APPENDIX A

COAL SEARCH

Appendix A
Coal Search

For PGW coal gasification plant GKT'S entrained bed coal gasification process was selected. The process utilizes high temperature (2700°F) atmospheric conditions with a continuous co-current stream of pulverized coal, oxygen and steam. The process can, in general, gasify all types of coal so long as it would allow normal pulverization; however, the coal should preferably have an ash fusion temperature of 2600°F or less, since coals with high ash fusion temperatures would require addition of fluxing agents. The following coal specifications were therefore developed to meet the process requirements:

Ash Fusion Temperature	2600°F max. (Reducing)
Sulfur (as received)	5.0 percent max.
Ash (as received)	15.0 percent max.
Moisture (as received)	10.0 percent max.
Size (as received)	2.0" x 0"

Specifications for sulfur, ash and moisture were so chosen to allow an evaluation of a wider range of coals. The coal size was so chosen to allow direct pulverization of coal without the need for preliminary crushing.

The search for candidate feed coals was initated by providing to potential coal suppliers the above coal specifications. Forty-six (46) coal companies in the states of Pennsylvania, Ohio, West Virginia, Kentucky and Indiana were contacted and thirteen (13) companies responded with varied degrees of interest and information (see Table A-1).

An overall evaluation was then performed based on the coal data provided by these companies. Raw gas characteristics and cold gas efficiencies, and thereby the annual tonnage coal requirements and costs were estimated. Coal reserves, long term coal supply, oxygen plant costs, sulfur removal cost and ash disposal cost were also considered in the evaluation. Tables A-2 to A-6 show the various data for the candidate coals.

The analysis showed that the single factor which affects the plant economics most strongly is the delivered coal cost ($\$/10^6$ Btu). The five coals selected as potential feedstock for the gasification plant are from Centralia, Berwind, Keystone, C & K, and Bradford coal companies.

TABLE A-1
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN PENNSYLVANIA	DESIRE TO SUPPLY COAL
Aloe Coal Company P.O. Box 50 Imperial, PA 15126	No Response
Consolidation Coal Company Consol Plaza 1800 Washington Rd. Pittsburgh, PA 15241	Yes
Allegheny & Eastern Coal Sales, Inc. 328 Allegheny Avenue Kittanning, PA 16201	No Response
Rochester & Pittsburgh Coal Co. 655 Church Street Indiana, PA 15701	Yes
Bradford Coal Company Bigler, PA 16825	Yes
North Cambria Fuels Co. 1st National Bank Bldg. Spangler, PA 15775	No Response
Reitz Coal Company 509 15th Street Windber, PA 15963	No Response
General Coal Company 2500 Fiedelity Bldg. Philadelphia, PA 19106	Yes
United Eastern Coal Sales Corp. P.O. Box 685 Villanova, PA 19085	No Response
Avery Coal Company, Inc. P.O. Box 232 Philipsburg, PA 16866	No Response
C & K Coal Company P.O. Box 69 Clarion, PA 16214	Yes
Ownes Coal Mining Co. R.D. 1 Penfield, PA 15849	No Response

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN PENNSYLVANIA	DESIRE TO SUPPLY COAL
Universal Minerals, Inc. P.O. Box 307 Portage, PA 15946	No Response
Acme Coal Co. L. V. No. 5 Vein Slope Williamstown, PA 17098	No - Anthracite Coal Only
Berwind Coal Sales Co. 1500 Market Street Centre Square West Philadelphia, PA 19102	Yes
Centralia Coal Sales Co. P.O. Box 478 Wilkes-Barre, PA 18703	Yes
C and G Coal Company Washington, PA	No - Supplies only Consolidation National Gas Company
Dickson Fuel Corp. P.O. Box 831 Rosemont, PA 19010	No - No Coal Available
Slattery Brothers, Inc. 110 Bala Ave. Bala-Cynwyd, PA 19004	No Response
Alcon Coal & Land Co., Inc. 650 Blue Bell West Blue Bell, PA 19422	Yes
Westmoreland Coal Co. 123 S. Broad Street 2500 Fidelity Bldg. Philadelphia, PA 19109	No Response
Lehigh Valley Coal Sales Co. 800 Exeter Avenue West Pittston, PA 18643	No Response
FMC Corporation National Resource Div. 2000 Market Street Philadelphia, PA 19103	No Response

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN PENNSYLVANIA	DESIRE TO SUPPLY COAL
Rafetto Coal Co., Inc. Aldan Park Manor Philadelphia, PA 19144	No Response
Keystone Coal Co. One East Market St. York, PA 17405	Yes
Hickman, Williams & Co. 1777 Walton Road Blue Bell, PA 19422	No Response
Miller Marketing Co. Suite 10-A 1445 City Line Avenue Philadelphia, PA 19151	Yes - Sent Coal Samples
Irish John K. Co., Inc. P.O. Box 885 Red Bank, NJ 07701	No Response
Universal Coal Co. 6411 Large Street Philadelphia, PA 19149	No Response
Russell L. Suender, Inc. P.O. Box 73 Port Carbon, PA 17965	No - Anthracite Coal Only
Eastern Association of Coal Corp. Kopper Bldg. Pittsburg, PA 15219	No Response

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN OHIO	DESIRE TO SUPPLY COAL
Youghiogheny and Ohio Coal Company 4614 Prospect Avenue Cleveland, OH 44103	No Response
Peabody Coal Company 225 Fairway Blvd. Columbus, OH 43213	Yes
Valley Camp Coal Company 700 Westgate Tower Cleveland, OH 44116	No Response
Ohio Coal and Construction Corp. P.O. Box 2388 Wintersville, OH 43952	No Response
Central Ohio Coal Company P.O. Box 98 Cumberland, OH 43732	No Response
North American Coal Corp. 12800 Shaker Blvd. Cleveland, OH 44120	Yes

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN WEST VIRGINIA	DESIRE TO SUPPLY COAL
Cannelton Industries, Inc. P.O. Box 1226 1250 One Valley Square Charlestown, WV 25324	Yes
Consolidated National Gas Company Mr. I. M. Ovrr C and G Coal Company 445 W. Main Street Clarksburg, WV	No - Supply Only to Gas Company
Pickards Mather and Company 322 70th Street Charleston, WV 25009	No Response
Bishcp Coal Company Pocahontas, WV 24635	Yes (See Consolidated Coal Company)
Barbour Coal Company P.O. Box 1744 Clarksburg, WV 26301	No Response

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN KENTUCKY	DESIRE TO SUPPLY COAL
Addington Brother Mining, Inc. (Ashland) P.O. Box 681 Ashland, KY 41101	No - Sells Only to Ashland Oil
Island Creek Coal Co. 2355 Harrodsburg Road P.O. Box 11430 Lexington, KY 40511	Yes
Sextet Mining Corporation Madisonville, KY 42431	No Response

TABLE A-1 (Cont'd)
COAL COMPANIES RECEIVING PGW INQUIRY LETTER

IN INDIANA	DESIRE TO SUPPLY COAL
Amax Coal Company 105 S. Meridean Street Indianapolis, IN 46225	No - Interest Western Market Only

TABLE A-2

SUMMARY OF COAL SEARCH RESULTS

Coal Supplier	Base	C&K	Consolidation	Bradford	General	R&P
Seam	Pittsburgh 8	Clarion, Kitt. Freeport	Pittsburgh	L. Kittaning	Brookville L. & U. Kitt.	L. Kitt.
Porximate Analysis, A.R.						
Moisture	4.58	6.0	5.00	5.33	9.62	4.5
FC + VM	87.59	85.3	83.11	80.83	77.98	82.5
Ash	7.83	8.7	11.89	13.84	12.40	13.0
Total	100.00	100.0	100.00	100.00	100.00	100.00
HHV, Btu/lb, A.R.	13,626	13,174	12,103	12,766	11,243	12,290
Delivered Coal Cost						
\$/Ton, A.R.	45.0	40.0	43.61	36.0	38.0	48.82
\$/Ton, MAF	51.38	46.89	52.47	44.54	48.73	59.18
$\$/10^6$ Btu	1.65	1.52	1.76	1.41	1.69	1.96
Pref. Candidate Coal(1)		X		X		

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(1) X indicates preferred candidate coals

TABLE A-2 (Cont'd)
SUMMARY OF COAL SEARCH RESULTS

Coal Supplier	North American	Island Creek		Centralia	Berwind	AC&L	Keystone
Seam	L. Kitt. PA "B Seam"	Bakertown & Freeport, WV	Freeport, WV	Bakerstown, Freeport & Kitt., WV	Brookville/ Clarion, PA	No. 8, PA	U. & L. Kitt. U. & L. Freeport PA
Reserve, 10^6 ton	5.11	73.9	54.1	100+	15	5	10
Production, 10^6 ton/yr	None	0.875	1.375	0.6	-(2)	-(3)	0.30
Proximate Analysis, A.R.							
Moisture	5.02	4.49	5.43	7.0	3	5	5
FC + VM	83.39	87.71	80.87	79.0	84	82	83
Ash	11.59	7.80	13.70	14.0	13	13	12
Sulfur	2.86	1.32	1.85	4.0	4	1.4	3
HHV, Btu/lb, A.R.	13,016	13,806	12,536	11,750	12,000(4)	12,500	12,500
Ash Fusion Temp., °F(1)	2340	2670	2690	2240	<2500(4)	2800+	2425
Delivered Coal Cost (6)							
$/Ton A.R.	46.06	56.58	41.58	38.58	[illegible].0	39.0	38.58
$/Ton MAF	55.23	64.51	51.42	48.84	[illegible]7.62	47.56	46.48
$/$10^6$ Btu	1.77	2.05	1.66	1.64	[illegible]1.67	1.56	1.54
Pref. Candidate Coal(5)				X	X		X

(1) Fluid temperature under reducing condition.
(2) Not in production at the present time.
(3) Not available
(4) Estimate
(5) X indicates preferred candidate coals.
(6) For 7000 ton unit train

TABLE A-3

SUMMARY OF COAL DATA

Coal Supplier	C&K	Consolidation	Bradford	General	R&P
Seam	Clarion, Kitt. Freeport	Pittsburgh	L. Kitt.	Brookville L&U Kitt.	L. Kitt.
Reserve, 10^6 Ton	60	800	15	50	25+
Production, 10^6 Ton/Yr	5	50	0.1	0.3	0.8
Loading	Conrail	Conrail, B&O	Conrail	Conrail	Bessemer/Lake Erie
Freight Rate Group	Clearfield	W.V. (B&O)	Clearfield	Clearfield	Butler-Mercer
Coal Size	2" x 0"	2" x 0"	3/4" x 0"	1-1/2" x 0"	2" x 0"
Unit Coal Cost, $/Ton					
FOB	29.0	31.75	25.0	27.0	35.54(2)
Freight(1)					
Single Car	-	15.83	15.07	15.07	-
Unit Train					
4000 Ton	-	-	-	-	15.22
7000 Ton	11.0	11.86	-	-	13.28
9000 Ton	-	-	-	-	12.26

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(1) From coal mines to City of Philadelphia
(2) April, 1979 price

TABLE A-3 (Cont'd)

SUMMARY OF COAL DATA

Coal Supplier	North American		Island Creek	
	L. Kitt., PA	U. Kitt., PA	Bakertown &	
Seam	"B" Seam	"E" Seam	Freeport, WV	Freeport, WV
Reserve, 10^6 ton	5.11	8.94	73.9	54.1
Production, 10^6 ton/yr	None	None	0.875	1.375
Loading	Chessie/Conrail	Chessie/Conrail	W. Maryland Rail	W. Maryland Rail
Freight Rate Group	-	-	U. Potomac Dist.	U. Potomac Dist.
Coal Size	3/4" or as req'd	3/4" or as req'd	1-1/2" x 0"	2.0" x 0"
Unit Coal Cost, \$/ton(1)				
FOB	35.0	35.0	45.00	30.0
Freight(2)				
Single Car	-	-	15.96(3)	15.96(3)
Unit Train				
4000 ton	-	-	-	-
7000 ton	11.06	11.06	11.58(5)	11.58(5)
9000 ton	-	-	-	-

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(1) 1st Quarter 1981 price.
(2) From coal mine to City of Philadelphia.
(3) Type of unit train not given in the letter responsed.
(4) Not in production at the present time, but set up mining operations to produce up to 30,000 tons.
(5) Estimate

TABLE A-3 (Cont'd)

SUMMARY OF COAL DATA

Coal Supplier	Centralia	Berwind	AC&L	Keystone
Seam	Bakerstown, Freeport & Kitt., WV	Brookville/Clarion, PA	No. 8, PA	U. & L. Kitt. U. & L. Freeport, PA
Reserve, 10^6 ton	100+	15	5	10
Production, 10^6 ton/yr	0.60	- (4)	-	0.30
Loading	-	Conrail-Windber, PA	Rail/Truck	Rail/Truck
Freight Rate Group	Cumberland-Piedmont Somerset	-	-	-
Coal Size	2.0" x 0"	2.0" x 0"	2.0" x 0"	2.0" x 0"
Unit Coal Cost, \$/ton (1)				
FOB	27.0	29.0	26.0	27.0
Freight (2)				
Single Car	15.82	15.07	-	-
Unit Train				
4000 ton	-	-	-	-
7000 ton	11.58	11.0 (5)	13.0	11.58 (3)
9000 ton	-	-	-	-

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(1) 2nd Quarter 1981 price
(2) From coal mine to City of Philadelphia
(3) Type of unit train not given in the letter responsed
(4) Not in production at the present time, but set up mining operations to produce up to 30,000 tons per month
(5) Estimate

TABLE A-4

CHARACTERISTICS OF POTENTIAL CANDIDATE COALS

Coal Supplier	Base		C&K		Consolidation		Bradford		General		R&P	
Seam	Pittsburgh No. 8		Clarion, Kitt. Freeports		Pittsburgh		L. Kittaning		Brookville L&U Kitt.		L. Kitt.	
Proximate Analyses, A.R.												
Moisture (seam)	4.58		5-7		4-6		5.33		<10		4.5	
Volatile Matter	37.33		32-36		36-37		22.71		22-26		34.9	
Fixed Carbon	50.26		45-50		48-52		58.37		56-50		47.6	
Ash	7.83		8-10		6.8-7.8		13.59		12-14		13.0	
Total	100.00		-		-		-		-		-	
HHV Range, Btu/lb A.R.	13,442		12,600-12,800		13,400		12,503		12,000		12,400	
HGI	64		55-60		58-63		90		85-95		57	
FSI	7.5		7.0		7-8.5		9		5-7.5		7.5-8	
Ultimate Analysis, Wt. %	Dry	A.R.	Dry	A.R.	Dry	A.R.	Dry	A.R.	Dry	A.R.	Dry	A.R.
Carbon	77.71	74.16	75.0	70.5	69.77	66.29	73.71	69.78	70.37	63.60	70.40	67.23
Hydrogen	5.28	5.04	5.5	5.2	4.99	4.74	4.48	4.24	4.26	3.85	4.94	4.72
Nitrogen	1.42	1.35	1.5	1.4	1.34	1.27	1.18	1.12	1.27	1.15	1.31	1.25
Chlorine	-	-	0.2	0.2	-	-	-	-	0.11	0.10	0.17	0.16
Sulfur	2.64	2.52	3.0	2.8	3.22	3.06	3.83	3.63	3.04	2.75	2.62	2.50
Oxygen	4.74	4.52	5.5	5.2	8.16	7.75	2.18	2.06	7.23	6.53	6.95	6.64
Ash	8.21	7.83	9.3	8.7	12.52	11.89	14.62	13.84	13.72	12.40	13.61	13.00
Moisture	-	4.58	-	6.0	-	5.00	-	5.33	-	9.62	-	4.50
Total	100.00	100.00	100.0	100.0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
HHV, Btu/lb, dry												
Reported	14,087	13,442	13,511	12,700	14,105	13,400	13,207	12,503	13,277	12,000	12,984	12,400
Calculated(1)	14,280	13,626	14,015	13,174	12,740	12,103	13,485	12,766	12,440	11,243	12,870	12,290

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(1) Dulong formula

TABLE A-4 (Cont'd)

CHARACTERISTICS OF POTENTIAL CANDIDATE COALS

Coal Supplier	Base	C&K	Consolidation	Bradford	General	R&P
Seam	Pittsburgh No. 8	Clarion, Kitt. Freeports	Pittsburgh	L. Kittaning	Brookville L&U Kitt.	L. Kitt.
Ash Mineral Composition, Wt. %						
Phos. Pentoxide	-	0.20	0.46	3.82	0.30	0.24
Silica	47.19	38.31	41.04	37.09	47.00	39.00
Ferric Oxide	16.23	30.31	19.61	27.30	18.20	26.80
Alumina	22.40	22.28	18.90	22.34	28.72	24.60
Titania	-	1.02	1.01	0.58	1.33	1.32
Lime	4.11	1.43	6.89	4.20	1.00	1.51
Magnesia	-	0.56	1.22	1.01	0.50	0.62
Sulfur Trioxide	0.87	1.73	6.40	1.39	0.97	2.04
Potassium Oxide	-	1.05	1.68	1.51	1.63	1.45
Sodium Oxide	-	0.47	0.88	0.76	0.35	0.25
Others	8.44(2)	2.64(3)	1.91(3)	-	-	2.17(3)
Total	100.00	100.00	100.00	100.00	100.00	100.00

Ash Fusibility Temp. °F	Base Red.	Base Ox.	C&K Red.	C&K Ox.	Consolidation Red.	Consolidation Ox.	Bradford Red.	Bradford Ox.	General Red.	General Ox.	R&P Red.	R&P Ox.
Initial Deformation	2093	2444	2000	2500	2050	-	2090	2240	-	2320	2090	2500
Softening	2138	2480	2200	2600	2150	-	2200	2350	-	2410	2275	2625
Fluid	2156	2516	2400	2650	2350	-	2340	2490	-	2520	2390	2800

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(1) Calculated from Dulong formula
(2) Only partial analysis was reported
(3) Unaccounted for

TABLE A-5

CHARACTERISTICS OF POTENTIAL CANDIDATE COALS

	North American			Island Creek			
	L. Kitt., PA	U. Freeport, PA		Bakertown &			
Seam	"B" Seam	"E" Seam		Freeport, WV		Freeport, WV	
Proximate Analysis, A.R.		1.50 Float	1.60 Float				
Moisture (seam)	5.02	-	-		4.49		5.43
Volatile Matter	- (2)	26.58	26.26		20.42		17.46
Fixed Carbon	- (2)	64.23	63.48		67.29		63.14
Ash	11.59	9.18	10.24		7.89		13.70
Total		99.95	99.98		100.00		100.00
HHV Range, Btu/lb., A.R.	13,016	14,100	13,910		13,806		12,536
HGI	-	-	-		105		100
FSI	-	-	-		9.0		9.0
Ultimate Analysis, Wt. %	A.R.	A.R.	A.R.	Dry	A.R.	Dry	A.R.
Carbon	-	-	-	81.07	77.43	75.92	71.82
Hydrogen	-	-	-	4.76	4.55	4.16	3.93
Nitrogen	-	-	-	1.52	1.45	1.41	1.33
Chlorine	-	-	-	0.15	0.14	0.11	0.10
Sulfur	2.86	1.74	2.02	1.38	1.32	1.96	1.85
Oxygen	-	-	-	2.95	2.82	1.95	1.84
Ash	-	-	-	8.17	7.80	14.49	13.70
Moisture	-	-	-	-	4.49	-	5.43
Total				100.00	100.00	100.00	100.00
HHV, Btu/lb, Dry							
Reported	13,016	14,100	13,910	-	13,806	-	12,536
Calcualted (1)	-	-	-	-	13,919	-	12,815

(1) Dulong formula
(2) Not available

TABLE A-5 (Cont'd)
CHARACTERISTICS OF POTENTIAL CONDIDATE COALS

Coal Supplier	Centralia		Berwind	AC&L	Keystone
Seam	Bakerstown, Freeport & Kitt., WV		Brookville/Clarion, PA	No. 8, PA	U. & L. Kitt U. & L. Freeport, PA
Proximate Analysis, A.R.					
Moisture (seam)	6.0-8.0		3	5.0	5
Volatile Matter	24.0-26.0		17	20.0	23-24
Fixed Carbon	50.0-55.0		67	60.6	53
Ash	13.0-15.0		13	13.0	12
Total			100	98.6	
HHV Range, Btu/lb., A.R.	11,500-12,000		12,000	12,500	12,500
HGI	70-80				
FSI	5-7				
Ultimate Analysis, Wt. %	Dry	A.R.	A.R.	A.R.	A.R.
Carbon	68.0-72.0	65.0-67.0	-	-	-
Hydrogen	4.6- 4.8	4.4- 4.6	-	-	-
Nitrogen	1.3- 1.4	1.2- 1.3	-	-	-
Chlorine	0.18-0.22	0.16-0.18	-	-	-
Sulfur	3.0- 5.0	3.0- 5.0	4.0	1.4	3.0
Oxygen	3.0- 3.3	3.8- 3.1	-	-	-
Ash	14.0-16.0	13.0-15.0	-	-	-
Moisture	- -	6.0- 8.0	-	-	-
Total					
HHV,Btu/lb, dry					
Reported	12,234-13,043	11,500-12,000	12,000	12,500	12,500
Calculated(1)	12,859-13,652	12,087-12,560	-	-	-

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(1) Dulong formula

TABLE A-6
ASH CHARACTERISTICS OF POTENTIAL CANDIDATE COALS

Coal Supplier	North American				Island Creek			
Seam	L. Kitt., PA "B" Seam		U. Freeport, PA "E" Seam		Bakertown & Freeport, W. V.		Freeport, W.V.	
Ash Mineral Composition, Wt. %	N.A.(2)		N.A. (2)					
Phos. Pentoxide	-		-		0.47		0.37	
Silica	-		-		45.84		48.00	
Ferric Oxide	-		-		13.02		14.33	
Alumina	-		-		30.45		29.55	
Titania	-		-		1.34		1.14	
Lime	-		-		3.11		1.84	
Magnesia	-		-		1.03		0.72	
Sulfur Trioxide	-		-		2.68		1.49	
Potassium Oxide	-		-		1.63		2.12	
Sodium Oxide	-		-		0.32		0.29	
Others (1)	-		-		0.11		0.15	
Total					100.00		100.00	
Ash Fusibility Temp., °F	Red.	Ox.	Red. 1.50 Fl./1.60 Fl.(3)	Ox. 1.50 Fl./1.60 Fl.	Red.	Ox.	Red.	Ox.
Initial Deformation	2145	-	2550/2210	2550/2530	2510	2700+	2500	2700+
Softening	2205	-	2380/2330	2640/2610	2560	2700+	2550	2700+
Fluid	2340	-	2510/2480	2700/2680	2670	2700+	2690	2700+

(1) Unaccounted for
(2) N.A. = Not available
(3) Fl. = float

TABLE A-6 (Cont'd)
ASH CHARACTERISTICS OF POTENTIAL CANDIDATE COALS

Coal Supplier	Centralia		Berwind		AC&L		Keystone	
Seam	Bakerstown, Freeport & Kittanings, WV		Brookville/Clarion, PA		No. 8, PA		U. & L. Kitt. U. & L. Freeport, PA	
Ash Mineral Composition, Wt. %			N.A.		N.A.		N.A	
Phos. Pentoxide	0.3- 6.5		-		-		-	
Silica	48.0-52.0		-		-		-	
Ferric Oxide	16.0-18.0		-		-		-	
Alumina	25.0-27.0		-		-		-	
Titania	1.4- 1.6		-		-		-	
Lime	1.0- 1.2		-		-		-	
Magnesia	0.8- 1.0		-		-		-	
Sulfur Troixode	1.0- 1.2		-		-		-	
Potassium Oxide	1.6- 1.8		-		-		-	
Sodium Oxide	0.8- 1.0		-		-		-	
Others(1)	- -		-		-		-	
Total								
Ash Fusibility Temp., °F	Red.	Ox.	Red.	Ox.	Red.	Ox.	Red.	Ox.
Initial Deformation	2020	2090	2150	-	2700	-	2275	-
Softening	2130	2200	2250	-	2800+	-	2350	-
Fluid	2240	2300	-	-	2800+	-	2425	-

(1) Unaccounted for
(2) N.A. = Not available
(3) Fl. = float

APPENDIX B

FLY ASH RECYCLE

Appendix B
Fly Ash Recycle

The GKT coal gasification process produces two types of solid wastes -granular slag and fine fly ash admixed with unburned carbon. Approximately 30% of the ash in the coal is recovered as quenched molten slag from the gasifier bottom while the remaining 70% (entrained in the raw gas) is recovered in the form of a filter cake from a downstream gas purification system consisting of wash column, settling basin, thickener, and rotary vacuum filter. When 1200 TPD of the Pittsburgh No. 8 coal is gasified in the usual manner, 33 TPD of slag (15% moisture) and 345 TPD of fly ash cake (50% moisture) are produced, and a total of 378 tons of solid wastes must be disposed of off-site. Furthermore, the fly ash cake contains a large fraction of unburned carbon (107 TPD) which is not an insignificant loss of carbon utilization.

In order to alleviate solid waste disposal problems and to reutilize some of the carbon contained in the fly ash cake, a scheme of recycling the fly ash cake back to the gasifier is incorporated in the present design. This is done by returning part of the fly ash cake via a conveyor system to pulverizers where it is mixed and pulverized with fresh coal. The mixture is dried to 1% moisture and gasified as in the non-recycle case.

Since the carbon in the fly ash cake is recovered and reutilized, fresh coal feed can be reduced by an amount equivalent to the carbon recycled. (In other words, the total carbon in the mixed feed remains the same as the straight feed.) As shown in Tables B-1 and B-2, the fresh coal feed can be steadily reduced and the overall carbon conversion efficiency improved as the fly ash recycle rate is increased. For example, at 50% recycle rate, fresh coal feed can be reduced from 1200 TPD to 1128 TPD and the carbon efficiency improved from 88% to 93.6%. In addition, the total solid wastes (slag and fly ash cake) can be reduced from 378 TPD to 250 TPD, and the quantities of carbon loss halved from 107 TPD to 54 TPD. With higher recycle rates, even better results can be achieved. However, as the recycle rate is increased, dust loading in the raw gas also increases (Table B-2), which will hamper the

TABLE B-1

EFFECT OF FLY ASH RECYCLE ON PULVERIZER PARAMETERS

Fly Ash Recycle Rate %	Pulverizer: Fresh Coal (1) TPD	Recycled (2) Fly Ash TPD	Total Mixed Feed TPD	Moisture in Mixed Feed %	Drying (3) Duty 10^9 Btu/D
0	1200	0	1200	4.58	0.150
30	1157	112	1269	8.60	0.337
40	1142	155	1297	10.00	0.409
50	1128	202	1330	11.47	0.487
60	1114	254	1368	13.02	0.576
80	1085	387	1472	16.52	0.800
100	1056	599	1655	21.03	1.161

Notes: (1) Pittsburgh No. 8 coal, 4.58% moisture as received

(2) 50% moisture filter cake

(3) Mixed feed is dried to 1% moisture; 1750 Btu/lb water drying duty

TABLE B-2

EFFECT OF FLY ASH RECYCLE ON CARBON CONVERSION AND THE QUANTITIES OF SOLID WASTES

Fly Ash Recycle Rate %	GKT Plant: Overall Carbon Eff. %	GKT Plant: Dust Loading in Raw Gas	Solid Waste Disposal: Slag(1) TPD	Solid Waste Disposal: Fly Ash Cake(2) TPD	Solid Waste Disposal: Total Solid Wastes TPD	Solid Waste Disposal: Carbon Loss(3) TPD
0	88.00	1 (base)	33	345	378	107
20	91.29	1.084	41	262	303	75
40	92.94	1.123	44	233	277	64
50	93.62	1.170	48	202	250	54
60	94.83	1.229	53	170	223	43
80	97.35	1.402	68	97	165	21
100	100.00	1.737	97	0	97	0

Notes: (1) 15% moisture granular slag
(2) 50% moisture filter cake
(3) Contained in the fly ash filter cake

capability of the wash column to remove fly ash from the gas. The capacity of pulverizers must also be increased to accommodate the increased throughput (Table B-1). More important, as the recycle rate is increased, the moisture in the mixed feed increases rapidly, since half of the fly ash cake recycled is water. At the 50% recycle rate, the moisture in the mixed feed reaches 11.47% or nearly equal to the design capacity (12%) of the air heaters associated with pulverizers. The required drying duty at this recycle rate is more than threefold (0.487×10^9 Btu/D) compared to the non-recycle case (0.150×10^9 Btu/D). Simple economic trade-off analysis also indicated that savings due to reduced coal feed would be about offset by the increase in the energy cost at the 50% recycle rate. For the present PGW coal gasification plant design, therefore, recycling of fly ash cake in the range of 0-50% is recommended.

APPENDIX C

STRETFORD PLANT SULFUR RECOVERY OPTIONS

Appendix C

Stretford Plant Sulfur Recovery Options

The Stretford plant is employed for removing H_2S from the raw gas coming from the GKT gasification plant. H_2S in the gas is converted to elemental sulfur which can be recovered as either filter cake or molten sulfur, the selection of which is dictated by the overall economics. The molten sulfur configuration generates a purge liquor stream which requires either on-site treatment by reductive incineration or disposal by hauling to a hazardous waste treatment facility.

In order to select the most economical and environmentally acceptable sulfur recovery option, the following five options were considered:

1. Filter cake disposal
2. Molten sulfur/purge disposal/sulfur credit
3. Molten sulfur/purge disposal/sulfur disposal
4. Molten sulfur/reductive incineration/sulfur credit
5. Molten sulfur/reductive incineration/sulfur disposal

The economic analysis was based on the C & K coal which is one of the selected candidate coals for gasification (Appendix A). The feed gas characteristics were predicted by the in-house combustion equilibrium (CEC) computer program. The comparative analysis is applicable to other candidate coals (including Pittsburgh No. 8 design coal) since the selection of the sulfur recovery option is based on the feed gas characteristics which are largely independent of the coal.

The basis and economic parameters along with the description of sulfur recovery options is described in the sections below. The molten sulfur/reductive incineration/sulfur credit option (case 5) was found to be most economical.

Basis for Comparative Analysis

Gas characteristics

Pressure: 4.5 Psig

Temperature: 105°F

Composition: (Mole %, wet)

CO	50.15
COS	0.04 (420 ppmv, dry)
CO_2	8.40
H_2	33.80
H_2O	5.57
H_2S	0.85 (9000 ppmv, dry)
N_2	1.19
HCN	NA
CS_2	NA

Mol Wt (wet) 20.075

Gas flow rate

Wet: 51,217 MM SCFM

Dry: 48,367 MM SCFM

Sulfur removal (assumed)

Efficiency: 95% of all H_2S, no COS removed

Sulfur Recovery Options - Description

Treatment of sulfur froth depends upon the amount to be handled. For small loads, filtration alone producing an impure sulfur cake might be an appropriate choice. Alternatively, filtration followed by batch autoclave melting and separation may be used to recover sulfur in another form. Larger loads might require centrifuging followed by continuous sulfur melting and separation in a jacketed autoclave, or in a direct steam injection sulfur melter.

When the sulfur is to be recovered by filtration, a rotary vacuum drum filter is generally used. The filter cake produced contains approximately 50% solids. One or more wash cycles are employed to economically recover the maximum amount of Stretford solution components from the cake. The filtrate and the wash solution are sent to a surge tank and are then returned to the system. Sometimes, depending on the water balance for a particular design, it might be necessary to concentrate the wash solution leaving the filter. Centrifuges employed for larger loads are of the continuous type. Filtrate and wash solution are again returned to the system.

To produce molten sulfur, sulfur cake or sulfur cake re-slurried in recycled water can be fed to an autoclave melter-separator. The melter-separator is a vessel with a jacket or internal coil which is heated by steam at about 100 psig. Molten sulfur separated from the aqueous solution of residual salts is pumped to storage. Recovered water and salts are returned to the system. Sulfur recovered by the above separator/melter methods is of a high purity in the range of 99.5% or better.

Economics

Capital and operating costs for the Stretford process are affected by many variables. The major design parameters that have a direct effect on the economics include the allowable hydrosulfide loading of the solution (which sets the circulation rate, hence pumping costs, etc.) and the required residence times in the various parts of the plant (which governs equipment sizes). A solution circulation rate could be 125-175 gal/lb sulfur depending on the hydrosulfide loadings. A residence times of 10 to 20 min. is required in the base of the absorber or in a separate holding tank to permit maximum conversion of hydrosulfide to sulfur prior to entering the oxidizer. About 5-min. delay is necessary after oxygen addition in the oxidizer to complete reoxidation of ADA.

Another factor that affects the economics is the sulfur disposal and/or recovery option selected (see Table C-1). The sulfur filter cake option (case 1) has the advantage of low capital costs, but operating costs are high due to loss of chemicals and high tonnage disposal of sulfur cake (containing about 50% moisture). Molten sulfur and Stretford purge disposal options (cases 2 and 3) add 20% to the capital cost; however the chemicals loss is only about 60 percent of the filter cake option. Also, the amount of solution purged is less and the disposal cost is lower. If recovered sulfur can be sold then sulfur credit will help reduce the overall cost of operation (case 2). If sulfur cannot be sold and has to be disposed (case 3), the overall operating costs per ton of sulfur output will be about $40 more than the filter cake disposal option (case 1).

With a sulfur melter, and reductive incineration for chemicals recovery added to the plant, the capital cost will be 35 percent higher than the filter cake option. This option with sulfur credit (case 4) shows improved economics over the base case. Compared with cases 2 and 3 the operating costs per ton of sulfur output are about $17 and $67 higher. With reductive incineration almost all $NaVO_3$ and Na_2CO_3 are recovered, minimizing the cost of chemicals. If no sulfur by-product credit is given (case 5) the operating cost is about $53 higher per ton sulfur output than case 1 (base case).

Table C-1 shows the comparative economics of the sulfur plant options. The data shown in Table C-2 was used for estimating the operating costs. The results show that with no sulfur by-product credit considered, the overall cost of operation for cases 3 and 5 is higher than the base case. However, when sulfur by-product credit of $60/ton is considered (cases 2 and 4) the overall cost of operation per ton of sulfur output is about $20-40 lower than the filter cake disposal option (case 1).

Conclusions

- If no sulfur by-product credit can be claimed, the filter-cake disposal option (case 1) should be considered.

TABLE C-1

ECONOMIC EVALUATION OF STRETFORD SULFUR PLANT OPTIONS

Case	1 (Base)	2	3	4	5
Sulfur Plant Options	Filter Cake Disposal	Molten Sulfur-Purge Disposal-Sulfur Credit	Molten Sulfur-Purge Disposal-Sulfur Disposal	Molten Sulfur-Red. Incineration-Sulfur Credit	Molten Sulfur-Red. Incineration-Sulfur Disposal
Total Plant Invest., MM$	7.400	8.880	8.880	9.990	9.990
Yearly Operating Cost, MM$					
Chemicals	0.492	0.312	0.312	0.193	0.193
Electricity	0.618	0.767	0.767	0.767	0.767
Steam	None	0.048	0.048	0.048	0.048
Fuel	None	None	None	0.166	0.166
Labor	0.114	0.114	0.114	0.114	0.114
Maintenance (2% of TPI)	0.148	0.178	0.178	0.200	0.200
Depreciation (20% of TPI)	1.480	1.776	1.775	1.998	1.998
Filter Cake Disposal	0.366	None	None	None	None
Purge Liquor Disposal	None	0.185	0.185	None	None
Sulfur Disposal	None	None	0.166	None	0.166
Sulfur Credit	None	-(0.498)	None	-(0.498)	None
Total	3.218	2.882	3.546	2.988	3.652
Overall Cost of Operation $/Ton Sulfur Output	387.83	347.35	427.35	360.15	440.14

(1) Plant investment is based on the conceptual cost estimates performed during Phase I of the current project.

TABLE C-2

ECONOMIC DATA FOR STRETFORD PLANT ALTERNATIVES

Sulfur Plant Options Case	1	2	3	4	5
Chemicals Make-up, lb/hr					
ADA	4.78	2.86	2.86	2.86	2.86
$NaVO_3$	3.04	1.82	1.82	0.18	0.18
Citric Acid	10.00	6.00	6.00	6.00	6.00
$NaCO_3$	62.74	60.00	60.00	3.76	3.76
Electricity Consumption, KWH/T Sulfur	1,491	1,540	1,540	1,540	1,540
Steam Consumption, lbs/T Sulfur	None	1,400	1,400	1,400	1,400
Fuel Consumption, 10^6 BTU/T Sulfur	None	None	None	4	4
Labor Requirements,	1 man/shift, 3 shift/day				
Waste Disposal, Tons/hr	2.312	0.519	1.5665	None	1.0475

Chemicals Cost, $/lb	ADA	- 6.45	Fuel Cost, $\$5/10^6$ BTU
	$NaVO_3$	- 5.75	
	Citric Acid	- 0.75	Labor Cost, $13/hr
	Na_2CO_3	- 0.10	

Electricity Cost, $0.05/KWhr

Steam Cost, $4.0/1000 lbs

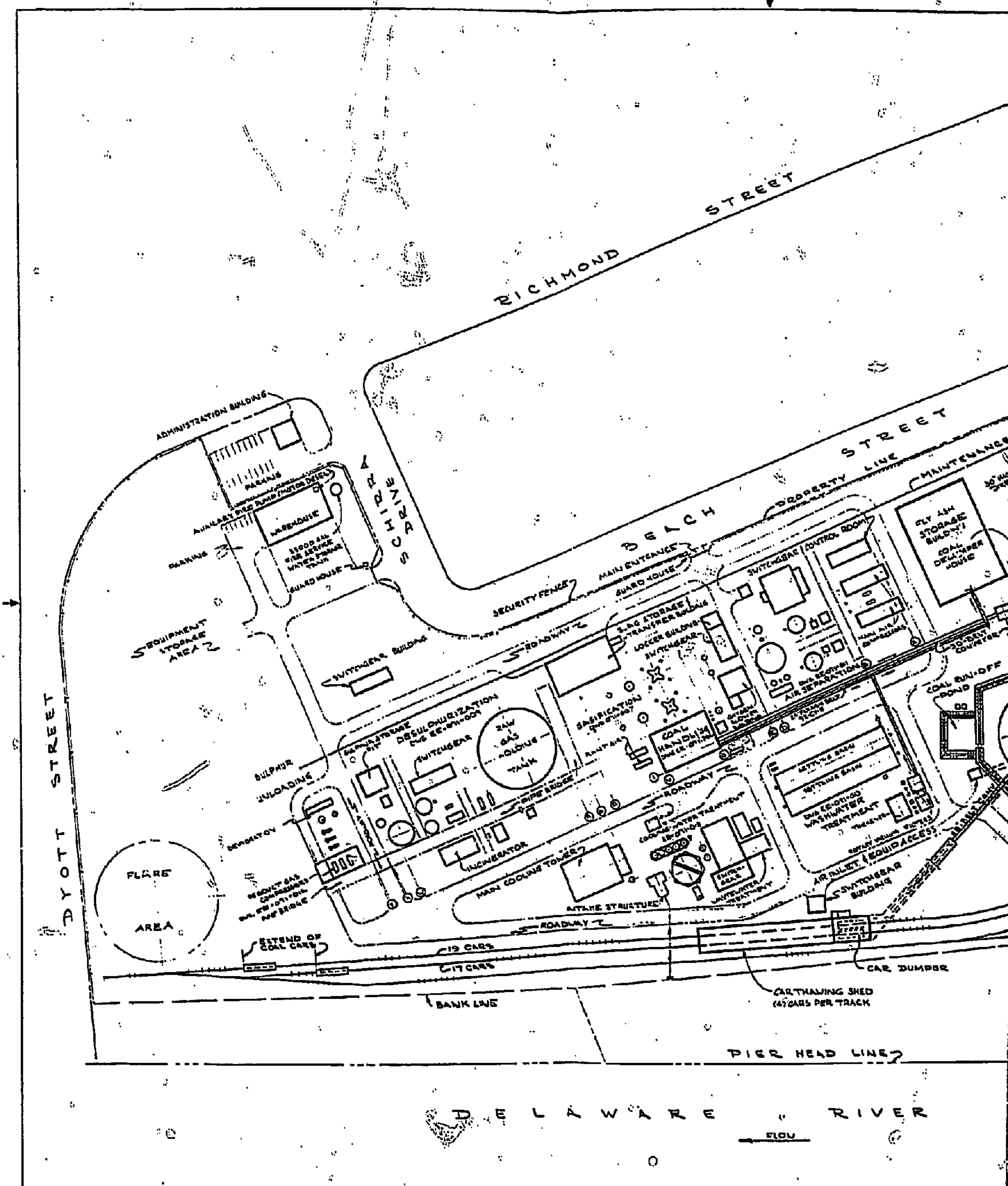
Solid Waste Disposal (Non-Toxic) Cost, $20/ton

Purge Disposal (Toxic) Cost, $45/ton

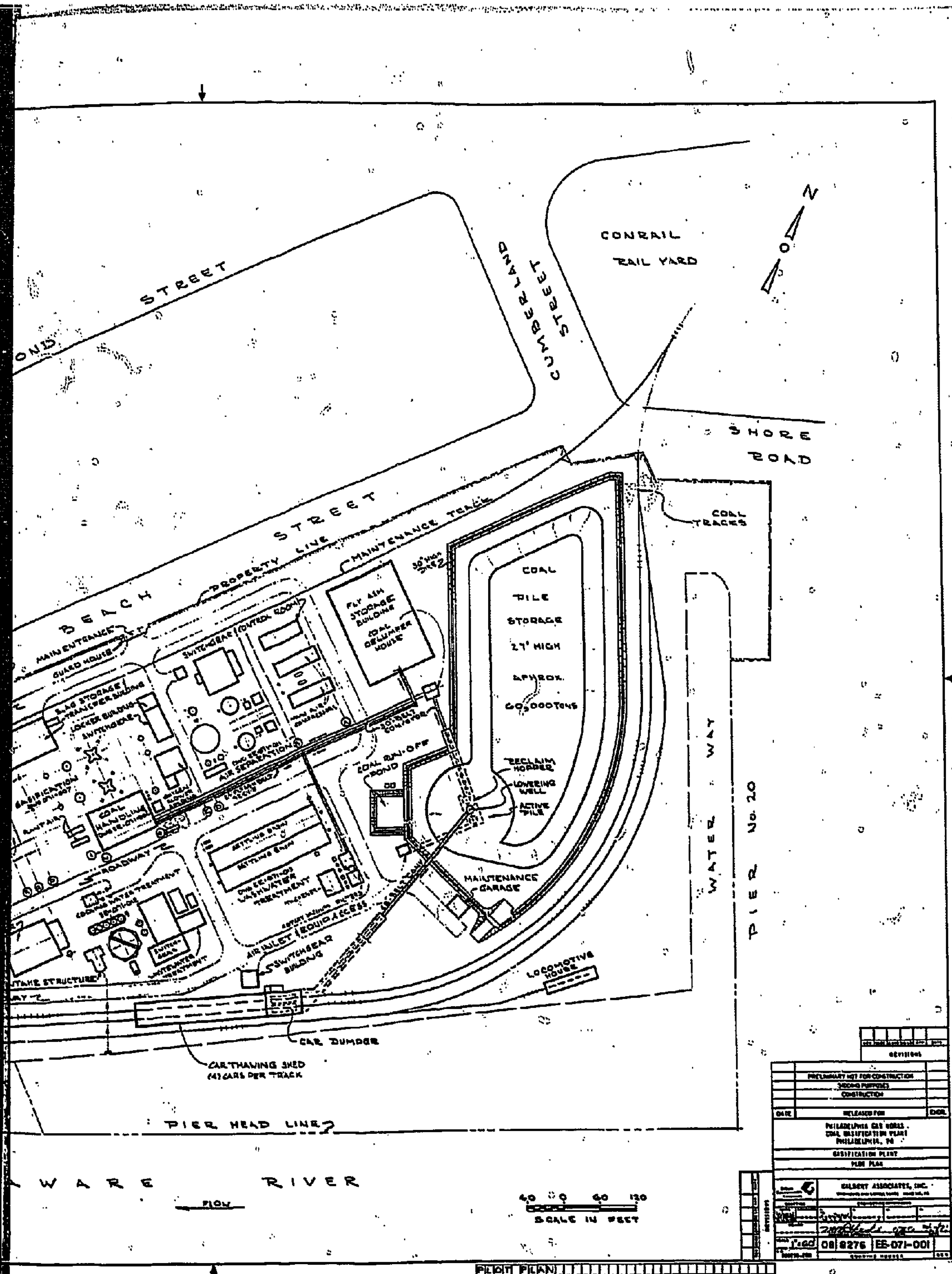
- If sulfur can be sold at about $60/ton or higher, the molten sulfur options (cases 2 and 4) should be considered. Reductive incineration (case 4) may be preferable to case 2 (purge disposal) because of marginal benefits of case 2 over case 4.

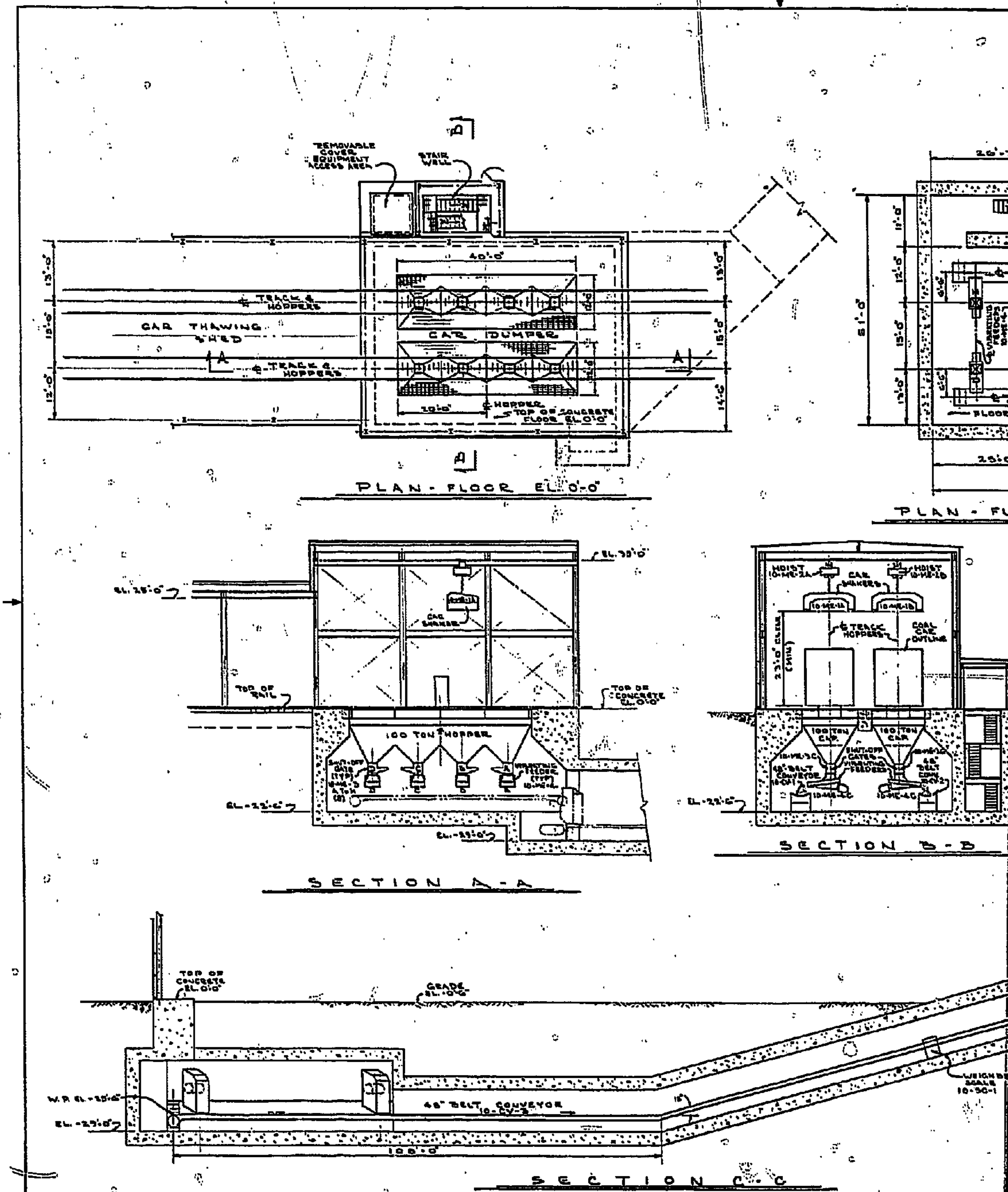
APPENDIX D

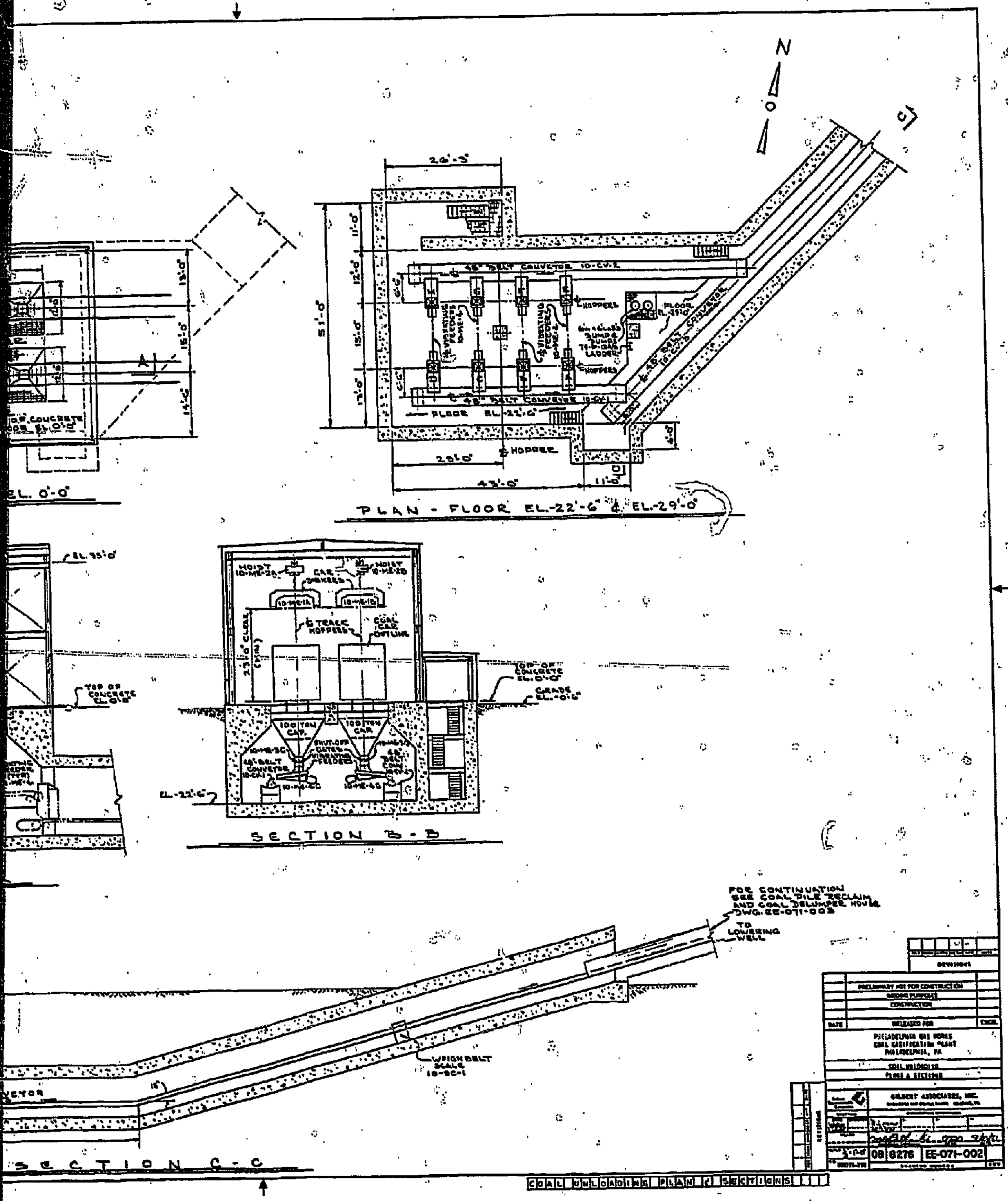
LAYOUT DRAWINGS

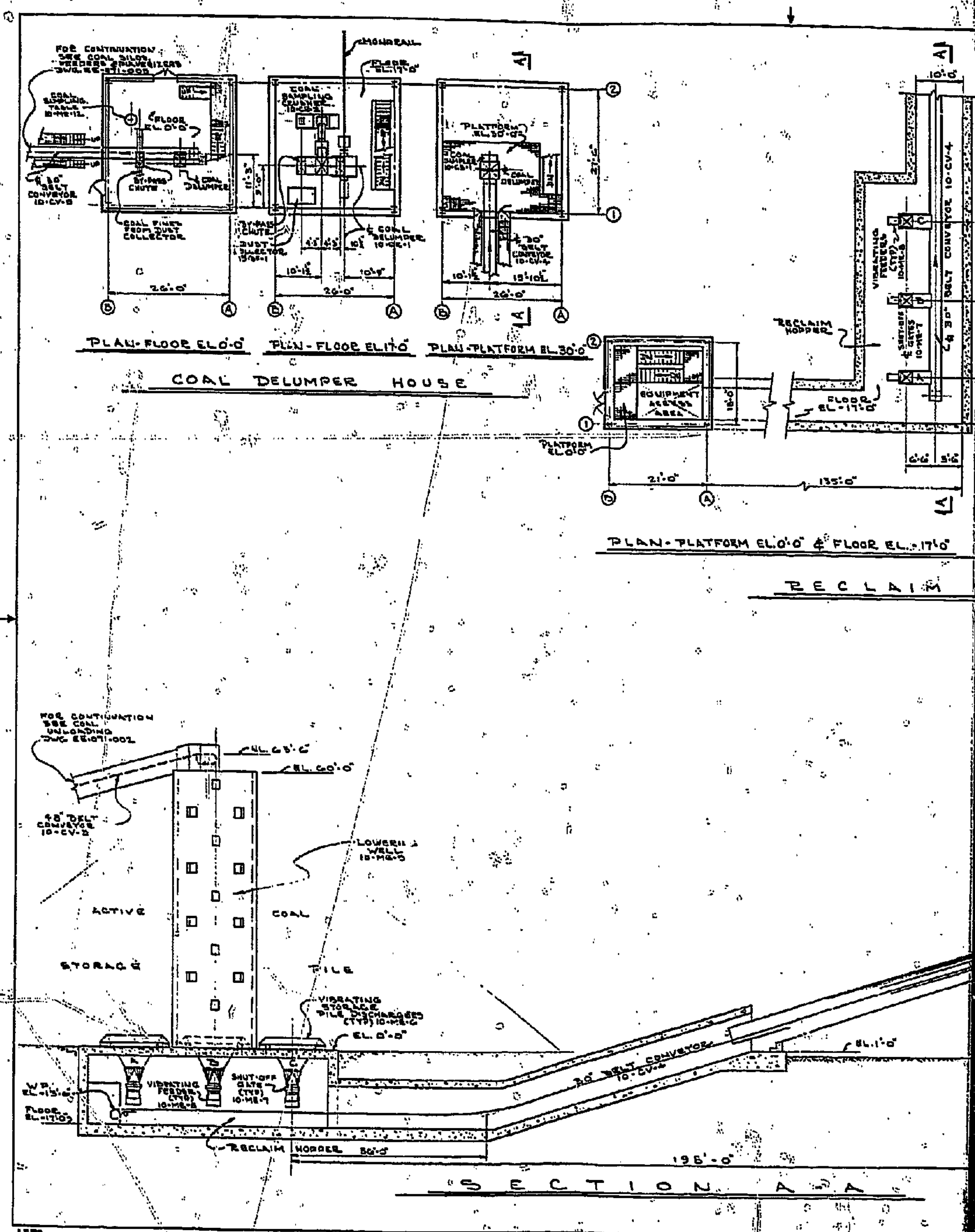


RICHMOND STREET
BEACH STREET
SCHIRRA DRIVE
DYOTT STREET
ADMINISTRATION BUILDING
PARKING
WAREHOUSE
GUARD HOUSE
EQUIPMENT STORAGE AREA
SWITCHGEAR BUILDING
SECURITY FENCE
MAIN ENTRANCE
ROADWAY
PROPERTY LINE
MAINTENANCE
CONTROL ROOM
SWITCHGEAR
FLY ASH STORAGE BUILDING
LOCKER BUILDING
GASIFICATION
COAL HANDLING
AIR SEPARATION
COAL RUN-OFF POND
DESULPHURIZATION
RAW GAS HOLDING TANK
SULPHUR UNLOADING
PIPE BRIDGE
INCINERATOR
WASHWATER TREATMENT
MAIN COOLING TOWER
INTAKE STRUCTURE
AIR INLET
SWITCHGEAR BUILDING
FLARE AREA
EXTEND OF COAL CARS
19 CARS
17 CARS
CAR DUMPER
CAR THAWING SHED
BANK LINE
PIER HEAD LINE
DELAWARE RIVER
FLOW

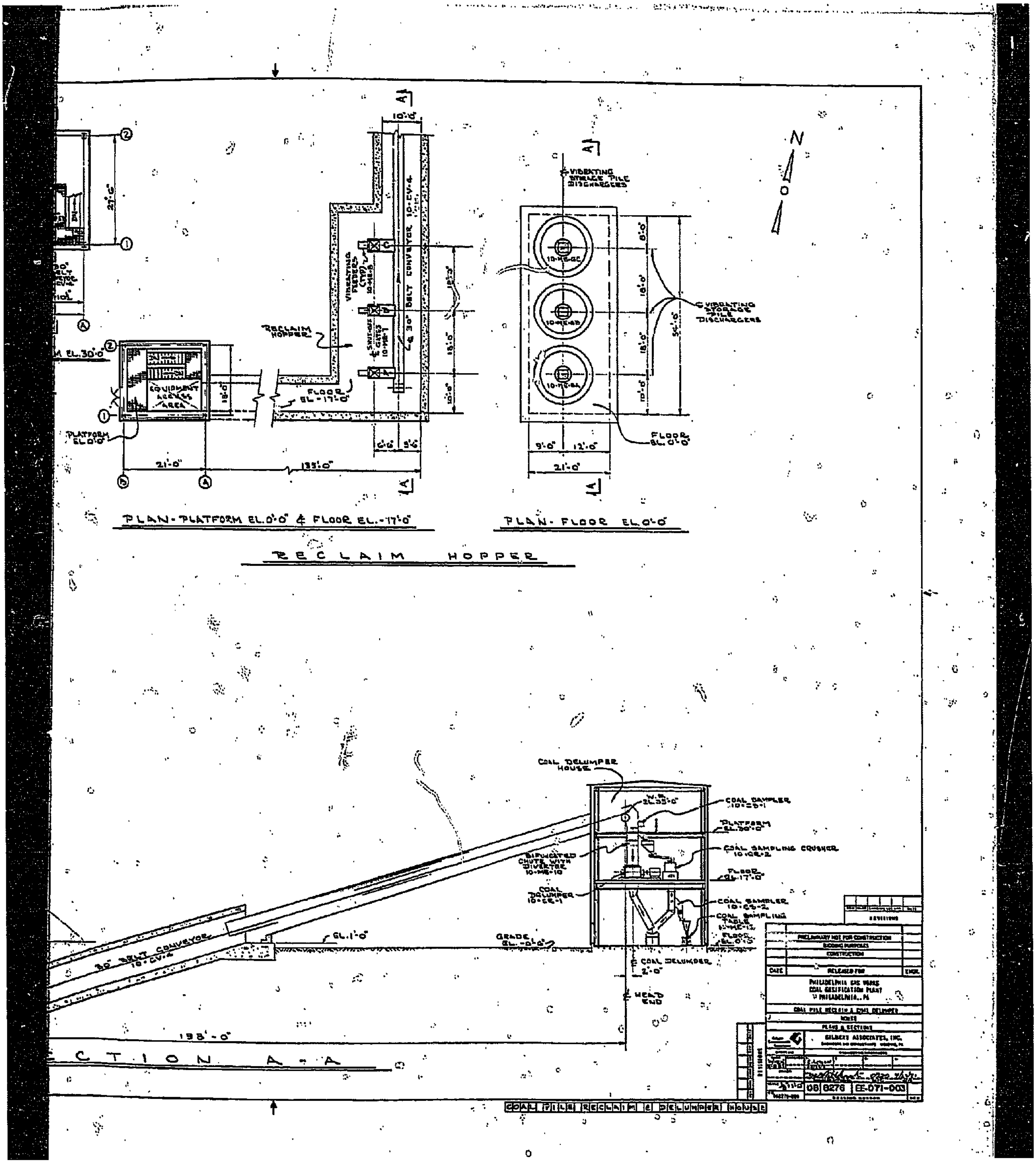

STREET
CUMBERLAND STREET
CONRAIL RAIL YARD
N
SHORE ROAD
COAL TRACKS
BEACH STREET
PROPERTY LINE
MAINTENANCE TRACK
MAIN ENTRANCE
GUARD HOUSE
SWITCHGEAR / CONTROL ROOM
FLY ASH STORAGE BUILDING
COAL DELUMPER HOUSE
COAL PILE STORAGE 27' HIGH APPROX. 60,000 TONS
RECLAIM HOPPER
LOWERING WELL
ACTIVE PILE
COAL RUN-OFF POND
AIR SEPARATION
COAL HANDLING
ROADWAY
SETTLING BASIN
WASHWATER TREATMENT
COOLING WATER TREATMENT
MAINTENANCE GARAGE
AIR INLET / SWITCHGEAR BUILDING
LOCOMOTIVE HOUSE
INTAKE STRUCTURE
CAR DUMPER
CAR THAWING SHED (4) CARS PER TRACK
WATER WAY
PIER No. 20
PIER HEAD LINE
RIVER
FLOW
40 0 60 120
SCALE IN FEET
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
GASIFICATION PLANT
GILBERT ASSOCIATES, INC.
08 8276
EE-071-001
PLOT PLAN


REMOVABLE COVER EQUIPMENT ACCESS AREA
STAIR WELL
40'-0"
CAR THAWING SHED
CAR DUMPER
PLAN - FLOOR EL. 0'-0"
PLAN - FL
CAR SHAKER
TOP OF RAIL
TOP OF CONCRETE EL. 0'-0"
100 TON HOPPER
SECTION A-A
HOIST
CAR SHAKERS
COAL CAR OUTLINE
100 TON CAP.
SECTION B-B
TOP OF CONCRETE EL. 0'-0"
GRADE EL. 0'-0"
48" BELT CONVEYOR
100'-0"
SECTION C-C

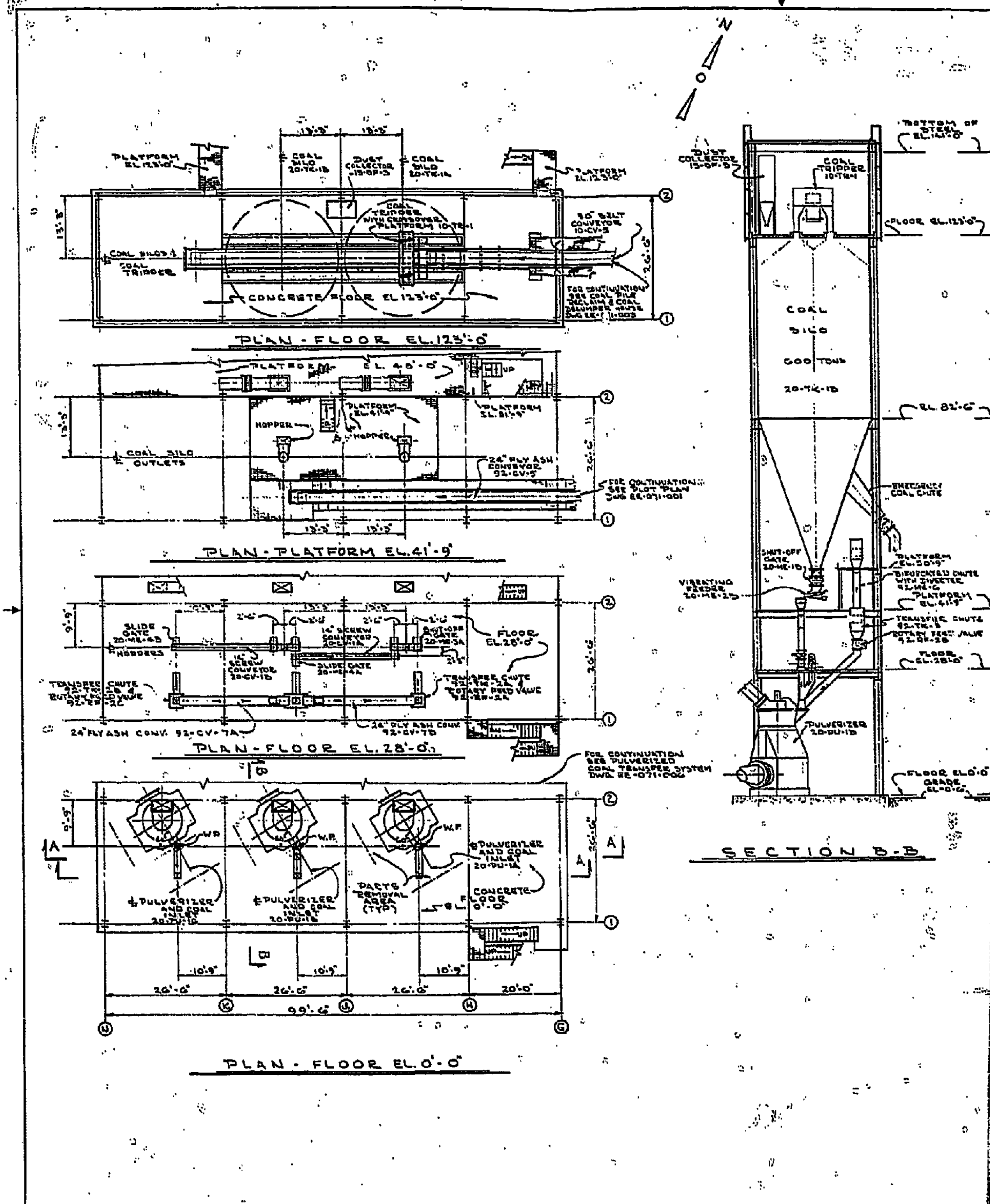

N
24'-5"
51'-0"
11'-0"
12'-0"
15'-0"
13'-0"
48" BELT CONVEYOR 10-CV-2
48" BELT CONVEYOR 10-CV-1
HOPPERS
FLOOR EL-22'-0"
℄ HOPPER
25'-0"
43'-0"
11'-0"
PLAN - FLOOR EL-22'-6" & EL-29'-0"
EL. 0'-0"
EL. 35'-0"
TOP OF CONCRETE EL. 0'-0"
HOIST 10-ME-2A
HOIST 10-ME-2B
CAR SHAKERS
℄ TRACK HOPPERS
COAL CAR OUTLINE
TOP OF CONCRETE EL. 0'-0"
GRADE EL.-0'-6"
100 TON CAR
SHUT-OFF GATES VIBRATING FEEDERS
48" BELT CONVEYOR
EL-22'-6"
SECTION B-B
FOR CONTINUATION SEE COAL PILE RECLAIM AND COAL DELUMPER HOUSE DWG. EE-071-003
TO LOWERING WELL
WEIGH BELT SCALE 10-SC-1
SECTION C-C
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
GILBERT ASSOCIATES, INC.
08 8276
EE-071-002
COAL UNLOADING PLAN & SECTIONS



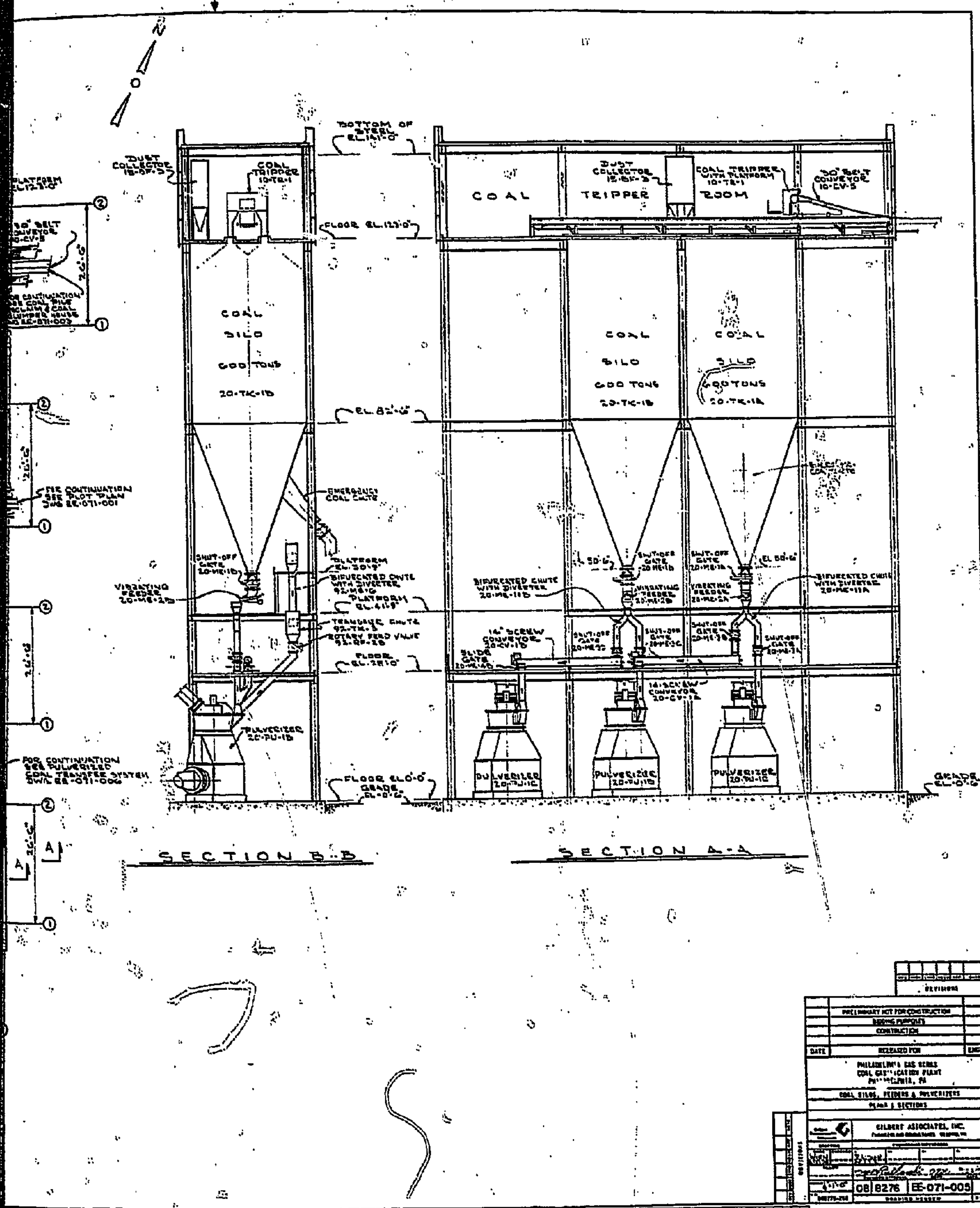
MONORAIL
PLAN - FLOOR EL. 0'-0"
PLAN - FLOOR EL. 17'-0"
PLAN - PLATFORM EL. 30'-0"
COAL DELUMPER HOUSE
26'-0"
EQUIPMENT ACCESS AREA
RECLAIM HOPPER
30" BELT CONVEYOR 10-CV-4
21'-0"
135'-0"
PLAN - PLATFORM EL. 0'-0" & FLOOR EL. -17'-0"
RECLAIM
48" BELT CONVEYOR 10-CV-2
ACTIVE COAL STORAGE PILE
EL. 0'-0"
RECLAIM HOPPER
30" BELT CONVEYOR 10-CV-4
196'-0"
SECTION A-A



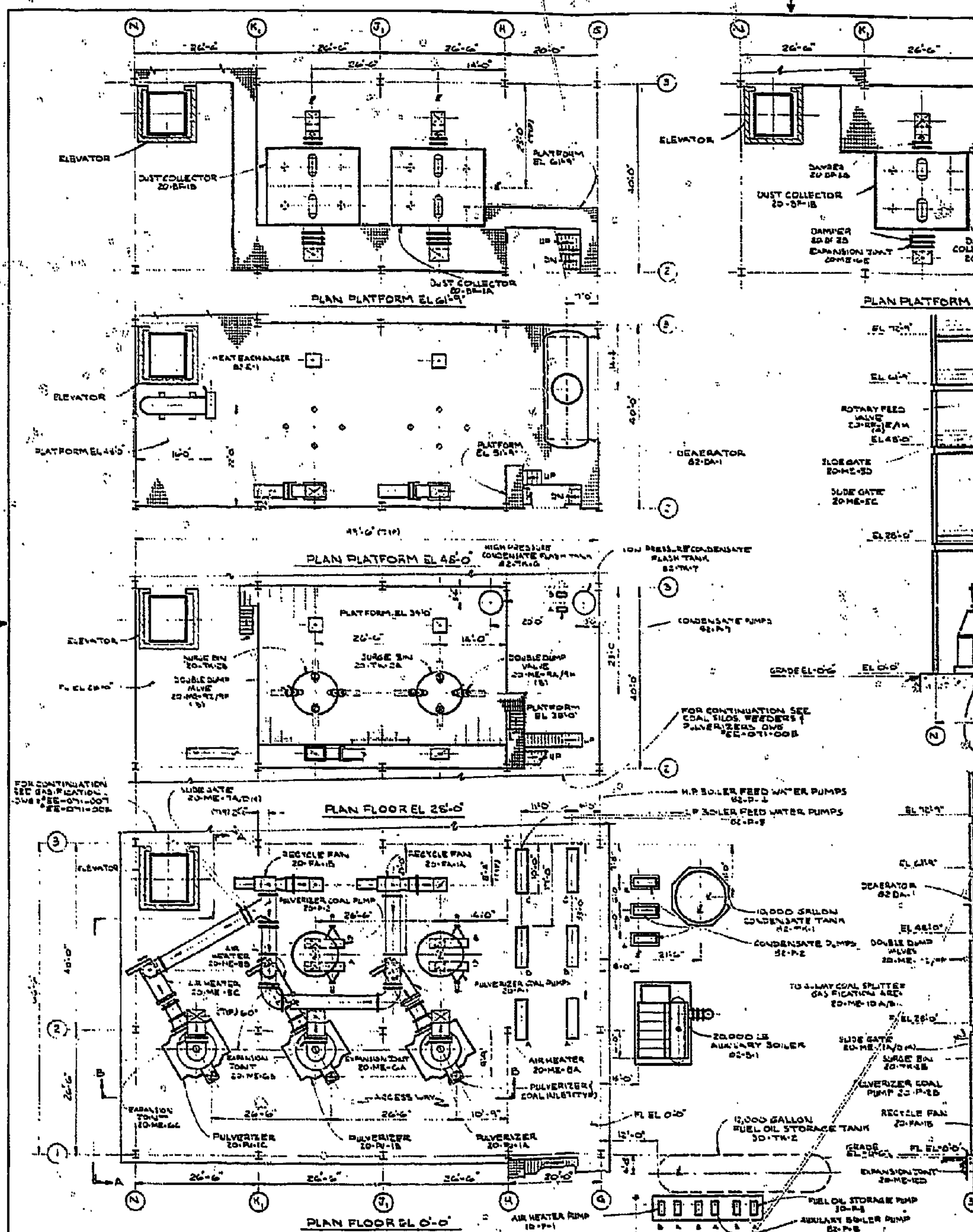
PLAN - PLATFORM EL.0'-0" & FLOOR EL.-17'-0"
PLAN - FLOOR EL.0'-0"
RECLAIM HOPPER
RECLAIM HOPPER
VIBRATING FEEDERS (TYP.) 10-ME-6
SHUT-OFF GATES 10-ME-7
30" BELT CONVEYOR 10-CV-4
EQUIPMENT ACCESS AREA
PLATFORM EL.0'-0"
FLOOR EL.-17'-0"
VIBRATING STORAGE PILE DISCHARGERS
FLOOR EL.0'-0"
N
COAL DELUMPER HOUSE
COAL SAMPLER 10-CS-1
PLATFORM EL.30'-0"
COAL SAMPLING CRUSHER 10-CR-2
BIFURCATED CHUTE WITH DIVERTER 10-ME-10
FLOOR EL.17'-0"
COAL DELUMPER 10-CE-1
COAL SAMPLER 10-CS-2
COAL SAMPLING TABLE
GRADE EL.-0'-0"
EL.1'-0"
30" BELT CONVEYOR 10-CV-4
HEAD END
193'-0"
SECTION A-A
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
COAL PILE RECLAIM & COAL DELUMPER HOUSE
PLANS & SECTIONS
GILBERT ASSOCIATES, INC.
08 8276 EE-071-003
COAL PILE RECLAIM & DELUMPER HOUSE

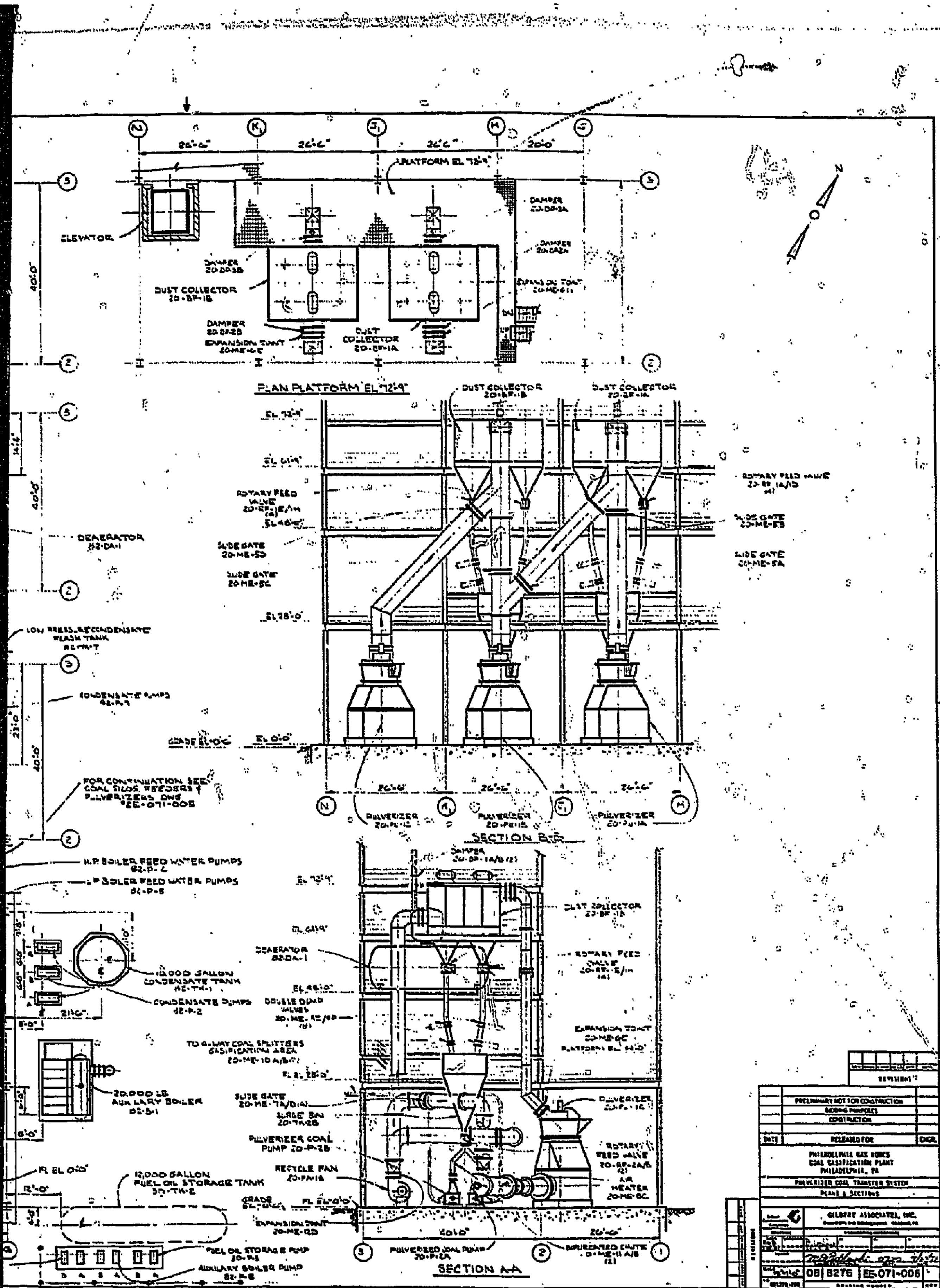


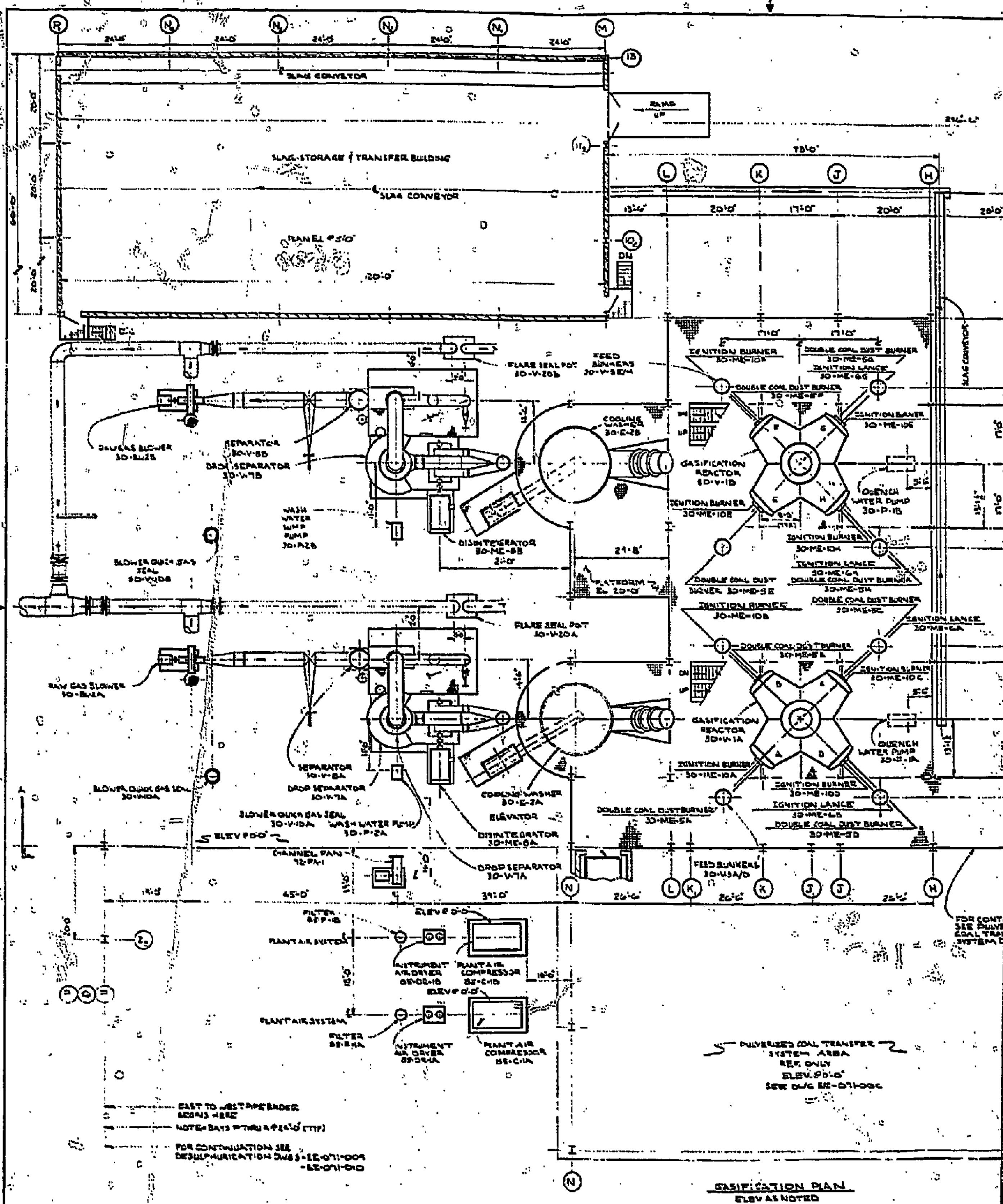
PLAN - FLOOR EL.123'-0"
PLATFORM EL.123'-0"
COAL SILO 20-TK-1B
DUST COLLECTOR 15-DF-3
COAL SILO 20-TK-1A
COAL TRIPPER WITH CROSSOVER PLATFORM 10-TR-1
30" BELT CONVEYOR 10-CV-5
COAL SILOS & COAL TRIPPER
CONCRETE FLOOR EL.123'-0"
PLAN - PLATFORM EL.41'-9"
PLATFORM EL.48'-0"
HOPPER
COAL SILO OUTLETS
24" FLY ASH CONVEYOR 92-CV-5
FOR CONTINUATION SEE PLOT PLAN DWG EE-071-001
PLAN - FLOOR EL.28'-0"
SLIDE GATE
HOPPERS
14" SCREW CONVEYOR
SLIDE GATE
FLOOR EL.28'-0"
TRANSFER CHUTE
ROTARY FEED VALVE
24" FLY ASH CONV. 92-CV-7A
24" FLY ASH CONV. 92-CV-7B
PLAN - FLOOR EL.0'-0"
FOR CONTINUATION SEE PULVERIZED COAL TRANSFER SYSTEM DWG EE-071-006
W.P.
℄ PULVERIZER AND COAL INLET 20-PU-1A
℄ PULVERIZER AND COAL INLET 20-PU-1B
℄ PULVERIZER AND COAL INLET 20-PU-1C
PARTS REMOVAL AREA (TYP)
CONCRETE FLOOR EL.0'-0"
26'-0"
26'-0"
26'-0"
20'-0"
99'-0"
10'-9"
SECTION B-B
BOTTOM OF STEEL EL.131'-0"
DUST COLLECTOR 15-DF-3
COAL TRIPPER 10-TR-1
FLOOR EL.123'-0"
COAL SILO 600 TONS 20-TK-1B
EL.83'-6"
EMERGENCY COAL CHUTE
SHUT-OFF GATE
VIBRATING FEEDER 20-ME-2B
PLATFORM EL.50'-0"
BIFURCATED CHUTE WITH DIVERTER
PLATFORM EL.41'-9"
TRANSFER CHUTE
ROTARY FEED VALVE
FLOOR EL.28'-0"
PULVERIZER 20-PU-1B
FLOOR EL.0'-0" GRADE



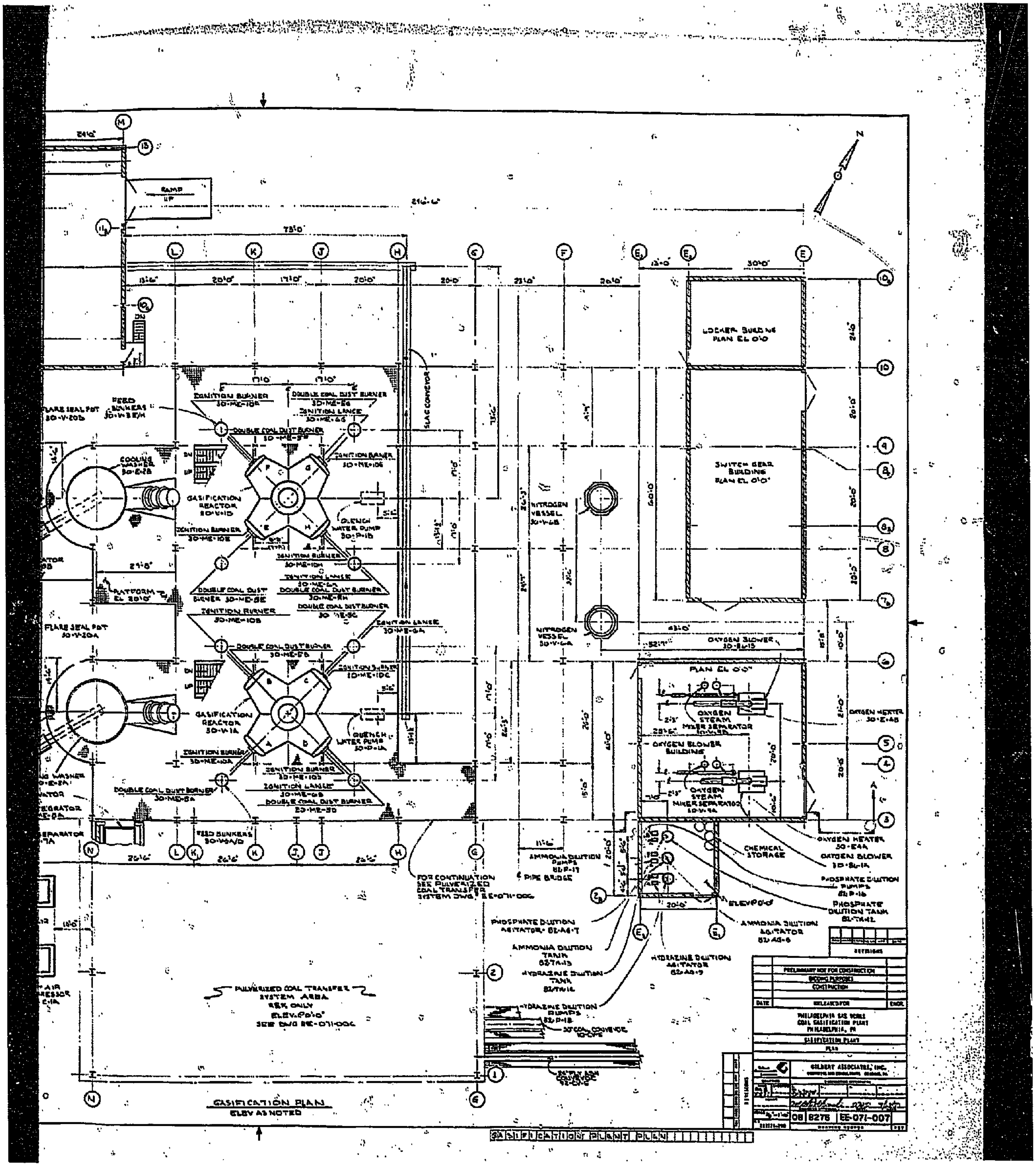
BOTTOM OF STEEL EL.131'-0"
DUST COLLECTOR
COAL TRIPPER
FLOOR EL.123'-0"
COAL TRIPPER ROOM
COAL SILO 600 TONS 20-TK-1B
COAL SILO 600 TONS 20-TK-1B
COAL SILO 600 TONS 20-TK-1A
EL.82'-0"
EMERGENCY COAL CHUTE
SHUT-OFF GATE
VIBRATING FEEDER
BIFURCATED CHUTE WITH DIVERTER
14" SCREW CONVEYOR
SLIDE GATE
ROTARY FEED VALVE
PULVERIZER 20-PU-1B
PULVERIZER 20-PU-1C
PULVERIZER 20-PU-1B
PULVERIZER 20-PU-1A
FLOOR EL.0'-0"
GRADE EL.-0'-6"
FOR CONTINUATION SEE PULVERIZED COAL TRANSFER SYSTEM
SECTION B-B
SECTION A-A
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
COAL SILOS, FEEDERS & PULVERIZERS
PLANS & SECTIONS
GILBERT ASSOCIATES, INC.
08 8276 EE-071-005
COAL SILOS FEEDERS & PULVERIZERS

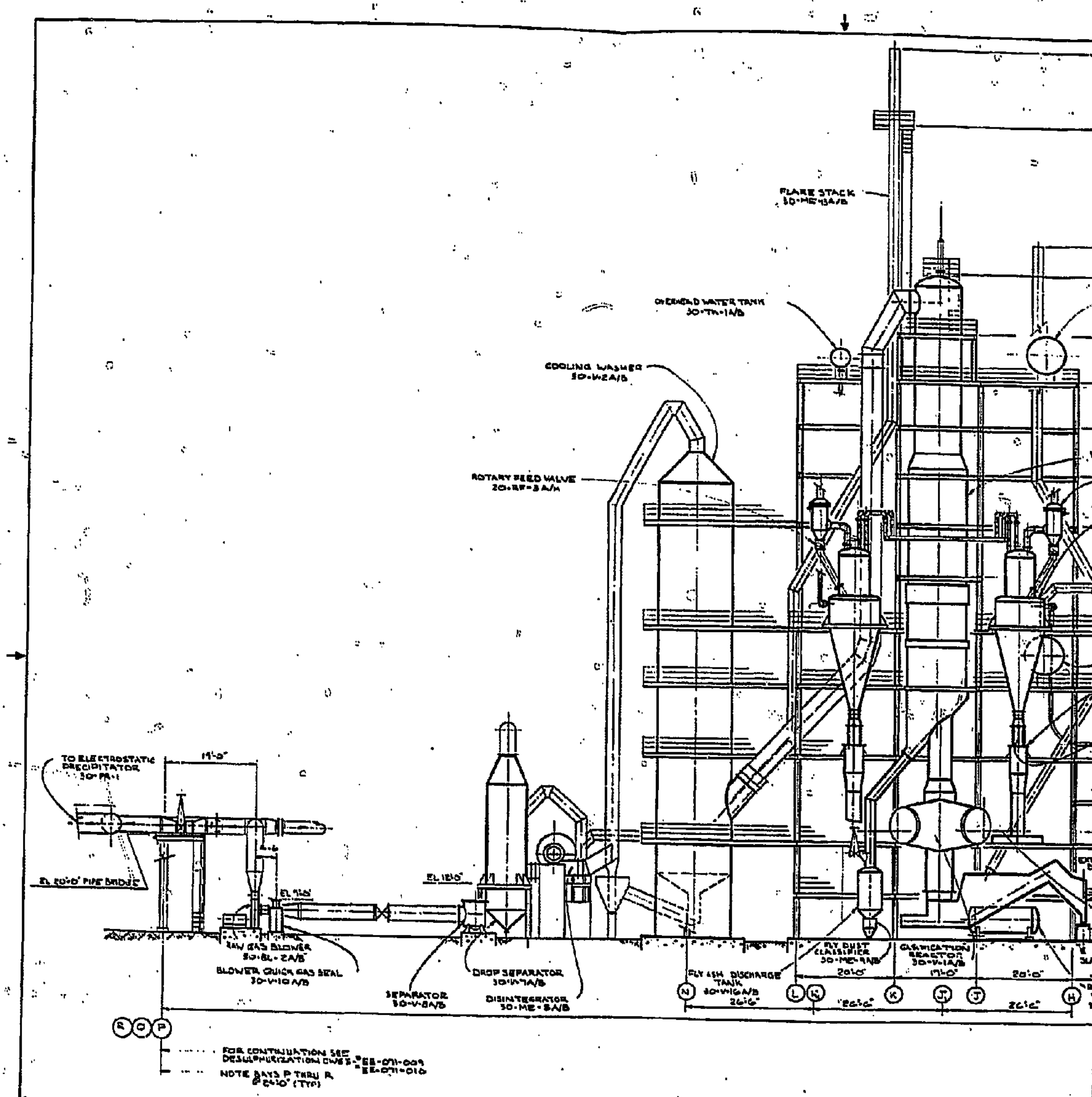

PLAN PLATFORM EL 61'-9"
ELEVATOR
DUST COLLECTOR 20-BF-1B
DUST COLLECTOR 20-BF-1A
PLATFORM EL 61'-9"
PLAN PLATFORM EL 48'-0"
HEAT EXCHANGER 82-E-1
PLATFORM EL 44'-0"
DEAERATOR 82-DA-1
HIGH PRESSURE CONDENSATE FLASH TANK 82-TK-6
LOW PRESSURE CONDENSATE FLASH TANK 82-TK-7
PLATFORM EL 34'-0"
CONDENSATE PUMPS 82-P-7
SURGE BIN 20-TK-2B
SURGE BIN 20-TK-2A
DOUBLE DUMP VALVE
PLATFORM EL 38'-0"
FOR CONTINUATION SEE COAL SILOS, FEEDERS & PULVERIZERS DWG
PLAN FLOOR EL 26'-0"
H.P. BOILER FEED WATER PUMPS
L.P. BOILER FEED WATER PUMPS
RECYCLE FAN 20-FA-1B
RECYCLE FAN 20-FA-1A
PULVERIZER COAL PUMP
AIR HEATER
10,000 GALLON CONDENSATE TANK
CONDENSATE PUMPS
20,000 LB AUXILIARY BOILER
EXPANSION JOINT
AIR HEATER 20-ME-8A
PULVERIZER COAL INLET (TYP)
ACCESS WAY
PULVERIZER 20-PU-1C
PULVERIZER 20-PU-1B
PULVERIZER 20-PU-1A
FL EL 0'-0"
12,000 GALLON FUEL OIL STORAGE TANK
FUEL OIL STORAGE PUMP
AUXILIARY BOILER PUMP
AIR HEATER PUMP
PLAN FLOOR EL 0'-0"
PLAN PLATFORM EL
ROTARY FEED VALVE
SLIDE GATE
GRADE EL 0'-0"
DEAERATOR 82-DA-1
DOUBLE DUMP VALVE
SURGE BIN
PULVERIZER COAL PUMP
RECYCLE FAN
EXPANSION JOINT


ELEVATOR
DUST COLLECTOR 20-BP-1B
PLAN PLATFORM EL 72'-9"
DUST COLLECTOR 20-BP-1B
DUST COLLECTOR 20-BP-1A
DEAERATOR 82-DA-1
SECTION B-B
PULVERIZER 20-PU-1C
PULVERIZER 20-PU-1B
PULVERIZER 20-PU-1A
H.P. BOILER FEED WATER PUMPS
L.P. BOILER FEED WATER PUMPS
12,000 GALLON CONDENSATE TANK
CONDENSATE PUMPS
20,000 LB AUX LARY BOILER
12,000 GALLON FUEL OIL STORAGE TANK
FUEL OIL STORAGE PUMP
AUXILARY BOILER PUMP
RECYCLE FAN
PULVERIZED COAL PUMP
SECTION A-A
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
CHKR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PULVERIZED COAL TRANSFER SYSTEM
PLANS & SECTIONS
GILBERT ASSOCIATES, INC.
08 8276 EE-071-005
PULVERIZED COAL TRANSFER SYSTEM

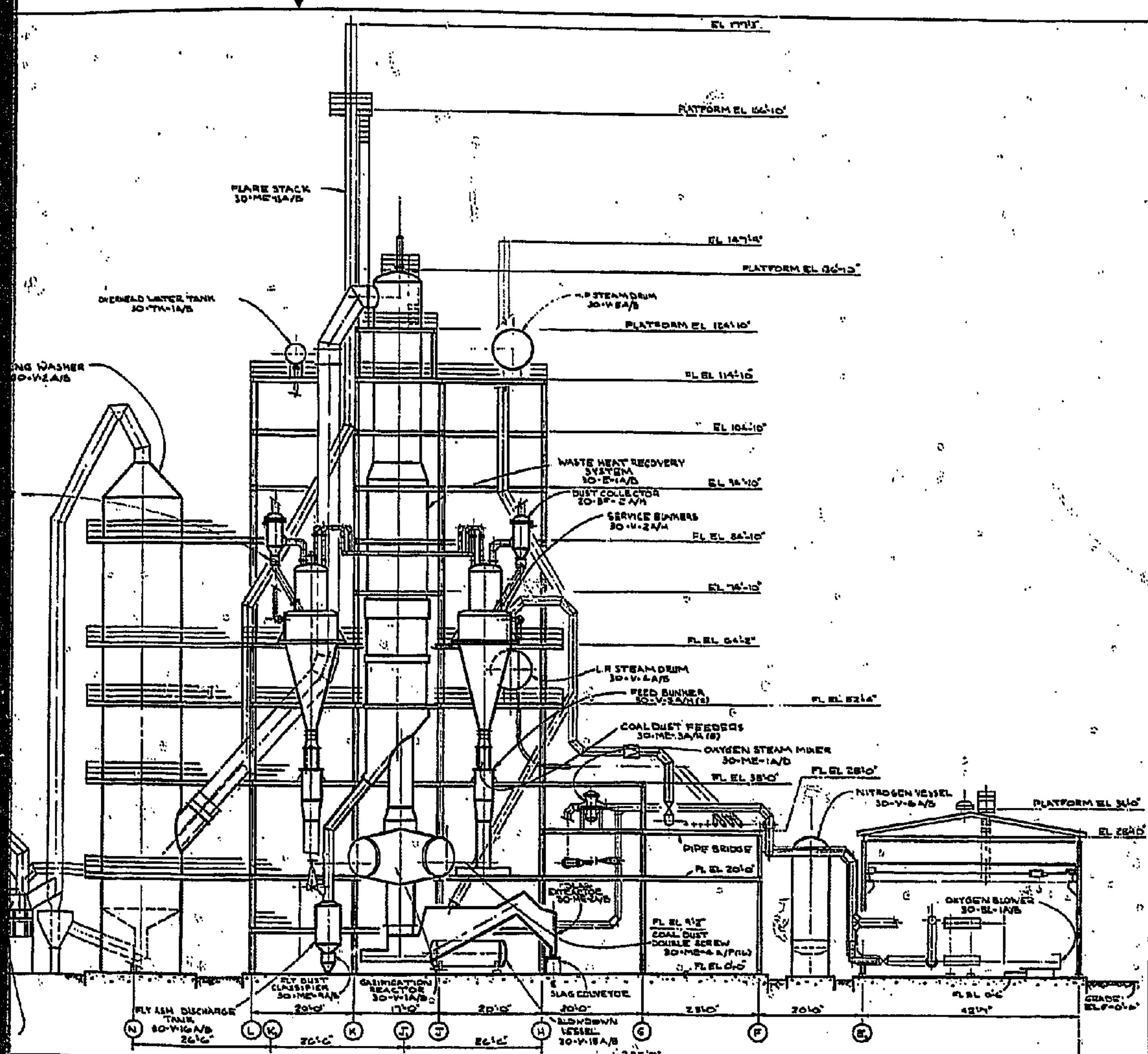


GASIFICATION PLAN
ELEV AS NOTED


GASIFICATION REACTOR 30-V-1B
GASIFICATION REACTOR 30-V-1A
IGNITION BURNER
DOUBLE COAL DUST BURNER
IGNITION LANCE
FEED BUNKERS
FLARE SEAL POT 30-V-20B
FLARE SEAL POT 30-V-20A
COOLING WASHER 30-E-2B
QUENCH WATER PUMP 30-P-1B
QUENCH WATER PUMP 30-P-1A
PLATFORM EL 20'0"
SLAG CONVEYOR
NITROGEN VESSEL 30-V-6B
NITROGEN VESSEL 30-V-6A
LOCKER BUILDING PLAN EL 0'0"
SWITCH GEAR BUILDING PLAN EL 0'0"
OXYGEN BLOWER 30-BL-1B
OXYGEN BLOWER BUILDING
OXYGEN STEAM MIXER SEPARATOR
OXYGEN HEATER 30-E-4B
OXYGEN HEATER 30-E-4A
OXYGEN BLOWER 30-BL-1A
CHEMICAL STORAGE
PHOSPHATE DILUTION PUMPS
PHOSPHATE DILUTION TANK
AMMONIA DILUTION AGITATOR
HYDRAZINE DILUTION AGITATOR
PHOSPHATE DILUTION AGITATOR
AMMONIA DILUTION TANK
HYDRAZINE DILUTION TANK
HYDRAZINE DILUTION PUMPS
AMMONIA DILUTION PUMPS
PIPE BRIDGE
FOR CONTINUATION SEE PULVERIZED COAL TRANSFER SYSTEM DWG. EE-071-006
PULVERIZED COAL TRANSFER SYSTEM AREA REF. ONLY ELEV. 0'0" SEE DWG EE-071-006
RAMP UP
GASIFICATION PLAN
ELEV AS NOTED
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
GASIFICATION PLANT PLAN
GILBERT ASSOCIATES, INC.
08 8275 EE-071-007
GASIFICATION PLANT PLAN



GASIFICATION SECTION A-A



GASIFICATION SECTION A-A

PRELIMINARY NOT FOR CONSTRUCTION

CONSTRUCTION

DATE | RELEASED FOR | ENGR.

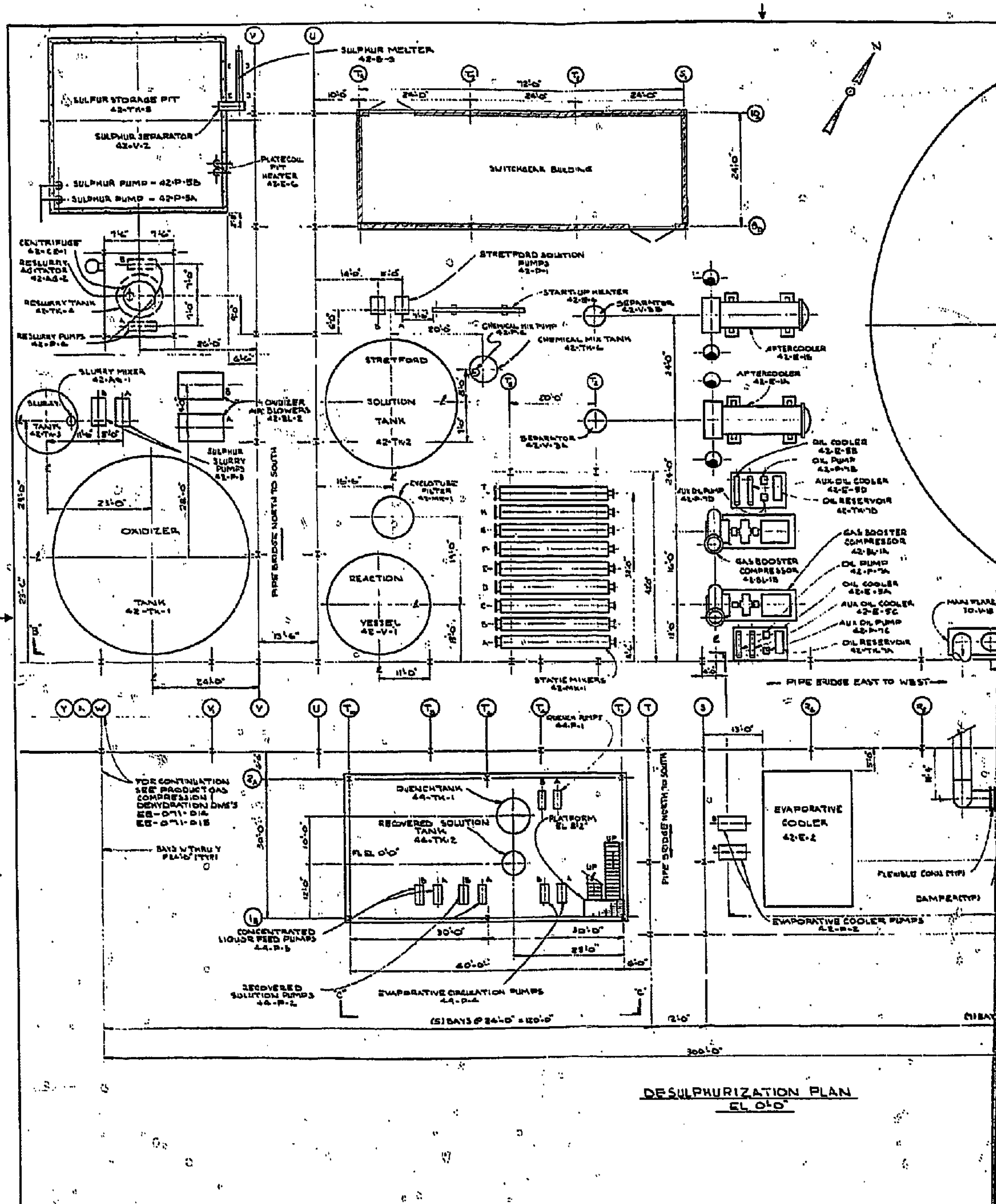
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA

GASIFICATION PLANT
SECTIONS

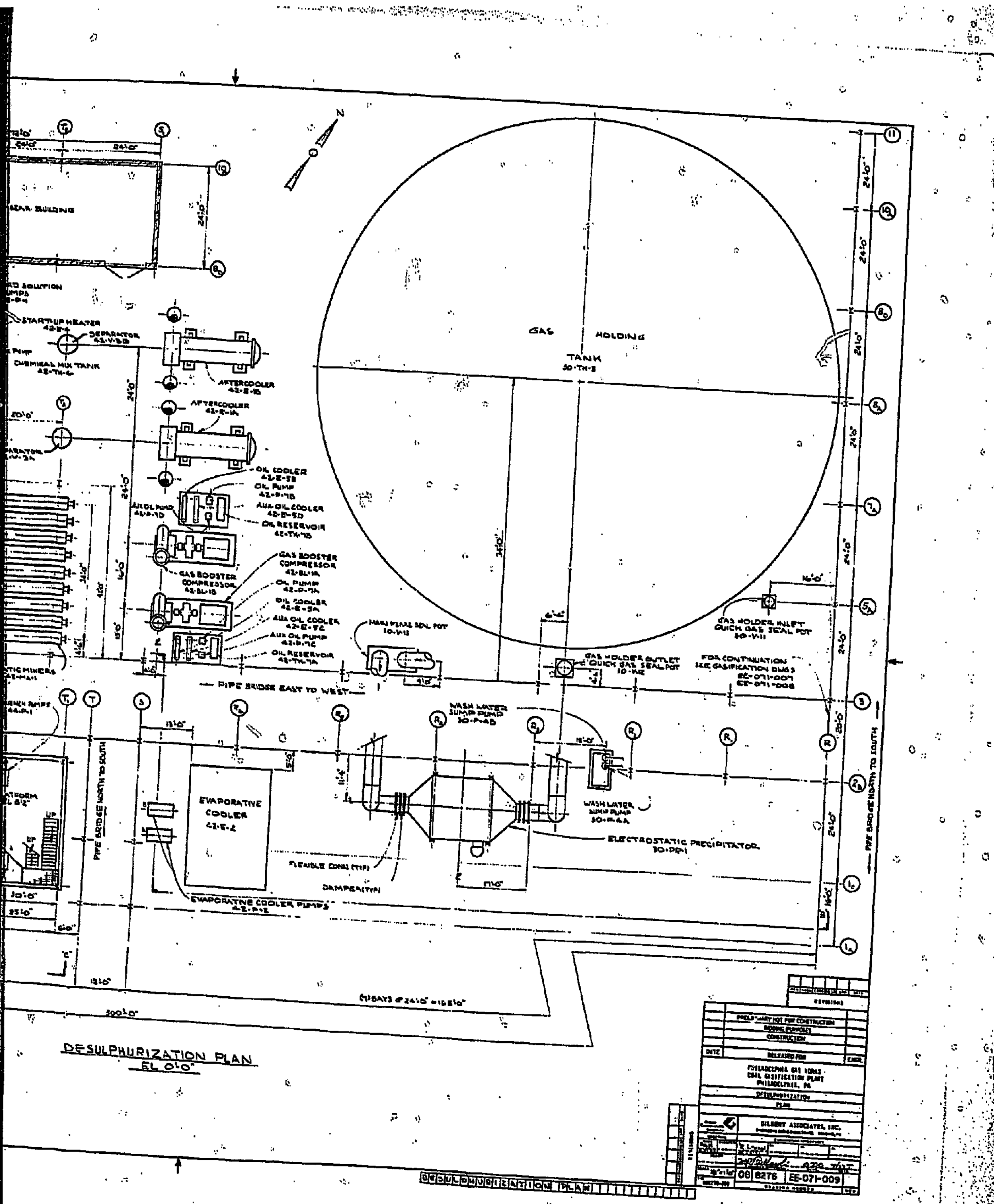
GILBERT ASSOCIATES, INC.

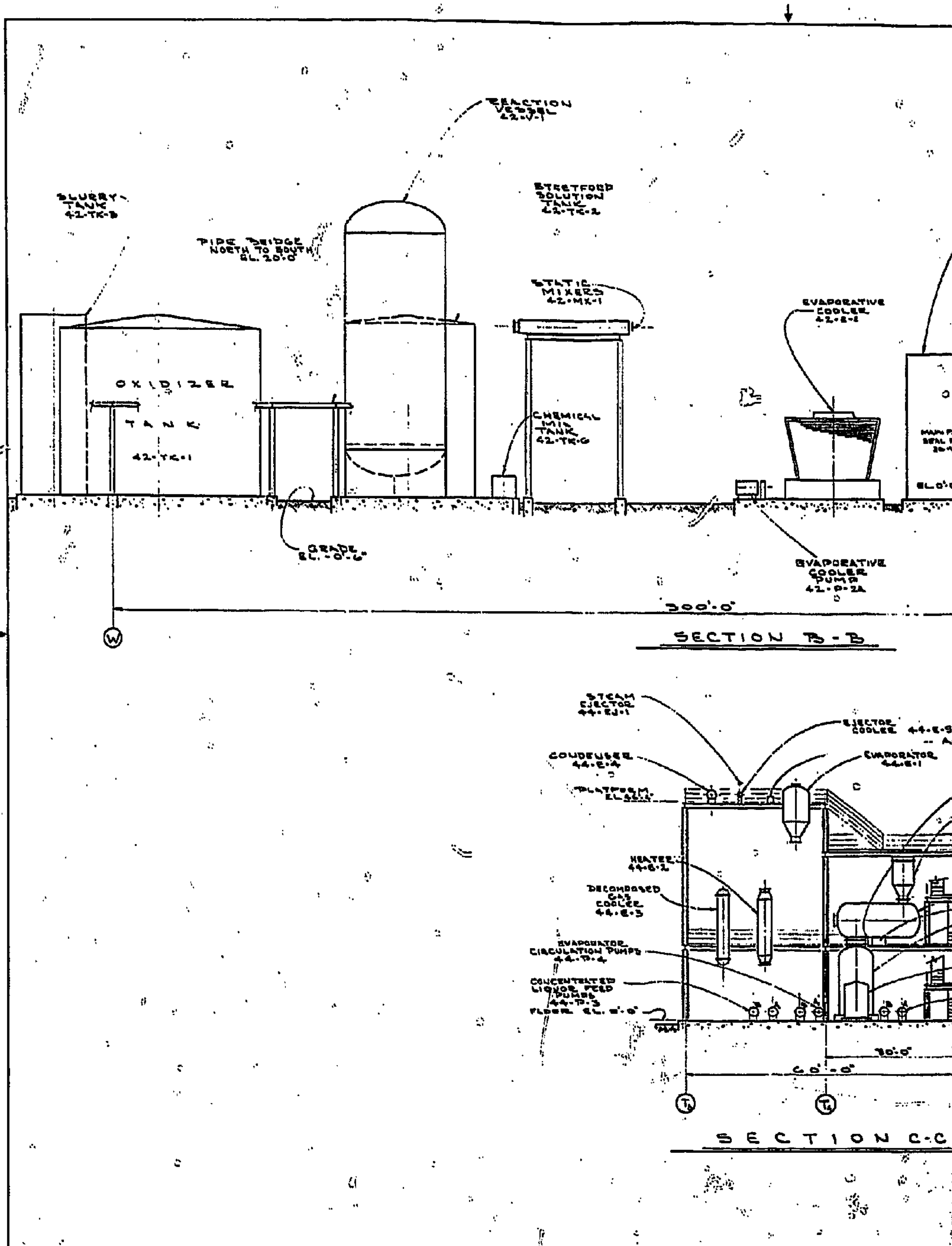
08 8276 EE-071-008

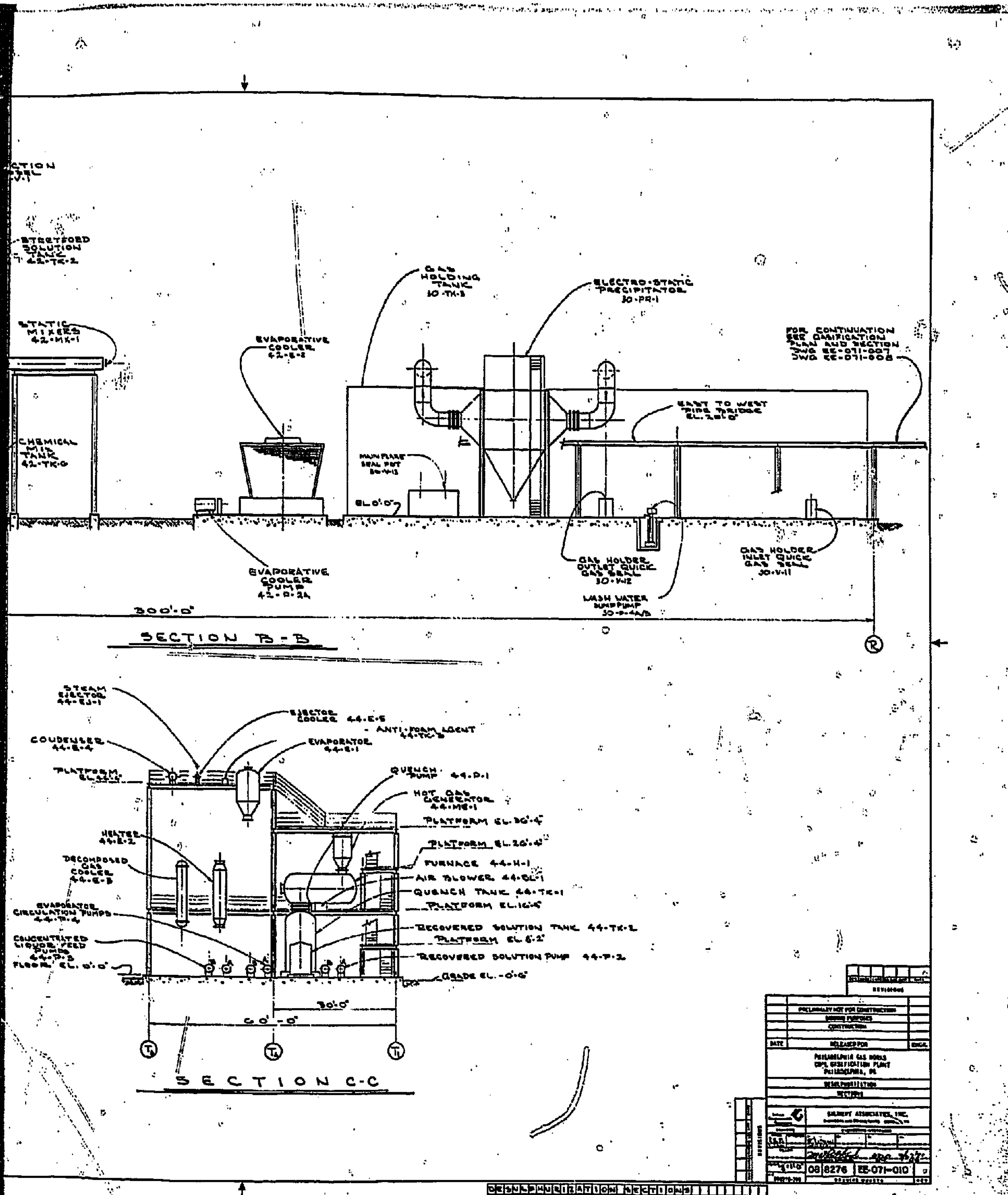
GASIFICATION PLANT SECTION

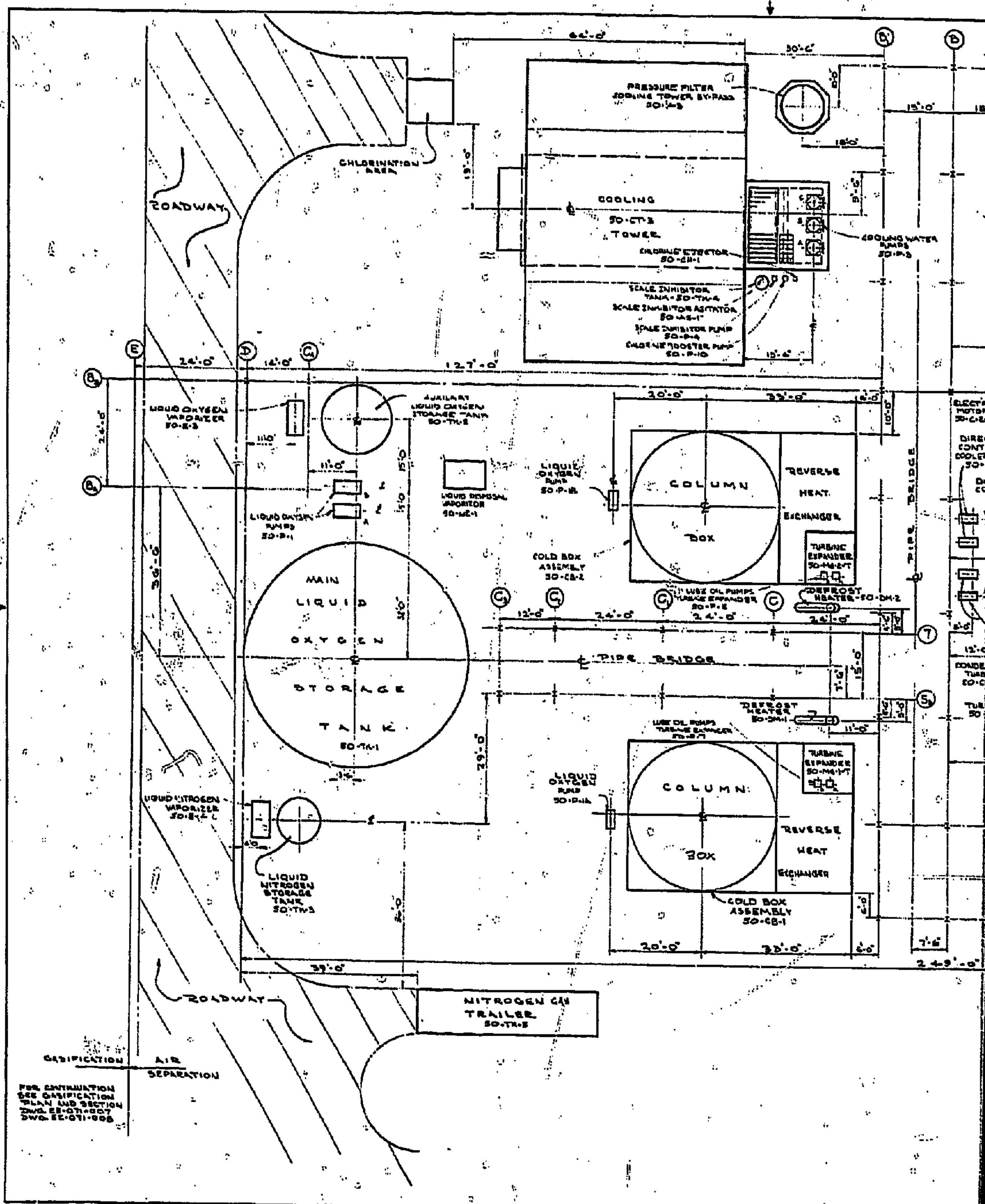


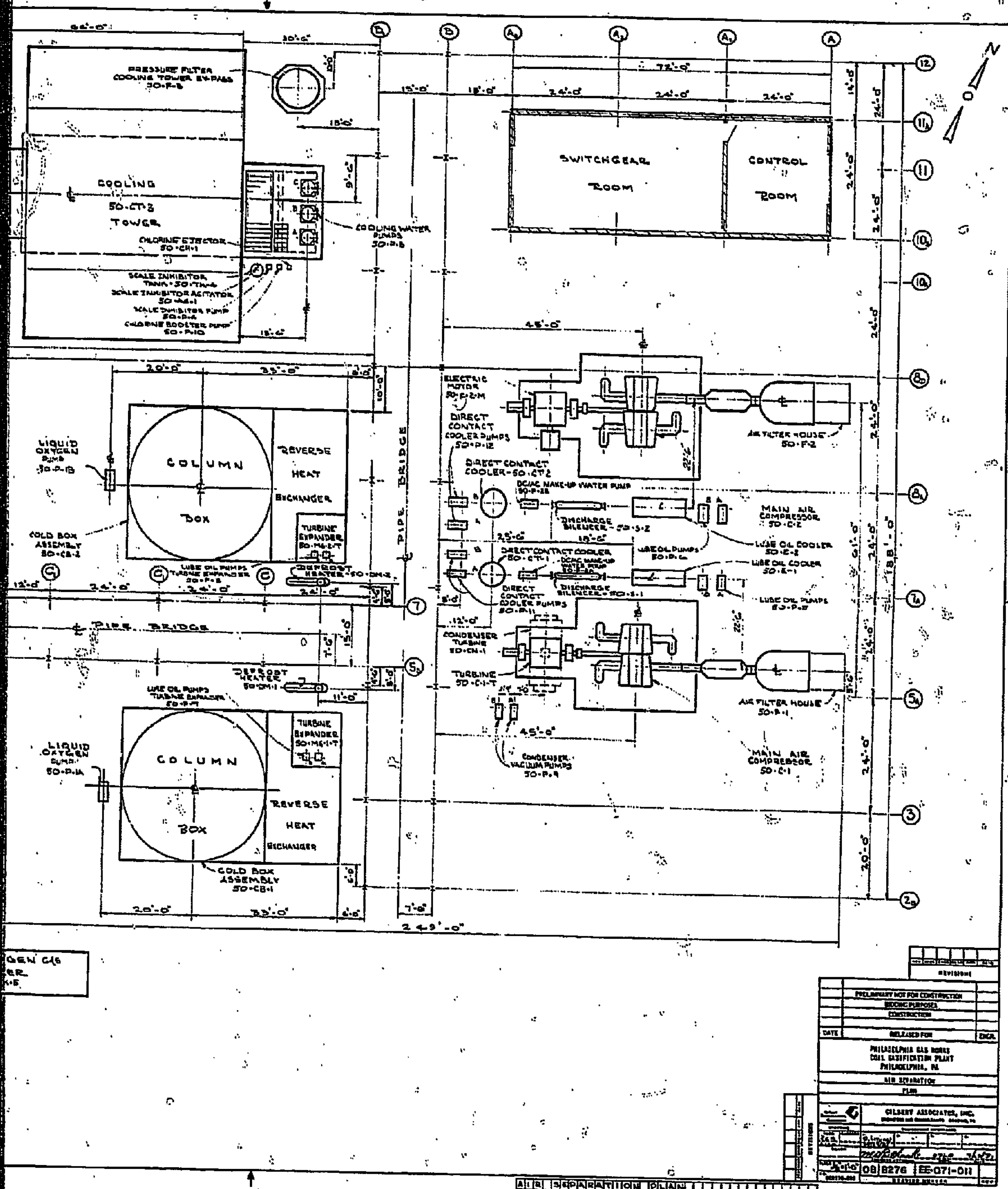
SULPHUR MELTER 42-E-3
SULFUR STORAGE PIT 42-TK-5
SULPHUR SEPARATOR 42-V-2
SULPHUR PUMP - 42-P-5B
SULPHUR PUMP - 42-P-5A
SWITCHGEAR BUILDING
CENTRIFUGE 42-CE-1
RESLURRY TANK
RESLURRY PUMPS
SLURRY MIXER 42-AG-1
SLURRY TANK
OXIDIZER AIR BLOWERS
SULPHUR SLURRY PUMPS
OXIDIZER
TANK 42-TK-1
PIPE BRIDGE NORTH TO SOUTH
STRETFORD SOLUTION PUMPS 42-P-1
STARTUP HEATER
SEPARATOR
CHEMICAL MIX PUMP
CHEMICAL MIX TANK
STRETFORD SOLUTION TANK 42-TK-2
CYCLOTUBE FILTER
REACTION VESSEL 42-V-1
STATIC MIXERS 42-MX-1
AFTERCOOLER
OIL COOLER
OIL PUMP
AUX OIL COOLER
OIL RESERVOIR
GAS BOOSTER COMPRESSOR
MAIN FLARE
PIPE BRIDGE EAST TO WEST
QUENCH TANK 44-TK-1
RECOVERED SOLUTION TANK 44-TK-2
PLATFORM
FOR CONTINUATION SEE PRODUCT GAS COMPRESSION & DEHYDRATION DWG'S
CONCENTRATED LIQUOR FEED PUMPS
RECOVERED SOLUTION PUMPS
EVAPORATIVE CIRCULATION PUMPS
EVAPORATIVE COOLER 42-E-2
EVAPORATIVE COOLER PUMPS
FLEXIBLE CONN (TYP)
DAMPER (TYP)
300'-0"
DESULPHURIZATION PLAN
EL 0'-0"

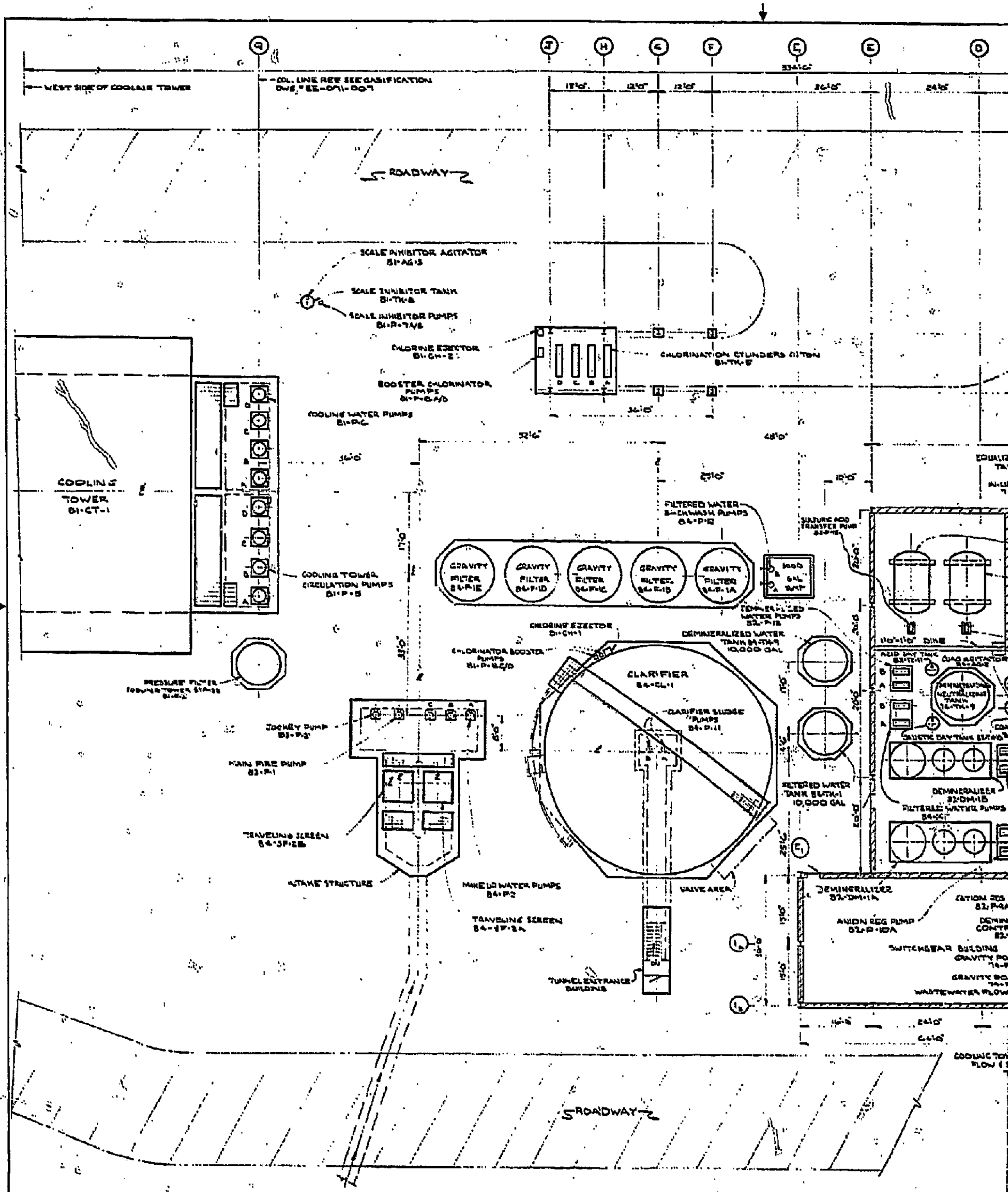

GAS HOLDING TANK
30-TK-3
PIPE BRIDGE EAST TO WEST
PIPE BRIDGE NORTH TO SOUTH
EVAPORATIVE COOLER
42-E-2
EVAPORATIVE COOLER PUMPS
ELECTROSTATIC PRECIPITATOR
30-PP-1
FLEXIBLE CONN (TYP)
DAMPER (TYP)
WASH WATER SUMP PUMP
30-P-4B
WASH WATER SUMP PUMP
30-P-4A
GAS HOLDER OUTLET QUICK GAS SEAL POT
GAS HOLDER INLET QUICK GAS SEAL POT
FOR CONTINUATION SEE GASIFICATION DWGS
EE-071-007
EE-071-008
AFTERCOOLER
42-E-1B
AFTERCOOLER
42-E-1A
OIL COOLER
OIL PUMP
AUX OIL COOLER
OIL RESERVOIR
GAS BOOSTER COMPRESSOR
42-BL-1A
GAS BOOSTER COMPRESSOR
42-BL-1B
STARTUP HEATER
SEPARATOR
CHEMICAL MIX TANK
GEAR BUILDING
PLATFORM
300'-0"
DESULPHURIZATION PLAN
EL 0'-0"
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
CHKR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
DESULPHURIZATION
PLAN
GILBERT ASSOCIATES, INC.
08
6276
EE-071-009
DESULPHURIZATION PLAN


REACTION VESSEL 42-V-1
SLURRY TANK 42-TK-3
STRETFORD SOLUTION TANK 42-TK-2
PIPE BRIDGE NORTH TO SOUTH EL. 20'-0"
STATIC MIXERS 42-MX-1
EVAPORATIVE COOLER 42-E-1
OXIDIZER TANK 42-TK-1
CHEMICAL MIX TANK 42-TK-6
GRADE EL. 0'-0"
EVAPORATIVE COOLER PUMP 42-P-2A
300'-0"
SECTION B-B
STEAM EJECTOR 44-EJ-1
EJECTOR COOLER 44-E-5
CONDENSER 44-E-4
EVAPORATOR 44-E-1
HEATER 44-E-2
DECOMPOSED GAS COOLER 44-E-3
EVAPORATOR CIRCULATION PUMPS 44-P-4
CONCENTRATED LIQUOR FEED PUMPS 44-P-3
30'-0"
60'-0"
SECTION C-C

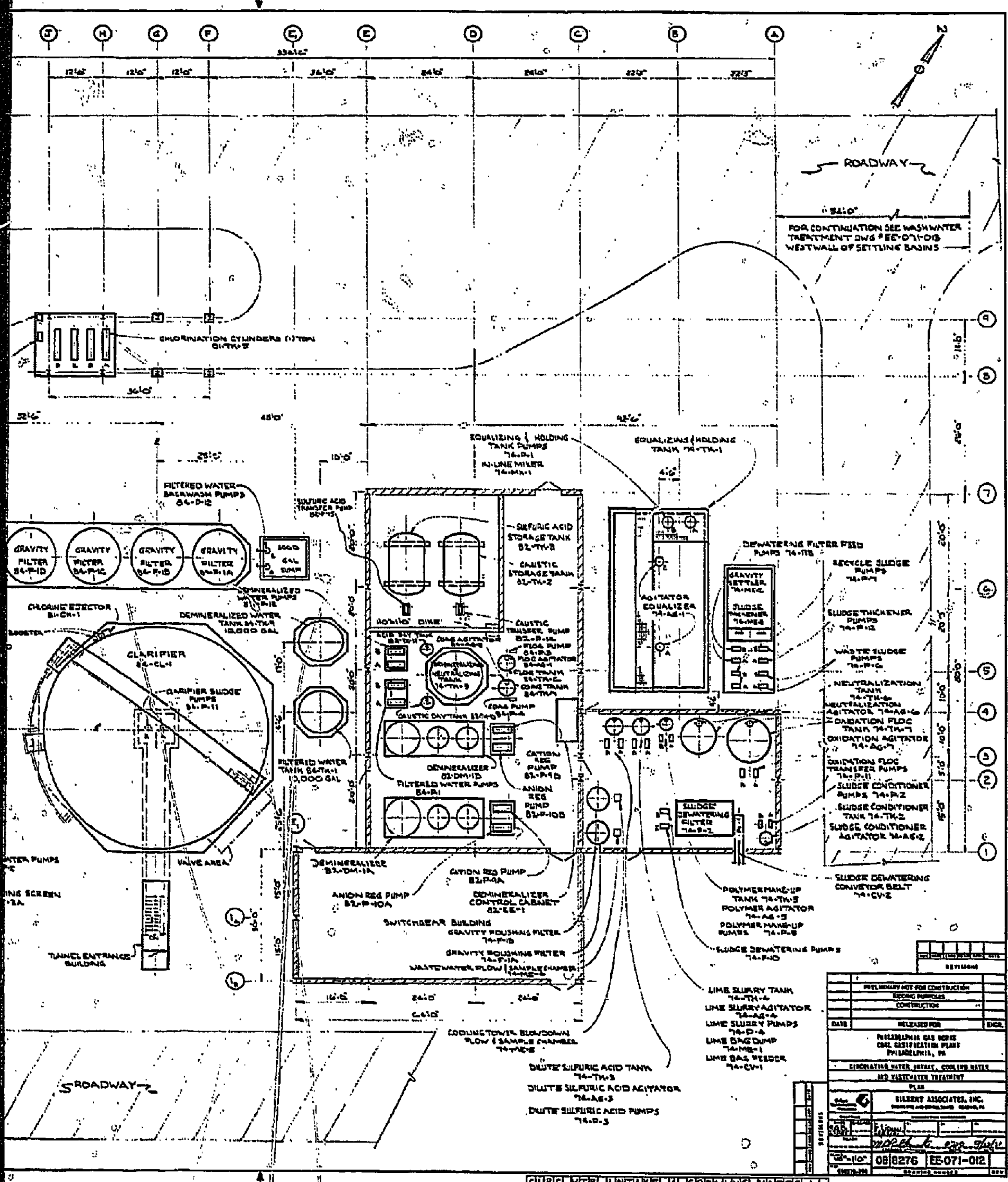

STRETFORD SOLUTION TANK 42-TK-2
STATIC MIXERS 42-MX-1
CHEMICAL MIX TANK 42-TK-6
EVAPORATIVE COOLER 42-E-2
GAS HOLDING TANK 30-TK-3
ELECTRO-STATIC PRECIPITATOR 30-PR-1
FOR CONTINUATION SEE GASIFICATION PLAN AND SECTION DWG EE-071-007 DWG EE-071-008
EAST TO WEST PIPE BRIDGE
MAIN FLARE SEAL POT
EL. 0'-0"
EVAPORATIVE COOLER PUMP 42-P-2A
GAS HOLDER OUTLET QUICK GAS SEAL 30-V-12
GAS HOLDER INLET QUICK GAS SEAL 30-V-11
WASH WATER SUMP PUMP
300'-0"
SECTION B-B
STEAM EJECTOR 44-EJ-1
EJECTOR COOLER 44-E-5
ANTI-FOAM AGENT
CONDENSER 44-E-4
EVAPORATOR 44-E-1
PLATFORM
QUENCH PUMP 44-P-1
HOT GAS GENERATOR 44-ME-1
PLATFORM EL. 30'-4"
HEATER 44-E-2
PLATFORM EL. 20'-4"
DECOMPOSED GAS COOLER 44-E-3
FURNACE 44-H-1
AIR BLOWER 44-BL-1
QUENCH TANK 44-TK-1
PLATFORM EL. 16'-6"
EVAPORATOR CIRCULATION PUMPS 44-P-4
RECOVERED SOLUTION TANK 44-TK-2
PLATFORM EL. 6'-2"
CONCENTRATED LIQUOR FEED PUMPS 44-P-3
RECOVERED SOLUTION PUMP 44-P-2
FLOOR EL. 0'-0"
GRADE EL. -0'-6"
30'-0"
60'-0"
SECTION C-C
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
GASIFICATION PLANT
PHILADELPHIA, PA
DESULPHURIZATION
SECTIONS
GILBERT ASSOCIATES, INC.
08 8276
EE-071-010
DESULPHURIZATION SECTIONS


PRESSURE FILTER
COOLING TOWER BY-PASS
CHLORINATION AREA
ROADWAY
COOLING
TOWER
CHLORINE EJECTOR
COOLING WATER PUMPS
SCALE INHIBITOR TANK
SCALE INHIBITOR AGITATOR
SCALE INHIBITOR PUMP
CHLORINE BOOSTER PUMP
LIQUID OXYGEN VAPORIZER
AUXILIARY LIQUID OXYGEN STORAGE TANK
LIQUID DISPOSAL VAPORIZER
LIQUID OXYGEN PUMP
LIQUID OXYGEN PUMPS
COLUMN
BOX
REVERSE HEAT EXCHANGER
TURBINE EXPANDER
COLD BOX ASSEMBLY
DEFROST HEATER
MAIN LIQUID OXYGEN STORAGE TANK
PIPE BRIDGE
LUBE OIL PUMPS TURBINE EXPANDER
LIQUID NITROGEN VAPORIZER
LIQUID NITROGEN STORAGE TANK
NITROGEN GAS TRAILER
GASIFICATION
AIR SEPARATION
FOR CONTINUATION SEE GASIFICATION PLAN AND SECTION

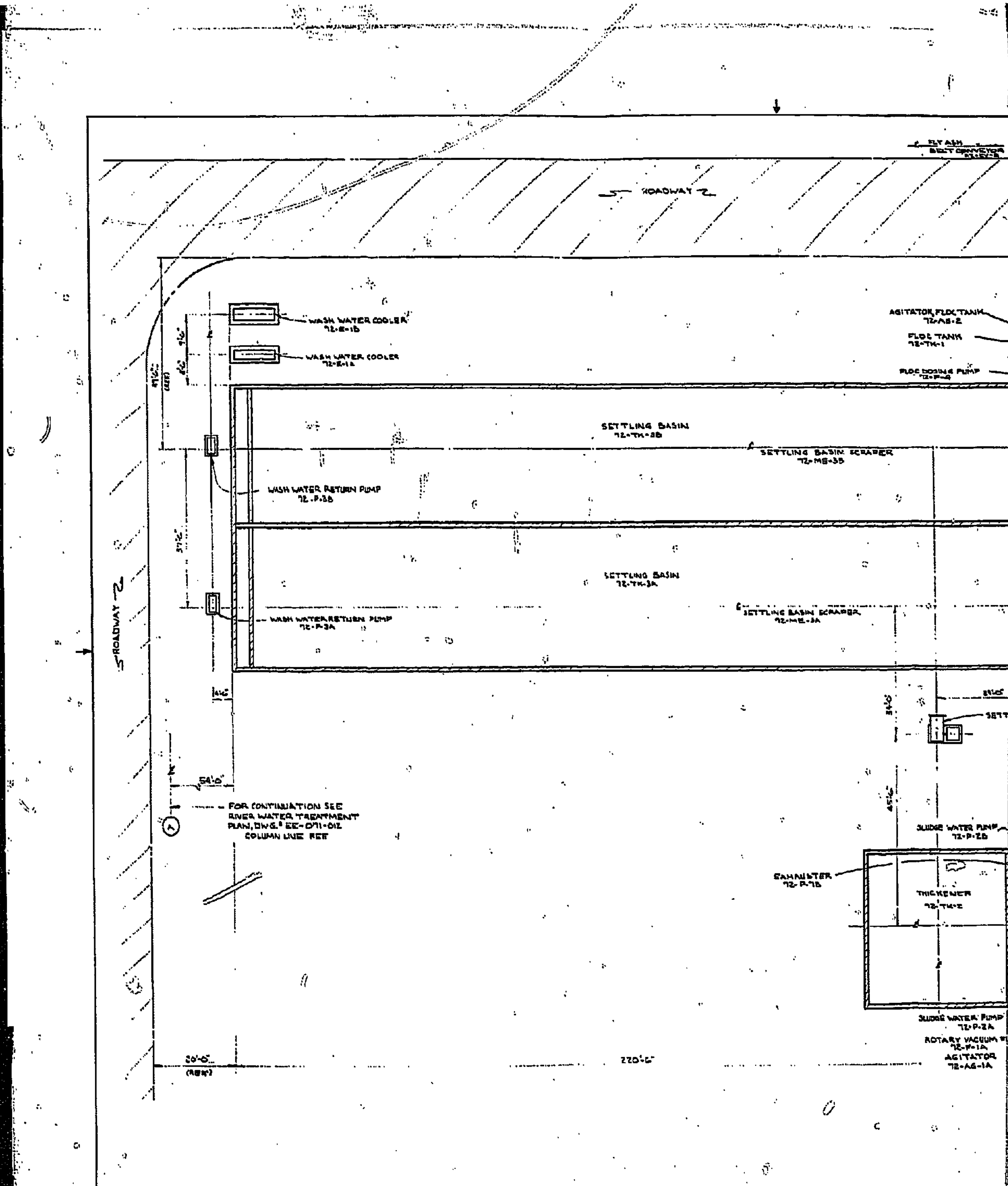

PRESSURE FILTER COOLING TOWER BY-PASS 50-F-3
COOLING 50-CT-3 TOWER
CHLORINE EJECTOR 50-CH-1
COOLING WATER PUMPS 50-P-6
SCALE INHIBITOR TANK 50-TK-4
SCALE INHIBITOR AGITATOR 50-AG-1
CHLORINE BOOSTER PUMP 50-P-10
SWITCHGEAR ROOM
CONTROL ROOM
LIQUID OXYGEN PUMP 50-P-1B
COLUMN BOX
REVERSE HEAT EXCHANGER
TURBINE EXPANDER
COLD BOX ASSEMBLY 50-CB-2
PIPE BRIDGE
ELECTRIC MOTOR
DIRECT CONTACT COOLER PUMPS 50-P-12
DIRECT CONTACT COOLER-50-CT-2
AIR FILTER HOUSE 50-F-2
MAIN AIR COMPRESSOR 50-C-2
LUBE OIL COOLER 50-E-2
LUBE OIL COOLER 50-E-1
DEFROST HEATER 50-DH-2
DIRECT CONTACT COOLER 50-CT-1
DISCHARGE SILENCER 50-S-1
LUBE OIL PUMPS 50-P-8
CONDENSER TURBINE 50-CN-1
TURBINE 50-C-1-T
DEFROST HEATER 50-DH-1
LIQUID OXYGEN PUMP 50-P-1A
COLD BOX ASSEMBLY 50-CB-1
CONDENSER VACUUM PUMPS 50-P-9
AIR FILTER HOUSE 50-F-1
MAIN AIR COMPRESSOR 50-C-1
249'-0"
188'-0"
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
AIR SEPARATION
PLAN
GILBERT ASSOCIATES, INC.
08 8276 EE-071-011
AIR SEPARATION PLAN

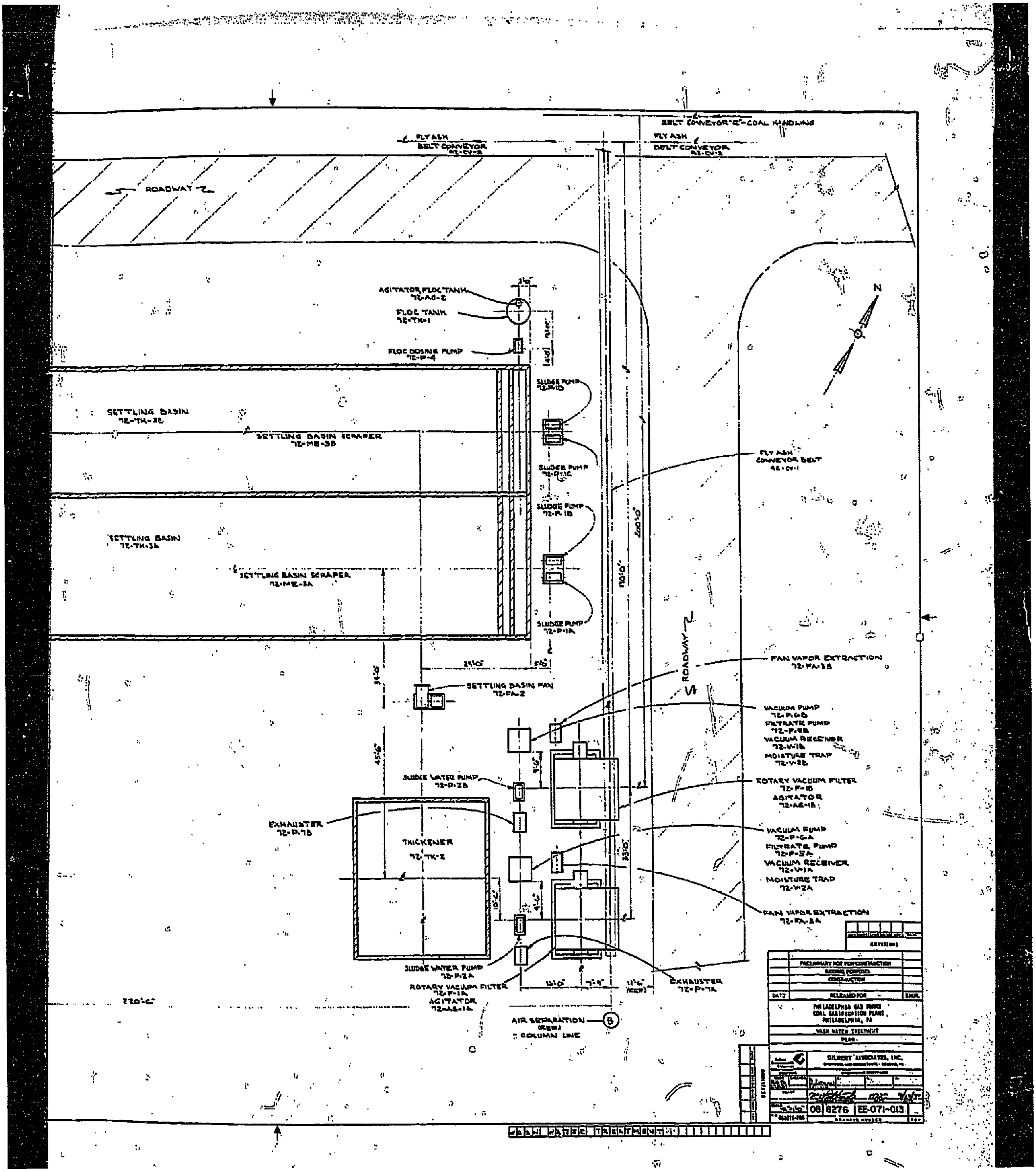


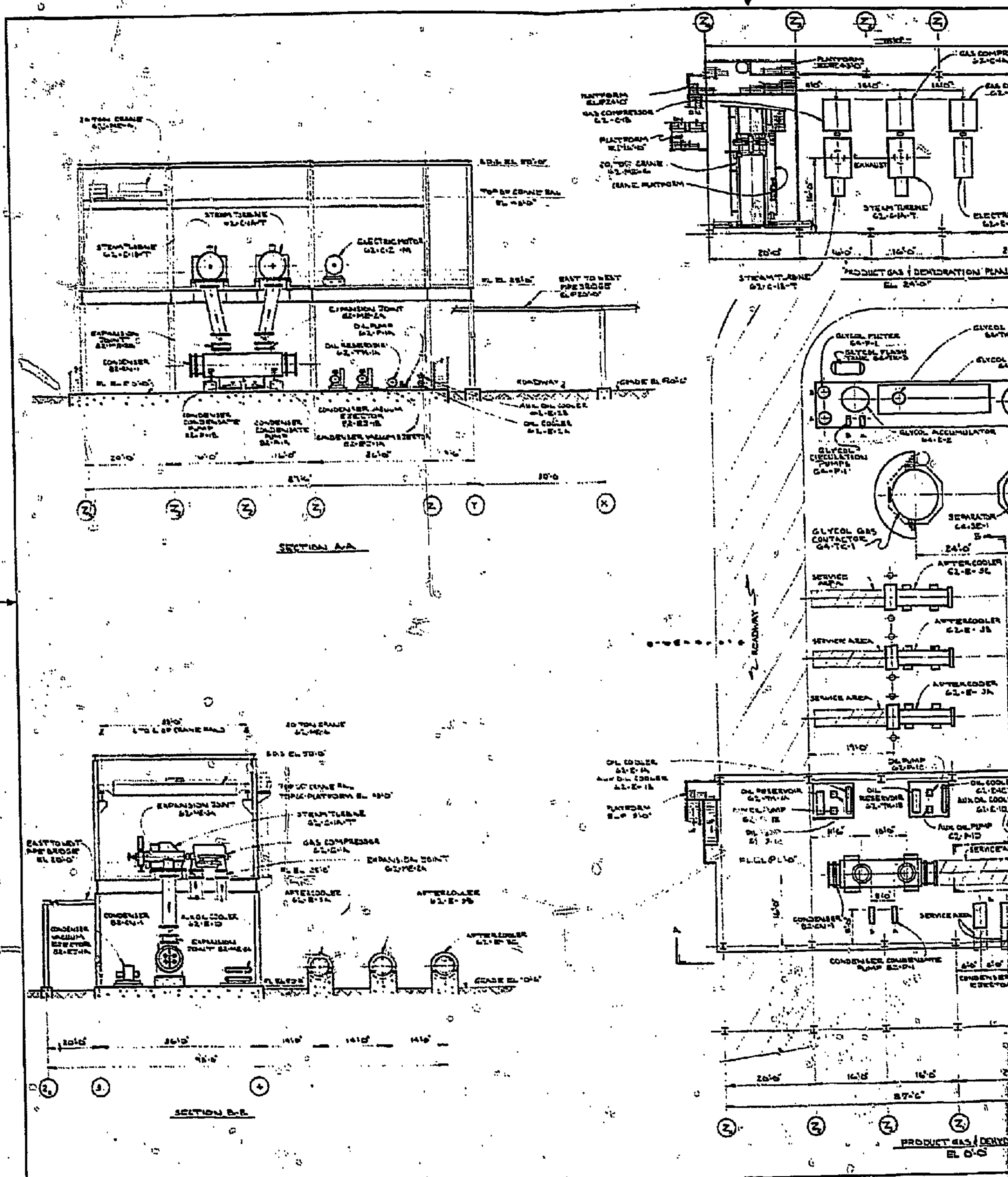
WEST SIDE OF COOLING TOWER
ROADWAY
SCALE INHIBITOR AGITATOR
SCALE INHIBITOR TANK
SCALE INHIBITOR PUMPS
CHLORINE EJECTOR
BOOSTER CHLORINATOR PUMPS
CHLORINATION CYLINDERS
COOLING WATER PUMPS
COOLING TOWER
61-CT-1
COOLING TOWER CIRCULATION PUMPS
FILTERED WATER BACKWASH PUMPS
GRAVITY FILTER
CLARIFIER
CLARIFIER SLUDGE PUMPS
CHLORINATOR BOOSTER PUMPS
DEMINERALIZED WATER PUMPS
DEMINERALIZED WATER TANK
10,000 GAL
FILTERED WATER TANK
10,000 GAL
PRESSURE FILTER
JOCKEY PUMP
MAIN FIRE PUMP
TRAVELING SCREEN
INTAKE STRUCTURE
MAKE UP WATER PUMPS
VALVE AREA
TUNNEL ENTRANCE BUILDING
DEMINERALIZER
FILTERED WATER PUMPS
ANION REG PUMP
SWITCHGEAR BUILDING
ROADWAY

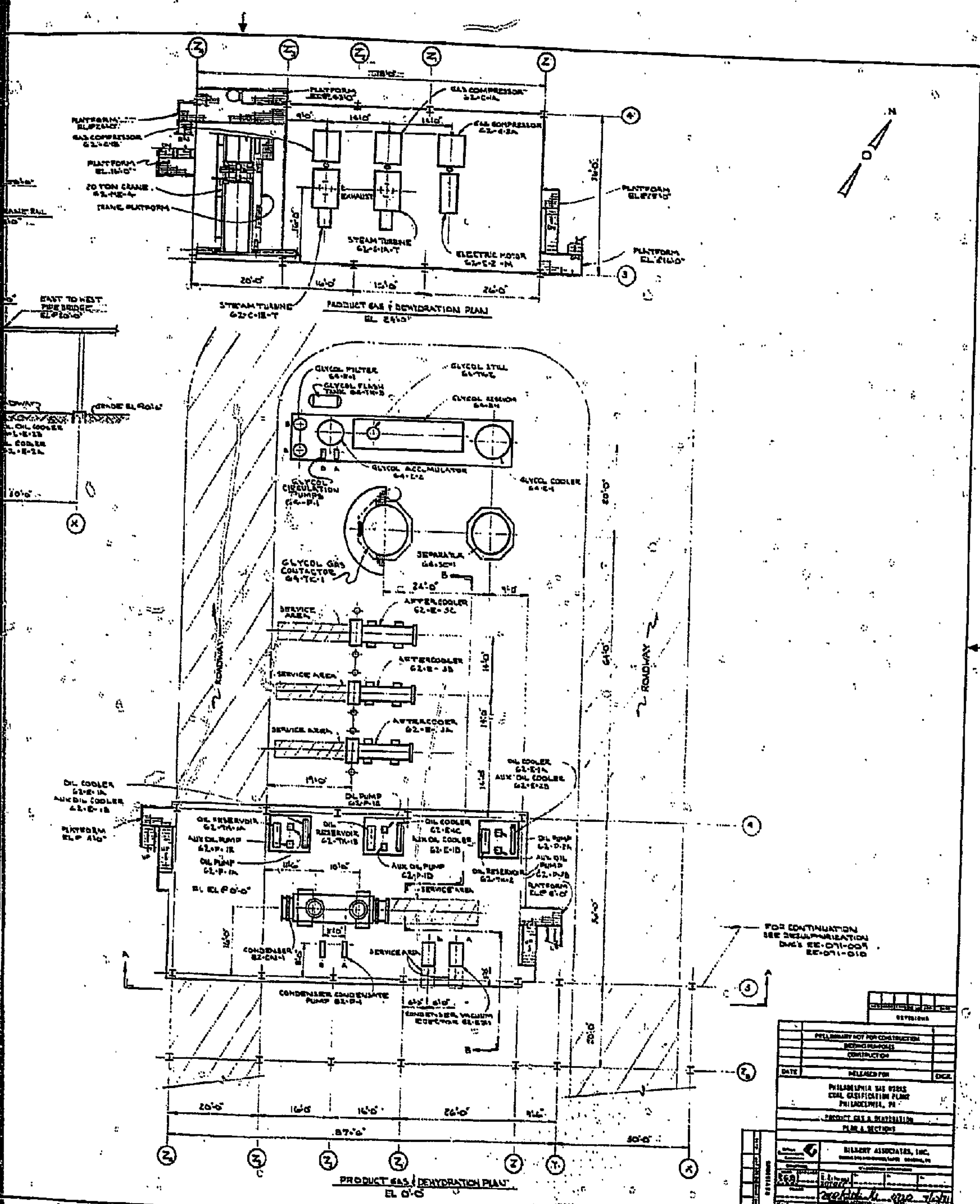


ROADWAY
FOR CONTINUATION SEE WASHWATER TREATMENT DWG EE-071-013 WESTWALL OF SETTLING BASINS
CHLORINATION CYLINDERS
EQUALIZING & HOLDING TANK PUMPS 74-P-1
IN-LINE MIXER 74-MX-1
EQUALIZING & HOLDING TANK 74-TK-1
FILTERED WATER BACKWASH PUMPS 84-P-12
SULFURIC ACID STORAGE TANK 82-TK-3
CAUSTIC STORAGE TANK 82-TK-2
GRAVITY FILTER 84-F-1D
GRAVITY FILTER 84-F-1C
GRAVITY FILTER 84-F-1B
GRAVITY FILTER 84-F-1A
CHLORINE EJECTOR 81-CH-1
DEMINERALIZED WATER PUMPS 81-P-18
DEMINERALIZED WATER TANK 84-TK-9 10,000 GAL
CLARIFIER 84-CL-1
CLARIFIER SLUDGE PUMPS 84-P-11
CAUSTIC TRANSFER PUMP
FLOC PUMP
FLOC AGITATOR
FLOC TANK
COAG TANK
COAG PUMP
CAUSTIC DAY TANK
AGITATOR EQUALIZER 74-AG-1
DEWATERING FILTER FEED PUMPS 74-P-18
RECYCLE SLUDGE PUMPS 74-P-7
GRAVITY SETTLER
SLUDGE THICKENER
SLUDGE THICKENER PUMPS 74-P-12
WASTE SLUDGE PUMPS 74-P-6
NEUTRALIZATION TANK 74-TK-6
NEUTRALIZATION AGITATOR 74-AG-6
OXIDATION FLOC TANK 74-TK-7
OXIDATION AGITATOR 74-AG-7
OXIDATION FLOC TRANSFER PUMPS 74-P-11
SLUDGE CONDITIONER PUMPS 74-P-2
SLUDGE CONDITIONER TANK 74-TK-2
SLUDGE CONDITIONER AGITATOR 74-AG-2
SLUDGE DEWATERING FILTER 74-F-2
SLUDGE DEWATERING CONVEYOR BELT 74-CV-2
DEMINERALIZER 82-DM-1B
FILTERED WATER PUMPS 84-P1
CATION REG PUMP 82-P-9B
ANION REG PUMP 82-P-10B
FILTERED WATER TANK 84-TK-1 10,000 GAL
VALVE AREA
DEMINERALIZER 82-DM-1A
CATION REG PUMP 82-P-9A
ANION REG PUMP 82-P-10A
DEMINERALIZER CONTROL CABINET 82-EE-1
SWITCHGEAR BUILDING
GRAVITY POLISHING FILTER 74-F-1B
GRAVITY POLISHING FILTER 74-F-1A
WASTEWATER FLOW & SAMPLE CHAMBER
POLYMER MAKE-UP TANK 74-TK-3
POLYMER AGITATOR 74-AG-3
POLYMER MAKE-UP PUMPS 74-P-8
SLUDGE DEWATERING PUMPS 74-P-10
LIME SLURRY TANK 74-TK-4
LIME SLURRY AGITATOR 74-AG-4
LIME SLURRY PUMPS 74-P-4
LIME BAG DUMP 74-MB-1
LIME BAG FEEDER 74-CV-1
COOLING TOWER BLOWDOWN FLOW & SAMPLE CHAMBER
DILUTE SULFURIC ACID TANK 74-TK-5
DILUTE SULFURIC ACID AGITATOR 74-AG-5
DILUTE SULFURIC ACID PUMPS 74-P-5
TUNNEL ENTRANCE BUILDING
ROADWAY
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
CIRCULATING WATER INTAKE, COOLING WATER
AND WASTEWATER TREATMENT
PLAN
GILBERT ASSOCIATES, INC.
08 8276
EE-071-012
CIRC WTR INTAKE & COOLING WATER


FLY ASH BELT CONVEYOR
ROADWAY
AGITATOR, FLOC TANK 72-AG-2
FLOC TANK 72-TK-1
FLOC DOSING PUMP 72-P-4
WASH WATER COOLER 72-E-1B
WASH WATER COOLER 72-E-1A
SETTLING BASIN 72-TK-3B
SETTLING BASIN SCRAPER 72-MS-3B
WASH WATER RETURN PUMP 72-P-3B
SETTLING BASIN 72-TK-3A
SETTLING BASIN SCRAPER 72-MS-3A
WASH WATER RETURN PUMP 72-P-3A
ROADWAY
54'-0"
FOR CONTINUATION SEE RIVER WATER TREATMENT PLAN, DWG.# EE-071-012 COLUMN LINE REF
7
SLUDGE WATER PUMP 72-P-2B
THICKENER 72-TK-2
SLUDGE WATER PUMP 72-P-2A
ROTARY VACUUM 72-F-1A
AGITATOR 72-AG-1A
20'-0" (REF)
220'-0"

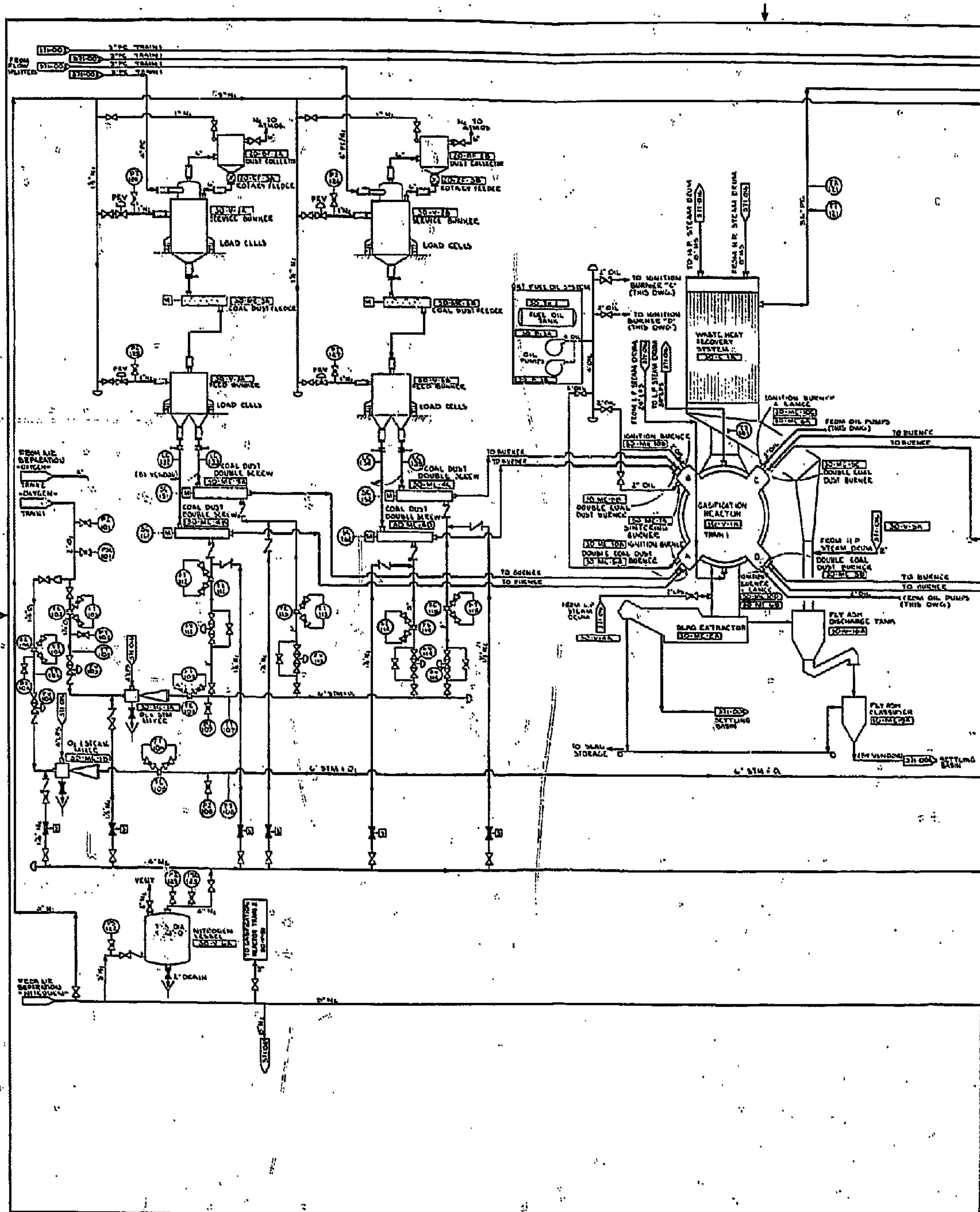

BELT CONVEYOR "E" - COAL HANDLING
FLY ASH BELT CONVEYOR
FLY ASH BELT CONVEYOR
ROADWAY
AGITATOR FLOC TANK 72-AG-2
FLOC TANK 72-TK-1
FLOC DOSING PUMP 72-P-4
SETTLING BASIN 72-TK-3B
SETTLING BASIN SCRAPER 72-ME-3B
SLUDGE PUMP 72-P-1D
SLUDGE PUMP 72-P-1C
SLUDGE PUMP 72-P-1B
SLUDGE PUMP 72-P-1A
SETTLING BASIN 72-TK-3A
SETTLING BASIN SCRAPER 72-ME-3A
FLY ASH CONVEYOR BELT
200'-0"
150'-0"
ROADWAY
SETTLING BASIN FAN 72-FA-2
FAN VAPOR EXTRACTION 72-FA-3B
VACUUM PUMP
FILTRATE PUMP 72-P-5B
VACUUM RECEIVER 72-V-1B
MOISTURE TRAP 72-V-2B
SLUDGE WATER PUMP 72-P-2B
ROTARY VACUUM FILTER 72-F-1B
AGITATOR 72-AG-1B
EXHAUSTER 72-P-7B
THICKENER 72-TK-2
VACUUM PUMP 72-P-6A
FILTRATE PUMP 72-P-5A
VACUUM RECEIVER 72-V-1A
MOISTURE TRAP 72-V-2A
FAN VAPOR EXTRACTION 72-FA-3A
SLUDGE WATER PUMP 72-P-2A
ROTARY VACUUM FILTER 72-F-1A
AGITATOR 72-AG-1A
EXHAUSTER 72-P-7A
220'-0"
AIR SEPARATION (REF) COLUMN LINE
B
N
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
WASH WATER TREATMENT
PLAN
GILBERT ASSOCIATES, INC.
08 8276 EE-071-013
WASH WATER TREATMENT


STEAM TURBINE
ELECTRIC MOTOR
CONDENSER
ROADWAY
SECTION A-A
SECTION B-B
EXPANSION JOINT
GAS COMPRESSOR
AFTERCOOLER
GLYCOL ACCUMULATOR
GLYCOL GAS CONTACTOR
SEPARATOR
SERVICE AREA
OIL RESERVOIR
CONDENSER CONDENSATE PUMP
PRODUCT GAS & DEHYDRATION PLAN
EL 0'-0"

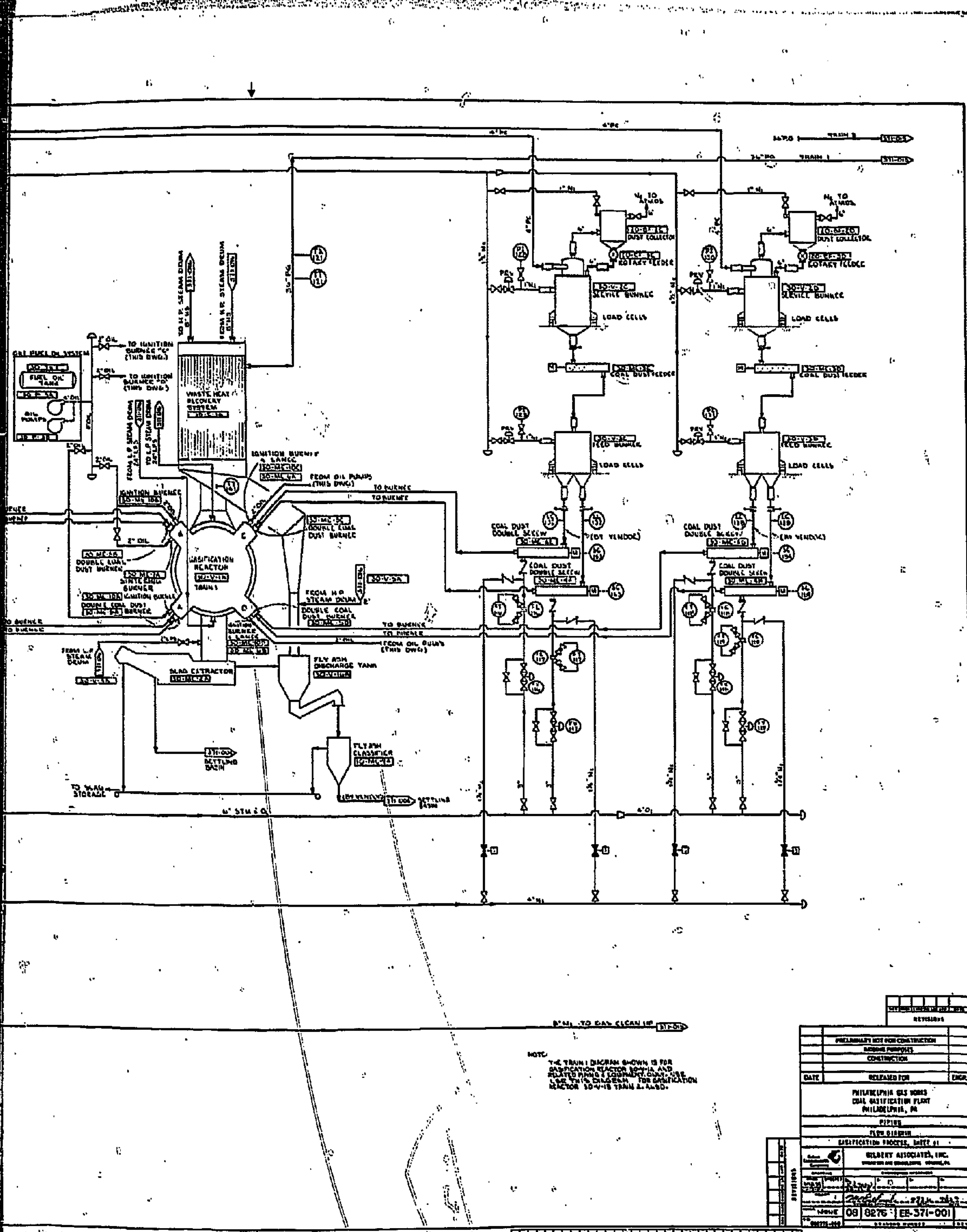

PRODUCT GAS & DEHYDRATION PLAN
EL 24'0"
GAS COMPRESSOR
STEAM TURBINE
ELECTRIC MOTOR
20 TON CRANE
CRANE PLATFORM
EAST TO WEST PIPE BRIDGE
GLYCOL FILTER
GLYCOL STILL
GLYCOL REBOILER
GLYCOL ACCUMULATOR
GLYCOL CIRCULATION PUMPS
GLYCOL COOLER
GLYCOL GAS CONTACTOR
SEPARATOR
SERVICE AREA
AFTERCOOLER
ROADWAY
OIL COOLER
AUX OIL COOLER
OIL RESERVOIR
OIL PUMP
AUX OIL PUMP
CONDENSER
CONDENSER CONDENSATE PUMP
CONDENSER VACUUM EJECTOR
FOR CONTINUATION SEE DESULPHURIZATION DWG'S EE-071-009 EE-071-010
PRODUCT GAS & DEHYDRATION PLAN
EL 0'0"
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PRODUCT GAS & DEHYDRATION
PLAN & SECTIONS
GILBERT ASSOCIATES, INC.
08 9276 EE-071-014

APPENDIX E

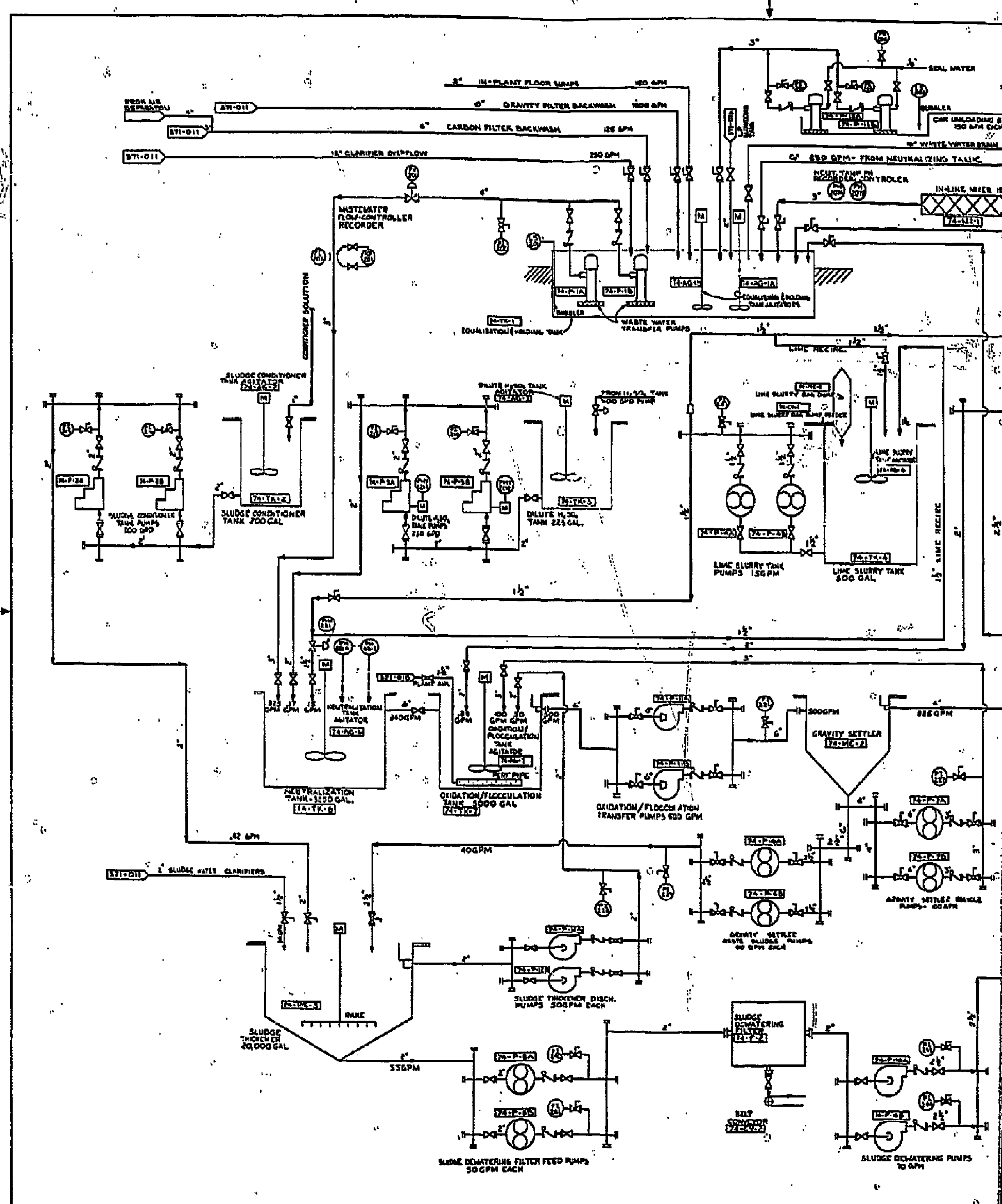
PIPING FLOW DIAGRAMS



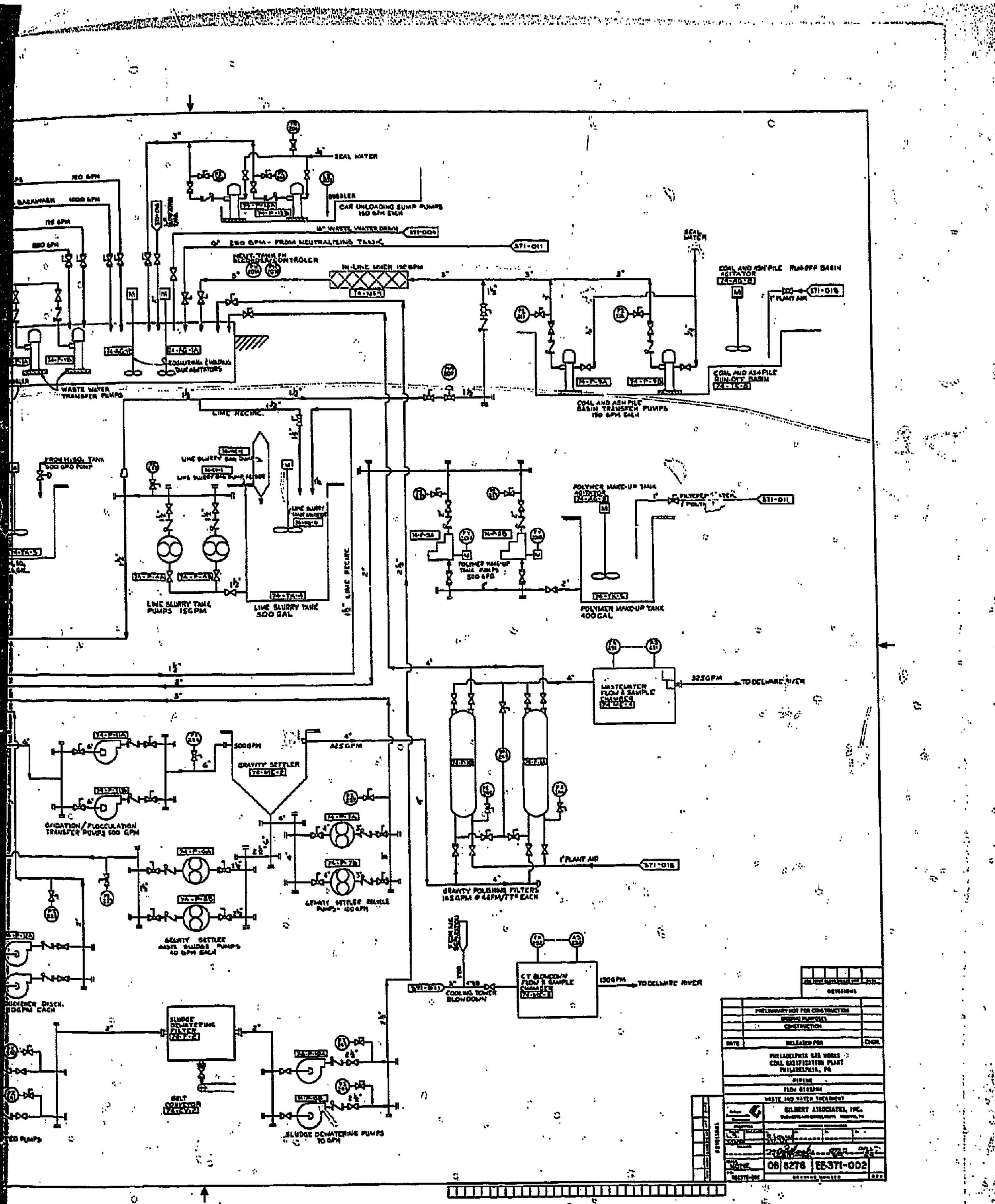
DUST COLLECTOR
ROTARY FEEDER
SERVICE BUNKER
LOAD CELLS
COAL DUST FEEDER
FEED BUNKER
COAL DUST DOUBLE SCREW
FUEL OIL TANK
OIL PUMPS
WASTE HEAT RECOVERY SYSTEM
GASIFICATION REACTOR
TRAIN 1
DOUBLE COAL DUST BURNER
IGNITION BURNER
SLAG EXTRACTOR
FLY ASH DISCHARGE TANK
FLY ASH CLASSIFIER
SETTLING BASIN
TO SLAG STORAGE
NITROGEN VESSEL
VENT

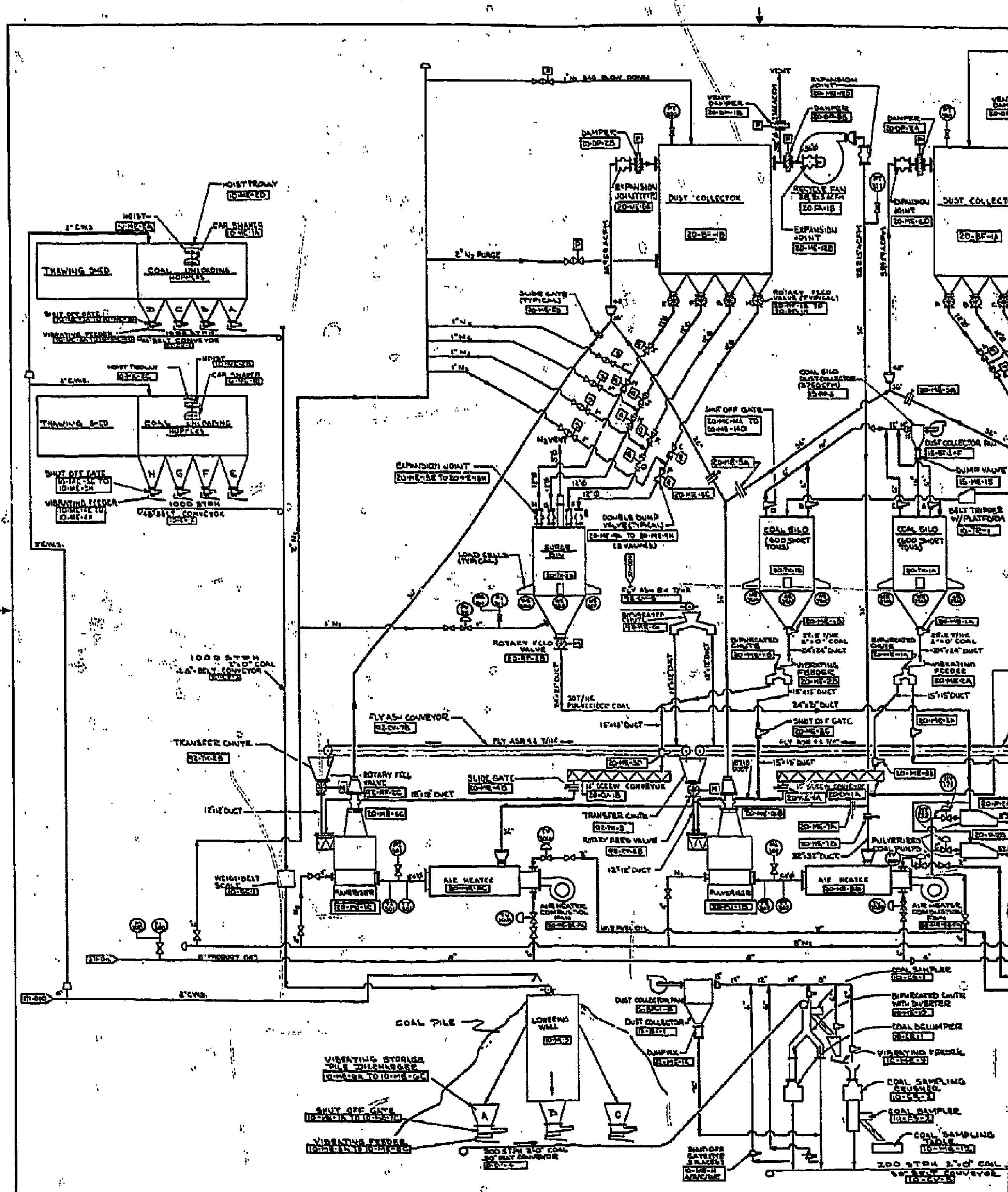


GASIFICATION REACTOR
WASTE HEAT RECOVERY SYSTEM
FUEL OIL TANK
OIL PUMPS
SLAG EXTRACTOR
FLY ASH DISCHARGE TANK
FLY ASH CLASSIFIER
DUST COLLECTOR
ROTARY FEEDER
SERVICE BUNKER
LOAD CELLS
COAL DUST FEEDER
FEED BUNKER
COAL DUST DOUBLE SCREW
DOUBLE COAL DUST BURNER
IGNITION BURNER
SETTLING BASIN
TO SLAG STORAGE
TO GAS CLEAN UP
NOTE:
THE TRAIN I DIAGRAM SHOWN IS FOR GASIFICATION REACTOR 30-V-1A AND RELATED PIPING & EQUIPMENT. USE THIS DIAGRAM FOR GASIFICATION REACTOR 30-V-1B TRAIN 2 ALSO.
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
GASIFICATION PROCESS, SHEET 01
GILBERT ASSOCIATES, INC.
NONE
09
8276
EB-371-001

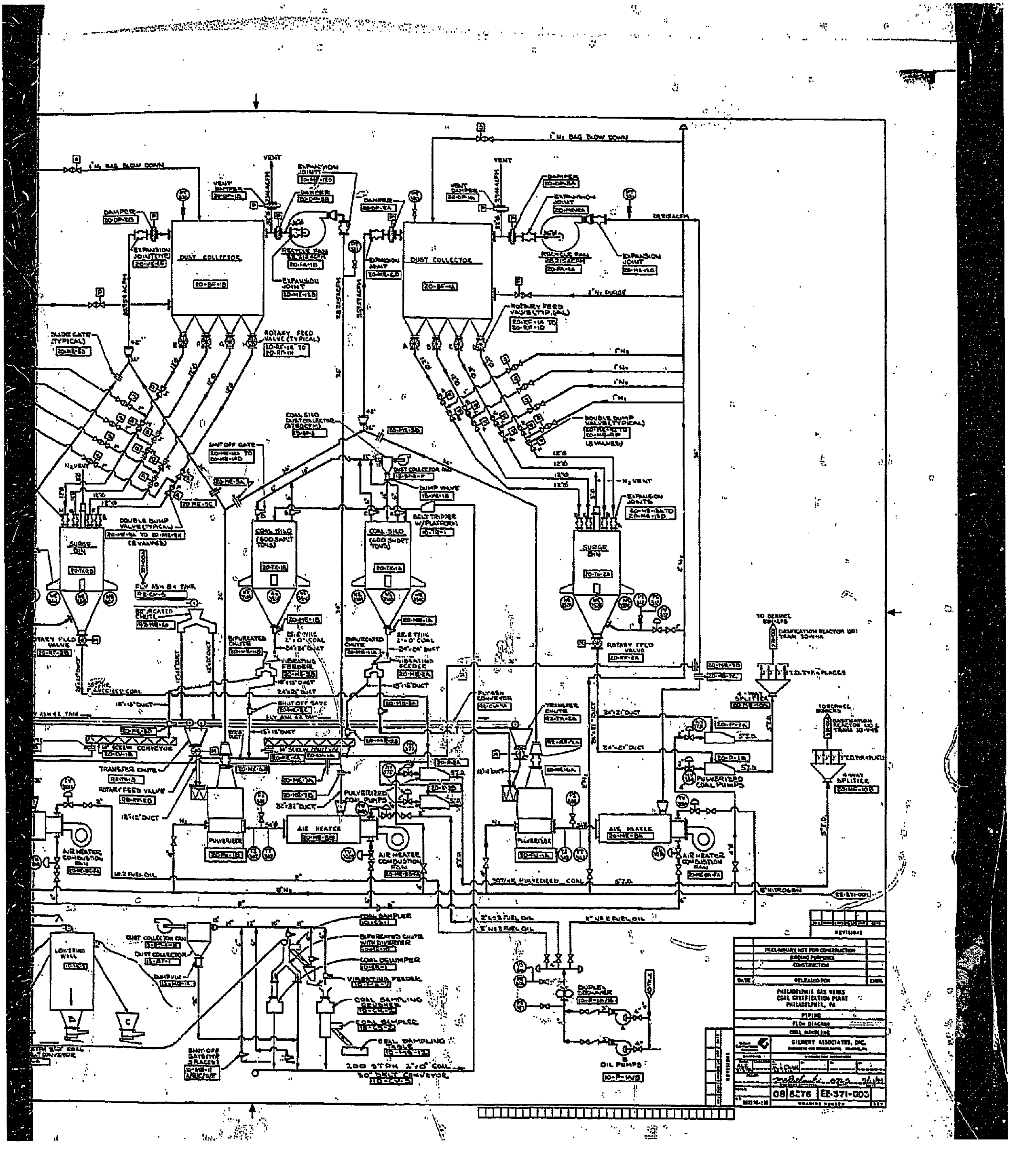


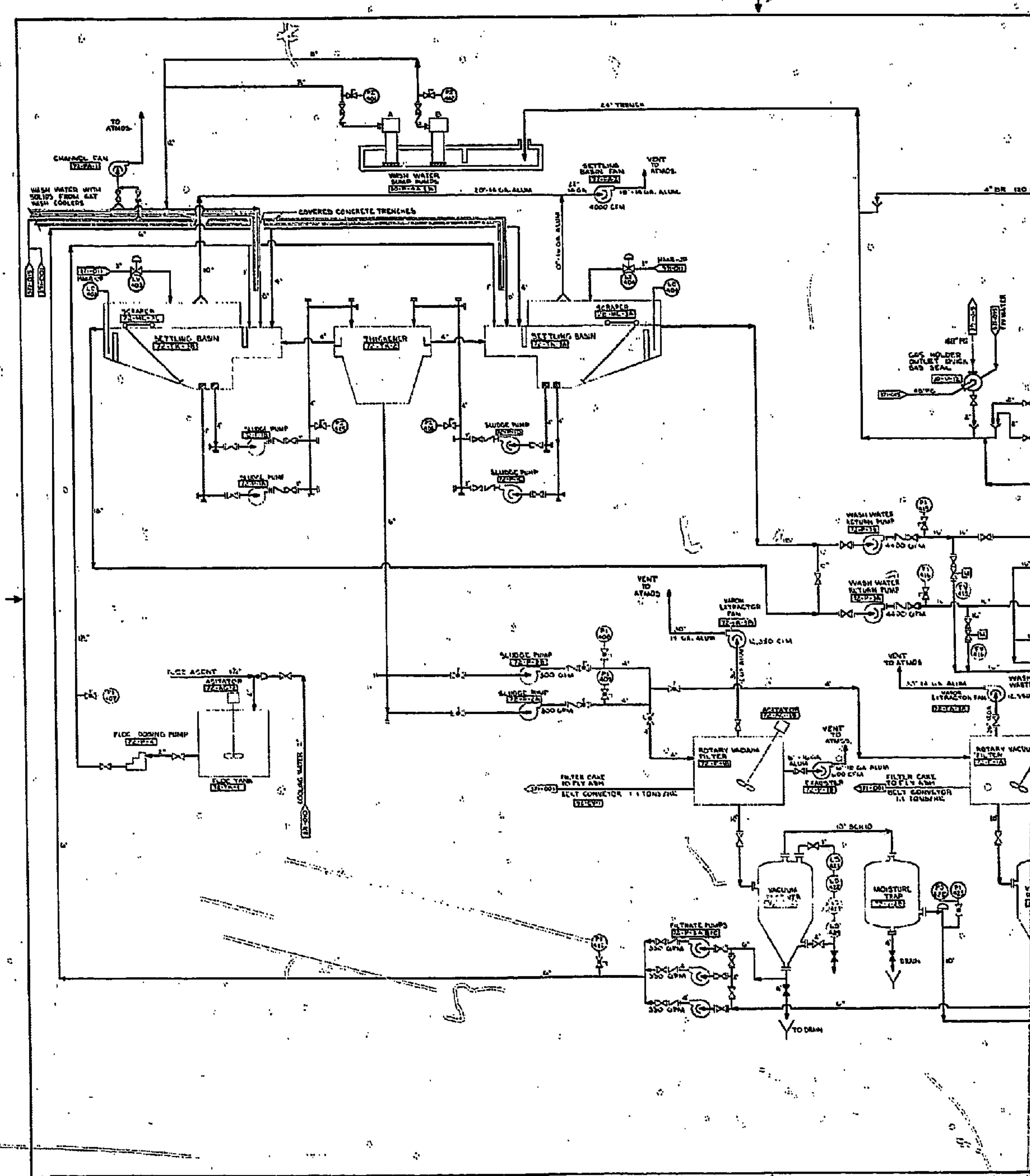
WASTEWATER FLOW-CONTROLLER RECORDER
EQUALIZATION/HOLDING TANK
WASTE WATER TRANSFER PUMPS
SLUDGE CONDITIONER TANK 200 GAL.
DILUTE H2SO4 TANK 225 GAL.
LIME SLURRY TANK PUMPS 15GPM
LIME SLURRY TANK 500 GAL.
LIME RECIRC.
NEUTRALIZATION TANK-3250 GAL.
OXIDATION/FLOCCULATION TANK 5000 GAL
OXIDATION/FLOCCULATION TRANSFER PUMPS 500 GPM
GRAVITY SETTLER
SLUDGE THICKENER DISCH. PUMPS 500GPM EACH
SLUDGE THICKENER 20,000 GAL
SLUDGE DEWATERING FILTER FEED PUMPS 50GPM EACH
SLUDGE DEWATERING FILTER
SLUDGE DEWATERING PUMPS
CARBON FILTER BACKWASH
GRAVITY FILTER BACKWASH
IN-PLANT FLOOR SUMPS
SEAL WATER

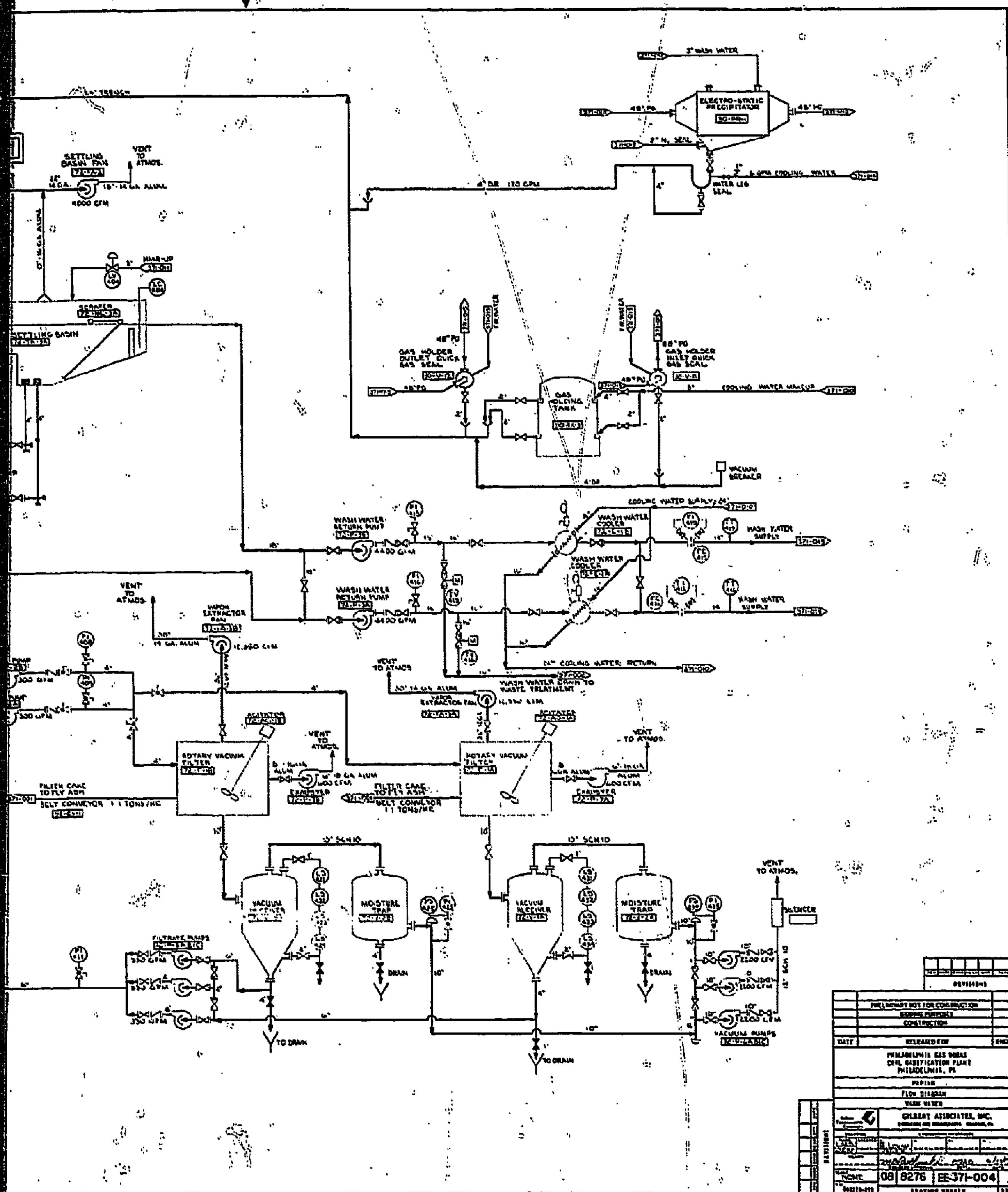

SEAL WATER
CAR UNLOADING SUMP PUMPS 150 GPM EACH
BACKWASH
WASTE WATER TRANSFER PUMPS
EQUALIZING & HOLDING TANK AGITATORS
IN-LINE MIXER 150 GPM
NEUT. TANK PH RECORDER/CONTROLLER
COAL AND ASH PILE RUNOFF BASIN AGITATOR
COAL AND ASH PILE RUN-OFF BASIN
COAL AND ASH PILE BASIN TRANSFER PUMPS 150 GPM EACH
PLANT AIR
LIME RECIRC.
LIME SLURRY TANK PUMPS 15 GPM
LIME SLURRY TANK 500 GAL
POLYMER MAKE-UP TANK AGITATOR
POLYMER MAKE-UP TANK PUMPS
POLYMER MAKE-UP TANK 400 GAL
WASTEWATER FLOW & SAMPLE CHAMBER
325 GPM
TO DELAWARE RIVER
GRAVITY SETTLER
OXIDATION/FLOCCULATION TRANSFER PUMPS 500 GPM
GRAVITY SETTLER WASTE SLUDGE PUMPS 40 GPM EACH
GRAVITY SETTLER RECYCLE PUMPS 100 GPM
GRAVITY POLISHING FILTERS
COOLING TOWER BLOWDOWN
C.T. BLOWDOWN FLOW & SAMPLE CHAMBER
TO DELAWARE RIVER
SLUDGE DEWATERING FILTER
BELT CONVEYOR
SLUDGE DEWATERING PUMPS 70 GPM
RELEASED FOR
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
WASTE AND WATER TREATMENT
GILBERT ASSOCIATES, INC.
NONE
08 8278
EE-371-002

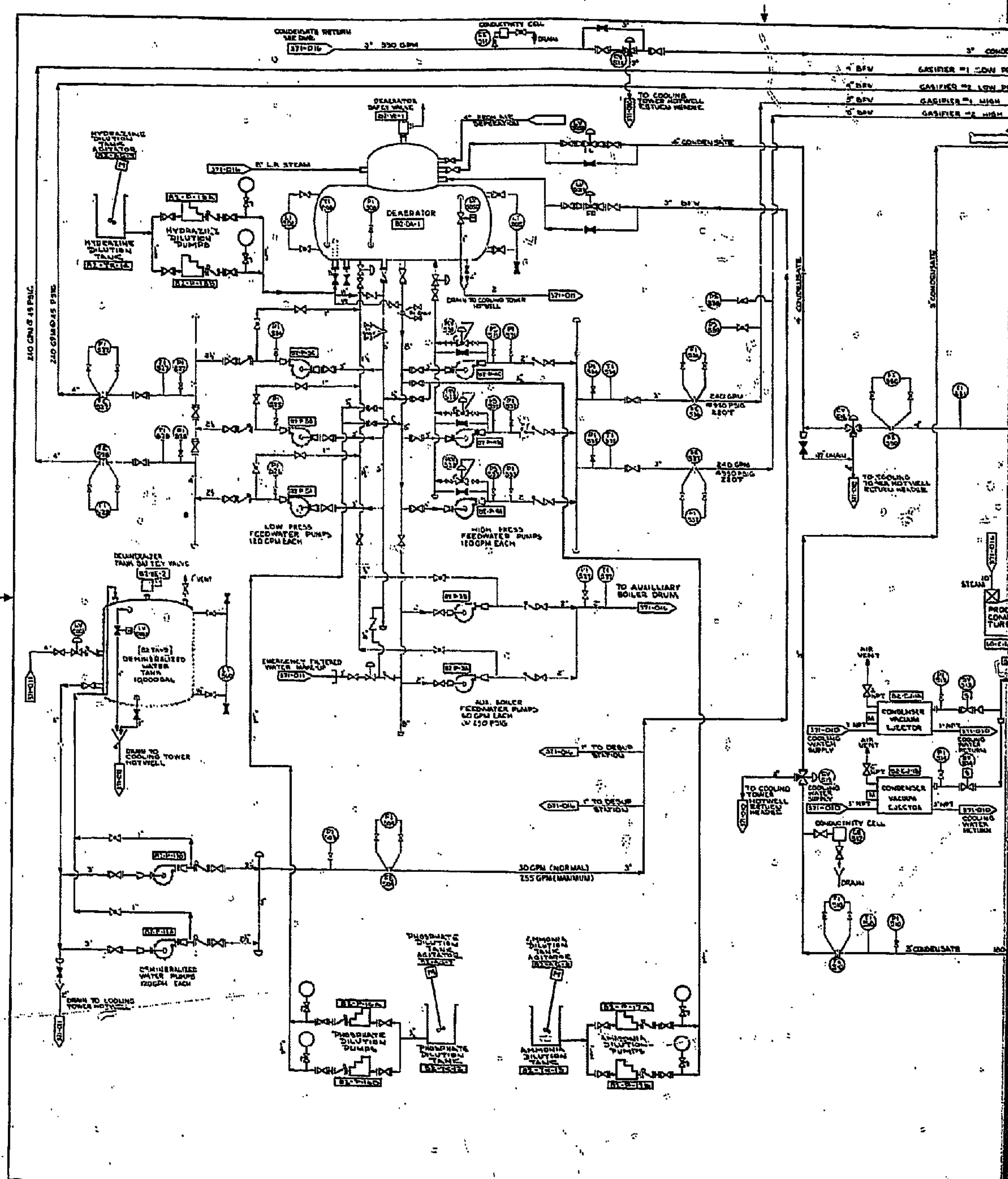


DUST COLLECTOR
RECYCLE FAN
DAMPER
EXPANSION JOINT
VENT
THAWING SHED
COAL UNLOADING HOPPERS
HOIST TROLLEY
CAR SHAKER
SHUT OFF GATE
VIBRATING FEEDER
1000 STPH
SURGE BIN
LOAD CELLS (TYPICAL)
ROTARY FEED VALVE
DOUBLE DUMP VALVE (TYPICAL)
SLIDE GATE
COAL SILO
BIFURCATED CHUTE
FLY ASH CONVEYOR
TRANSFER CHUTE
SCREW CONVEYOR
AIR HEATER
AIR HEATER COMBUSTION FAN
PULVERIZER
PULVERIZED COAL PUMPS
WEIGH BELT SCALE
PRODUCT GAS
COAL PILE
LOWERING WELL
VIBRATING STORAGE PILE DISCHARGER
DUST COLLECTOR FAN
DUMPER
COAL SAMPLER
BIFURCATED CHUTE WITH DIVERTER
COAL DELUMPER
COAL SAMPLING CRUSHER
COAL SAMPLING TABLE

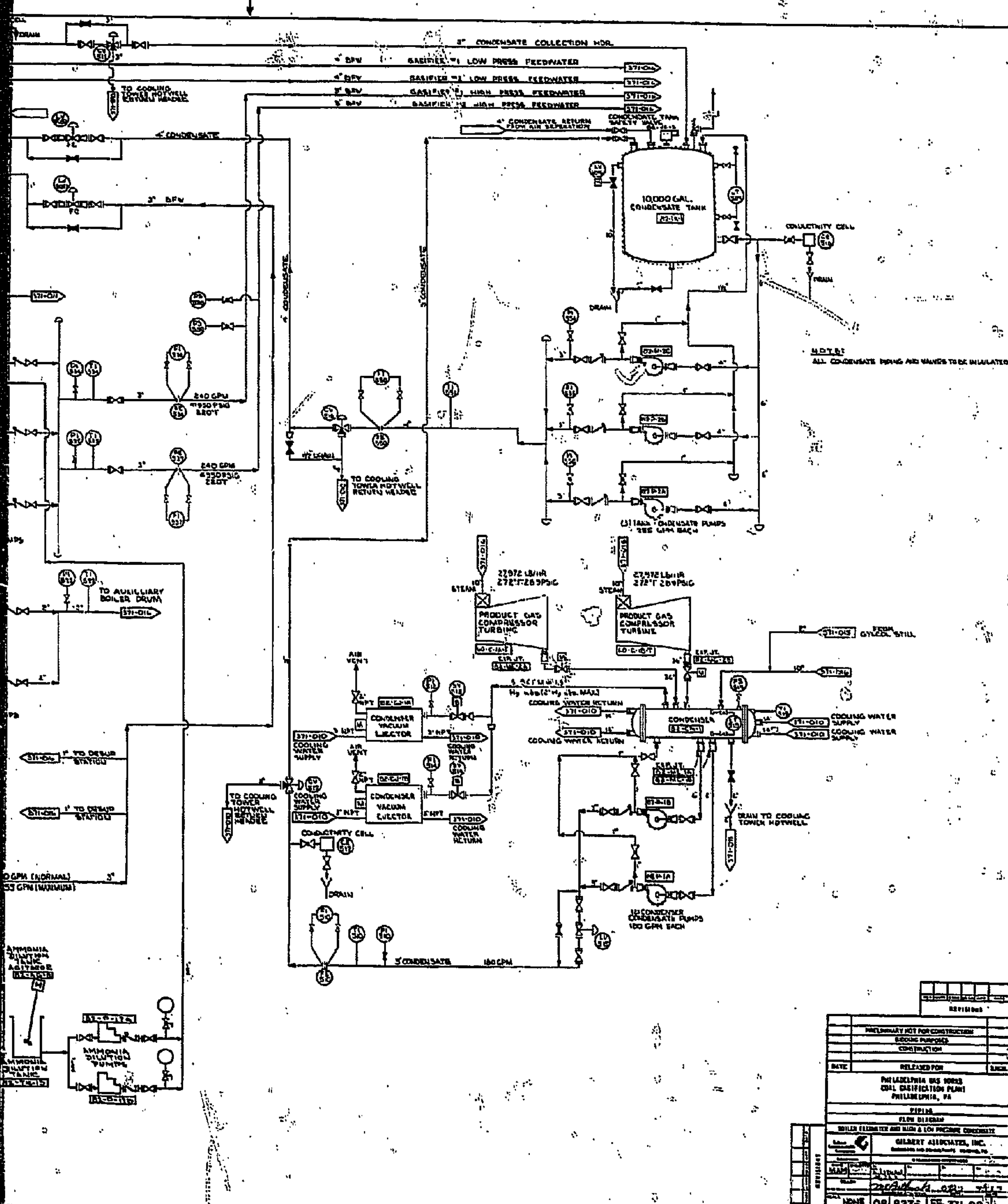

DUST COLLECTOR
20-BF-1B
DUST COLLECTOR
20-BF-1A
1" N2 BAG BLOW DOWN
VENT
EXPANSION JOINT
DAMPER
ROTARY FEED VALVE (TYPICAL)
SLIDE GATE (TYPICAL)
DOUBLE DUMP VALVE (TYPICAL)
SURGE BIN
COAL SILO (600 SHORT TONS)
20-TK-1B
20-TK-1A
BIFURCATED CHUTE
VIBRATING FEEDER
SHUT OFF GATE
BELT TRIPPER W/PLATFORM
FLY ASH 84 T/HR
FLYASH CONVEYOR
TRANSFER CHUTE
ROTARY FEED VALVE
SCREW CONVEYOR
PULVERIZER
AIR HEATER
20-HE-8B
20-HE-8A
AIR HEATER COMBUSTION FAN
PULVERIZED COAL PUMPS
4-WAY SPLITTER
TO SERVICE BURNERS
GASIFICATION REACTOR
8" NITROGEN
EE-371-001
NO.2 FUEL OIL
DUPLEX STRAINER
OIL PUMPS
10-P-1A/B
LOWERING WELL
DUST COLLECTOR FAN
DUST COLLECTOR
COAL SAMPLER
BIFURCATED CHUTE WITH DIVERTER
COAL DELUMPER
COAL SAMPLING CRUSHER
COAL SAMPLING TABLE
200 STPH 2"x0" COAL
30" BELT CONVEYOR
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
GILBERT ASSOCIATES, INC.
08 8276
EE-371-003
DRAWING NUMBER
REV


24" TRENCH
WASH WATER SUMP PUMPS
CHANNEL FAN
TO ATMOS.
WASH WATER WITH SOLIDS FROM GAS WASH COOLERS
COVERED CONCRETE TRENCHES
SETTLING BASIN FAN
VENT TO ATMOS.
4000 CFM
SCRAPER
SETTLING BASIN
THICKENER
SLUDGE PUMP
GAS HOLDER OUTLET DRIP GAS SEAL
WASH WATER RETURN PUMP
VAPOR EXTRACTOR FAN
FLOC AGENT
AGITATOR
FLOC DOSING PUMP
FLOC TANK
COOLING WATER
ROTARY VACUUM FILTER
FILTER CAKE TO FLY ASH
BELT CONVEYOR
EXHAUSTER
VACUUM RECEIVER
MOISTURE TRAP
FILTRATE PUMPS
DRAIN
TO DRAIN

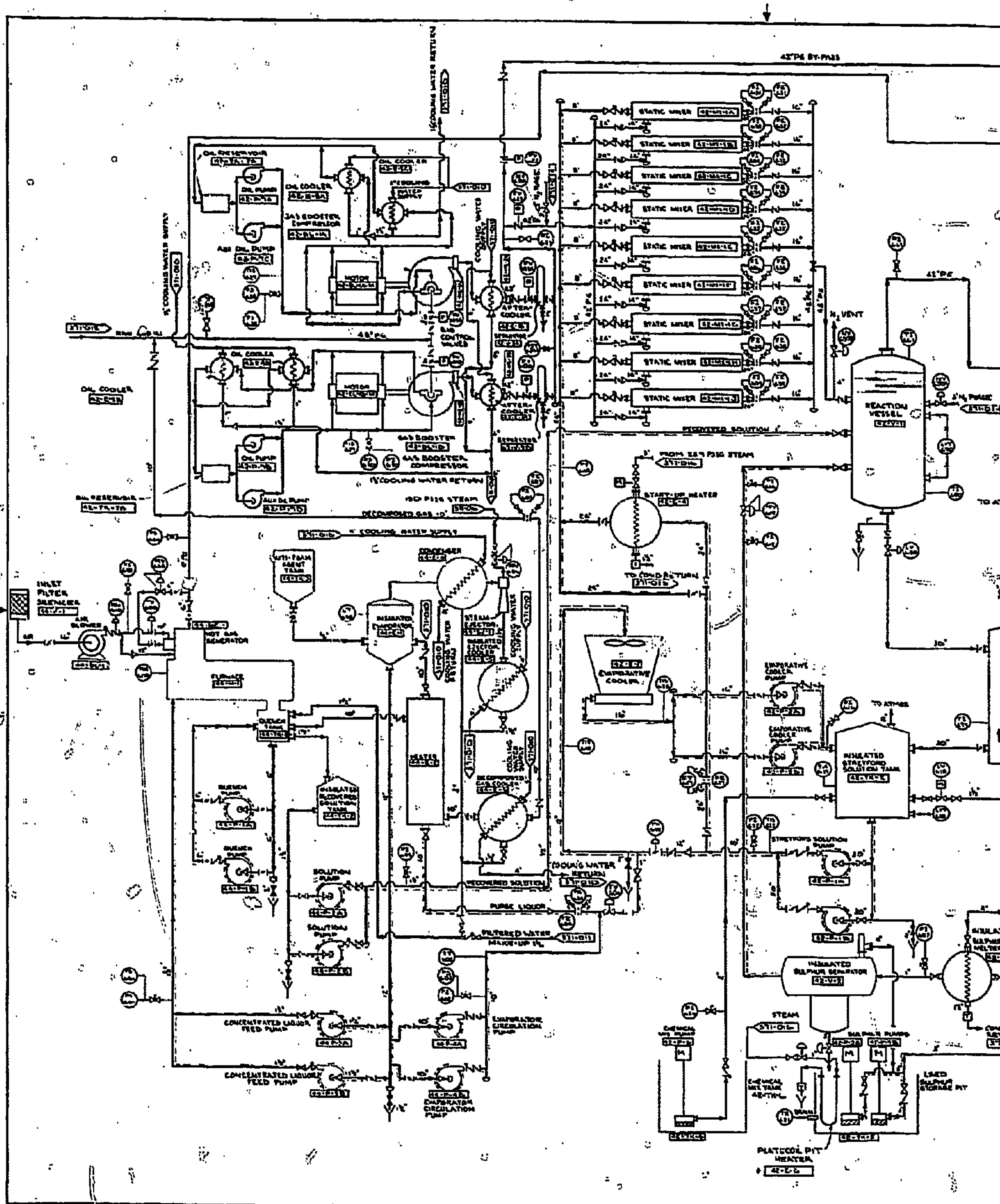

3" WASH WATER
ELECTRO-STATIC PRECIPITATOR
WATER LEG SEAL
GAS HOLDER OUTLET QUICK GAS SEAL
GAS HOLDER INLET QUICK GAS SEAL
GAS HOLDING TANK
VACUUM BREAKER
COOLING WATER MAKEUP
SETTLING BASIN FAN
VENT TO ATMOS.
4000 CFM
SCRAPER
SETTLING BASIN
WASH WATER RETURN PUMP
WASH WATER COOLER
WASH WATER SUPPLY
4400 GPM
VAPOR EXTRACTOR FAN
12,800 CFM
24" COOLING WATER RETURN
WASH WATER DRAIN TO WASTE TREATMENT
AGITATOR
ROTARY VACUUM FILTER
EXHAUSTER
FILTER CAKE TO FLY ASH
BELT CONVEYOR 1.1 TONS/HR
VACUUM RECEIVER
MOISTURE TRAP
FILTRATE PUMPS
350 GPM
VACUUM PUMPS
SILENCER
TO DRAIN
DRAIN
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
WASH WATER
GILBERT ASSOCIATES, INC.
NONE
08 8276 EE-371-004
DRAWING NUMBER



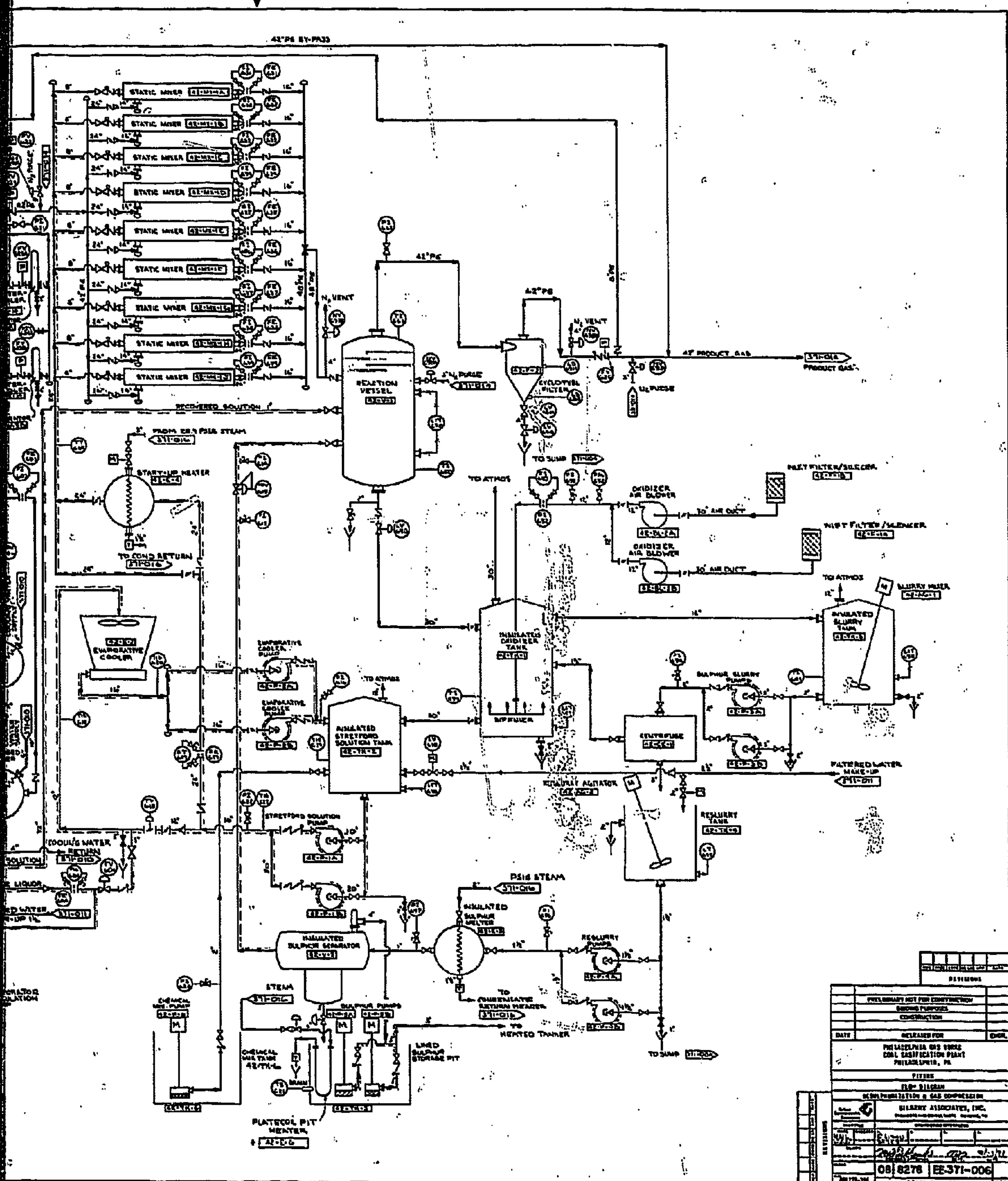
CONDENSATE RETURN SEE DWG.
CONDUCTIVITY CELL
3" 350 GPM
DEAERATOR SAFETY VALVE
DEAERATOR
8" L.P. STEAM
4" CONDENSATE
3" BFW
HYDRAZINE DILUTION TANK AGITATOR
HYDRAZINE DILUTION PUMPS
HYDRAZINE DILUTION TANK
DRAIN TO COOLING TOWER HOTWELL
LOW PRESS FEEDWATER PUMPS 120 GPM EACH
HIGH PRESS FEEDWATER PUMPS 120 GPM EACH
240 GPM
TO AUXILLIARY BOILER DRUM
EMERGENCY FILTERED WATER MAKE-UP
AUX. BOILER FEEDWATER PUMPS 60 GPM EACH @ 150 PSIG
DEMINERALIZED WATER TANK
DEMINERALIZED WATER PUMPS 120GPM EACH
DRAIN TO COOLING TOWER HOTWELL
30 GPM (NORMAL)
255 GPM (MAXIMUM)
PHOSPHATE DILUTION TANK AGITATOR
PHOSPHATE DILUTION PUMPS
PHOSPHATE DILUTION TANK
AMMONIA DILUTION TANK AGITATOR
AMMONIA DILUTION TANK
AMMONIA DILUTION PUMPS
CONDENSER VACUUM EJECTOR
COOLING WATER SUPPLY
COOLING WATER RETURN
AIR VENT
TO COOLING TOWER HOTWELL RETURN HEADER
3" CONDENSATE



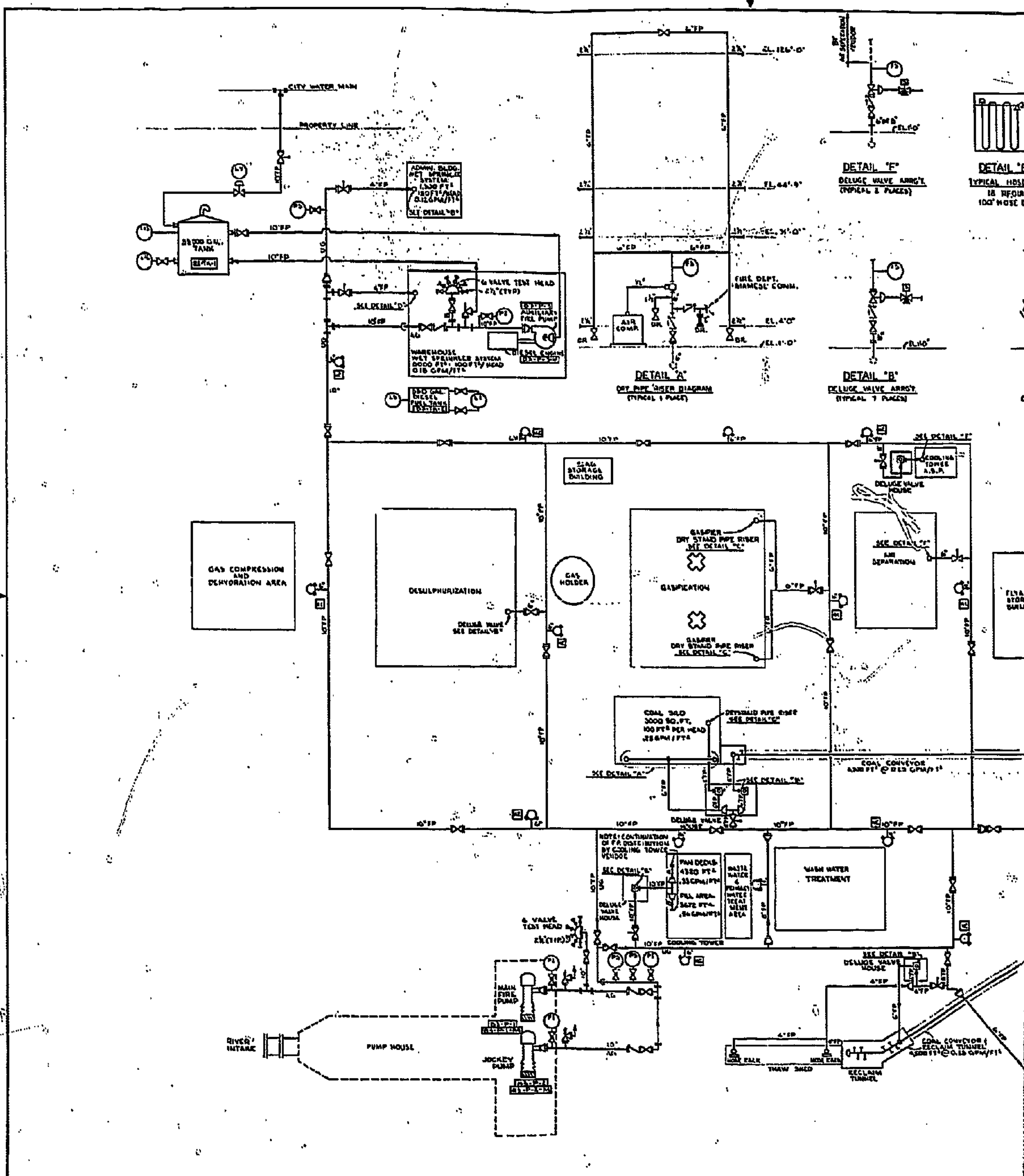
3" CONDENSATE COLLECTION HDR.
GASIFIER #1 LOW PRESS FEEDWATER
GASIFIER #2 LOW PRESS FEEDWATER
GASIFIER #1 HIGH PRESS FEEDWATER
GASIFIER #2 HIGH PRESS FEEDWATER
10,000 GAL. CONDENSATE TANK
CONDUCTIVITY CELL
DRAIN
NOTE: ALL CONDENSATE PIPING AND VALVES TO BE INSULATED
(3) TANK CONDENSATE PUMPS 285 GPM EACH
TO COOLING TOWER HOTWELL RETURN HEADER
TO AUXILLIARY BOILER DRUM
PRODUCT GAS COMPRESSOR TURBINE
CONDENSER
CONDENSER VACUUM EJECTOR
COOLING WATER SUPPLY
COOLING WATER RETURN
AIR VENT
DRAIN TO COOLING TOWER HOTWELL
(2) CONDENSER CONDENSATE PUMPS 180 GPM EACH
3" CONDENSATE
AMMONIA DILUTION PUMPS
AMMONIA DILUTION TANK
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
BOILER FEEDWATER AND HIGH & LOW PRESSURE CONDENSATE
GILBERT ASSOCIATES, INC.
NONE
08
8276.
EE-371-00a



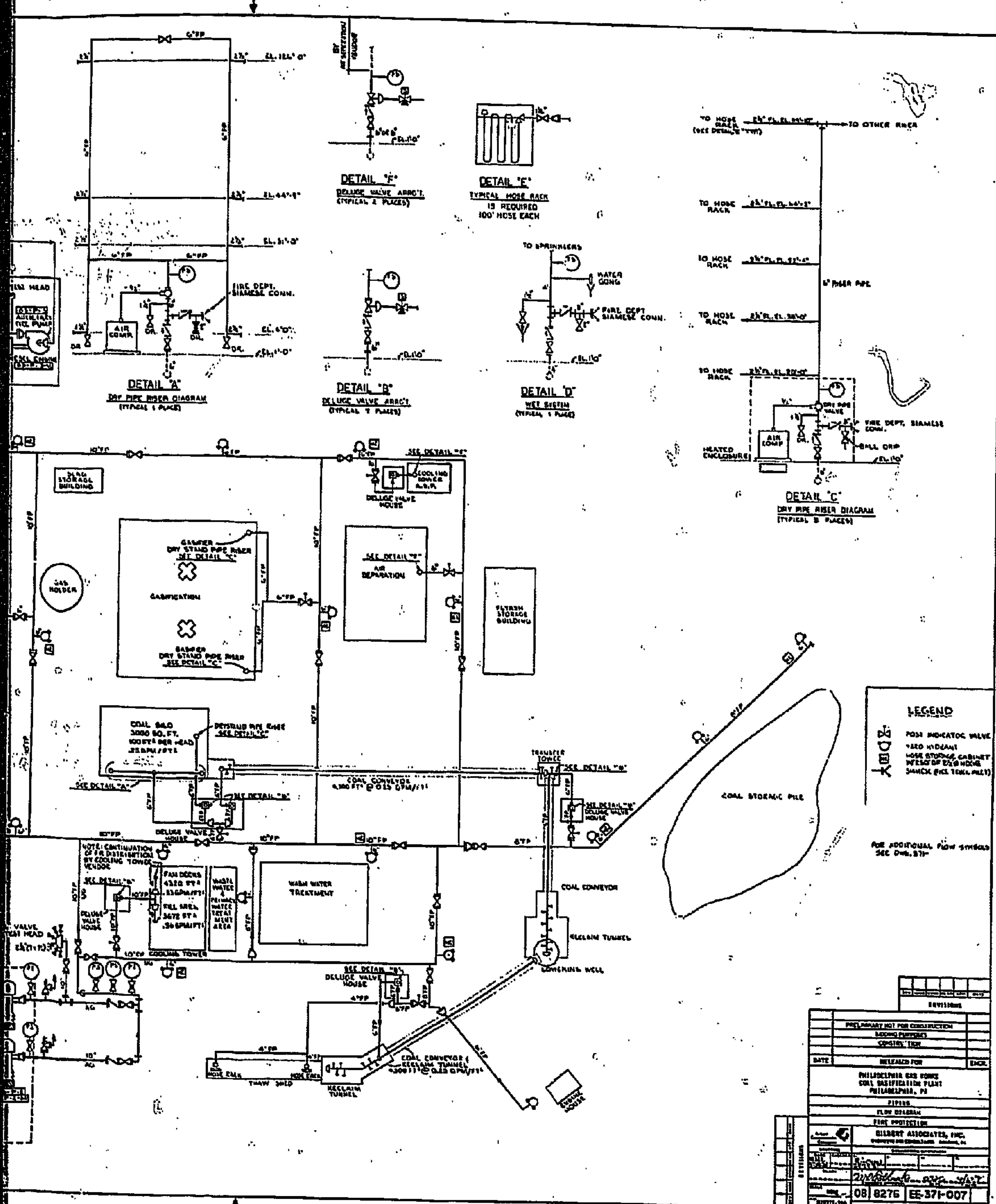
STATIC MIXER
REACTION VESSEL
INLET FILTER SILENCER
AIR BLOWER
HOT GAS GENERATOR
FURNACE
GAS BOOSTER COMPRESSOR
OIL COOLER
OIL PUMP
AUX OIL PUMP
OIL RESERVOIR
MOTOR
AFTER-COOLER
CONDENSER
HEATER
START-UP HEATER
EVAPORATIVE COOLER
EVAPORATIVE COOLER PUMP
INSULATED STRETFORD SOLUTION TANK
STRETFORD SOLUTION PUMP
INSULATED SULPHUR SEPARATOR
SULPHUR PUMPS
USED SULPHUR STORAGE PIT
PLATECOIL PIT HEATER
CHEMICAL MIX TANK
CONCENTRATED LIQUOR FEED PUMP
EVAPORATOR CIRCULATION PUMP
QUENCH PUMP
QUENCH TANK
SOLUTION PUMP
RECOVERED SOLUTION
PURGE LIQUOR
FILTERED WATER MAKE-UP
COOLING WATER RETURN
COOLING WATER SUPPLY
DECOUPLED GAS
STEAM
TO ATMOS.
42"PE BY-PASS



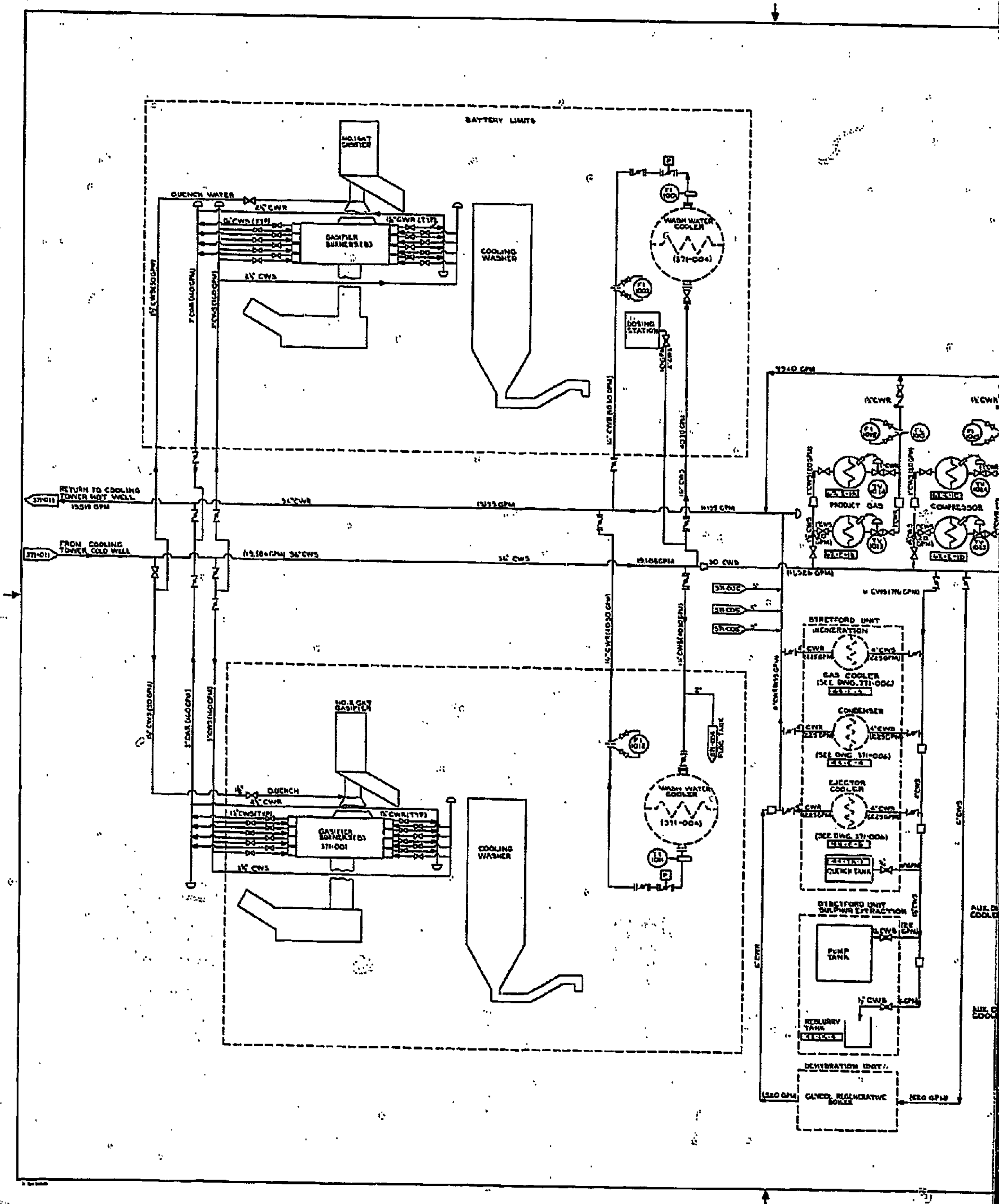
42" PS BY-PASS
STATIC MIXER
REACTION VESSEL
CYCLONE FILTER
42" PRODUCT GAS
PRODUCT GAS
N_2 VENT
N_2 PURGE
RECOVERED SOLUTION
TO SUMP
START-UP HEATER
TO COND RETURN
TO ATMOS
OXIDIZER AIR BLOWER
30" AIR DUCT
INLET FILTER/SILENCER
SLURRY MIXER
INSULATED SLURRY TANK
INSULATED OXIDIZER TANK
DIFFUSER
EVAPORATIVE COOLER
EVAPORATIVE COOLER PUMP
INSULATED STRETFORD SOLUTION TANK
STRETFORD SOLUTION PUMP
SULPHUR SLURRY PUMP
CENTRIFUGE
FILTERED WATER MAKE-UP
RESLURRY AGITATOR
RESLURRY TANK
RESLURRY PUMPS
PSIG STEAM
INSULATED SULPHUR MELTER
INSULATED SULPHUR SEPARATOR
TO CONDENSATE RETURN HEADER
TO HEATED TANKER
STEAM
SULPHUR PUMPS
LINED SULPHUR STORAGE PIT
CHEMICAL MIX TANK
CHEMICAL MIX PUMP
PLATECOIL PIT HEATER
DRAIN
COOLG WATER RETURN
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
DESULPHURIZATION & GAS COMPRESSION
GILBERT ASSOCIATES, INC.
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
08 8276 EE-371-006

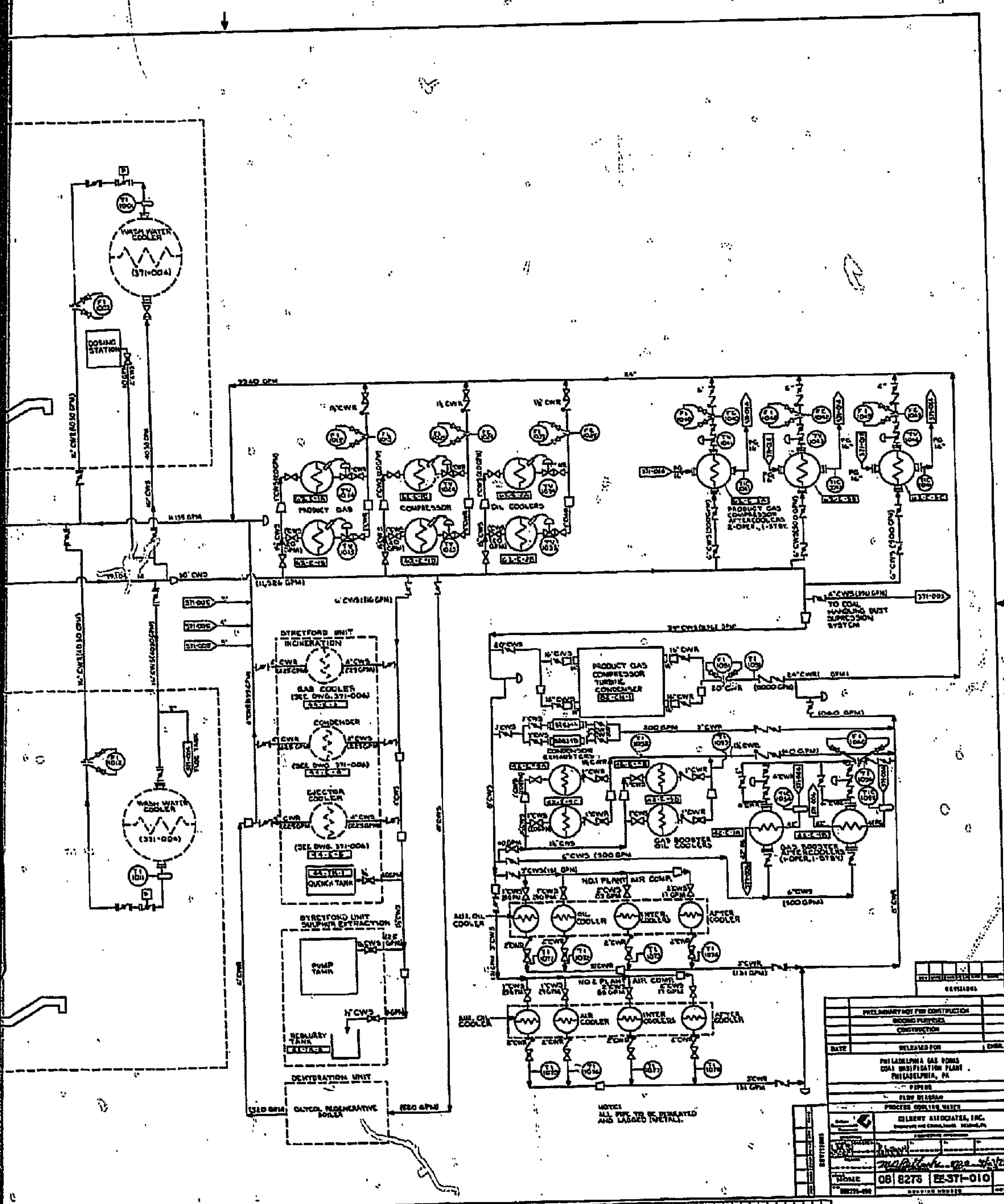


CITY WATER MAIN
PROPERTY LINE
DETAIL "A"
DRY PIPE RISER DIAGRAM
DETAIL "B"
DELUGE VALVE ARRG'T
DETAIL "F"
DELUGE VALVE ARRG'T
DETAIL "E"
WAREHOUSE
WET SPRINKLER SYSTEM
SLAG STORAGE BUILDING
GAS COMPRESSION AND DEHYDRATION AREA
DESULPHURIZATION
GAS HOLDER
GASIFICATION
AIR SEPARATION
COAL CONVEYOR
WASH WATER TREATMENT
COOLING TOWER
MAIN FIRE PUMP
JOCKEY PUMP
RIVER INTAKE
PUMP HOUSE
THAW SHED
RECLAIM TUNNEL

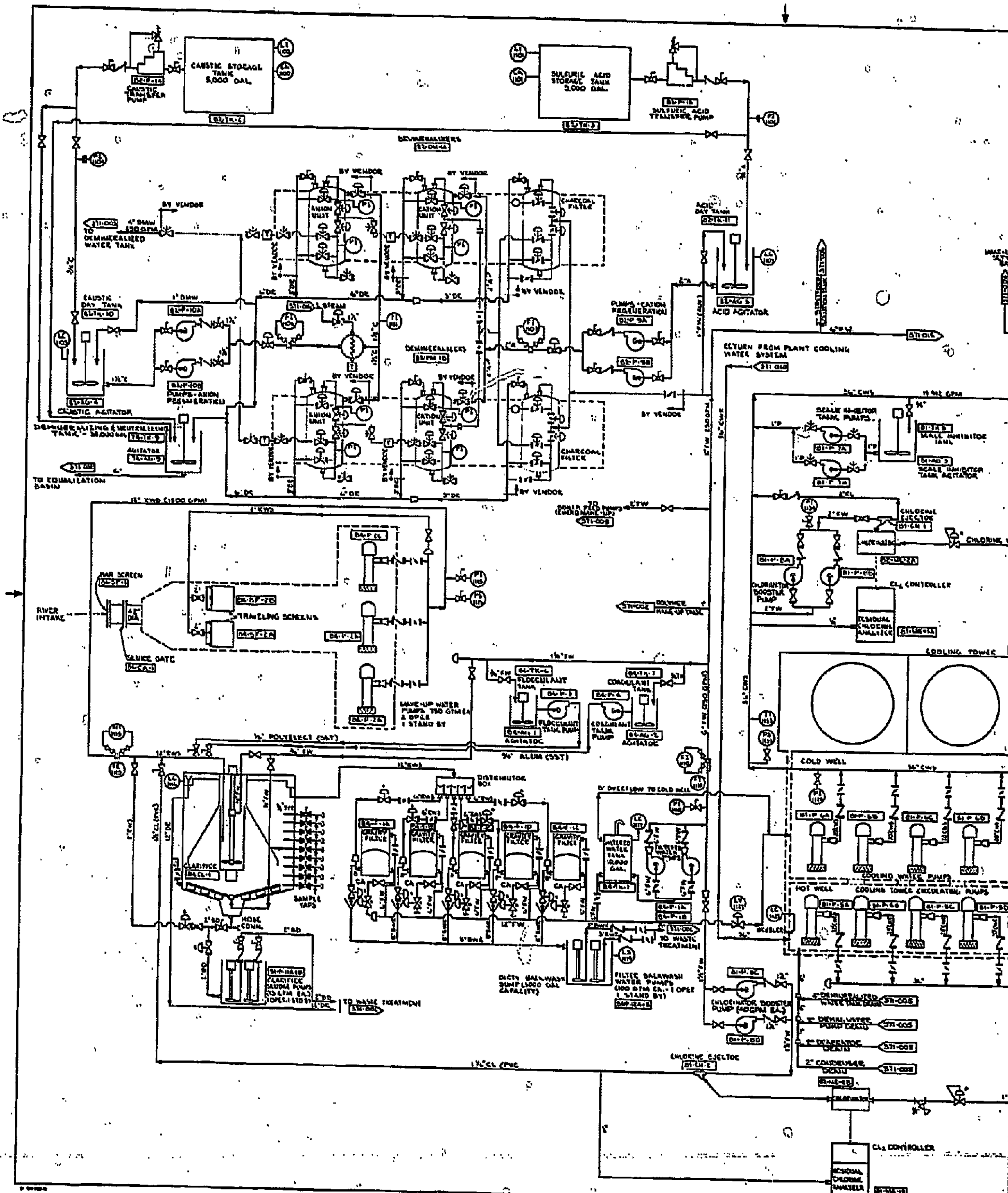


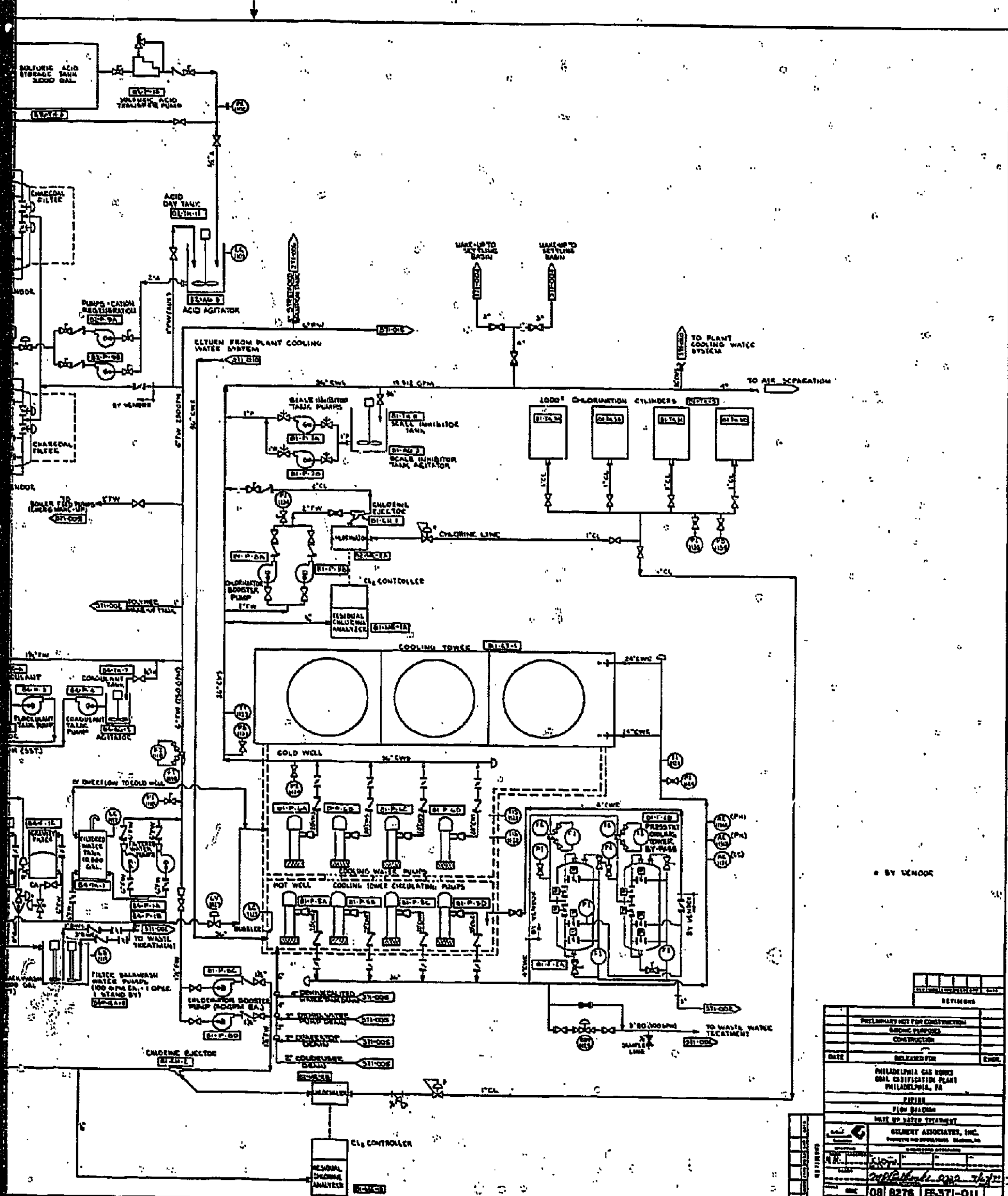
DETAIL "A"
DRY PIPE RISER DIAGRAM
DETAIL "B"
DELUGE VALVE ARRG'T
DETAIL "C"
DRY PIPE RISER DIAGRAM
DETAIL "D"
WET SYSTEM
DETAIL "E"
TYPICAL HOSE RACK
15 REQUIRED
100' HOSE EACH
DETAIL "F"
DELUGE VALVE ARRG'T
TO OTHER RISER
6" RISER PIPE
FIRE DEPT. SIAMESE CONN.
AIR COMP
HEATED ENCLOSURE
BALL DRIP
TO SPRINKLERS
WATER GONG
SLAG STORAGE BUILDING
GAS HOLDER
GASIFICATION
AIR SEPARATION
FLYASH STORAGE BUILDING
DELUGE VALVE HOUSE
COAL SILO
COAL CONVEYOR
TRANSFER TOWER
COAL STORAGE PILE
WASTE WATER TREATMENT
COOLING TOWER
RECLAIM TUNNEL
COAL CONVEYOR
HOSE RACK
THAW SHED
LEGEND
POST INDICATOR VALVE
YARD HYDRANT
FOR ADDITIONAL FLOW SYMBOLS SEE DWG. 371-
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
FIRE PROTECTION
GILBERT ASSOCIATES, INC.
08 8276 EE-371-007


BATTERY LIMITS
QUENCH WATER
COOLING WASHER
WASH WATER COOLER
(371-004)
DOSING STATION
RETURN TO COOLING TOWER HOT WELL
FROM COOLING TOWER COLD WELL
PRODUCT GAS
COMPRESSOR
STRETFORD UNIT
GAS COOLER
CONDENSER
EJECTOR COOLER
QUENCH TANK
PUMP TANK
DEHYDRATION UNIT
GLYCOL REGENERATIVE BOILER

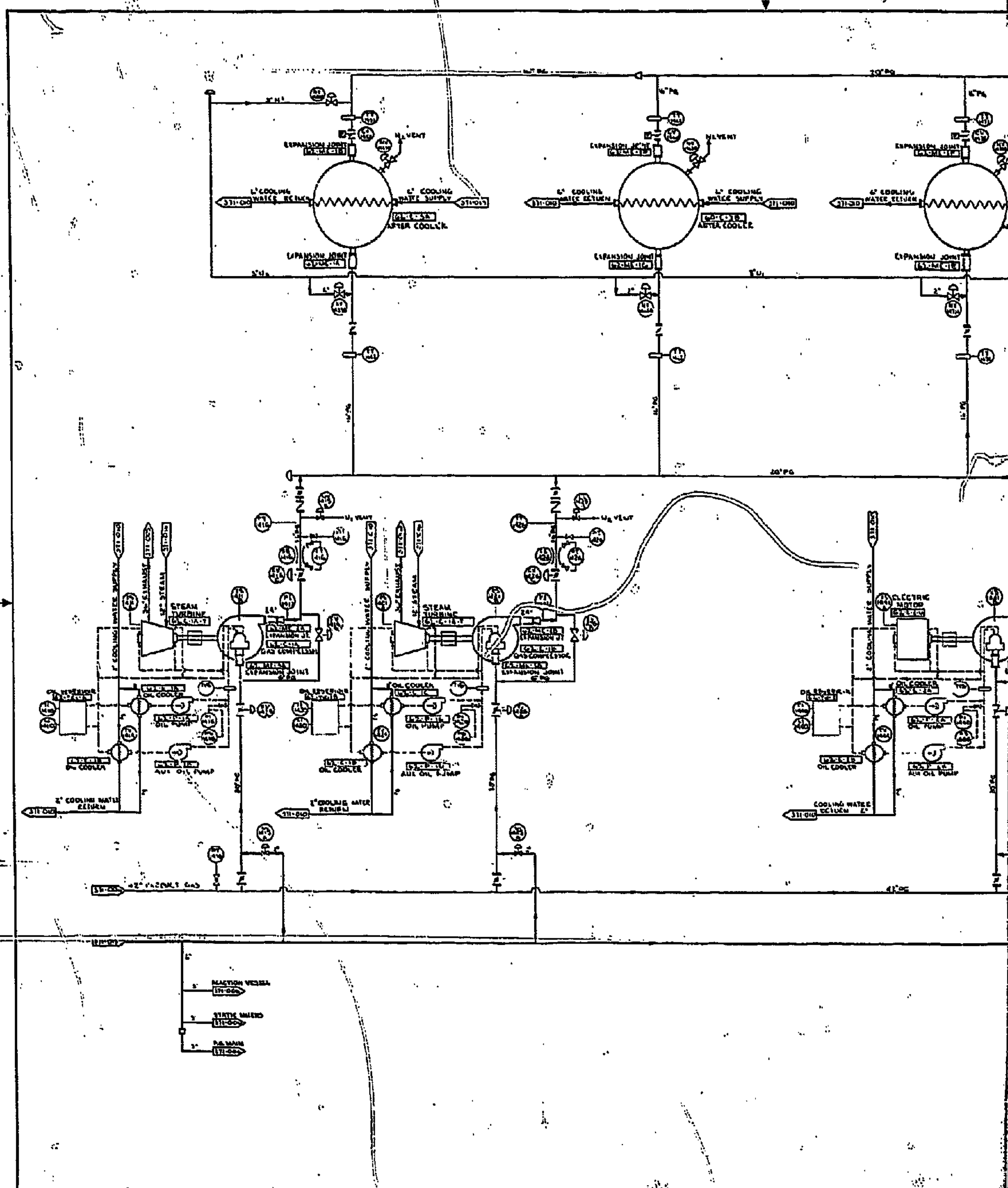


WASH WATER COOLER
DOSING STATION
PRODUCT GAS COMPRESSOR OIL COOLERS
PRODUCT GAS COMPRESSOR AFTERCOOLERS
TO COAL HANDLING DUST SUPRESSION SYSTEM
STRETFORD UNIT INCINERATION
GAS COOLER
CONDENSER
EJECTOR COOLER
QUENCH TANK
STRETFORD UNIT SULPHUR EXTRACTION
PUMP TANK
SLURRY TANK
DEHYDRATION UNIT
GLYCOL REGENERATIVE BOILER
PRODUCT GAS COMPRESSOR TURBINE CONDENSER
GAS BOOSTER OIL COOLERS
GAS BOOSTER AFTERCOOLERS
NO.1 PLANT AIR COMP.
NO.2 PLANT AIR COMP.
AUX. OIL COOLER
OIL COOLER
AIR COOLER
INTER COOLERS
AFTER COOLER
NOTES: ALL PIPE TO BE INSULATED AND LAGGED (METAL).
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
PROCESS COOLING WATER
GILBERT ASSOCIATES, INC.
NONE
08 8275 EE-371-010
DRAWING NUMBER

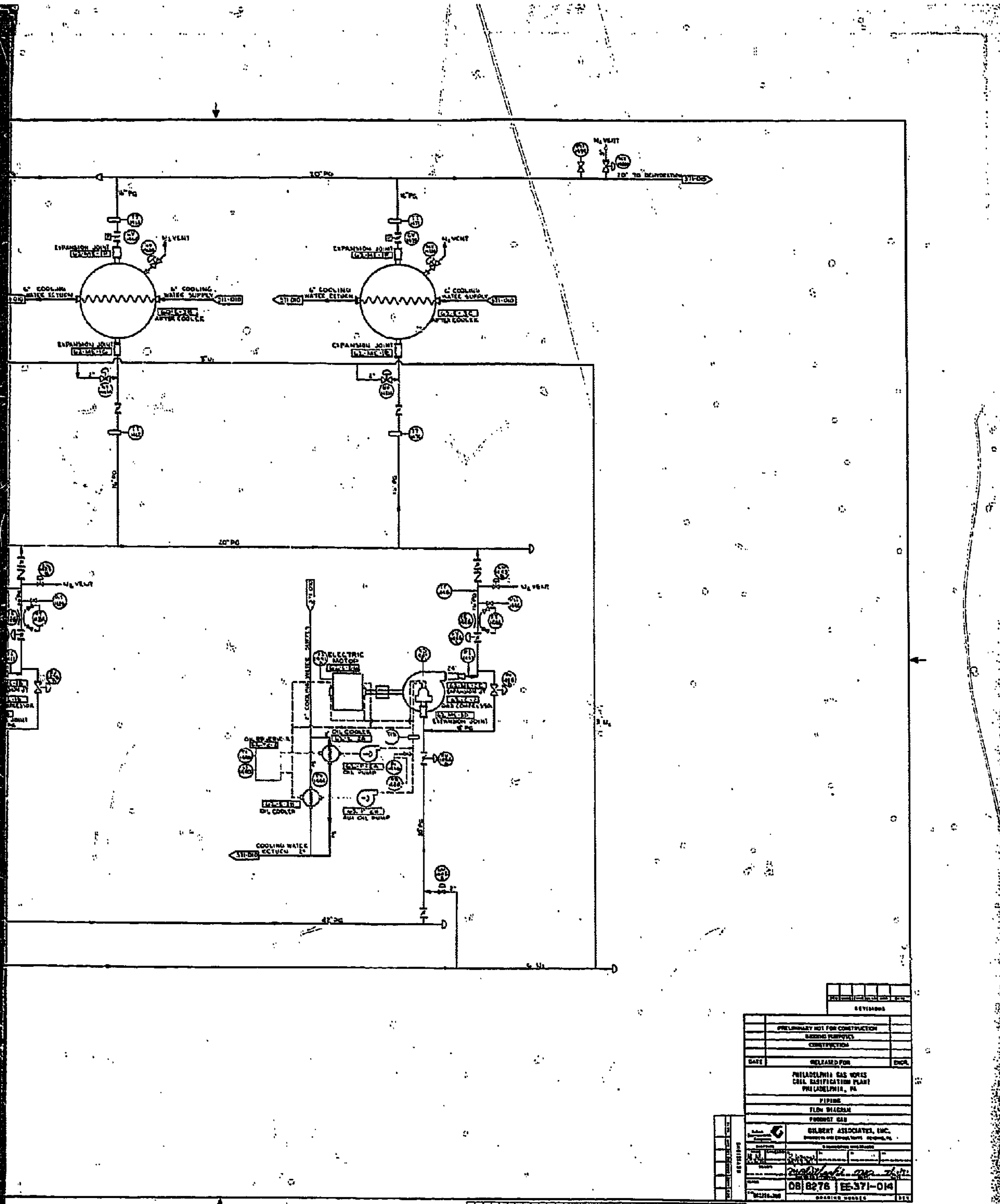

CAUSTIC STORAGE TANK 5,000 GAL.
SULFURIC ACID STORAGE TANK 5,000 GAL.
DEMINERALIZERS
RIVER INTAKE
TRAVELING SCREENS
COOLING TOWER
COLD WELL
HOT WELL
SAMPLE TAPS

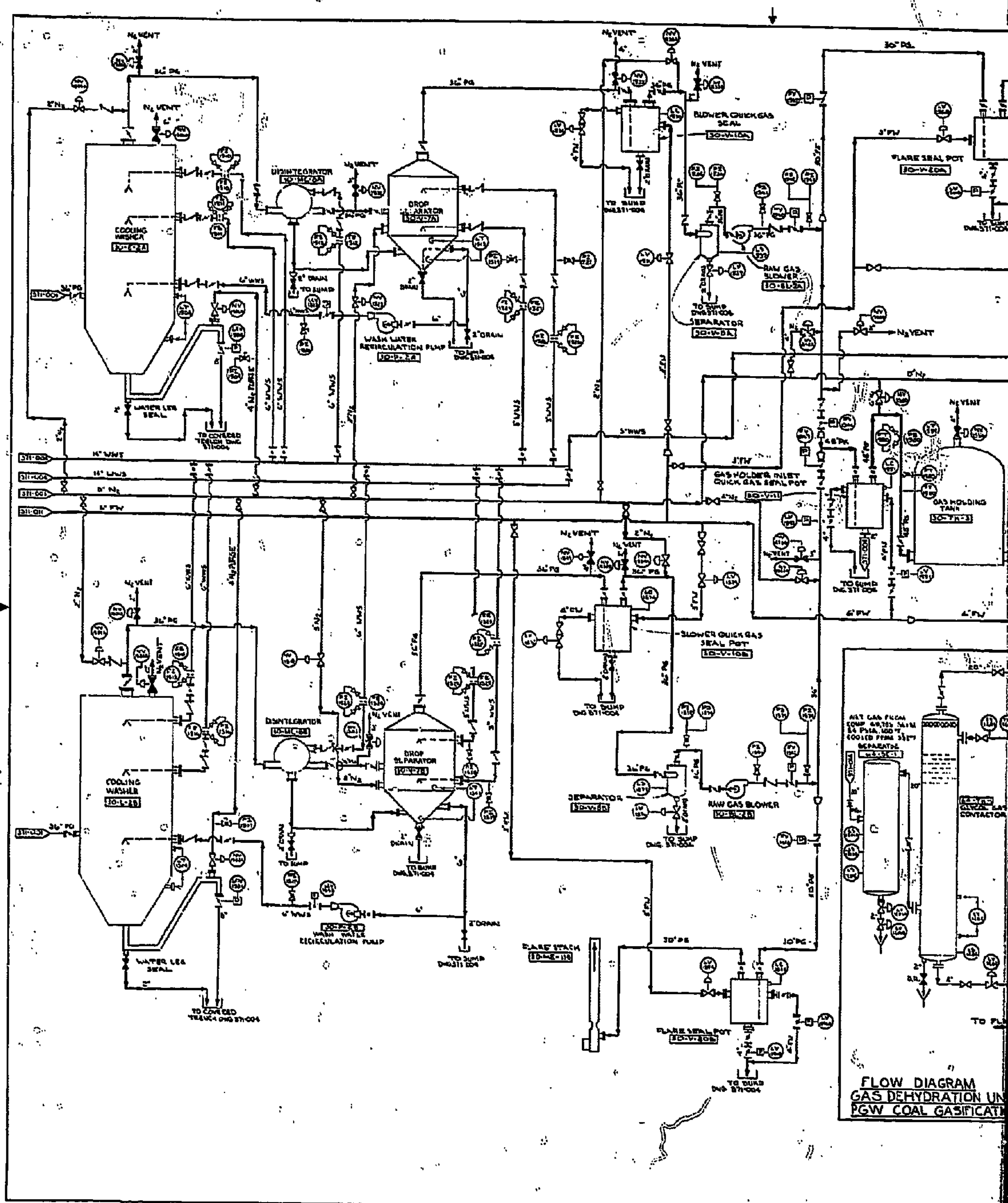


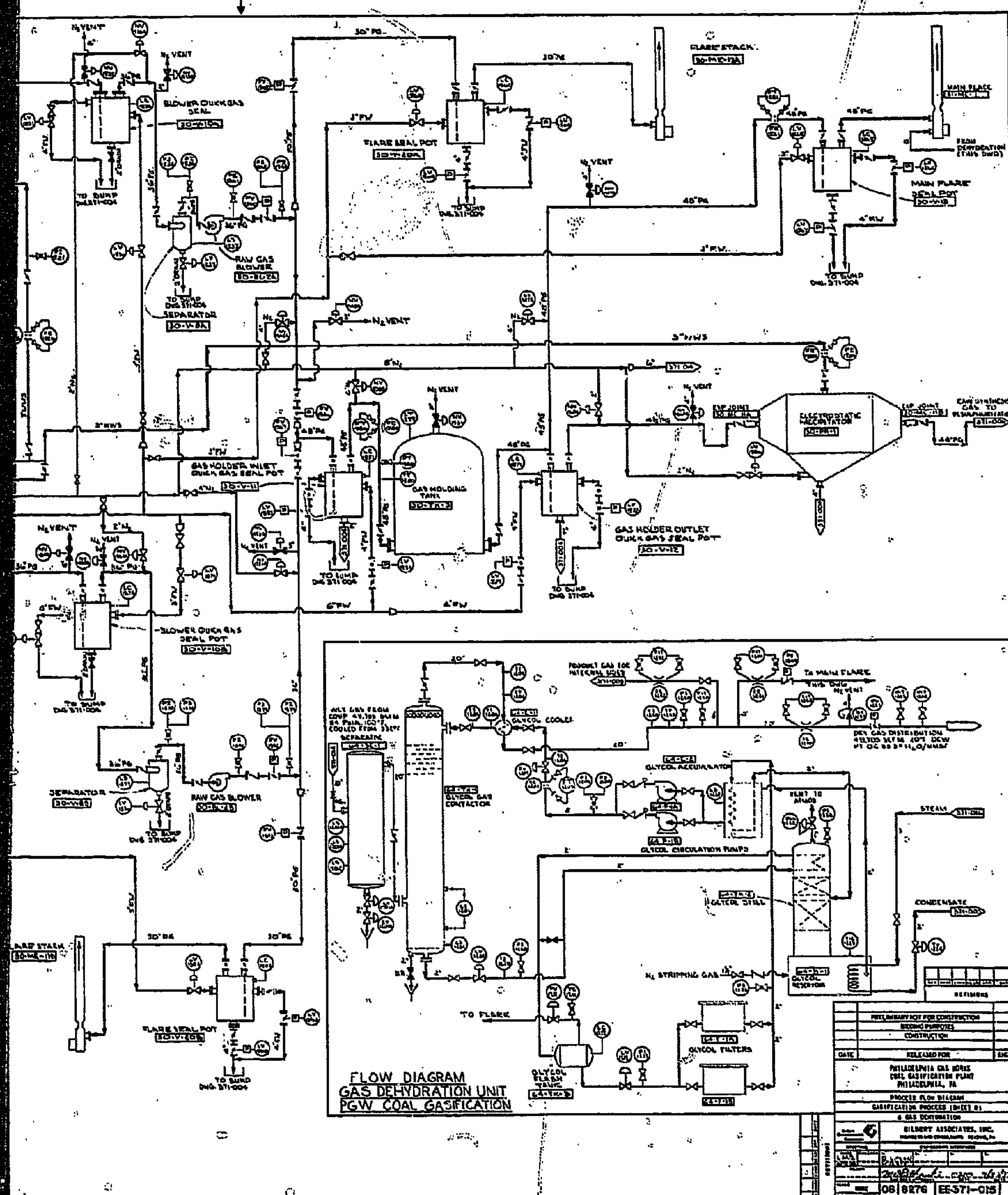
SULFURIC ACID STORAGE TANK
ACID DAY TANK
ACID AGITATOR
CHARCOAL FILTER
RETURN FROM PLANT COOLING WATER SYSTEM
MAKE-UP TO SETTLING BASIN
TO PLANT COOLING WATER SYSTEM
TO AIR SEPARATION
CHLORINATION CYLINDERS
SCALE INHIBITOR TANK
CHLORINE EJECTOR
CHLORINE LINE
CL2 CONTROLLER
RESIDUAL CHLORINE ANALYZER
COOLING TOWER
COLD WELL
HOT WELL
COOLING WATER PUMPS
COOLING TOWER CIRCULATING PUMPS
TO WASTE TREATMENT
TO WASTE WATER TREATMENT
SAMPLE LINE
CHLORINE EJECTOR
* BY VENDOR
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
CHKD.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
MAKE UP WATER TREATMENT
GILBERT ASSOCIATES, INC.
08 8276 EE-371-011



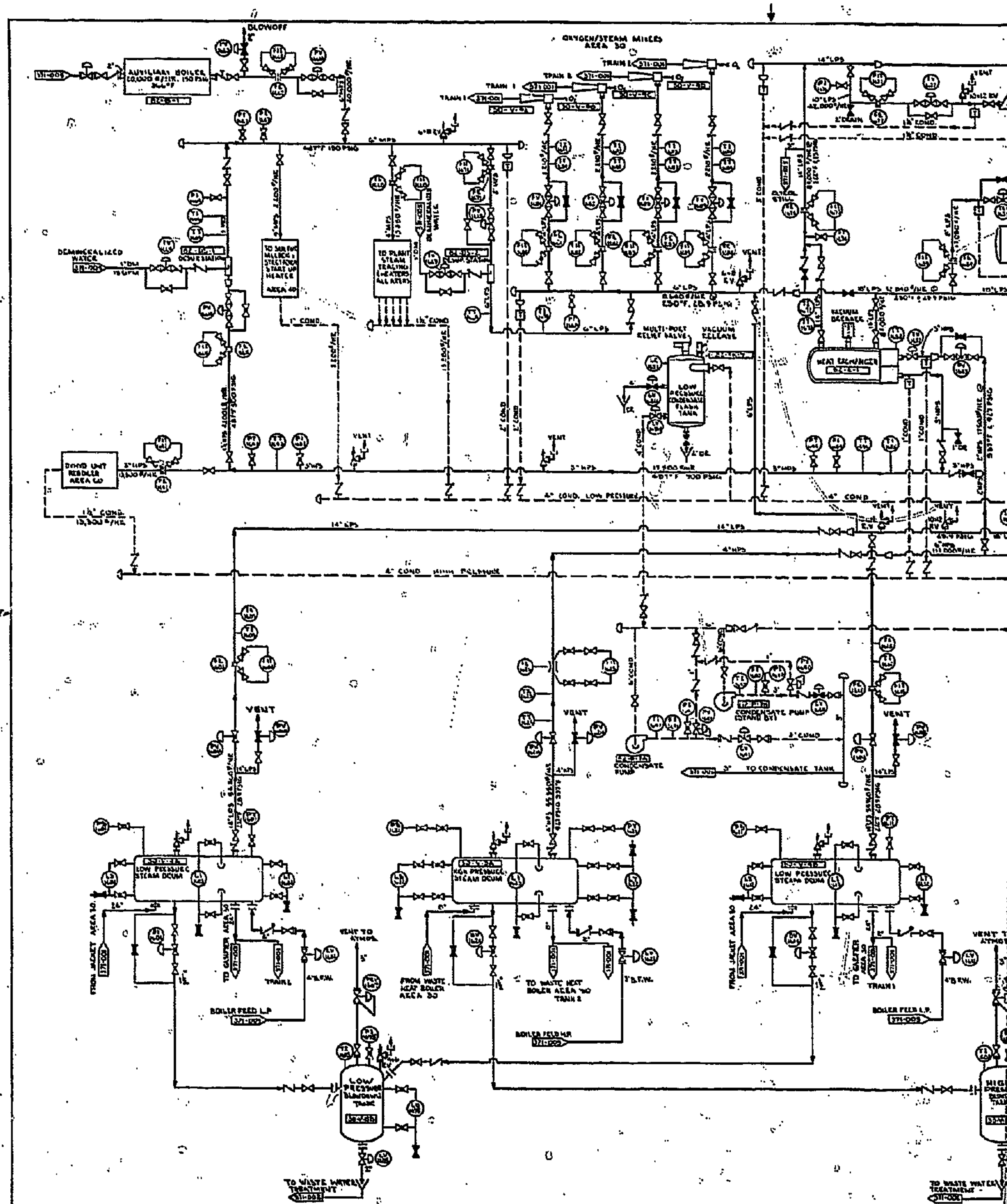
EXPANSION JOINT
AFTER COOLER
H2 VENT
STEAM TURBINE
GAS COMPRESSOR
OIL RESERVOIR
OIL COOLER
OIL PUMP
AUX OIL PUMP
ELECTRIC MOTOR
2" COOLING WATER RETURN
REACTION VESSEL


20" PG
N₂ VENT
20" TO DEHYDRATION
EXPANSION JOINT
6" COOLING WATER RETURN
6" COOLING WATER SUPPLY
AFTER COOLER
20" PG
N₂ VENT
ELECTRIC MOTOR
GAS COMPRESSOR
EXPANSION JOINT
OIL COOLER
OIL RESERVOIR
OIL PUMP
AUX OIL PUMP
COOLING WATER RETURN
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
PRODUCT GAS
GILBERT ASSOCIATES, INC.
REVISIONS
08 8276 EE-371-014
DRAWING NUMBER

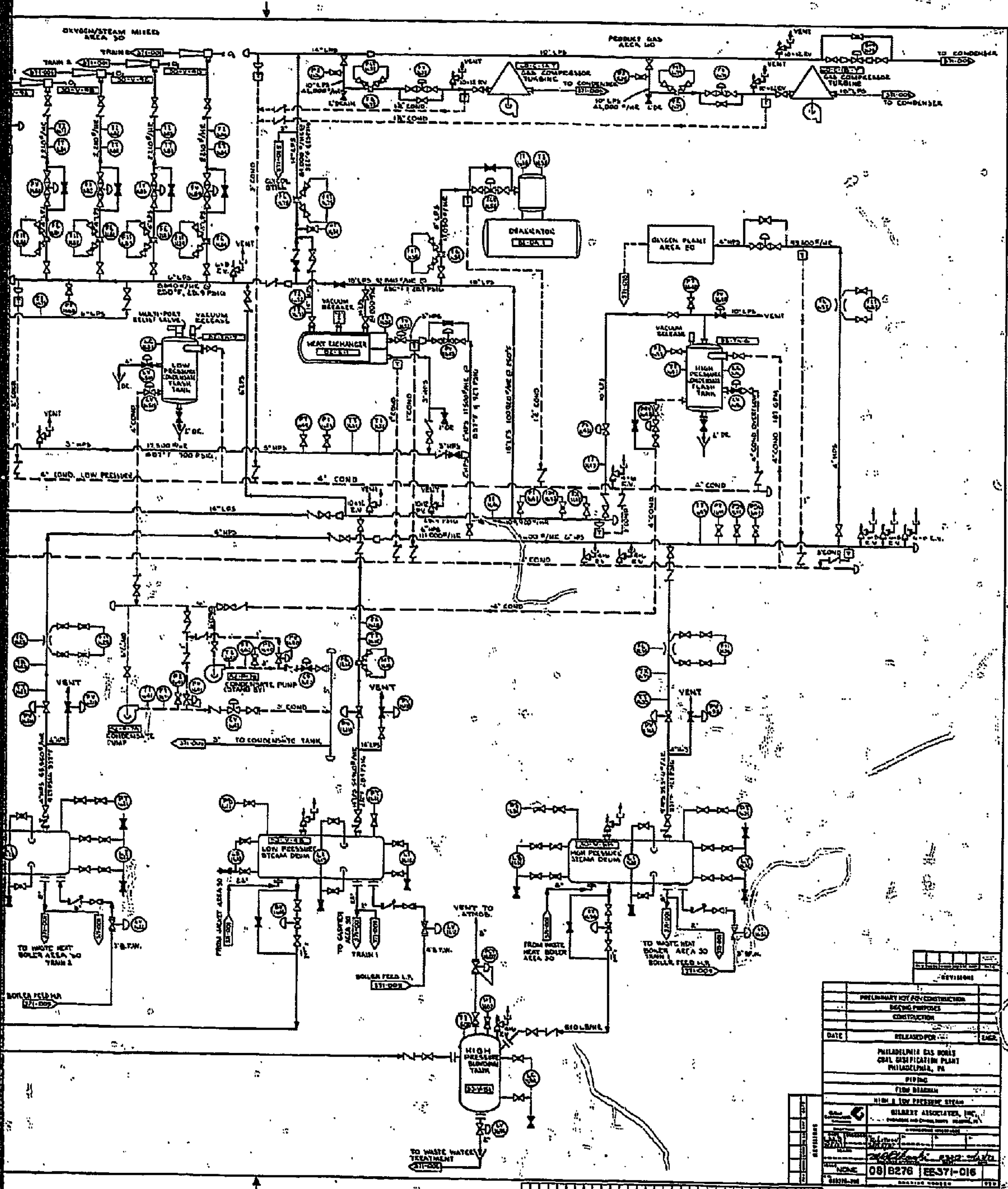

COOLING WASHER
DISINTEGRATOR
DROP SEPARATOR
WASH WATER RECIRCULATION PUMP
WATER LEG SEAL
TO COVERED TRENCH
BLOWER QUICK GAS SEAL
RAW GAS BLOWER
SEPARATOR
FLARE SEAL POT
GAS HOLDER INLET QUICK GAS SEAL POT
GAS HOLDING TANK
BLOWER QUICK GAS SEAL POT
FLARE STACK
N2 VENT
TO SUMP
FLOW DIAGRAM
GAS DEHYDRATION UN
PGW COAL GASIFICAT



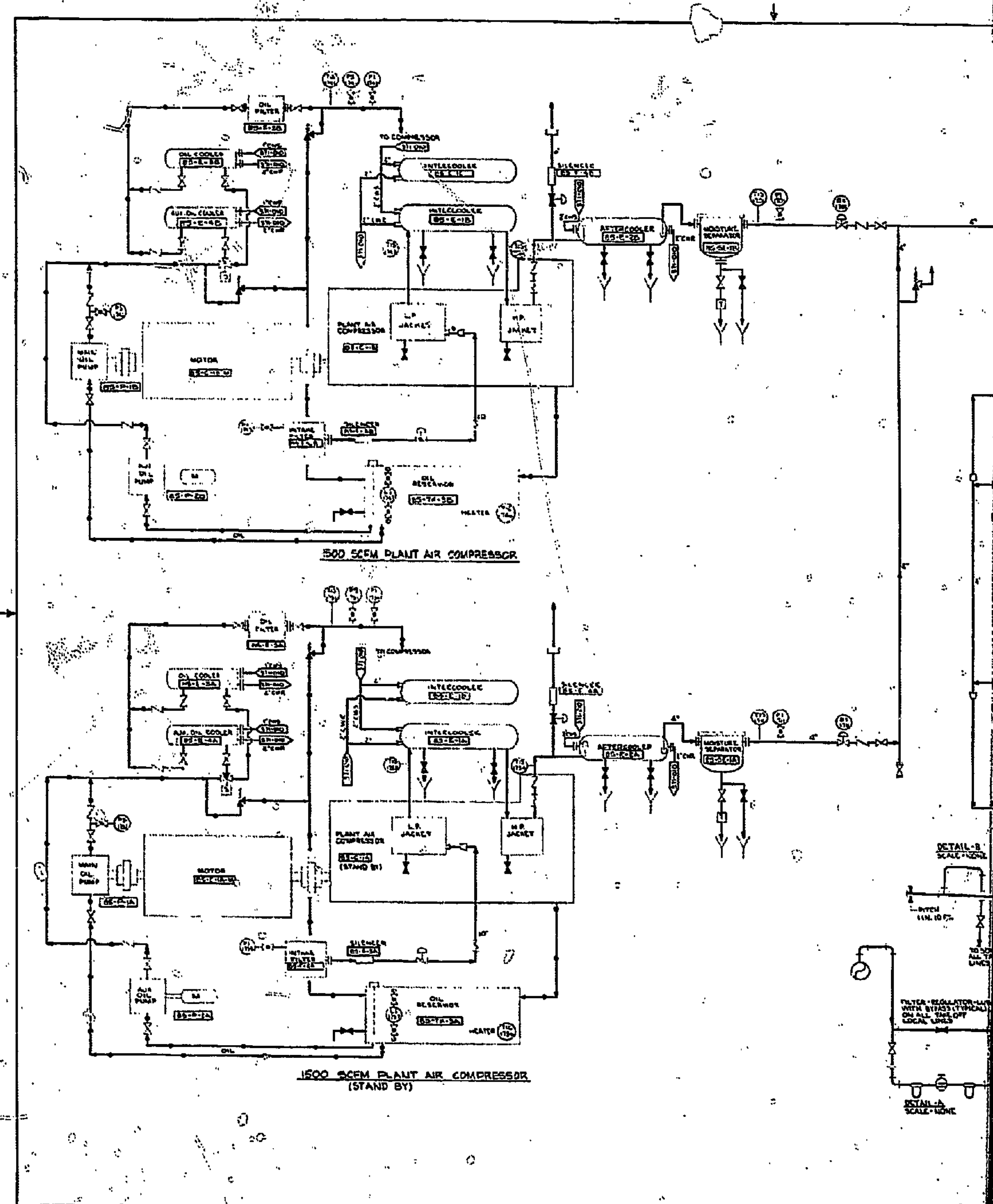
FLARE STACK
MAIN FLARE
BLOWER QUICK GAS SEAL
FLARE SEAL POT
MAIN FLARE SEAL POT
RAW GAS BLOWER
SEPARATOR
ELECTROSTATIC PRECIPITATOR
GAS HOLDER INLET QUICK GAS SEAL POT
GAS HOLDING TANK
GAS HOLDER OUTLET QUICK GAS SEAL POT
BLOWER QUICK GAS SEAL POT
TO SUMP
N2 VENT
GLYCOL COOLER
GLYCOL ACCUMULATOR
GLYCOL CIRCULATION PUMPS
GLYCOL GAS CONTACTOR
GLYCOL STILL
GLYCOL REBOILER
GLYCOL FILTERS
GLYCOL FLASH TANK
N2 STRIPPING GAS
TO FLARE
TO MAIN FLARE
STEAM
CONDENSATE
VENT TO ATMOS
FLOW DIAGRAM
GAS DEHYDRATION UNIT
PGW COAL GASIFICATION
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PROCESS FLOW DIAGRAM
GILBERT ASSOCIATES, INC.
08 8276 EE-571-015

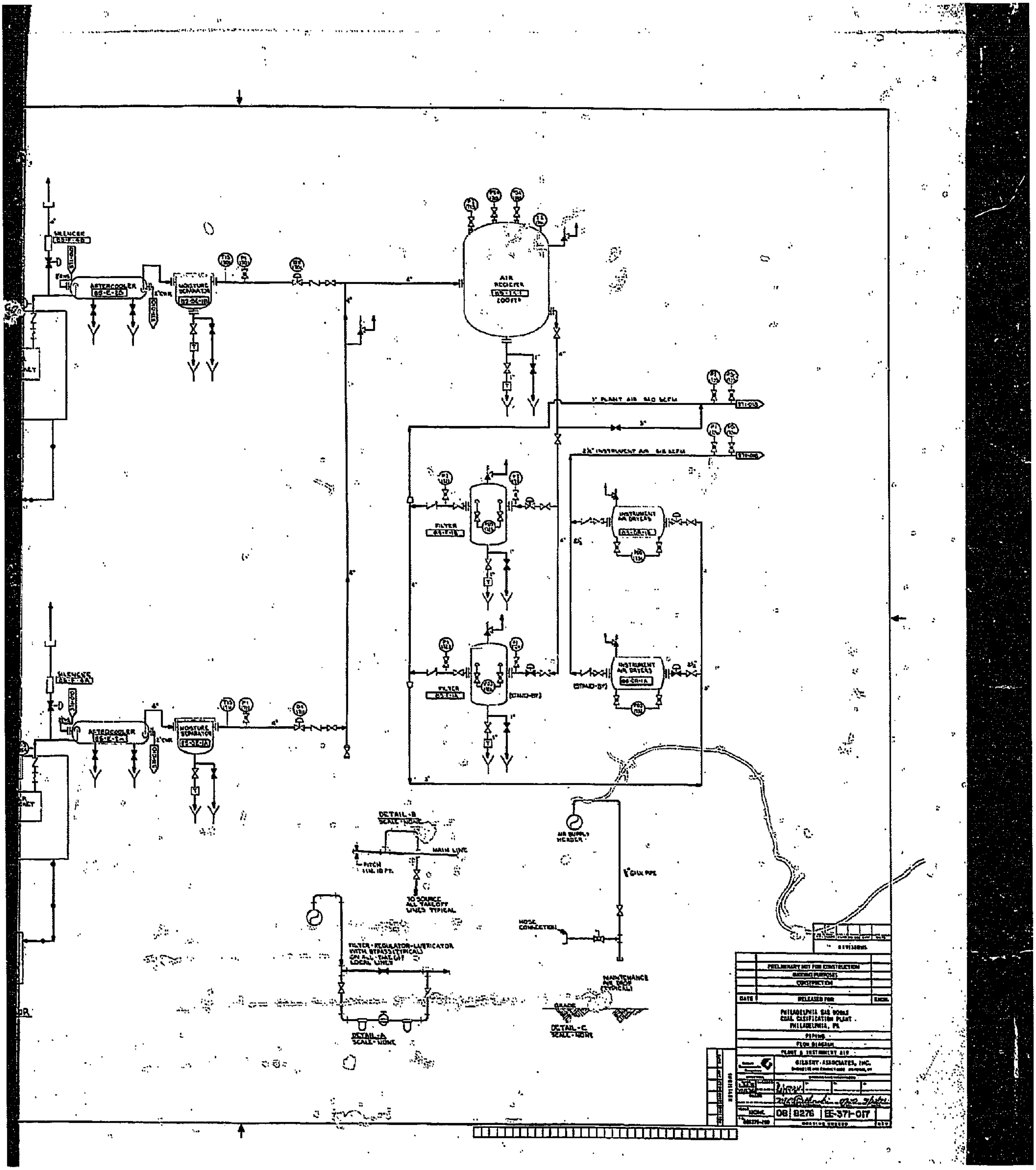


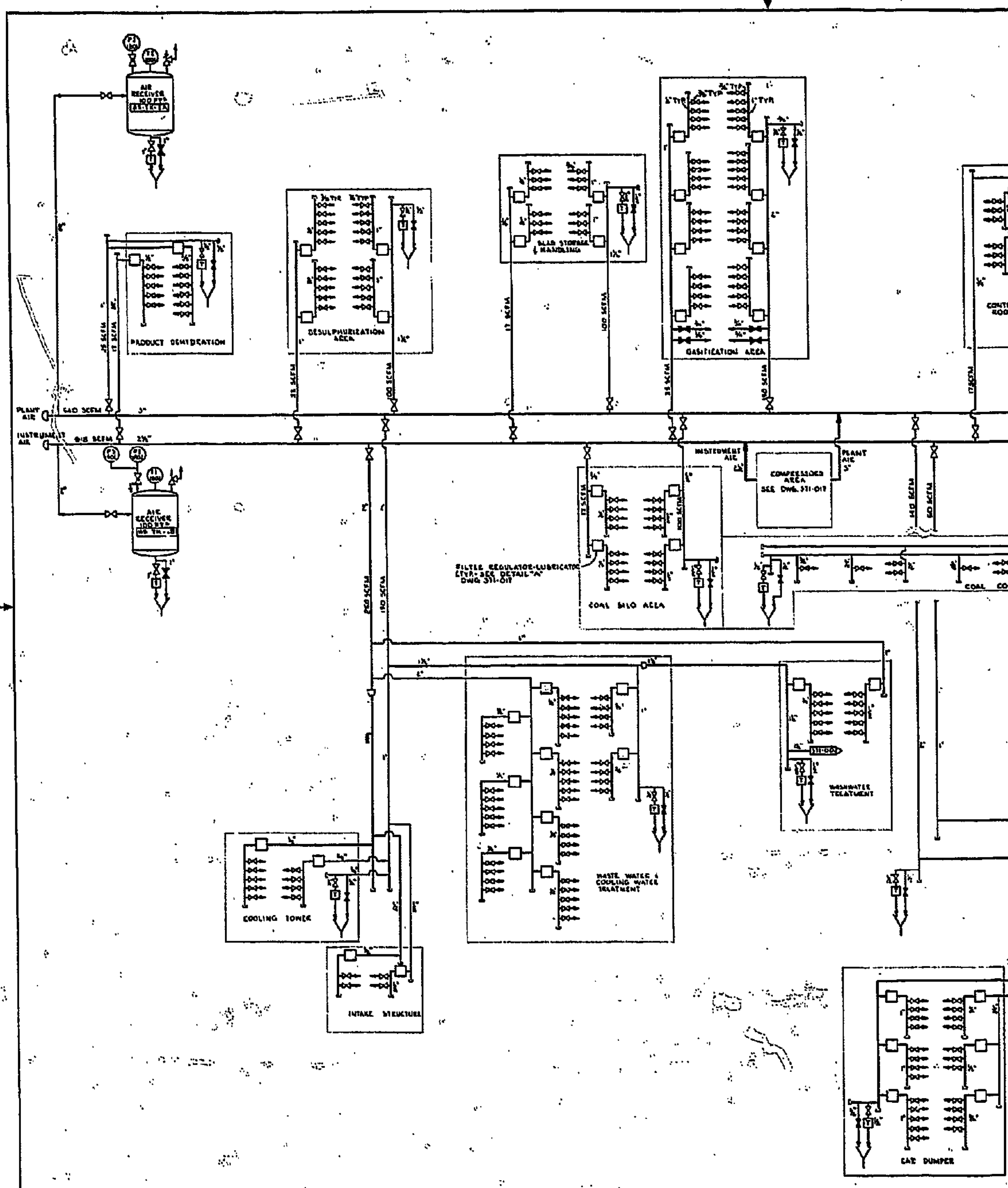
BLOWOFF
OXYGEN/STEAM MIXERS AREA 30
AUXILIARY BOILER
DEMINERALIZED WATER
MULTI-PORT RELIEF VALVE
VACUUM RELEASE
LOW PRESSURE CONDENSATE FLASH TANK
HEAT EXCHANGER
VENT
4" COND. LOW PRESSURE
4" COND HIGH PRESSURE
CONDENSATE PUMP
TO CONDENSATE TANK
LOW PRESSURE STEAM DRUM
HIGH PRESSURE STEAM DRUM
BOILER FEED L.P.
BOILER FEED H.P.
VENT TO ATMOS.
LOW PRESSURE BLOWDOWN TANK
TO WASTE WATER TREATMENT

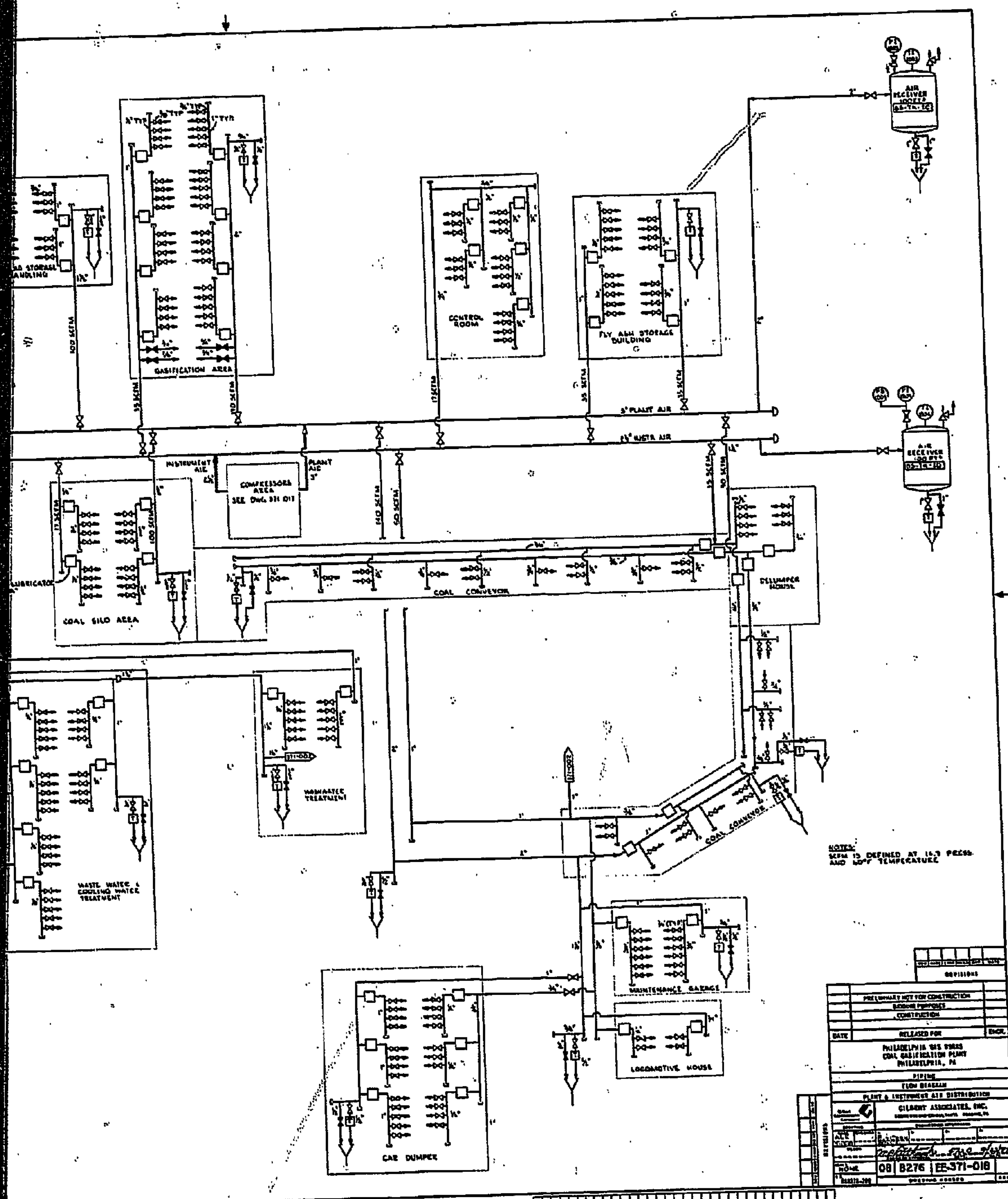


OXYGEN/STEAM MIXER AREA 30
PRODUCT GAS AREA 40
GAS COMPRESSOR TURBINE
TO CONDENSER
DEAERATOR
OXYGEN PLANT AREA 80
HEAT EXCHANGER
LOW PRESSURE CONDENSATE FLASH TANK
HIGH PRESSURE CONDENSATE FLASH TANK
VACUUM BREAKER
VENT
4" COND. LOW PRESSURE
4" COND
CONDENSATE PUMP
TO CONDENSATE TANK
LOW PRESSURE STEAM DRUM
HIGH PRESSURE STEAM DRUM
VENT TO ATMOS.
BOILER FEED L.P.
BOILER FEED H.P.
TO WASTE HEAT BOILER AREA 30 TRAIN 2
HIGH PRESSURE BLOWDOWN TANK
TO WASTE WATER TREATMENT
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
BIDDING PURPOSES
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
HIGH & LOW PRESSURE STEAM
GILBERT ASSOCIATES, INC.
NONE
08
B276
EE371-016


1500 SCFM PLANT AIR COMPRESSOR
1500 SCFM PLANT AIR COMPRESSOR
(STAND BY)
INTERCOOLER
AFTERCOOLER
MOISTURE SEPARATOR
MOTOR
OIL FILTER
OIL COOLER
AUX. OIL COOLER
MAIN OIL PUMP
AUX OIL PUMP
OIL RESERVOIR
HEATER
INTAKE FILTER
SILENCER
L.P. JACKET
H.P. JACKET
PLANT AIR COMPRESSOR
TO COMPRESSOR
DETAIL-B
SCALE-NONE
DETAIL-A
SCALE-NONE


SILENCER
AFTERCOOLER
MOISTURE SEPARATOR
AIR RECEIVER
3" PLANT AIR
2½" INSTRUMENT AIR
FILTER
INSTRUMENT AIR DRYERS
(STAND-BY)
DETAIL-B
SCALE-NONE
MAIN LINE
TO SOURCE ALL TAKEOFF LINES TYPICAL
AIR SUPPLY HEADER
HOSE CONNECTION
FILTER-REGULATOR-LUBRICATOR WITH BYPASS (TYPICAL) ON ALL TAKE-OFF LOCAL LINES
MAINTENANCE AIR DROP (TYPICAL)
GRADE
DETAIL-A
SCALE-NONE
DETAIL-C
SCALE-NONE
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
PLANT & INSTRUMENT AIR
GILBERT ASSOCIATES, INC.
NONE
08 8276 EE-371-017


AIR RECEIVER
PRODUCT DEHYDRATION
DESULPHURIZATION AREA
SLAG STORAGE & HANDLING
GASIFICATION AREA
PLANT AIR
540 SCFM
INSTRUMENT AIR
INSTRUMENT AIR
COMPRESSOR AREA SEE DWG. 511-017
PLANT AIR 3"
FILTER REGULATOR-LUBRICATOR (TYP) SEE DETAIL "A" DWG. 511-017
COAL SILO AREA
WASTE WATER & COOLING WATER TREATMENT
WASHWATER TREATMENT
COOLING TOWER
INTAKE STRUCTURE
CAR DUMPER


GASIFICATION AREA
CONTROL ROOM
FLY ASH STORAGE BUILDING
AIR RECEIVER
3" PLANT AIR
2½" INSTR AIR
INSTRUMENT AIR
PLANT AIR
COMPRESSORS AREA SEE DWG. 371-017
COAL SILO AREA
LUBRICATOR
COAL CONVEYOR
DELUMPER HOUSE
WASTE WATER & COOLING WATER TREATMENT
WASHWATER TREATMENT
MAINTENANCE GARAGE
LOCOMOTIVE HOUSE
CAR DUMPER
NOTES:
SCFM IS DEFINED AT 14.7 PRESS. AND 60°F TEMPERATURE
REVISIONS
PRELIMINARY NOT FOR CONSTRUCTION
CONSTRUCTION
DATE
RELEASED FOR
ENGR.
PHILADELPHIA GAS WORKS
COAL GASIFICATION PLANT
PHILADELPHIA, PA
PIPING
FLOW DIAGRAM
PLANT & INSTRUMENT AIR DISTRIBUTION
GILBERT ASSOCIATES, INC.
NONE
08 8276 EE-371-018