DOE/MC/27339 -- 4065
(DE95009711)

ENCOAL Mild Coal Gasification Project Public Design and Construction Report

Topical Report

December 1994

Work Performed Under Contract No.: DE-FC21-90MC27339

For
U.S. Department of Energy
Office of Fossil Energy
Morgantown Energy Technology Center
Morgantown, West Virginia

By
ENCOAL Corporation
Gillette, Wyoming

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Distribution Category UC-109

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P.O. Box 880
Morgantown, West Virginia 26507-0880

By
ENCOAL Corporation
P.O. Box 3038
Gillette, Wyoming

December 1994

ENCOAL MILD COAL GASIFICATION PROJECT
PUBLIC DESIGN AND CONSTRUCTION REPORT
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Appendices B – E were omitted from this report.

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GLOSSARY

ASME	American Society of Mechanical Engineers
BS&W	Basic Sediment & Water
Btu	British Thermal Units
CDL	Coal Derived Liquid
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
DOE	U.S. Department of Energy
ENCOAL	ENCOAL Corporation, wholly-owned subsidiary of SMC Mining Company
ESP	Electrostatic Precipitators
^0F	Degrees Fahrenheit
ft.	Feet
$ft.^2$	Square Feet
HP	Horsepower
H_2O	Water
H_2S	Hydrogen Sulfide
in.	Inches
Kellogg	The M. W. Kellogg Company
lb/hr	Pounds per Hour
LFC Technology	Liquid From Coal Technology
MM Btu/hr	Million British Thermal Units per Hour
Max	Maximum
MSHA	Mine Safety and Health Administration
NO_x	Nitrogen Oxides
O_2	Oxygen
PDF	Process Derived Fuel
PLC	Programmable Logic Controller
%	Percent
pH	Measure of alkalinity and acidity on a scale of 0 to 14
psia	Pounds per Square Inch Absolute
psig	Pounds per Square Inch Gauge
RPM	Rotations per Minute
SMC	SMC Mining Company, wholly owned subsidiary of Zeigler Coal Holding Company, formerly Shell Mining Company
SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
turnkey	Subcontracting method that includes design, furnishing and installation responsibility
vol	Volume

1.0 SUMMARY

The process engineering, detailed design and construction have been completed for a coal processing demonstration plant whose products will have a significantly greater value than that of the plant feed. The plant is designed to process 1000 ton/day of subbituminous Power River Basin (PRB) low-sulfur coal feed and to produce two products, a solid fuel and a liquid fuel. The solid product, Process Derived Fuel (PDF), is a stable, low-sulfur, high-Btu fuel similar in composition and handling properties to bituminous coal. The liquid product, Coal Derived Liquid (CDL), is a heavy, low-sulfur, liquid fuel similar in properties to heavy industrial fuel oil.

Since this is a demonstration plant, operating flexibility was a major factor in the process design. Environmental concerns, automation, and safety practices were also given a very high priority.

2.0 INTRODUCTION

This Public Design Report describes the 1000 ton per day ENCOAL mild coal gasification demonstration plant now in operation at the Buckskin Mine near Gillette, Wyoming. The project is being cost-shared by the U.S. Department of Energy (DOE), under the Clean Coal Technology Program administered by the Morgantown Energy Technology Center under Cooperative Agreement number DE-FC21-90MC27339.

The objective of the project is to demonstrate that the proprietary Liquids From Coal (LFC) technology can reliably and economically convert low Btu PRB coal into a superior, high-Btu solid fuel (PDF), and an environmentally attractive low-sulfur liquid fuel (CDL). The Project's plans also call for the production of sufficient quantities of PDF and CDL to permit utility companies to carry out full scale burn tests.

While some process as well as mechanical design was done in 1988, the continuous design effort was started in July, 1990. Civil construction was started in October, 1990; mechanical erection began in May, 1991. Virtually all of the planned design work was completed by July 1991. Most major construction was complete by April, 1992 followed by plant testing and commissioning. Plant operation began in late May, 1992. This report covers both the detailed design and initial construction aspects of the Project.

3.0 PROJECT BACKGROUND

ENCOAL's parent company, Shell Mining Company (SMC), began working on upgrading low rank coal in the early 1970's. In 1986 SMC held discussions with SGI International (SGI), a technology company located in La Jolla, California, to learn of their LFC technology. The LFC technology is a mild pyrolysis process which converts coal into a solid fuel and a liquid fuel. The PDF is a stable, low-moisture, low-sulfur material comparable to bituminous coal except it is more reactive during combustion. The CDL is similar in properties to low-sulfur heavy industrial fuel oil.

Using coal from the Buckskin Mine as a feed stock, SMC and SGI ran a series of pilot plant tests beginning in 1987 in SGI's small scale pilot plant unit located near Pittsburgh, PA. The tests concentrated on various aspects of the LFC process, such as drying and pyrolyzing of coal, solids carry over, liquid collection and process variables. In addition, PDF and CDL were produced for laboratory testing. Several different flow schemes and process modifications were evaluated during these tests. For instance, the unit was upgraded from a 50 lb per hour batch process to a 200 lb per hour semi-continuous process. The experimental studies were extended into 1988 with the following results:

(1) Semi-continuous operation was achieved
(2) To the extent possible, process variables were evaluated
(3) Acceptable mass balances were calculated
(4) Sufficient quantities of products were produced for characteristic analysis and process evaluation

Extensive product testing was conducted at Shell Development Company's Westhollow Research Center in Houston, Texas. PDF was subjected to a month-long, around-the-clock test burn in a laboratory combustion facility. The results showed that the PDF was a very stable product with very desirable combustion properties. The composition of CDL was analyzed for over 200 compounds. The usual tests to characterize the properties of fuel oils were also run on the CDL. These laboratory results, as well as further discussions with potential customers, led SMC to believe that the LFC technology held significant promise to be technologically and commercially sound. In January, 1988, SMC solicited proposals from five major engineering companies and ultimately selected The M. W. Kellogg Company (Kellogg) to (1) perform a thorough investigation of the process, (2) design a nominal 1000 ton/day plant, and (3) prepare a cost estimate.

To guide the design team, SMC developed the following objectives for the demonstration plant:

(1) Provide products for commercial scale test burns
(2) Obtain data for the design of future commercial plants
(3) Demonstrate plant and process performance
(4) Provide capital and operating costs data
(5) Support future LFC technology licensing efforts

Given these objectives, a project team was assembled and charged with the responsibility of designing the facilities. The team developed a set of guidelines to aid the design:

(1) Keep scale-up from the SGI pilot plant reasonable.
(2) Use currently available commercial equipment as much as possible.
(3) Keep the process simple, postpone the refinement of CDL.
(4) Match the products to existing markets.
(5) Minimize all releases to the environment.

Although SMC was pleased with the results of the LFC technology evaluation, product analysis, and market forecast for the sale of the products, the total cost of the project represented a sizeable undertaking. In 1989, SMC decided to seek funding support from the DOE under the Clean Coal Technology Program. ENCOAL Corporation, a wholly-owned subsidiary of SMC, was formed for the purposes of entering into a Cooperative Agreement with the DOE and of

designing and constructing the 1000 ton per day demonstration plant. The Cooperative Agreement with the DOE was signed on September 17, 1990. Figure 3.1 shows the Project Master Schedule developed by ENCOAL and accepted by the DOE for completion of design (Phase I) and construction (Phase II) of the demonstration plant facilities. This Project schedule was moderately aggressive and required the use of fast-tracking methods, that is the overlap of design and construction. It was felt at the time that there was some room for improvement if changes in the design could be kept to a minimum and equipment deliveries promised by vendors were met. Neither of these improvements occurred and it took the full effort of all Project team members to maintain the original schedule.

The Buckskin Mine of Triton Coal Company, another wholly-owned subsidiary of SMC, was chosen as the host location for the plant. This large PRB surface mine is located in northeastern Wyoming as shown on Figure 3.2. Selected in part because Triton is a sister company, the Buckskin Mine had an available site, existing roads, railroad, coal storage and handling facilities, utilities and infrastructure sufficient to support both the mine and ENCOAL. In addition, Triton could supply the raw coal for processing. Figure 3.3 shows the site layout for the existing Buckskin Mine facilities and the new ENCOAL Project facilities.

The site is surrounded by active coal mining operations and property that will be mined in the next few years. Geologically, the plant area is an ancient ocean bottom environment that is extremely variable due to its proximity to the burn zone at the subsurface outcrop of the major coal seam. Competent rock is rare and deep in most of the plant site area, and soil bearing conditions vary from poor to 2000 pounds per square foot. Under the actual plant site itself was an exception, however, and the preliminary geotechnical work showed that a spread foundation was acceptable for the PDF plant and screening building structures. All other structures required concrete caissons of various depths. Geographically, the plant site is at approximately 4100 feet elevation and is subject to cold weather extremes. Although not located in a highly active tectonic region, the plant site is subjected daily to nearby blasting activities in the mine. All of these conditions were evaluated in the plant design and appropriate equipment ratings, civil designs and winterization were included.

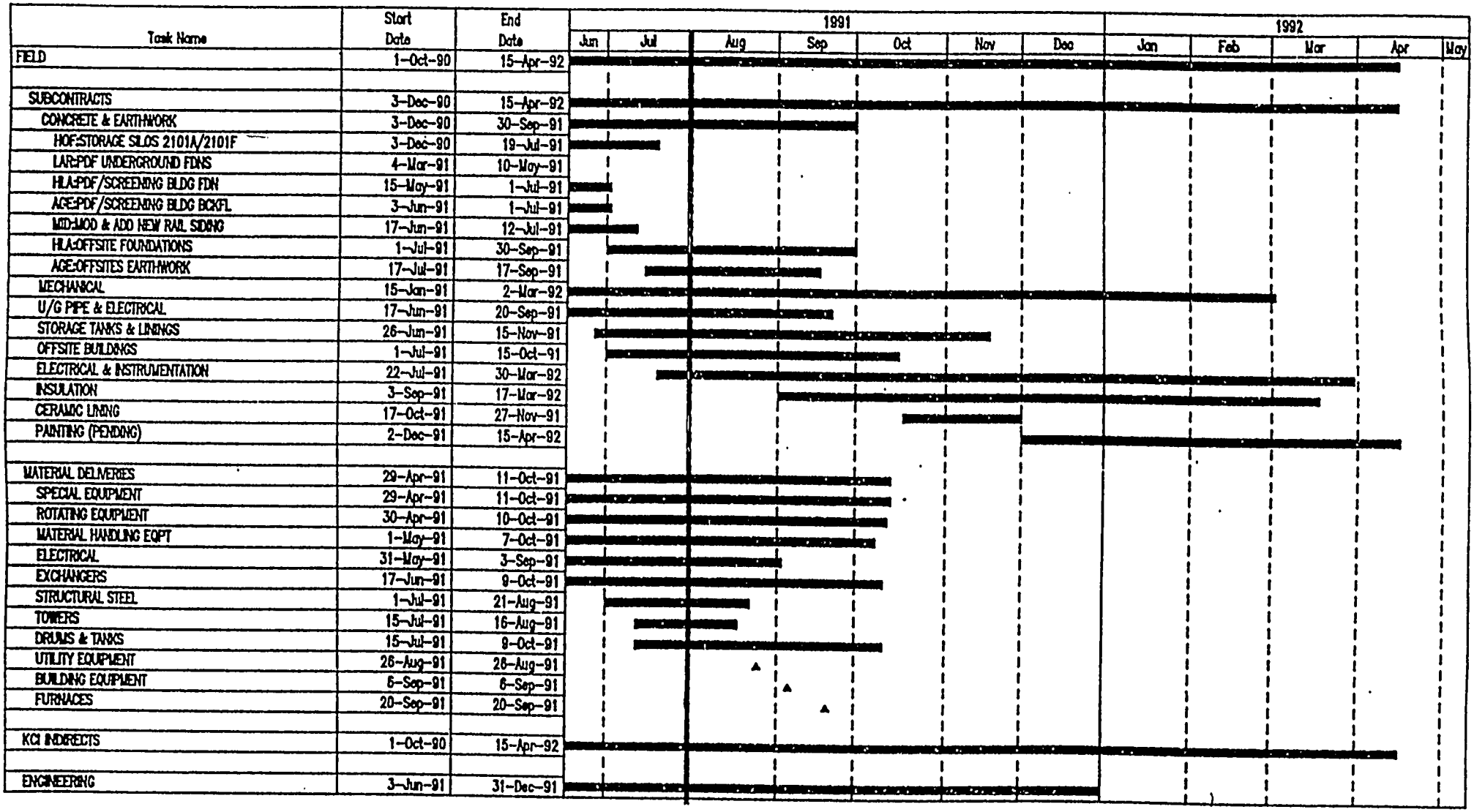
The home office engineering and design group at Kellogg completed their work in July, 1991. All remaining engineering, which mostly involved review and approval of field changes, was done by ENCOAL and Kellogg Construction Inc.(KCI) on-site engineers. Field engineering was more extensive on this Project because the home office engineering team was demobilized before developing a totally complete design. However, this decision proved to be cost effective, especially considering the impact on the Project Master Schedule if the field construction was delayed. With the design completed and construction in the final stages, commissioning and plant startup began in the 2nd quarter of 1992. Full integrated operation was achieved at near design conditions for 24 continuous hours on June 17, 1992.

4.0 OVERVIEW OF PROCESS

The LFC process is a mild gasification or pyrolysis process which involves heating of coal under carefully controlled conditions to produce gaseous compounds. Figure 4.1 shows a simplified flow diagram of ENCOAL's application of the LFC technology.

ENCOAL CORPORATION
MILD GASIFICATION DEMONSTRATION PLANT
FIELD MASTER SCHEDULE

M.W. KELLOGG JOB: 6683
LOCATION: GILLETTE, WYOMING
DATA DATE: 31 JULY 1991



Task Name	Start Date	End Date
FIELD	1-Oct-90	15-Apr-92
SUBCONTRACTS	3-Dec-90	15-Apr-92
CONCRETE & EARTHWORK	3-Dec-90	30-Sep-91
HOF:STORAGE SILOS 2101A/2101F	3-Dec-90	19-Jul-91
LAR:PDF UNDERGROUND FDNS	4-Mar-91	10-May-91
HLA:PDF/SCREENING BLDG FDN	15-May-91	1-Jul-91
AGE:PDF/SCREENING BLDG BCKFL	3-Jun-91	1-Jul-91
MID:MOD & ADD NEW RAIL SIDING	17-Jun-91	12-Jul-91
HLA:OFFSITE FOUNDATIONS	1-Jul-91	30-Sep-91
AGE:OFFSITES EARTHWORK	17-Jul-91	17-Sep-91
MECHANICAL	15-Jan-91	2-Mar-92
U/G PIPE & ELECTRICAL	17-Jun-91	20-Sep-91
STORAGE TANKS & LININGS	26-Jun-91	15-Nov-91
OFFSITE BUILDINGS	1-Jul-91	15-Oct-91
ELECTRICAL & INSTRUMENTATION	22-Jul-91	30-Mar-92
INSULATION	3-Sep-91	17-Mar-92
CERAMIC LINING	17-Oct-91	27-Nov-91
PAINTING (PENDING)	2-Dec-91	15-Apr-92
MATERIAL DELIVERIES	29-Apr-91	11-Oct-91
SPECIAL EQUIPMENT	29-Apr-91	11-Oct-91
ROTATING EQUIPMENT	30-Apr-91	10-Oct-91
MATERIAL HANDLING EQPT	1-May-91	7-Oct-91
ELECTRICAL	31-May-91	3-Sep-91
EXCHANGERS	17-Jun-91	9-Oct-91
STRUCTURAL STEEL	1-Jul-91	21-Aug-91
TOWERS	15-Jul-91	16-Aug-91
DRUMS & TANKS	15-Jul-91	9-Oct-91
UTILITY EQUIPMENT	26-Aug-91	26-Aug-91
BUILDING EQUIPMENT	6-Sep-91	6-Sep-91
FURNACES	20-Sep-91	20-Sep-91
KCI INDIRECTS	1-Oct-90	15-Apr-92
ENGINEERING	3-Jun-91	31-Dec-91

Figure 3.1

MINE LOCATION MAP
EASTERN POWDER RIVER BASIN

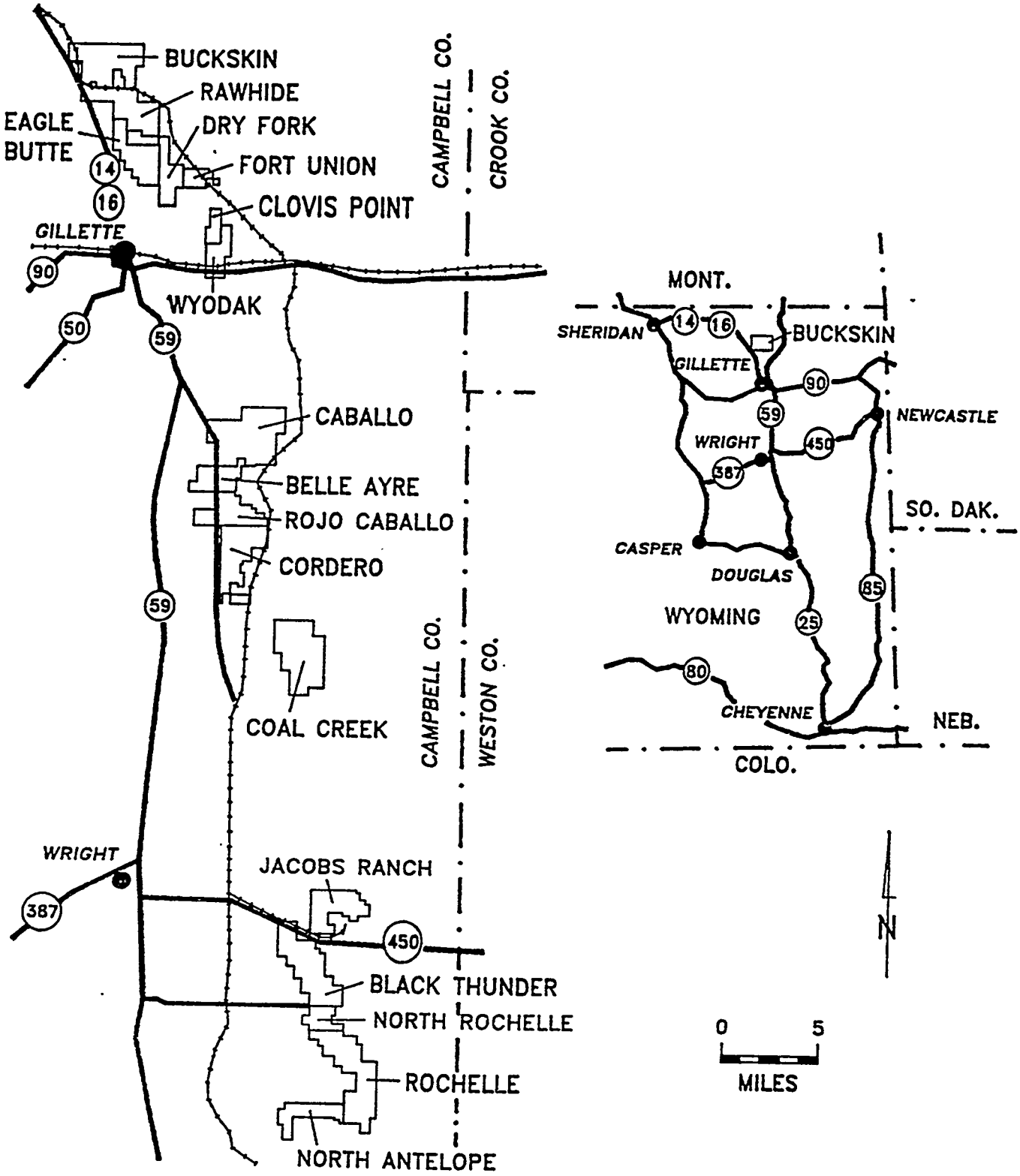
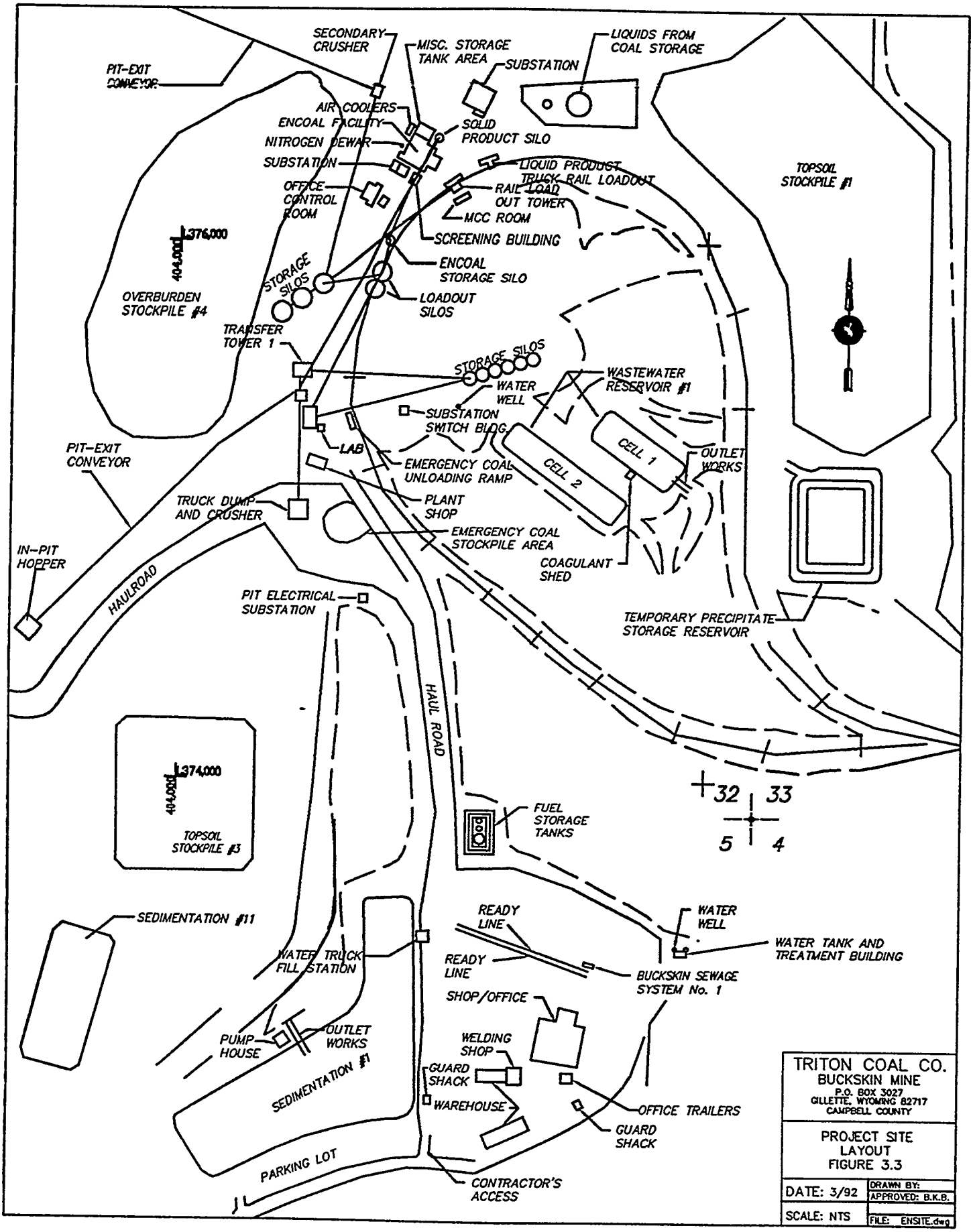


Figure 3.2


SECONDARY CRUSHER
MISC. STORAGE TANK AREA
SUBSTATION
LIQUIDS FROM COAL STORAGE
PIT-EXIT CONVEYOR
AIR COOLERS
ENCOAL FACILITY
NITROGEN DEWAR
SUBSTATION
SOLID PRODUCT SILO
OFFICE CONTROL ROOM
LIQUID PRODUCT TRUCK-RAIL LOADOUT
RAIL LOAD OUT TOWER
MCC ROOM
SCREENING BUILDING
TOPSOIL STOCKPILE #1
376,000
404,000
OVERBURDEN STOCKPILE #4
STORAGE SILOS
ENCOAL STORAGE SILO
LOADOUT SILOS
TRANSFER TOWER 1
STORAGE SILOS
WASTEWATER RESERVOIR #1
WATER WELL
SUBSTATION SWITCH BLDG.
LAB
CELL 1
CELL 2
OUTLET WORKS
PIT-EXIT CONVEYOR
EMERGENCY COAL UNLOADING RAMP
TRUCK DUMP AND CRUSHER
PLANT SHOP
EMERGENCY COAL STOCKPILE AREA
IN-PIT HOPPER
HAULROAD
COAGULANT SHED
PIT ELECTRICAL SUBSTATION
TEMPORARY PRECIPITATE STORAGE RESERVOIR
HAUL ROAD
374,000
404,000
TOPSOIL STOCKPILE #3
32
33
5
4
FUEL STORAGE TANKS
SEDIMENTATION #11
READY LINE
WATER WELL
WATER TANK AND TREATMENT BUILDING
WATER TRUCK FILL STATION
READY LINE
BUCKSKIN SEWAGE SYSTEM No. 1
SHOP/OFFICE
PUMP HOUSE
OUTLET WORKS
WELDING SHOP
GUARD SHACK
SEDIMENTATION #1
WAREHOUSE
OFFICE TRAILERS
GUARD SHACK
PARKING LOT
CONTRACTOR'S ACCESS
TRITON COAL CO.
BUCKSKIN MINE
P.O. BOX 3027
GILLETTE, WYOMING 82717
CAMPBELL COUNTY
PROJECT SITE LAYOUT
FIGURE 3.3
DATE: 3/92
DRAWN BY:
APPROVED: B.K.B.
SCALE: NTS
FILE: ENSITE.dwg

Run-of-mine coal is conveyed from the Buckskin Mine to a storage silo. The coal from this silo is screened to remove oversize and undersize materials. The specification coal feed, 2" x 1/8" size, passes through a GAMMA-METRICS coal analyzer which measures the moisture, ash, carbon, hydrogen, sulfur, and other contents of the feed coal. The coal is then fed into a perforated rotary grate dryer where it is heated by a hot gas stream. The residence time of the coal and temperature of the inlet gas have been selected to reduce the moisture content of the coal without initiating chemical changes. The solid bulk temperature is controlled so that no significant amount of methane, carbon monoxide or carbon dioxide is released from the coal.

The solids from the dryer are then transferred to the pyrolyzer where the temperature of the dried coal is raised to about 1000^0F by a hot recycled gas stream. The rate of heating of the solids i.e., the inlet temperature and flow rate of the hot recycled gas stream, is carefully controlled because it determines the properties of the solid and liquid products. In the pyrolyzer, a chemical reaction occurs which results in the release of volatile gaseous materials from the coal. Solids exiting the pyrolyzer are quickly quenched to stop the pyrolysis reaction. They are then cooled and transferred to the PDF storage silo. Since the solids have no surface moisture and, therefore, are likely to be dusty, a dust suppressant called MK is added as they leave the PDF product silo as final product.

The gas produced in the pyrolyzer is sent through a cyclone for removal of particulates. It is then sent to a quench tower to stop any secondary reaction and to condense the desired liquids. Only CDL is condensed in this step; the condensation of water is avoided. The gas stream leaving the quench tower may contain some CDL in the form of a fine mist. In order to recover the liquid mist, three electrostatic precipitators (ESP's) operating in parallel were installed. The finished CDL product is pumped from the bottom of the quench tower to storage.

The residual gas from the electrostatic precipitators is divided into three streams. Most of it is recycled directly to the pyrolyzer. Some is burned in the pyrolyzer combustor and then mixed with the recycled gas to provide heat for the mild gasification reaction. The remainder of the gas is burned in the dryer combustor, which converts sulfur compounds to sulfur oxides (SO_x) and hydrocarbons to carbon oxides (CO_x). Nitrogen oxide (NO_x) and carbon monoxide (CO) emissions are controlled by appropriate design of the combustor. The hot flue gas from the dryer combustor is blended with the recycled gas from the dryer to provide heat for drying.

The off-gas from the dryer first passes through a cyclone to remove the entrained particulates. It is then divided into two streams. Most of it is recycled directly to the dryer while the remainder is treated with sodium carbonate solution in a two-stage scrubber system. By spraying the off-gas with sodium carbonate solution, the first stage scrubber captures the fine particulates that escape the dryer cyclone, and the second stage scrubber removes most of the sulfur oxides from the gas stream by converting it into sodium sulfite. The sulfite is then oxidized into sodium sulfate. The treated gas is vented to the atmosphere through a stack while the spent solution is sent into a non-discharging pond for evaporation.

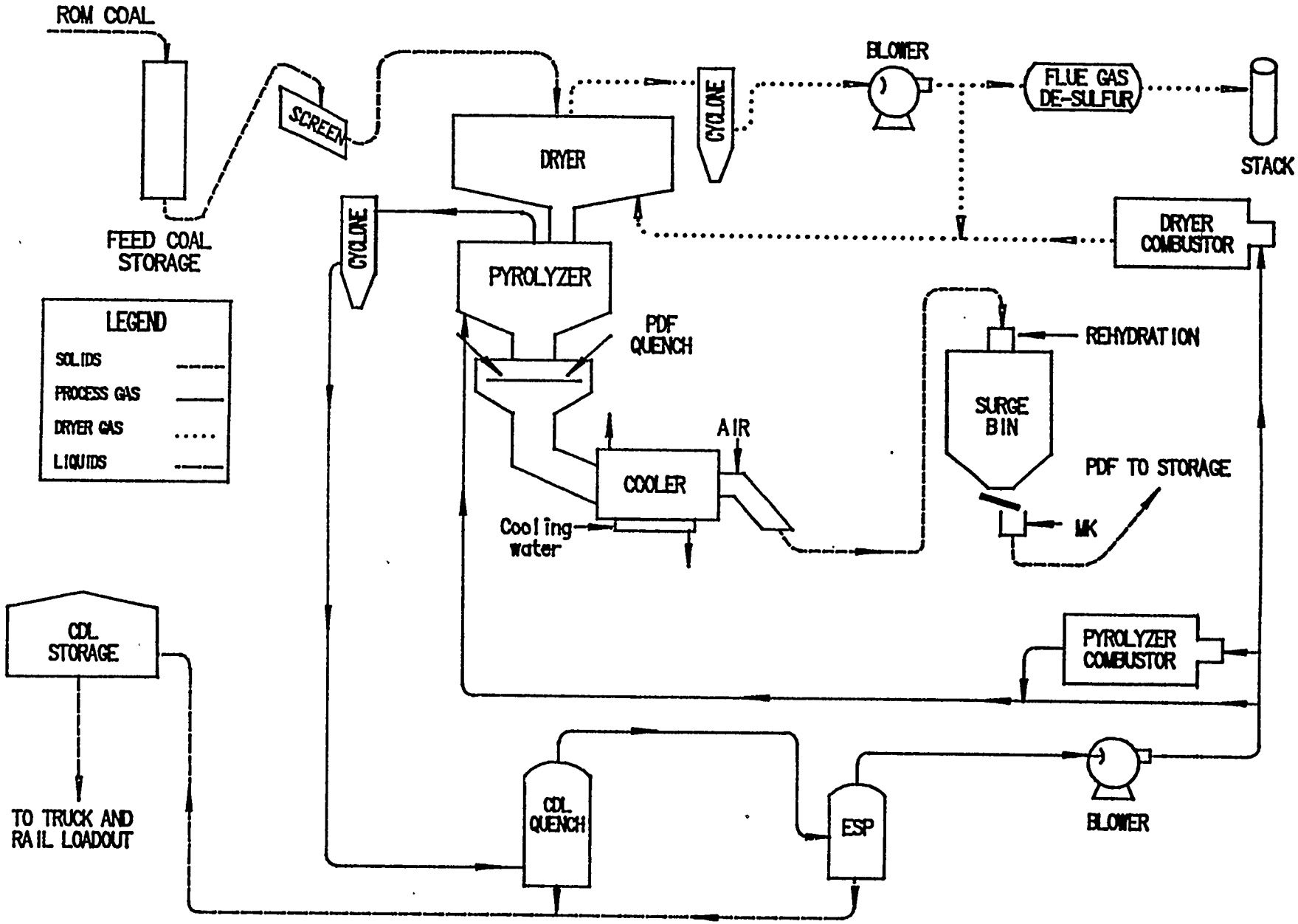


FIGURE 4.1 SIMPLIFIED FLOW DIAGRAM

5.0 OVERVIEW OF DESIGN CONSIDERATIONS

Early in the design phase of the Project, ENCOAL and Kellogg developed a document called the "Design Basis" which contained the underlying premises for the design of the PDF plant and associated facilities. Site specific information such as elevation, climate, wind and snow conditions, rainfall and tectonic activity was listed. The industry standards to be used in the design and the governing industry codes that must be followed were identified. It was determined that the Project would fall under the jurisdiction of the Mine Safety And Health Administration (MSHA) due to its location on the Buckskin Mine property. This carried a special set of requirements for design, especially in the areas of coal drying, lifting and hoisting, electrical classifications and personnel safety protection.

Other areas covered by the Design Basis were the nominal capacity of the plant, namely 1000 tons feed coal per day and the over-design margin for given conditions. In general, a margin of 15% over the nominal design for individual pieces of equipment was the guideline, but this margin was defined so that it would not be additive. A "Process Release" document was also produced based on the description in Section 4. The Process Release contained the detailed heat and material balance for all individual process streams.

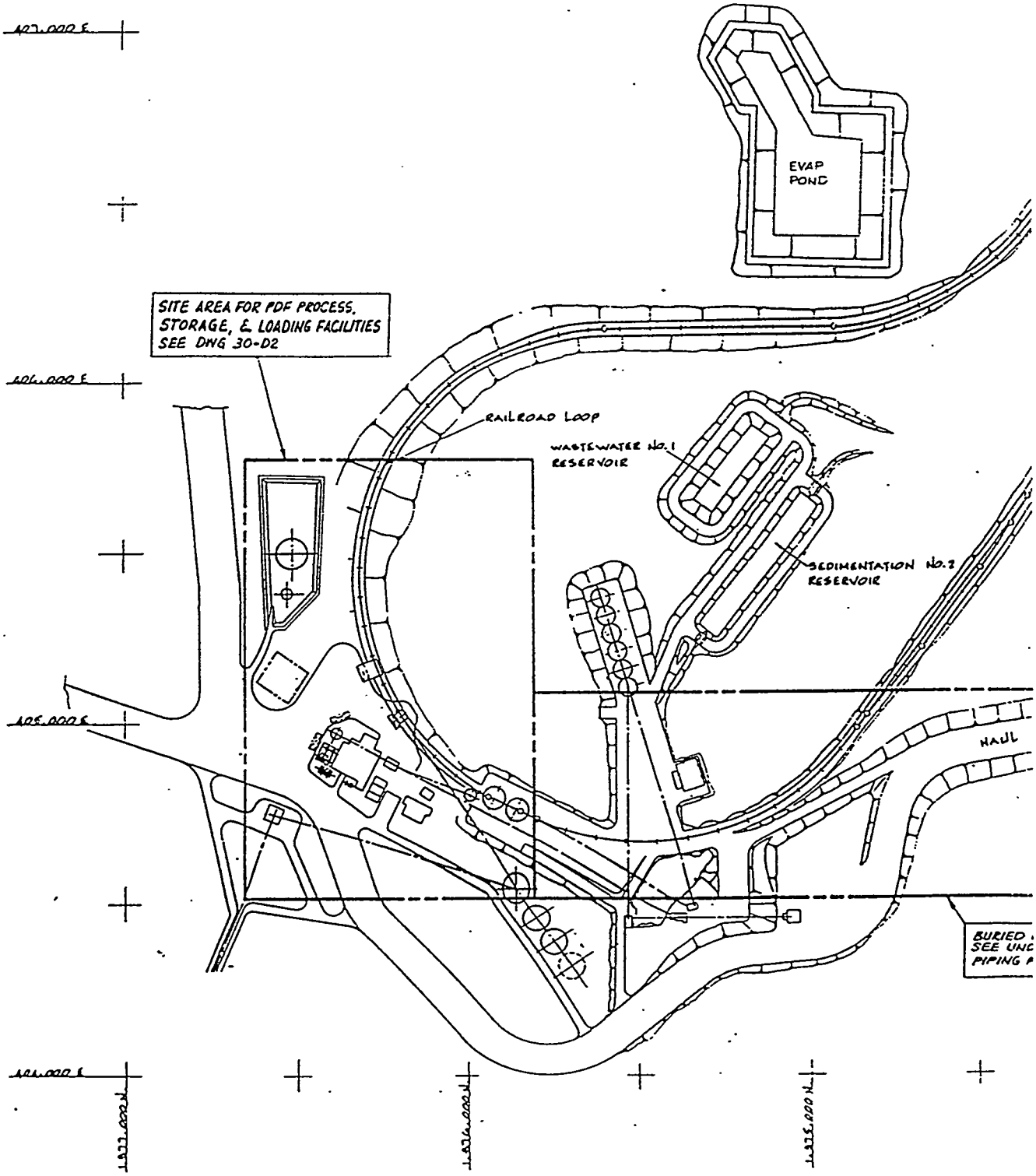
About halfway through the detailed design effort at Kellogg, after sufficient work had been done to describe the facilities, a Hazards of Operations (HazOps) review was performed. A group of experts was assembled from the design team and from external sources at Kellogg and Shell. The group produced a report with recommendations for design modifications, training provisions and operating procedures. The HazOps recommendations were followed carefully, and the design modifications were implemented.

5.1 CIVIL DESIGN

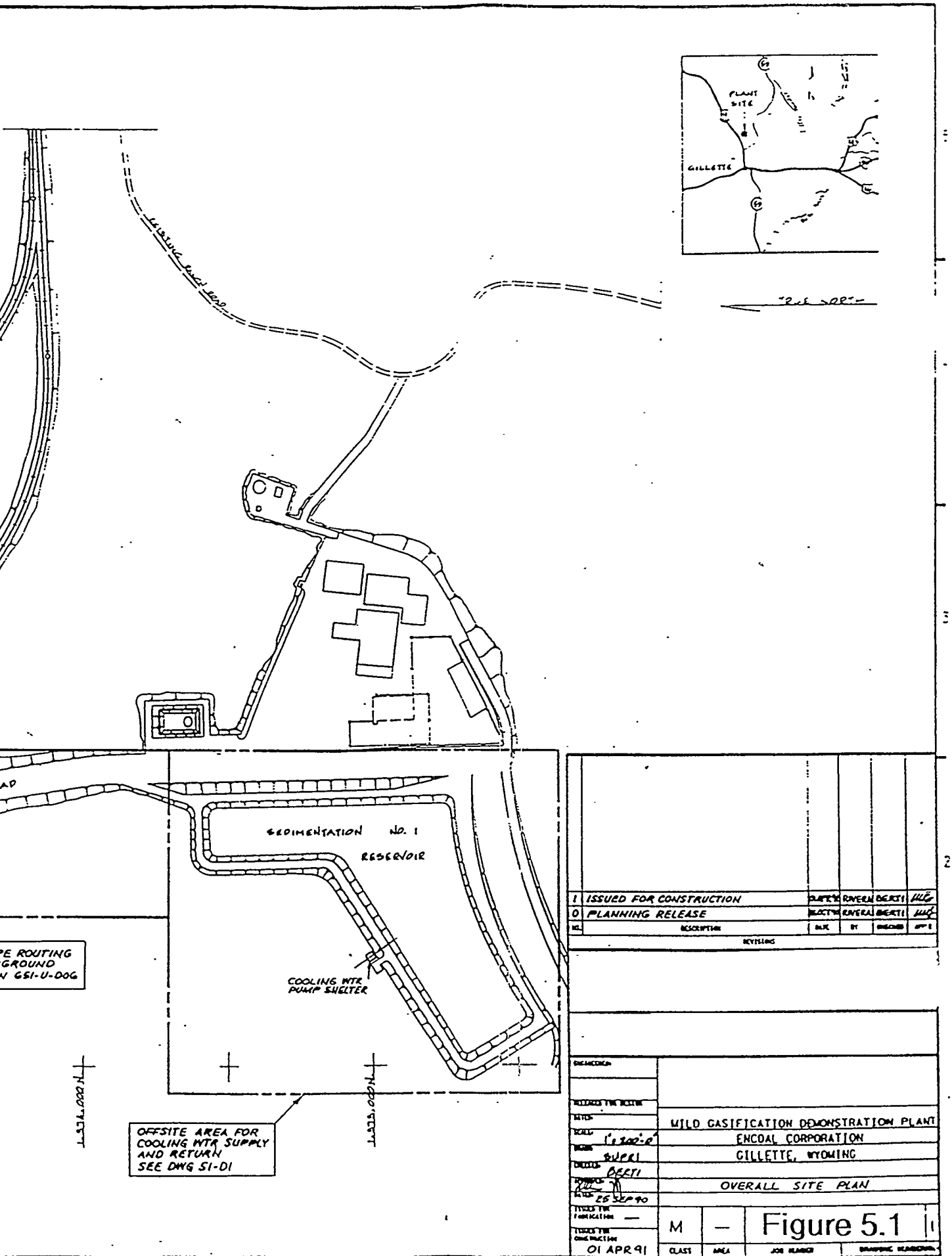
The category called civil design on the ENCOAL Project includes the site preparation, drainage, ponds, foundations and structures as well as the architectural features of the buildings. Since the ENCOAL Project is located on an active mine site, the civil design had to be coordinated with the mine, especially the drainage and ponds. Run-off from the mine passes through the PDF plant site in several places and had to be handled. Wastewater and run-off collection ponds were combined for the mine and new facilities wherever possible. At the same time as the ENCOAL Project was in construction, the mine installed a major expansion project, further emphasizing the need for close coordination of the Project designs. Detailed plot plans are shown in Figures 5.1 through 5.7.

The Civil Engineering group developed a set of guidelines for their designs. Some of the highlights were:

(1) Use a safety factor of four for structural design.
(2) In the absence of local building codes for the site, use standard industrial codes.
(3) Enclose and heat all buildings due to the weather factor.
(4) Design for wind load of 100 mph and snow load of 30 psf.
(5) A ventilation system must cool the PDF building in hot weather and exhaust noxious gases in emergencies.


EVAP POND
SITE AREA FOR PDF PROCESS, STORAGE, & LOADING FACILITIES SEE DWG 30-D2
RAILROAD LOOP
WASTEWATER No. 1 RESERVOIR
SEDIMENTATION No. 2 RESERVOIR
HAUL

D
22X34



NO.	DESCRIPTION	BY	CHECKED	APP'D
1	ISSUED FOR CONSTRUCTION	RIVERA	BERTI	MLC
0	PLANNING RELEASE	RIVERA	BERTI	MLC

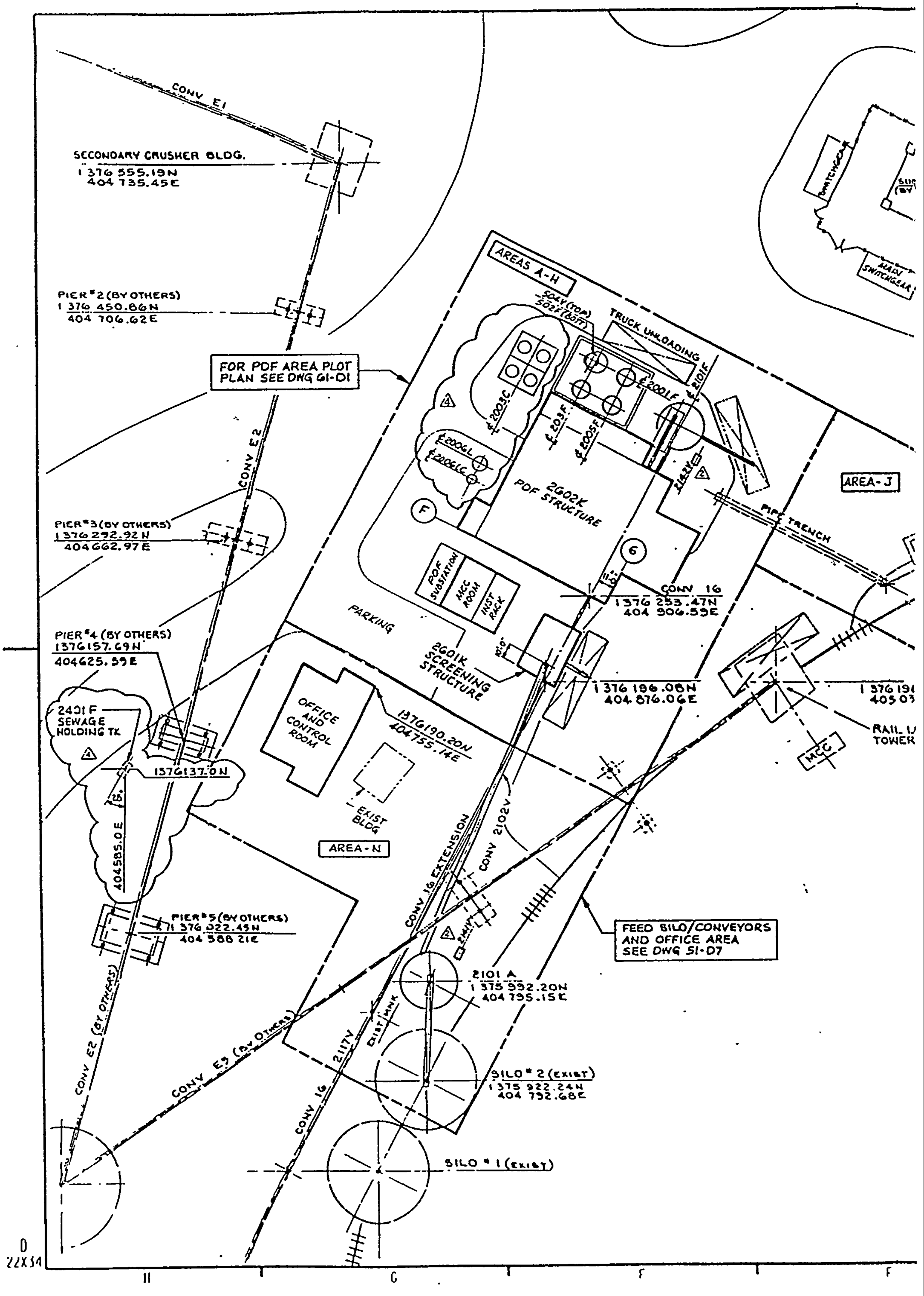
REVISIONS

DESIGNED	
RELEASED FOR BIDDING	
DATES	
SCALE	1"=200'-0"
DRAWN	SUPRI
CHECKED	BERTI
APPROVED	
DATES	25 SEP 90
ISSUED FOR FABRICATION	—
ISSUED FOR CONSTRUCTION	01 APR 91

MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING

OVERALL SITE PLAN

CLASS	AREA	JOB NUMBER	DRAWING NUMBER
M	—	Figure 5.1	


CONV E1
SECONDARY CRUSHER BLDG.
1 376 555.19N
404 735.45E
PIER #2 (BY OTHERS)
1 376 450.86N
404 706.62E
FOR PDF AREA PLOT PLAN SEE DWG 61-01
CONV E2
PIER #3 (BY OTHERS)
1 376 292.92 N
404 662.97 E
PIER #4 (BY OTHERS)
1376157.69N
404625.59E
2401 F
SEWAGE HOLDING TK
1376137.0N
404585.0E
PIER #5 (BY OTHERS)
1 376 022.45N
404 588 21E
CONV E2 (BY OTHERS)
CONV E3 (BY OTHERS)
AREAS A-H
TRUCK UNLOADING
2602K
PDF STRUCTURE
PDF SUBSTATION
MCC ROOM
INST RACK
PARKING
2601K
SCREENING STRUCTURE
CONV 16
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404 906.59E
1 376 196.08N
404 876.06E
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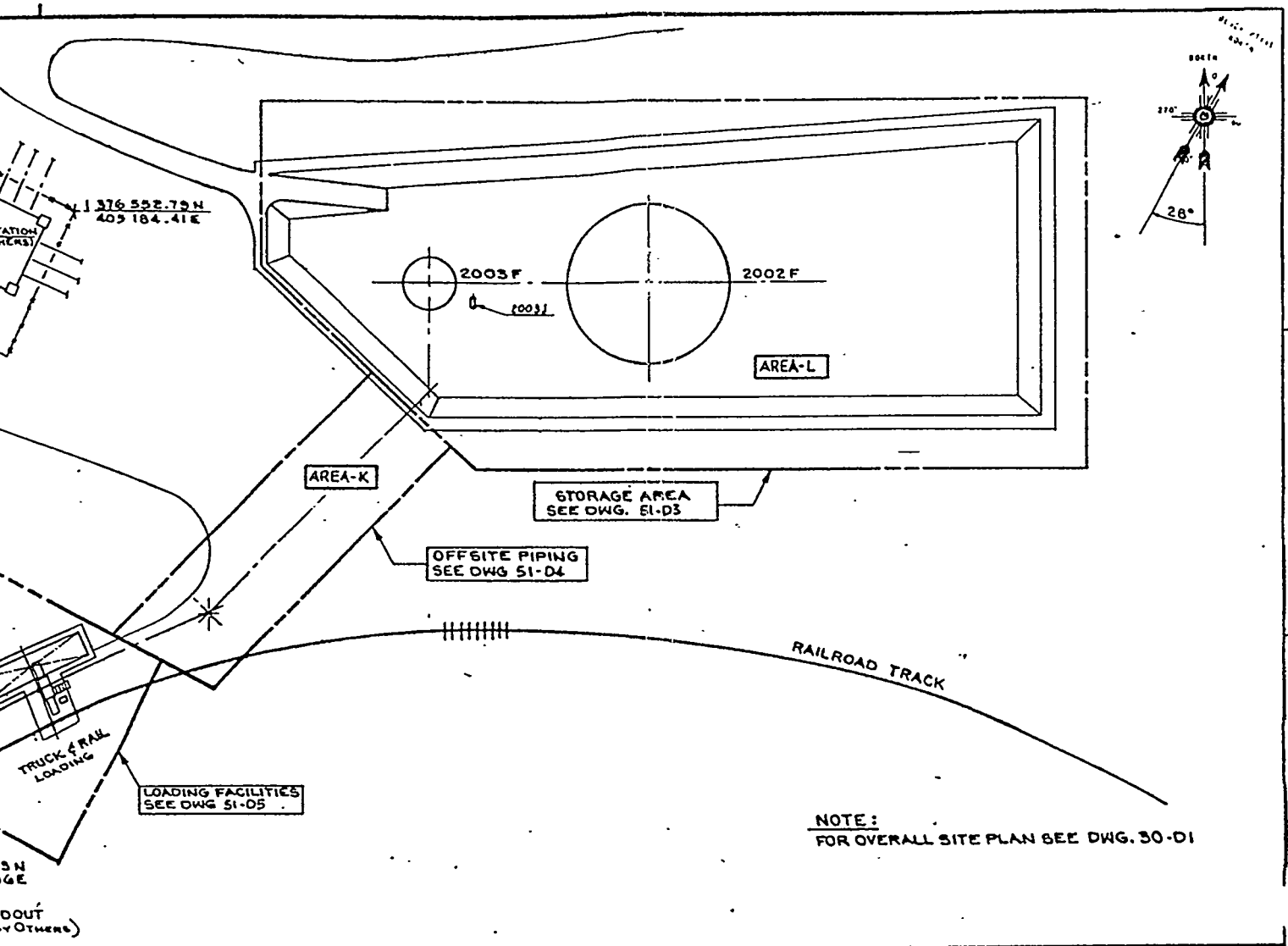
1376190.20N
404755.14E
EXIST BLDG
AREA-N
AREA-J
PIPE TRENCH
RAIL U
TOWER
MCC
CONV 16 EXTENSION
CONV 2102V
2101 A
1 375 992.20N
404 795.15E
FEED SILO/CONVEYORS AND OFFICE AREA SEE DWG 51-07
SILO #2 (EXIST)
1 375 922.24N
404 732.68E
SILO #1 (EXIST)
CONV 16
MAIN SWITCHGEAR
D
22X34
H
G
F



NOTE:
FOR OVERALL SITE PLAN SEE DWG. 30-01

GENERAL PIPING NOTES:

1. All piping shall conform to the Project Piping and Instrumentation Diagrams. See P&IO Dwg. 63-0-1 (General Notes, Symbols & Index).
2. Line identification number consist of service code, line number, line size (NPS) and line class.
3. See Index of Piping Material Classes (10PMC-6663) and individual line class sheets for piping specs.
4. See Pipeline Nomenclature for Insulation Type/Thickness, Temperature, Design Pressure, and Paint Code.
5. For Piping Coatings, Insulation and Fireproofing see Project P Class Summary - Technical Standard P1-1TS-6563.
6. Hydrostatic test vents and drains are the responsibility of contractor.
7. Piping isometrics are only provided for 30" and larger pipe. See Isometric Index sheets 601-A-A1 and 601-B-A1.
8. All 3" ∅ and smaller piping to have dimensions and routing field verified prior to fabrication and installation.
9. Dust collection system routing is the responsibility of contractor.
10. For details of 72" ∅ and larger ducts plus refractory lined ducts see Piping Mechanical detail drawings.
11. For pipe supports see Piping Mechanical location plans and details.
12. For utility station arrangement see P&IO 63-0-4.
13. For firewater hose rack stations see P&IO 64-0-6.

REFERENCE SPECIFICATIONS:

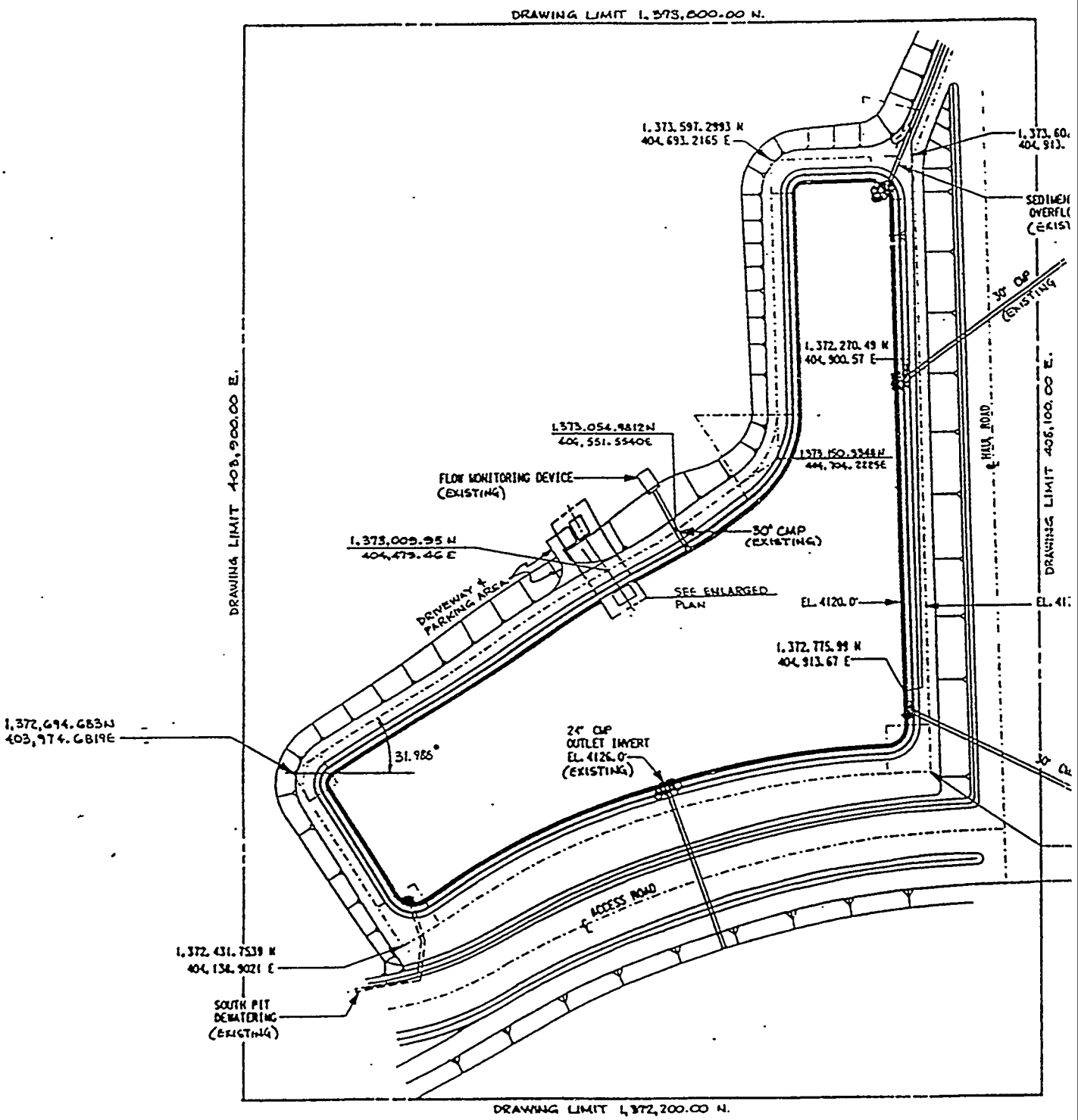
10PMC-6663	Index of Piping Material Classes
M25-2TS	Pipeline Strainers Y-Type
M25-3TS	Tee Strainers Type 1 (Weld Hook Flange)
M25-7TS	In-Line Strainers Type 3
M36-1TS-88	Blanks and Spacers - Figure 8 and Paddle Type
M40-1TS	Class M - Piping Specifications General Piping Practices

NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D
	REVISIONS				
4	REVISED AS NOTED	10MAY91	MDJ	BERTI	
3	ISSUED FOR CONSTRUCTION	01APR91	RIVERA	BERTI	
2	REVISED AS NOTED	24JAN91	KIZER		
1	PLANNING RELEASE - ADD REF. AREAS	26OCT90	Rivera		

ENGINEER	
RELEASED FOR BIDDING	
DATE	—
SCALE	1" = 40'
DRAWN	Rivera
CHECKED	BERTI
APPROVED	
DATE	25 SEP 90
ISSUED FOR FABRICATION	—
ISSUED FOR CONSTRUCTION	01 APR 91

MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
PDF AREA
SITE PLAN

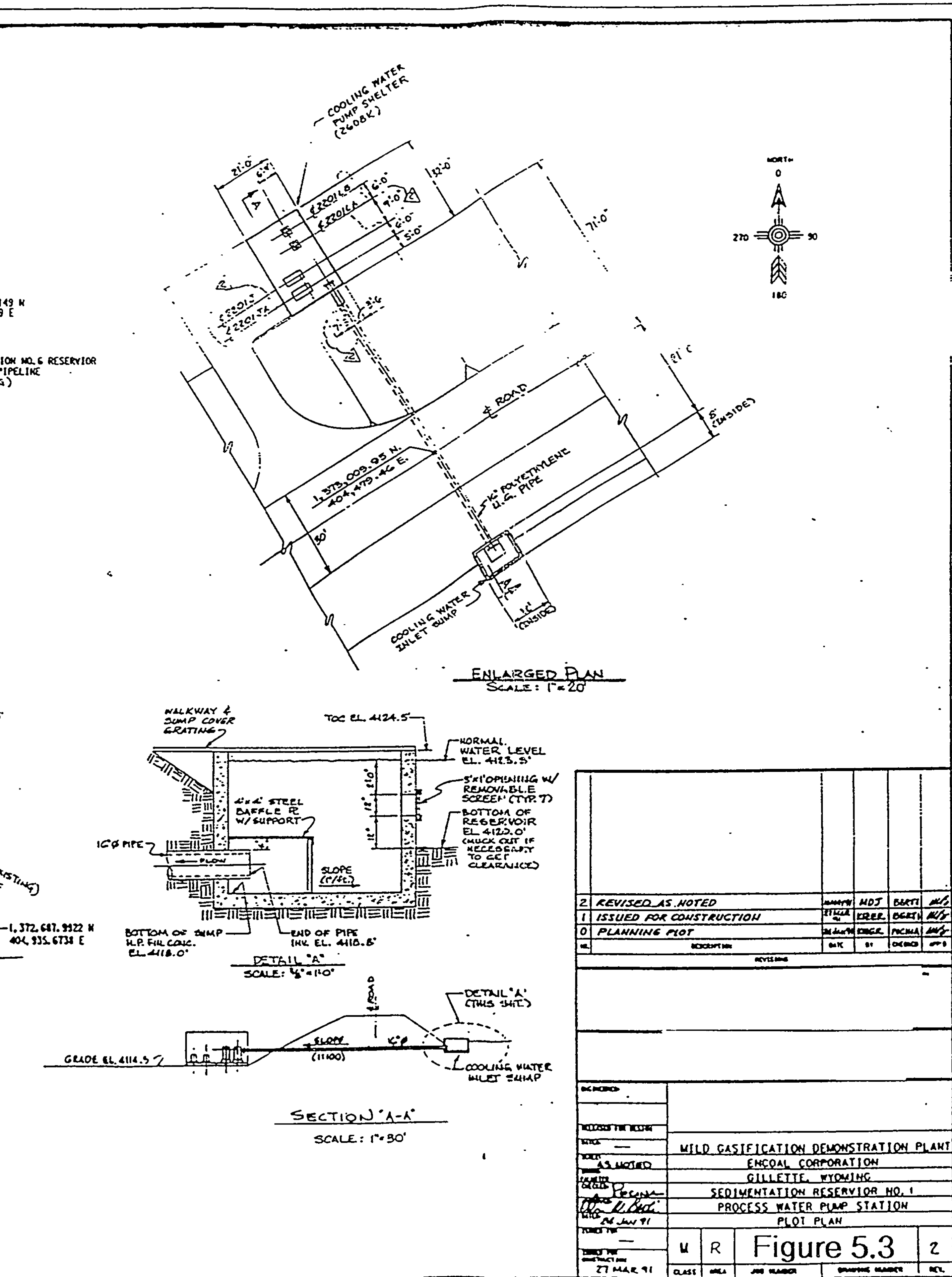
CLASS	AREA	JOB NUMBER	DRAWING NO.	
M	—	Figure 5.2		4

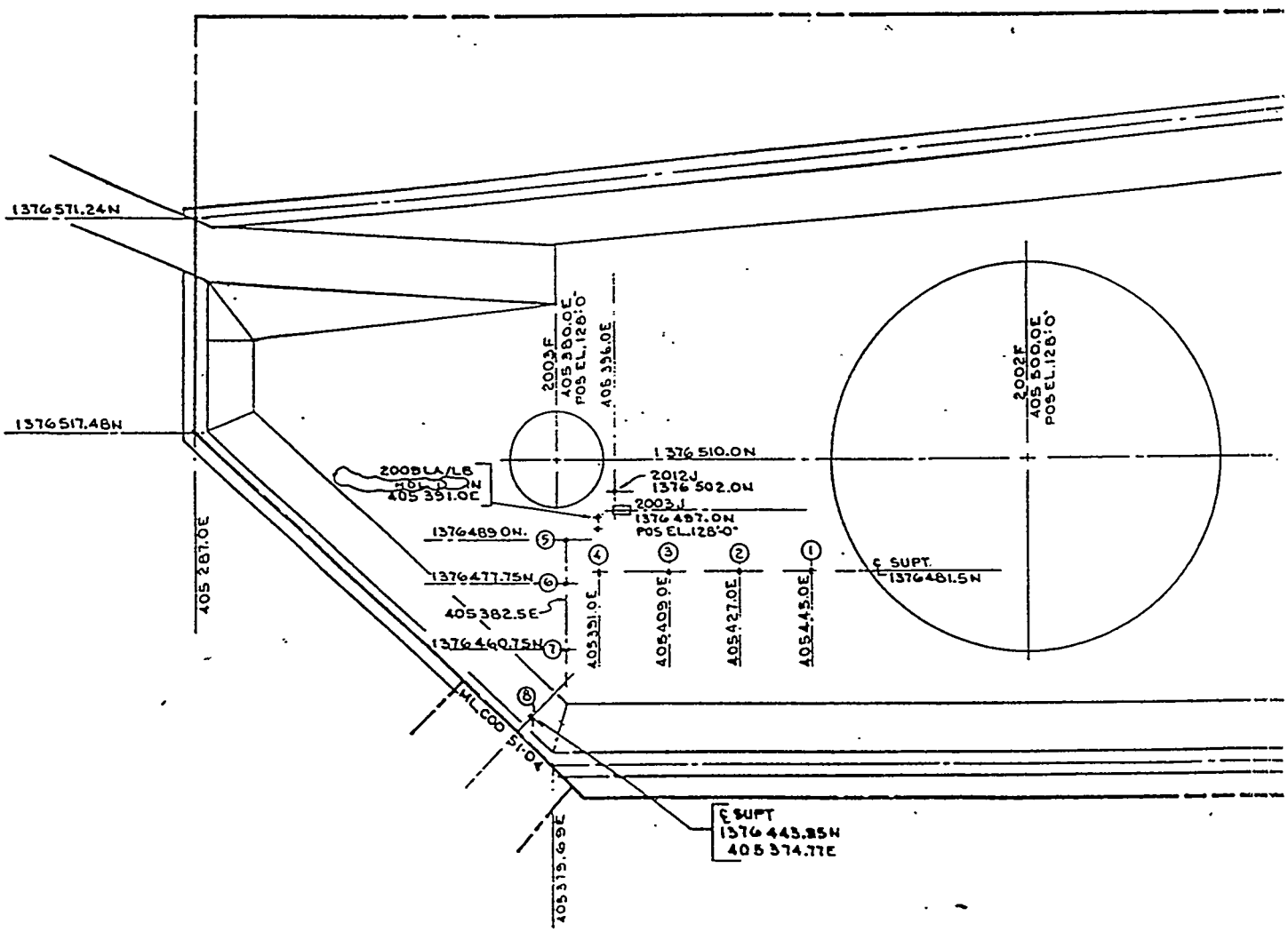


PLAN
SCALE: 1"=100'

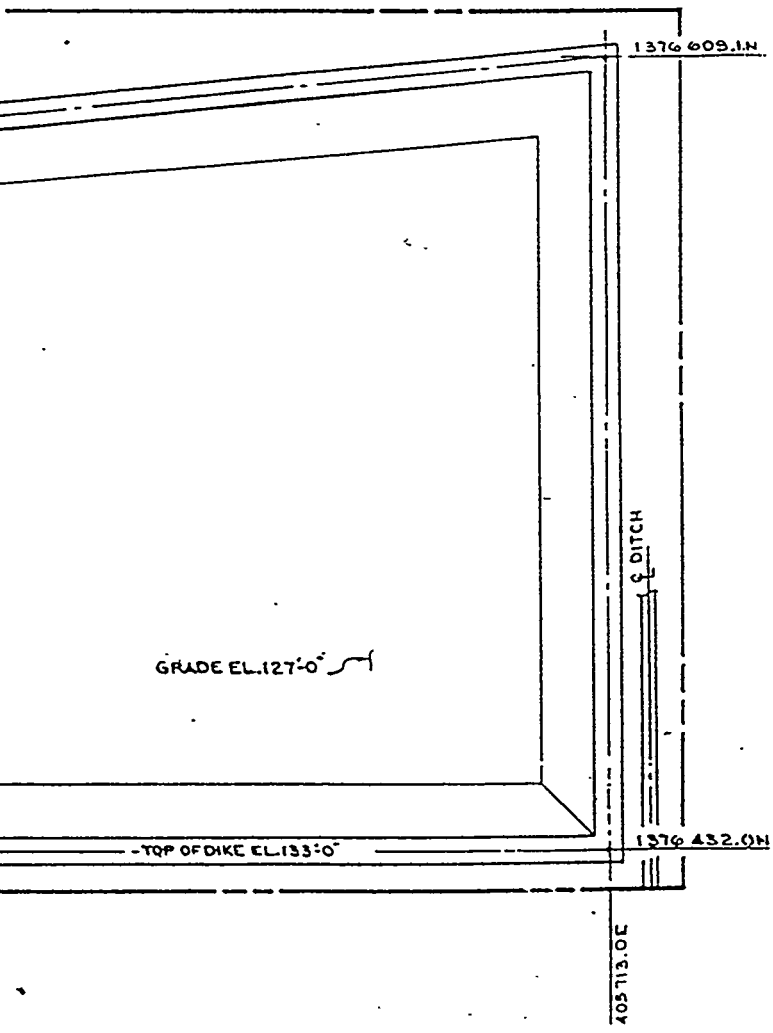
FILE V:\PROJECTS\222.1043\PLAN\STA_ACT.1
DATE 3-OCT-90 TIME 15:18:32
ISSUE BY PALMITER BOX R024

0
22X34


COOLING WATER PUMP SHELTER (2608K)
ENLARGED PLAN
SCALE: 1"=20'
1,373,009.95 N.
404,479.46 E.
6" POLYETHYLENE U.G. PIPE
COOLING WATER INLET SUMP
5' (INSIDE)
℄ ROAD
NORTH
WALKWAY & SUMP COVER GRATING
TOC EL. 4124.5
NORMAL WATER LEVEL EL. 4123.5'
4"x4" STEEL BAFFLE R W/ SUPPORT
BOTTOM OF RESERVOIR EL. 4120.0'
SLOPE
10Ø PIPE
FLOW
BOTTOM OF SUMP
END OF PIPE
DETAIL "A"
DETAIL "A" (THIS SHT.)
SLOPE (1:100)
GRADE EL. 4114.5
COOLING WATER INLET SUMP
SECTION "A-A"
SCALE: 1"=30'
-1,372,687.9922 N
404,935.6738 E
2 REVISED AS NOTED
1 ISSUED FOR CONSTRUCTION
0 PLANNING PLOT
AS NOTED
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
SEDIMENTATION RESERVIOR NO. 1
PROCESS WATER PUMP STATION
PLOT PLAN
27 MAR 91
Figure 5.3


1376571.24N
1376517.48N
405287.0E
2003F
405380.0E
POS EL.128'-0"
405336.0E
2002F
405500.0E
POS EL.128'-0"
1376510.0N
2012J
1376502.0N
2003J
1376487.0N
POS EL.128'-0"
2005LA/LB
405391.0E
1376489.0N.
1376477.75N
405382.5E
1376460.75N
405331.0E
405409.0E
405427.0E
405445.0E
℄ SUPT.
1376481.5N
ML.COO 51'-04
℄ SUPT
1376443.85N
405374.77E
405379.69E

D
22X34



1	ISSUE FOR CONSTRUCTION	27 MAR 91	ENGR'A		
0	PLANNING PLOT	24 JAN 91	ENGR'A		
NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D

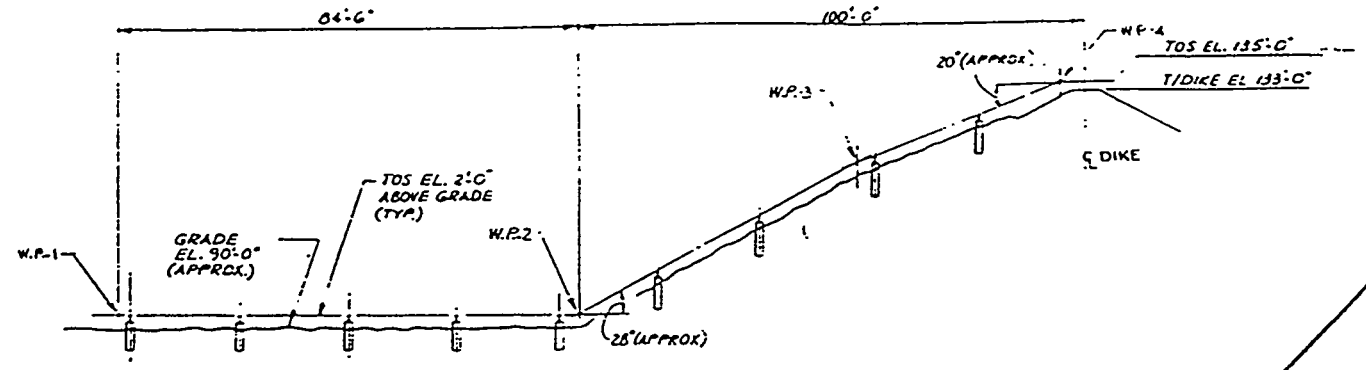
REVISIONS

DRAWING NO.	
RELEASED FOR DESIGN	
DATE	—
SCALE	1" = 20'
DRAWN	RIVERA
CHECKED	
APPROVED	
DATE	24 JAN 91
ISSUED FOR FABRICATION	—
ISSUED FOR CONSTRUCTION	27 MAR 91

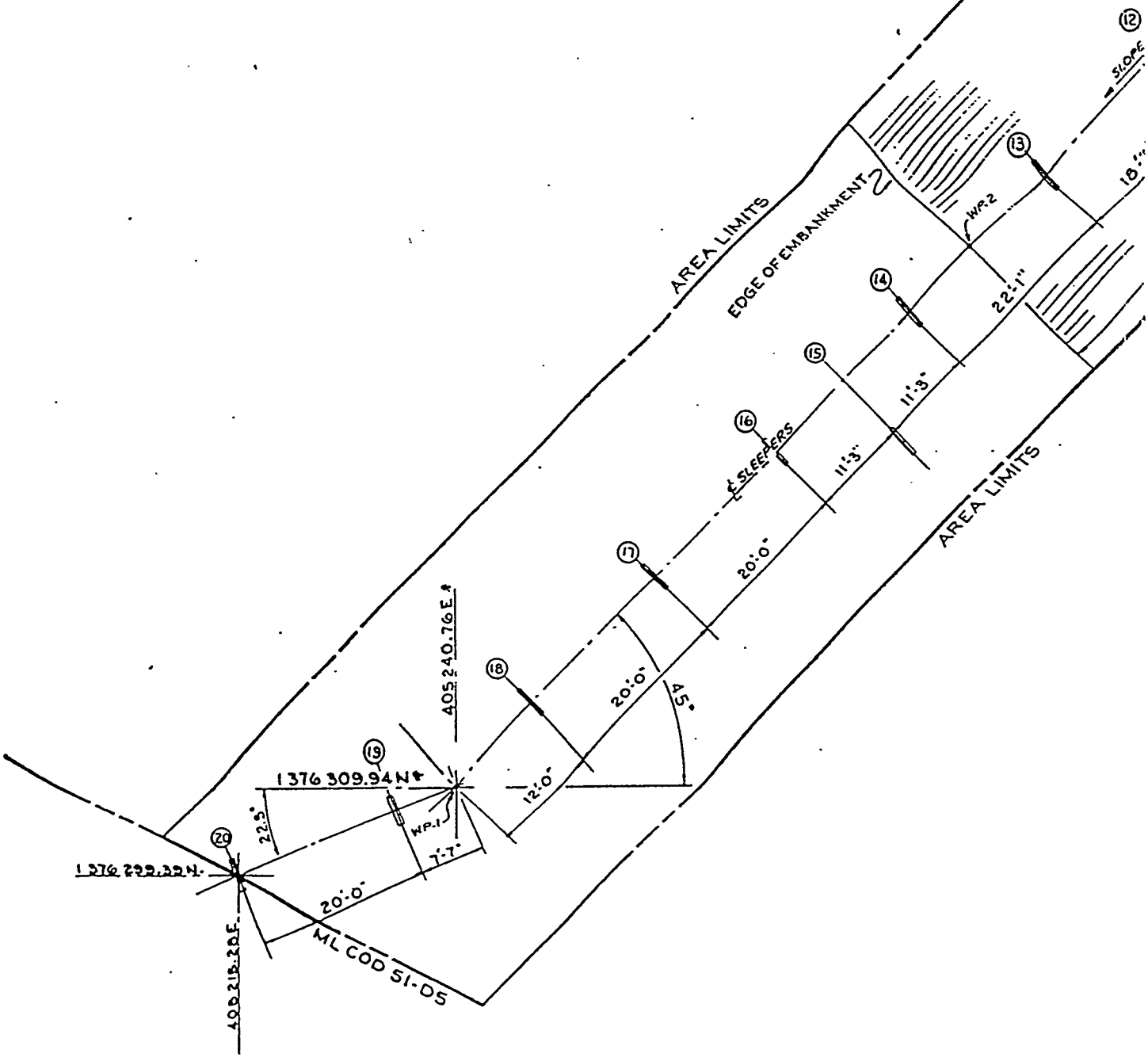
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
OFFSITES - AREA "L"
COL STORAGE AREA
PLOT PLAN

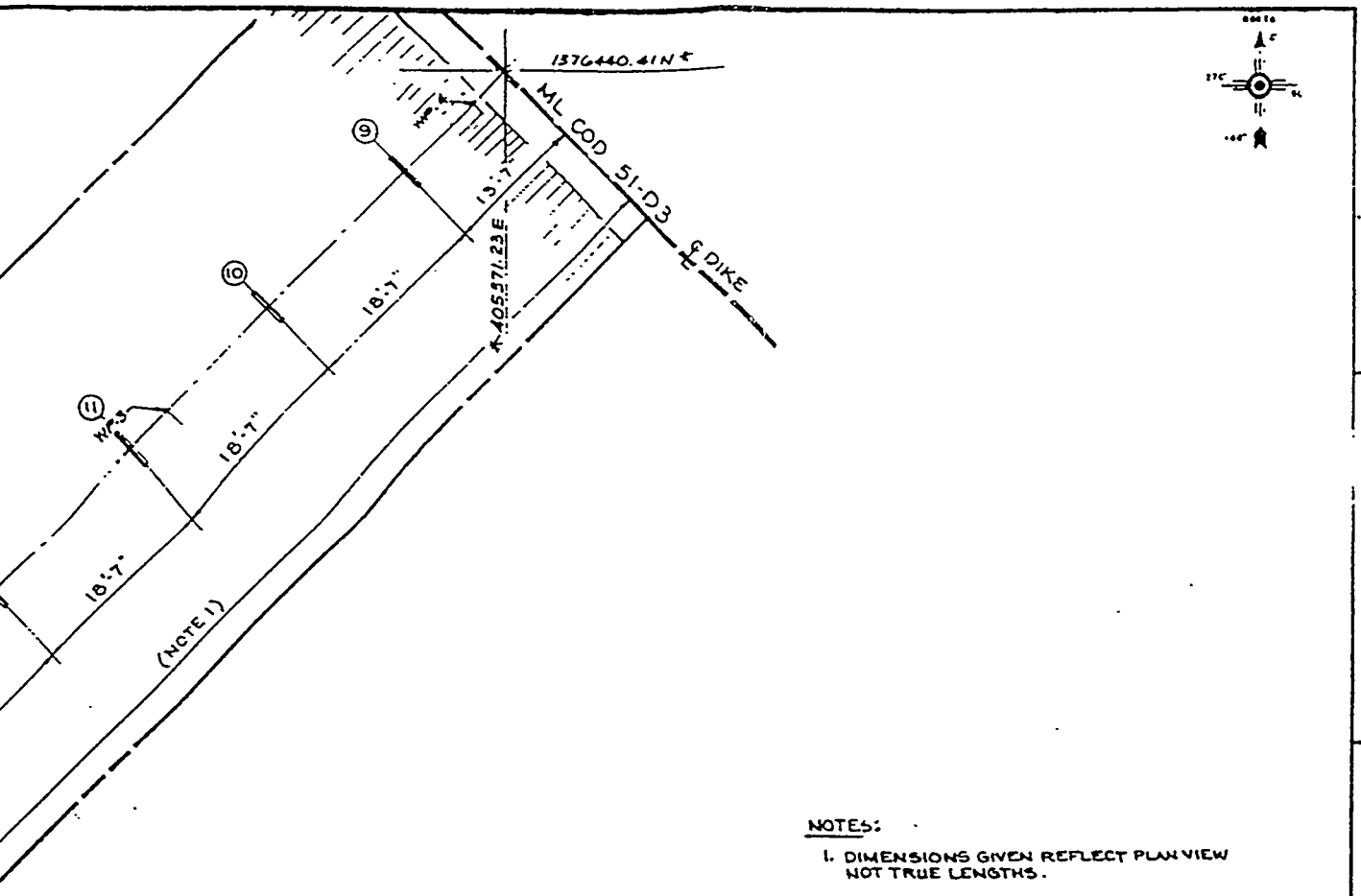
Figure 5.4

M	L		1
CLASS	AREA	JOB NUMBER	DRAWING NUMBER	REV.



EMBANKMENT PROFILE
(SCALE - 1/16"=1'-0")





NOTES:

1. DIMENSIONS GIVEN REFLECT PLAN VIEW NOT TRUE LENGTHS.

* COORDINATES ARE CENTERED ON UNC PL-104-2-P5

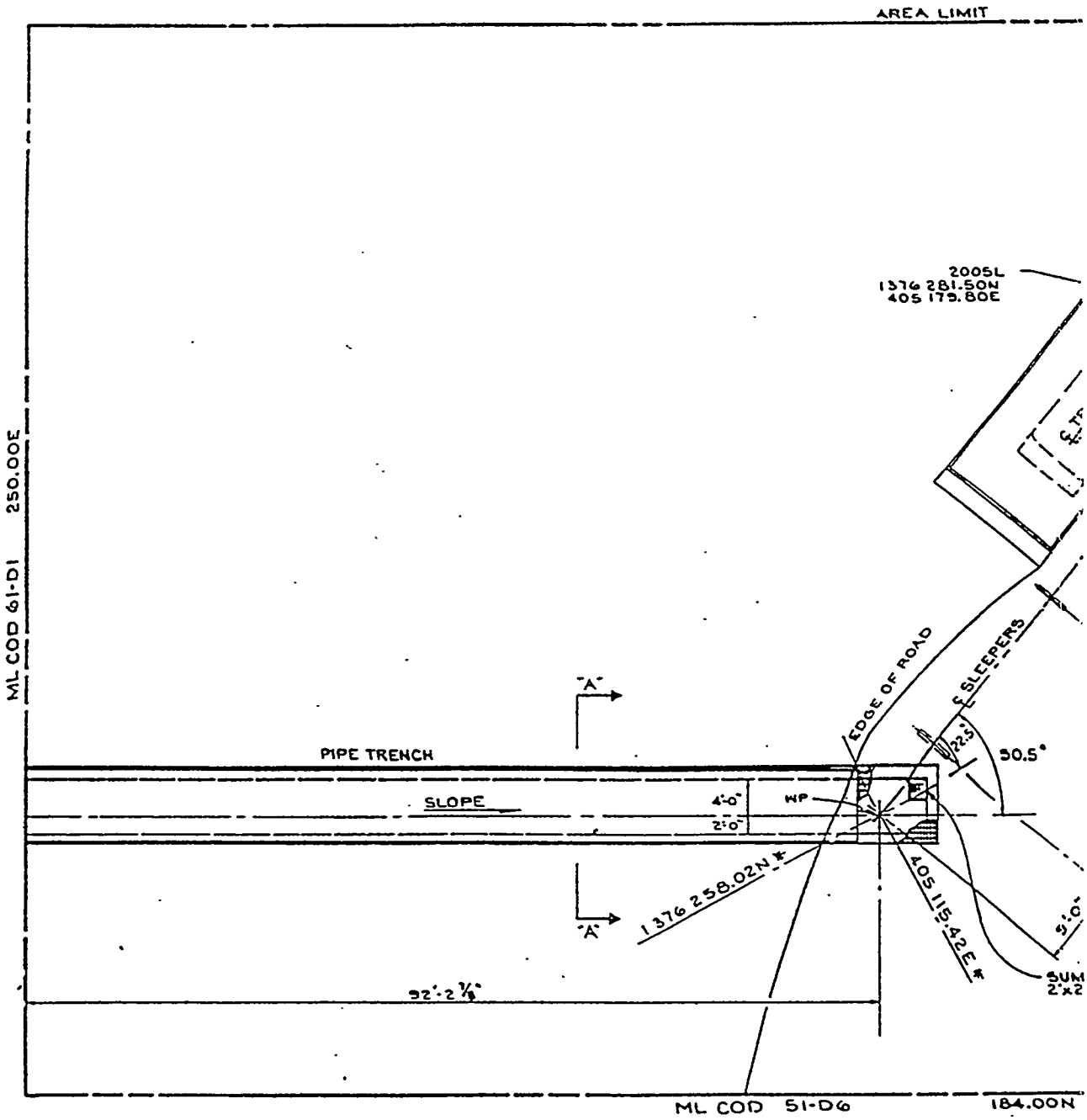
NO.	DESCRIPTION	BY	CHECKED	APP'D
1	ISSUE FOR CONSTRUCTION	ENDERA		
0	PLANNING PLOT	ENDERA		

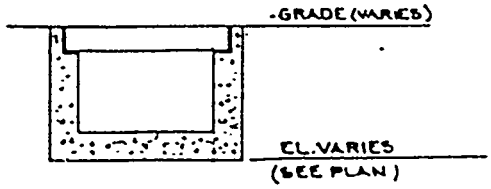
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
OFFSITES-AREA "K"
PIPE SLEEPER AREA
PLOT PLAN

SCALE 1/8 • 1'-0"
DRAWN RIVERA
CHECKED Perera
APPROVED W. Smith
DATE 24 JAN 91
DATE 27 MAR 91

M | K | Figure 5.5 | 1

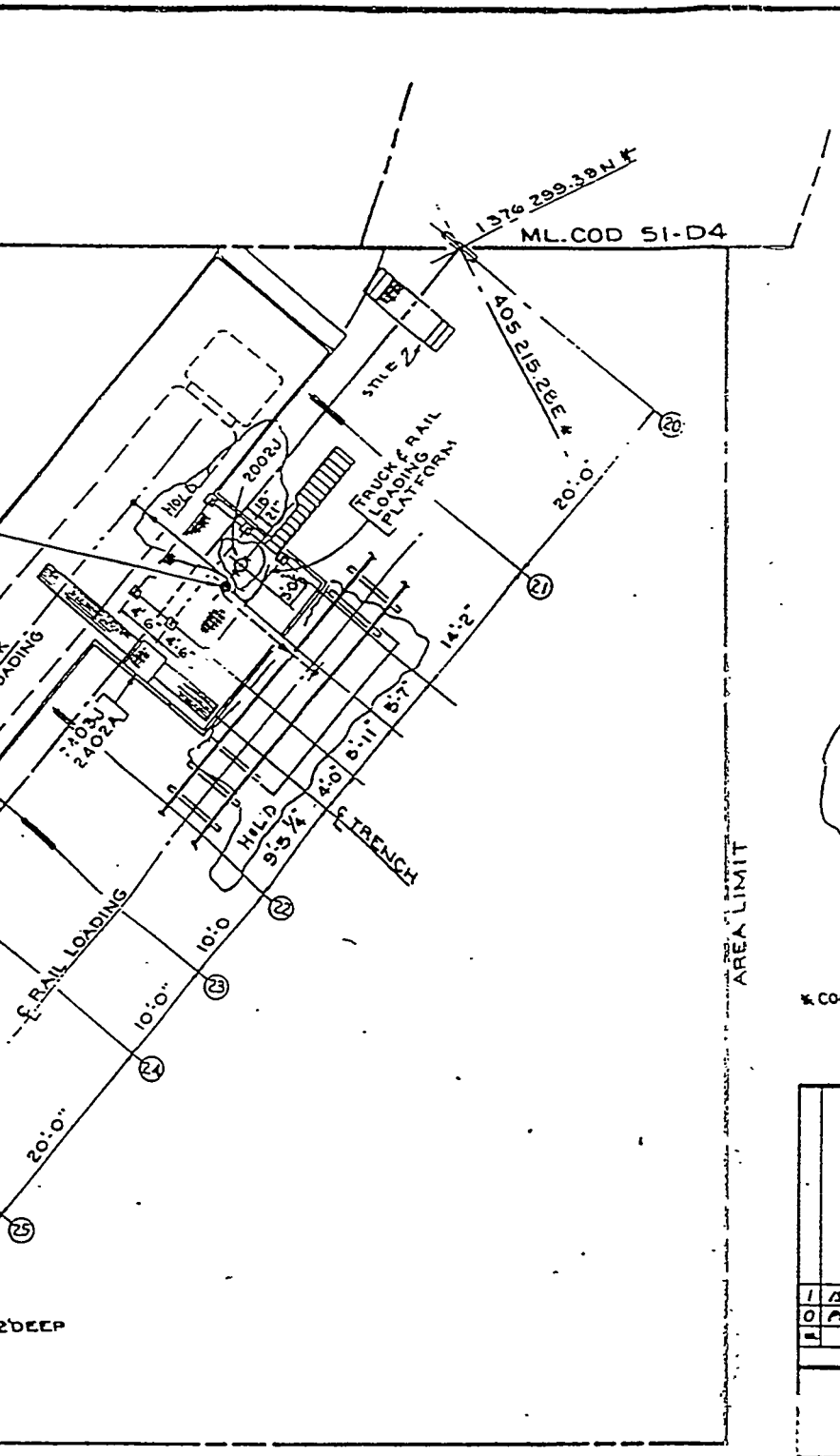
CLASS | AREA | JOB NUMBER | DRAWING NUMBER | REV.





PIPE TRENCH
SECTION "A-A"

0
22X34



HOLD:

1) DRAINAGE FOR UNDER R.R. CAR STATION.

2) PUMP 200 2 J

℄ COORDINATES ARE CENTERED ON LINE PL-104-2"-B

1	ISSUE FOR CONSTRUCTION	RTRUCK	RIVERA		
0	PLANNING PLOT	DRAWN	JR		
NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D

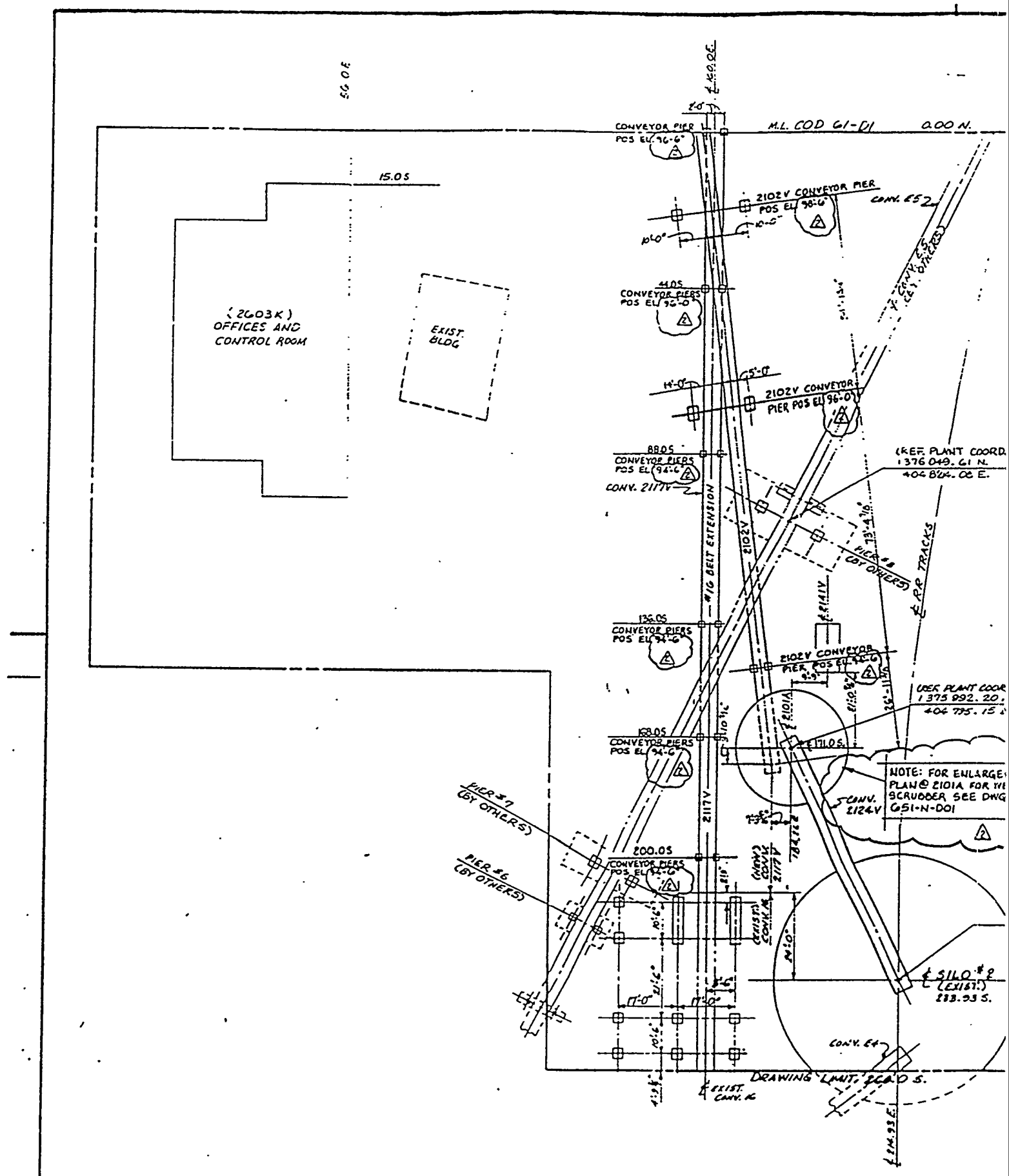
REVISIONS

ENCOAL CORPORATION

DESIGNED	
RELEASED FOR BIDDING	
SCALE	—
SCALE	40 = 1'-0"
DRAWN	RIVERA
CHECKED	
APPROVED	
DATE	24 JAN 91
CHECKED FOR AS-BUILT CONDITIONS	
CHECKED FOR CONSTRUCTION	27 MAR 91

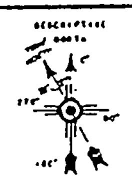
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
OFFSITES-AREA-J
TRUCK & RAIL LOADING
PLOT PLAN

CLASS	AREA	JOB NUMBER	DRAWING NUMBER	REV.
M	J	Figure 5.6		1



D
22X34

2 H G F E



PLANNING LIMIT 850.0 E.

(REF. PLANT COORD.)
1375 028.24 N.
404 792.68 E.

NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D
2	REVISED AS NOTED		MOJ	BERTI	
1	ISSUE FOR CONSTRUCTION	27 MAR 91	MOJ	BERTI	
0	PLANNING PLOT		EWELL	HGK	

REVISIONS

SCALE	1/16" = 1'-0"
DRAWN	H.G. KISER
CHECKED	BOCUJA
DATE	26 JAN 91
ISSUED FOR CONSTRUCTION	27 MAR 91

MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
OFFSITES - AREA "N"
FEED COAL SILO AND CONVEYORS
PLOT PLAN

CLASS	AREA	JOB NUMBER	DRAWING NUMBER	REV.
M	N	Figure 5.7		2

(6) Design all drainage structures for the 100 year, 24 hour event.
(7) Use bolted connections for all field erected joints with specially designed torque limiting bolts.

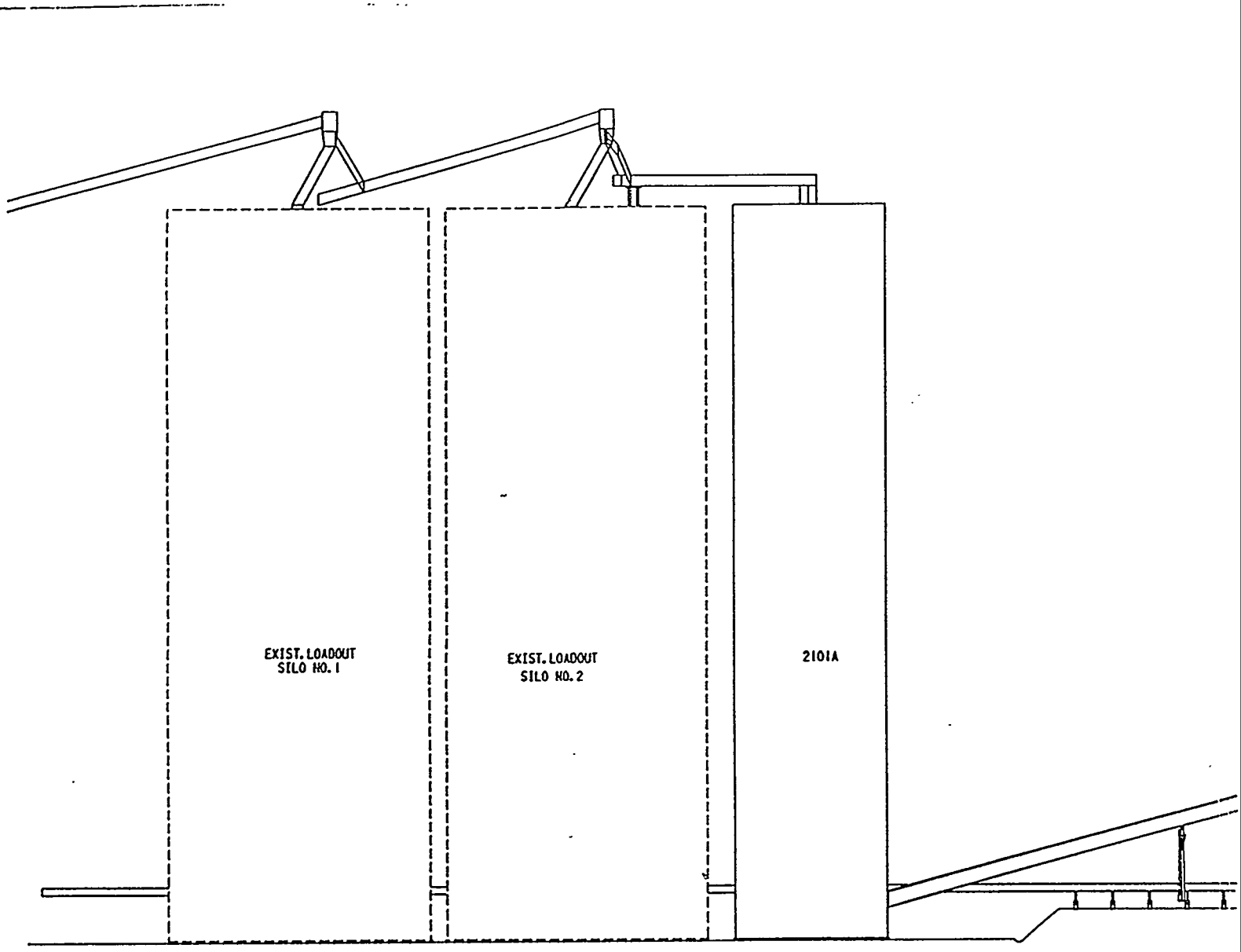
During the 1988 preliminary design studies by Kellogg, a conceptual layout of the PDF plant structure was developed. One of the first tasks for the Civil Engineering group after re-activating the project in 1990, was to re-evaluate and finalize the PDF plant structure. This was essential for design of the foundation, an early item on the Project Master Schedule for construction. Being an engineered structure, the steel had to be detailed and ordered early in the schedule also. The review of the PDF structure was completed expediently and resulted in significant reductions of floor space and steel. The revised planning drawings of the structures for the PDF building and screening building elevation views are shown in Figures 5.8 through 5.12. Figures 5.13 through 5.17 show the final floor plans for the PDF structure and screening building.

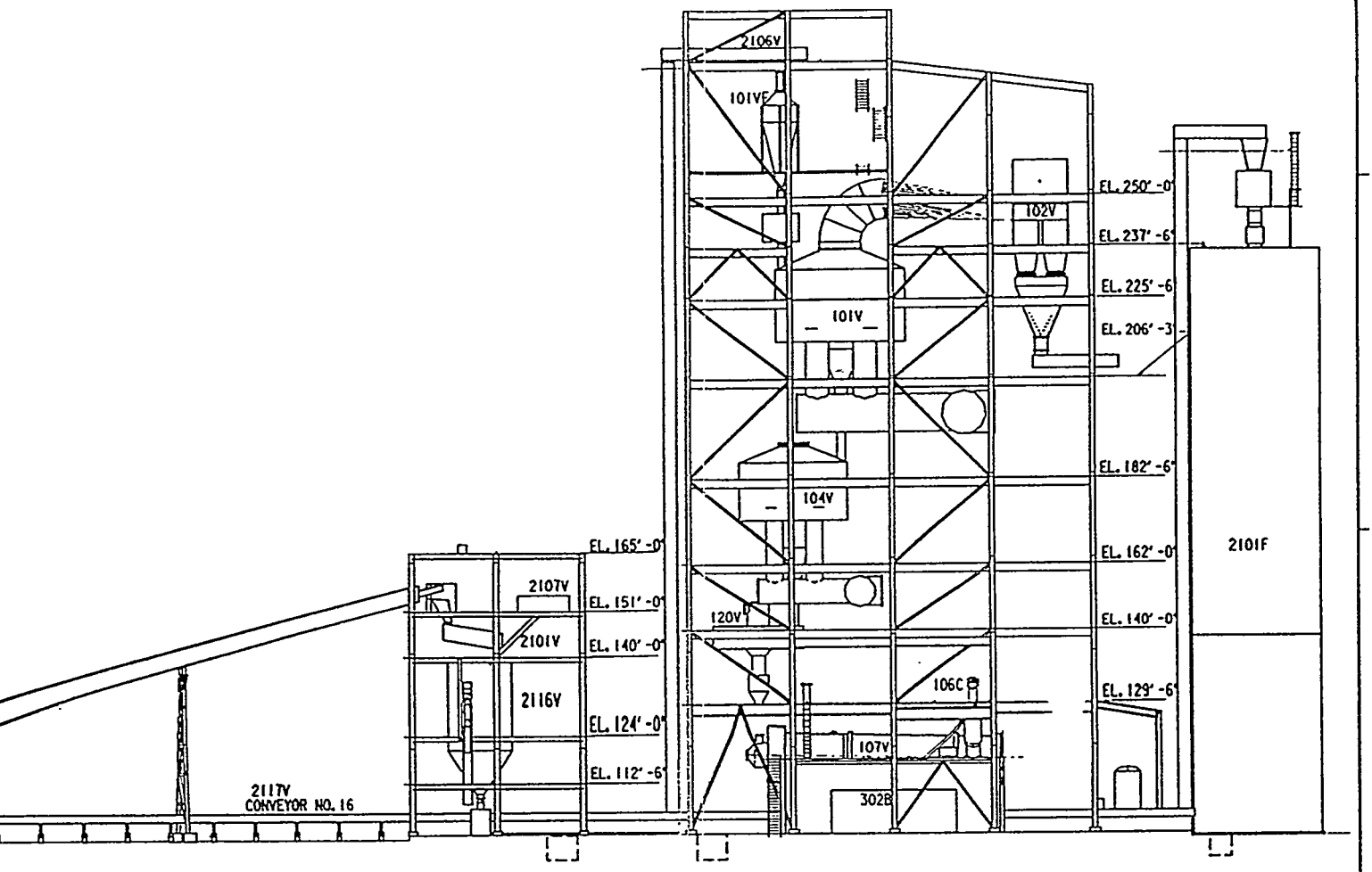
MSHA requires that a coal dryer be separated from other coal handling facilities by 100 feet or more or, if enclosed in a common building, the dryer must be separated by walls that will prevent a deflagration from entering other parts of the building. Special venting requirements also affect the dryer off-gas ductwork and cyclone inlet and outlet ductwork. Here, explosion doors are required for pressure relief and a process gas relief valve is required for both pressure relief and over-temperature of the dryer loop. ENCOAL chose to keep all PDF facilities in one building and thus zoned the building to meet the MSHA requirements. Zone 1 was unclassified and included the plant building up to the underside of the 6th floor. Zone 2 was the designation for the 6th through 9th floors which contained the dryer. The headhouse at the top of the plant where coal enters was classified electrically and so became Zone 3, which had to be pressurized and sealed mechanically from both Zones 1 and 2. The previous figures show the floor layouts in each of these zones.

5.2 MECHANICAL DESIGN

Pressure vessels, valves, piping, tanks and rotating equipment fall under the category of mechanical design. For the ENCOAL facility, with its near atmospheric conditions, pressure was not a major problem. Other than utilities and fluid pumping systems, all pressures in the LFC process are measured in inches of water, both positive and negative. The main process vessels were specified for two pounds of pressure and one pound vacuum. Consequently, none of the process vessels were specified to be ASME Code stamped since this does not apply at these low pressures. However, it was specified that all vessels would be built in accordance with ASME code requirements. The exceptions to this standard were the utility boiler and the liquid nitrogen storage equipment which required full ASME Code certification.

It was recognized from the outset that the PDF plant would go through a lot of start-up and shut-down cycles. Elevated temperatures dictated that provisions be made for expansion and contraction, so spring cans and expansion joints were incorporated into support for vessels, large diameter piping (ductwork) and certain equipment. Piping larger than 30" was isometrically detailed by Kellogg's design group and furnished prefabricated to the field erection contractor. All of this large diameter pipe and ductwork was custom built from plate. Smaller diameter piping was specified to American Petroleum Institute (API) or American National Steel Institute


EXIST. LOADOUT
SILO NO. 1
EXIST. LOADOUT
SILO NO. 2
2101A

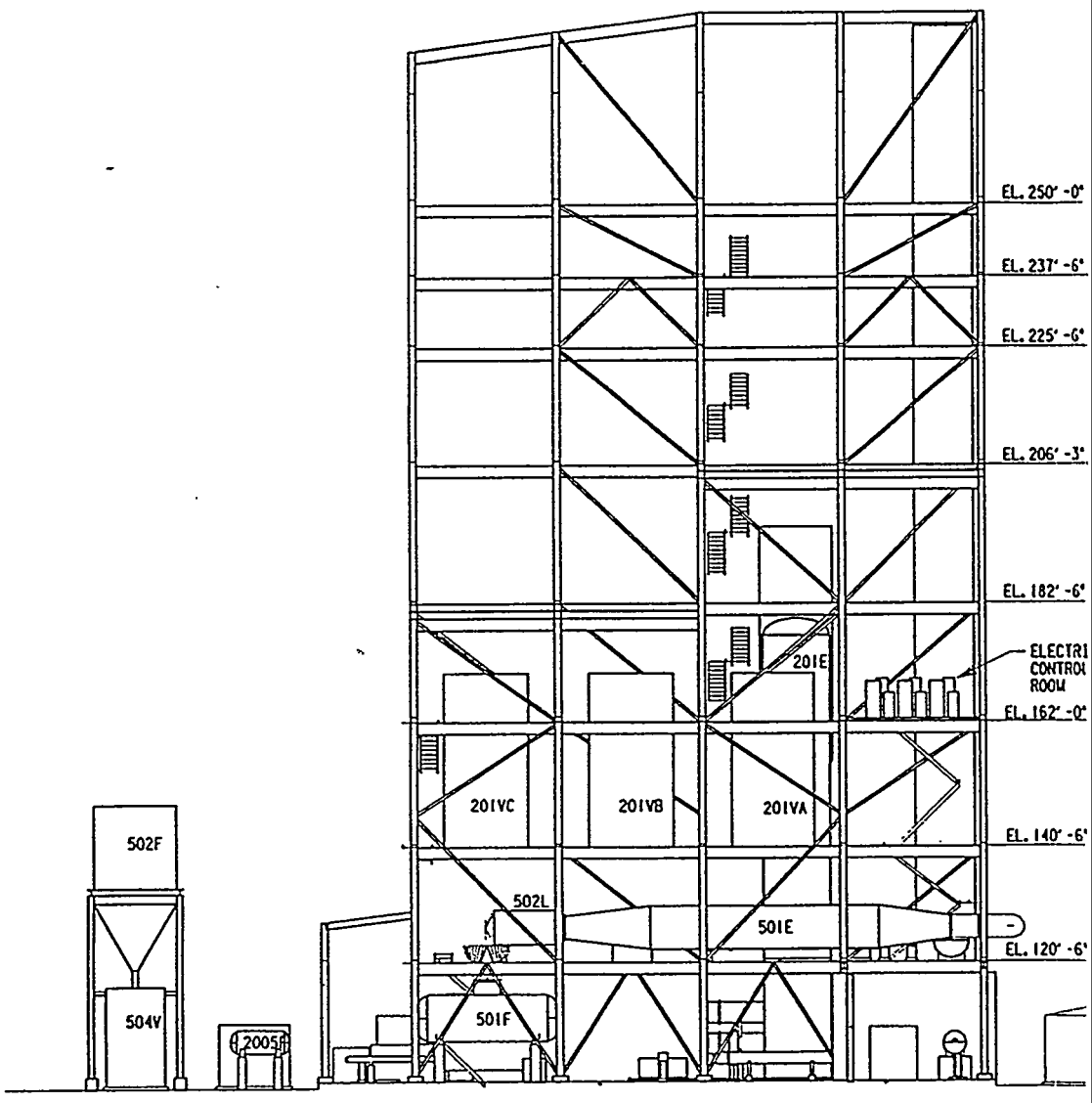


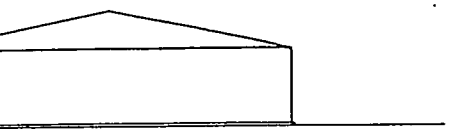
NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D

REVISIONS

ENGINEERED	
RELEASED FOR DESIGN	
DATED	
SCALE: 1" = 20'-0"	MILD GASIFICATION DEMONSTRATION PLANT
DRAWN: PALMATEER	ENCOAL CORPORATION
CHECKED	GILLETTE, WYOMING
APPROVED	PDF BUILDING & PROCESS AREA
DATED	LOOKING WEST ELEVATION
ISSUED FOR FABRICATION	PLANNING PLOT

M — Figure 5.8 — 0


EL. 250'-0"
EL. 237'-6"
EL. 225'-6"
EL. 206'-3"
EL. 182'-6"
ELECTRI
CONTROL
ROOM
EL. 162'-0"
EL. 140'-6"
EL. 120'-6"
201E
201VC
201VB
201VA
502F
502L
501E
501F
504V
200SF



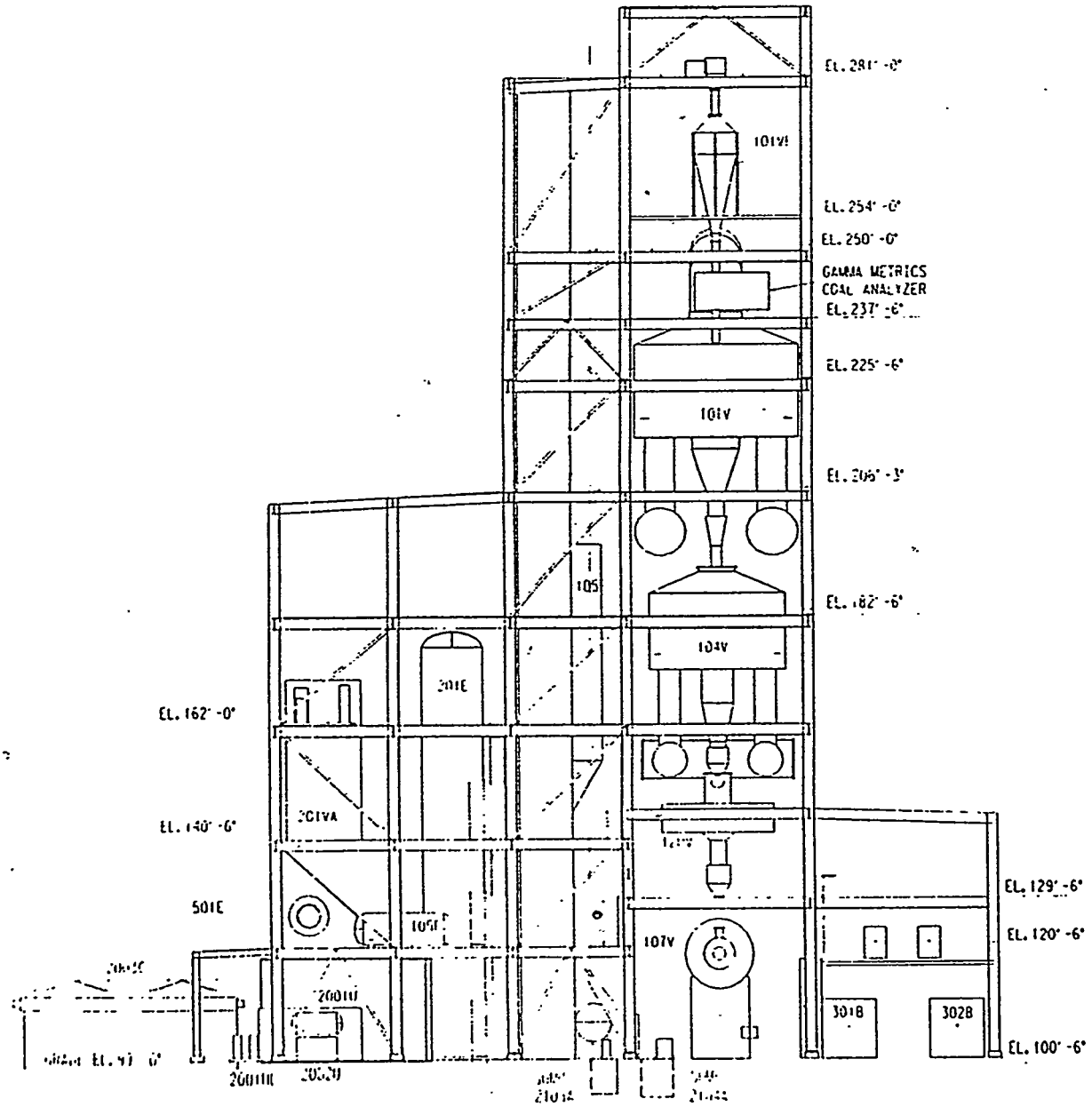
2401F

NO.	DESCRIPTION	DATE	BY	CHECKED	APP.

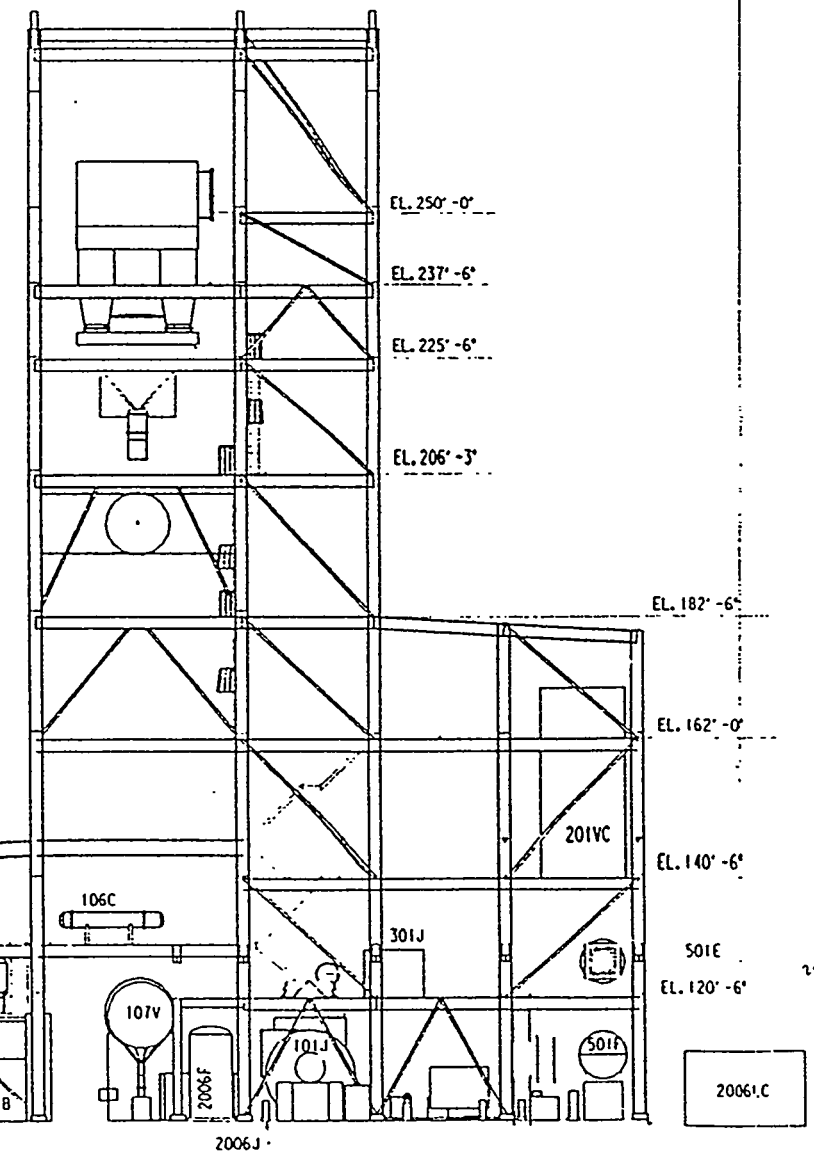
REVISIONS

ENCOAL CORPORATION

ENGINEERED	
RELEASED FOR DESIGN	
DATED	
SCALE: 1/16" = 1'-0"	MILD GASIFICATION DEMONSTRATION PLA
DRAWN	ENCOAL CORPORATION
PLOTTER	GILLETTE, WYOMING
CHECKED	RDF BUILDING & PROCESS AREA
APPROVED	LOOKING EAST ELEVATION
DATED	PLANNING PLOT
ISSUED FOR FABRICATION	

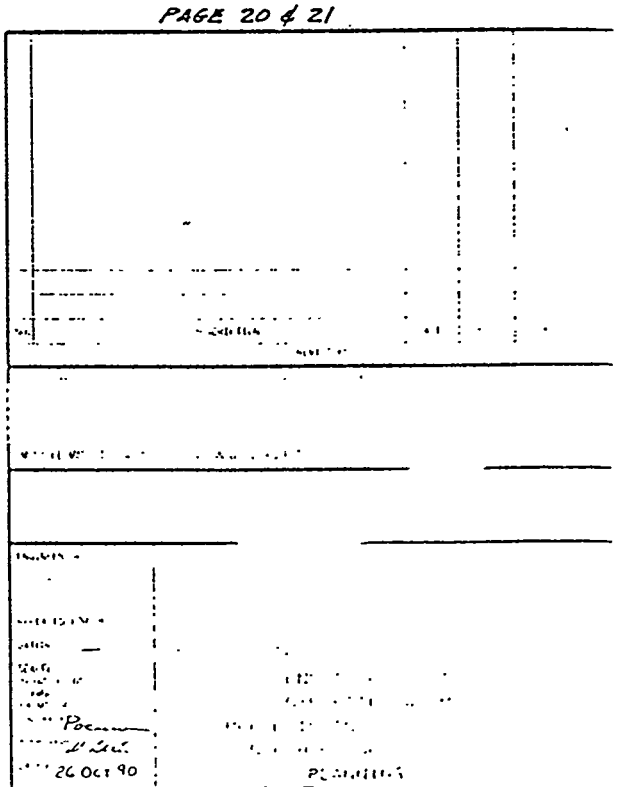


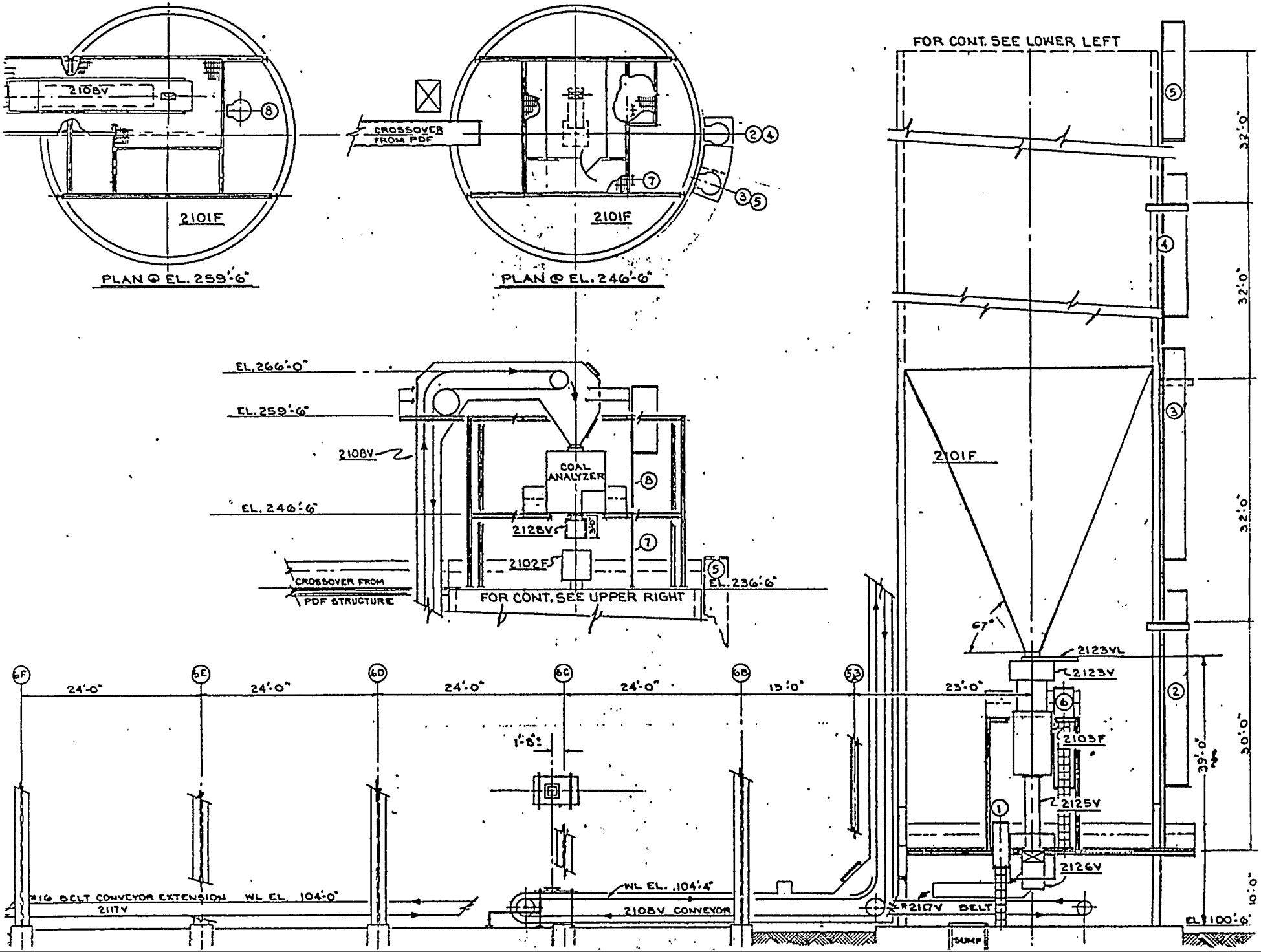
NORTH ELEVATION



SOUTH ELEVATION

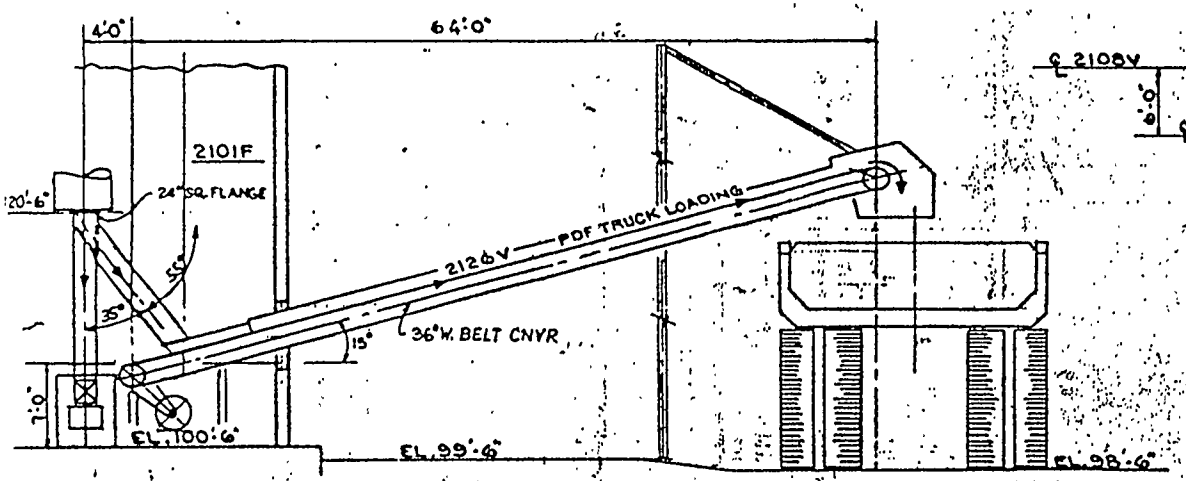
PAGE 20 & 21



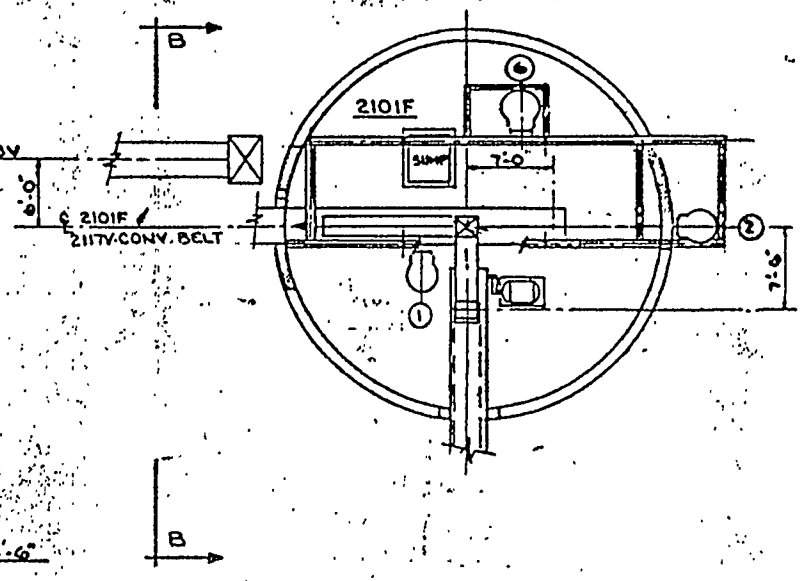

2108V
2101F
PLAN @ EL. 259'-6"
CROSSOVER FROM PDF
2101F
PLAN @ EL. 246'-6"
FOR CONT. SEE LOWER LEFT
EL. 266'-0"
EL. 259'-6"
2108V
COAL ANALYZER
EL. 246'-6"
2128V
2102F
EL. 236'-6"
CROSSOVER FROM PDF STRUCTURE
FOR CONT. SEE UPPER RIGHT
2101F
32'-0"
32'-0"
32'-0"
30'-0"
39'-0"
10'-0"
67°
2123VL
2123V
2103F
2125V
2126V
2117V BELT
EL. 100'-6"
SUMP
6F
6E
6D
6C
6B
5.3
24'-0"
24'-0"
24'-0"
24'-0"
15'-0"
23'-0"
1'-6"
#16 BELT CONVEYOR EXTENSION WL EL. 104'-0"
2117V
WL EL. 104'-4"
2108V CONVEYOR

(THIS DWG.)

EXIST #16 BELT EXTENDED
SEE DWG 130-D3



SECTION "B-B"
(THIS DWG).



PLAN @ EL. 100'-6"

NOTES: TO SILO VENDOR:

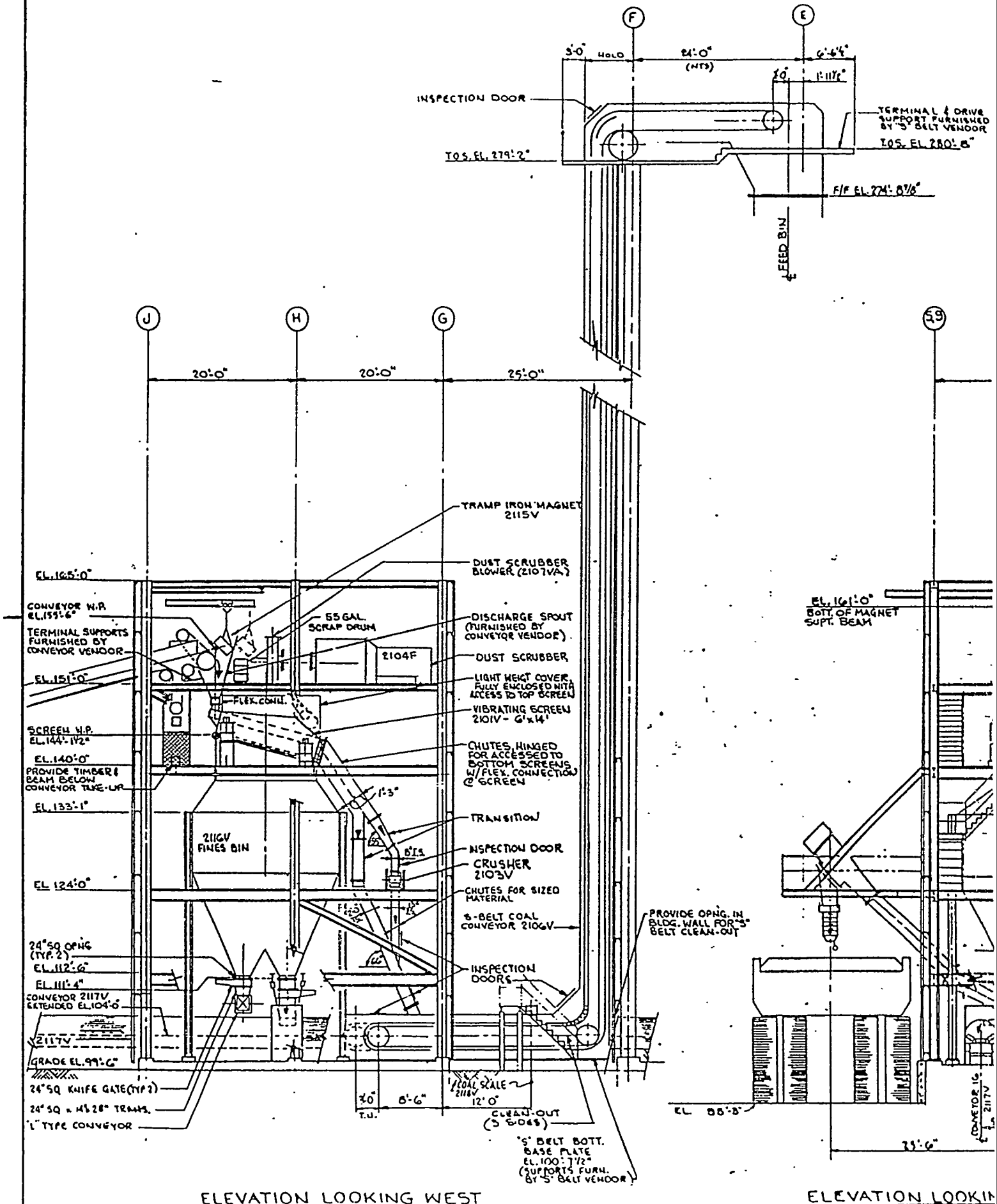
1. MATERIAL OF CONSTRUCTION FOR THE HOPPER SHALL BE QUOTED AS FOLLOWS:
   - CARBON STEEL WITH 10ga 304 SS LINER WITH 2B FINISH
2. PDF BIN IS LOCATED @ DH-6 AS SHOWN ON DRAWING 68-693-1 (SEE GEOTECHNICAL REPORT)
3. TOTAL EQUIPMENT LOAD ON TOP OF THE SILO IS APPROX. 25,000 LBS AND @ BOTTOM APPROX 20,000 LBS (VENDOR TO PROVIDE BEDDING PLATE ACCOMODATE BOTTOM LIN
4. SILO CAPACITY APPROX. 1000 TON OF PDF. PDF DENSITY = 38 LBS/FT^3 VEDOR SHALL DESIGN SILO BASED ON FULL WITH COAL @ DENSITY OF ASA/
5. QUOTE SHALL INCLUDE
   1 EXPLOSION DOORS & METHANE VENTS
   2 MANHOLES, HANDRAIL, NOZZLES FOR INSTRUMENT
   3 LADDER TO GRADE
   4 GUIDE CLIPS FOR VERTICAL PORTION OF 'S' BELT
   5 ROOF BEAMS TO SUPPORT STRUCTURE

REV	DESCRIPTION	INITIALS
0	INQUIRY	

ENGINEERED
PREPARED FOR BIDDING
DATES
SCALE 1/8" = 1'-0"
DRAWN RIVERA
CHECKED
APPROVED
DATES
ISSUED FOR FABRICATION
DATES

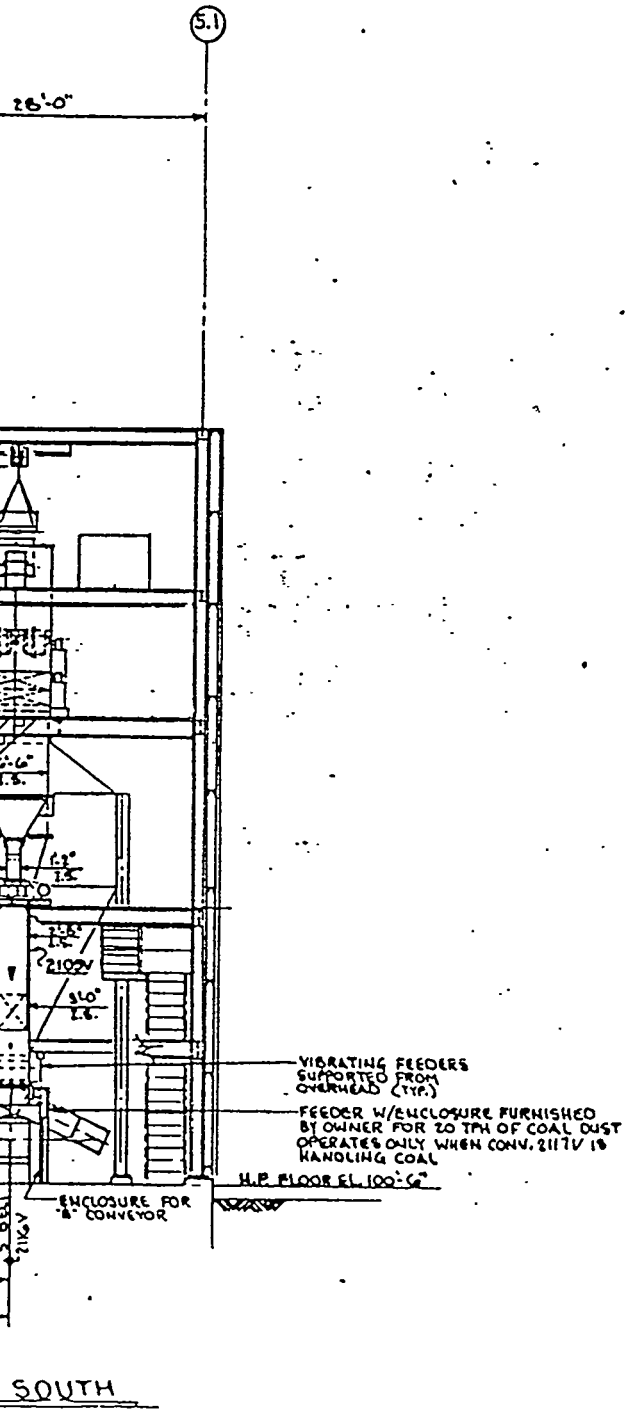
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
PDF BIN AREA
PLAN & SECTIONS

Figure 5.11



ELEVATION LOOKING WEST

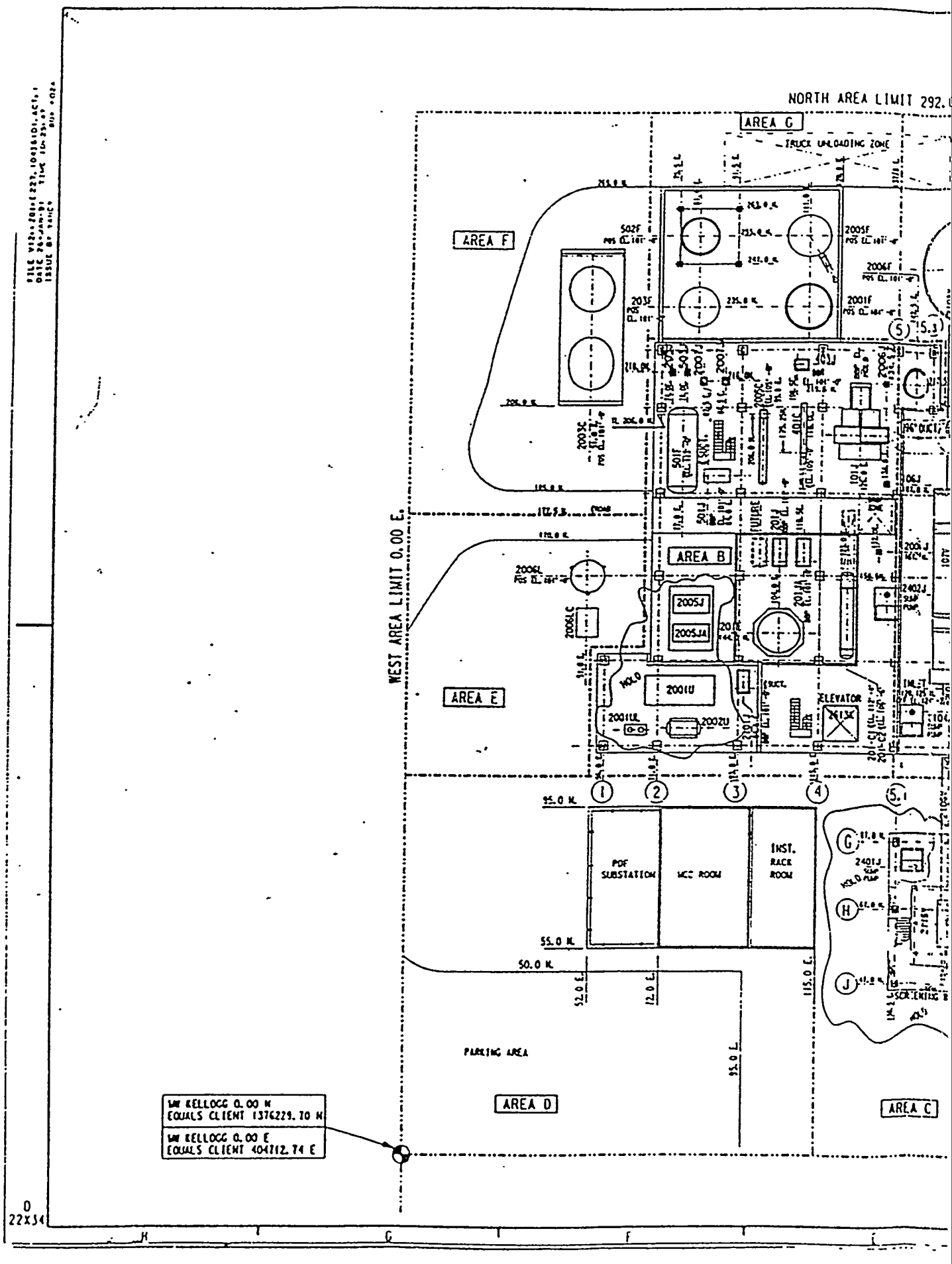
ELEVATION LOOKIN

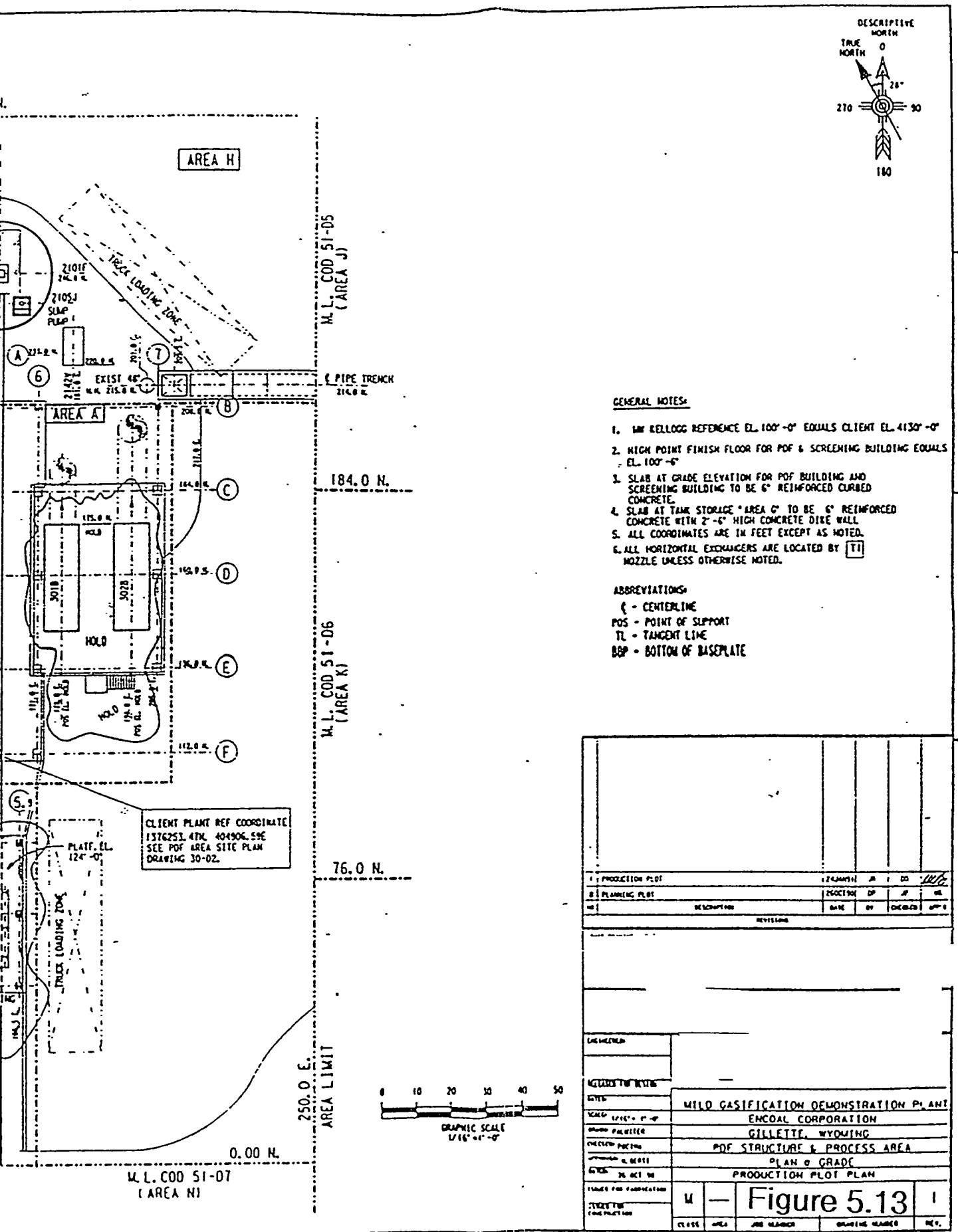


NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D
	REVISIONS				

ENGINEERED	
RELEASED FOR BIDDING	
DATED	
SCALE	1/8" = 1'-0"
DESIGN	RIVERA
CHECKED	
APPROVED	
DATED	
ISSUED FOR FABRICATION	
	MILD GASIFICATION DEMONSTRATION PLANT
	ENCOAL CORPORATION
	GILLETTE, WYOMING
	SCREENING & CRUSHING
	ELEVATIONS, SECTIONS & DETAILS
	SOLIDS HANDLING

Figure 5.12


NORTH AREA LIMIT 292.
AREA G
TRUCK UNLOADING ZONE
AREA F
AREA B
AREA E
AREA D
AREA C
WEST AREA LIMIT 0.00 E.
ELEVATOR
PDF SUBSTATION
MCC ROOM
INST. RACE ROOM
PARKING AREA
SW KELLOGG 0.00 N
EQUALS CLIENT 1376229.70 N
SW KELLOGG 0.00 E
EQUALS CLIENT 404712.74 E
22X34



GENERAL NOTES:

1. MW KELLOGG REFERENCE EL. 100'-0" EQUALS CLIENT EL. 4130'-0"
2. HIGH POINT FINISH FLOOR FOR POF & SCREENING BUILDING EQUALS EL. 100'-6"
3. SLAB AT GRADE ELEVATION FOR POF BUILDING AND SCREENING BUILDING TO BE 6" REINFORCED CURBED CONCRETE.
4. SLAB AT TANK STORAGE "AREA G" TO BE 6" REINFORCED CONCRETE WITH 2'-6" HIGH CONCRETE DIKE WALL
5. ALL COORDINATES ARE IN FEET EXCEPT AS NOTED.
6. ALL HORIZONTAL EXCHANGERS ARE LOCATED BY TI NOZZLE UNLESS OTHERWISE NOTED.

ABBREVIATIONS:

℄ - CENTERLINE
POS - POINT OF SUPPORT
TL - TANGENT LINE
BSP - BOTTOM OF BASEPLATE

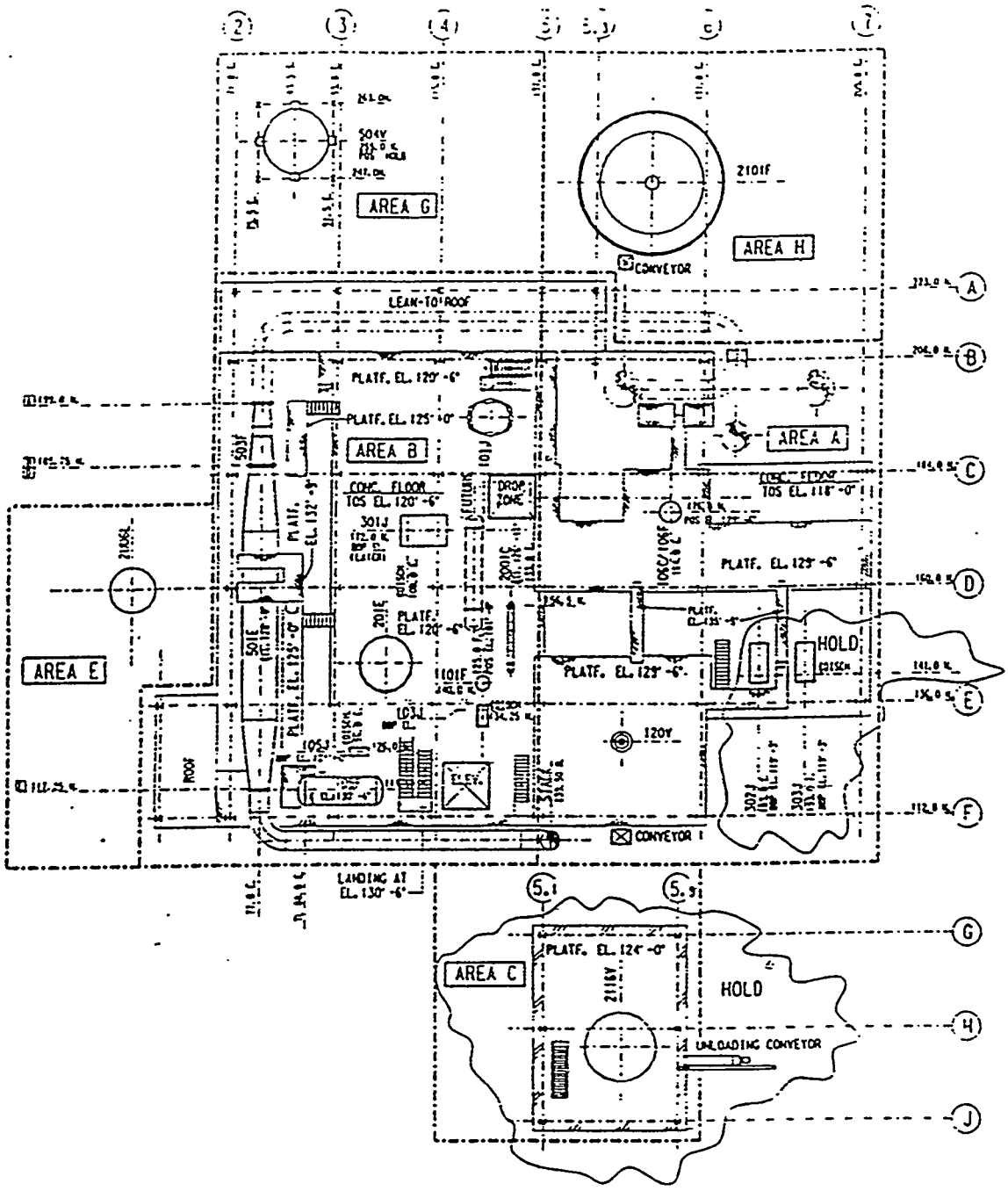
A	PRODUCTION PLOT	[illegible]	JR	DD	
B	PLANNING PLOT	26OCT90	DP	JR	ML
NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D

REVISIONS

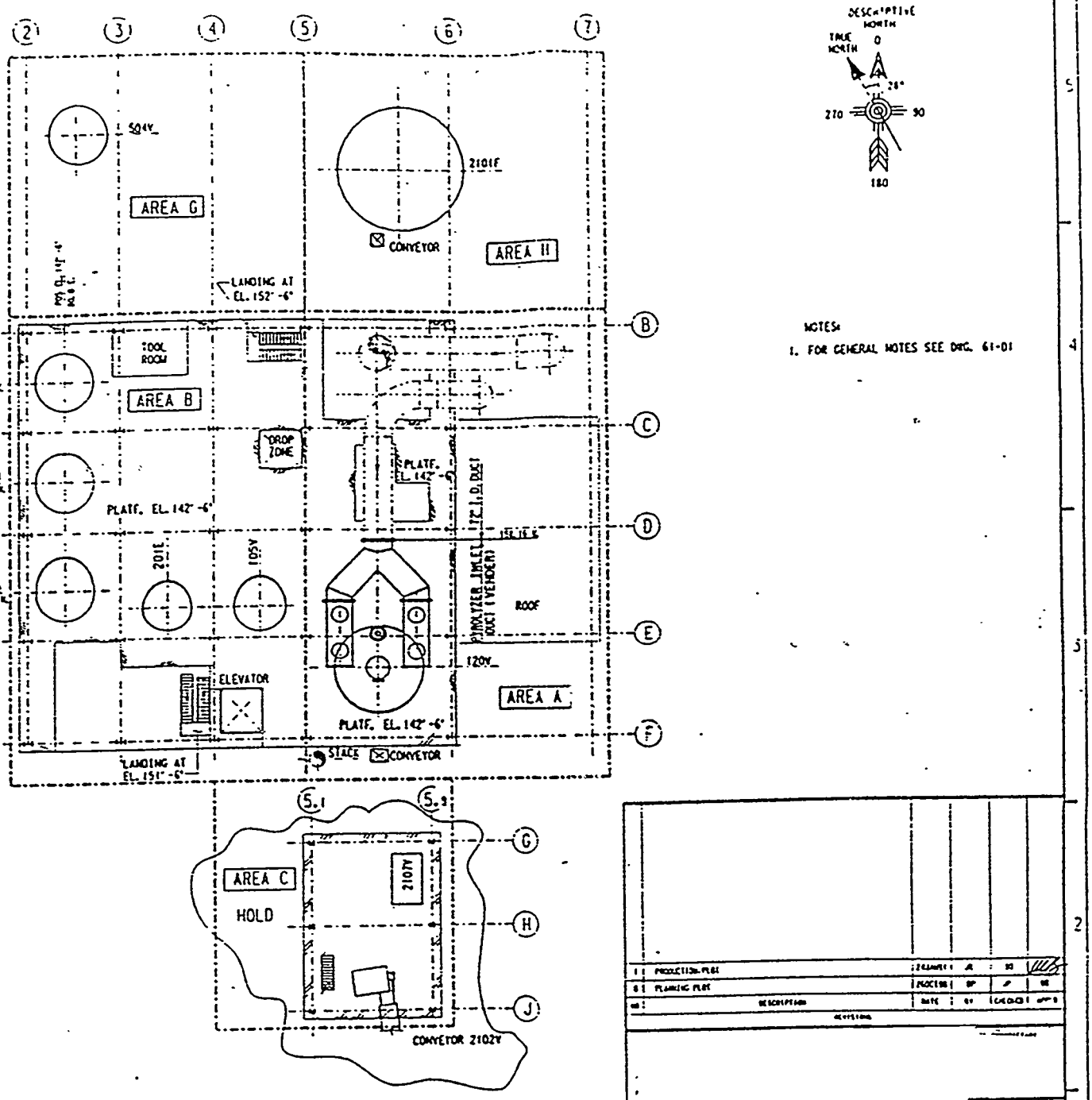
ENGINEER	
DATE	
SCALE	1/16"=1'-0"
DRAWN	P.MILLER
CHECKED	
APPROVED	G. MOTT
DATE	26 OCT 90
ISSUED FOR FABRICATION	
ISSUED FOR CONSTRUCTION	

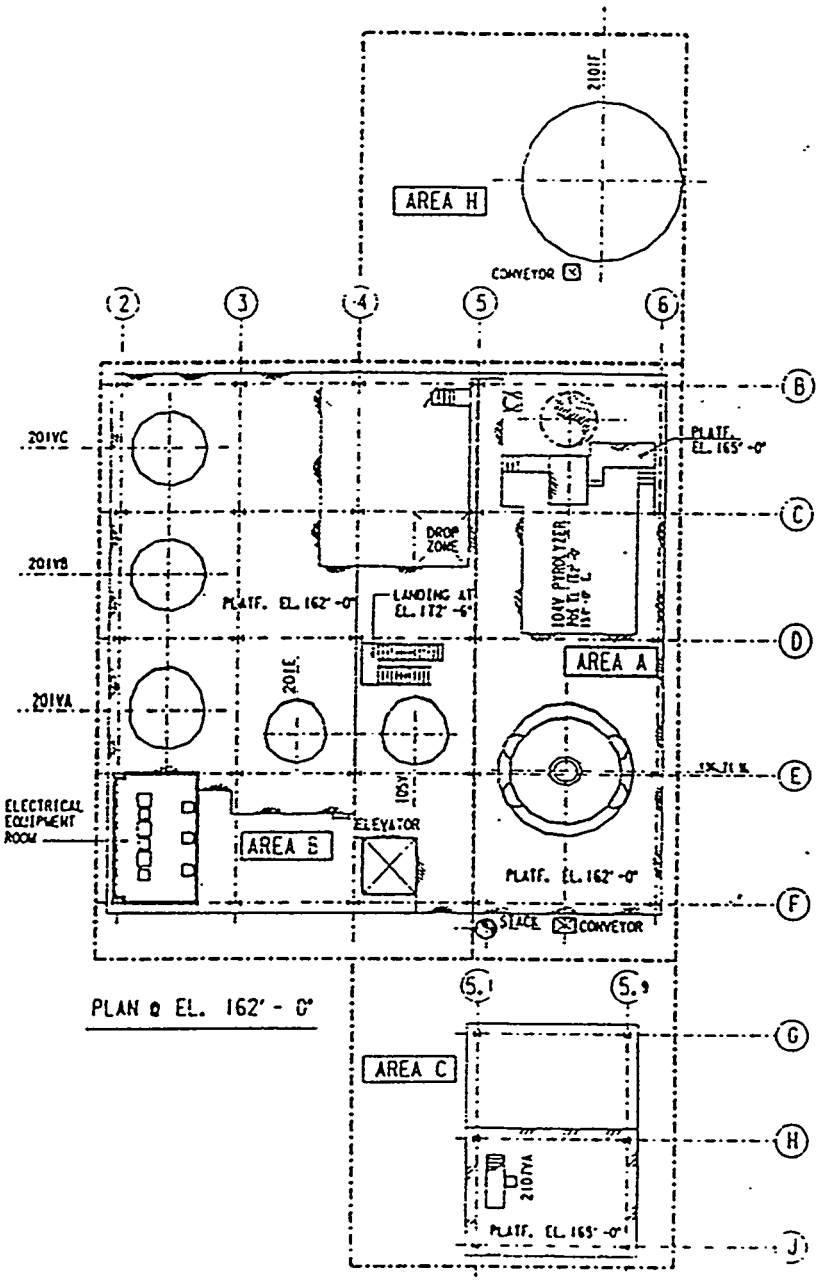
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
POF STRUCTURE & PROCESS AREA
PLAN @ GRADE
PRODUCTION PLOT PLAN

CLASS	AREA	JOB NUMBER	DRAWING NUMBER	REV.
M	—	Figure 5.13		1

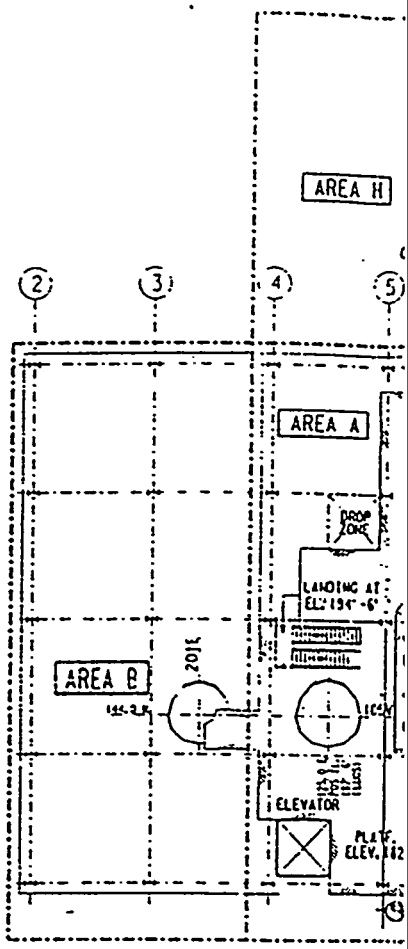


PLAN @ EL. 120' - 6" & EL. 129' - 6"


AREA G
AREA II
AREA B
AREA A
AREA C
HOLD
TOOL ROOM
DROP ZONE
ELEVATOR
ROOF
CONVEYOR
CONVEYOR 2102V
LANDING AT EL. 152'-6"
PLATF. EL. 142'-6"
TRUE NORTH
DESCRIPTIVE NORTH
NOTES:
1. FOR GENERAL NOTES SEE DRG. 61-01
ENCOAL CORPORATION
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
POF STRUCTURE & PROCESS AREA
PRODUCTION PLOT PLAN
Figure 5.14

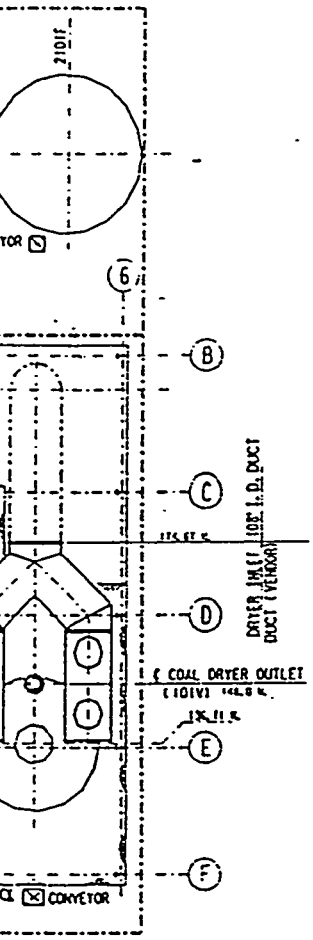


PLAN @ EL. 162' - 0"

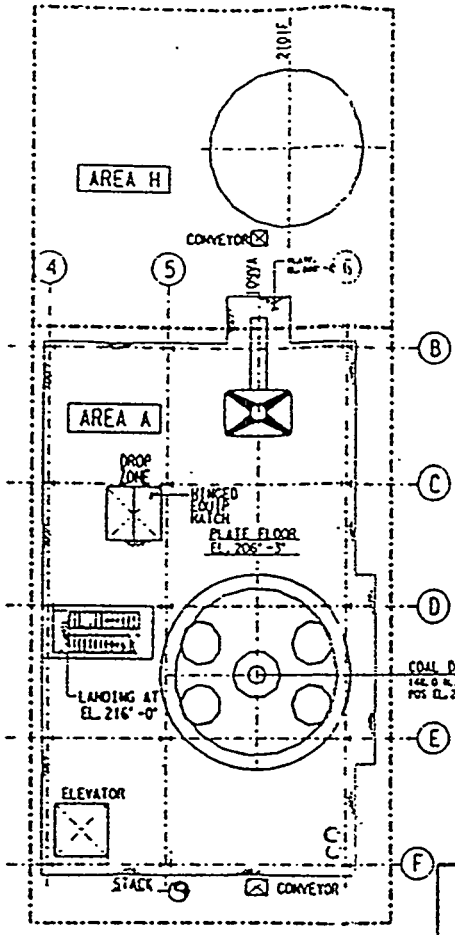


PLAN @ EL.

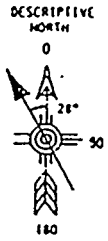
D
22X34



62' - 6"



PLAN @ EL. 206'-3"



NOTES

1. FOR GENERAL NOTES SEE DWG. 61-01

NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D
1	PRODUCTION PLOT	[illegible]	JB	BB	
0	PLANNING PLOT	[illegible]	BP	JP	

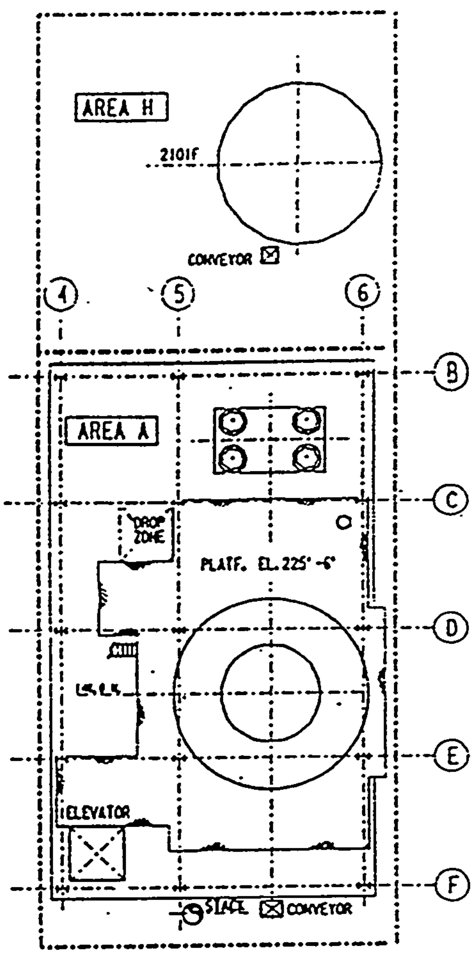
REVISIONS

ENCOAL CORPORATION

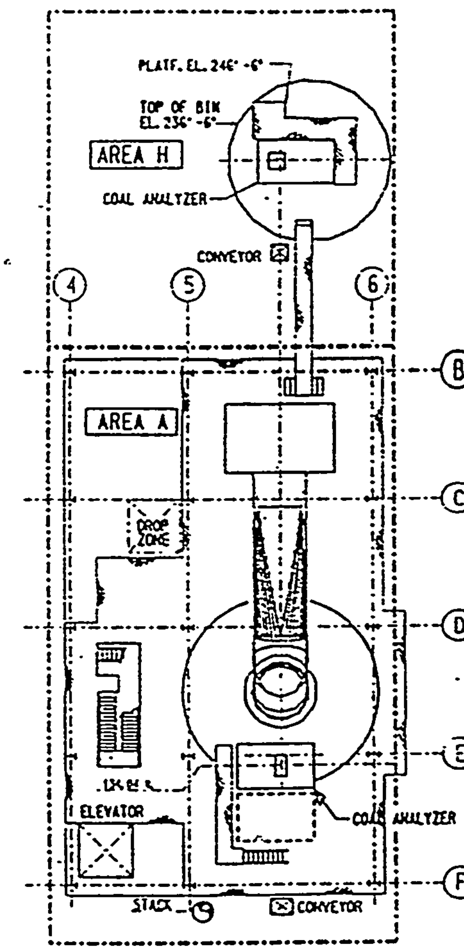
	MILD GASIFICATION DEMONSTRATION PLANT
	ENCOAL CORPORATION
	GILLETTE, WYOMING
	POF STRUCTURE & PROCESS AREA
	PLAN @ EL. 162'-0" TO EL. 225'-6"
	PRODUCTION PLOT PLAN
M	— Figure 5.15 1
CLASS	AREA JOB NUMBER DRAWING NUMBER REV.

0 10 20 30 40 50

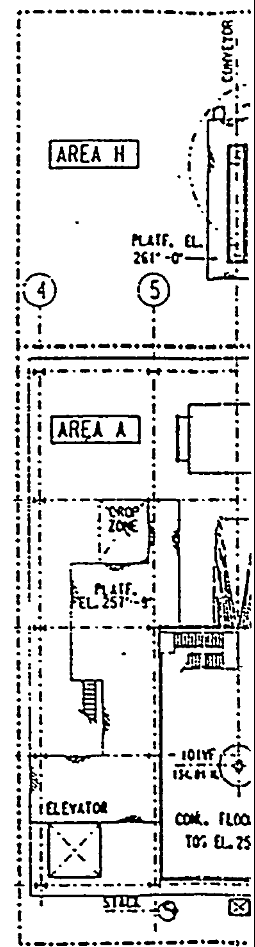
GRAPHIC SCALE
1/16"=1'-0"



PLAN @ EL. 225' - 6"



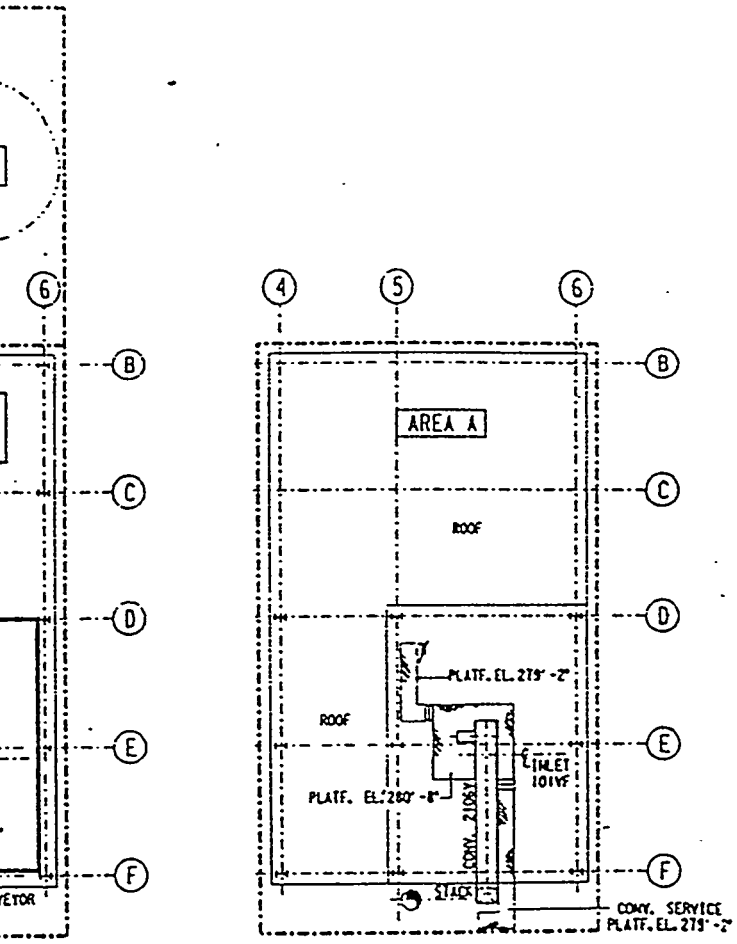
PLAN @ EL. 235' - 6"



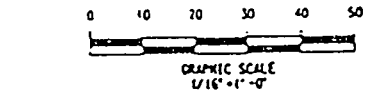
PLAN @ EL. 25

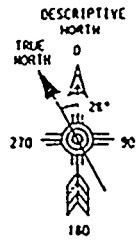
D
22X34

H G F E



PLAN @ EL. 279' - 2"





1	PRODUCTION PLOT				
0	PLANNING PLOT				
NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D

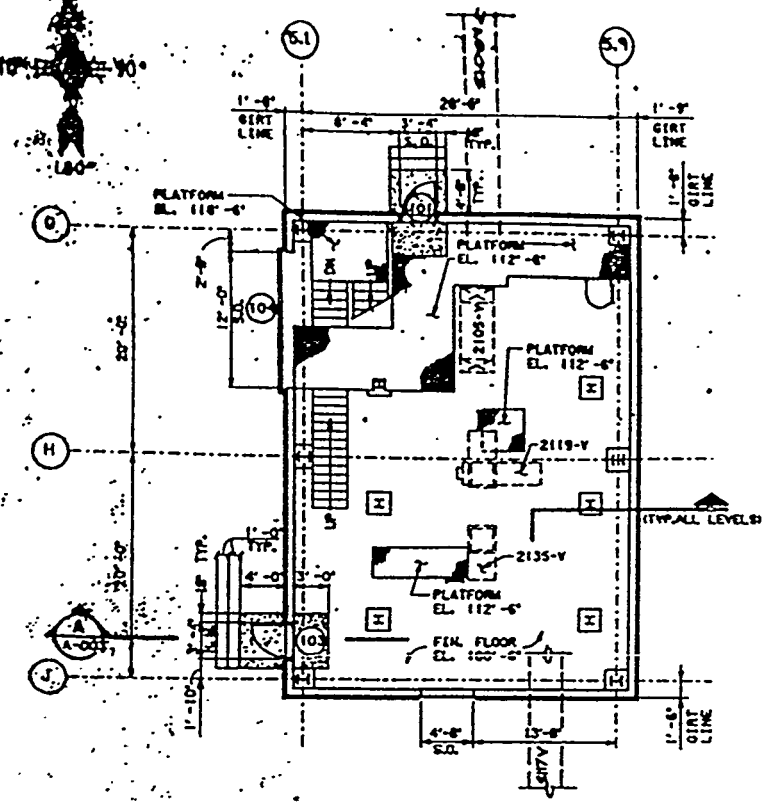
PROPRIETARY

ENCOAL CORPORATION

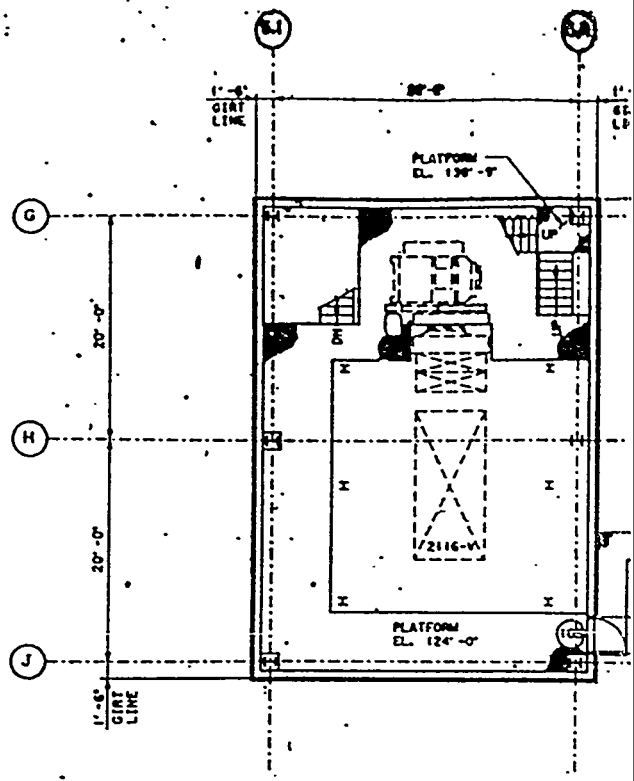
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
POF STRUCTURE & PROCESS AREA
PLAN @ EL. 225'-6" AND ABOVE
PRODUCTION PLOT PLAN

M | — | Figure 5.16 | 1

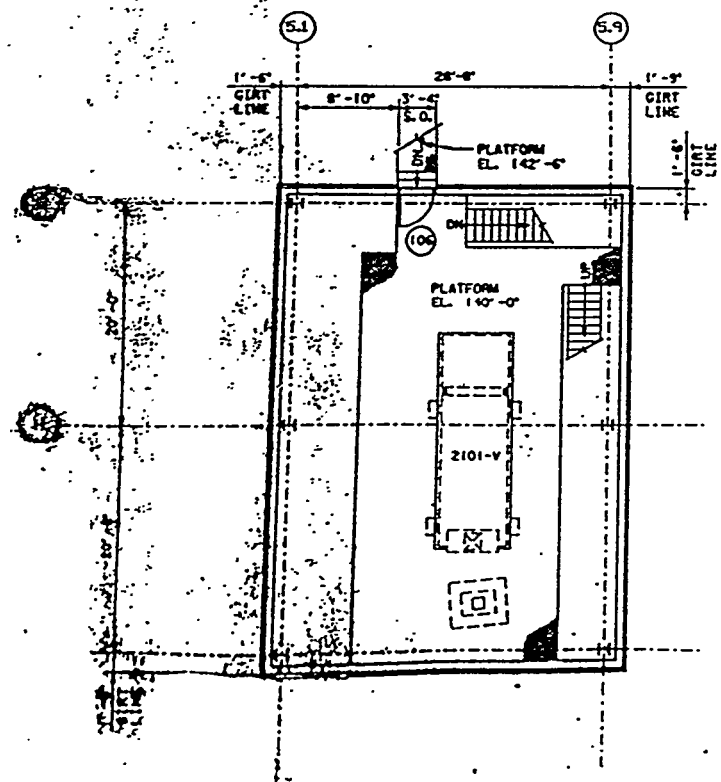
CLASS | AREA | JOB NUMBER | DRAWING NUMBER | REV.



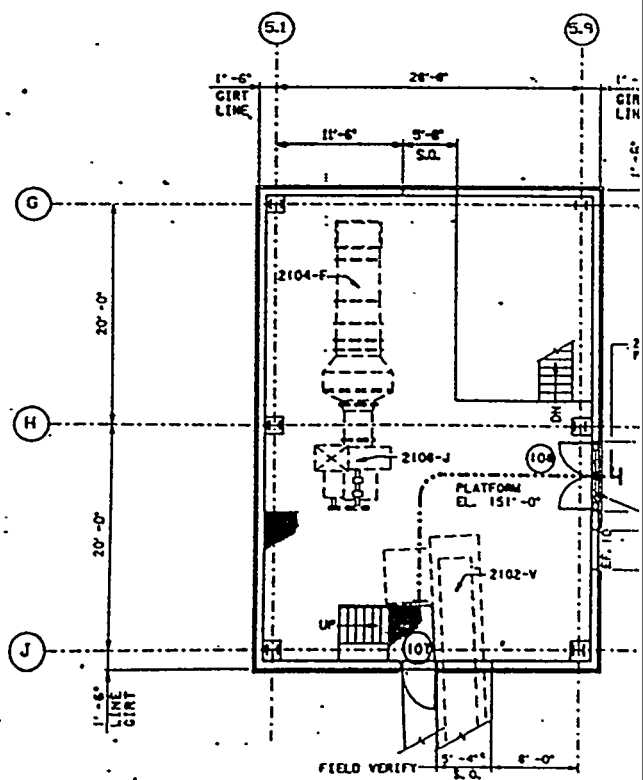
FLOOR PLAN - ELEV. 100'-6"



FLOOR PLAN - ELEV. 124'-0



FLOOR PLAN - ELEV. 140'-0"



FLOOR PLAN - ELEV. 151'-0

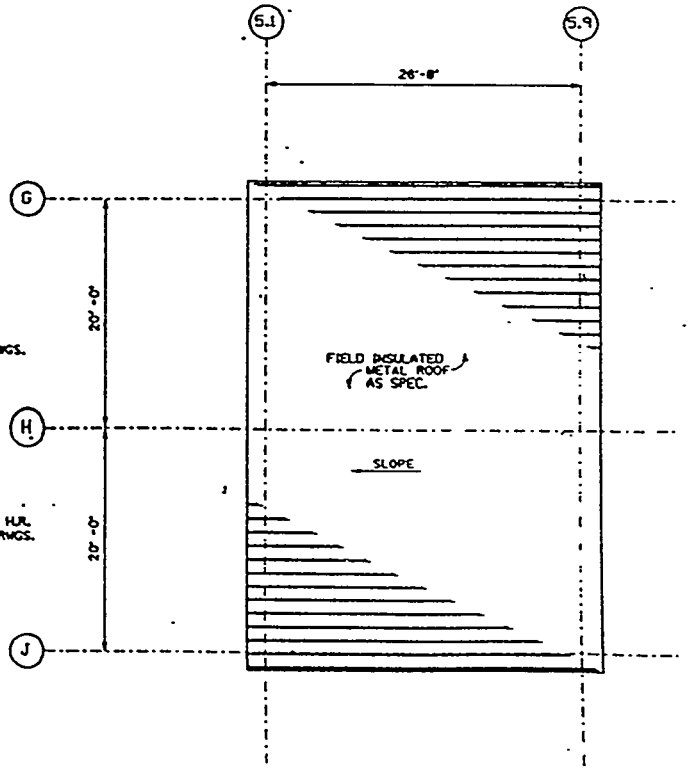
GENERAL NOTES:

1. FOR BUILDING SPECIFICATION SEE SPECIFICATION NUMBER SP-6603-K-04.
2. FOR BUILDING LOCATION SEE DRAWING NO. 30-02.
3. THIS SYMBOL (A / A-001) DENOTES SECTION "A" SHOWN ON DRAWING NO. 2601K-A-001.
4. THIS SYMBOL (8 / A-001) DENOTES DETAIL "8" SHOWN ON DRAWING NO. 2601K-A-001.
5. DO NOT SCALE THESE DRAWINGS. WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
6. COORDINATE THESE DRAWINGS WITH MECHANICAL AND ELECTRICAL DRAWINGS FOR ANY PENETRATIONS THRU FLOORS, WALLS AND ROOF.
7. DRAWINGS SHALL GOVERN WHEN A DIFFERENCE EXISTS BETWEEN DRAWINGS AND SPECIFICATIONS.
8. BUILDING SUBCONTRACTOR TO PROVIDE CMU LINTEL AT ALL MASONRY OPENINGS EXCEEDING 16" IN WIDTH. REINFORCE LINTEL WITH 2 #4 BARS AT MASONRY OPENING OF 3'-0" MAXIMUM, AND 2 #5 BARS AT THE GREATER. ALL LINTELS SHALL HAVE A MINIMUM OF 8" MASONRY BEARING AT EACH END. FILL ALL LINTEL CELLS WITH CONCRETE.

9. LEGEND (ABBREVIATIONS):

A.F.F.	ABOVE FINISH FLOOR
REF.	REFERENCE
EQ.	EQUAL
M.O.	MASONRY OPENING
CMU	CONCRETE MASONRY UNITS
H.M.	HOLLOW METAL
S.O.	STEEL OPENING
U.O.N.	UNLESS OTHERWISE NOTED

10. REINFORCE ALL CONCRETE MASONRY UNITS WITH #5 VERTICAL REINFORCING BARS @ DOWEL LOCATIONS (48" O.C.MAX.). PROVIDE TRUSS TYPE HORIZONTAL REINFORCING @ ALTERNATE COURSES. FILL CELLS WITH CONCRETE WHERE VERTICAL REINFORCING OCCURS.
11. PLATFORMS, COLUMNS, TRENCHES ARE SHOWN FOR REFERENCE ONLY. REFER TO STRUCTURAL/CIVIL DRAWINGS FOR EXACT LOCATIONS AND DIMENSIONS.
12. BUILDING SUBCONTRACTOR SHALL COORDINATE WITH VENDORS TO LOCATE AND FABRICATE ALL SECONDARY STEELS REQUIRED FOR FLASHING AT ALL ROOFING/SIDING PENETRATIONS (CONVEYORS, BELTS, PIPING, ETC.) FOR WEATHERTIGHT CONDITION PER METAL ROOFING/SIDING MANUFACTURERS' STANDARD.



ROOF PLAN

NO.	DESCRIPTION	DATE	BY	CHECKED	APP'D
0	ISSUE FOR CONSTRUCTION	24 MAY 91	W. COX	[illegible]	

REVISIONS

ENCOAL CORPORATION

ENGINEER:	
RELEASED FOR DESIGN	
DATES:	
SCALE: 1/4"=1'-0"	MILD GASIFICATION DEMONSTRATION PLANT
DRAWN: R. SIMEN	ENCOAL CORPORATION
CHECKED: D. VANHYEN	GILLETTE, WYOMING
APPROVED: M. JAISWAL	ARCHITECTURAL
DATES: 24 MAY 91	SCREENING BUILDING 2601K
ISSUED FOR FABRICATION	FLOOR & ROOF PLANS
ISSUED FOR CONSTRUCTION 24 MAY 91	

Figure 5.17

(ANSI) standards. Piping smaller than 3" was furnished by the erection contractor and was field routed. All valves were supplied by Kellogg using their Vendor Quality Management approach where the design is done jointly with the vendor representatives in Kellogg's engineering office.

The presence of high temperatures and dusty, corrosive fluids in much of the gas and liquid piping was a given. Carbon steel was selected as the base material for all piping systems, with refractory lining systems for temperatures over 600°F. A protective coating between the refractory and steel was applied. Over 1000°F, a dual refractory liner consisting of formed panels and then gunned refractory was used. Otherwise, a single layer of gunned refractory was specified, this layer being hardened where high dust loading was predicted for erosion protection and modified for acid resistance where corrosion was also predicted.

Control of corrosion and erosion where refractory was not specified was also a concern. Vessels and piping where acid condensation could take place were lined with Hasteloy C-22 or fabricated from Incoloy alloys. This included all of the dryer off gas ductwork, cyclones and blower housing. High corrosion rates were not expected in other areas of the plant. Prior to the cyclones in the dryer and pyrolyzer loops, high dust loadings were expected, but these areas were protected by hardened refractory. Therefore the balance of the plant piping and vessels were simply given a 1/8" corrosion/erosion allowance. Most of the time the actual wall thickness was governed by structural requirements, which made the wall thickness 3/8" plus the corrosion allowance.

In many industrial plants where availability is essential, the major equipment is spared by installation of redundant parallel units, each of which can handle full plant throughput. In the ENCOAL Project, being a demonstration plant, it was decided to spare only equipment in streams essential for process control. This minimized the capital cost and reduced the risks on the Project. As a result, only three critical pumps were spared with in-line, ready to run standby units. Based on the high reliability of the major equipment, this decision was not expected to have a significant impact on future plant availability.

All rotating equipment was specified to comply with current MSHA standards for 8 hour noise exposure and to be gas tight. Not every manufacturer was able to meet the noise standard, but collectively, the PDF building was held within acceptable limits. Even though gas tight equipment was specified, an ambient air monitoring system was added to the PDF building to detect SO_2, H_2S, CH_4 and CO. The monitoring system was interlocked with the building ventilation system and a plant evacuation alarm.

5.3 ELECTRICAL AND INSTRUMENTATION DESIGN

Classification of the various plant facilities for the electrical design was one of the first engineering activities. Review of the National Electrical Code (NEC) and MSHA regulations resulted in the following area classifications:

Class 1, Division 1, Group D and F:

PDF building headhouse; enclosed area under coal and PDF silos; enclosed trenches

Class 2, Division 2, Group D and F:

Screening building; within 10 feet of conveyors, silo openings and trench covers

Unclassified:

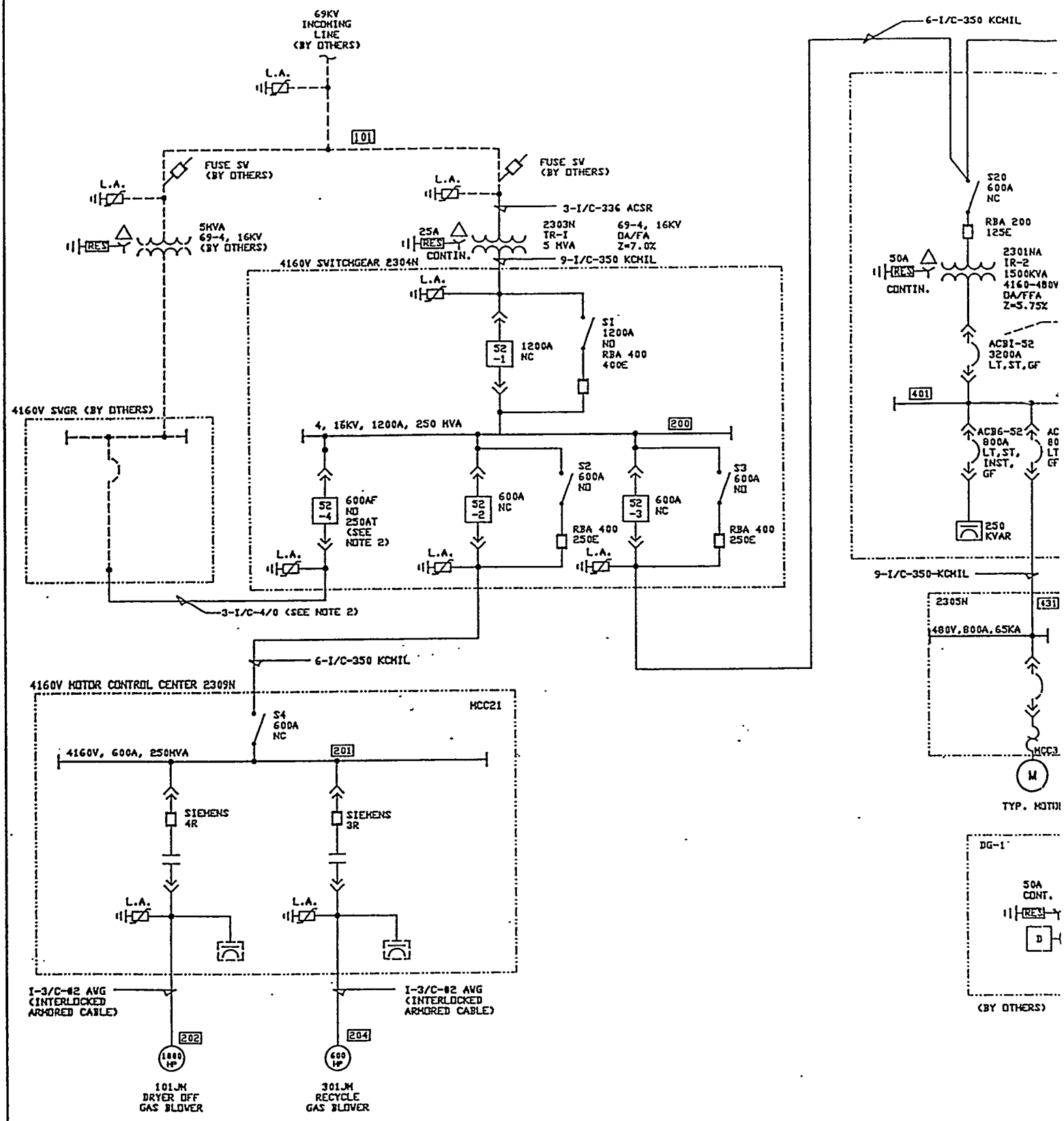
Remainder of PDF building; remote buildings; electrical rooms

These classifications along with the zoning of the PDF building as described in Section 5.1 for pressure containment of the coal dryer, were reviewed with the MSHA Division office in Denver to get their input and concurrence. Following these discussions, the classifications were disseminated to all design groups. Also issued were the 4160 volt and 480 volt one-line diagrams (Figures 5.18 - 5.21) for all of the demonstration facilities based on the equipment listed in the process release. Spare conduit, wiring, switchgear locations, and junction box capacity were built into the design to allow for future additions and deletions.

Also early in the design phase, standards were defined for the motors, switchgear, variable frequency drives and the control system. All motors greater than 5 horsepower were furnished by Kellogg rather than equipment vendors, and were specified to be mill and chemical duty and energy efficient with a service factor of 1.15. Switchgear was specified to meet MSHA's requirement for bypassing and testing on line on a monthly basis. Solid state variable frequency drives were specified where required with local/remote control and programmable ramping. For the control system, it was decided to use an Allen Bradley Programmable Logic Controller (PLC) based system with the Control View operator interface rather than a main frame based distributive control system. This decision saved a considerable amount of money in hardware and programming time and did not sacrifice anything in quality, flexibility or data gathering capability.

Being a first-of-its-kind demonstration plant, a lot of extra instrumentation and sample stations were included in the facilities design. One of the key elements of the LFC Technology as developed by SGI is closed loop control and optimization of the plant operation via sophisticated computer programs. Called Level 0, this ultimate control system requires reliable, accurate information from field instruments. State of the art sensors for pressure, temperature, flow rates, density, pH and level were used throughout the plant. Two areas of concern were gas flow measurement in the dirty, hot, corrosive process gas streams and the reliable detection of critical levels. Hot wire anemometers were selected for the severe gas flow applications. Mechanical level detectors were installed on the dryer and pyrolyzer outlets and nuclear devices were specified for all other critical level measurement applications. Feed coal composition and product qualities are also required by the Level 0 control system. The only proven instrument that could provide the instantaneous analyses needed for closed loop control was the GAMMA-METRICS nuclear coal analyzer. Two of these analyzers were installed in the plant, one on the raw coal inlet and one on the PDF outlet.

The Level 0 control system was designed to reside on a remote VAX computer and gather information through a modem. It was a given that the demonstration plant would not start up using Level 0. Instead Level 0 would be put on line to "learn" by gathering data from the 132 field monitoring points, making predictions for plant operating parameters and comparing its predictions to the actual operating conditions. The Level 0 system would then be calibrated during the first two years plant operation and eventually be put into on-line plant control service once it had demonstrated reliability and accuracy.

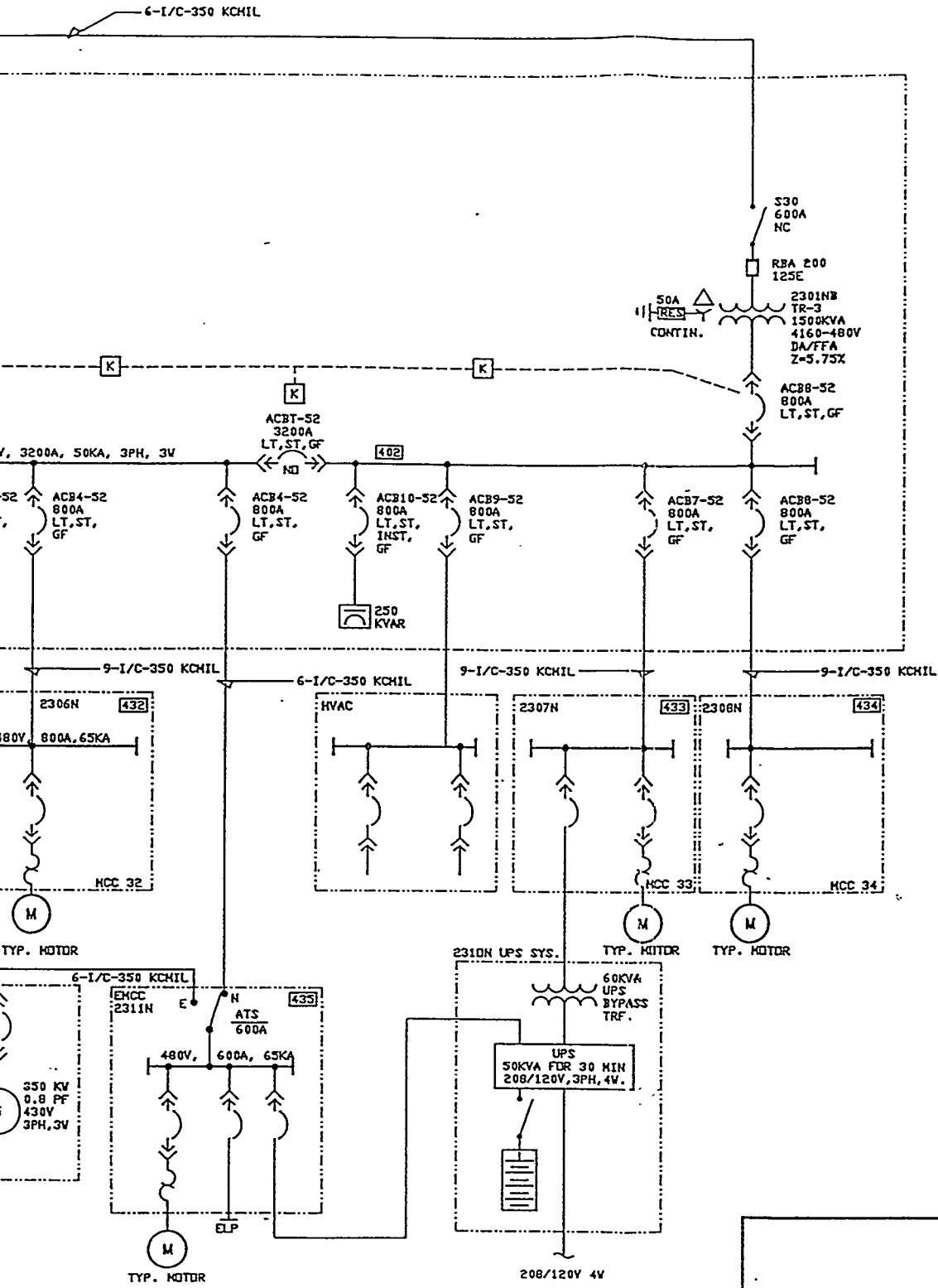


NOTES:

1. FOR DRAWING LEGEND SEE DWG. 701-001.
2. CABLE SIZE BASED ON AVAILABLE SPARE CAPACITY OF THE 5MVA TRANSFORMERS. BREAKER TRIP SETTINGS MUST BE COORDINATED TO PROTECT THIS CABLE. *EXTREME CAUTION MUST BE USED WHEN OPERATING THIS BREAKER AS IT CAN BE FED FROM EITHER SIDE.*

REFERENCE DRAWINGS:

701-D03	4160V SWITCHGEAR
701-D04	4160V MCC 21
701-D05	PDF SUBSTATION
701-D06	480V MCC-31
701-D07	480V MCC-32
701-D08	480V MCC-33
701-D09	480V MCC-33
701-D10	480V MCC-34
701-D11	480V MCC-34
701-D12	480V EMCC
701-D13	MISC. 480V OFFSITE
701-D14	UPS



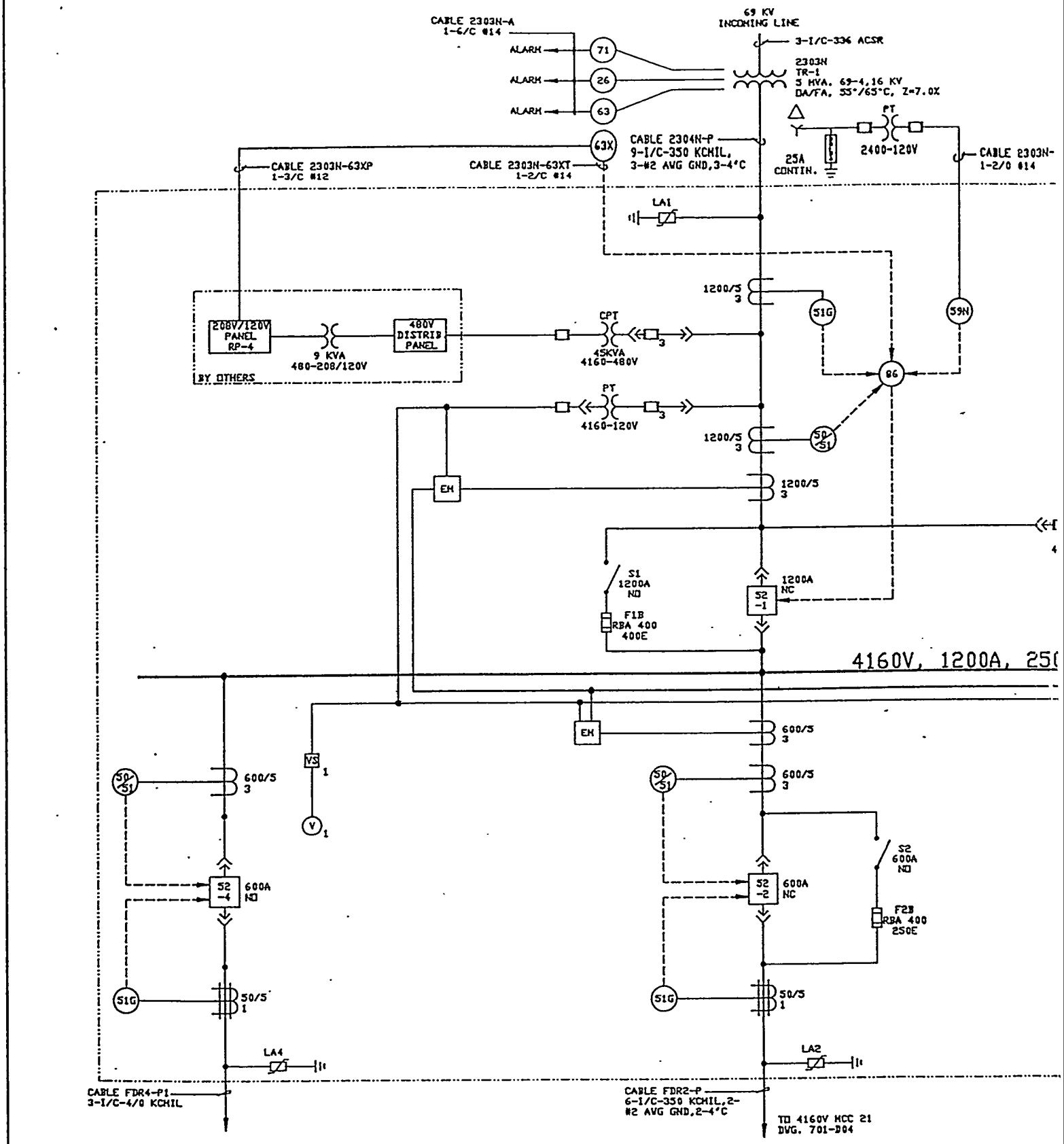
F3	FIELD REVISION	6NOV92			
2F	FIELD REVISION	24SEP91			
2	GEN. REVISIONS	15JAN91	JFH	RFH	RFH
1	INCORPORATED CLIENT COMMENTS AND ISSUED FOR CONSTRUCTION	17MAY91	RFH	MLB	DK/DB
	ISSUED FOR CLIENT APPROVAL		RFH	MLB	

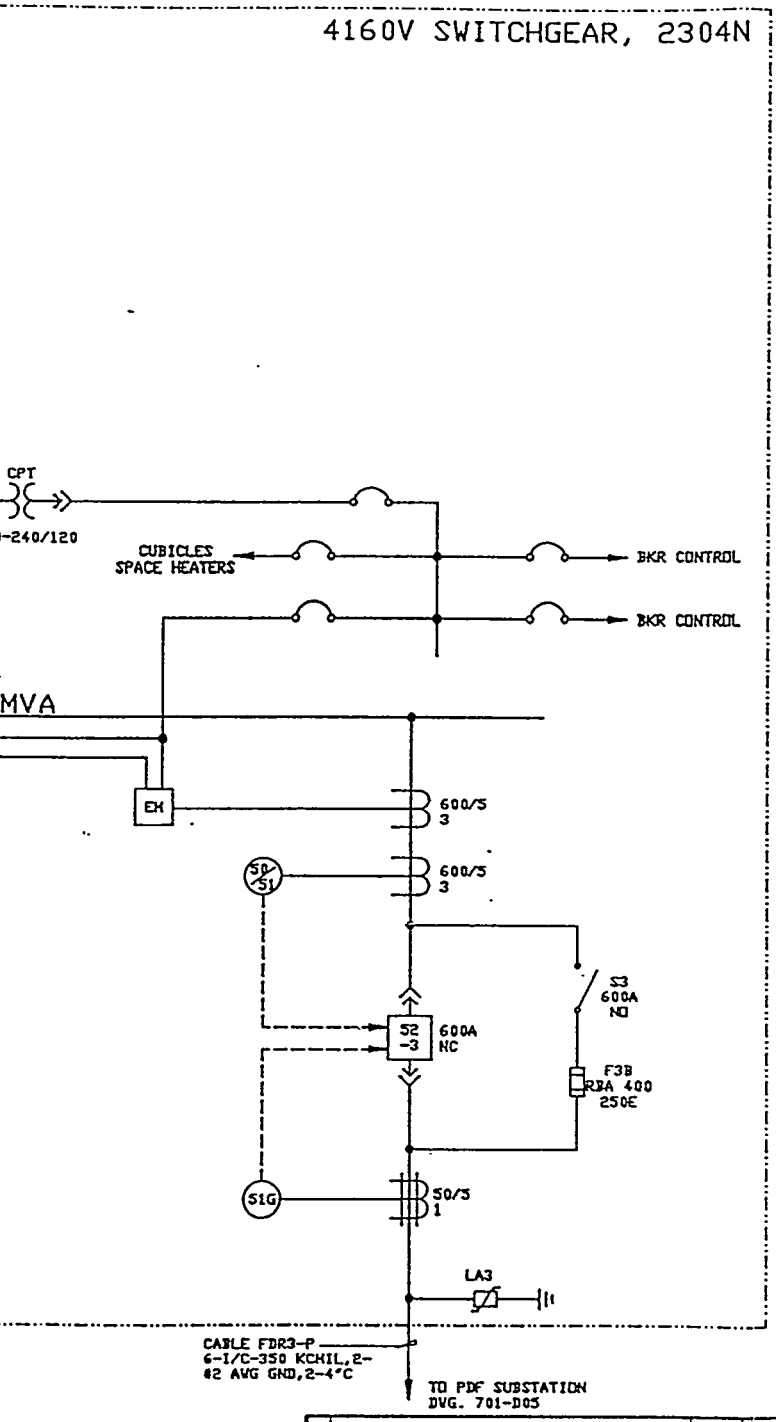
ENGINEERED:
ED HANSEN
DRAWING IN AUTOCAD SYS
Encoal
RELEASED FOR DESIGN
DATE:
12 MAR 91
DRAWN:
J.C. LANE
CHECKED:
APPROVED:
DATE:
12 MAR 91
ISSUED FOR:

ENCOAL CORPORATION

MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
ELECTRICAL
OVERALL ONE-LINE DIAGRAM

Figure 5.18


CABLE 2303N-A
1-6/C #14
ALARM
71
ALARM
26
ALARM
63
69 KV
INCOMING LINE
3-I/C-336 ACSR
2303N
TR-1
5 MVA. 69-4.16 KV
OA/FA. 55°/65°C. Z=7.0%
PT
2400-120V
25A
CONTIN.
CABLE 2303N-
1-2/0 #14
63X
CABLE 2304N-P
9-I/C-350 KCMIL,
3-#2 AVG GND,3-4°C
CABLE 2303N-63XP
1-3/C #12
CABLE 2303N-63XT
1-2/C #14
LA1
1200/5
3
51G
59N
208V/120V
PANEL
RP-4
9 KVA
480-208/120V
480V
DISTRIB
PANEL
BY OTHERS
CPT
45KVA
4160-480V
3
86
PT
4160-120V
50
-51
EM
S1
1200A
NO
F1B
RBA 400
400E
S2
-1
1200A
NC
4160V, 1200A, 250
600/5
3
VS
1
V
1
S2
-4
600A
NO
S2
-2
600A
NC
S2
600A
NO
F2B
RBA 400
250E
50/5
1
LA4
LA2
CABLE FDR4-P1
3-I/C-4/0 KCMIL
CABLE FDR2-P
6-I/C-350 KCMIL,2-
#2 AVG GND,2-4°C
TO 4160V MCC 21
DWG. 701-D04



NOTES:

1. FOR DRAWING LEGEND SEE DWG. 701-D01.
2. FOR OVERALL ONE-LINE DIAGRAM SEE DWG. 701-D02.
3. FOR ALARM WIRING SEE DWG. 703-B05.

F3	FIELD REVISION				
1	ISSUED FOR CONSTRUCTION				

ENGINEERS:

RELEASED FOR BIDDING

ENCOAL CORPORATION

MILD GASIFICATION DEMONSTRATION PLANT

ENCOAL CORPORATION

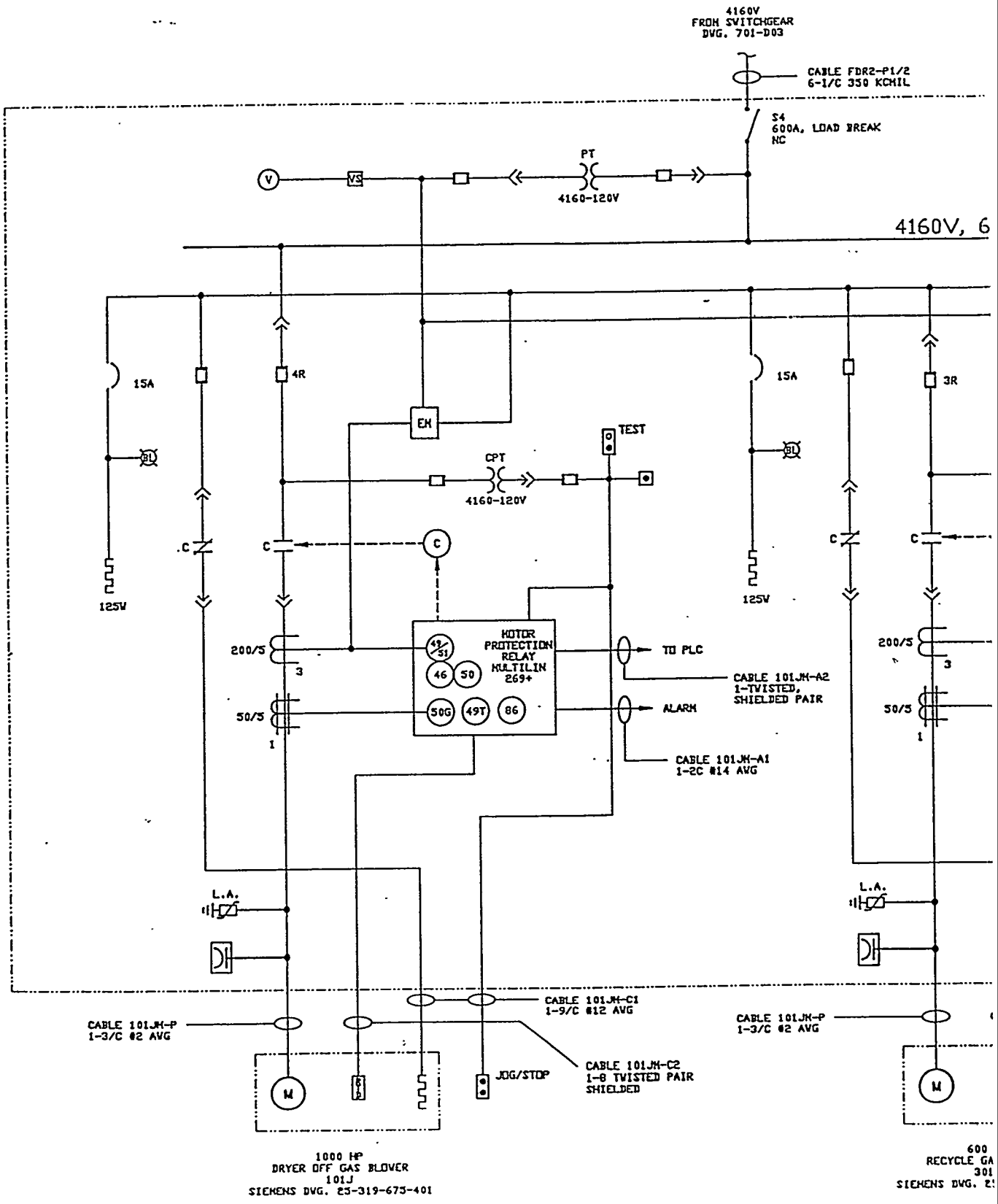
GILLETTE, WYOMING

ELECTRICAL

ONE-LINE DIAGRAM

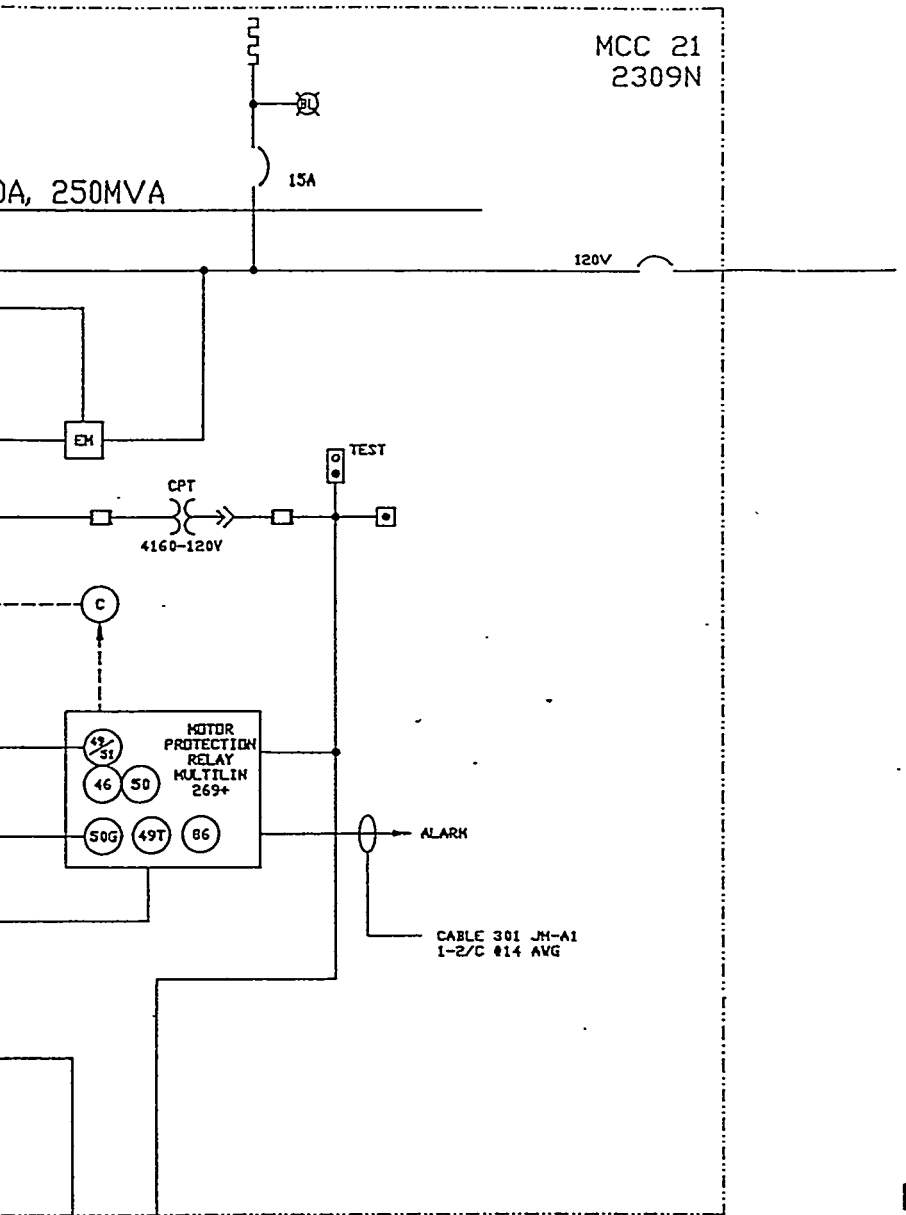
4160V SWITCHGEAR

Figure 5.19


4160V
FROM SWITCHGEAR
DWG. 701-D03
CABLE FDR2-P1/2
6-1/C 350 KCMIL
S4
600A, LOAD BREAK
NC
PT
4160-120V
V
VS
4160V, 6
15A
4R
EM
TEST
CPT
4160-120V
15A
3R
125V
125V
C
C
C
C
200/5
3
50/5
1
MOTOR
PROTECTION
RELAY
MULTILIN
269+
49/51
46
50
50G
49T
86
TO PLC
CABLE 101JM-A2
1-TWISTED,
SHIELDED PAIR
ALARM
CABLE 101JM-A1
1-2C #14 AWG
200/5
3
50/5
1
L.A.
L.A.
CABLE 101JM-C1
1-9/C #12 AWG
CABLE 101JM-P
1-3/C #2 AWG
CABLE 101JM-P
1-3/C #2 AWG
CABLE 101JM-C2
1-8 TWISTED PAIR
SHIELDED
JOG/STOP
M
M
1000 HP
DRYER OFF GAS BLOWER
101J
SIEMENS DWG. 25-319-675-401
600
RECYCLE GA
301
SIEMENS DWG. 2

NOTES:

1. FOR DRAWING LEGEND SEE DWG. 701-D01
2. FOR OVERALL ONE LINE DIAGRAM SEE DWG. 701-D02
3. FOR ALARM WIRING SEE DWG. 703-B05

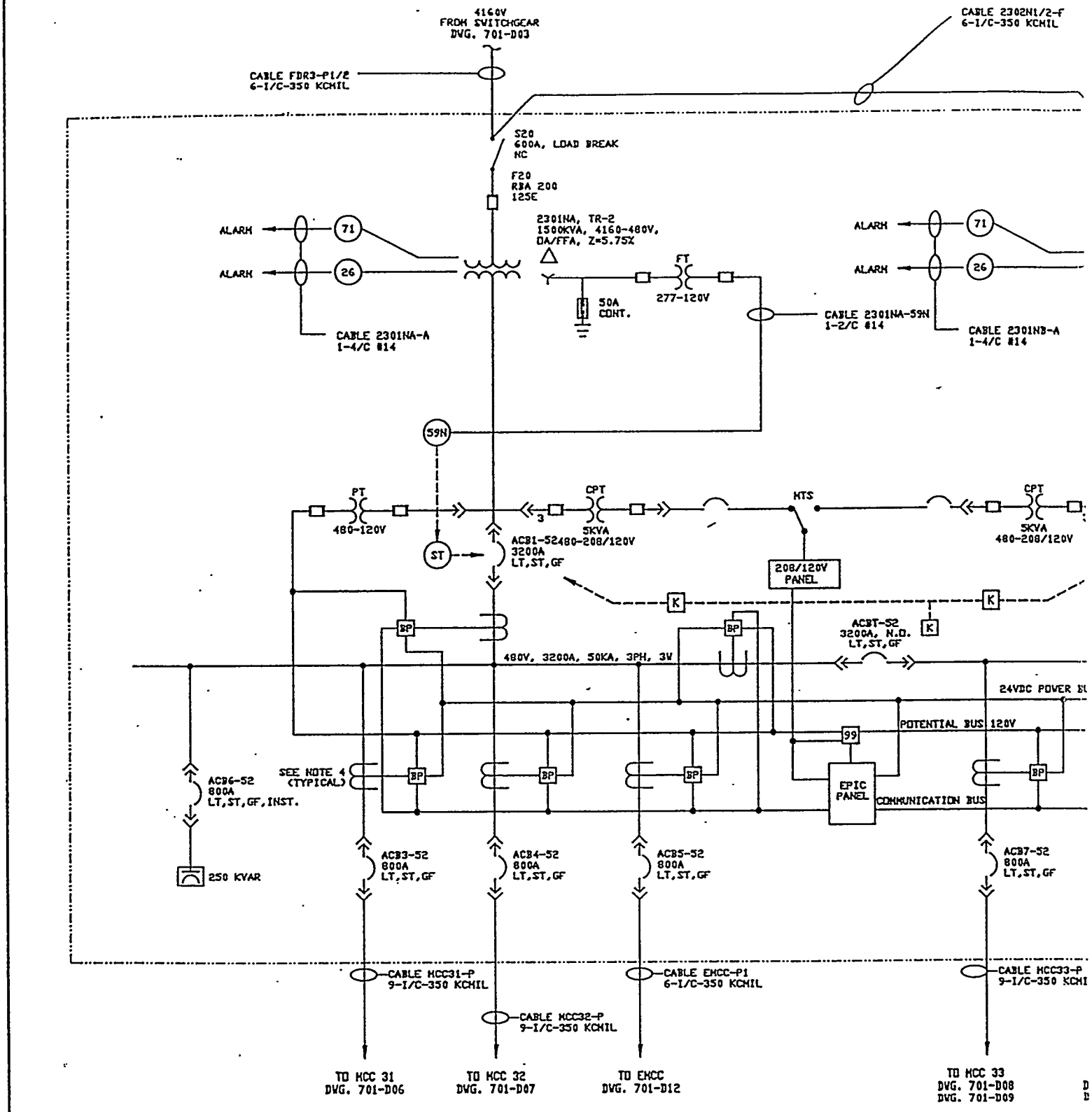


F3	FIELD REVISION				
1	ISSUED FOR CONSTRUCTION				

ENCOAL CORPORATION

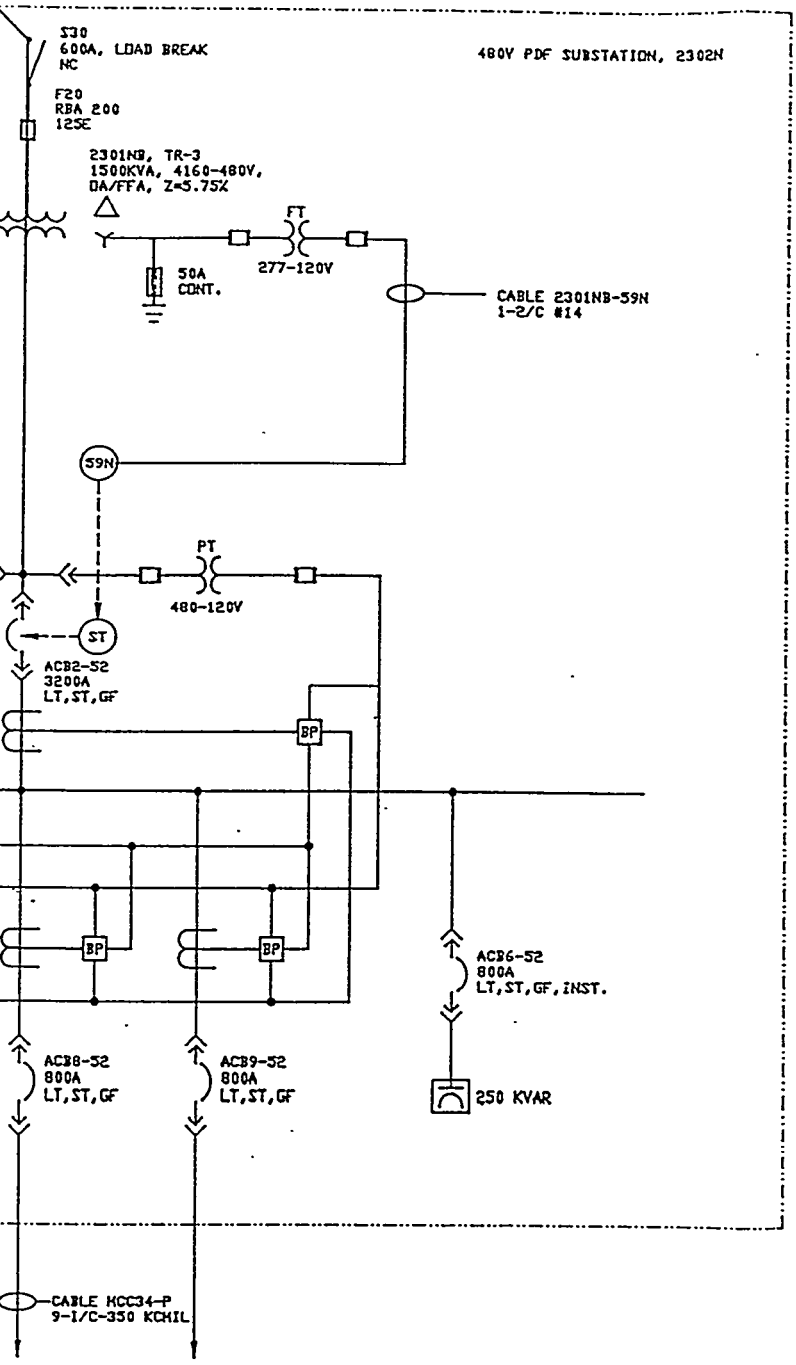
MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
ELECTRICAL
OVERALL ONE-LINE DIAGRAM
4160V MOTOR CONTROL CENTER MCC21

Figure 5.20


4160V
FROM SWITCHGEAR
DWG. 701-D03
CABLE FDR3-P1/2
6-1/C-350 KCMIL
CABLE 2302N1/2-F
6-1/C-350 KCMIL
S20
600A, LOAD BREAK
NC
F20
RBA 200
125E
2301NA, TR-2
1500KVA, 4160-480V,
DA/FFA, Z=5.75%
ALARM
71
ALARM
26
CABLE 2301NA-A
1-4/C #14
FT
277-120V
50A
CONT.
CABLE 2301NA-59N
1-2/C #14
ALARM
71
ALARM
26
CABLE 2301NB-A
1-4/C #14
59N
PT
480-120V
CPT
5KVA
480-208/120V
ST
ACB1-S2
3200A
LT,ST,GF
MTS
CPT
5KVA
480-208/120V
208/120V
PANEL
K
K
K
BP
BP
ACBT-S2
3200A, N.O.
LT,ST,GF
480V, 3200A, 50KA, 3PH, 3W
24VDC POWER SU
POTENTIAL BUS 120V
99
SEE NOTE 4
(TYPICAL)
BP
BP
BP
BP
EPIC
PANEL
COMMUNICATION BUS
ACB6-S2
800A
LT,ST,GF,INST.
250 KVAR
ACB3-S2
800A
LT,ST,GF
ACB4-S2
800A
LT,ST,GF
ACB5-S2
800A
LT,ST,GF
ACB7-S2
800A
LT,ST,GF
CABLE MCC31-P
9-1/C-350 KCMIL
CABLE MCC32-P
9-1/C-350 KCMIL
CABLE EMCC-P1
6-1/C-350 KCMIL
CABLE MCC33-P
9-1/C-350 KCMI
TO MCC 31
DWG. 701-D06
TO MCC 32
DWG. 701-D07
TO EMCC
DWG. 701-D12
TO MCC 33
DWG. 701-D08
DWG. 701-D09

NOTES:

1. FOR DRAWING LEGEND SEE DWG. 701-D01
2. FOR OVERALL ONE LINE DIAGRAM SEE DWG. 701-D02
3. FOR ALARM WIRING SEE DWG. 703-B85
4. CT'S ARE A PART OF ELECTRONIC BKR. PROGRAMMER, SIZE TO BE DETERMINED BY VENDOR.



R3	FIELD REVISION	8NOV92			
1	ISSUED FOR CONSTRUCTION	12JUL91	RCW	KLB	DM/DB

ENCOAL CORPORATION

ENGINEER:
RELEASED FOR DESIGN

MILD GASIFICATION DEMONSTRATION PLANT
ENCOAL CORPORATION
GILLETTE, WYOMING
ELECTRICAL
OVERALL ONE-LINE DIAGRAM
480V PDF SUBSTATION

Figure 5.21

One of the recommendations of the HazOps study group was to develop emergency shut-down (ESD) procedures. This was done as part of the initial electrical and instrumentation design. Safe, orderly ESD being paramount, the requirements for instrument air capacity, nitrogen capacity and standby power were determined. A battery operated uninterruptable power supply (UPS) was installed to provide backup power to the control computers and certain other electrically operated safety devices. In addition, for longer term outages, a standby generator was installed to maintain power to the UPS system, nitrogen vaporizer, emergency lighting, standby glycol circulation pump and control room.

6.0 MAJOR EQUIPMENT FUNCTIONS AND DESCRIPTIONS

The following sections discuss each of the major equipment items or groups according to function in the overall process. For a more complete major equipment list, refer to Appendix A, Table A.1, which contains a cross reference of the equipment names and the number designation.

6.1 FEED COAL SYSTEM

Coal is conveyed from the Buckskin Mine into a 3000 ton storage silo (Figure 6.1). A variable speed vibrating feeder (Figure 6.2) loads coal automatically from the silo onto a conveyor which continuously transfers the coal to a triple deck coal screen (Figure 6.3). The triple deck screen divides the feed coal into undersized (less than 1/8"), sized (1/8 in. to 2 in.), and oversized (greater than 2 in.) materials. Undersized coal is returned to Triton via truck or conveyor. Coal greater than 2 in. is fed into a crusher (Figure 6.4) to reduce its size. Outfall from the crusher is combined with the sized coal from the screen and is transferred to a 7 ton dryer coal feed hopper by an "S" belt, a flexible wall, ribbed vertical lifting conveyor. A general arrangement drawing for the coal handling equipment in the next three sections is shown in Figure 6.5.

6.2 COAL DRYER AND CYCLONE

The coal dryer (Figures 6.6 and 6.7) is a Salem Furnace Company shallow bed rotary grate type dryer with a grate diameter of 30 ft. 9 in. The grate is perforated for gas flow and has a circular opening in the center for discharging coal. Several types of dryers were considered in the early stages of equipment selection; the choice was highly influenced by the desire to minimize particle size degradation during coal handling. The coal enters the dryer at the outer edge of the grate through the inlet chute. The distance between the discharge of the inlet chute and the grate establishes the coal bed depth. As the grate rotates, stationary rabbles (Figure 6.8), which act like plows, move the coal toward the center of the grate. The coal then falls through the center opening into a duct (soaking pit) which deposits the coal on the pyrolyzer grate situated below the dryer.

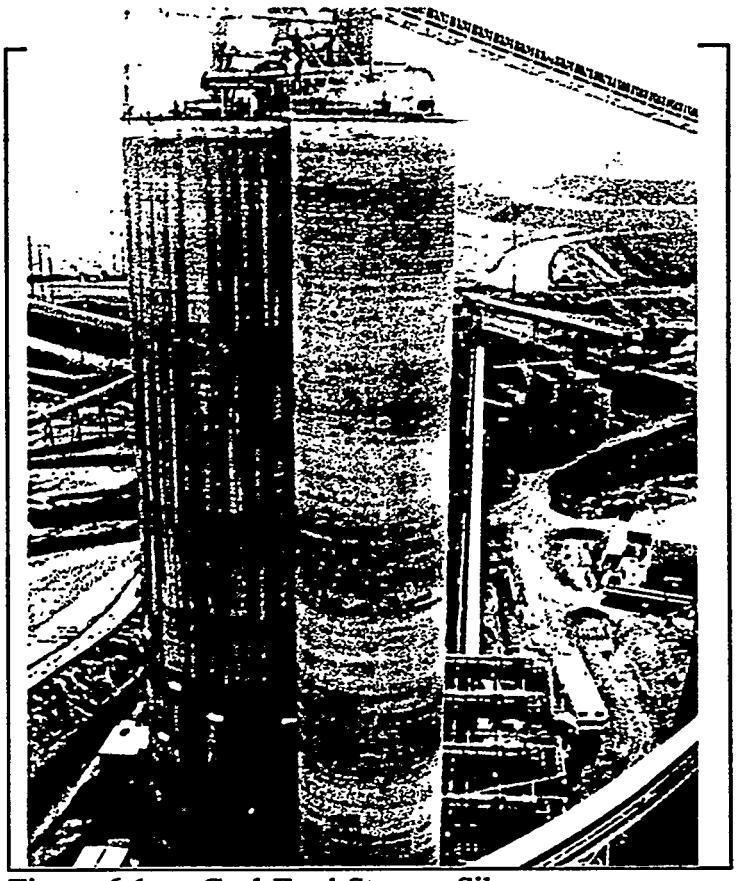


Figure 6.1 Coal Feed Storage Silo

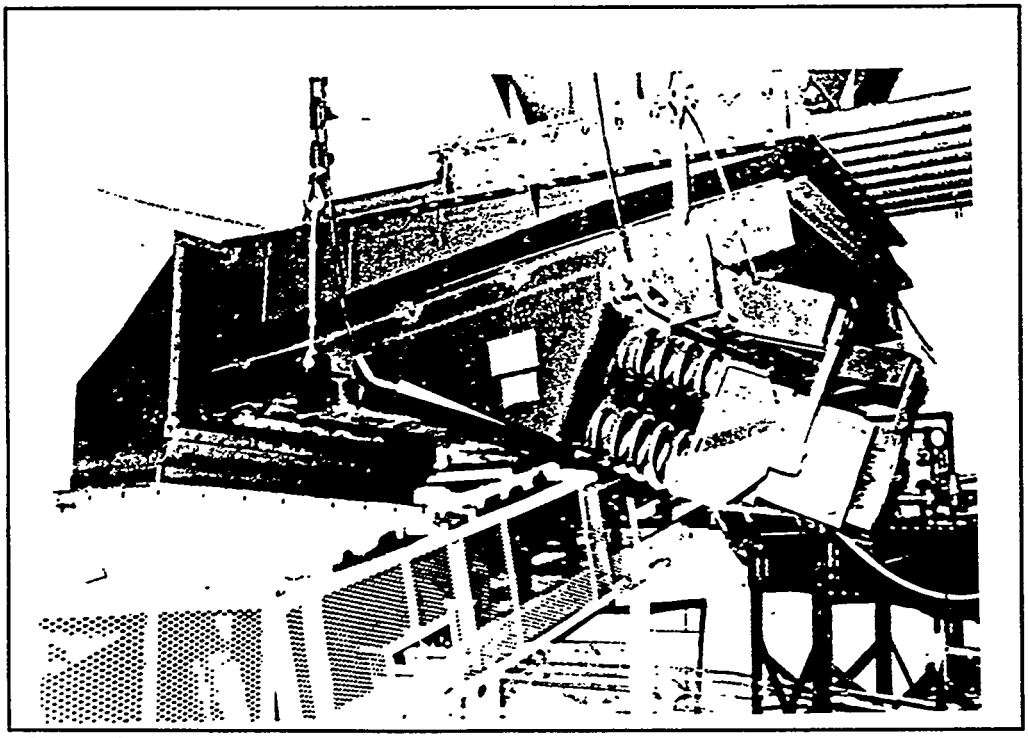


Figure 6.2 Vibrating Feeder

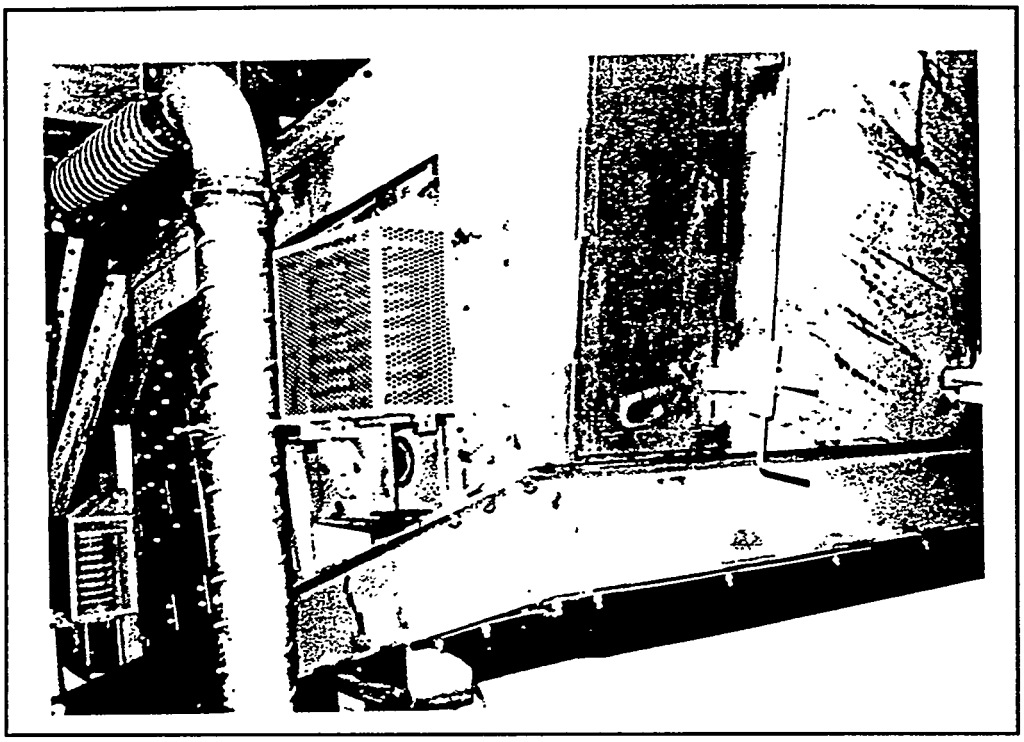


Figure 6.3 Triple Deck Coal Screen

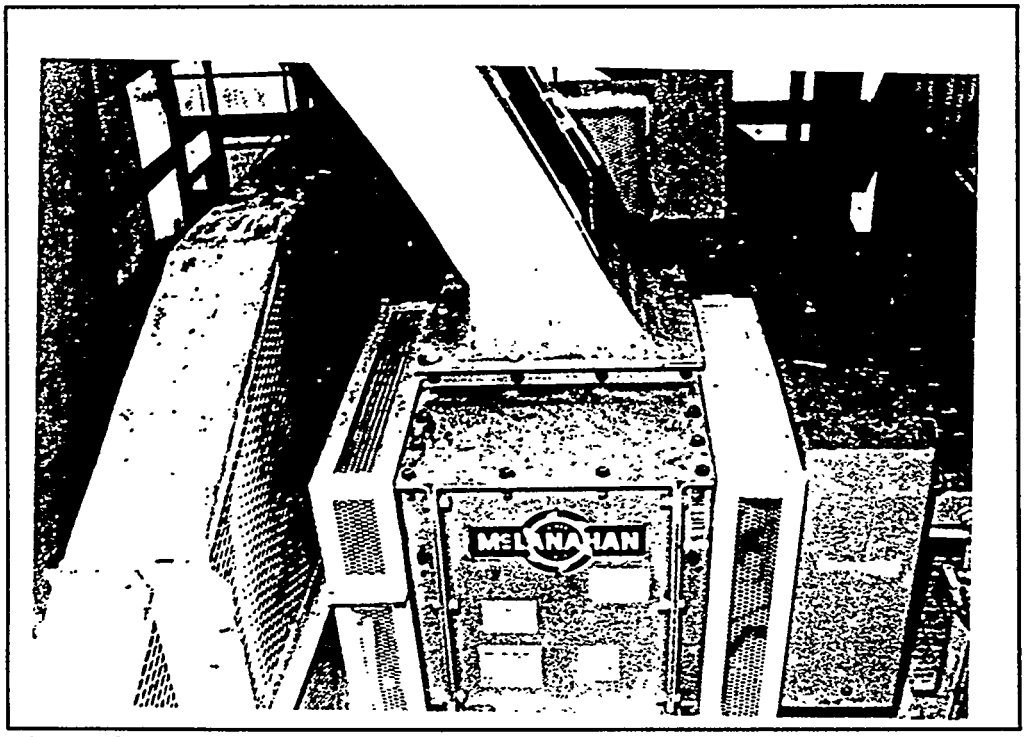
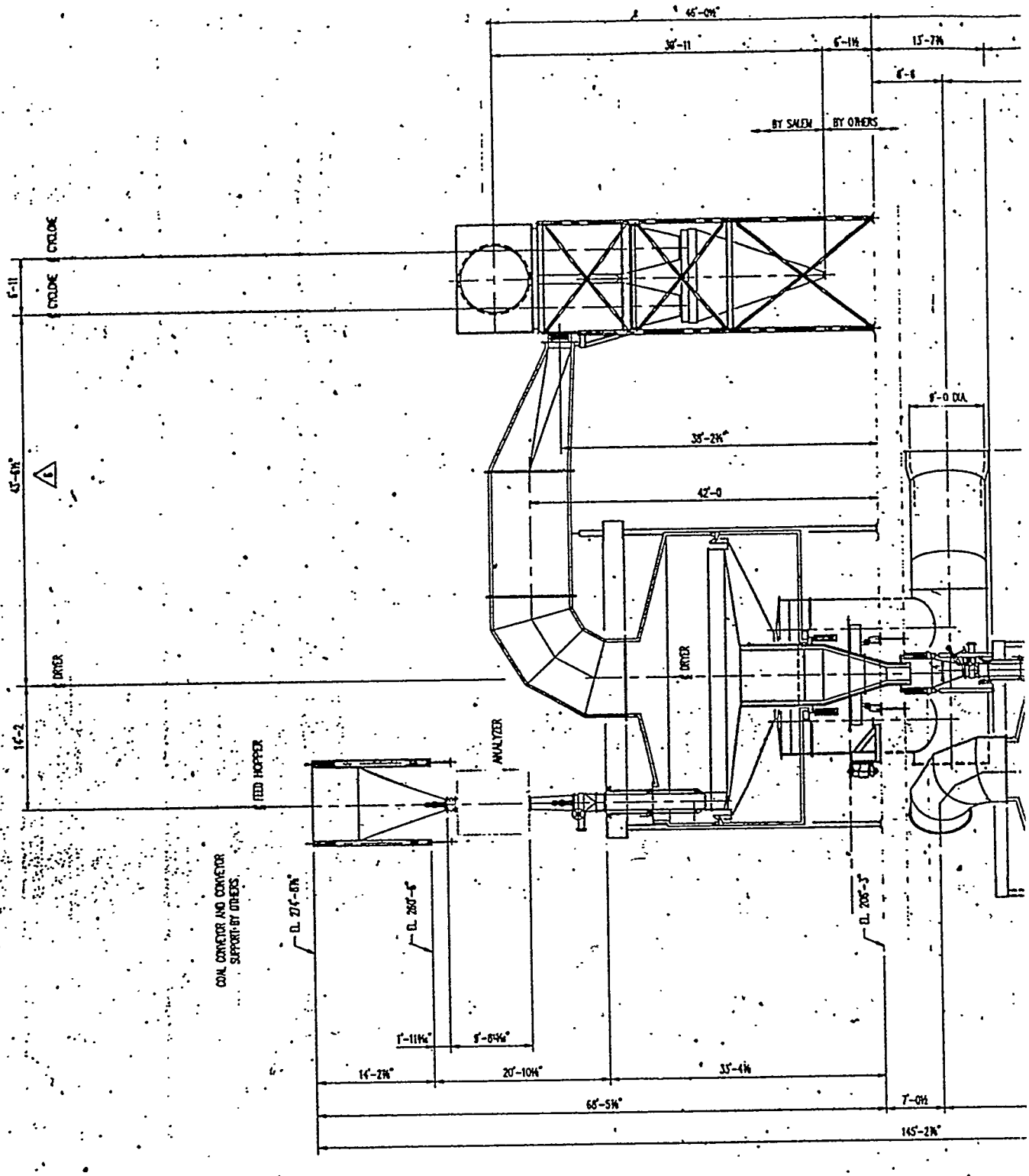


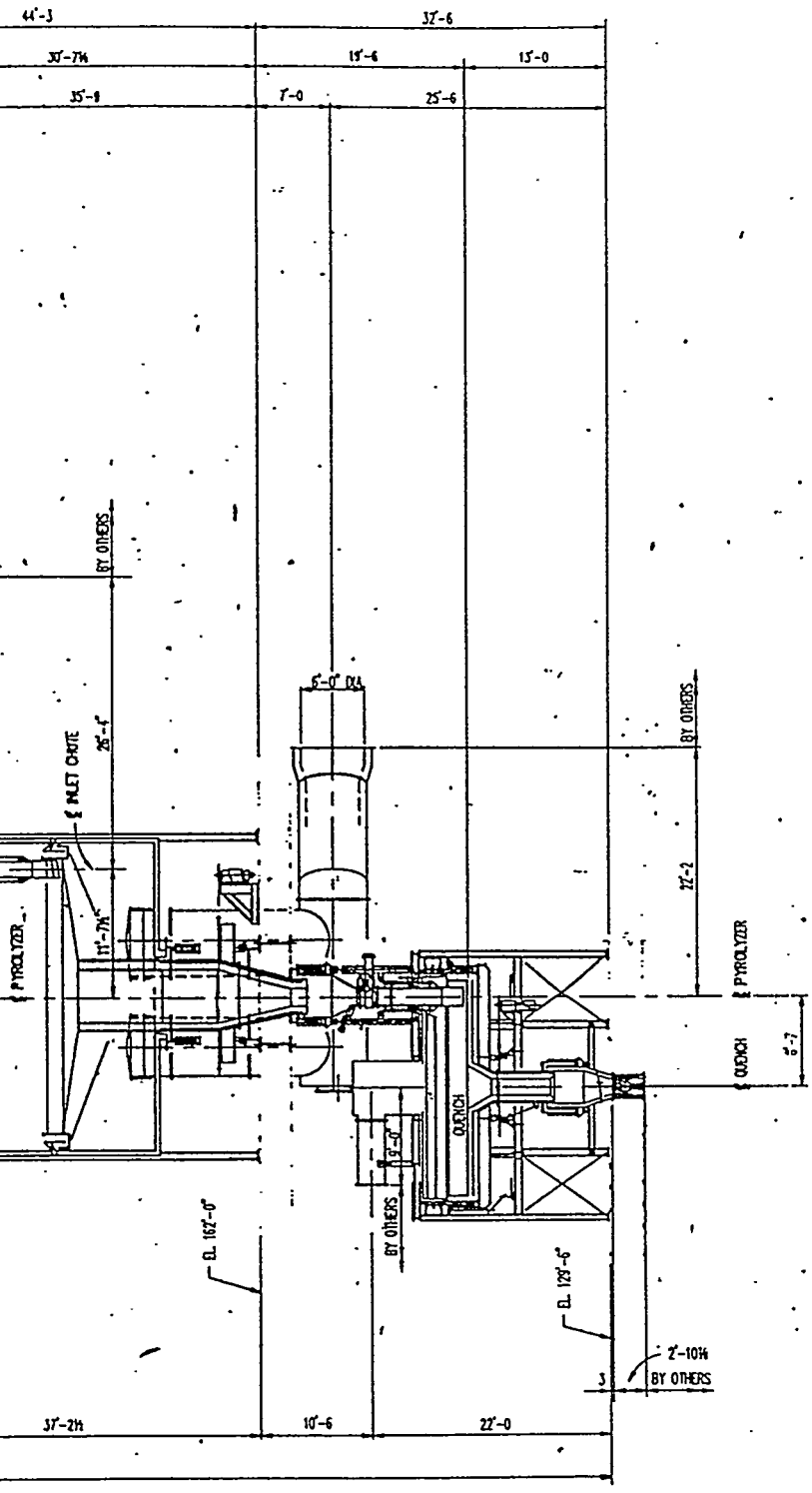
Figure 6.4 Coal Crusher



NO.	REVISION	DATE	CHK.
8			
7			
6	REV. DWG. TO CYCLONE & ROTATED ROD-OUT	9/23/94	T.H.
5	DWG. UPDATED AND ADDED ROD-OUTS	2/17/94	T.H.H.

NO.	REVISION	DATE	CHK.	NO
4	DWG. U			
3	DWG. U			
2	DWG. U			
1	REV. 6			

FINISH 12
11
10
9
STANDARDS



COMPOSITE SECTIONAL ELEVATION
LOOKING WEST

APPROVED FOR CONSTRUCTION
SALEM FURNACE CO.
PITTSBURGH, PA.

REVISED

SALEM FURNACE CO.
ENGINEERING
JUN 4 1991

NOTE-
ACCESS LADDERS, PLATFORMS, AND ETC. BY OTHERS.

ACCEPTANCE
FOR ENGINEERING USE

ENCOAL CORPORATION
MILD GASIFICATION DEMONSTRATION PLANT
GILLETTE, WYOMING

M. W. KELLOGG
JOB NO. 6583 3004
REQ. NO. MWK P.O. #6583-11180-V389-02
VENDOR P. O. NO. 4013
ITEM NO. 101V
ITEM DESCRIPTION DRYER, PYROLYZER, AND QUENCH CHAMBER - COMPOSITE ELEVATION

APPARATUS SHOWN ON THIS DRAWING IS PROTECTED BY U.S. PATENT NO 4,834,650

REVISION	DATE	CHK.	APP
AND REV. JOB NO. (MWS 3004)	11/5/90	T.M.K.	
	6/15/88	T.M.K.	
	7/15/88	T.M.K.	
& REDUCED OVERALL HEIGHT	7/21/88	T.M.K.	

SCALE 1/8"=1'-0" DATE 6/21/88
DR T.M.K.
TR
CHK
APP

Salem furnace co.
a Siemens Company
BOX 2222 • PITTSBURGH, PENNSYLVANIA 15230 • PHONE 412-923-2300

DRYER, PYROLYZER, AND QUENCH CHAMBER
COMPOSITE ELEVATION

JOB No. 4013

Figure 6.5

FF 4013-G5-1

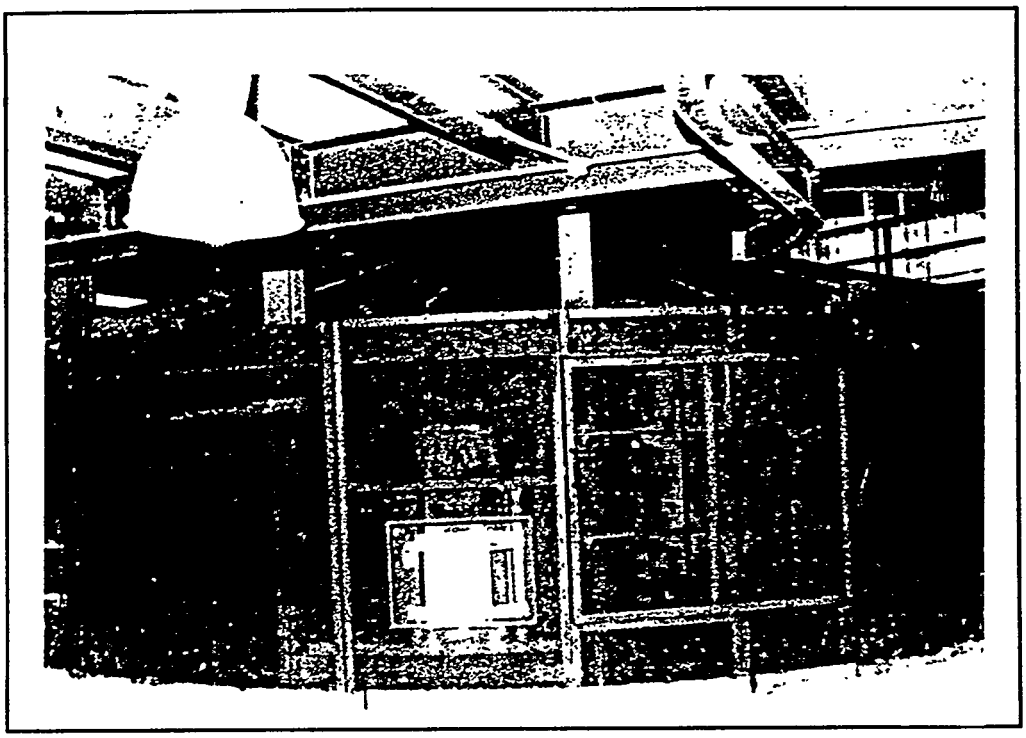


Figure 6.6 Salem Coal Dryer

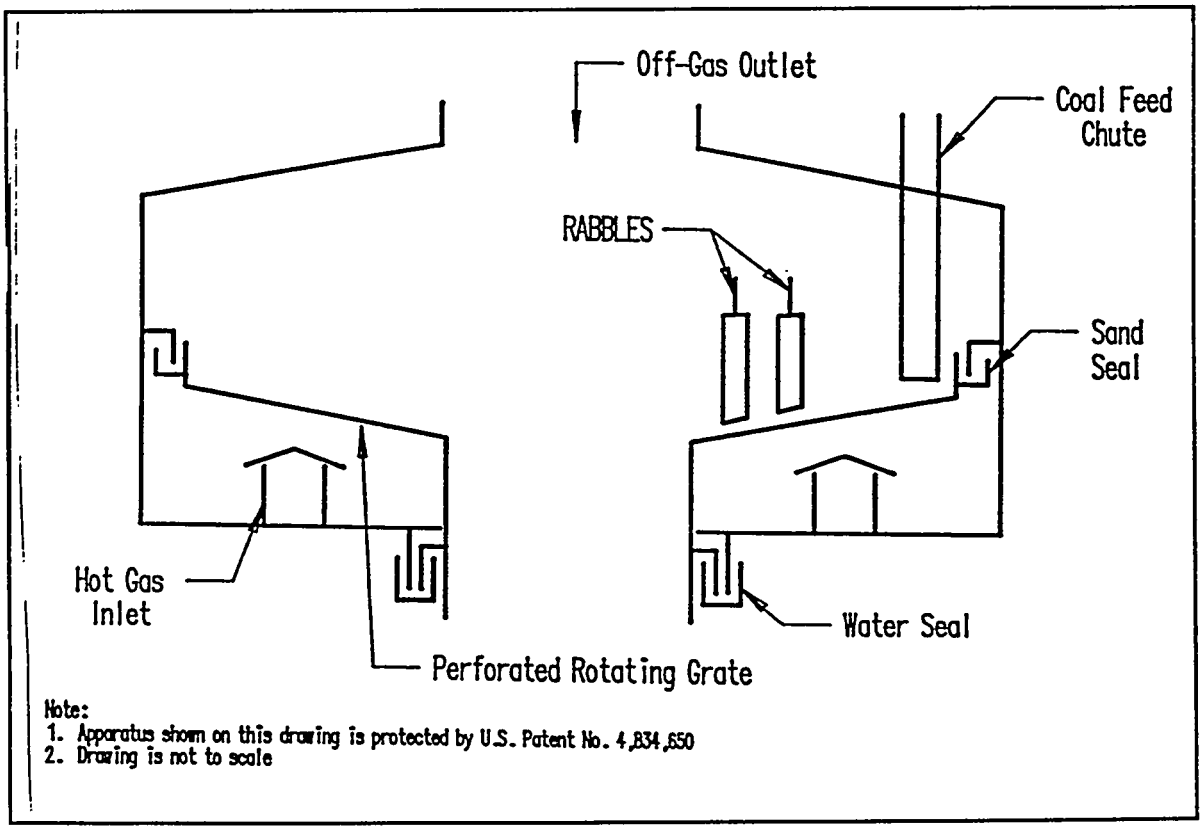


Figure 6.7 Sketch of the Dryer Internals

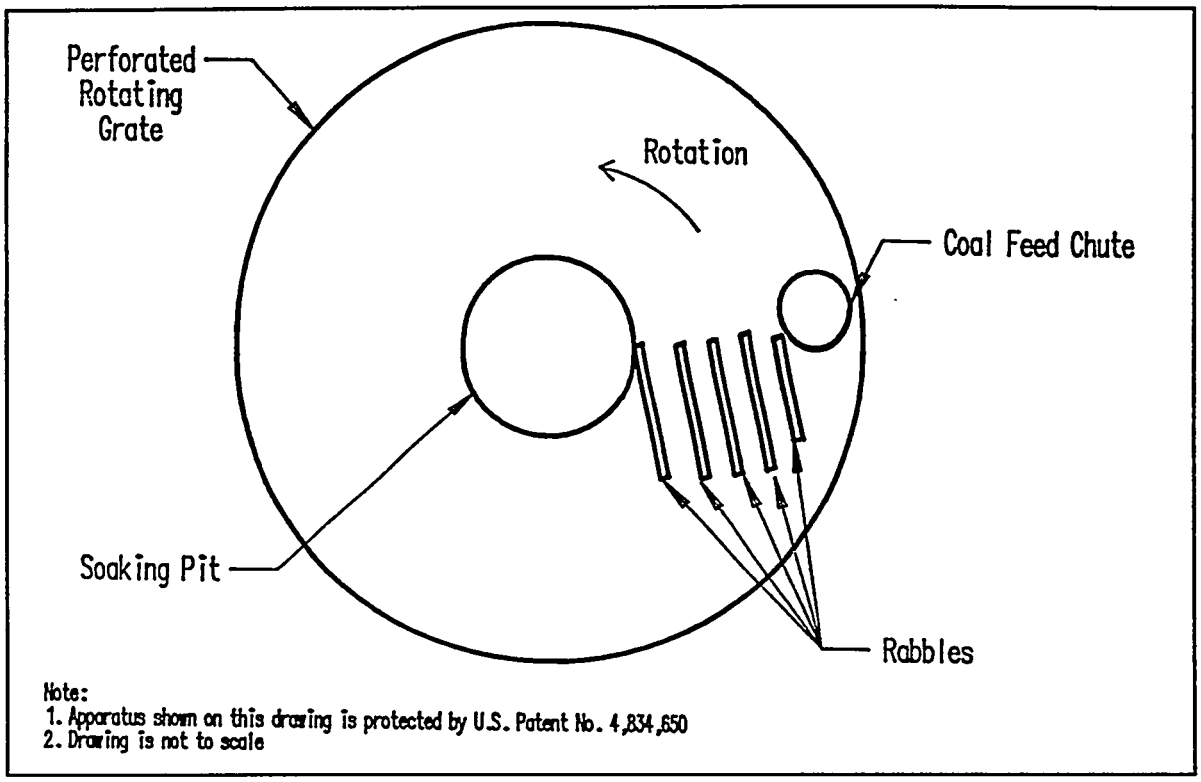


Figure 6.8 Dryer Rabbles Arrangement

As the coal particles move across the grate in a spiral path, they are in direct contact with a hot gas stream that flows upward through the perforated rotating grate. The hot gas stream is a mixture of hot flue gas from the dryer combustor and recycled gas from the dryer. The inlet gas flow rate and temperature to the dryer are the two major control variables which affect the drying process.

Since the perforated grate of the dryer is rotating while the shell of the dryer is stationary, a sand seal was installed between the outer edge of the grate and the shell of the dryer to prevent the hot gas from bypassing the grate through the clearance between the grate and shell. Furthermore, since the rotating structure of the grate extends outside the enclosure vessel, water seals are installed between the external moving and stationary members to contain the gas within the dryer.

The hot gas that flows through the perforated grate removes the moisture from the coal through convective heat transfer. The gas flow rate through the coal bed is not sufficiently high to fluidize the coal. However, some coal fines are entrained. The vapor stream leaving the dryer flows through a cyclone to remove most of the entrained particulates. In the cyclone (Figures 6.9 and 6.10), the dust-laden gas enters a cylindrical chamber tangentially and leaves the vessel through a central opening. The coal fine particles tend to move toward the wall of the cyclone by the virtue of their inertia. Coal particles from the cyclone are collected into a hopper. The collected fines are dropped from the hopper into a screw conveyor/cooler (Figure 6.11) where they are cooled to ambient temperature by indirect heat-exchange with cooling water. The cooled fines are then mixed with water and transferred to the PDF cooler sump.

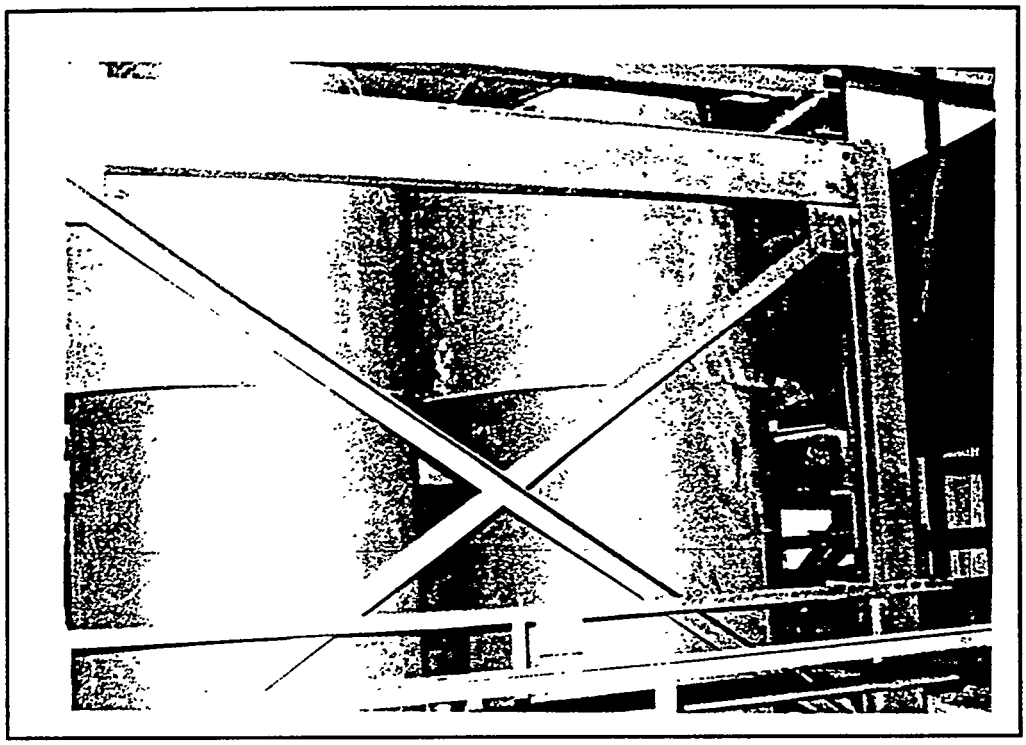


Figure 6.9 Dryer Cyclone

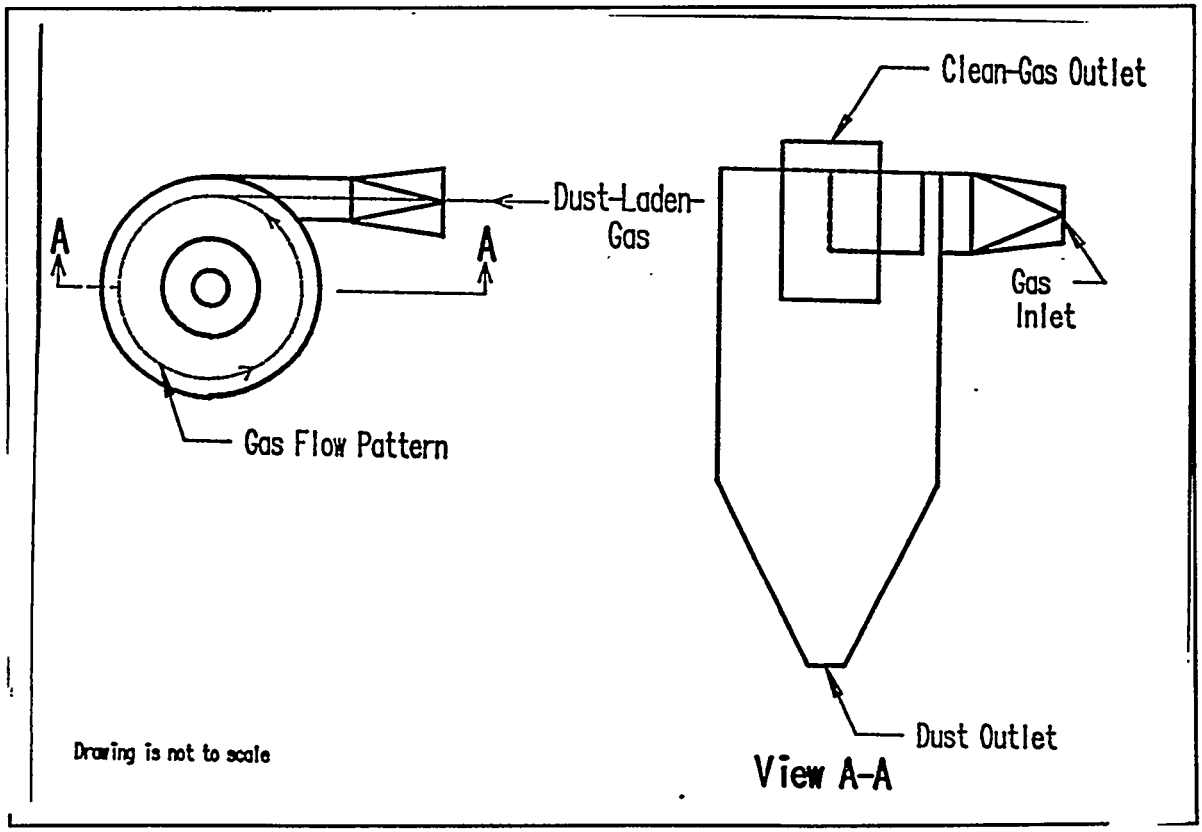


Figure 6.10 Typical Cyclone Design

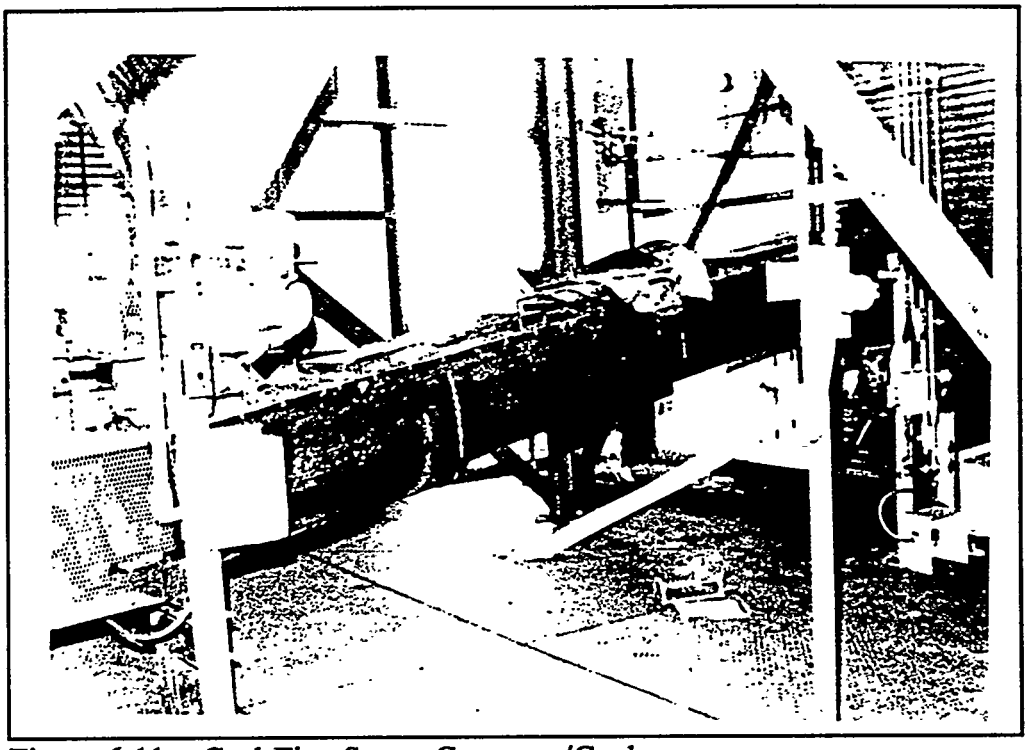


Figure 6.11 Coal Fine Screw Conveyor/Cooler

A motor operated valve is located in the soaking pit which allows dried coal to drop from the dryer into the pyrolyzer. This valve can be closed to isolate one vessel from the other. When operating, a standing leg of solids provides a vapor seal between the two vessels.

6.3 COAL PYROLYZER AND CYCLONE

The pyrolyzer (Figure 6.12) is also manufactured by Salem Furnace Company. Dried coal drops from the dryer into the pyrolyzer through the soaking pit. The design of the pyrolyzer is similar to the dryer. The mechanisms by which coal is moved through the pyrolyzer and heated by a stream of hot gas are essentially the same as those described for the dryer in section 6.2. The grate is perforated for gas flow and has a diameter of 25 ft. 5 in. Solids are discharged from the pyrolyzer through a circular opening in the center of the grate into a quench table situated below the pyrolyzer.

The gas leaving the top of the pyrolyzer flows through the pyrolyzer cyclone to remove entrained coal particulates. The pyrolyzer cyclone operates by the same principle as the dryer cyclone. The coal particulates that are captured by the cyclone are collected into a surge bin where they are mixed with water to form a slurry. The slurry is pumped to a floor sump for treatment as described in section 9.2.

A motor operated valve is located in the soaking pit which allows coal to drop from the pyrolyzer into the quench table. The valve can be closed to isolate one vessel from the other. A standing leg of solids provides the vapor seal between the pyrolyzer and the quench table when this valve is opened.

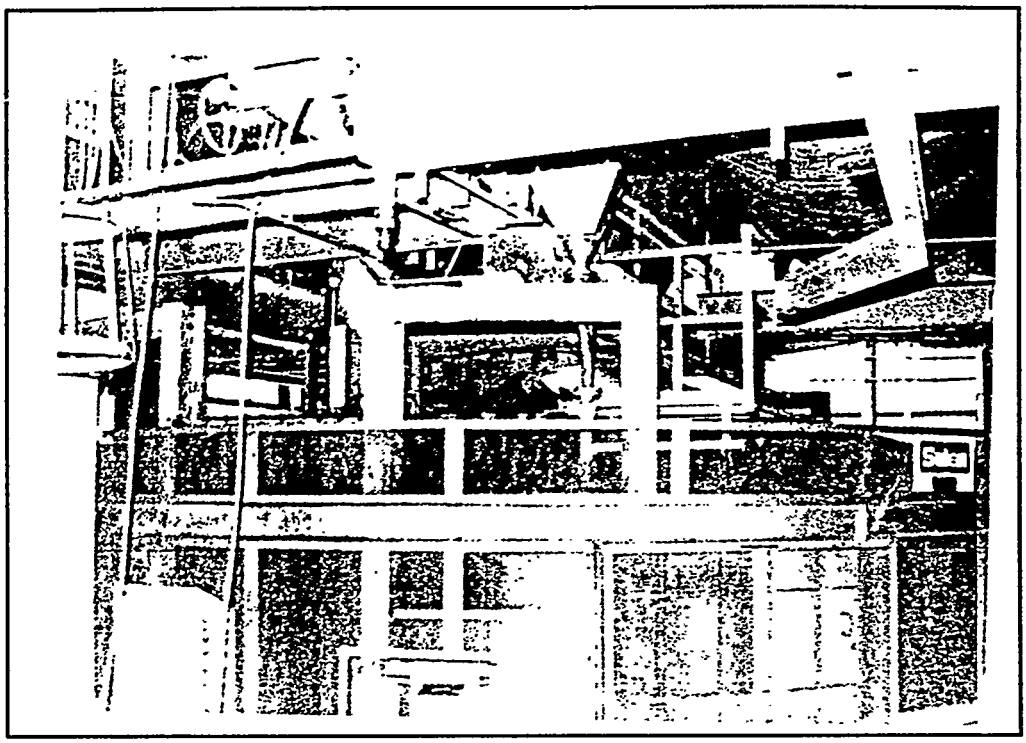


Figure 6.12 Salem Coal Pyrolyzer

6.4 QUENCH TABLE

Hot pyrolyzed coal particles drop from the pyrolyzer central discharge chute onto the outer edge of the rotating deck of the Salem quench table (Figure 6.13). The rotating deck is lined with refractory and has a circular opening in the center for discharging solids. This rotating deck is not perforated, thus being different from those in the dryer and pyrolyzer. As the table rotates, stationary rabbles transfer the pyrolyzed coal from the perimeter to a central outlet chute. As the pyrolyzed coal particles move across the table in a serial path, they are quickly quenched by spraying water on them to stop the pyrolysis reaction. The steam that is generated by quenching the solids is sent to a condenser (Figure 6.14) where it is condensed by cold glycol/water solution. The condensed water is recycled back to the quench table.

6.5 PDF COOLER

The quenched pyrolyzed coal is dropped from the quench table discharge chute through a rotary valve into the PDF cooler where it is cooled to ambient temperature. The cooler (Figure 6.15) is a rotating cylindrical vessel which measures 11 ft. in diameter and 50 ft. in length and is manufactured by the Rennenberg Division of Heyl and Patterson. A general arrangement drawing for this vessel is shown in Figure 6.16. The vessel is oriented horizontally with a slight incline angle. Internally, the vessel contains 120 cooling coils which run the length of the vessel. The coils are 3 1/2 in. in diameter with cooling water flowing through them. Thus, the pyrolyzed coal is cooled indirectly in this vessel. The solids enter the end of the cooler, which has a slight vertical lift, tumble over the cooling tubes, and flow out the opposite end.

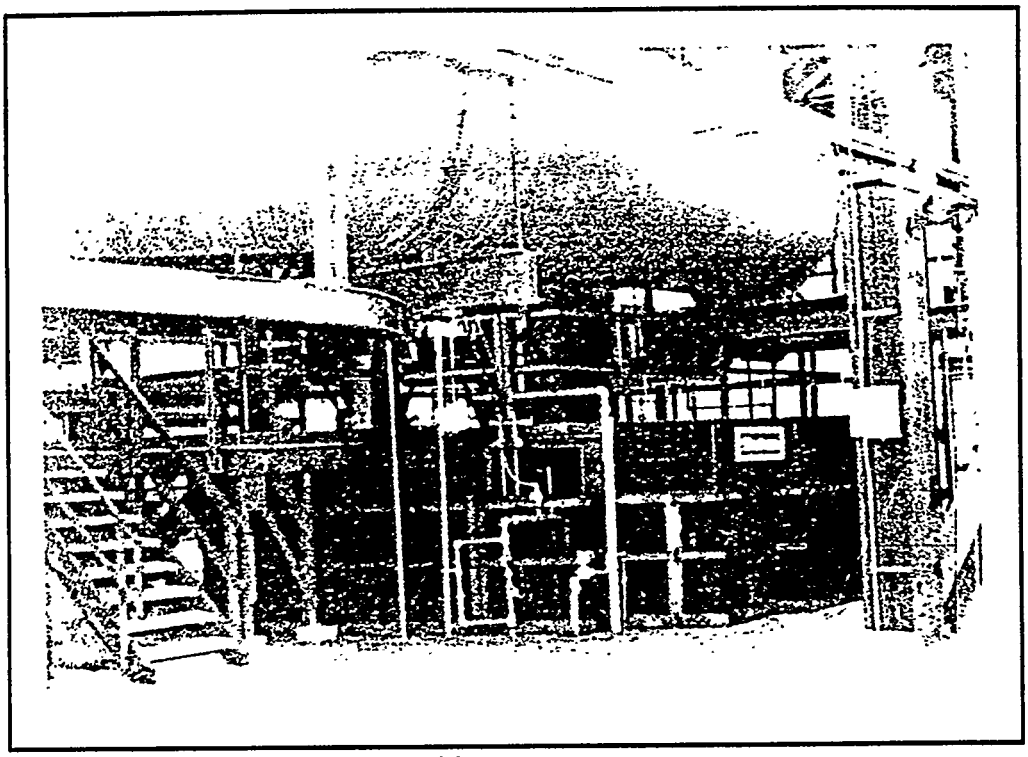


Figure 6.13 Salem Quench Table

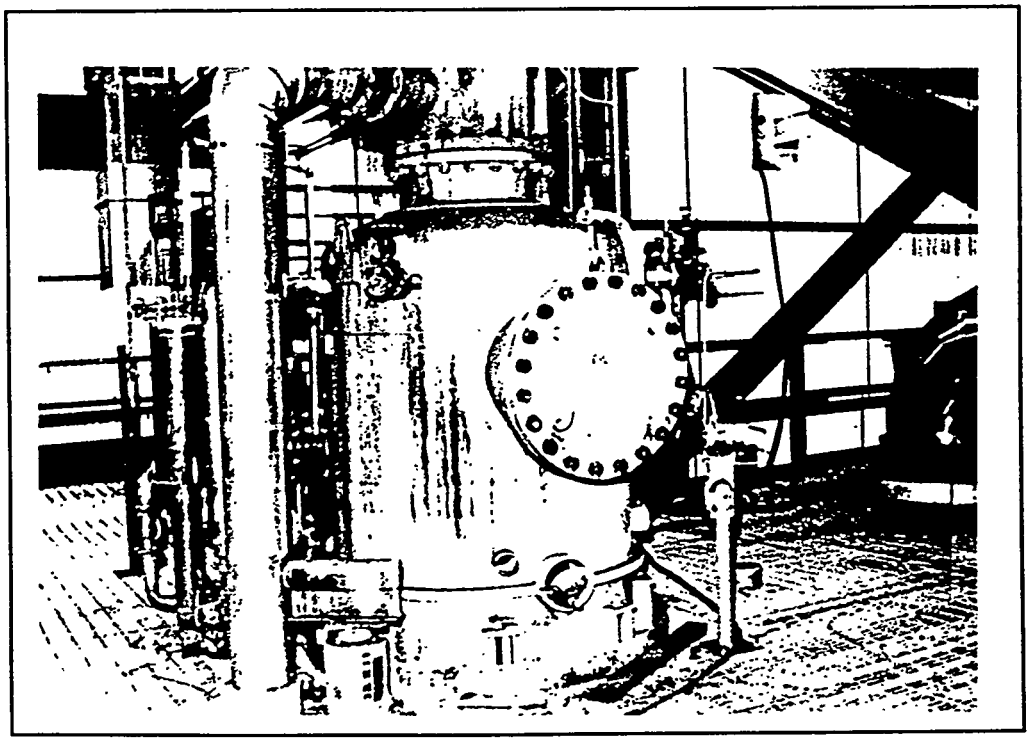


Figure 6.14 Quench Steam Condenser

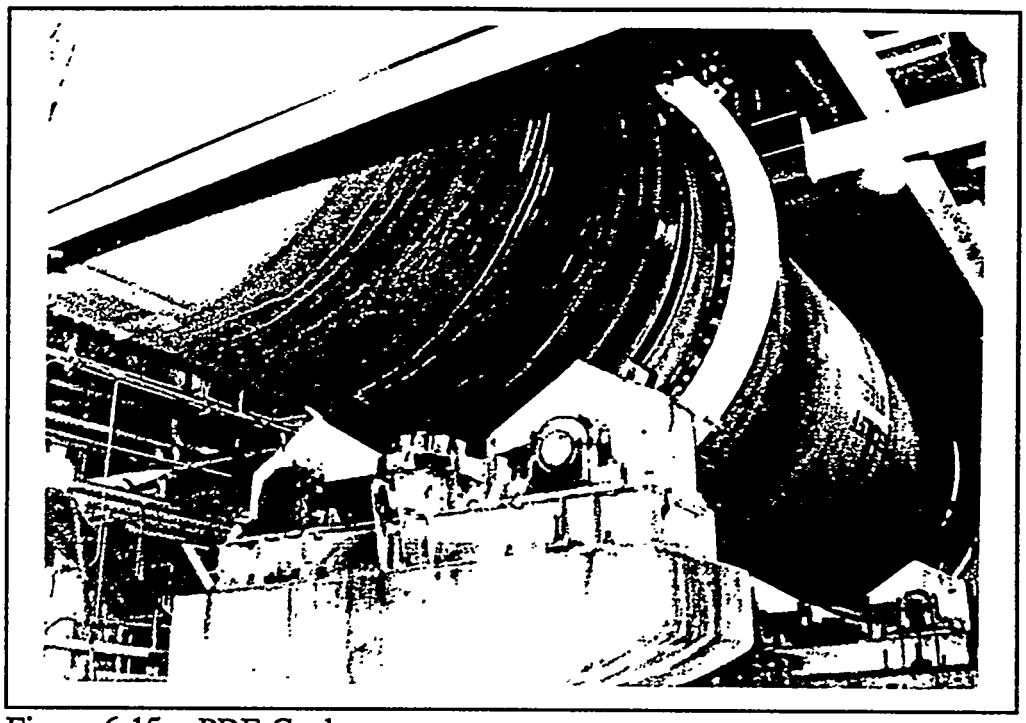


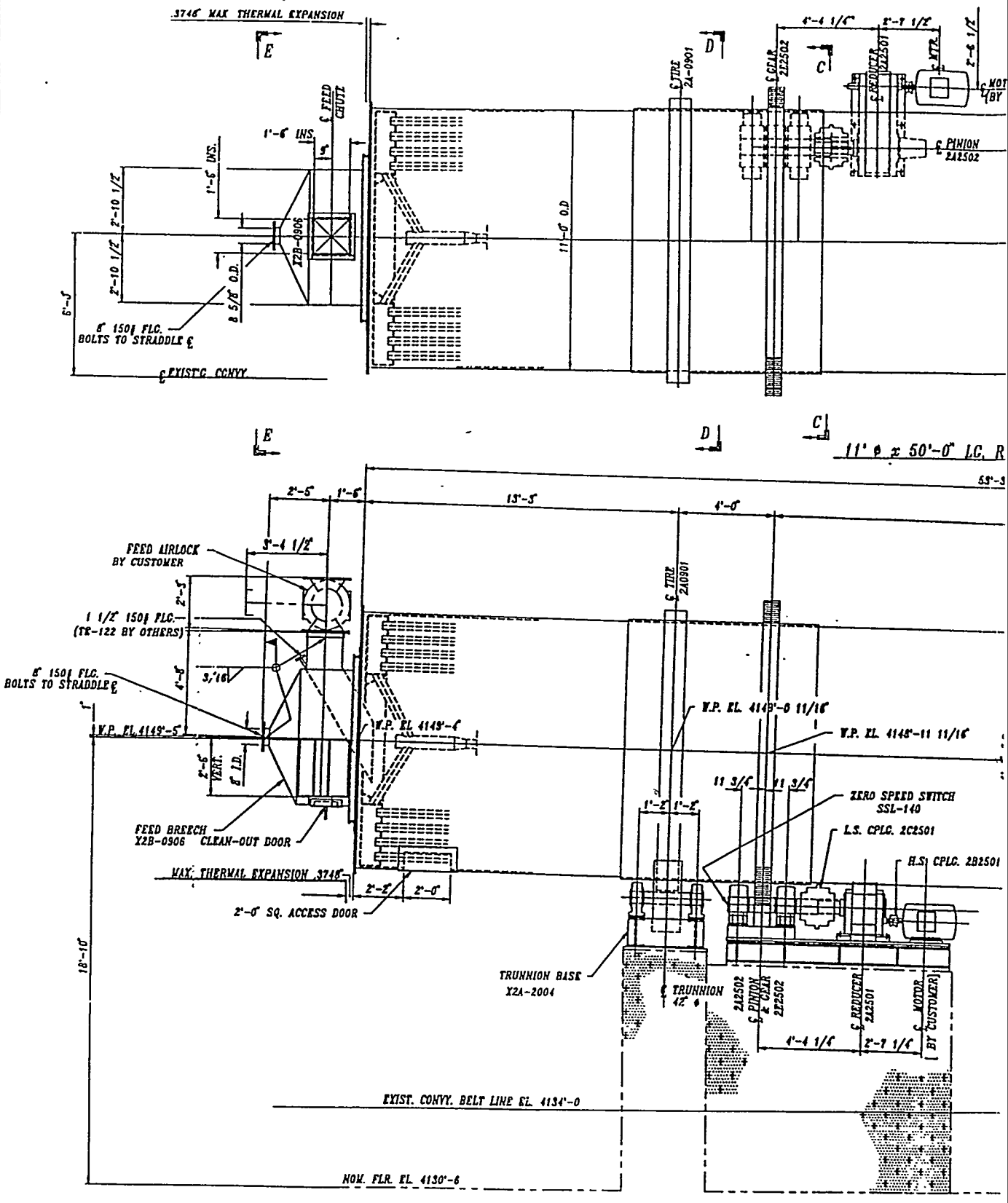
Figure 6.15 PDF Cooler

6.6 PDF PRODUCT SYSTEM

The cooled solids, now PDF, drop from the PDF cooler onto an "S" belt which is a flexible wall, ribbed vertical lifting conveyor and has the same design as the coal feed "S" belt. The PDF is conveyed to a GAMMA-METRIC coal analyzer (Figure 6.17) which measures its moisture, ash, carbon, hydrogen, nitrogen, sulfur and Btu contents. After the PDF passes through the analyzer, it is dropped into the PDF storage silo. When the PDF storage silo is to be emptied, a mass flow feeder transfers the PDF from the silo into a dust suppressant applicator in which a dust suppressant known as MK is applied to the surface of the PDF.

6.7 QUENCH TOWER

The quench tower (Figures 6.18 and 6.19) is a typical packed-bed column which condenses the organics in the off-gas from the pyrolyzer cyclone by bringing the gas into direct countercurrent contact with a liquid (CDL) stream. A general arrangement drawing of the quench tower is shown in Figure 6.20. The vessel is 12.5 ft. in diameter and 80.5 ft. in height. Internal vapor and liquid reflux distributors are provided to achieve cross-sectionally uniform vapor and liquid flows. The column contains a bed of Glitsch Grid packing which provides ample surface area for vapor/liquid contact. Cooled condensed organic liquid (CDL) is circulated by a pump to the top of the column while the off-gas enters the column from the bottom. By direct contact, heat is removed from the off-gas by the CDL and desirable organics condense in liquid form. The hot CDL is then pumped from the bottom of the column through a shell and tube heat-exchanger where it is cooled by a 50/50 glycol water solution as described in Section 7.4. Most of the cooled CDL is recirculated to the top of the quench tower as reflux; a small portion is sent to storage. The temperature and flow rate of the reflux are controlled to give the desired exit temperature for the gas stream leaving the top of the tower.



ELEVATION OF 11' ø x 50' LC. I

NOTES: 1.) INLET AND OUTLET WATER CHAMBER DESIGN PRESS IS
2.) THERMAL EXPANSION (0.3748) AT SOLIDS FEED IS ABS.
FEED CHUTE AND AIR OUTLET ARE FIXED SO NO FLEX

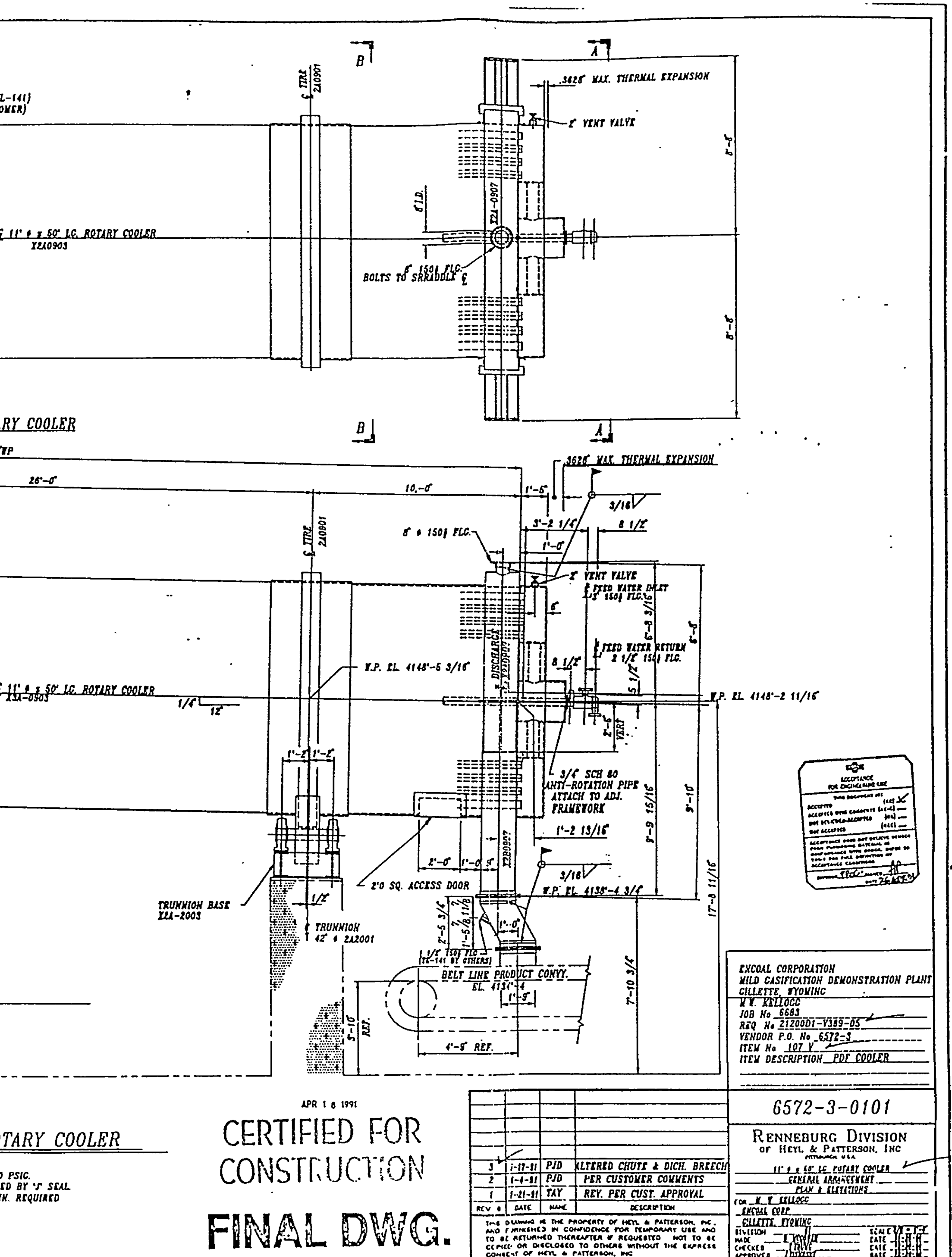

.3626" MAX. THERMAL EXPANSION
2" VENT VALVE
11" ø x 50' LG. ROTARY COOLER
BOLTS TO SADDLE
8" 150# FLG.
2'-0 SQ. ACCESS DOOR
TRUNNION BASE X2A-2003
TRUNNION 42" ø 2A2001
3/4" SCH 80 ANTI-ROTATION PIPE ATTACH TO ADJ. FRAMEWORK
FEED WATER INLET 3" 150# FLG.
FEED WATER RETURN 2 1/2" 150# FLG.
W.P. EL. 4148'-5 3/16"
W.P. EL. 4148'-2 11/16"
W.P. EL. 4138'-4 3/4"
BELT LINE PRODUCT CONVY. EL. 4134'-4
4'-9" REF.
ENCOAL CORPORATION
MILD GASIFICATION DEMONSTRATION PLANT
GILLETTE, WYOMING
M.W. KELLOGG
JOB No 6683
REQ No 21200D1-V389-05
VENDOR P.O. No 6572-3
ITEM No 107 V
ITEM DESCRIPTION PDF COOLER
6572-3-0101
RENNEBURG DIVISION OF HEYL & PATTERSON, INC
11' ø x 50' LG. ROTARY COOLER
GENERAL ARRANGEMENT PLAN & ELEVATIONS
3 1-17-91 PJD ALTERED CHUTE & DICH. BREECH
2 1-4-91 PJD PER CUSTOMER COMMENTS
1 1-21-91 TAY REV. PER CUST. APPROVAL
REV # DATE NAME DESCRIPTION
APR 1 8 1991
CERTIFIED FOR CONSTRUCTION
FINAL DWG.

Figure 6.16

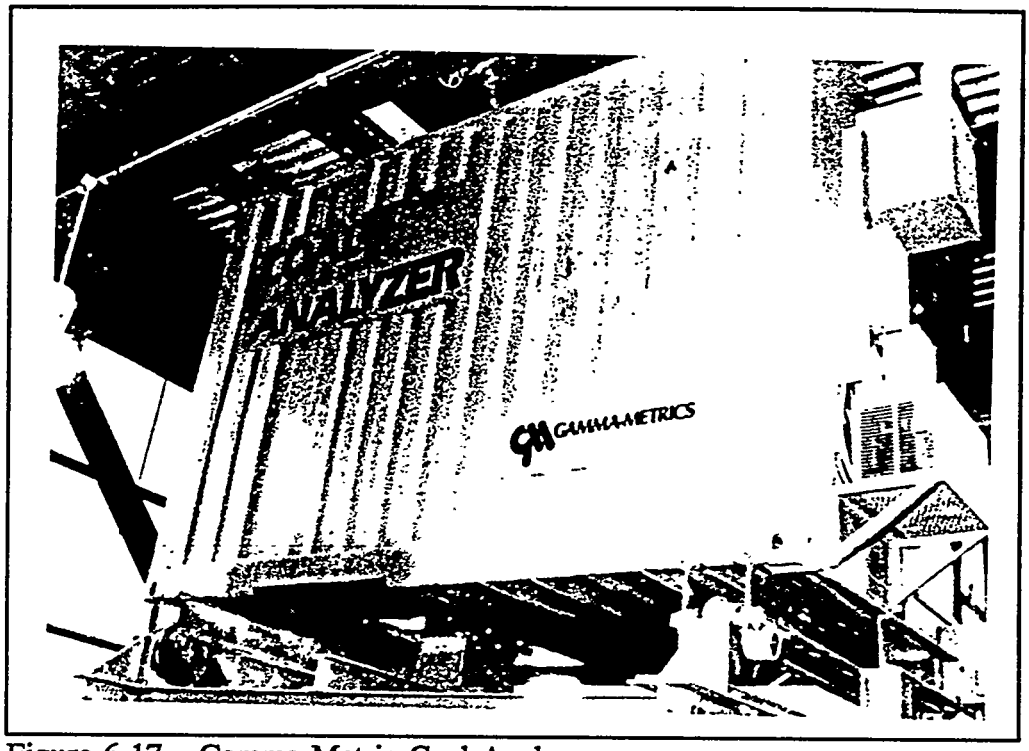


Figure 6.17 Gamma-Metric Coal Analyzer

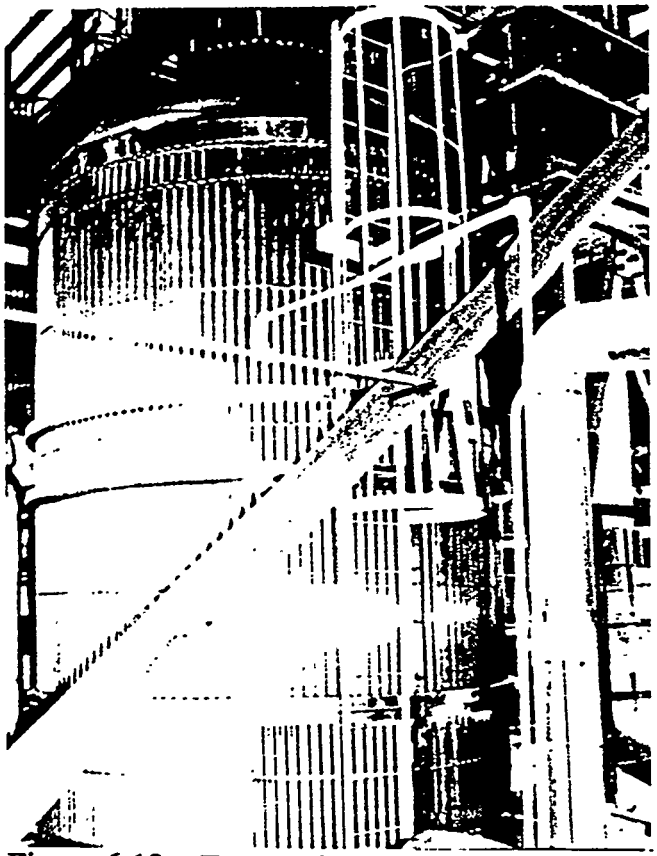


Figure 6.18 Top Portion of the Quench Tower

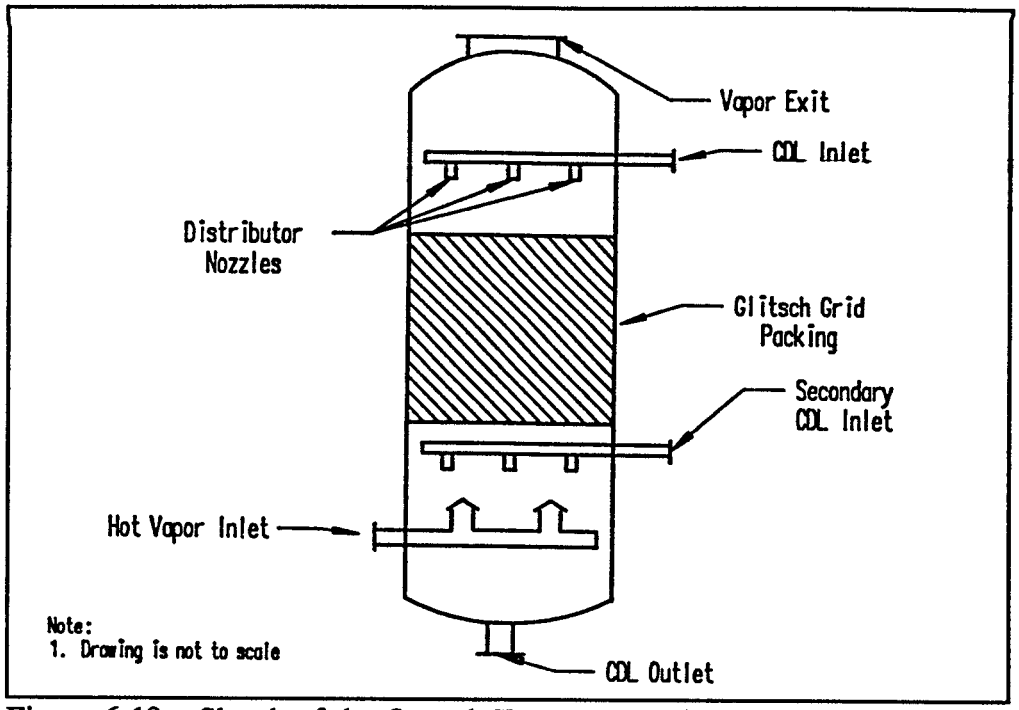


Figure 6.19 Sketch of the Quench Tower Internals

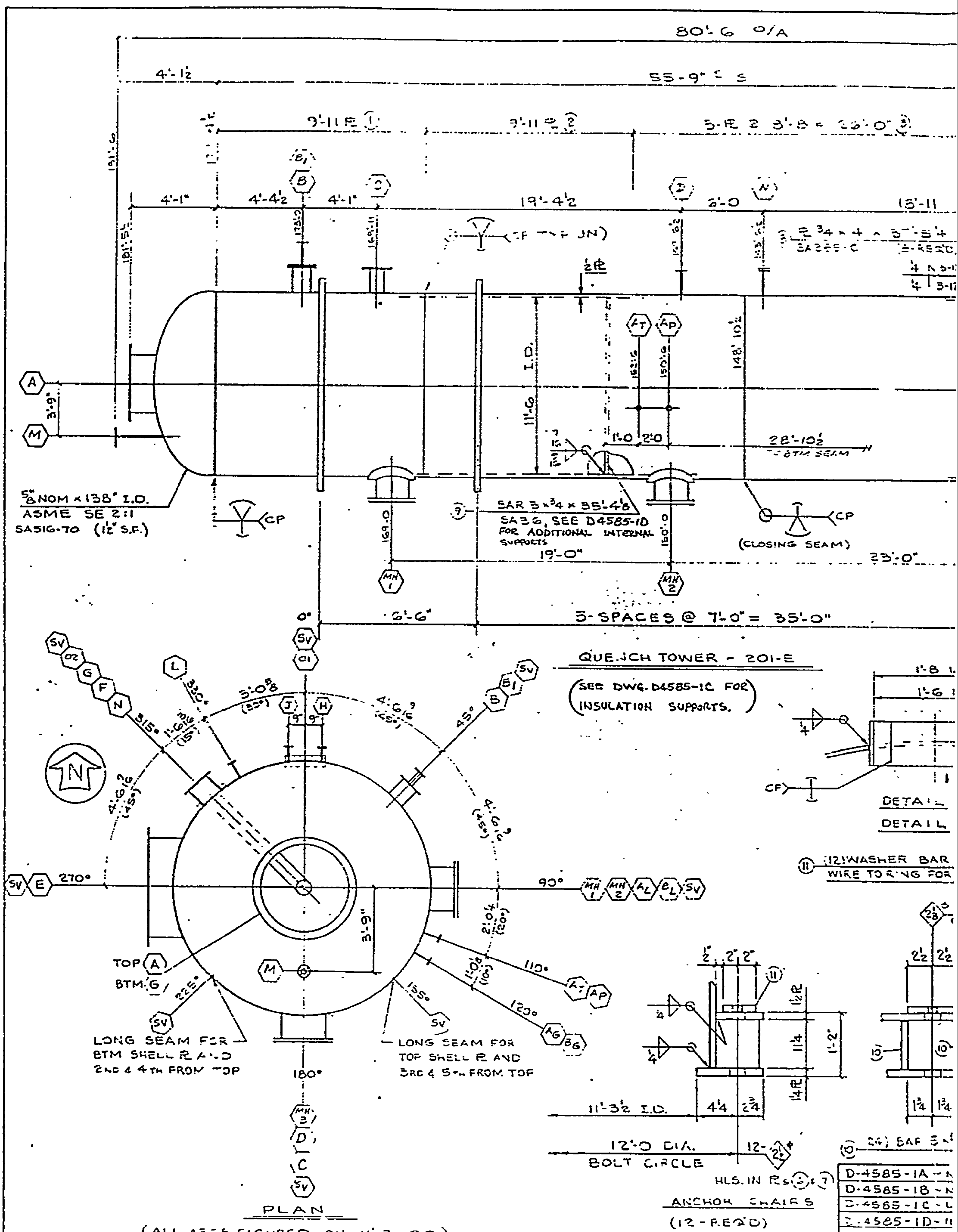
6.8 ELECTROSTATIC PRECIPITATORS

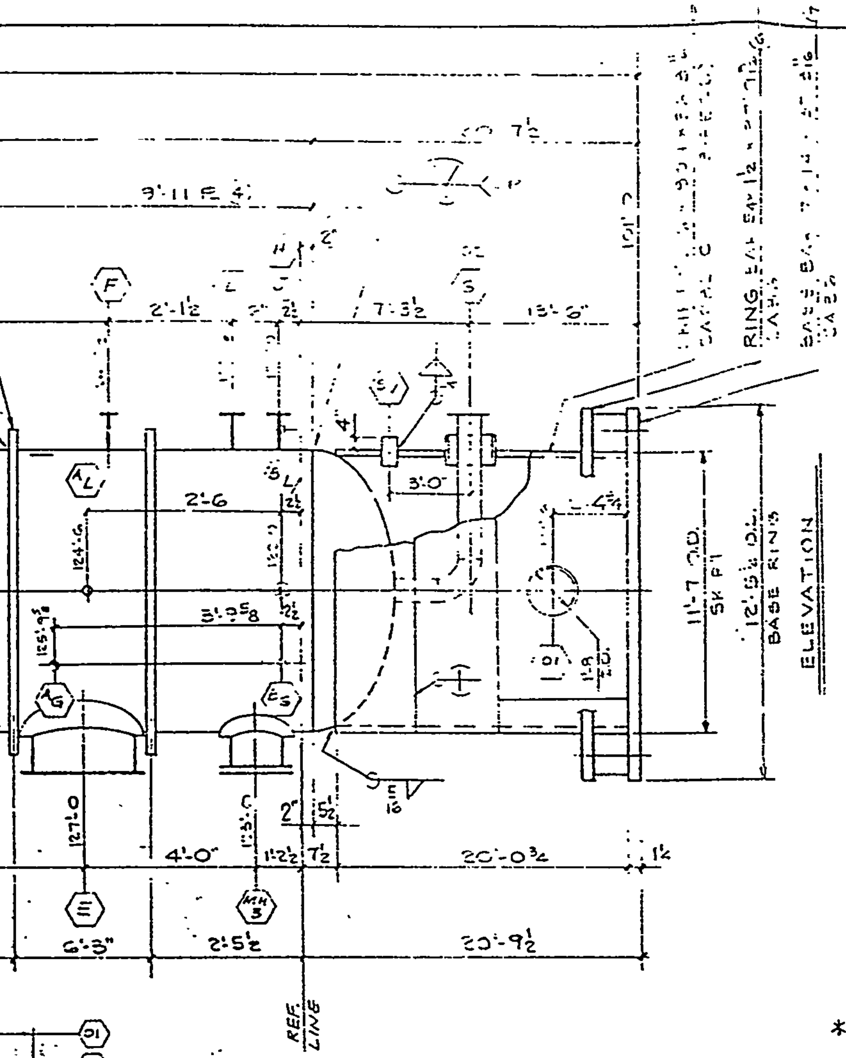
The gas stream leaving the quench tower may contain some CDL in the form of a fine mist. It was predicted that between 25 to 50% of the CDL condensed in the quench tower could be smaller than 2 microns drop size. In order to recover the mist as liquid, three Lodge Cottrell electrostatic precipitators (ESP) operating in parallel were installed. Figure 6.21 shows a general arrangement of the ESP's. Each vessel is 13.5 ft. in diameter, 24 ft. 4 in. in height, and contains nearly 300 electrodes (Figure 6.22). In each tube is a wire electrode (Figure 6.23); the liquid particles are charged by an electric field and move to the surface of the tube where they are collected. This is achieved by maintaining a high electrical potential between the electrode and the tube. Liquid collected in the tubes runs down the tube wall and is collected in the open bottom section of the ESP. From each of the 3 ESP's, the liquid flows by gravity into a collection line that transports it to the bottom of the quench tower where it combines with the rest of the CDL.

6.9 COAL DERIVED LIQUID (CDL) HANDLING SYSTEM

The net liquid product from the LFC process is taken as a slip stream from the reflux being returned to the top of the quench tower. As the CDL flows to storage (Figure 6.24), it is analyzed for immiscible water content by a BS&W monitor. If the water content is greater than 1 percent by volume, the CDL is considered to be off-specification (off-spec) and is automatically diverted to an off-spec CDL storage tank. Off-spec CDL can be pumped back to the quench tower for reprocessing. If the CDL meets specification, it flows into the CDL product storage tank.

CDL can be loaded to tank car or tank truck from the storage tank through a CDL loading pump and meter (Figure 6.25).


80'-6 O/A
55-9" T S
4'-1½
19'-4½
5/8 NOM × 138" I.D.
ASME SE 2:1
SA516-70 (1½" S.F.)
11'-6 I.D.
28'-10½
(CLOSING SEAM)
19'-0"
23'-0"
6'-6"
5-SPACES @ 7'-0" = 35'-0"
QUENCH TOWER - 201-E
(SEE DWG. D4585-1C FOR INSULATION SUPPORTS.)
SA36, SEE D4585-1D FOR ADDITIONAL INTERNAL SUPPORTS
LONG SEAM FOR BTM SHELL R AND 2ND & 4TH FROM TOP
LONG SEAM FOR TOP SHELL R AND 3RD & 5TH FROM TOP
PLAN
(ALL ARCS FIGURED ON 11'-7 O.D.)
11'-3½ I.D.
12'-0 DIA. BOLT CIRCLE
ANCHOR CHAIRS
(12 - REQ'D)
DETAIL
D-4585-1A
D-4585-1B
D-4585-1C
D-4585-1D



℞ ½ x 8⅛ x 5'-4⅝ (01) SA-36
℞ ½ x 8⅛ x 4'-10⅜ (02) SA-36

PAINT NOTES:
EXTERIOR SURFACES ONLY TO BE SANDBLASTED (NEAR WHITE) BOTTOM 6 FT OF SHELL, BOTTOM HEAD, AND UPPER 6 FT OF SKIRT TO BE PRIMED WITH CARBO ZINC 11 (2 - 3 MIL DFT) REMAINING SURFACES OF SHELL AND SKIRT TO BE PAINTED WITH 2 COATS OF TARSET SUPER 1332 (4-6 MIL PER CT DFT).

MARK NO.	NO. REQ'D.	SIZE	DESCRIPTION	SERVICE	REMARKS
5V	8	3"	SCH 40 PIPE	VENT	IN SKIRT
02	1	18"	½" ℞ ROLLED	SKIRT SLEEVE	"
01	1	20"	½" ℞ ROLLED	ACCESS OPENING	"
BL	1	3"	150# RF	INSTRUMENT CONN.	
AL	1	1"	150# RF	"	
AP	1	1"	150# RF	"	
AT	1	1"	150# RF	"	
BG	1	1"	150# RF	LG	
AG	1	1"	150# RF	LG	

NOZZLE SCHEDULE

MARK NO.	NO. REQ'D.	SIZE	DESCRIPTION	SERVICE	REMARKS
[illegible]	1	24	150# RF	MANWAY	[illegible]
[illegible]	1	24	150# RF	MANWAY	"
[illegible]	1	24	150# RF	MANWAY	"
N	1	4	150# RF	SPARE	W/BLIND
[illegible]	1	2"	150# RF	VENT	
L	1	1½	150# RF	STEAM OUT	
[illegible]	1	1½	150# RF	GLYCOL WATER OUT	W/ ¾" CPLG & PLUG
[illegible]	1	1½	150# RF	GLYCOL WATER IN	W/ ¾" CPLG & PLUG
3	[illegible]	12	150# FF	LIQUID OUT	
[illegible]	1	3"	150# RF	LIQUID FROM ESP	
[illegible]	1	24	150# FF	F/PYROLIYZER CYCLONE	
[illegible]	1	4"	150# RF	LIQUID IN	
[illegible]	1	10"	150# RF	LIQUID IN	
B	1	10	150# RF	WASH HEADER LIQ-IN	B1 = 3"
A	1	48"	150# FF	VAPORS OUT	

NOZZLE SCHEDULE

1989 ADDENDA

NOTES

CONSTRUCTION: ALL WELDED, ASME CODE SECT. VIII DIV. 1 ASME SERIAL NO. N.A.
USE QUALIFIED WELDERS AS REQUIRED BY ASME CODE. INSPECTED BY N.A.
MATERIAL: SHELL SA 285-C
HEADS SA516-70
STUDS ASTM A-193 GRADE B7 NUTS ASTM A-194 CLASS 2H
FLANGES SA-105
NOZZLE NECKS SA106 B & SA285-C
GASKETS RING TYPE 4075 FOR PRESS - FULLFACE 2AS NON-PRESS.
COUPLINGS SA-105
X-RAY SPOT STRESS RELIEVE NONE JOINT EFFICIENCY: SHELL 85 %, HEAD 85 %.
INTERNAL DESIGN PRESSURE 16 PSI DESIGN TEMPERATURE 550 °F. EXTERNAL {5.5 PSI @ 100°F, 1.50 PSI @ 550°F}
OPERATING PRESSURE 12.3 PSI @ 190/550 °F. MIN. DESIGN METAL TEMP. -19°F.
CORROSION ALLOWANCE ⅛" HEAD & SHELL MAT'L ARE EXEMPT FROM IMPACT TESTING PER UCS-66 (UG-20(f))
* HYDROSTATIC TEST PRESSURE SHOP 24 PSI
TEST ALL REINFORCING PADS WITH AIR AT NOT LESS THAN 50 LB. AND SOAP SUDS APPLIED TO NOZZLE WELDING INSIDE OF VESSEL.
BOLT HOLES TO STRADDLE VERTICAL CENTER LINE OF VESSEL.
COAT ALL MACHINED SURFACES, INCLUDING FLANGES, BOLTS AND NUTS, WITH RUST PREVENTING COMPOUND.
BEFORE SHIPMENT COVER ALL NOZZLE FACES WITH STEEL OR WOOD. DOPE AND PLUG ALL THREADED OPENINGS.
VESSEL SHALL BE THOROUGHLY CLEANED INSIDE AND OUTSIDE, AND FREE FROM RUST, SLAG, SCALE, WELD SPATTER AND FOREIGN MATTER.
* FIELD HYDOSTATIC TEST PRESSURE 24 PSI @ TOP TANGENT LINE.

TOLERANCES

NOZZLES LONGITUDINAL DIMENSION ± ⅛" SHELL SECTIONS ± ⅛"
NOZZLES ORIENTATION ± ⅛° SHELL OVERALL ±
TRAY SPACING ± ⅛" TRAY OVERALL ± 1"
ALL BUBBLE CAP TRAYS MUST BE FLAT WITHIN ± ⅛" AND MUST BE ASSEMBLED IN VESSEL LEVEL WITHIN 1/16" PER FOOT OF DIAMETER WITH ¼" MAXIMUM.
NOZZLE FACES MUST BE PERPENDICULAR TO RADIAL CENTER LINE ± 1/32" AT OUTSIDE EDGE OF FLANGE.
PAINT EXTERIOR ONLY TO BE SANDBLASTED (NEAR WHITE) (SEE PAINT NOTES)
ESTIMATED SHIPPING WT. 83 500 LB.

This is an **ASME CODE** Vessel

Proceed with fabrication only when material has been checked against

MILL TEST REPORTS

NUMBER REQUIRED ONE (201-E)
CUSTOMER REFERENCE DWG. 411-B1
CUSTOMER P. O. 6683-312 0001-D211-01
CUSTOMER: THE M.W. KELLOGG COMPANY
GILLETTE, WYOMING

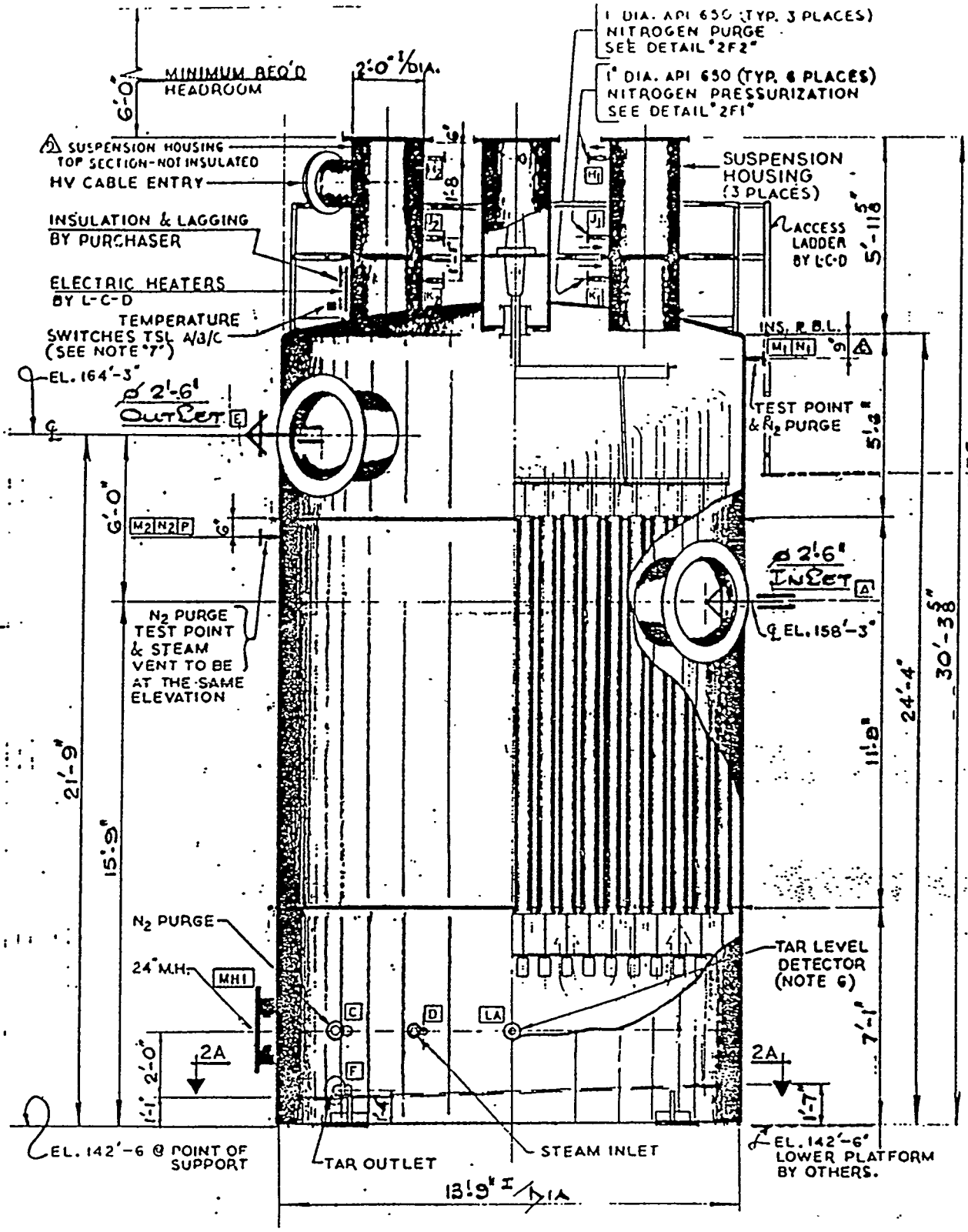
ZZLE DETAILS
ZZLE DETAILS
T LUG & EXT. CLIPS
SUAL BRKT. & COIL DETAILS

NOZZLES A & B WERE RF; ADD INSULATION SUPPORT RING — 5-24-91
CUSTOMER COMMENTS — 4-11-91

13'8" ID QUENCH TOWER
MILD GASIFICATION
DEMONSTRATION PLANT
GILLETTE, WYOMING

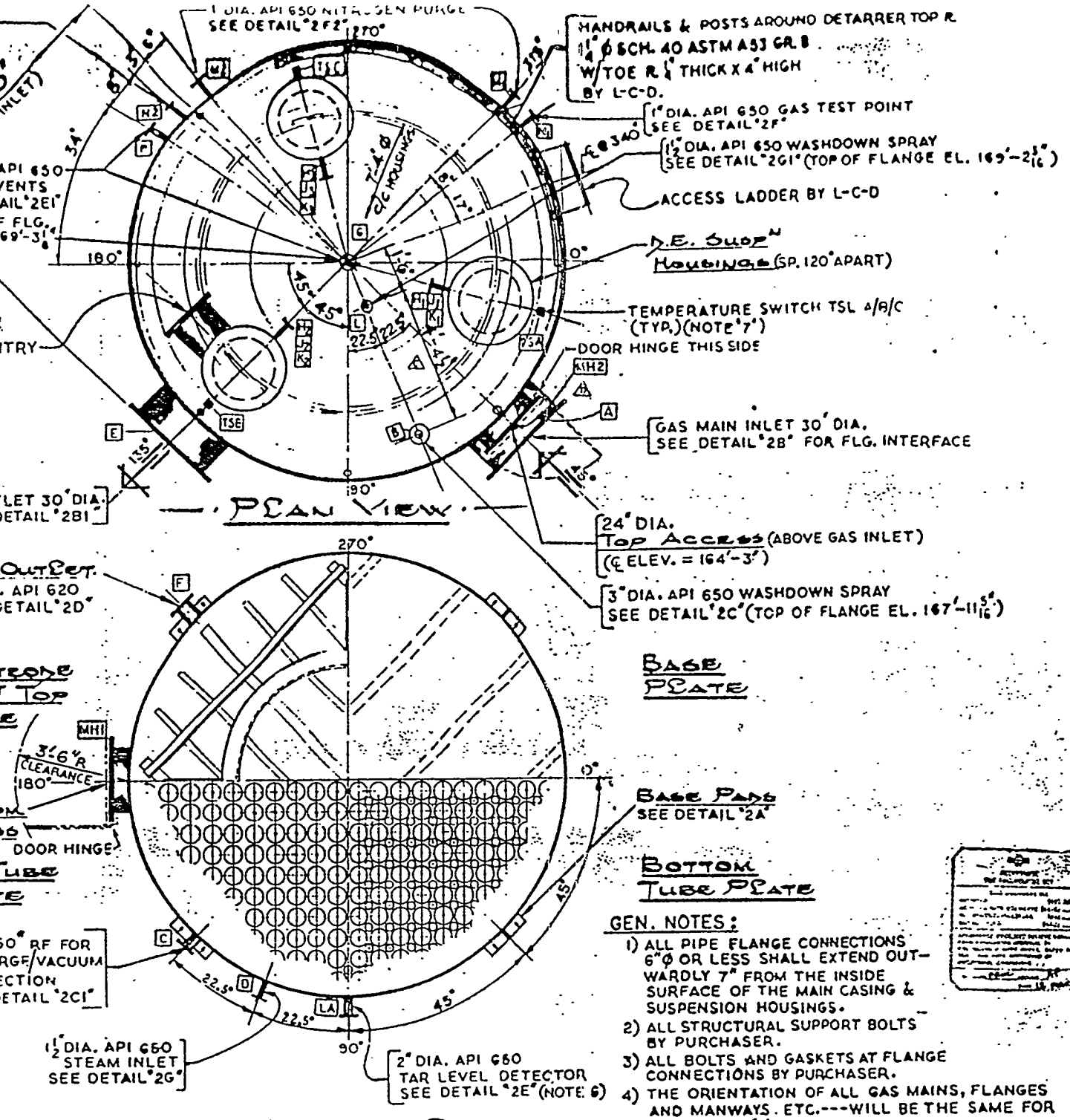
JOB # 7694
DRN BY SBA
DATE 3-5-91
CHKD BY TN

Figure 6.20



PART SECTIONAL ELEVATION

REV	DESCRIPTION
E	ISSUED FOR CONSTRUCTION
D	ADDED DOOR HINGE LOCATION ETC
C	REV. DIM. "9" WAS 6" 4'-4" W
B	REV. PER CUSTOMER COMM
A	ISSUED FOR CUSTOMER AP



GEN. NOTES:

1) ALL PIPE FLANGE CONNECTIONS 6"ϕ OR LESS SHALL EXTEND OUTWARDLY 7" FROM THE INSIDE SURFACE OF THE MAIN CASING & SUSPENSION HOUSINGS.
2) ALL STRUCTURAL SUPPORT BOLTS BY PURCHASER.
3) ALL BOLTS AND GASKETS AT FLANGE CONNECTIONS BY PURCHASER.
4) THE ORIENTATION OF ALL GAS MAINS, FLANGES AND MANWAYS. ETC.---WILL BE THE SAME FOR ALL THREE (3) DETARRERS.
5) QUANTITIES SHOWN ARE FOR ONE (1) DETARRER, THREE (3) DETARRERS REQUIRED THIS CONTRACT.
6) TAR LEVEL DETECTOR LSH 223 ON DETARRER 201VA; LSH 224 ON DETARRER 201VB; LSH 225 ON DETARRER 201VC (SWITCHES NOT BY L-C-D).
7) INSULATOR TEMPERATURE SWITCHES TSL 217A/B/C ON DETARRER 201VA; TSL 218A/B/C ON DETARRER 201VB; TSL 219A/B/C ON DETARRER 201VC (SWITCHES BY L-C-D).

WORK THIS DWG. WITH DWG. 0095320IE002

M.W.K. P.O. 6683-2120001-V514-01 ITEMS 201VA/VB/VC
(3) BDT 1F - 0.5 x 12 - 284

DWN. BY: CMR 1/23/91
CHK. BY: AES 1/29/91
APPR. BY: JET 3/7/91
APPR. FOR CONST. BY: 1/1 3/7/91
SCALE: NONE

ENVIRONMENTAL PRODUCTS DIVISION — DRESSER

ENCOAL CORPORATION
MILD GASIFICATION DEMONSTRATION PLANT
GILLETTE, WYOMING
GENERAL ARRANGEMENT OF DETARRER

DWG. NO. Figure 6.21 REV. E

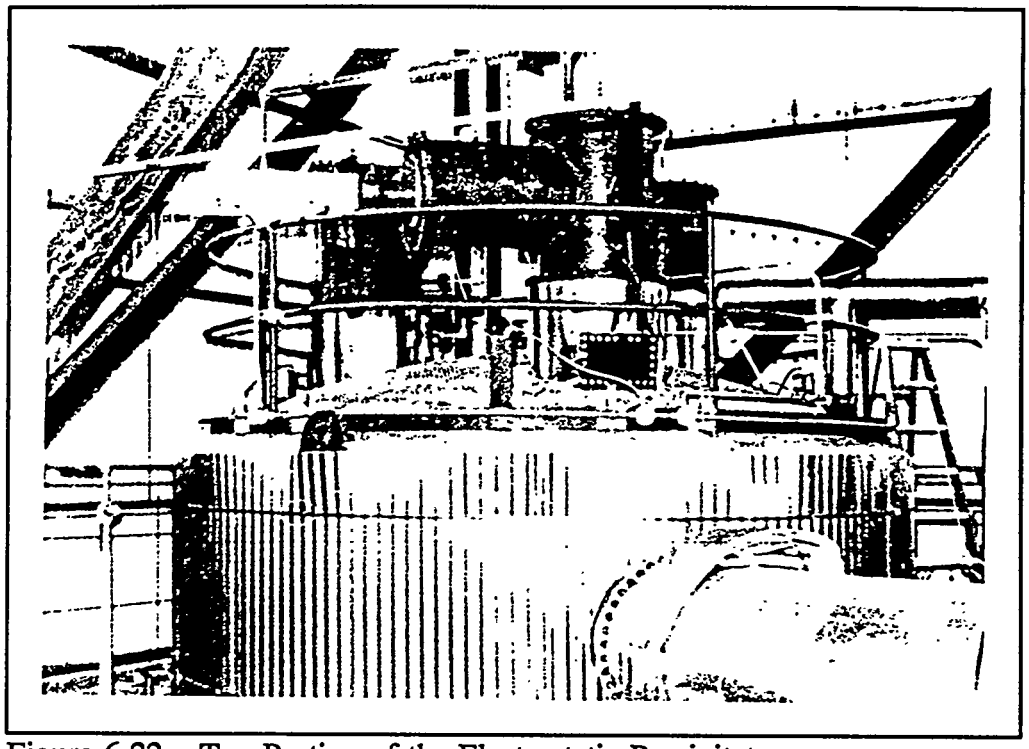


Figure 6.22 Top Portion of the Electrostatic Precipitator

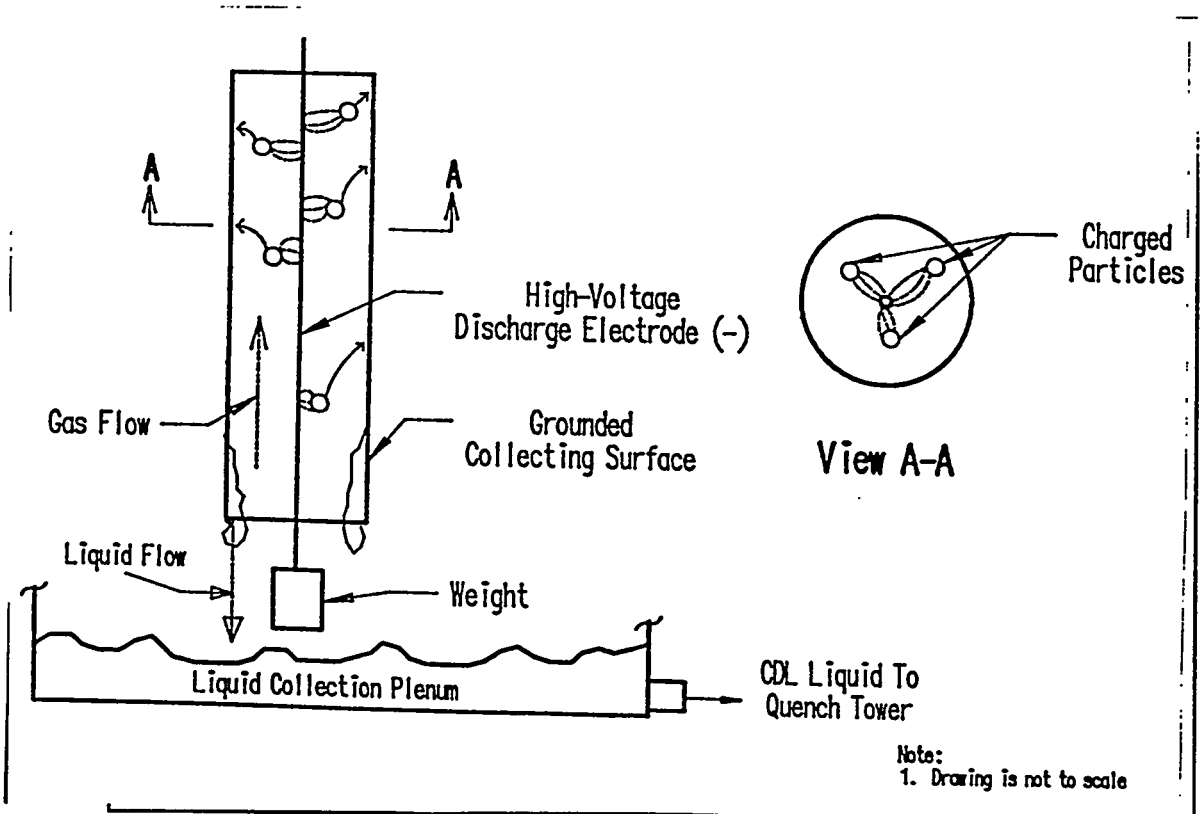


Figure 6.23 Sketch of Electrode Arrangement

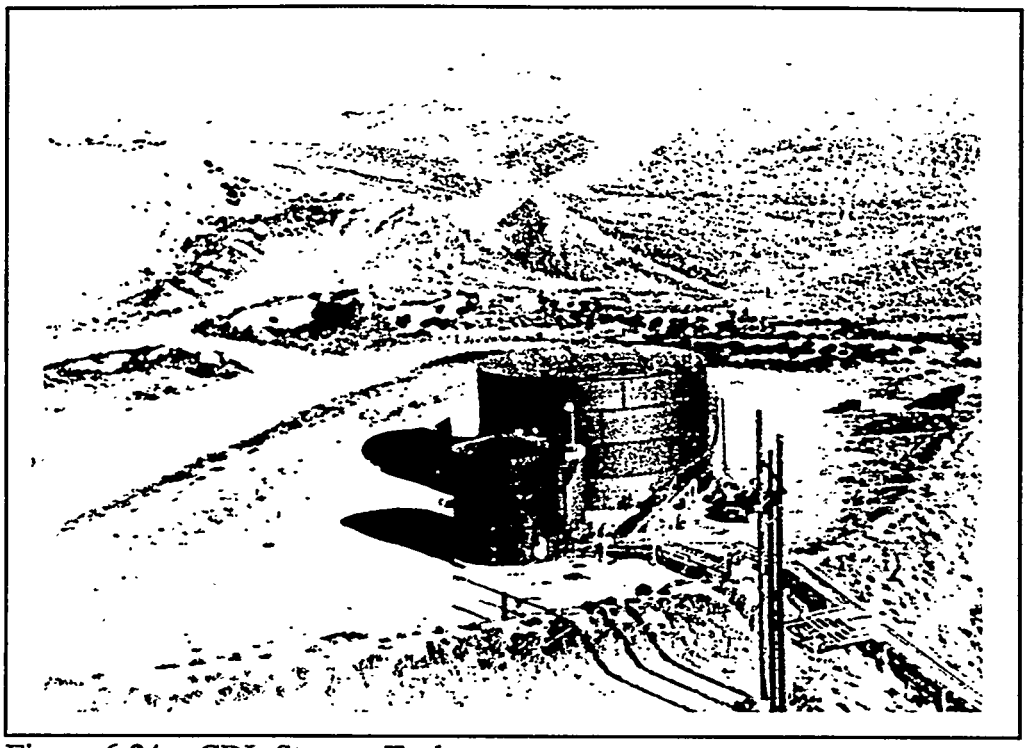


Figure 6.24 CDL Storage Tanks

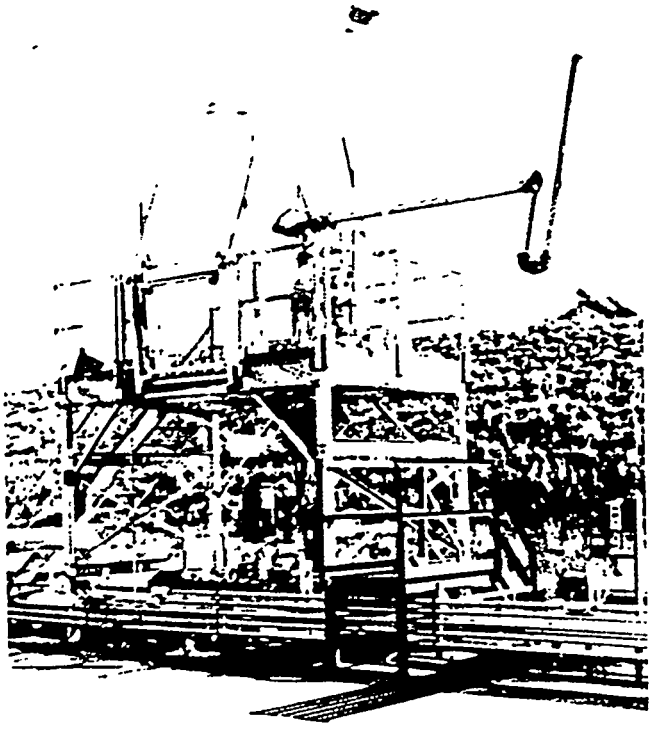


Figure 6.25 CDL Meter

6.10 DRYER BLOWER

Recirculation of hot gases in the dryer loop is provided by a large blower (Figure 6.26). Recycled gas flows from the dryer cyclone to the suction of the blower. The gas is then pushed by the blower, mixed with the hot flue gas from the dryer combustor, and moved into the dryer under the grate to provide heat for the drying process. The dryer blower is a high-volume, low-head fan driven by a 1000 HP, 1200 RPM electric motor. The motor is connected to the blower through a variable speed fluid-coupling. Gas flow demands are met by adjusting the settings on the variable speed coupling. The maximum head differential that the blower will develop is about 23 in. of H_2O pressure. The height of the blower shell is 16 ft. and the suction and discharge ducts are 8 ft. in diameter.

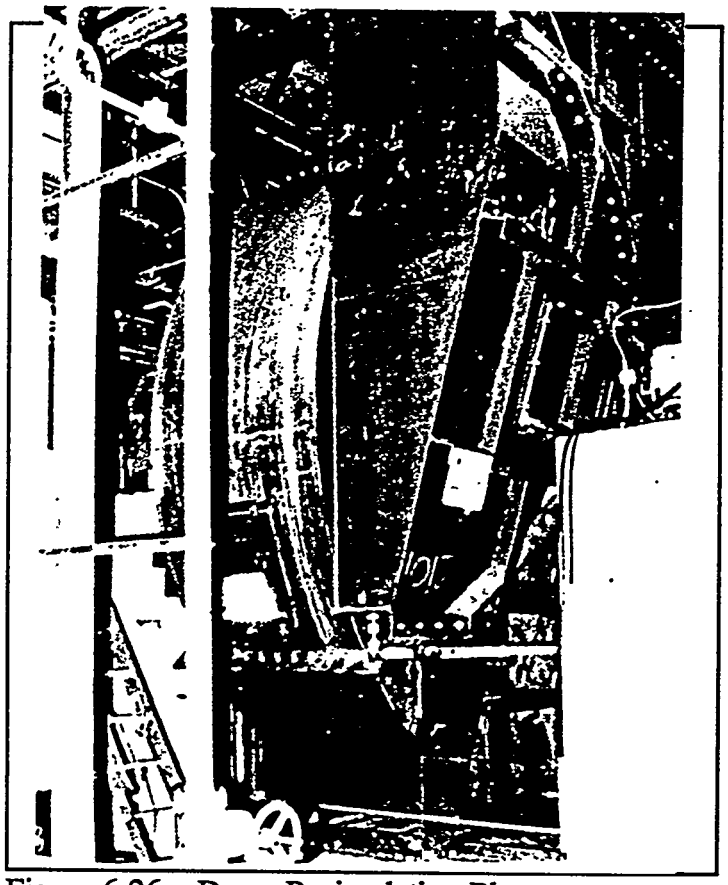


Figure 6.26 Dryer Recirculation Blower

6.11 PYROLYZER BLOWER

A 600 HP blower moves the pyrolyzer off-gas from the ESP's to the combustors and to recirculation in the pyrolyzer loop. The shell of the pyrolyzer blower (Figure 6.27) is 12 ft. 3 in. in height and a 1780 RPM motor drives the blower. Gas flow control is achieved by adjusting an inlet damper located at the blower suction. The maximum differential head that the blower will develop is about 31 in. of H_2O pressure. The suction and discharge ducts are 4 ft. in diameter.

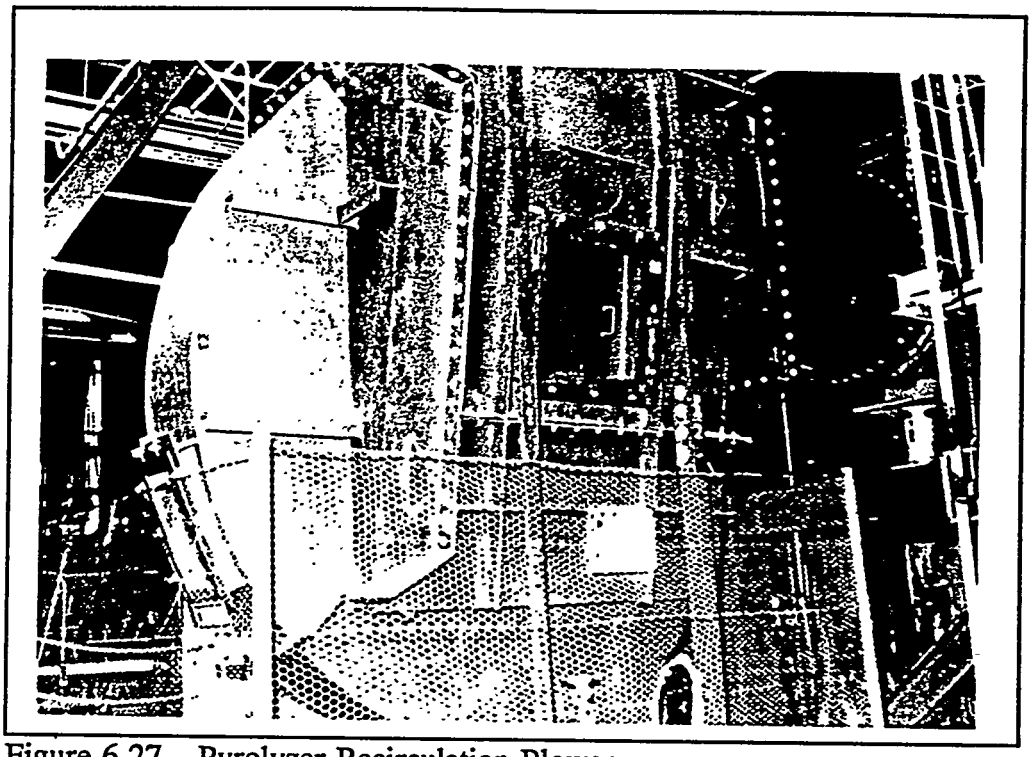


Figure 6.27 Pyrolyzer Recirculation Blower

6.12 COMBUSTORS

The dryer and pyrolyzer combustors (Figure 6.28) are gas fired heaters which supply the heat required for drying and pyrolyzing the coal. A general arrangement drawing typical of both combustors is shown in Figure 6.29 and Figure 6.30 shows the internals. Recycled gas from the discharge of the pyrolyzer blower, which contains non-condensible hydrocarbons, is the primary fuel for each combustor. Due to the low Btu value of the recycled gas (50-70 Btu/SCF), natural gas is burned as supplemental fuel. Each combustor is equipped with a forced draft air blower (Figure 6.31) which supplies air for combustion and takes suction from the atmosphere. Each blower is driven directly by a 100 HP motor.

The combustors contain a natural gas fired pilot burner for the ignition of the flame within the combustor. Each combustor is equipped with natural gas burners which can deliver a maximum of 17 MM Btu per hour. The primary fuel burners are ring type which contain clusters of nozzles. The burner management system for each combustor is controlled by individual programmable logic control (PLC) systems. The PLC monitors a number of variables and controls the natural gas and air so that the on-gas temperatures to the dryer and pyrolyzer are maintained.

6.13 PURGE GAS TREATMENT

In order to meet environmental standards, the purge gas being discharged to the atmosphere by the LFC process must be treated. The off-gas from the process, containing mostly water vapor, nitrogen, carbon dioxide and small amounts of sulfur oxides, (Table 6.1) is vented to a desulfurization unit (Figure 6.32) which consists of a wet gas scrubber and a horizontal

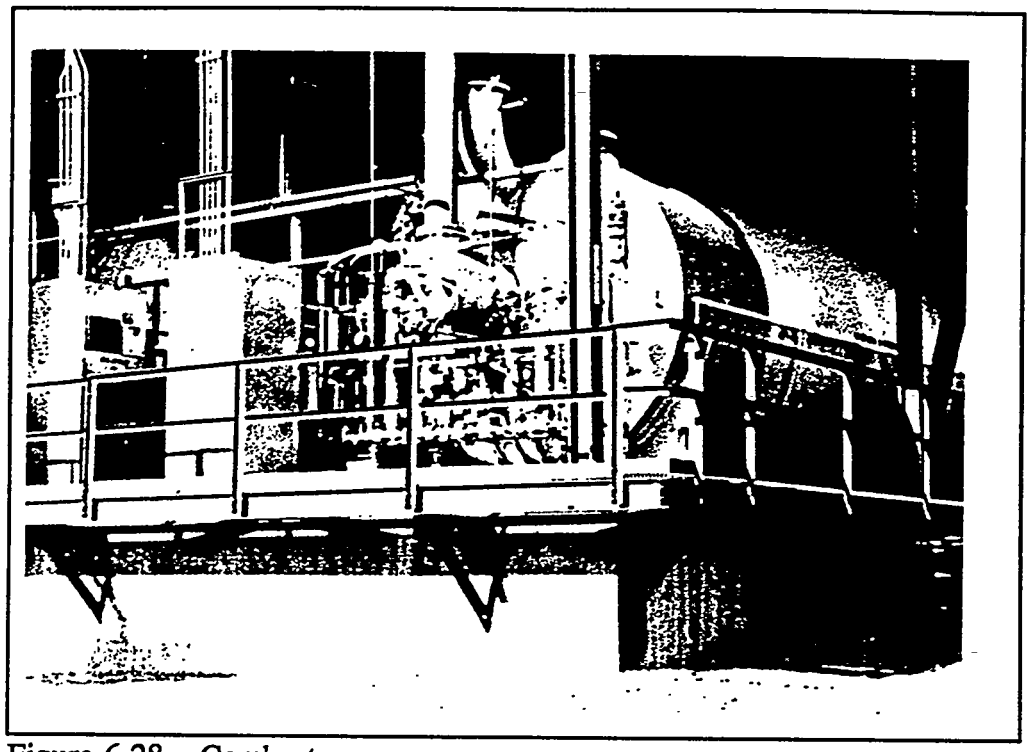


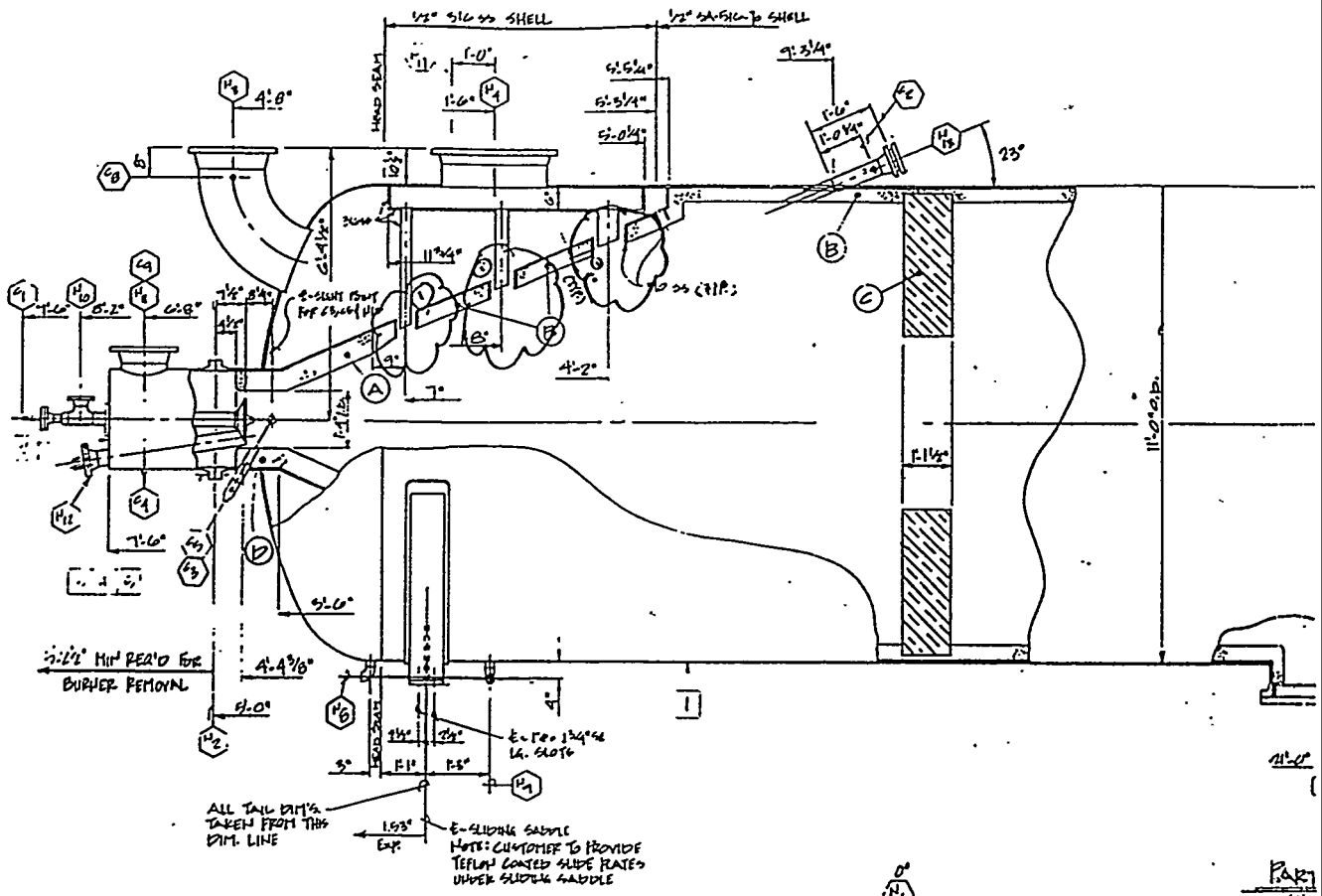
Figure 6.28 Combustors

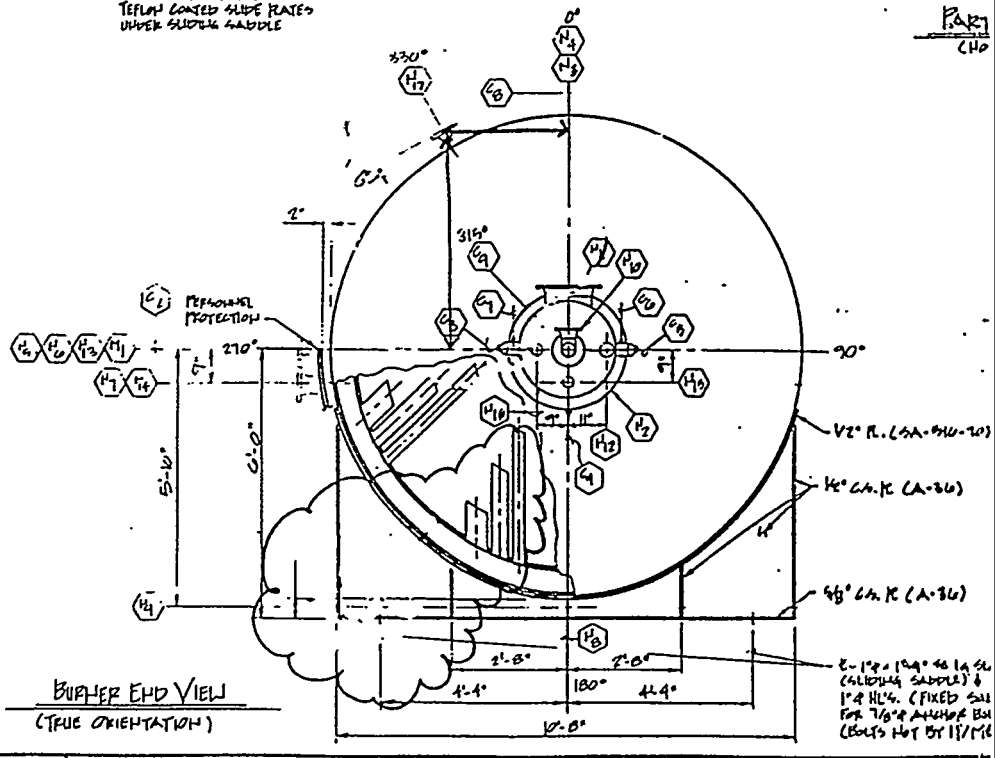
scrubber. The gas is treated with sodium carbonate solution which converts the sulfur oxides to sodium sulfite. In the wet gas scrubber, dual atomization nozzles disperse the sodium carbonate solution into fine particles with compressed air and spray it into the purge gas stream to reduce the entrained particulates and sulfur oxides. The horizontal scrubber further reduces sulfur oxides in the purge gas as it flows horizontally through spray curtains of sodium carbonate solution. The gas then passes through mist eliminators just prior to leaving the horizontal scrubber to capture any entrained treating solution in the form of fine mist. (Figure 6.33)

Table 6.1 Purge Gas Composition

COMPOSITION	WT. % UNTREATED	WT. % TREATED
CO	0.03	0.03
CO_2	14.10	14.01
N_2	46.74	46.60
H_2O	37.93	38.64
SO_x	0.50	0.02
NO_x	0.02	0.02
O_2	0.41	0.68
Solids	0.27	~0.00

The spent treating solution is discharged to an evaporation pond (Figure 6.34) where the sodium sulfite will oxidize into sodium sulfate. At the end of the Project life, the sodium sulfate, dried by evaporation, is encapsulated in a clay lined pod, covered with top soil and reclaimed.



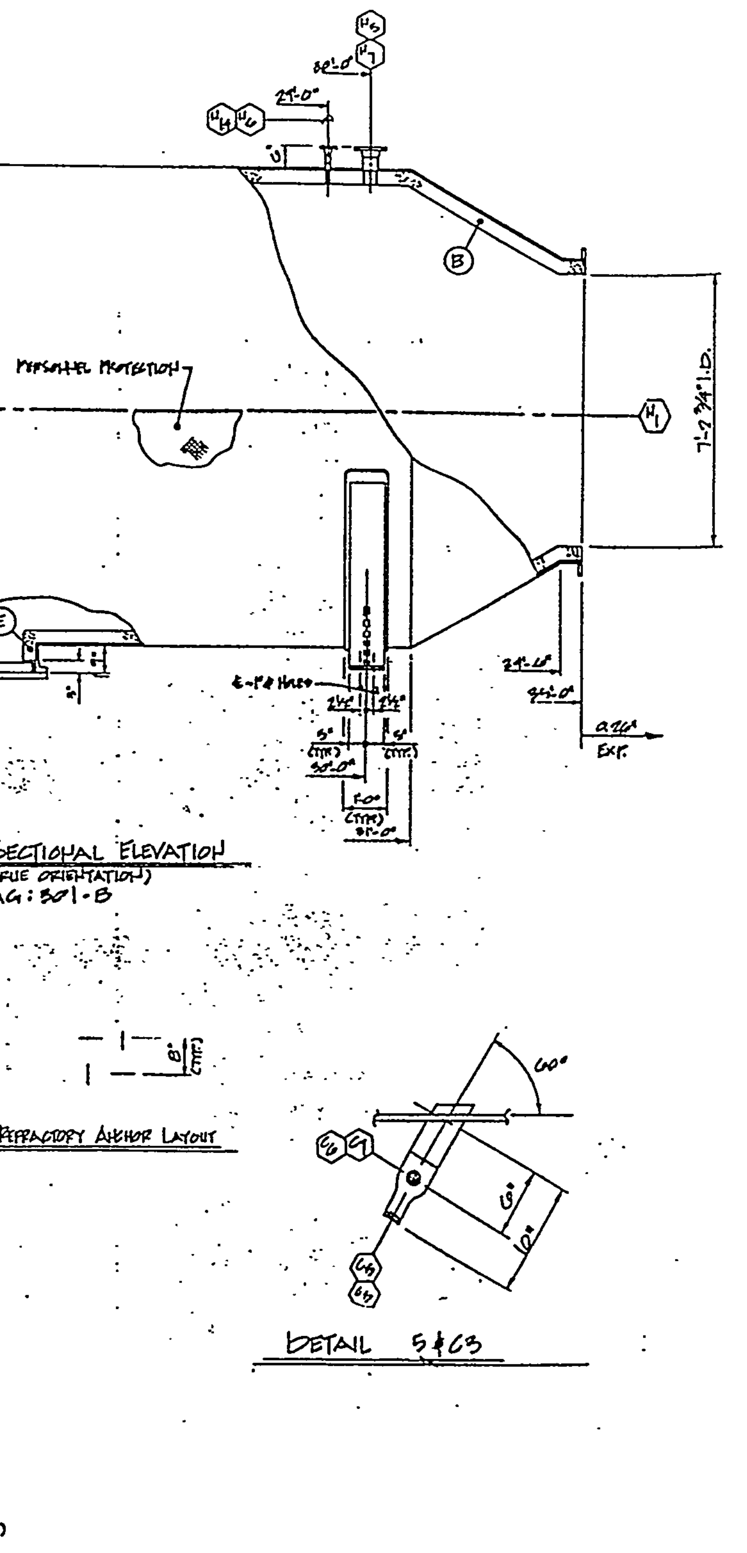


Notes :
1.) ALL FLANGE BOLTING TO STRADDLE NORMAL ℄s.
2.) ALL TAG NO's. TO BE PRECEDED BY 17/MILL JOB NO.
3.) MTR's REQ'D ON ALL MTLS, PLATE & FITTINGS
4.) FINISH SPEC.- EXT. CS. SURFACE PREP: SANDBLAST PER SSPC-SP10 & PRIME W/ 2-3 MILS D.F.T. AMERON's DIMETCOTE 6 & FINISH W/ 4-6 MILS D.F.T.

AMERON's SBS.

No.	Date	By	Chk'd	App'd	Description

Revisions



NOZZLE LEGEND

MK.	QTY.	DESCRIPTION
N1	1	OUTLET FLG. ~ 3/4" THK. × 8'-6" O.D. × 8'-0" I.D. W/64 - 3/4" HLS. ON 8'-3 3/4" B.C.
N2	1	BURNER MTG. FLG. ~ 28" - CLASS 150 API-605 RF
N3	1	COMB. AIR CONN. ~ 18" - 150# RF
N4	1	PRIMARY FUEL GAS CONN. ~ 30" CLASS 150 API-605 RF
N5, N6	2	THERMOWELL ~ 1" - 150# RF
N7, N14	2	SAMPLE PORT ~ 4" - 150# RF
N8, N9	2	DRAIN PORT ~ 2" BW
N10	1	BURNER GAS CONN. ~ 3" - 150# RF
N11	1	BURNER COMB. AIR CONN. ~ 12" - 150# RF
N12	1	BURNER PILOT MTG. FLG. ~ 4" - 150# FF
N13	1	SIGHT PORT MTG. FLG. ~ 4" - 150# FF
N15	1	AUXILIARY PORT W/ BLIND ~ 2" - 150# RF
N16	1	SIGHT PORT MTG. FLG. ~ 2" - 150# FF
M1	1	LINED MANWAY W/ BLIND & DAVIT ~ 32" CLASS 150 API-605 RF
N17	1	STEAM CONN. ~ 6" - 150# RF
C1	1	BURNER GAS CONN. ~ 1" MNPT
C2, 7	3	PURGE CONN. ~ 1/2" FNPT
C3, 5	2	SCANNER MTG. ~ 1" MNPT
C4	1	BURNER DRAIN W/ PLUG ~ 1" FNPT
C8, 9	1	NITROGEN PURGE CONN. ~ 1" FNPT

REFRACTORY / INSULATION LEGEND

REFR. & BRICKS TO BE SUPPLIED BY M.W. KELLOGG, SHIPPED LOOSE & INSTALLED IN FIELD BY OTHERS

ITEM	DESCRIPTION
A	6" THK. AP GREEN GREENCAST 94 W/(309 SS ANCHORS SHOP INSTALLED)
B	4" THK. AP GREEN KAST-O-LITE 30 W/(309 SS ANCHORS SHOP INSTALLED)
C	13 1/2" WIDE CHOKE ~ AP GREEN ARCH BRICK
	1ST ROW ~ 54 - #2 ARCH & 6 - #1 ARCH (4'-0" I.D.) 13 1/2" × 4 1/2" × 2 1/2" ARCH BRICK
	2ND ROW ~ 3 - #3 ARCH & 70 - #2 ARCH (13 1/2" × 6" × 3" ARCH BRICK)
	3RD ROW ~ 66 - #2 ARCH & 19 - #1 ARCH (13 1/2" × 6" × 3" ARCH BRICK)
	4TH ROW ~ 53 - #2 ARCH & 45 - #1 ARCH (13 1/2" × 6" × 3" ARCH BRICK)
	5TH ROW ~ 41 - #2 ARCH & 69 - #1 ARCH (13 1/2" × 6" × 3" ARCH BRICK)
	6TH ROW ~ 29 - #2 ARCH & 94 - #1 ARCH (13 1/2" × 6" × 3" ARCH BRICK)
	7TH ROW ~ 16 - #2 ARCH & 119 - #1 ARCH (13 1/2" × 6" × 3" ARCH BRICK), BACK W/ 1" THK. AP GREEN
	KAST-O-LITE 30
D	5 5/8" THK. AP GREEN GREENCAST 94 W/ 309 SS ANCHORS
E	3 5/8" THK. AP GREEN KAST-O-LITE 30 W/ 309 SS ANCHORS

DESIGN DATA

VESSEL TO BE CONSTRUCTED IN STRICT ACCORDANCE W/ THE 1989 EDITION OF THE ASME CODE & THE LATEST A89 ADDENDA FOR PRESSURE VESSELS

DESIGN PRESSURE - 15 PSIG @ 650°F MAX. DESIGN METAL TEMP.
DESIGN PRESSURE - 15 PSIG @ -14°F MIN. DESIGN METAL TEMP.
RADIOGRAPH - SPOT
JOINT EFFICIENCY - 85%
STRESS RELIEVE - N/A
HYDROSTATIC TEST PRESSURE - N/A
CORROSION ALLOWANCE - 0

ASME SECT. VIII DIV. 1.
NO CODE STAMP REQ'D.

FOUNDATION LOADS

SADDLE LOAD	FIXED	SLIDING
DEAD LOAD	44.3 K	56.6 K
EARTHQUAKE SHEAR	3.1 K	4.0 K
EARTHQUAKE OTM	18.6 K-FT.	24.0 K-FT.
FRICTION LOAD	5.7 K	5.7 K

TOTAL DEAD LOAD W/ REFRACTORY - 100.9 K
WITHOUT REFRACTORY - 45.3 K
SEISMIC ZONE 1 (PER UBC 88)

MATERIAL NOTE

SHELL ~ SA-516-70 1/2" THK. UNLESS NOTED OTHERWISE
HEAD ~ SA-516-70 1/2" THK. MIN. 2:1 ELLIPTICAL W/ 2" SKIRT
NOZZLE NECKS ~ STD. WT OR SCH. 40 SA-106B
BOLTING ~ SA-193 B7 STUD BOLTS W/ SA-194 2H NUTS
GASKETS ~ NON-ASBESTOS

Dwg. No.	Subject
B-3T0-007	4" SIGHT PORT ASSY
30-104	MANWAY ASSY
30-107	BURNER ASSY

Reference Drawings

This drawing is the property of and intended only for the private use of IT/McGILL Pollution Control Systems and may not be reproduced or given to third parties without prior written consent.

Drawn: DJ
Date: 4-22-91
Scale: —
Checked: [illegible]
App'd: DEO
Customer: M.W. KELLOGG

DRYER COMBUSTOR
(ONE ~ REQ'D.)
(301-B)

IT McGILL Pollution Control Systems
Tulsa, Oklahoma

P.O. No. 6655.21001-B010-01
Jobsite: GILLETTE, WY.
Revision No. 0
Drawing No. D430413-30-106
Sheet ONE of ONE

Figure 6.29

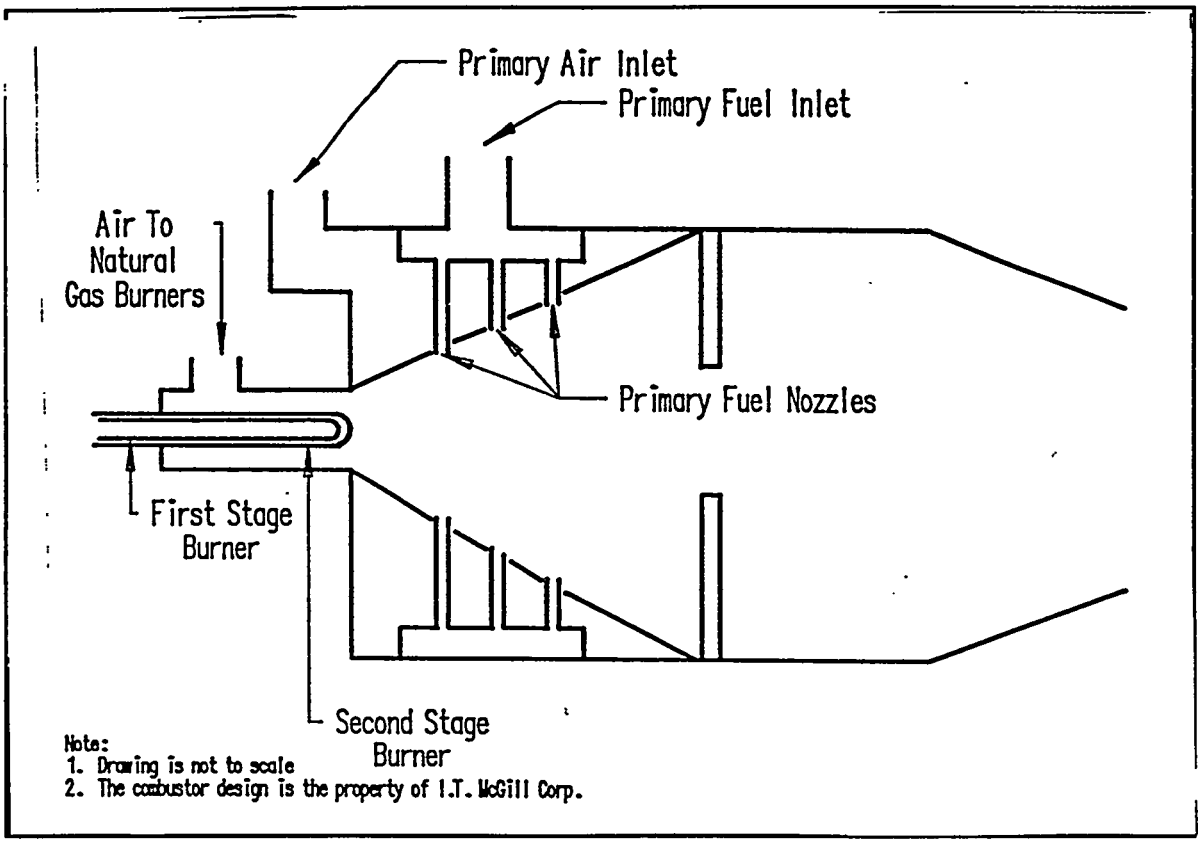


Figure 6.30 Sketch of the Combustor Internals

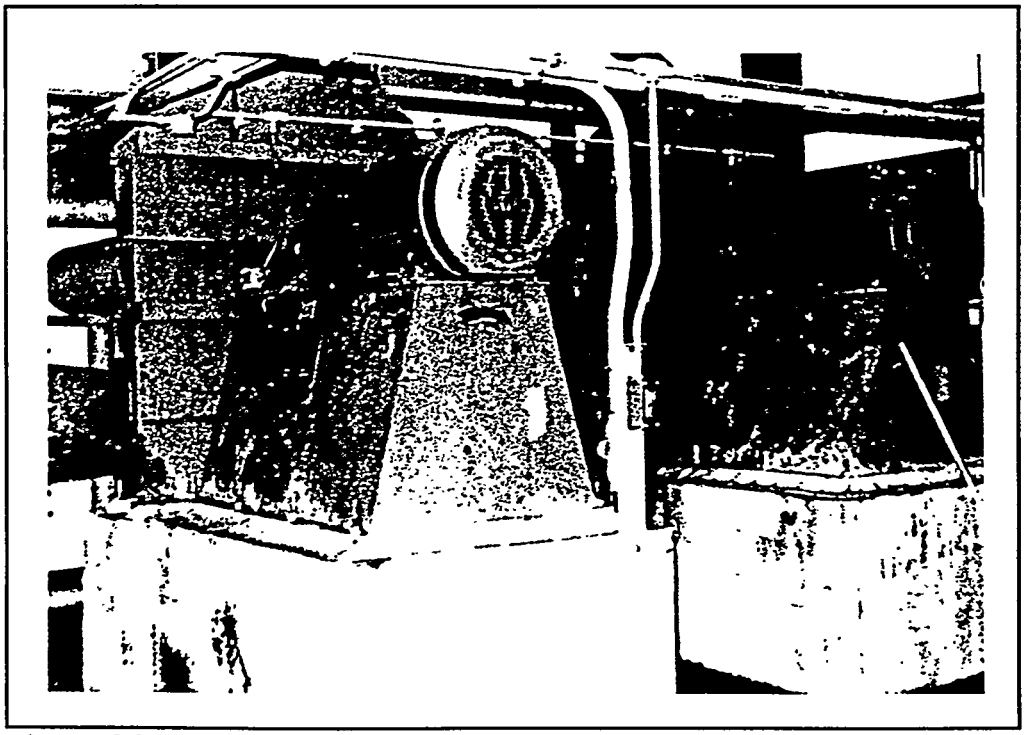


Figure 6.31 Combustion Air Blowers

Page 57 Omitted

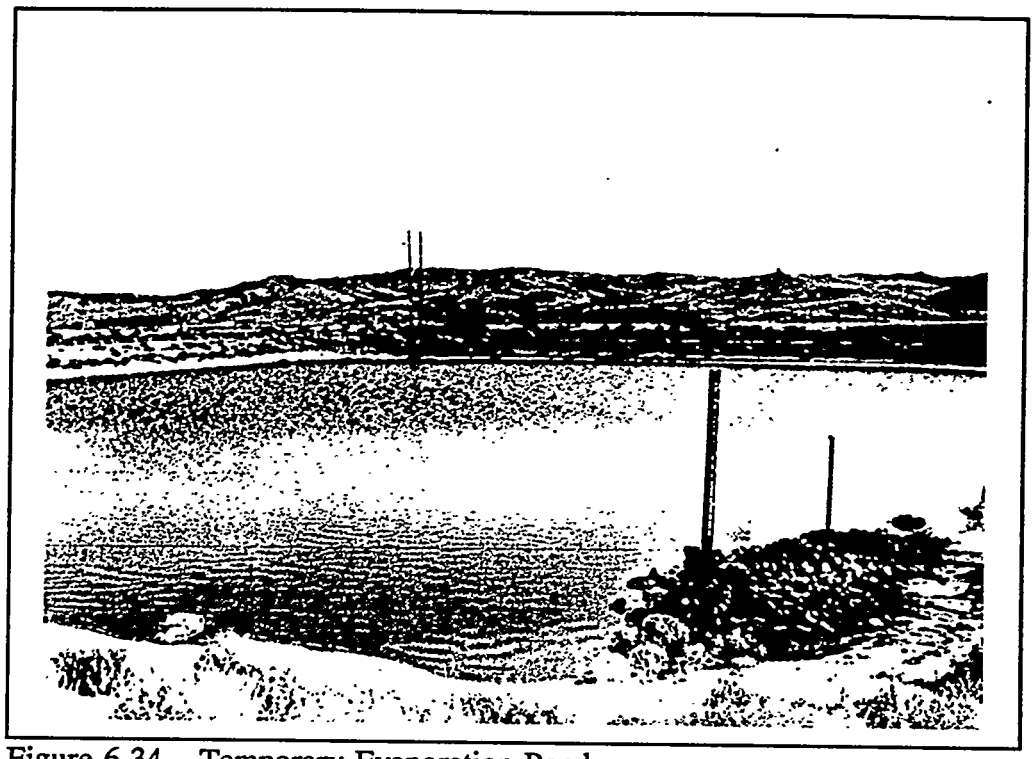


Figure 6.34 Temporary Evaporation Pond

6.14 DUST SCRUBBERS

When raw coal is conveyed from the feed coal silo, through the screening facilities, to the dryer feed hopper, coal dust is generated as the coal is loaded onto or discharged from a conveyor. In order to control the emission of dust, two dust scrubbers (Figures 6.35 and 6.36), one at the bottom of the feed coal silo and the other at the screening building, were installed. The dust scrubbers are used to collect coal fines at various transfer points i.e., the discharge of coal from or onto a conveyor. The dust scrubber, with the aid of a blower, pulls a suction at each transfer point. As the dust laden air stream passes through the scrubber, dual atomization nozzles disperse water into a fine mist with compressed air and spray it into the air stream. The air stream then flows through chevron separators to remove the coal dust and water, and the clean air is discharged to the atmosphere.

During startup and shutdown conditions, there are times when the facilities are not operating at design conditions, and dried, underpyrolyzed coal (off-spec PDF) is produced. The transfer of off-spec PDF to the PDF storage silo can be dusty. Therefore, two additional dust scrubbers were installed. They are used to collect coal fines at various transfer points where PDF is conveyed, e.g. from the PDF cooler to the PDF storage silo, and from the storage silo to conveyors.

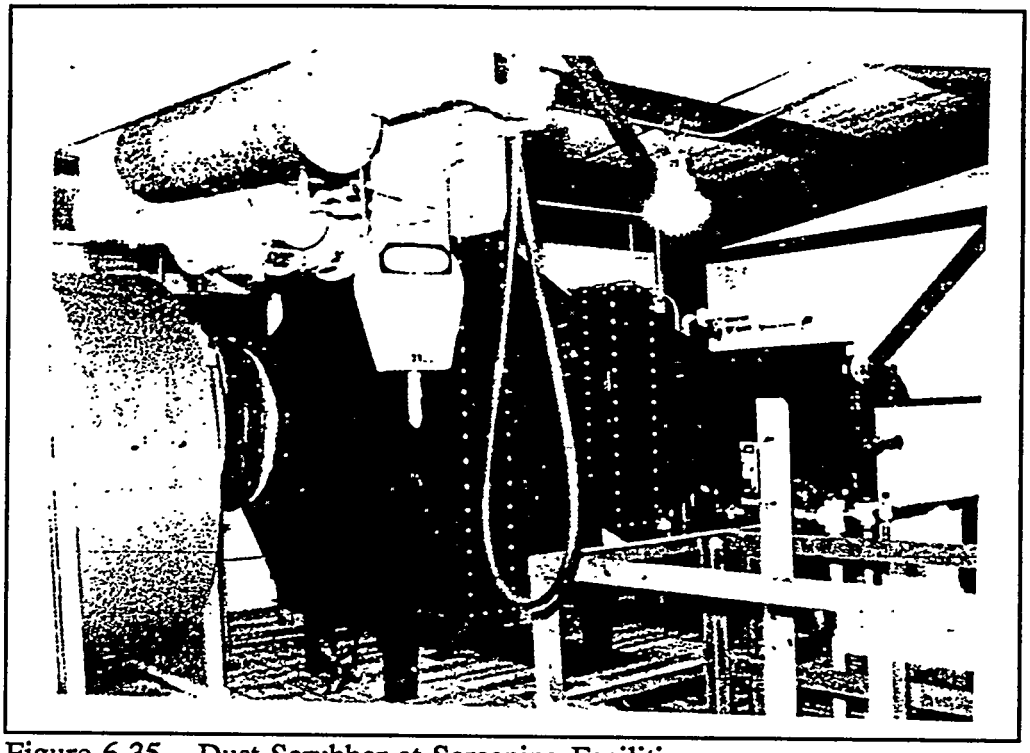


Figure 6.35 Dust Scrubber at Screening Facilities

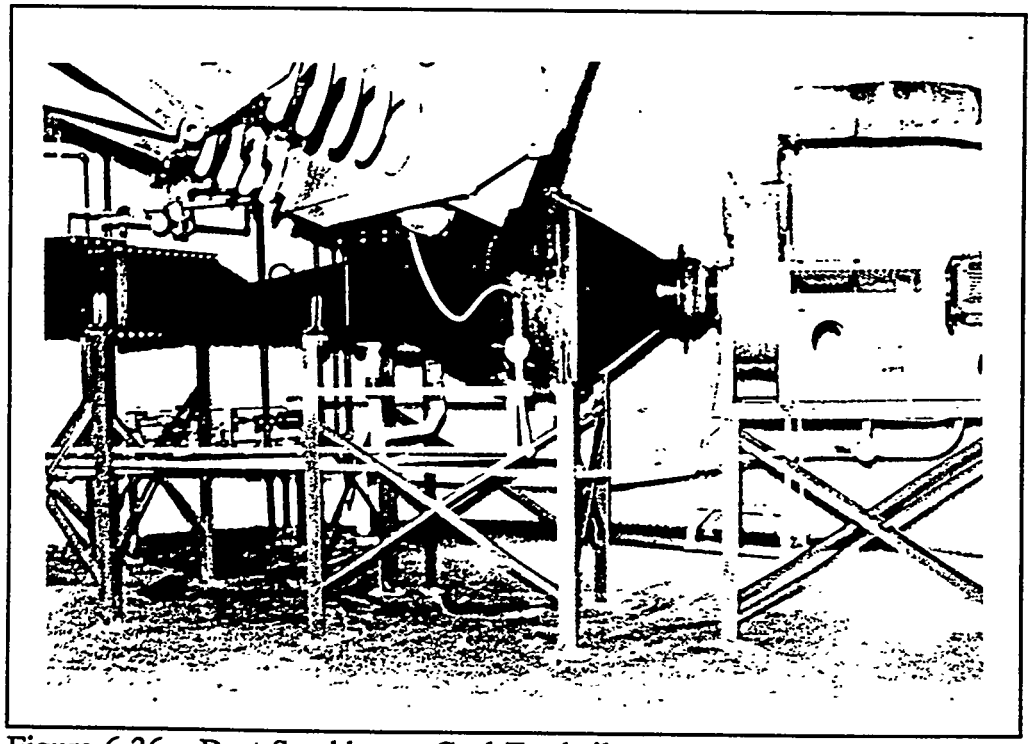


Figure 6.36 Dust Scrubber at Coal Feed silo