	3.80	
CHLORINE	480	0.10	
ASH/SLAG	79,122	16.60	
DRY TOTAL	480,255	—	442,510
WATER	46,919	—	—
WET TOTAL	527,174	100.00	—
STPD DRY	5,763		5,310
STPD WET	6,326		—
BTU/LB HHV DRY	12,362		—

REFERENCES			
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION

REVISIONS								
NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	
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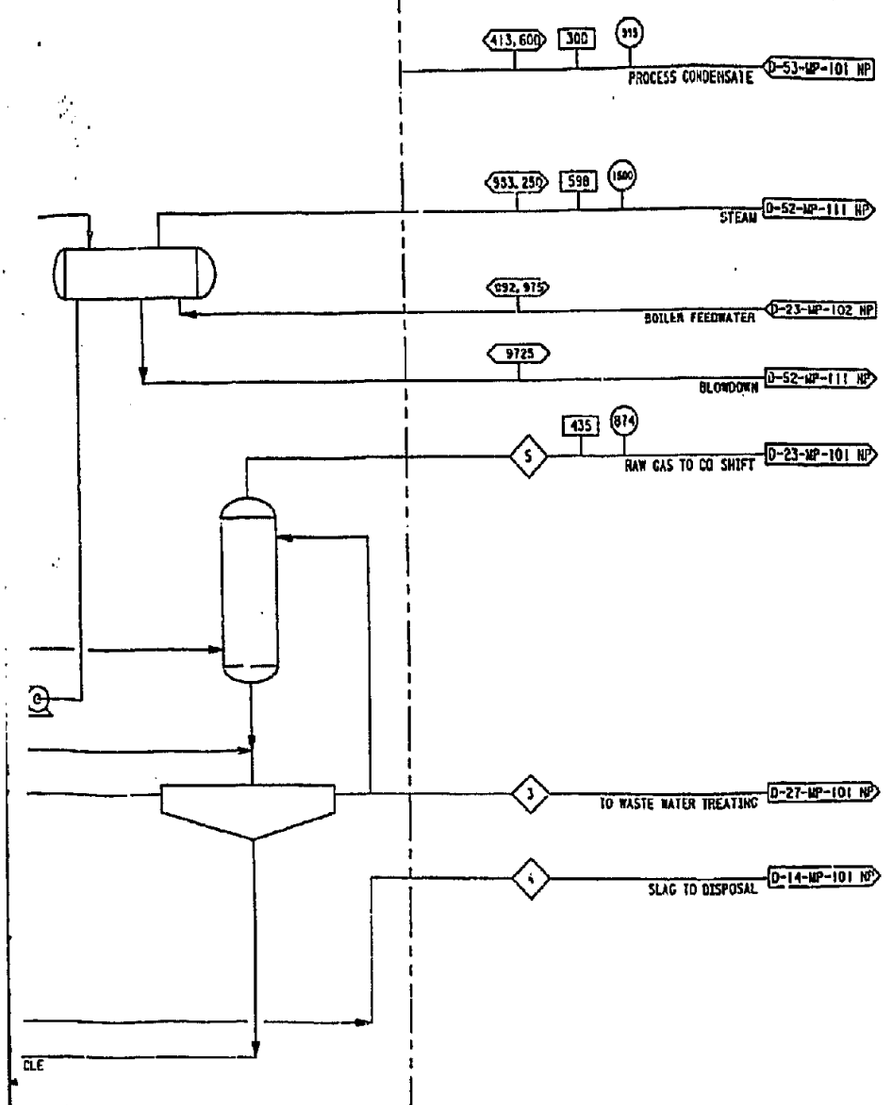
B	6/25/82		JCL	RAW	GS		FOR CL	
A	4/1/82		JCL	RAW	GS		FOR CL	
NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT		

STEAM DRUM

SCRUBBER SYSTEM

NOTES:

1. THE GASIFICATION UNIT CONSISTS OF SIX TRAINS, 5 OPERATING AND 1 SPARE.
2. MATERIAL BALANCE STREAMS ARE SHOWN AT NORMAL OPERATING CONDITIONS FOR FIVE GASIFIER TRAINS OF A NOMINAL 12,500 BPD GASOLINE PLANT.



COMPONENT	5 RAW GAS FROM GASIFICATION		
	MOL. WT.	LB MOL/HR	MOL %
H_2	2.02	15,645.27	36.19
CH_4	16.04	85.86	0.20
CO	28.01	18,940.21	43.81
CO_2	44.01	7,697.10	17.81
N_2	28.02	205.75	0.48
Ar	39.94	69.07	0.16
H_2S	34.08	550.29	1.27
COS	60.07	33.93	0.08
TOTAL DRY		43,227.48	100.00
H_2O		30,792.69	
TOTAL WET		74,020.17	
LBS/HR		1,486,240	
MOLECULAR WT.		20.08	
MMSCFD		674.1	
PSIA		874	
°F		435	

COMPONENT	3 EFFLUENT WATER	4 SLAG TO DISPOSAL
	LB/HR	LB/HR
CARBON	—	395
HYDROGEN	—	—
OXYGEN	—	—
NITROGEN	—	—
ARGON	—	—
SULFUR	—	—
CHLORINE	—	—
ASH/SLAG	1149	78574
DRY TOTAL	1149	78959
WATER	572871	31771
WET TOTAL	574020	110740

D21MP101R.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

PROCESS FLOW & CONTROL DIAGRAM GASIFICATION - UNIT 21

SCALE: NONE | ACCOUNT NUMBER: 2600 | JOB NUMBER: 6182 | REVISION: C

DOCUMENT NUMBER: D-21-MP-101 NP

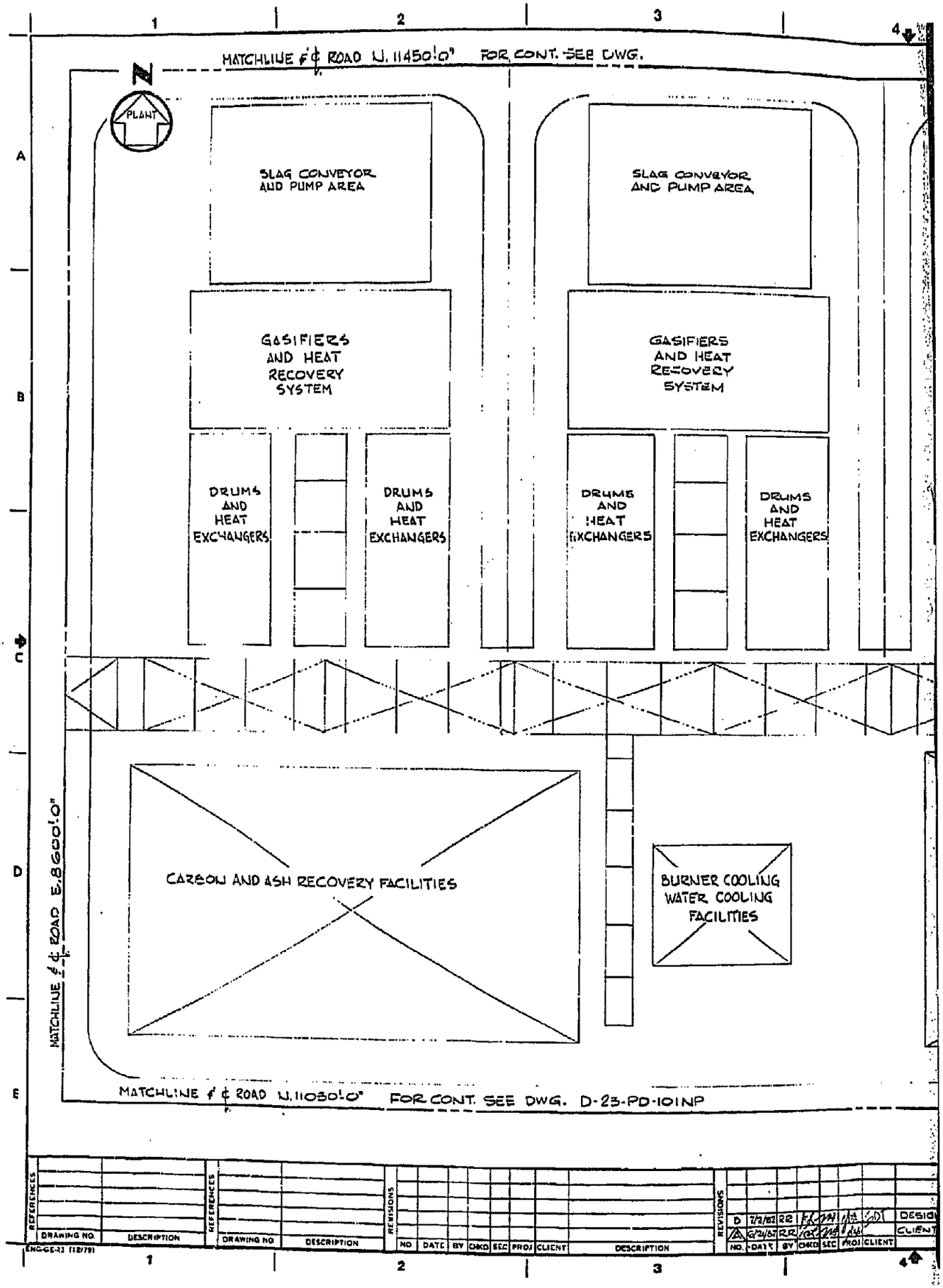
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

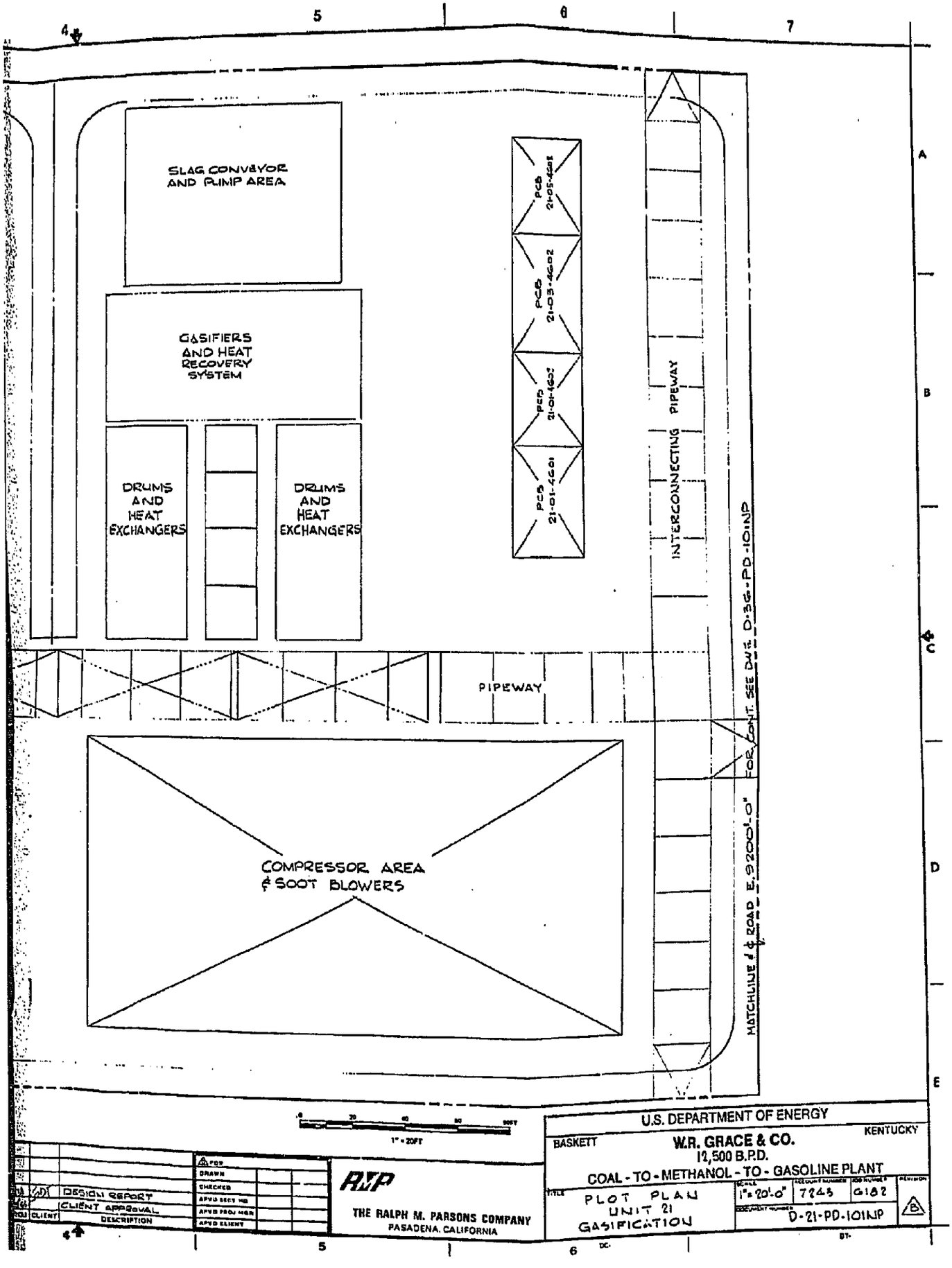
CLIENT	DESCRIPTION	FOR	DRAWN	CHECKED	APVD DEPT MGR	APVD PROJ MGR	APVD CLIENT
DT	FOR DESIGN REPORT						
	FOR CLIENT APPROVAL						
	FOR CLIENT 50% REVIEW						

F. Plot Plan/General Arrangement Drawing

The Plot Plan/General Arrangement Drawing for Gasification Unit 21 is as follows:

Drawing No.	Title
D-21-PD-101NP	Plot Plan - Unit 21 Gasification


MATCHLINE ℄ ROAD N. 11450'0" FOR CONT. SEE DWG.
N
PLANT
SLAG CONVEYOR AND PUMP AREA
SLAG CONVEYOR AND PUMP AREA
GASIFIERS AND HEAT RECOVERY SYSTEM
GASIFIERS AND HEAT RECOVERY SYSTEM
DRUMS AND HEAT EXCHANGERS
DRUMS AND HEAT EXCHANGERS
DRUMS AND HEAT EXCHANGERS
DRUMS AND HEAT EXCHANGERS
CARBON AND ASH RECOVERY FACILITIES
BURNER COOLING WATER COOLING FACILITIES
MATCHLINE ℄ ROAD E. 8600'0"
MATCHLINE ℄ ROAD N. 11030'0" FOR CONT. SEE DWG. D-23-PD-101NP
1
2
3
4
A
B
C
D
E



1" = 20FT

		POT	
		DRAWN	
		CHECKER	
		APVD SECT MGR	
		APVD PROJ MGR	
		APVD CLIENT	
1	2/01	DESIGN REPORT	
0		CLIENT APPROVAL	
NO.		DESCRIPTION	

RMP

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: PLOT PLAN UNIT 21 GASIFICATION

SCALE: 1" = 20'-0" | ACCOUNT NUMBER: 7245 | JOB NUMBER: 6182

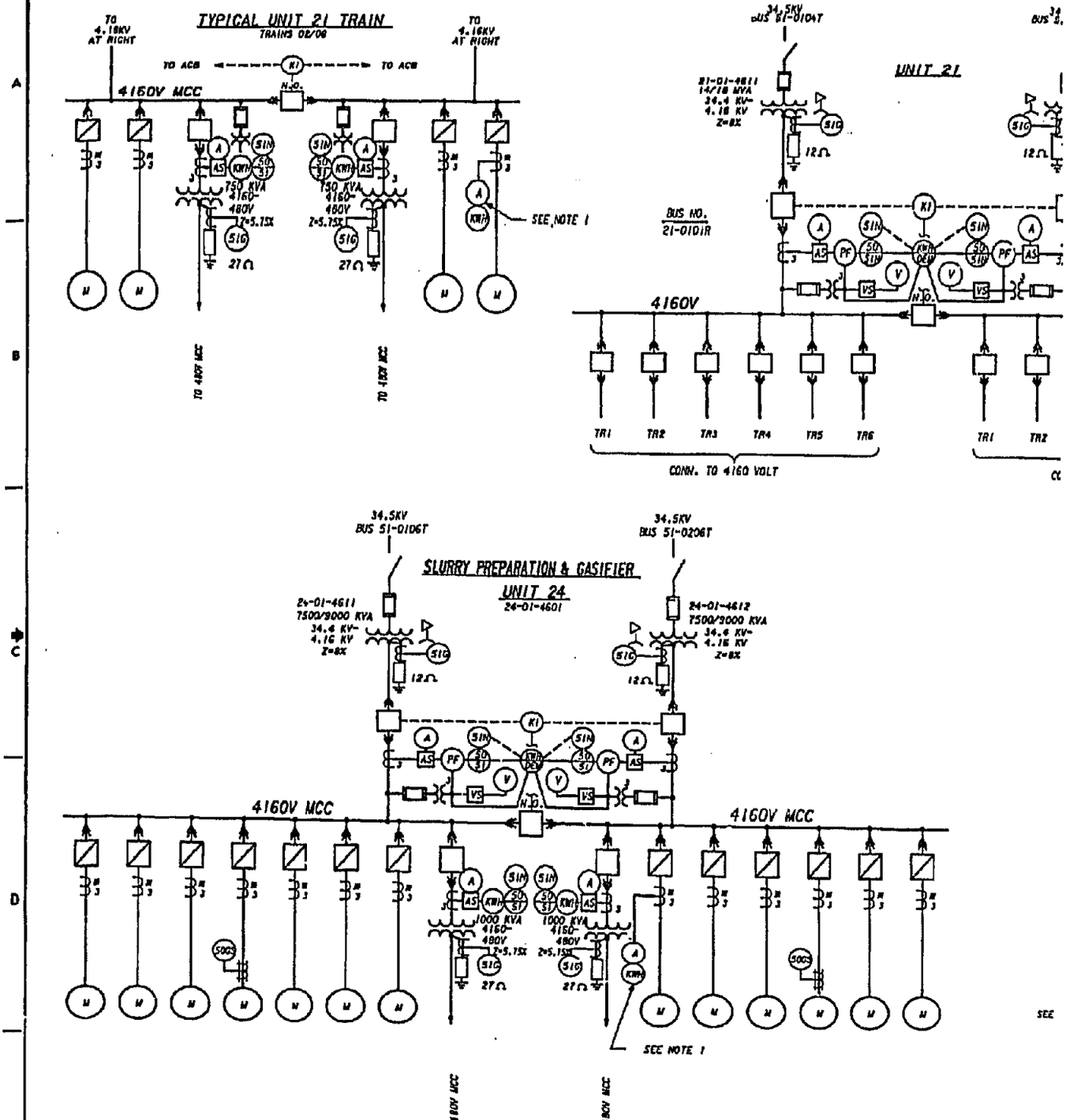
DRAWING NUMBER: D-21-PD-101NP

REVISION: B

G. Single-Line Diagram

The Single-Line Diagram for Gasification Unit 21 is as follows:

Drawing No.	Title
D-51-EE-103NP	One-Line Diagram - Units 21 and 24



REFERENCES		REFERENCES		REVISIONS								REVISIONS								
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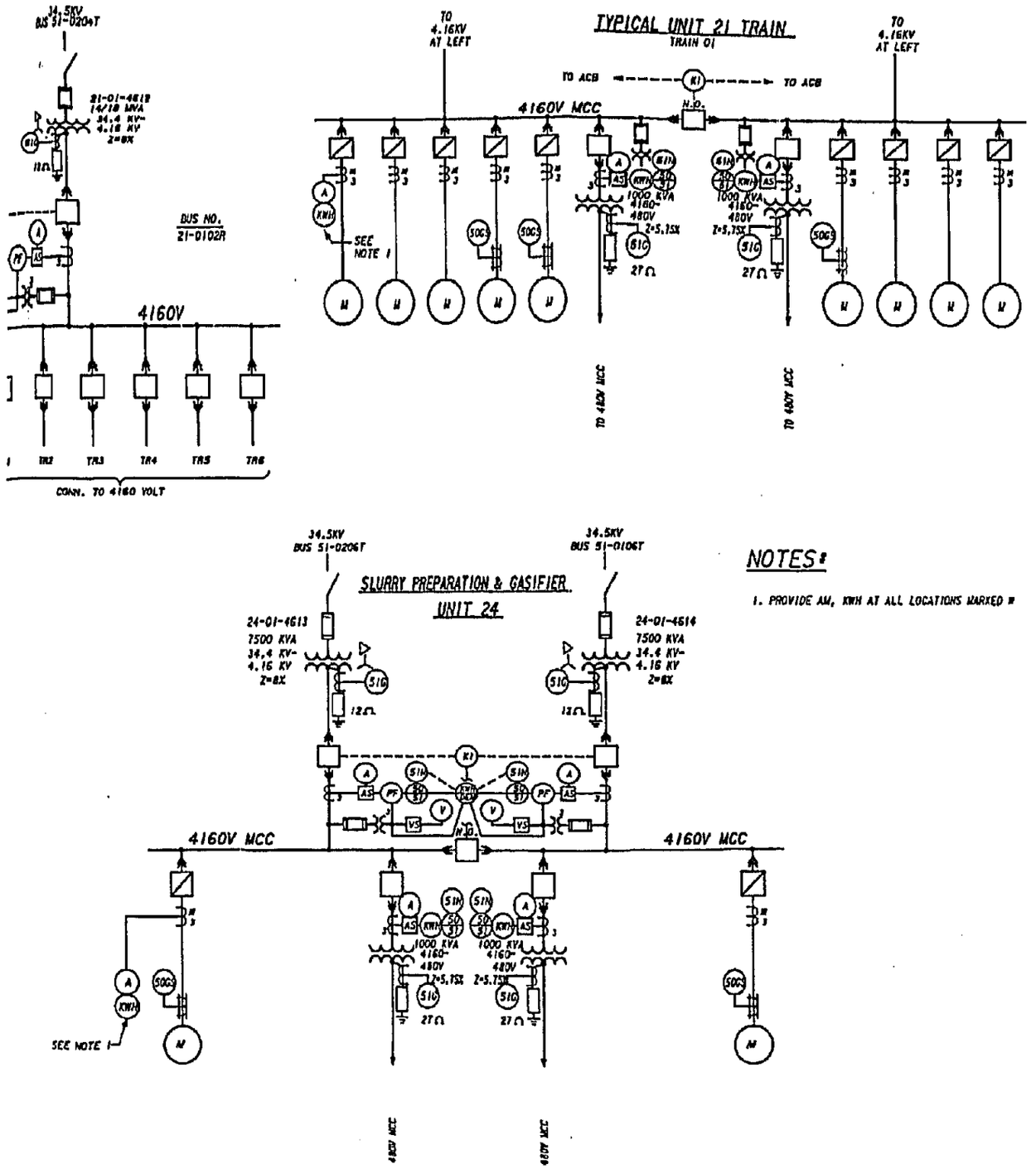
												A	6-18-82	HT	TS	RYE			ISSUE

ENG-GE-25 1187981



		FOR	
		DRAWN	HT
		CHECKED	
WR	FOR DESIGN REPORT	APVD SECT HD	
	ISSUED FOR CLIENT APPROVAL	APVD PROJ MGR	
CLIENT	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT **W.R. GRACE & CO.** KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: ONE LINE DIAGRAM
TEXACO COAL GASIFICATION U-21
COAL GRINDING & SLURRY PREP. U-24

SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
NONE	4600	6182	H

DOCUMENT NUMBER: D-51-EE-103NP

1.2.6 OXYGEN - UNIT 22

The partial oxidation process associated with the Texaco Gasification Process (TCGP) requires an oxidizer to sustain the partial combustion of the coal feedstock. This oxidizer in the form of high-purity gaseous oxygen is supplied from an air separation plant which cryogenically separates air into its major components oxygen and nitrogen. All of the oxygen is required for the gasification process while the nitrogen produced is used for process, purge, catalyst regeneration, and blanketing requirements in the process and offsite units.

A. Basis of Design

The design of the air separation (oxygen) plant is based upon the utility supply of 7,500 stpd of oxygen at 99.5% purity. The oxygen is compressed to 1,100 psig to feed the TCGP. Due to the large requirement of oxygen, three parallel 2,500-stpd air separation plants (trains), which are based on the largest commercially available, are included in the design. Total nitrogen produced from these plants is about 2,550 stpd and available at 7 psig with a maximum 10 ppmv oxygen content. The feed and product streams for this unit are shown on page II-1.2.6-3.

B. Process Selection Rationale

A summary of the process selection rationale discussed below is based upon the engineering trade-off study performed for this unit.

1. Oxygen Plant Vendor Comparison. Investigations were made of the principal air separation plant suppliers in order to establish a source of information for the preliminary design. These investigations included Air Liquide, Lotepro, Union Carbide, Airco, and Air Products. The approach dictated for this unit was that the air separation plant is a process utility which is required to supply the specific amount of purity oxygen noted above for process requirements. Therefore, the selection of an air separation plant vendor was not necessary and was not made.

Based primarily on the extensive experience of Air Liquide in its supply of large-scale oxygen plants for the SASOL facility and lower capital cost, it was determined that data for the preliminary design would be obtained from Air Liquide.

2. Gaseous Oxygen Compression vs Liquid Oxygen Pumping. Two alternative oxygen pressurization process schemes were considered: gaseous oxygen compression and liquid oxygen pumping. Of the five oxygen plant vendors contacted, none had considerable experience in liquid oxygen pumping. Airco, Air Products, Lotepro, and Union Carbide favored gaseous oxygen compression. Air Liquide was open, however; its very extensive experience recently in the SASOL plants is with centrifugal compression to 500 psig.

From the oxygen plant vendors' comments, it was concluded that the current industry consensus is that gaseous oxygen compression is preferred to liquid oxygen pumping, and gaseous oxygen compression was researched further.

3. Gaseous Oxygen Compression. Based on current commercial experience, the selected scheme was centrifugal compression to 610 psig followed by reciprocating compression to 1,100 psig. Sulzer and Demag confirmed that in 1982 there were centrifugal oxygen compressors operating at 1,500 psig and that commercial experience is being developed for all-centrifugal oxygen compressors.

C. Process Description

The equipment arrangement and material balance for this unit are shown on Process Flow and Control Diagrams D-22-MP-101NP, -102NP, -103NP, -104NP, -105NP, and -106NP.

Feed Streams

Component	Air to Cold Box (lb mol/hr)	(mol%)
N_2	52,683	78.11
Ar	627	0.93
O_2	14,137	20.96
Total dry, lb mol/hr	67,447	100.00
H_2O	-	
Total wet, lb mol/hr	67,447	
Total, lb/hr	1,953,410	
Pressure, psia	84	
Temperature, °F	95	

Product Streams

Component	Oxygen to Gasification (lb mol/hr)	(mol%)	Nitrogen (lb mol/hr)	(mol%)
N_2	-	-	5,867.7	100.00
O_2	13,742.2	99.50	0.05	Max. 10 ppmv
Ar	69.1	0.50	0.3	50 ppmv
Total dry, lb mol/hr	13,811.3	100.00	5,868.05	100.00
H_2O	-			
Total wet, lb mol/hr	13,811.3		5,868.05	
Total, lb/hr	442,510		164,400	
Pressure, psia	1,115		22	
Temperature, °F	201		90	

Atmospheric air, after passing through an inlet air filter, is compressed in the air compressor. Following compression, the air is cooled in direct-contact Water Wash Tower 22-01-1203. The cooled compressed air then enters the cold box, an enclosed steel structure containing cryogenic equipment filled with insulating material. The air enters through a set of automatic switching valves that controls the flow to Reversing Exchanger 22-01-1306. The reversing exchanger is an assembly of brazed aluminum, extended surface heat exchangers that have the dual function of cooling the air and removing water and carbon dioxide from it at the same time. The air is cooled by heat exchange with outflowing gaseous products and waste nitrogen. The passages are arranged so that at predetermined intervals the air and waste nitrogen streams are switched by operation of the valves at the warm end, with the check valves controlling the flows at the cold end. When the air is cooled, the contained moisture is condensed as water and ice, and the carbon dioxide is deposited as a solid at lower temperatures. When the air and waste nitrogen passages are switched over, the deposits are evaporated into the vent stream in one set of passages and carried out of the system while the impurities from the air are deposited in the other set. Since all the passages are in thermal contact with each other and with the products, there is continuous heat exchange.

The cooled air, now at about -280°F and close to its dew point, is sent to the bottom of High-Pressure Column 22-01-1202 as feed. The principal function of this column is to provide pure nitrogen at the top as product, impure liquid nitrogen as reflux for Low-Pressure Column 22-01-1201, and a liquid rich in oxygen at the bottom as feed for the low-pressure column. Reflux for the high-pressure column is provided by Main Vaporizer 22-01-1310, which by vaporizing liquid oxygen in the sump of the low-pressure column, condenses nitrogen rising from below.

Rich liquid from the sump of the high-pressure column is withdrawn and passed through either Rich Liquid Filter 22-01-2203 or 22-01-2204. These filters, filled with adsorbent, serve to remove the bulk of any hydrocarbons that enter with the air and are not deposited in the reversing exchanger. Following the filters, the rich liquid is subcooled in

Auxiliary Vaporizer 22-01-1308 by vaporizing liquid oxygen and then expanded into the low-pressure column as feed. The low-pressure column operates at about 19 psia, with boil-up from the main vaporizer and rich liquid feed and impure liquid nitrogen reflux from the high-pressure column.

Pure oxygen is produced at the bottom of the low-pressure column. As a safety precaution, part of the liquid is circulated via thermosiphon action in the auxiliary vaporizer through Liquid Oxygen Filter 22-01-2202, which is similar to the rich liquid filters. Another part of the liquid oxygen will be withdrawn to Oxygen Vaporizer 22-01-1311, where it is partially evaporated to give a gaseous oxygen product. The gaseous product is withdrawn overhead from Separator 22-01-1204, while excess liquid is returned to the sump of the low-pressure column by either Oxygen Pump 22-01-1503 or 22-01-1504. In order to evaporate the liquid oxygen, a stream of gas having essentially the same composition as air is taken from the high-pressure column, condensed, and then fed back to the column. Part of this condensed air is withdrawn again from the column and used as additional reflux in the low-pressure column.

Gaseous waste nitrogen is produced at the top of the low-pressure column. This is used in Subcooler 22-01-1309 to subcool the liquid nitrogen product and reflux streams and the liquid air reflux. The waste is warmed further by condensing a small airstream and by the pure gaseous nitrogen product before it passes out through the reversing exchanger, removing the deposited water and carbon dioxide as it is finally warmed to ambient temperature and exhausted through a silencer. The gaseous oxygen and nitrogen products also flow out through the reversing exchanger, leaving at ambient temperature, ready for compression.

In order to maintain the correct temperatures throughout the cold box, it is necessary to produce refrigeration at a low-temperature level. This is achieved by taking some pure gaseous nitrogen from the top of the high-pressure column, reheating it partially in the cold-reversing exchanger and then expanding it in Turbine 22-01-1803. The turbine is coupled

to an electric generator, and the gas temperature will be lowered by about 70°F while producing power. It is be sent back through the subcooler and the reversing exchanger as gaseous nitrogen product.

The plant is provided with the means to dispose of purged liquids by evaporation, using warm compressed air in Purge Stack 22-01-1401. For deriming and reactivation of filters, Derime System 22-01-2803 with Regeneration Heater 22-01-1321 is provided, and the dry air heated in Defrosting Heater 22-01-1312.

D. Risk Assessment

The gasification unit requires a maximum of 6,150 stpd of oxygen at 1,100 psig. Three oxygen plants provide this. High-pressure oxygen gas is provided by compressing the gaseous oxygen from the cold box in two stages. The centrifugal compressor compresses oxygen to about 610 psig and the reciprocating compressor to 1,100 psig. The nitrogen gas required by the process units is provided by compressing the low-pressure nitrogen produced in the cold box. Using this approach, most of the equipment remains within the limits of commercially proven technology. The recently commissioned 3 x 1,000-stpd oxygen facility near Houston employs this combination to compress the oxygen output to 1,250 psig, the only difference being the capacity of the oxygen compressors: 2,500 stpd vs 1,000 stpd.

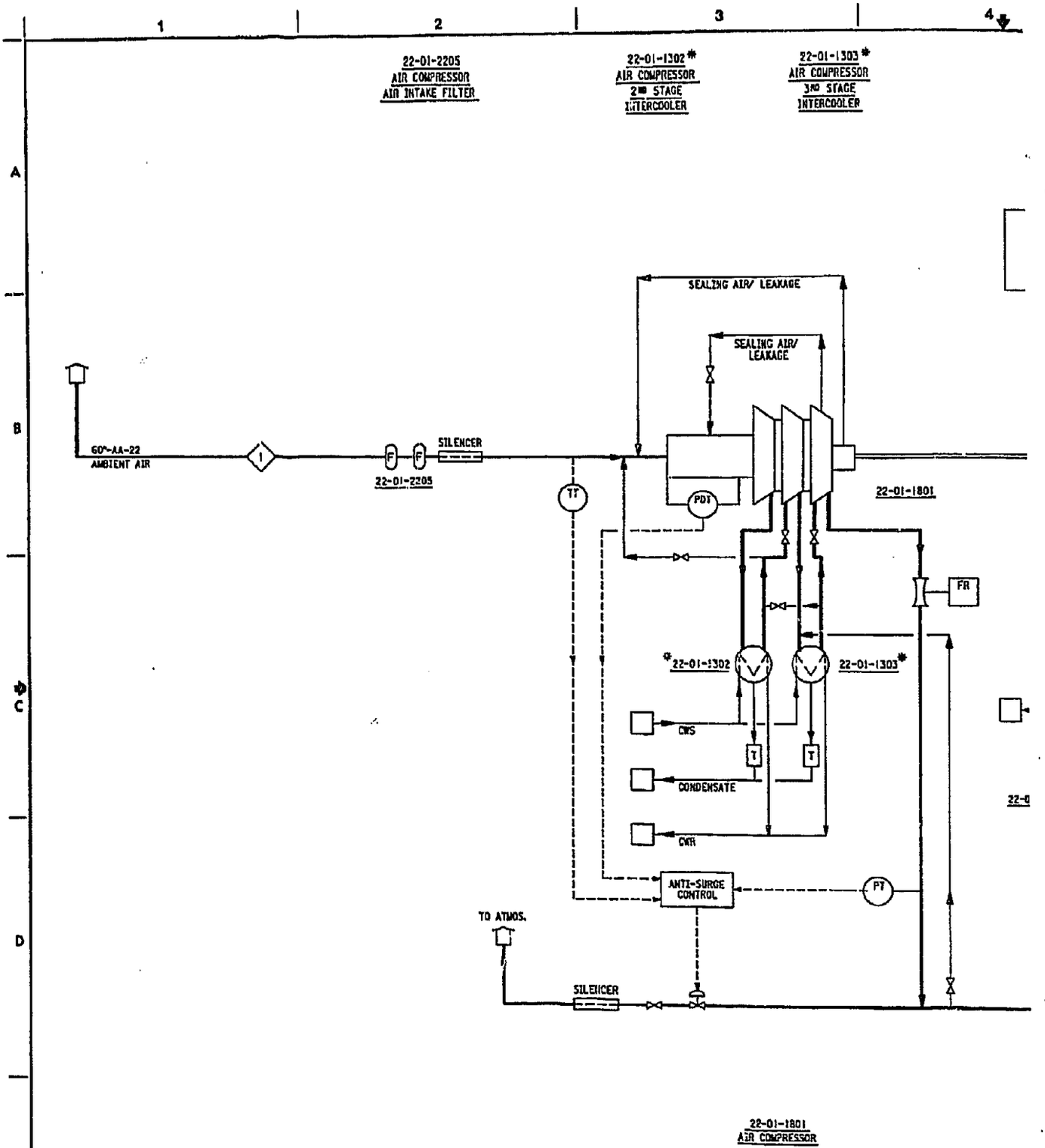
The oxygen supply is of critical importance to the gasifiers to maintain plant output. Fortunately, in recent years there has been excellent experience with large oxygen plants. The design selected is similar to the system operated successfully at SASOL. Air compressor and oxygen compressor selections have been influenced strongly by commercial experience. The oxygen plants at SASOL and this plant produce 2,500 stpd of oxygen at 500 psig and 1,100 psig, respectively. The oxygen compression facilities are now designed and operated with a very high level of safety and reliability.

The cold box, with few moving parts and 100% installed spares, contributes very little to shutdown time of the plant. With normal air quality, there are no problems of corrosion using the specified standard materials of construction. Adequate oxygen capacity is included to allow for flexible operation of the gasifiers and maintenance, deriming, etc.

E. Process Flow and Control Diagrams (Including Material Balance)

Process Flow and Control Diagrams for Oxygen Plant Unit 22 are as follows:

Drawing No.	Title
D-22-MP-101NP	PFCD Oxygen Plant - Unit 22 Air Compression
D-22-MP-102NP	PFCD Oxygen Plant - Unit 22 Cold Box
D-22-MP-103NP	PFCD Oxygen Plant - Unit 22 Cold Box
D-22-MP-104NP	PFCD Oxygen Plant - Unit 22 Oxygen Compression
D-22-MP-105NP	PFCD Oxygen Plant - Unit 22 Common Equipment
D-22-MP-106NP	PFCD Oxygen Plant - Unit 22 Material Balance



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															B	7/10/92	RD					FOR D
															A							FOR C

ENG-GE-43 112/791

22-01-2804 *
LUBE OIL SYSTEM

22-01-1301
AIR COMPRESSOR
TURBINE
STEAM CONDENSER

22-01-2805 *
STEAM CONDENSER
EJECTOR

NOTES:
1. THE EQUIPMENT SHOWN ON THIS DRAWING IS FOR ONE TRAIN. THERE ARE THREE IDENTICAL TRAINS IN THIS UNIT.

22-01-2810 *

22-01-1801T

SC

PRESSURE CONTROL SIGNAL FROM H.P. OXYGEN HEADER

D-22-MP-105 NP

130 PSIG STEAM

150 PSIG STEAM

22-01-2805

CWR

CWS

LC

22-01-1301

CONDENSATE

22-01-1505
22-01-1506

TO 160

32"-A-22
COMPRESSED AIR/WASH WATER TOWER

D-22-MP-102 NP

22-01-1801T
AIR COMPRESSOR
TURBINE

22-01-1505
22-01-1506
AIR COMPRESSOR TURBINE
CONDENSATE PUMPS

EQUIPMENT SHOWN ON THIS DRAWING:

22-01-1301	22-01-1801
22-01-1302	22-01-1801T
22-01-1303	22-01-2205
22-01-1505	22-01-2804
22-01-1506	22-01-2805

D22MP101N.DGA

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BASKETT — W.R. GRACE & CO. — KENTUCKY

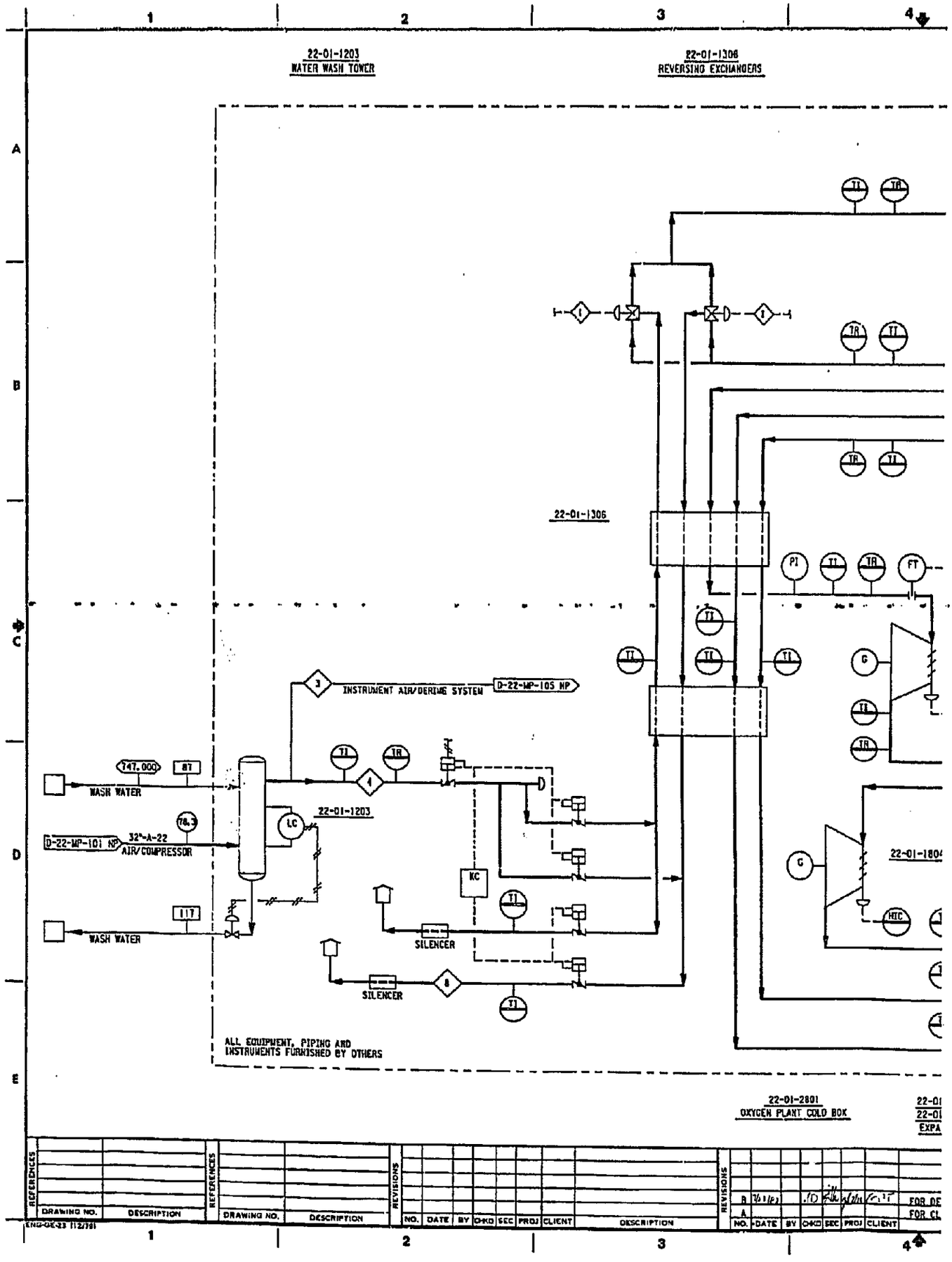
12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

PROCESS FLOW & CONTROL DIAGRAM OXYGEN PLANT - UNIT 22 AIR COMPRESSION	SCALE: NONE	ACCOUNT NUMBER: 2800	JOB NUMBER: 6182
	DOCUMENT NUMBER: D-22-MP-101 NP		REVISION: B

DESCRIPTION	DRAWN	CHECKED	APVD SECT HD	APVD PROJ MGR	APVD CLIENT
FOR DESIGN REPORT	MCV				
FOR CLIENT APPROVAL					

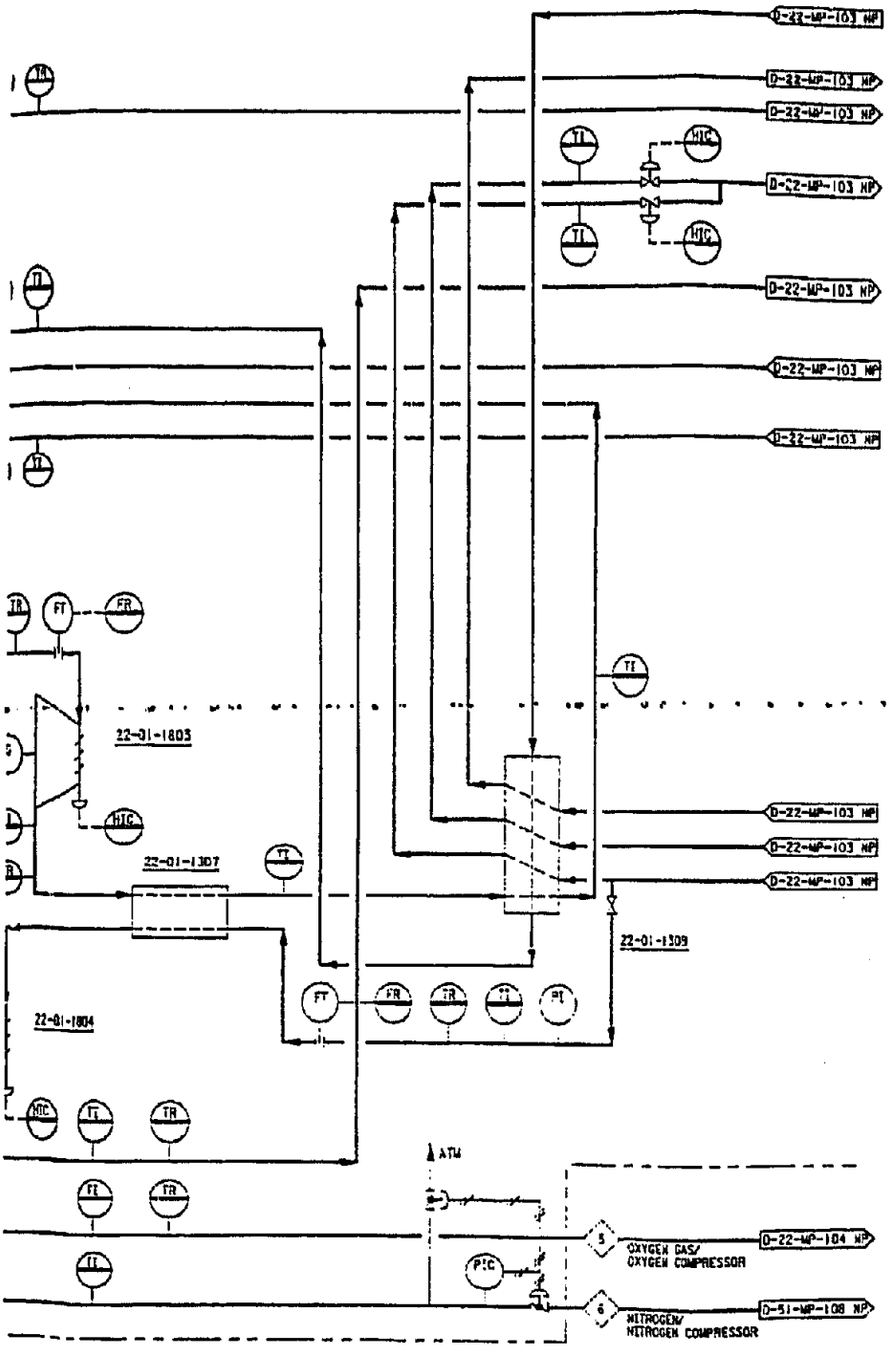
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA


22-01-1203
WATER WASH TOWER
22-01-1306
REVERSING EXCHANGERS
22-01-1306
INSTRUMENT AIR/DERIME SYSTEM
D-22-MP-105 MP
WASH WATER
747,000
BT
22-01-1203
LC
D-22-MP-101 MP
32"-A-22
AIR/COMPRESSOR
WASH WATER
SILENCER
SILENCER
KC
ALL EQUIPMENT, PIPING AND
INSTRUMENTS FURNISHED BY OTHERS
22-01-2801
OXYGEN PLANT COLD BOX
22-01-1804
PI
TI
TR
FT
FI
HIC

22-01-1307
EXPANDER EXCHANGER

22-01-1309
SUBCOOLER

NOTES:
1. THE EQUIPMENT SHOWN ON THIS DRAWING IS FOR ONE TRAIN. THERE ARE THREE IDENTICAL TRAINS IN THIS UNIT.



EQUIPMENT SHOWN ON THIS DRAWING:

22-01-1203	22-01-1803
22-01-1306	22-01-1804
22-01-1307	22-01-2801
22-01-1309	

22-01-1803
22-01-1804
EXPANDERS

D22MP102N.DGA

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COAL - TO - METHANOL - TO - GASOLINE PLANT

DRAWN		
CHECKED		
APVD PROJ MGR		
APVD CLIENT		
FOR DESIGN REPORT		
FOR CLIENT APPROVAL		
DESCRIPTION		

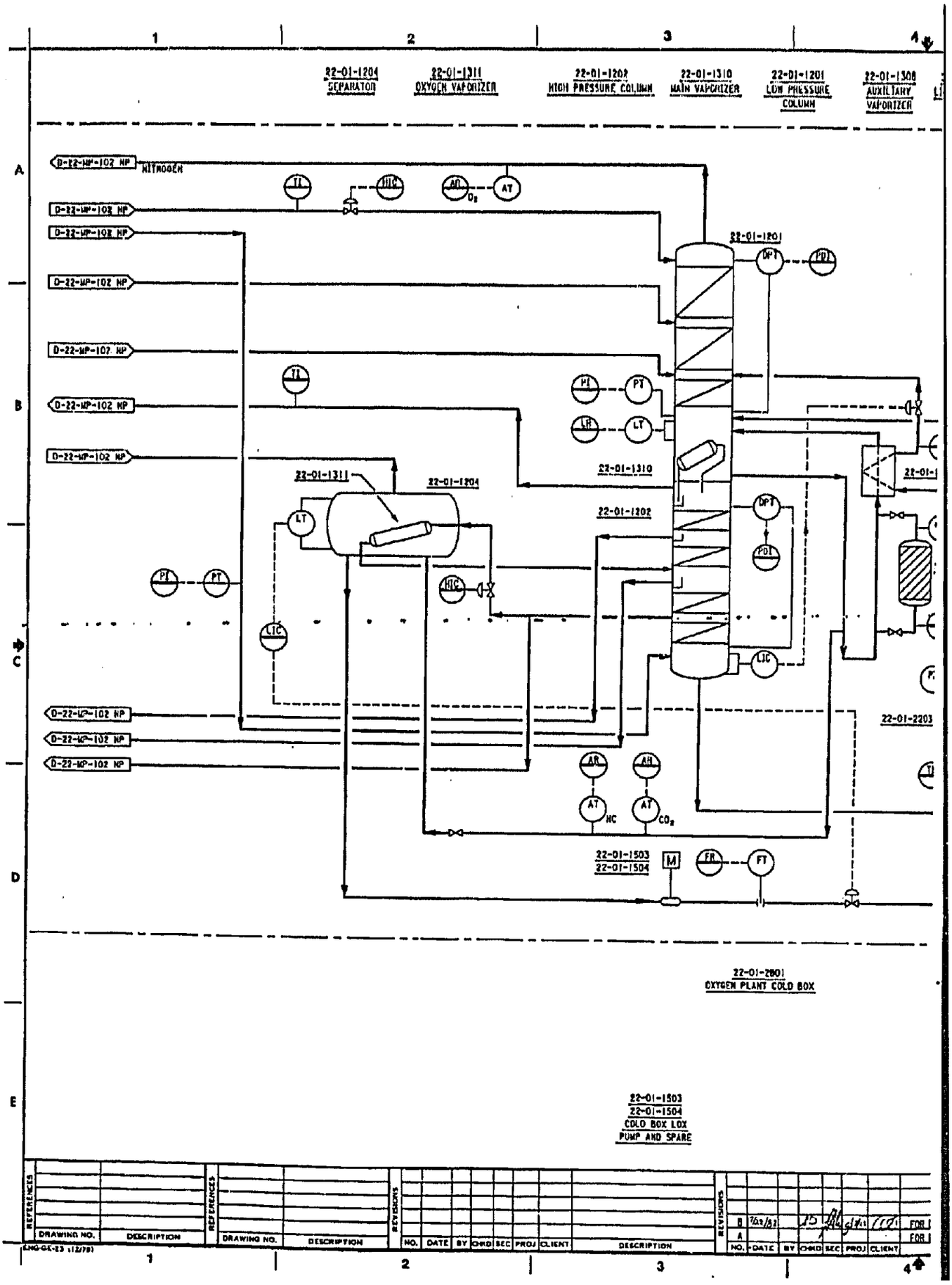
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

TITLE: PROCESS FLOW AND CONTROL DIAGRAM
OXYGEN PLANT - UNIT 22
COLD BOX EXCHANGERS

SCALE: NONE | ACCOUNT NUMBER: 2800 | JOB NUMBER: 6182

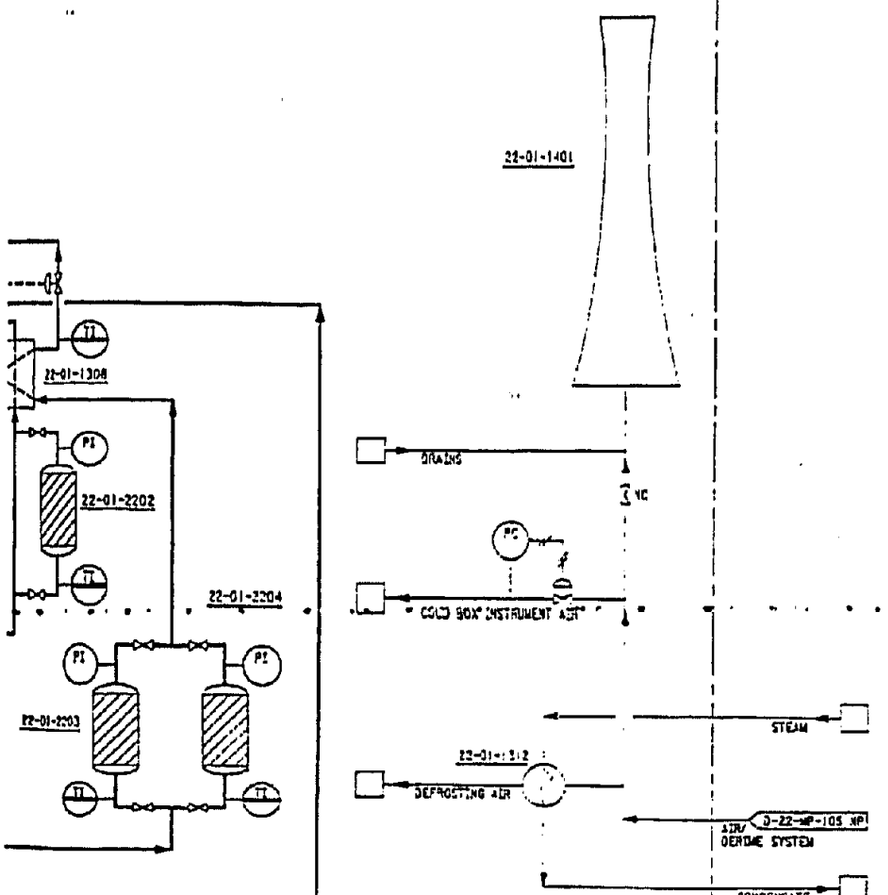
DRAWING NUMBER: D-22-MP-102 NP

REVISION: 9


22-01-1204 SEPARATOR
22-01-1311 OXYGEN VAPORIZER
22-01-1202 HIGH PRESSURE COLUMN
22-01-1310 MAIN VAPORIZER
22-01-1201 LOW PRESSURE COLUMN
22-01-1308 AUXILIARY VAPORIZER
D-22-MP-102 NP
NITROGEN
TI
HIC
AR
AT
PT
PDT
LT
LIC
FR
FT
M
22-01-2203
22-01-2801
OXYGEN PLANT COLD BOX
22-01-1503
22-01-1504
COLD BOX LOX PUMP AND SPARE

01-1308 SECONDARY PURIFIER | 22-01-2202 LIQUID OXYGEN FILTER | 22-01-2203, 2204 HIGH LIQUID FILTERS | 22-01-1312 DEFROSTING HEATER | 22-01-1401 PURGE STACK

NOTES:
1. THE EQUIPMENT SHOWN ON THIS DRAWING IS FOR ONE TRAIN. THERE ARE THREE IDENTICAL TRAINS IN THIS UNIT.



EQUIPMENT SHOWN ON THIS DRAWING:

22-01-1201	22-01-2202
22-01-1202	22-01-2203
22-01-1204	22-01-2204
22-01-1308	22-01-2801
22-01-1310	
22-01-1311	
22-01-1312	
22-01-1401	
22-01-1501	
22-01-1504	

D22MP103N.DGN

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12,500 S.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

FOR DESIGN REPORT	
FOR CLIENT APPROVAL	
DESCRIPTION	
CLIENT	

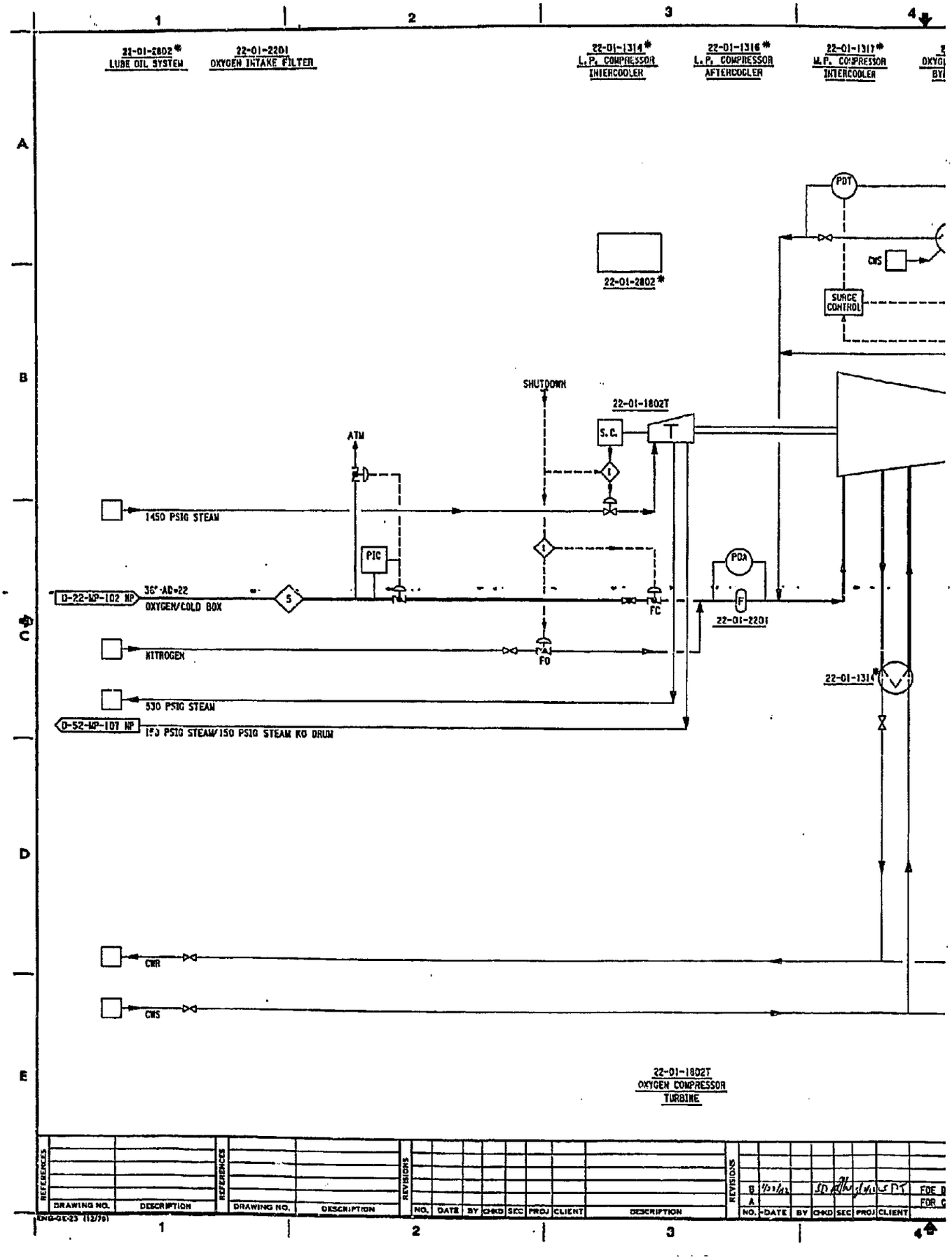
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

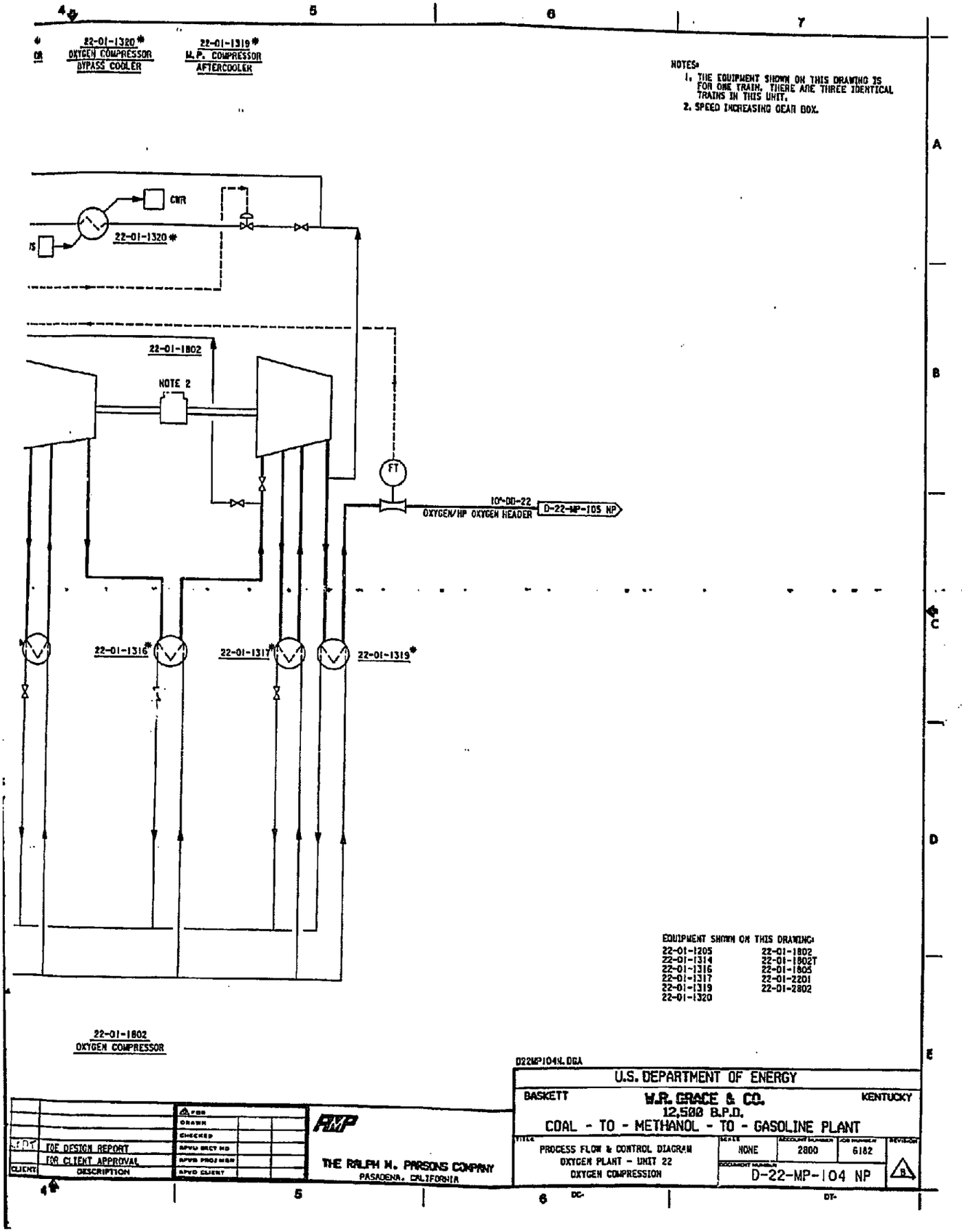
PROCESS FLOW AND CONTROL DIAGRAM
OXYGEN PLANT - UNIT 22
COLD BOX

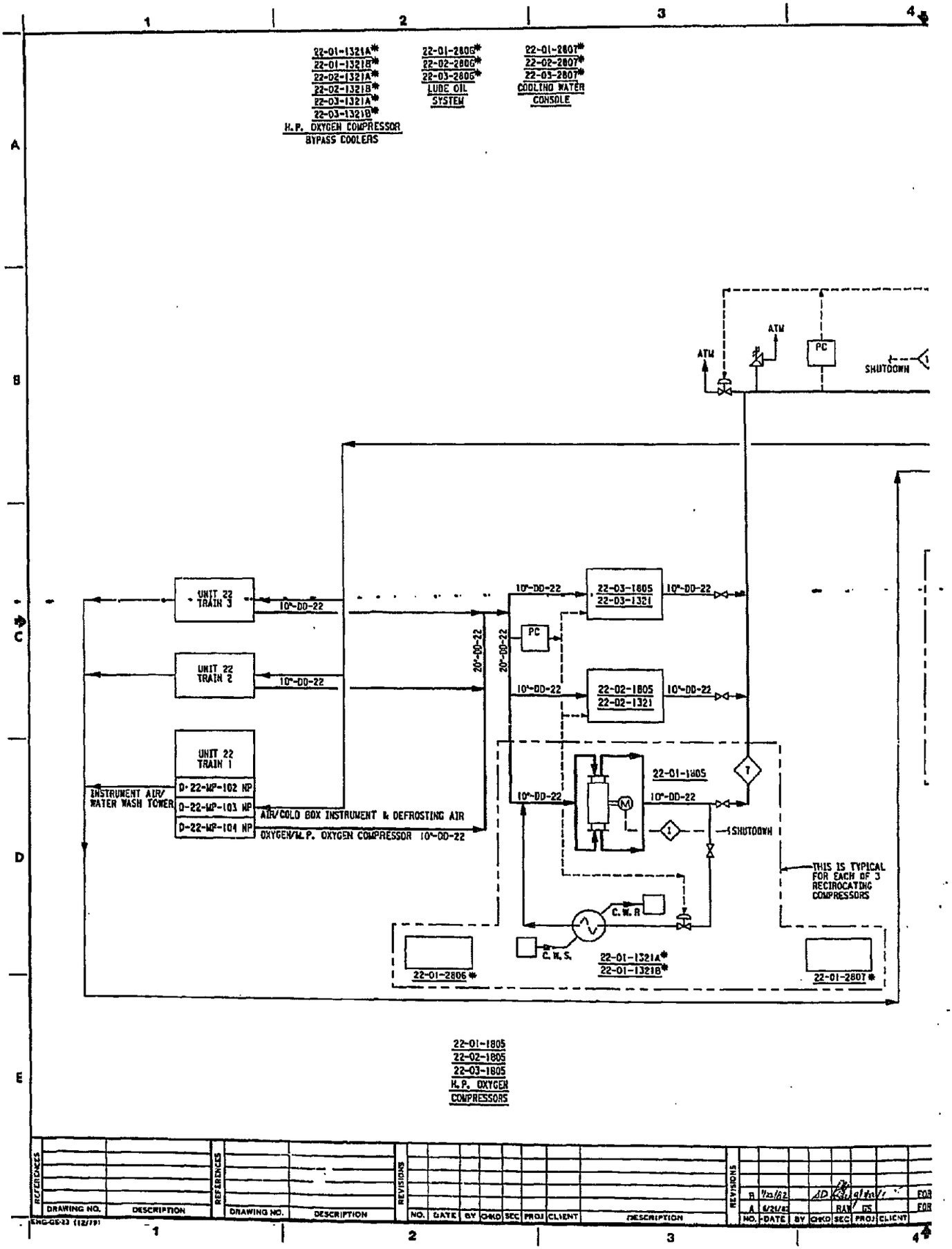
NONE | 2800 | 6122

D-22-MP-103 NP

3

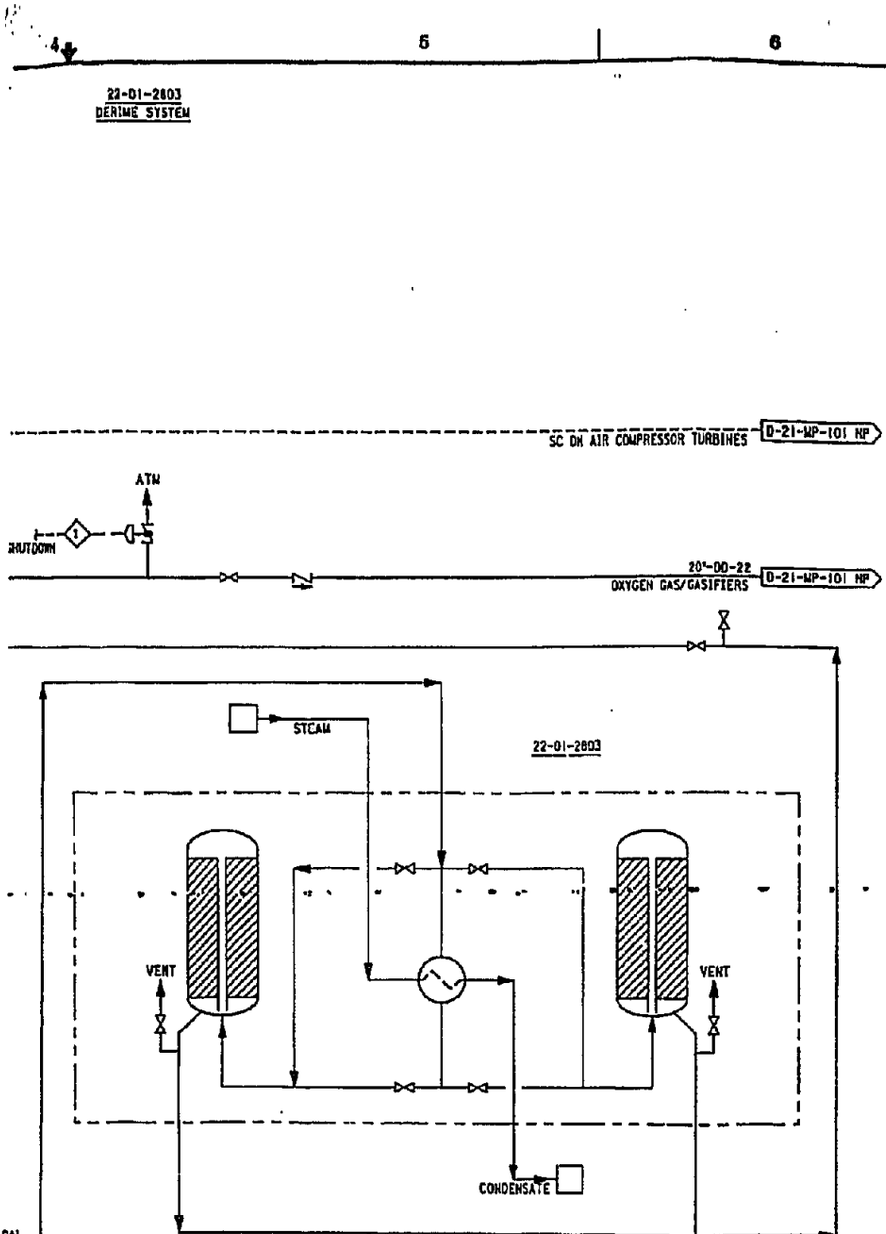

22-01-2802*
LUBE OIL SYSTEM
22-01-2201
OXYGEN INTAKE FILTER
22-01-1314*
L.P. COMPRESSOR
INTERCOOLER
22-01-1316*
L.P. COMPRESSOR
AFTERCOOLER
22-01-1317*
M.P. COMPRESSOR
INTERCOOLER
PDT
CWS
SURGE CONTROL
22-01-2802*
SHUTDOWN
22-01-1802T
S.C.
ATM
1450 PSIG STEAM
PIC
PDA
D-22-MP-102 MP
36"-AD-22
OXYGEN/COLD BOX
FC
22-01-2201
NITROGEN
FO
22-01-1314*
530 PSIG STEAM
D-52-MP-107 MP
150 PSIG STEAM/150 PSIG STEAM KO DRUM
CWR
CWS
22-01-1802T
OXYGEN COMPRESSOR
TURBINE
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
B 1/31/83
A
FOR D
FOR C


22-01-1320 *
OXYGEN COMPRESSOR
BYPASS COOLER
22-01-1319 *
M.P. COMPRESSOR
AFTERCOOLER
NOTES:
1. THE EQUIPMENT SHOWN ON THIS DRAWING IS FOR ONE TRAIN. THERE ARE THREE IDENTICAL TRAINS IN THIS UNIT.
2. SPEED INCREASING GEAR BOX.
CWR
22-01-1320 *
22-01-1802
NOTE 2
FT
10"-DD-22
OXYGEN/HP OXYGEN HEADER
D-22-MP-105 NP
22-01-1316 *
22-01-1317 *
22-01-1319 *
EQUIPMENT SHOWN ON THIS DRAWING:
22-01-1205
22-01-1314
22-01-1316
22-01-1317
22-01-1319
22-01-1320
22-01-1802
22-01-1802T
22-01-1805
22-01-2201
22-01-2802
22-01-1802
OXYGEN COMPRESSOR
D22MP104N.DGA
U.S. DEPARTMENT OF ENERGY
BASKETT
W.R. GRACE & CO.
KENTUCKY
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT
PROCESS FLOW & CONTROL DIAGRAM
OXYGEN PLANT - UNIT 22
OXYGEN COMPRESSION
NONE
2800
6182
D-22-MP-104 NP
B
DRAWN
CHECKED
APVD DSGN MGR
APVD PROJ MGR
APVD CLIENT
FOR DESIGN REPORT
FOR CLIENT APPROVAL
DESCRIPTION
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA



REFERENCES			REFERENCES			REVISIONS								REVISIONS									
DRAWING NO.	DESCRIPTION		DRAWING NO.	DESCRIPTION		NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT			
														B	9/23/82	AD			RAW	DS		FOR	
														A	6/21/82							FOR	

ENG-GE-23 (12/79)



NOTES:

1. THE EQUIPMENT SHOWN ON THIS DRAWING IS FOR THREE TRAINS. THERE ARE 3 RECIPROCATING COMPRESSORS FOR 3 TRAINS IN OXYGEN PLANT UNIT 22.

EQUIPMENT SHOWN ON THIS DRAWING:

22-01-1321A	22-03-1805
22-01-1321B	22-01-2803
22-02-1321A	22-01-2806
22-02-1321B	22-02-2806
22-03-1321A	22-03-2806
22-03-1321B	22-01-2807
22-01-1805	22-02-2807
22-02-1805	22-03-2807

D22MP105N.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: PROCESS FLOW AND CONTROL DIAGRAM OXYGEN PLANT - UNIT 22 COMMON EQUIPMENT

SCALE: NONE | ACCOUNT NUMBER: 2600 | JOB NUMBER: 5182

DOCUMENT NUMBER: D-22-MP-105 NP

REVISION: B

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

CLIENT	DESCRIPTION	APVD CLIENT
	FOR CLIENT APPROVAL	APVD PROJ MGR
	FOR DESIGN REPORT	APVD ASST MD
		CHECKED
		DRAWN
		APVD

COMPONENT	① AMBIENT AIR INTAKE		② AIR LOSSES		③ INSTRUMENT AIR		④ PROCESS AIR		⑤ OXYGEN GAS TO OXYGEN COMPRESSOR		
MOL WEIGHT	LB MOL/HR	MOL %	LB MOL/HR	MOL %	LB MOL/HR	MOL %	LB MOL/HR	MOL %	LB MOL/HR	MOL %	LB
N_2 28.02	21,925.87	78.11	828.20	78.11	24.37	78.11	21,073.30	78.11	0.0	0.0	
AR 39.94	261.05	0.93	9.86	0.93	0.29	0.93	250.90	0.93	27.62	0.50	
O_2 32.00	5,883.58	20.96	222.24	20.96	6.54	20.96	5,654.80	20.96	5,496.88	99.50	
TOTAL FLOW	28,070.50	100.00	1,060.30	100.00	31.20	100.00	26,979	100.00	5,524.50	100.00	
MOL WEIGHT	28.96		28.96		28.96		28.96		32.04		
LB/HR	812,978		30,708		904		781,366		177,004		
MMSCFD	255.66		9.66		0.28		245.72		50.32		
PRESSURE PSIA	14.3		-		80		84		22		
TEMPERATURE °F	80		-		90		95		90		

REFERENCES			REFERENCES			REVISIONS										REVISIONS								
DRAWING NO.	DESCRIPTION		DRAWING NO.	DESCRIPTION		NO	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION			NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
																B	7/13/82						FOR DE
																A	5/21/82		RAM		QS		FOR CL

ENG-GE-23 (12/78)

NOTES:

1. THE MATERIAL BALANCE SHOWN ON THIS DRAWING IS FOR ONE OF THREE TRAINS AND FOR NORMAL OPERATION.
2. AIR LOSSES, (2), OCCUR BETWEEN AIR INTAKE AND COLD BOX. (STREAM (2) IS NOT INDICATED ON THE PFCDS).

5 CAS TO OMPRESSOR		6 GASEOUS NITROGEN		7 OXYGEN TO GASIFIERS		8 WASTE NITROGEN	
R	MOL %	LB MOL/HR	MOL %	LB MOL/HR	MOL %	LB MOL/HR	MOL %
0	0.0	2,347.06	100.00	0.0	0.0	18,725.15	98.00
12	0.50	0.12	50 PPM	27.62	0.50	223.56	1.17
18	99.50	0.02	10 PPM	5,496.88	99.50	158.59	0.83
0	100.00	2,347.20	100.00	5,524.50	100.00	19,107.30	100.00
.04		28.02		32.04		28.19	
,004	"	65,761	"	177,004	"	538,601	"
.32		21.38		50.32		174.02	
12		22		1,115		14.7	
0		90		201		90	

		DES		
		DRAWN		
		CHECKED		
2	FOR DESIGN REPORT	APVD DEPT MGR		
1	FOR CLIENT APPROVAL	APVD PROJ MGR		
CLIENT	DESCRIPTION	APVD CLIENT		

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

D2214P106N.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

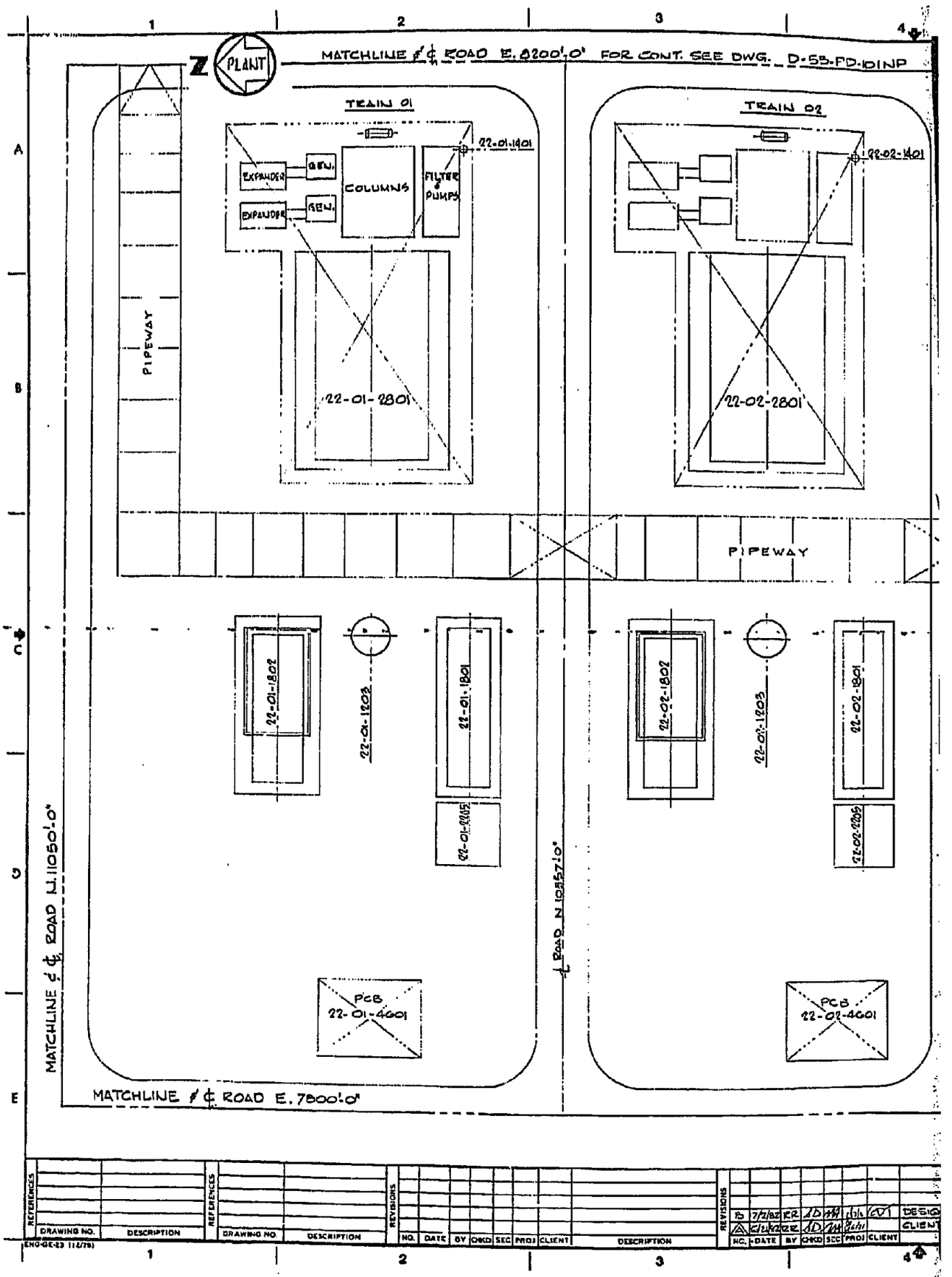
COAL - TO - METHANOL - TO - GASOLINE PLANT

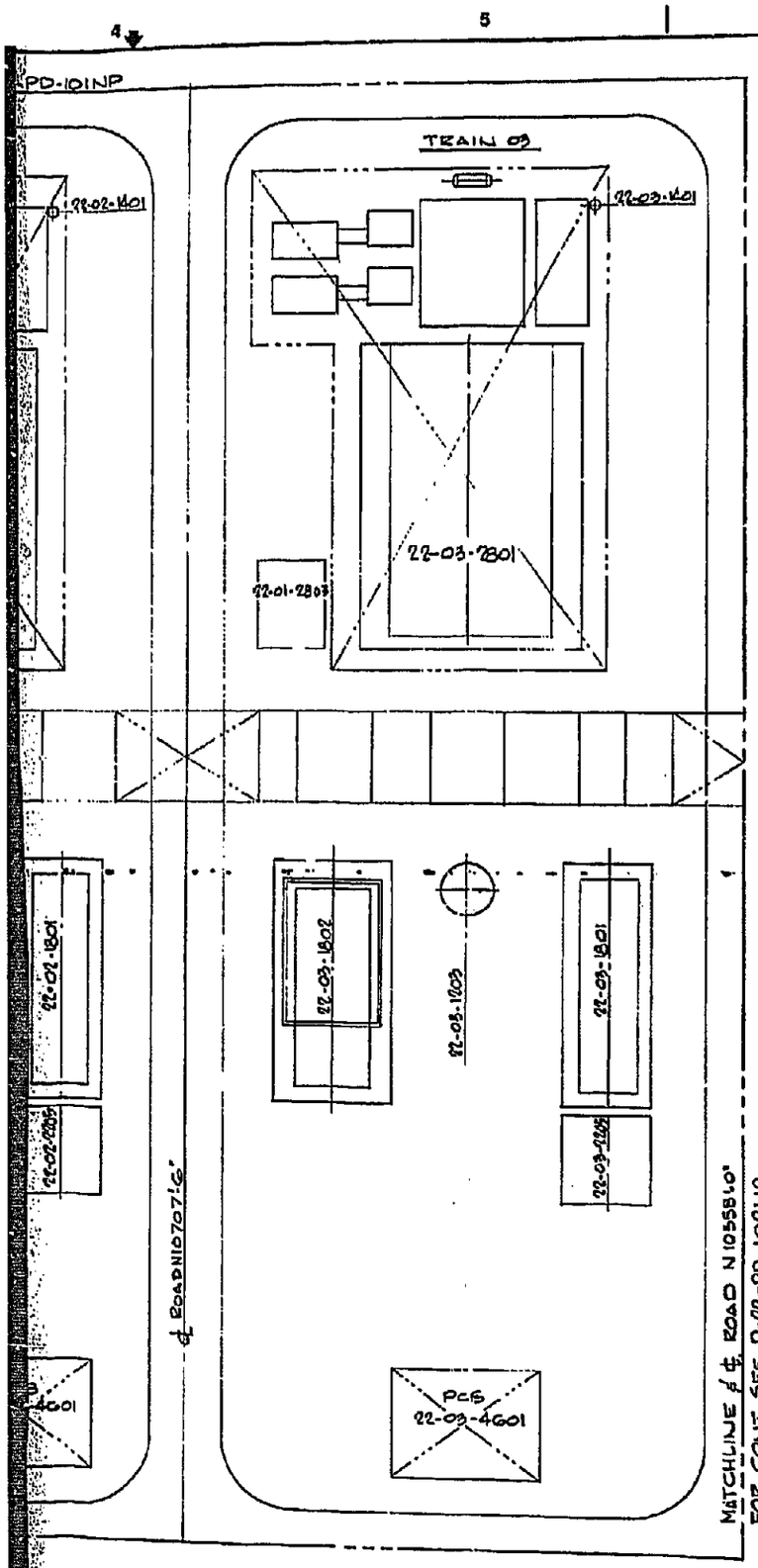
TITLE	SCALE	ACCOUNT NUMBER	JOB NUMBER	REVISION
PROCESS FLOW & CONTROL DIAGRAM OXYGEN PLANT - UNIT 22 MATERIAL BALANCE	NONE	2800	6182	B
	DRAWING NUMBER: D-22-MP-106 NP			

F. Plot Plan/General Arrangement Drawings

Plot Plan/General Arrangement Drawings for Oxygen Plant Unit 22 are as follows:

Drawing No.	Title
D-22-PD-101NP	Plot Plan - Unit 22 Oxygen Plant
D-22-PD-102NP	Plot Plan - Units 22 and 51 Oxygen and Nitrogen Compression
D-22-PD-103NP	Elevation - Unit 22 Oxygen Plant


PLANT
MATCHLINE ℄ ROAD E.9200'.0' FOR CONT. SEE DWG. D-55-PD-1DINP
TRAIN 01
TRAIN 02
EXPANDER
GEN.
EXPANDER
GEN.
COLUMNS
FILTER & PUMPS
22-01-1401
22-02-1401
PIPEWAY
22-01-2801
22-02-2801
PIPEWAY
22-01-1802
22-01-1202
22-01-1801
22-01-2005
22-02-1802
22-01-1203
22-02-1801
22-02-2005
℄ ROAD N.10257.0'
PCB 22-01-4001
PCB 22-02-4001
MATCHLINE ℄ ROAD N.11050'.0'
MATCHLINE ℄ ROAD E.7800'.0'



EQUIPMENT LIST

22-01 THRU 03-1801	AIR COMPRESSOR W/ACCESSORIES
* 22-01 THRU 03-1302	AIR COMPRESSOR 2ND. STAGE INTERCOOLER
* 22-01 THRU 03-1303	AIR COMPRESSOR 3RD. STAGE INTERCOOLER
* 22-01 THRU 03-2804	LUBE OIL SYSTEM
* 22-01 THRU 03-1801T	AIR COMPRESSOR TURBINE
* 22-01 THRU 03-1901	AIR COMPRESSOR TURBINE STEAM CONDENSER
* 22-01 THRU 03-2805	AIR COMP. TURBINE CONDENSER EJECTOR
* 22-01 THRU 03-1505	CONDENSATE PUMP
* 22-01 THRU 03-1806	CONDENSATE PUMP SPARE
* 22-01 THRU 03-2203	AIR INTAKE FILTER
22-01 THRU 03-1802	OXYGEN COMPRESSOR W/ACCESSORIES
* 22-01 THRU 03-1314	L.P. COMPRESSOR INTERCOOLER
* 22-01 THRU 03-1316	L.P. COMPRESSOR AFTERCOOLER
* 22-01 THRU 03-1317	M.P. COMPRESSOR INTERCOOLER
* 22-01 THRU 03-1319	M.P. COMPRESSOR AFTERCOOLER
* 22-01 THRU 03-1320	OXYGEN COMP. BYPASS COOLER
* 22-01 THRU 03-2802	LUBE OIL SYSTEM
* 22-01 THRU 03-1802T	OXYGEN COMPRESSOR TURBINE
* 22-01 THRU 03-2201	OXYGEN COMP INTAKE FILTER
22-01 THRU 03-2801	COLD BOX W/ACCESSORIES
* 22-01 THRU 03-1201	L.P. COLUMN
* 22-01 THRU 03-1202	H.P. COLUMN
* 22-01 THRU 03-1204	OXYGEN SEPARATOR
* 22-01 THRU 03-1306	REVERSING EXCHANGER
* 22-01 THRU 03-1307	EXPANDER EXCHANGER
* 22-01 THRU 03-1308	AUXILIARY VAPORIZER
* 22-01 THRU 03-1309	SUBCOOLER
* 22-01 THRU 03-1310	MAIN VAPORIZER
* 22-01 THRU 03-1311	OXYGEN VAPORIZER
* 22-01 THRU 03-1312	DEFROSTING HEATER
22-01 THRU 03-1401	PURGE STACK
* 22-01 THRU 03-1503	COLD BOX LOX PUMP
* 22-01 THRU 03-1504	COLD BOX LOX PUMP, SPARE
* 22-01 THRU 03-1603	EXPANDER
* 22-01 THRU 03-1204	EXPANDER
* 22-01 THRU 03-2202	LIQUID OXYGEN FILTER
* 22-01 THRU 03-2203	RICH LIQUID FILTER
* 22-01 THRU 03-2204	RICH LIQUID FILTER
22-01-2803	DERIME SYSTEM W/ACCESSORIES
22-01 THRU 03-1203	WATER WASH TOWER

NOTES:
1. * INDICATES EQUIPMENT NOT SHOWN OR INCLUDED WITH MAJOR EQUIPMENT.
2. ALL COMPRESSORS SHALL BE UNDER SHELTERS.
3. SEE DWG. D-22-PD-102NP FOR EQUIPMENT LIST AND PLOT PLAN FOR H.P. OXYGEN COMPRESSORS AND NITROGEN COMPRESSORS.

1" = 20'-0"

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,800 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

PROJ	CLIENT	DESCRIPTION	DRAWN	CHECKED	APPD SECT HD	APPD PROJ MGR	APPD CLIENT
01		DESIGN REPORT					
		CLIENT APPROVAL					

RMP

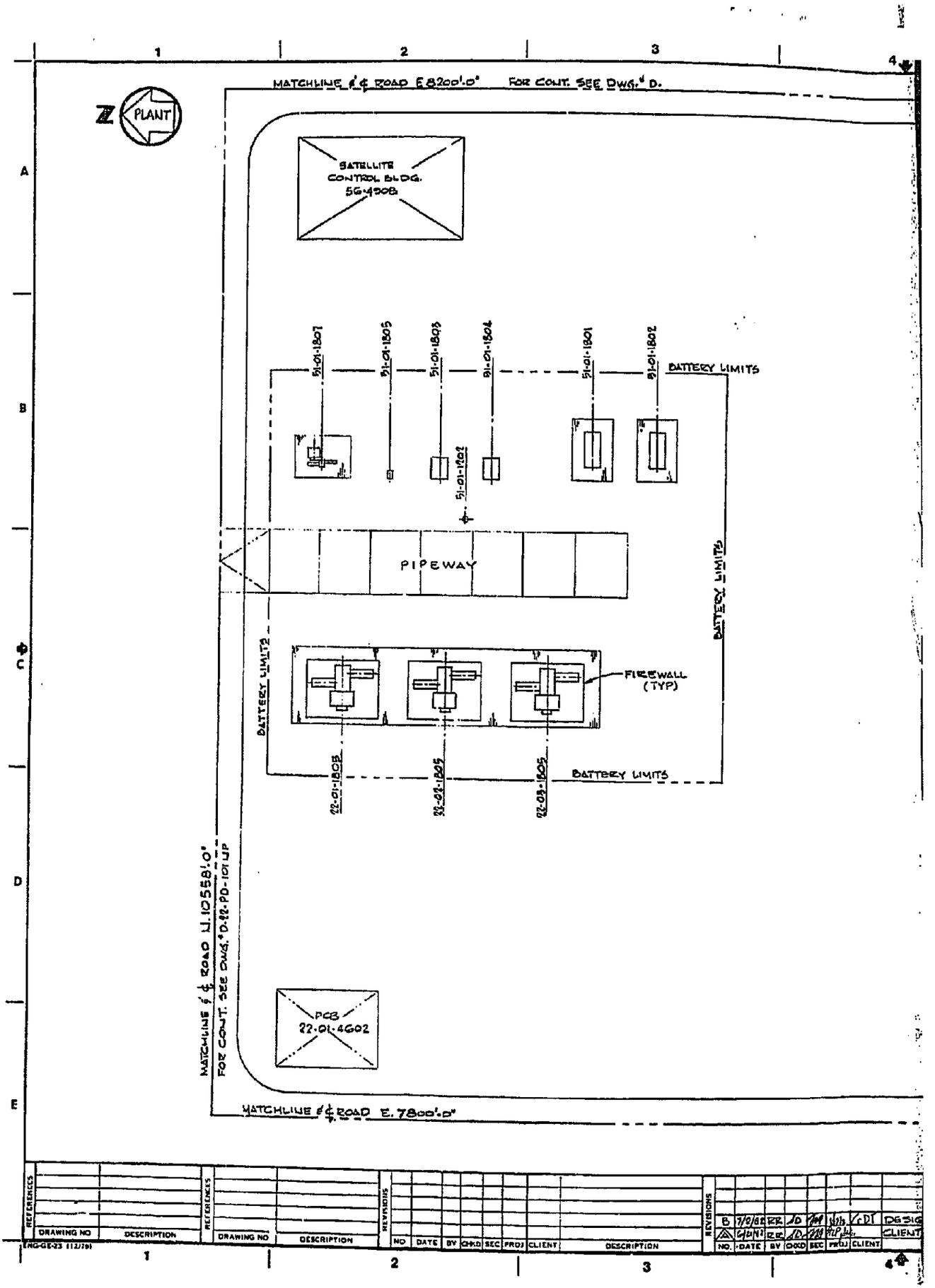
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

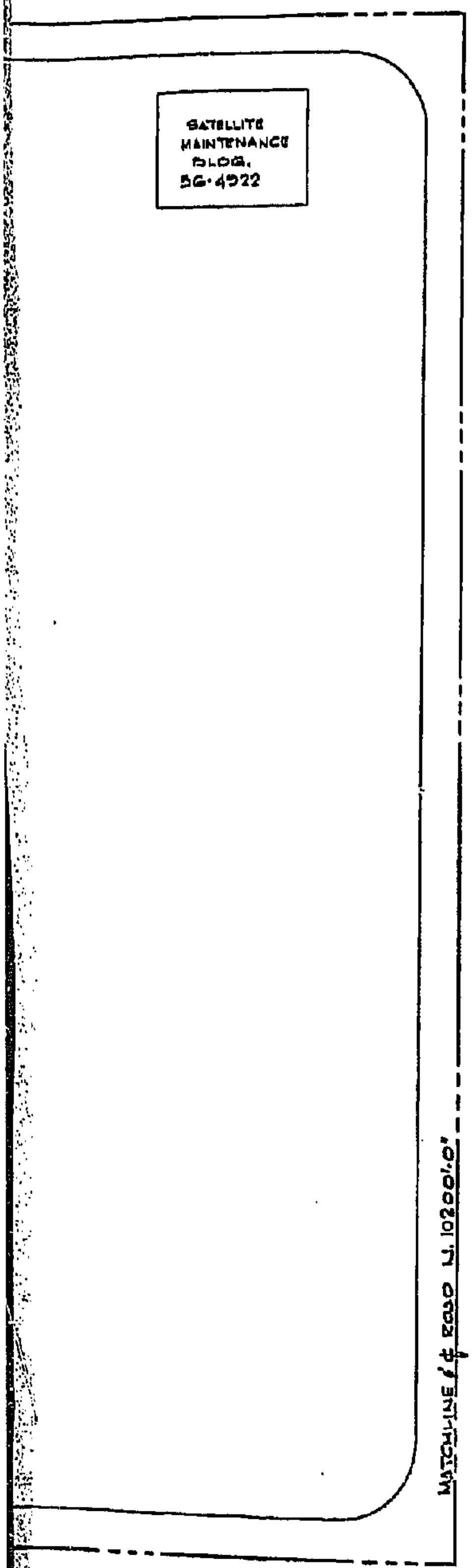
TITLE: PLOT PLAN UNIT 22 OXYGEN PLANT

SCALE: 1"= 20'-0" | ACCOUNT NUMBER: 7243 | JOB NUMBER: 6182

DOCUMENT NUMBER: D-22-PD-101NP

REVISION: A


MATCHLINE ℄ ROAD E.8200'-0" FOR CONT. SEE DWG. 4 D.
PLANT
SATELLITE CONTROL BLDG. 5G-4908
51-01-1807
51-01-1805
51-01-1803
51-01-1804
51-01-1801
51-01-1802
BATTERY LIMITS
51-01-1802
PIPEWAY
BATTERY LIMITS
BATTERY LIMITS
FIREWALL (TYP)
22-01-1803
22-01-1805
22-01-1805
BATTERY LIMITS
MATCHLINE ℄ ROAD N.10558'-0"
FOR CONT. SEE DWG. 4 D-22-PD-101 UP
PCB 22-01-4602
MATCHLINE ℄ ROAD E.7800'-0"
1
2
3
4
A
B
C
D
E
REFERENCES
DRAWING NO
DESCRIPTION
REVISIONS
NO
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
B 7/9/82 RR JD
DESIGN
CLIENT
ENG-GE-23 (12/79)



EQUIPMENT LIST UNIT 22

22-01 THRU 03-1805 — H.P. OXYGEN COMPRESSOR, W/
- 22-01 THRU 03-2806 — LUBE OIL SYSTEM
- 22-01 THRU 03-2807 — COOLING WATER CONSOLE, INCLUDED WITH COMPRESSOR

22-01 THRU 03-1371 A/B — H.P. OXYGEN COMPRESSOR BYPASS COOLER (NOT SHOWN)

EQUIPMENT LIST UNIT 51

51-01-1202 — H.P. NITROGEN SURGE VESSEL

51-01-1801T — LOW PRESSURE NITROGEN COMPRESSOR, W/
- 51-01-1319 — AFTERCOOLER

51-01-1802T — LOW PRESSURE NITROGEN COMPRESSOR SPARE, W/
- 51-01-1320 — AFTERCOOLER

51-01-1803 — H.P. NITROGEN COMPRESSOR, W/
- 51-01-1321 — 1ST. STAGE INTERCOOLER
- 51-01-1323 — 2ND. STAGE INTERCOOLER
- 51-01-1325 — AFTERCOOLER

51-01-1804 — H.P. NITROGEN COMPRESSOR SPARE, W/
- 51-01-1322 — 1ST. STAGE INTERCOOLER
- 51-01-1324 — 2ND. STAGE INTERCOOLER
- 51-01-1326 — AFTERCOOLER

51-01-1805 — HF ACID UNLOADING NITROGEN COMPRESSOR, W/
- 51-01-1327 — AFTERCOOLER

51-01-1807 — REGENERATION NITROGEN COMPRESSOR, W/
- 51-01-1328 — AFTERCOOLER

NOTES:
1. ALL COMPRESSORS SHALL BE UNDER SHELTERS.

1" = 20FT

A	(DI)	DESIGN REPORT	DRAWN	RE
		CLIENT APPROVAL	CHECKED	
NO	CLIENT	DESCRIPTION	APVD	

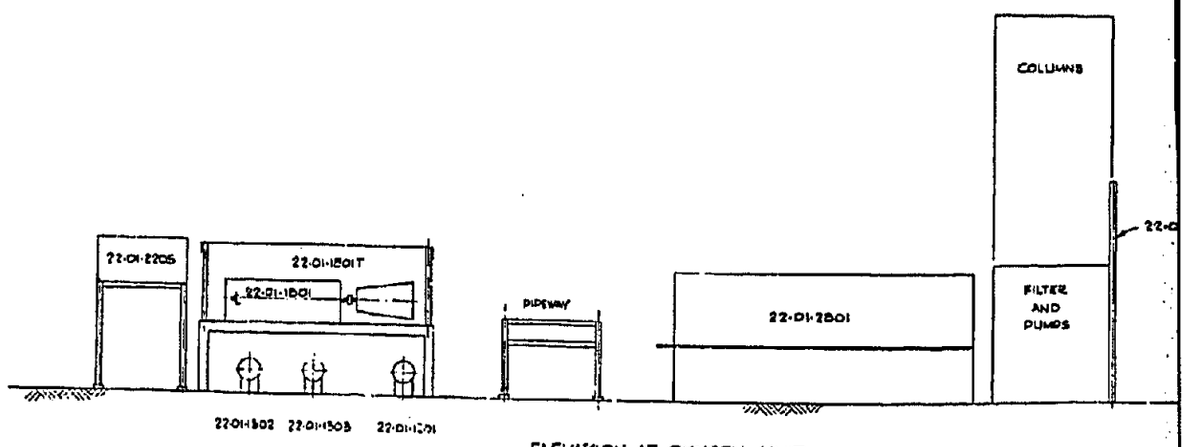
RMP — THE RALPH M. PARSONS COMPANY, PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY
BASKETT — W.R. GRACE & CO. — KENTUCKY
12,900 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: PLOT PLAN
UNIT 22 OXYGEN COMPRESSION
UNIT 51 NITROGEN COMPRESSION

SCALE: 1"=20'-0" | 7245 | 6182 | REVISION: B
DOCUMENT NUMBER: D-22-PD-102 NP

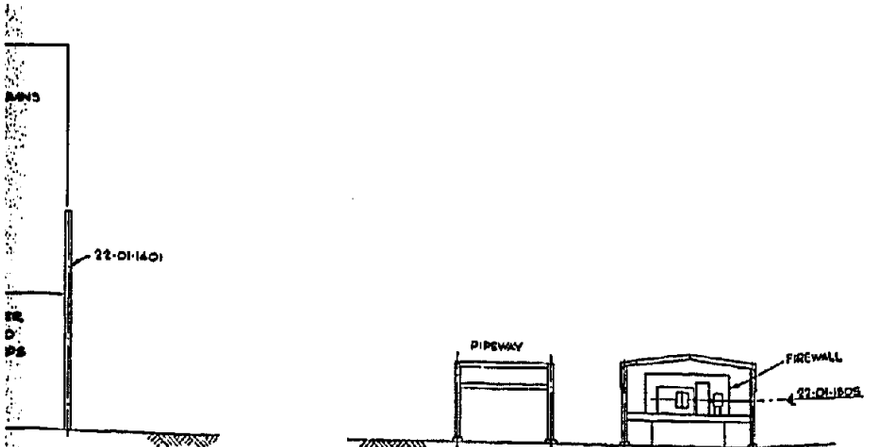
p



ELEVATION AT OXYGEN UNIT

REFERENCES			REFERENCES			REVISIONS								REVISIONS									
DRAWING NO.	DESCRIPTION		DRAWING NO	DESCRIPTION		NO	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT			
														B	7/5/62	NH	JD				DESIGN		
														A	7/7/62	NH	JD				CLIENT		

ENG-GC-23 (12/79)



ELEVATION AT H.R OXYGEN COMPRESSORS

		DES	
		DRAWN	
		CHECKED	
TD	DESIGN REPORT	APVD SECT HD	
	CLIENT APPROVAL	APVD PROJ MGR	
	DESCRIPTION	APVD CLIENT	

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: ELEVATIONS UNIT 22 OXYGEN PLANT

SCALE	ACCOUNT NUMBER	JOB NUMBER	AE's SEAL
1" = 20FT	7245	6152	

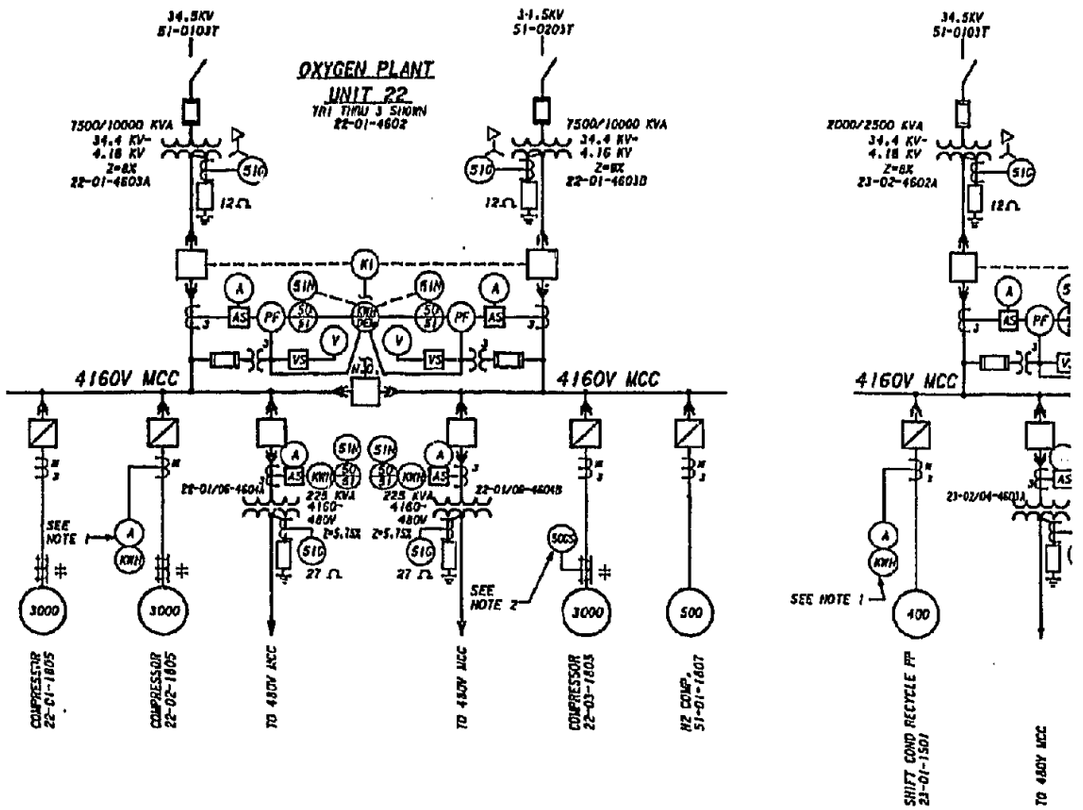
DOCUMENT NUMBER: D-22-PD-103 NP

REV: B

G. Single-Line Diagram

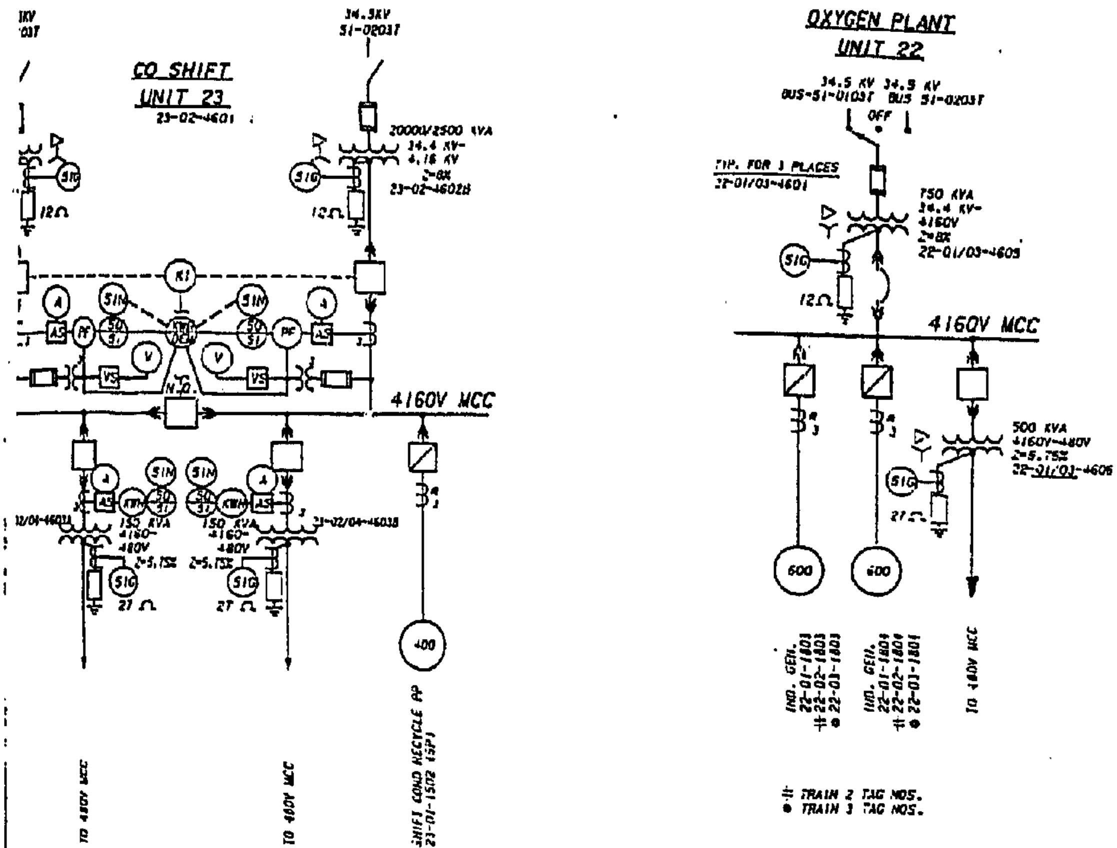
Signle-Line Diagram for Oxygen Plant Unit 22 is as follows:

Drawing No.	Title
D-51-EE-104NP	One Line Diagram - Units 22 and 23



REFERENCES		REFERENCES		REVISIONS								REVISIONS								
DRAWING NO.	DESCRIPTION	DRAWING NO.	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION	NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
												B	7-28-82	LS	T.L.				FOR DES
												A	5-16-82	MT	TJS	RTB			ISSUED

ENGGE-33 (12/78)



NOTES:

1. PROVIDE AM, KWH METERS AT ALL LOCATIONS MARKED •
2. PROVIDE 50GS RELAY TO ALL MOTORS MARKED #

	FOR DESIGN REPORT
	ISSUED FOR CLIENT APPROVAL
CLIENT	DESCRIPTION

DRAWN: HT

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

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: ONE LINE DIAGRAM OXYGEN PLANT U-22 CO SHIFT UNIT U-23

SCALE	ACCOUNT NUMBER	JOB NUMBER
NONE	4600	6182

DOCUMENT NUMBER: D-51-EE-104NP — REVISION: B

1.2.7 CO SHIFT - UNIT 23

The CO Shift Unit processes about 62% of the raw synthesis gas from the coal gasification unit over a cobalt-molybdenum catalyst bed to obtain the required H_2:CO ratio for the methanol synthesis unit and recovers heat as the gas if cooled for further downstream processing. The balance of the raw gas is diverted to a separate gas cooling system, which recovers heat to produce steam.

A large amount of heat is available from cooling shift reactor effluent and unshifted gas. An integrated heat recovery scheme is designed to recover useful energy for heating shift feed gas, high-pressure boiler feedwater, process condensate, and vacuum condensate. Process condensate from cooled shift effluent and unshifted gas are reheated and returned to the gasification unit.

A. Basis of Design

Raw gas from the gasification unit is split into one shifted train and one unshifted train. The split of syngas into shifted and unshifted trains results in lower capital and operating costs for the downstream Acid Gas Removal Unit. The Basis of Design includes Feed Streams and Product Streams (shown on the following two pages).

B. Process Selection Rationale

The raw syngas received from the gasification unit consists mainly of CO, H_2, and CO_2, with sulfur present as H_2S and COS. The water/gas shift reaction converts CO and H_2O to CO_2 and H_2 so that the desired H_2:CO ratio is obtained to feed the downstream Methanol Synthesis Unit.

Feed Streams

Component	Raw Shift Feed Gas (lb mol/hr)	(mol%)	Makeup Steam (lb mol/hr)	Unshifted Gas (lb mol/hr)	(mol%)
H_2	9,767.34	36.19	-	5,877.91	36.19
CH_4	53.60	0.20	-	32.26	0.20
CO	11,824.37	43.81	-	7,115.82	43.81
CO_2	4,805.36	17.81	-	2,891.83	17.81
N_2	128.45	0.48	-	77.30	0.48
Ar	43.12	0.16	-	25.95	0.16
H_2S	343.55	1.27	-	206.74	1.27
COS	21.18	0.08	-	12.75	0.08
Total Dry, lb mol/hr	26,986.97	100.00	-	16,240.56	100.00
H_2O	19,218.69		7,768.26	11,565.85	
Total Wet, lb mol/hr	46,205.66		7,768.26	27,806.41	
Total, lb/hr	927,780.00		139,950.00	558,360.00	
Pressure, psia	850		900	850	
Temperature, °F	435		640	435	

Product Streams

Component	Shifted Effluent to AGR (lb mol/hr)	(mol%)	Unshifted Gas to AGR (lb mol/hr)	(mol%)	Combined Condensate (lb mol/hr)
H_2	18,386.66	51.61	5,877.91	36.19	-
CH_4	53.60	0.15	32.26	0.20	-
CO	3,205.03	9.00	7,115.82	43.81	-
CO_2	13,442.86	37.73	2,891.83	17.81	-
N_2	128.45	0.36	77.30	0.48	-
Ar	43.12	0.12	25.95	0.16	-
H_2S	361.71	1.02	206.74	1.27	-
COS	3.03	0.01	12.75	0.08	-
Total Dry, lb mol/hr	35,624.46	100.00	16,240.56	100.00	-
H_2O	42.59		18.82		29,853.90
Total Wet, lb mol/hr	35,667.05		16,259.38		29,853.90
Total, lb/hr	737,910.00		350,330.00		537,850.00
Pressure, psia	795		820		790
Temperature, °F	100		100		223

The water/gas shift reaction has been used in many chemical process plants; however, in most applications, a nonsulfur-tolerant catalyst is used to treat a sulfur-free gas. The sulfur content of the raw syngas requires a sulfur-tolerant shift catalyst (e.g., a cobalt-molybdenum type). The catalyst manufacturer with the most experience in sour gas shift is BASF with its K8-11 catalyst. The reactor is sized according to the BASF catalyst requirement. The resulting shift section is capable of operating with catalyst from any of the other three vendors solicited for recommendations.

The system is designed for maximum useful recovery of waste heat from the shifted train and unshifted train. The use of waste heat for generating steam and heating condensate and boiler feedwater reduces the cost of providing gasoline.

The feed gas is split into shifted and unshifted streams to individual acid gas absorbers to give the most economical design. The H_2:CO ratio in the feed to the Methanol Synthesis Unit is adjusted by varying the flow of syngas to the shifted train.

Direct sour shift following gasification is selected over a scheme using sulfur removal, conventional hot shift followed by CO_2 removal. Positioning the conventional hot shift between sulfur removal and CO_2 removal involves cooling and reheating the raw gas from gasification and thus will reduce the overall thermal efficiency of the Gasoline Plant.

C. Process Description

The equipment arrangement and material balance for the CO Shift - Unit 23 is presented on Process Flow and Control Diagrams D-23-MP-101NP, -102NP, and -103NP.

The purpose of the CO Shift Unit is to shift carbon monoxide and steam to carbon dioxide and hydrogen in order to obtain the ratio required for methanol synthesis. Approximately 62% of the raw syngas from gasification passes through the shift section while the remainder of the raw syngas is routed through the gas cooling section of the CO Shift Unit.

The portion of the raw syngas going to the shift section is mixed with superheated makeup steam to obtain a steam to dry gas ratio of 1:1. The shift feed gas is heated to 600°F in Shift Effluent/Feed Heat Exchanger 23-01-1301 and then flows to Shift Reactor 23-01-2501. Approximately 73% of the CO entering the reactor is shifted with H_2O to CO_2 and H_2. The shift reaction is exothermic and the gas temperature rises from 600°F at the reactor inlet to 879°F at the outlet.

The shift reactor effluent is cooled by exchange with reactor feed in Shift Effluent/Feed Heat Exchanger 23-01-1301. The shift effluent gas is cooled to 250°F in a series of four exchangers: Shift Effluent Boiler Feedwater Heater 23-01-1302, Shift Effluent 50-psig Steam Generator 23-01-1303, HP Boiler Feedwater Preheater 23-01-1304, and HP Turbine Condensate Exchanger 23-01-1305. The heat removed from the shift effluent is used to heat HP boiler feedwater from 250°F to 500°F and turbine condensate from 126°F to 220°F and to generate 50-psig steam. The condensate in the shift effluent is removed in Shift Effluent 1st Knockout Pot 23-01-1202.

The Shift Effluent 1st Knockout Pot overhead is finally cooled by flowing through a series of two exchangers, Shift Effluent Air Cooler 23-01-1306 and Shift Effluent Water Cooler 23-01-1307. These exchangers cool the gas to 100°F. The condensate formed in the air cooler and water cooler is separated from the gas in Shift Effluent 2nd Knockout Pot 23-01-1204. The overhead from the Shift Effluent 2nd Knockout Pot flows to the Acid Gas Removal Unit.

The raw syngas from gasification not destined for the shifted section is sent to the unshifted gas cooling section. The diverted raw gas is cooled by a series of six exchangers. Approximately 94% of the heat removed from the raw gas in the unshifted section is recovered by generating steam and heating condensate, while the remaining 6% of the waste heat is lost to air and water cooling.

The raw diverted gas from the gasification section is cooled in Shift Bypass 150-psig Steam Generator 23-01-1308 and then flows to Shift Bypass 50-psig Steam Generator 23-01-1309. The partially condensed bypass stream from the 50-psig Steam Generator flows to Shift Condensate Heater 23-01-1311, where heat is recovered by heating condensate from 223°F to 300°F. The bypass stream is cooled further in HP Turbine Condensate Heater 23-01-1312, where heat removed from the bypass stream is used to heat turbine condensate from 126°F to 220°F. The bypass stream flows from HP Turbine Condensate Heater 23-01-1311 to Shift Bypass 1st Knockout Pot 23-01-1203, where the condensate is separated from the gas.

The overhead from Shift Bypass 1st Knockout Pot 23-01-1203 is cooled to 100°F by two exchangers in series: Shift Bypass Air Cooler 23-01-1312 and Shift Bypass Water Cooler 23-01-1313. The condensate formed in the two coolers is separated from the gas in Shift Bypass 2nd Knockout Pot 23-01-1207. The unshifted gas leaving Shift Bypass 2nd Knockout Pot 23-01-1207 is sent to the Acid Gas Removal Unit.

The condensate from each knockout pot in the shifted section and unshifted section is sent to Knockout Pots Bottoms Collecting Drum 23-01-1205. Part of the condensate from the collecting drum is reheated to 300°F in Shift Condensate Heater 23-01-1310, then returned to the gasification unit. The remainder of the condensate is sent to the gasification unit as makeup water.

D. Risk Assessment

The CO Shift Unit uses conventional cobalt-molybdenum (CoMo) sour-shift catalysts backed by several years of commercial experience. The catalyst is available from several reputable suppliers such as BASF and United Catalyst Inc. However, the shift unit designed for this project is capable of using catalysts from other suppliers as well. The process configuration of the CO Shift system is simple and process conditions do not pose any fabrication problems.

The BASF sulfur-tolerant shift conversion catalyst, with more than 10 years of successful operation, was selected for this project. Presently this catalyst is in operation in several plants. BASF shift catalysts meet the following requirements:

(1) High activity in the presence of sulfur compounds in the synthesis gas.

(2) High mechanical strength.

(3) Resistance to high stream partial pressure.

BASF catalyst K8-11 is used in a temperature range of approximately 450°F to 950°F. It is resistant to temperatures of up to 1,000°F. Successful pilot tests have been made at pressures of up to 1,500 psia, and there is a plant in operation at 1,100 psia.

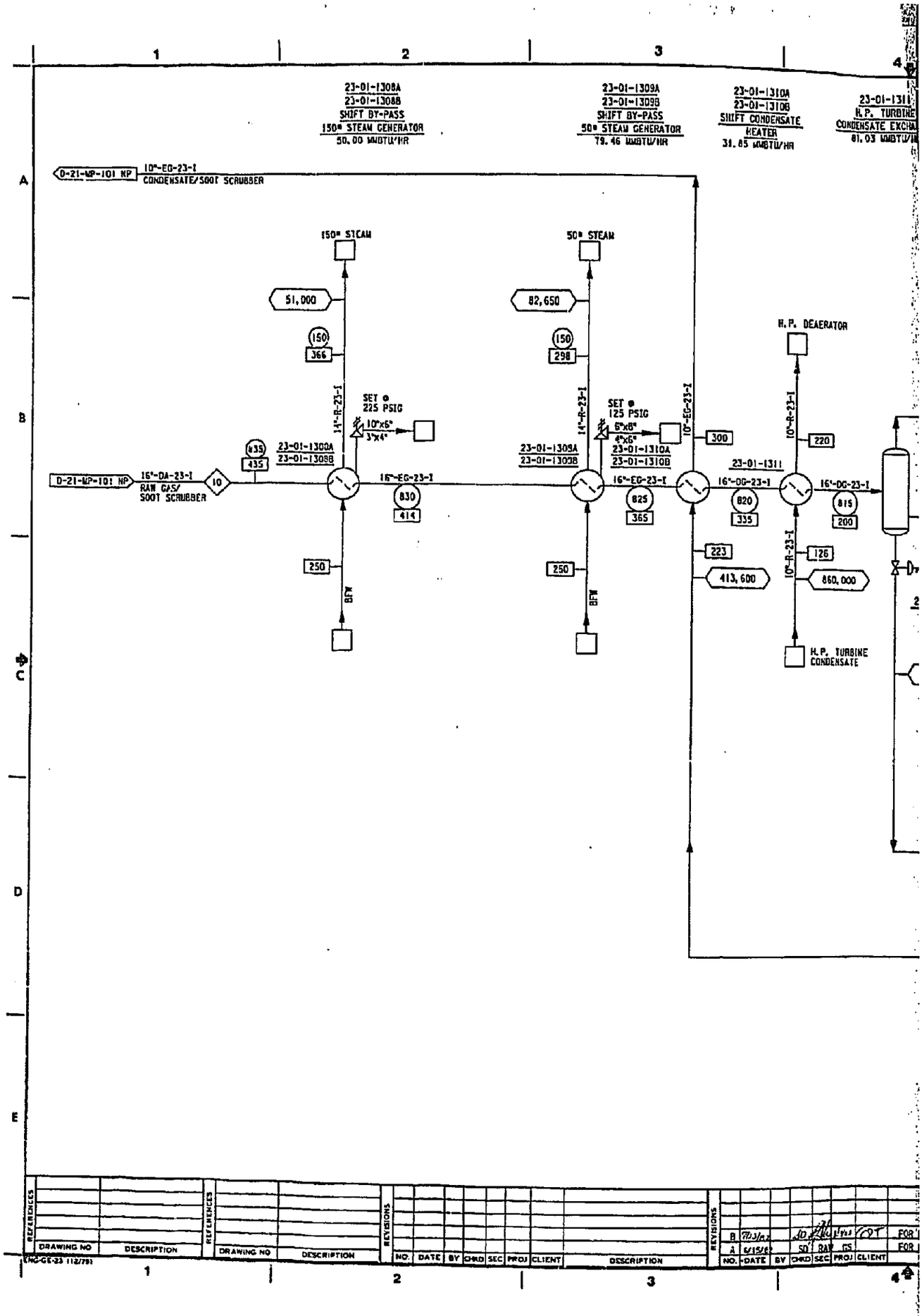
Shift catalyst has a lifetime of about 2 years or more when it is directly exposed to raw gas from the gasifiers, such as in this case where there is only one shift reactor per train.

Technical risk in this section is minimal.

E. Process Flow and Control Diagrams (Including Material Balance)

Process Flow and Control Diagrams for CO Shift Unit 23 are as follows:

Drawing No.	Title
D-23-MP-101NP	PFCD CO Shift - Unit 23 Gas Cooling
D-23-MP-102NP	PFCD CO Shift - Unit 23 Shift Section
D-23-MP-103NP	Material Balance CO Shift - Unit 23


23-01-1308A
23-01-1308B
SHIFT BY-PASS
150# STEAM GENERATOR
50.00 MMBTU/HR
23-01-1309A
23-01-1309B
SHIFT BY-PASS
50# STEAM GENERATOR
79.46 MMBTU/HR
23-01-1310A
23-01-1310B
SHIFT CONDENSATE
HEATER
31.85 MMBTU/HR
23-01-1311
H.P. TURBINE
CONDENSATE EXCHA
81.03 MMBTU/H
D-21-MP-101 NP
10"-EG-23-1
CONDENSATE/SOOT SCRUBBER
150# STEAM
50# STEAM
51,000
82,650
150
366
298
H.P. DEAERATOR
14"-R-23-1
SET @
225 PSIG
10"x6"
3"x4"
SET @
125 PSIG
6"x6"
4"x6"
10"-EG-23-1
300
10"-R-23-1
220
435
23-01-1308A
23-01-1308B
23-01-1309A
23-01-1309B
23-01-1310A
23-01-1310B
23-01-1311
D-21-MP-101 NP
16"-DA-23-1
RAW GAS/
SOOT SCRUBBER
10
16"-EG-23-1
16"-DG-23-1
830
414
825
365
820
335
815
200
250
BFW
223
413,600
126
860,000
H.P. TURBINE
CONDENSATE
REFERENCES
DRAWING NO
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
B 7/31/92
A 6/15/92
SD
RAY
GS
FOR
ENG-GE-23 11/2/791

23-01-1311
H.P. TURBINE CONDENSATE EXCHANGER
81.03 MMBTU/HR

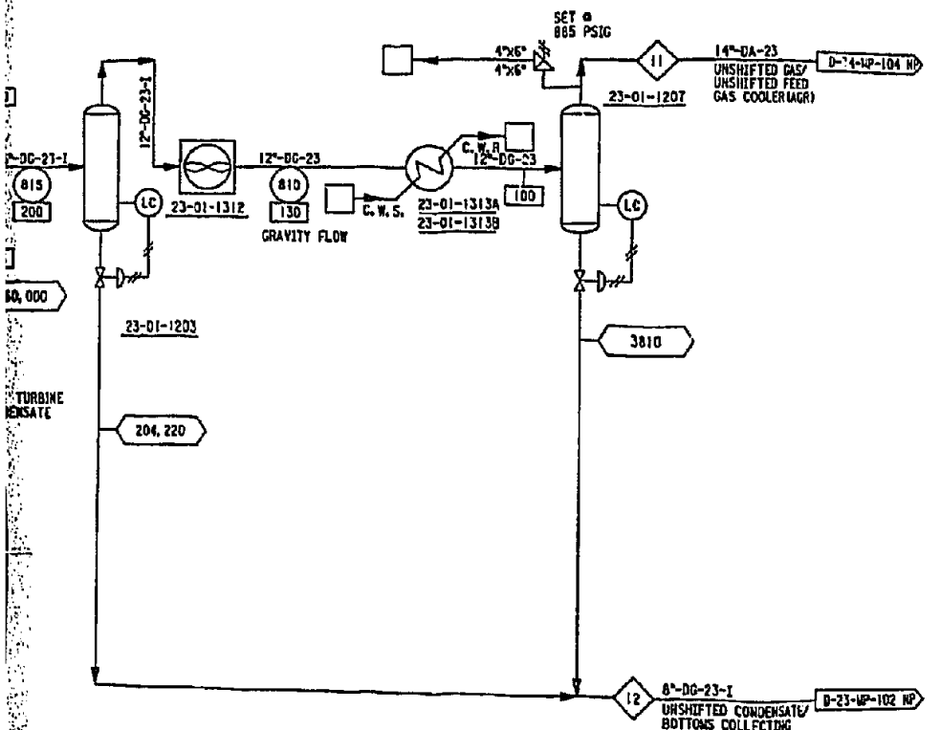
23-01-1203
SHIFT BY-PASS
1ST K.O. POT

23-01-1312
SHIFT BY-PASS
AIR COOLER
11.92 MMBTU/HR

23-01-1313A
23-01-1313B
SHIFT BY-PASS
WATER COOLER
4.18 MMBTU/HR

23-01-1207
SHIFT BY-PASS
2ND K.O. POT

NOTES:
1. HEAT AND MATERIAL BALANCES SHOWN ARE AT THE NORMAL OPERATING CONDITIONS.
2. LINE SIZING IS BASED ON THE DATA OF DESIGN OPERATING CONDITIONS.



EQUIPMENT SHOWN ON THIS DRAWING:

23-01-1203	23-01-1310B
23-01-1207	23-01-1311
23-01-1308A	23-01-1312
23-01-1308B	23-01-1313A
23-01-1309A	23-01-1313B
23-01-1310A	

D23MP101N.DGN

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: PROCESS FLOW AND CONTROL DIAGRAM
CO SHIFT - UNIT 23
GAS COOLING

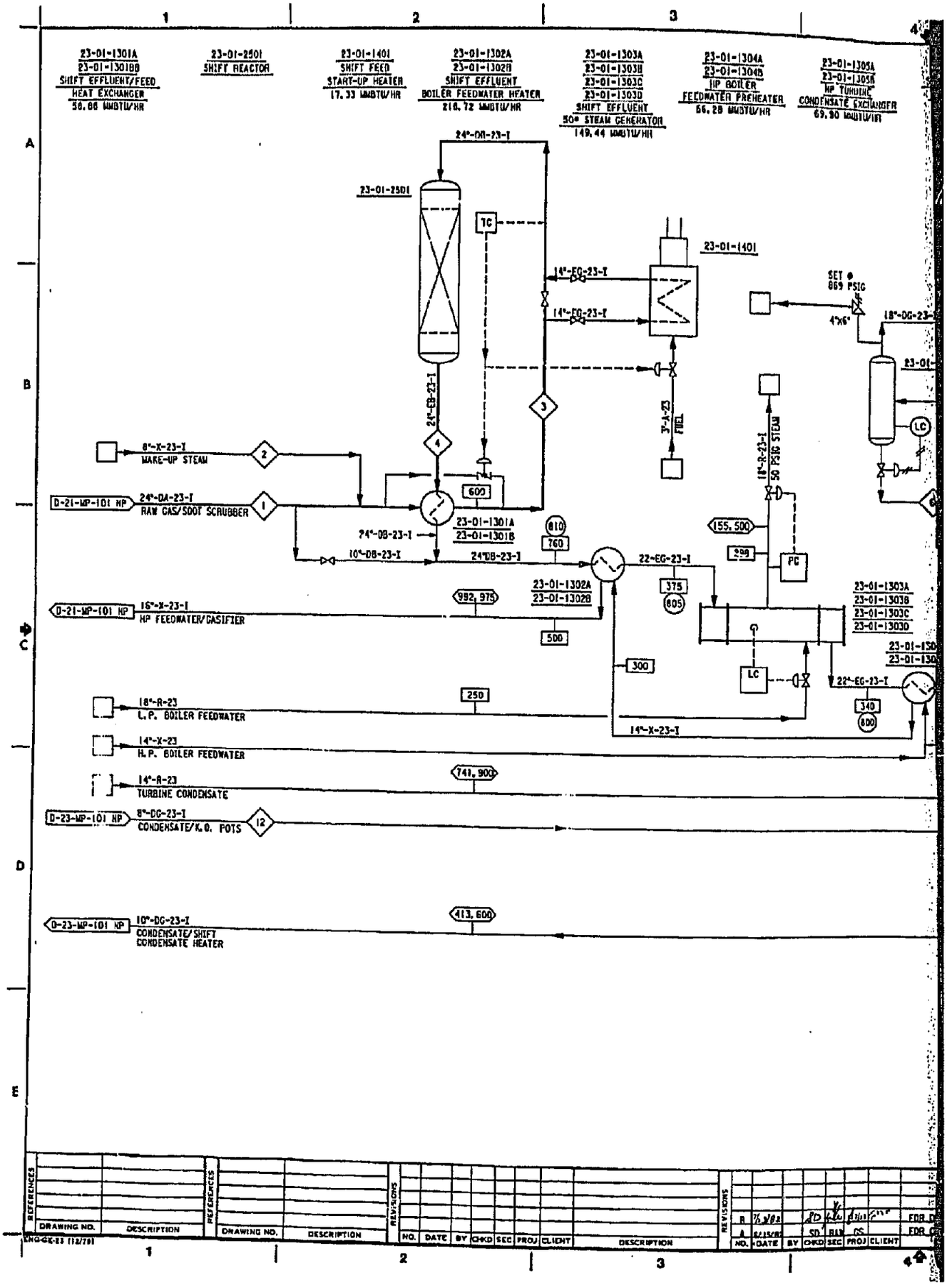
SCALE: NONE | ACCOUNT NUMBER: 2800 | JOB NUMBER: 6182

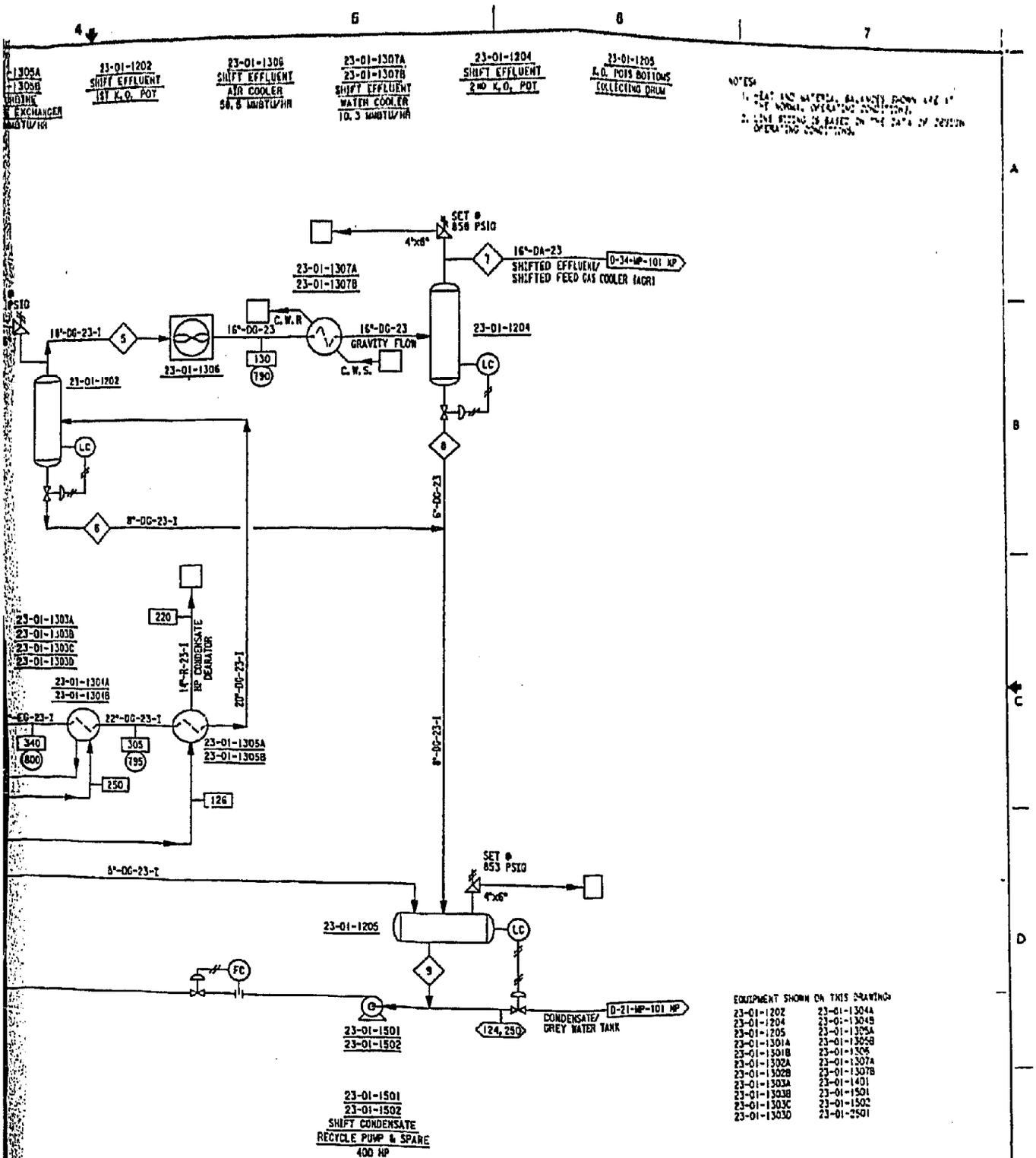
DOCUMENT NUMBER: D-23-MP-101 NP

REVISION: B

DES	DRAWN	CHECKED	APVD SECT MGR	APVD PROJ MGR	APVD CLIENT
1/24	DT	FOR DESIGN REPORT			
		FOR CLIENT APPROVAL			
PROJ	CLIENT	DESCRIPTION			

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA


23-01-1301A
23-01-1301B
SHIFT EFFLUENT/FEED
HEAT EXCHANGER
56.66 MMBTU/HR
23-01-2501
SHIFT REACTOR
23-01-1401
SHIFT FEED
START-UP HEATER
17.33 MMBTU/HR
23-01-1302A
23-01-1302B
SHIFT EFFLUENT
BOILER FEEDWATER HEATER
218.72 MMBTU/HR
23-01-1303A
23-01-1303B
23-01-1303C
23-01-1303D
SHIFT EFFLUENT
50# STEAM GENERATOR
149.44 MMBTU/HR
23-01-1304A
23-01-1304B
HP BOILER
FEEDWATER PREHEATER
56.28 MMBTU/HR
23-01-1305A
23-01-1305B
HP TURBINE
CONDENSATE EXCHANGER
69.90 MMBTU/HR
24"-DA-23-I
23-01-2501
TC
23-01-1401
14"-EG-23-I
14"-EG-23-I
SET @
869 PSIG
4"x6"
18"-DG-23-
23-01-
LC
24"-EB-23-I
3"-A-23
FUEL
8"-X-23-I
MAKE-UP STEAM
D-21-MP-101 NP
24"-DA-23-I
RAW GAS/SOOT SCRUBBER
600
23-01-1301A
23-01-1301B
24"-DB-23-I
10"-DB-23-I
24"DB-23-I
810
760
18"-R-23-I
50 PSIG STEAM
155, 500
998
PC
22"-EG-23-I
375
805
23-01-1302A
23-01-1302B
992, 975
500
D-21-MP-101 NP
16"-X-23-I
HP FEEDWATER/DASIFIER
23-01-1303A
23-01-1303B
23-01-1303C
23-01-1303D
23-01-130
23-01-130
300
LC
22"-EG-23-I
340
890
250
18"-R-23
L.P. BOILER FEEDWATER
14"-X-23-I
14"-X-23
H.P. BOILER FEEDWATER
14"-X-23-I
741, 903
14"-R-23
TURBINE CONDENSATE
D-23-MP-101 NP
8"-DG-23-I
CONDENSATE/K.O. POTS
12
413, 600
D-23-MP-101 NP
10"-DG-23-I
CONDENSATE/SHIFT
CONDENSATE HEATER
REFERENCES
DRAWING NO.
DESCRIPTION
REFERENCES
DRAWING NO.
DESCRIPTION
REVISIONS
NO.
DATE
BY
CHKD
SEC
PROJ
CLIENT
DESCRIPTION
REVISIONS
R
A
FOR D
FOR C
ENG-GE-83 112/791


23-01-1305A
23-01-1305B
23-01-1202
SHIFT EFFLUENT
1ST K.O. POT
23-01-1306
SHIFT EFFLUENT
AIR COOLER
50.8 MMBTU/HR
23-01-1307A
23-01-1307B
SHIFT EFFLUENT
WATER COOLER
10.3 MMBTU/HR
23-01-1204
SHIFT EFFLUENT
2ND K.O. POT
23-01-1205
K.O. POTS BOTTOMS
COLLECTING DRUM
SET @
856 PSIG
4"x6"
16"-DA-23
SHIFTED EFFLUENT/
SHIFTED FEED GAS COOLER (AGR)
D-34-MP-101 KP
23-01-1307A
23-01-1307B
16"-DG-23-1
16"-DG-23
C.W.R
C.W.S.
GRAVITY FLOW
23-01-1306
23-01-1204
23-01-1202
8"-DG-23-1
6"-DG-23
20"-DG-23-1
LP-R-23-1
LP CONDENSATE
DEAERATOR
22"-DG-23-1
23-01-1305A
23-01-1305B
8"-DG-23-1
SET @
853 PSIG
4"x6"
23-01-1205
CONDENSATE/
GREY WATER TANK
D-21-MP-101 NP
124, 250
23-01-1501
23-01-1502
23-01-1501
23-01-1502
SHIFT CONDENSATE
RECYCLE PUMP & SPARE
400 HP
EQUIPMENT SHOWN ON THIS DRAWING
23-01-1202
23-01-1204
23-01-1205
23-01-1301A
23-01-1301B
23-01-1302A
23-01-1302B
23-01-1303A
23-01-1303B
23-01-1303C
23-01-1303D
23-01-1304A
23-01-1304B
23-01-1305A
23-01-1305B
23-01-1306
23-01-1307A
23-01-1307B
23-01-1401
23-01-1501
23-01-1502
23-01-2501
D23MP102NL DGA
U.S. DEPARTMENT OF ENERGY
BASKETT
W.R. GRACE & CO.
KENTUCKY
12,500 B.P.D.
COAL - TO - METHANOL - TO - GASOLINE PLANT
PROCESS FLOW CONTROL DIAGRAM
CO SHIFT - UNIT 23
SHIFT SECTION
NONE
2800
6182
D-23-MP-102 NP
FOR DESIGN REPORT
FOR CLIENT APPROVAL
DESCRIPTION
THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

COMPONENT		1 RAW GAS TO SHIFT MAIN	2 MAKE-UP STEAM	3 SHIFT FEED GAS	4 SHIFT REACTOR EFFLUENT	5 1ST K.O. POT OVERHEAD	6 1ST K.O. POT CONDENSATE	7 SHIFTED EFFLUENT TO AGR	8 2ND K.O. P CONDENSAT
	MOL. WT.	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR
H_2	2.02	9,767.34		9,767.34	18,386.66	18,386.66		18,386.66	
CH_4	16.04	53.60		53.60	53.60	53.60		53.60	
CO	28.01	11,824.37		11,824.37	3,205.03	3,205.03		3,205.03	
CO_2	44.01	4,805.36		4,805.36	13,442.86	13,442.86		13,442.86	
N_2	28.02	128.45		128.45	128.45	128.45		128.45	
Ar	39.94	43.12		43.12	43.12	43.12		43.12	
H_2S	34.08	343.55		343.55	361.71	361.71		361.71	
COS	60.07	21.18		21.18	3.03	3.03		3.03	
TOTAL DRY		26,986.95		26,986.95	35,624.46	35,624.46		35,624.46	
H_2O		19,218.69	7,768.26	26,986.95	18,349.46	1,370.66	16,978.80	42.59	1,328.0
TOTAL WET		46,205.64	7,768.26	53,973.92	53,973.92	36,995.12	16,978.80	35,667.05	1,328.0
POUNDS/HR		927,780	139,950	1,067,730	1,067,730	761,840	305,890	737,910	23,9
MMSCFD		20.08	18.02	19.78	19.78	20.59	18.02	20.69	18.0
PRESS, PSIA		850	900	840	830	805	805	795	79
TEMP °F		439	640	600	679	250	250	100	10

REFERENCES

DRAWING NO.	DESCRIPTION
ENG-GE-23 12/78	

REFERENCES

DRAWING NO	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	
B	7/23/81						FOR C
A	6/15/81	SD	RAW	GS			FOR

7 IFTED LUENT AGR	8 2ND K.O. POT CONDENSATE	9 COMBINED CONDENSATE	10 RAW GAS TO UNSHIFTED TRAIN	11 UNSHIFTED GAS TO AGR	12 UNSHIFTED CONDENSATE
ES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR	MOLES/HR
386.66			5,877.91	5,877.91	
53.60			32.26	32.26	
205.03			7,115.82	7,115.82	
442.86			2,891.83	2,891.83	
128.45			77.30	77.30	
43.12			25.95	25.95	
361.71			206.74	206.74	
3.03			12.75	12.75	
624.46			16,240.56	16,240.56	
142.59	1,328.07	29,633.90	11,565.85	18.82	11,547.03
587.05	1,328.07	29,633.90	27,806.41	16,259.38	11,547.03
37,910	23,930	537,850	558,360	350,330	208,030
20.69	18.02	18.02	20.08	21.55	18.02
24.85			253.26	148.09	
795	795	790	850	820	820
100	100	233	435	100	199

NO.	DESCRIPTION	BY	CHECKED	APVD SECT MGR	APVD PROJ MGR	APVD CLIENT
3						
2						
1	FOR DESIGN REPORT					
0	FOR CLIENT APPROVAL					

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

D23MP103N.DGA

U.S. DEPARTMENT OF ENERGY

BASKETT — M.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

TITLE: MATERIAL BALANCE
CO SHIFT - UNIT 23

SCALE: NONE | 2600 | 6182

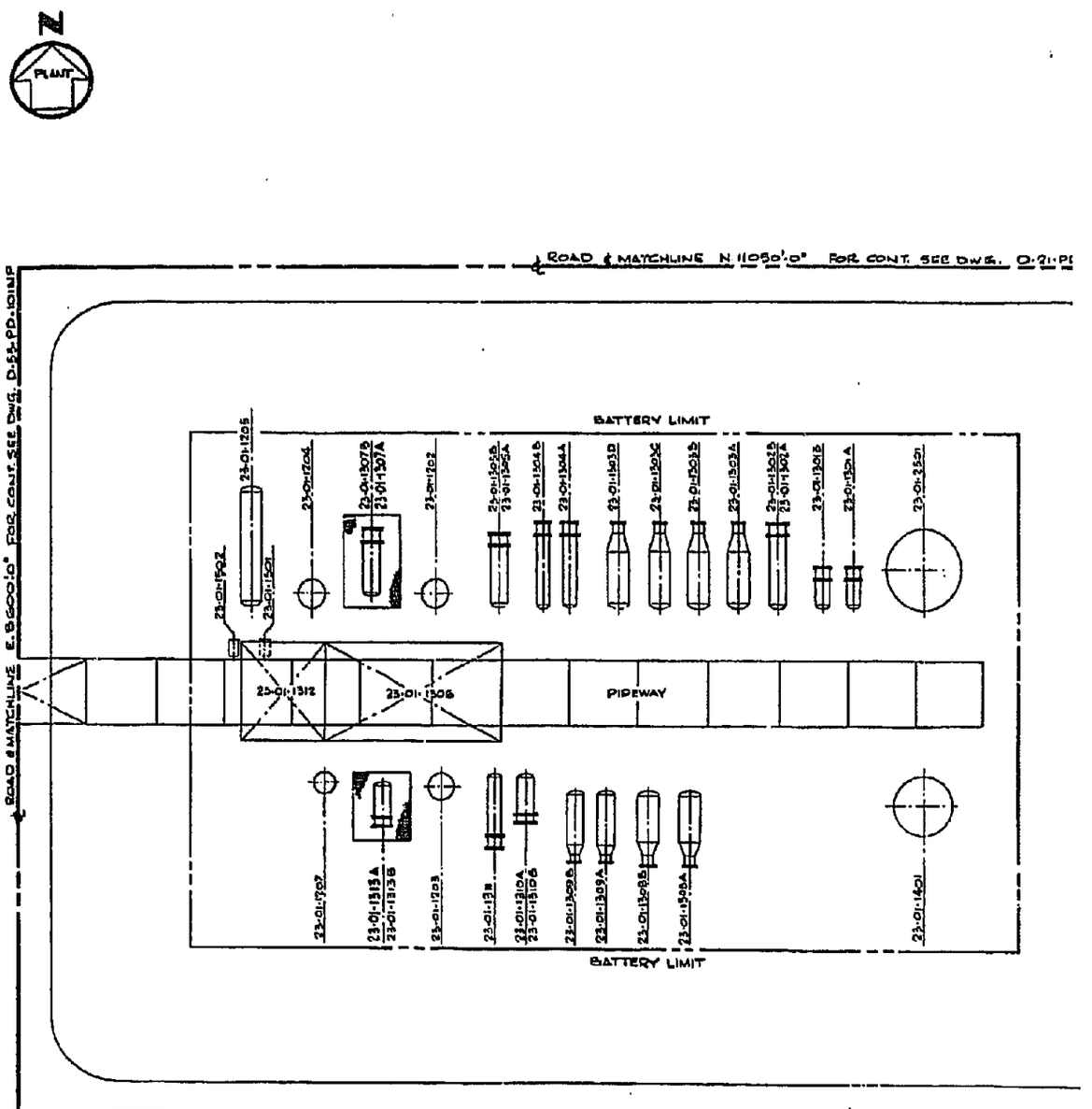
D-23-MP-103 NP

REVISION: 5

F. Plot Plan/General Arrangement Drawings

Plot Plan/General Arrangement Drawings for CO Shift Unit 23 are as follows:

Drawing No.	Title
D-23-PD-101NP	Plot Plan - Unit 23 CO Shift
D-23-PD-102NP	Plot Plan - Unit 23 CO Shift



EQUIPMENT LIST

23-01-1202	SHIFT EFFLUENT 1ST K.O POT
23-01-1205	SHIFT BYPASS 1ST K.O. POT
23-01-1204	SHIFT EFFLUENT 2ND K.O POT
23-01-1205	K.O. POTS BOTTOMS COLLECTING DRUM
23-01-1207	SHIFT BYPASS 2ND K.O. POT

23-01-1301A & B	SHIFT EFFLUENT/FEED HEAT EXCHANGER
23-01-1302 A & B	SHIFT EFFLUENT BOILER FEED WATER HEATER
23-01-1303A & D	SHIFT EFFLUENT/50# STEAM GENERATOR
23-01-1304A & B	H.P BOILER FEED WATER PREHEATER
23-01-1305 A & B	H.P. TURBINE CONDENSATE EXCHANGER
23-01-1306	SHIFT EFFLUENT AIR COOLER
23-01-1307A & B	SHIFT EFFLUENT WATER COOLER
23-01-1308A & B	SHIFT BYPASS 150# STEAM GENERATOR
23-01-1309A & B	SHIFT BYPASS 50# STEAM GENERATOR
23-01-1310A & B	SHIFT CONDENSATE HEATER
23-01-1311	M.P. TURBINE CONDENSATE EXCHANGER
23-01-1312	SHIFT BYPASS AIR COOLER
23-01-1313 A & B	SHIFT BYPASS WATER COOLER

23-01-1401	SHIF
23-01-1501	SHIF
23-01-1502	SHIF
23-01-2501	SHIF

REFERENCES

DRAWING NO	DESCRIPTION
D-23-PD-102NP	ELEVATION - CO. SHIFT

REFERENCES

DRAWING NO	DESCRIPTION

REVISIONS

NO.	DATE	BY	CHKD	SEC	PROJ	CLIENT	DESCRIPTION
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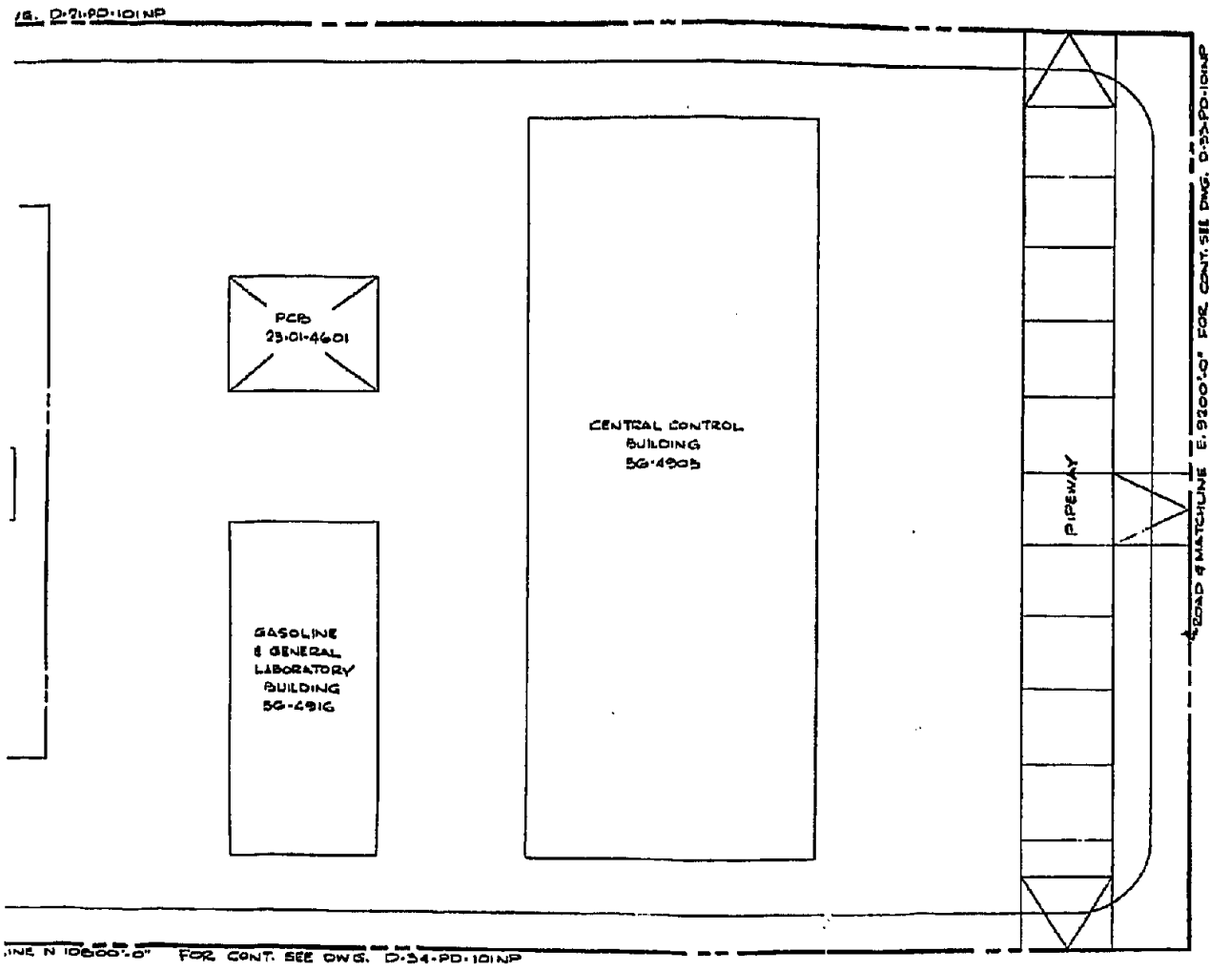
ENG-GE-23 (12/79)



401 SHIFT FEED STARTUP HEATER

501 SHIFT CONDENSATE RECYCLE PUMP
502 SHIFT CONDENSATE RECYCLE PUMP (SPARE)

2501 SHIFT REACTOR

U.S. DEPARTMENT OF ENERGY

BASKETT — W.R. GRACE & CO. — KENTUCKY

12500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

PLOT PLAN
UNIT 23
CO. SHIFT

SCALE: 1" = 20FT | ACCOUNT NUMBER: 7243 | JOB NUMBER: 6182

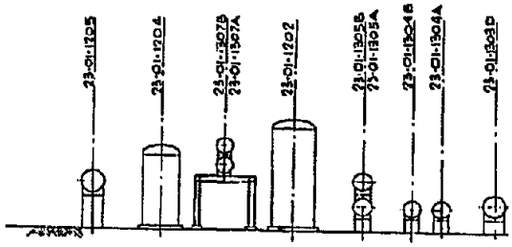
DOCUMENT NUMBER: D-23-PD-101 NP

REVISION: 6

THE RALPH M. PARSONS COMPANY
PASADENA, CALIFORNIA

DESIGN REPORT
CLIENT APPROVAL
DESCRIPTION

FOR
DRAWN
CHECKED
APVD SECT MGR
APVD PROJ MGR
APVD CLIENT



REFERENCES		REFERENCES		REVISIONS								REVISIONS									
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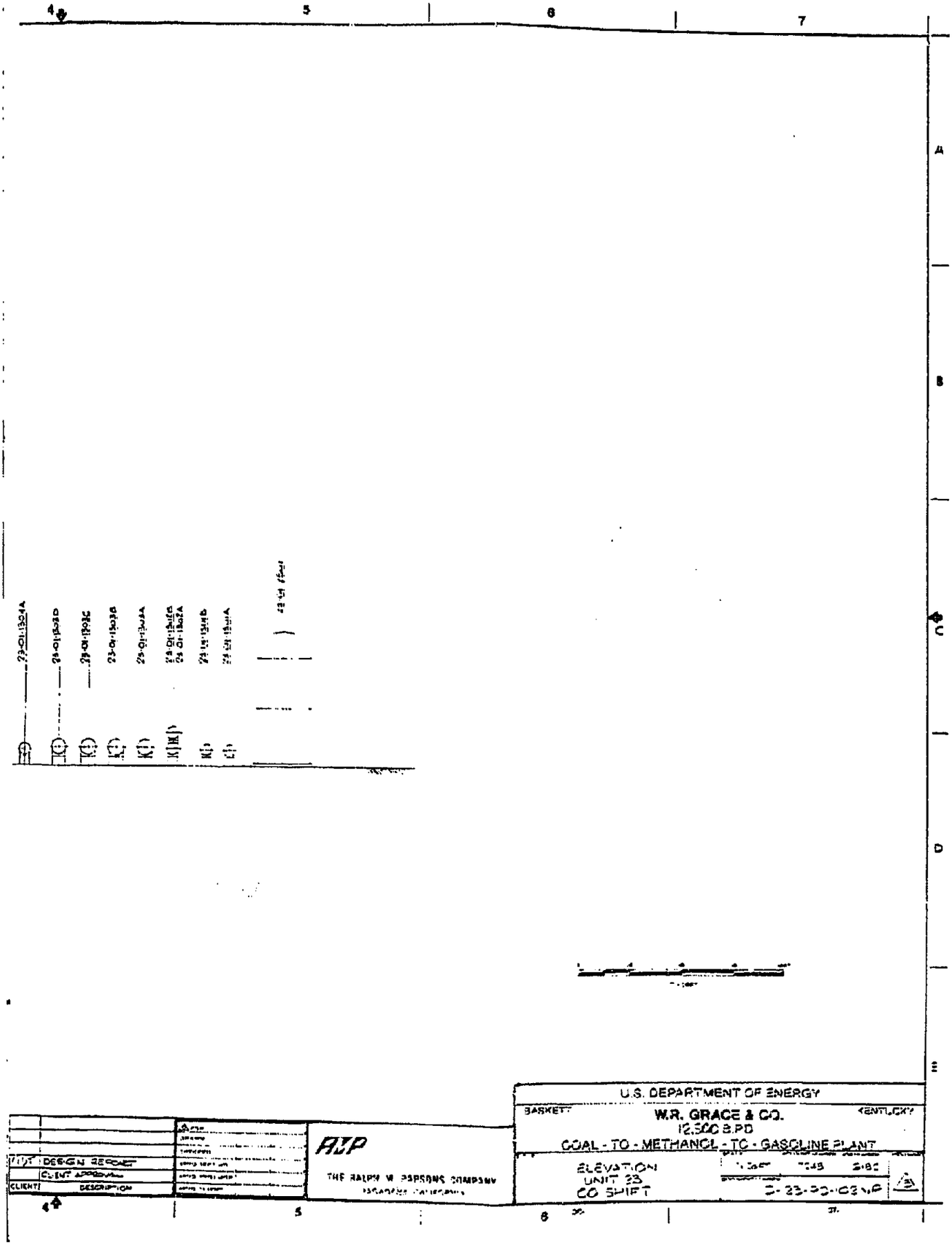
												A	6/16/82	PH	JD	RB	JMH	CHJ	CLIEN

ENG-DE-53 (12/78)

1 2 3 4



U.S. DEPARTMENT OF ENERGY

BARKETT — W.R. GRACE & CO. — KENTUCKY

12,500 B.P.D.

COAL - TO - METHANOL - TO - GASOLINE PLANT

ELEVATION
UNIT 23
CO SHIFT

D-23-20-03 V.P

THE RALPH M. PARSONS COMPANY

DESIGN RECORD

CLIENT APPROVAL

CLIENT DESCRIPTION

G. Single-Line Diagram

See Volume II, 1.2.6(G) for CO Shift Unit 23 Single-Line Diagram.