UNIT 3600 - ACID GAS STRIPPING (RECTISOL)

1. SCOPE

Benzene-rich methanol and sour methanol, rich in carbon dioxide and hydrogen sulfide, from Unit 2600 are regenerated in this unit. Benzene, a carbon dioxide rich stream, and a hydrogen sulfide rich stream are recovered from the methanol. The unit consists of six separation columns, a recycle compressor and other auxiliary equipment.

2. DESIGN CONDITIONS

This unit is designed to regenerate the sour methanol for return to Unit 2600 while producing a carbon dioxide rich gas containing less than 5 PPM hydrogen sulfide, a hydrogen sulfide rich acid gas containing a minimum of 25 mol percent hydrogen sulfide, and a liquid benzene fraction.

3. PROCESS FLOW

The system is shown on Process Flow Diagram #1843-36.00-7G. To the benzene-water-methanol mixture from Unit 2600 is added water from the bottom of the methanol/water separator. The benzene fraction is then separated from the methanol-water mixture in the decanter and sent to Unit 1400. The methanol-water mixture is then separated in a simple distillation column, the water is pumped back to the decanter, and the methanol pumped back to the benzene wash tower in Unit 2600. Acid gases dissolved in

the methanol and stripped out in the separator are sent to the H_2S rich acid gas stream. Sour methanol from the H_2S wash tower and CO_2 wash tower in Unit 2600 enter the stripping columns where the dissolved methane is stripped off. The stripped gas is then compressed and sent to Unit 2600. A portion of the CO_2 rich methanol from the stripping column is expanded. The released CO_2 joins the CO_2 rich stream, the expanded methanol is sent to the H_2S wash column in Unit 2600. The remainder of the sour methanol from the stripping columns is expanded into the CO_2 stripping column. In this column the CO_2 rich gas is purified and H_2S is concentrated in the methanol. The CO_2 rich gas stream is then heated up in Unit 2600 prior to going to the stack.

The H_2S rich methanol from the CO_2 stripping column is pumped to the methanol regeneration column. The sweet methanol from the column is pumped to CO_2 wash tower in Unit 2600. The H_2S rich acid gas from the column is sent to Unit 3200.

4. UTILITIES SUMMARY

Cooling Water	-	727 GPM
Boiler Feedwater	-	None
Steam Generated	-	830 Lbs/Hr @ 50 PSIG, Sat.
Steam Consumption	-	18,100 Lbs/Hr @ 100 PSIG, Sat.
	-	30,500 Lbs/Hr @ 50 PSIG, Sat.
* Motor Horsepower	-	4850 HP (Operating)
Air Cooler Fan Power	-	150 HP
Refrigeration	-	(Normal) 910 T/Hr @ (-) 50°F
	-	(Max) 1140 T/Hr @ (-) 50°F
Methanol Loss	-	135 Lbs/Hr

* 500 HP credit for power recovery turbine Item #36.08-08.

5. SPECIAL NOTE

This design is part of LINDE AG'S RECTISOL Process. Due to the proprietary nature of this process, the Process Flow Diagram and the descriptive write-up in this report have been simplified and condensed. The cost estimate is based on a complete confidential design disclosure by LINDE AG.

CUSTOMER: INSTITUTE OF GAS TECHNOLOGY

MASTER ITEM INDEX
UNIT 3600
ACID GAS STRIPPING (RECTISOL)
* (SIMPLIFIED)

*CENSORED VERSION FOR PUBLICATION

PROJECT W-1843
DATE 3/1/72
DATE _____

ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT. **	REMARKS
36.06-01		METHANOL/WATER SEPARATOR						
36.06-02		STRIPPING COLUMN						
36.06-03		STRIPPING COLUMN						
36.06-04		CO_2 STRIPPING COLUMN						
36.06-05		METHANOL REGEN. COLUMN						
36.06-42		DECANTER						
36.06-44		SEPARATOR						
36.08-01	A,B	2-METHANOL PUMP						
		& MOTOR						
36.08-03	A, B	2-WATER PUMP						
		& MOTOR						

* DUE TO THE PROPRIETARY NATURE OF THIS PROCESS, NOT ALL EQUIPMENT IS LISTED.

CUSTOMER : INSTITUTE OF GAS TECHNOLOGY

MASTER ITEM INDEX
UNIT 3600
ACID GAS STRIPPING (RECTISOL)
* (SIMPLIFIED)

* CENSORED VERSION FOR PUBLICATION

PROJECT _____
DATE _____
DATE _____

ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT. #	REMARKS
36.08-05	A,B	2-SOUR METHANOL PUMP						
		& MOTOR						
36.08-07	A,B	2-SWEET METHANOL PUMP						
		& MOTOR						
36.09-01		RECYCLE GAS COMPRESSOR						
		& MOTOR						

UNITS 4100, 4300, and 4400 - GASEOUS WASTE TREATMENT

1. SCOPE

These units cover the waste treatment requirements for the several gaseous effluents from the Demonstration Plant which cannot be released directly to the atmosphere, due to air pollution standards. These gaseous effluents, and the plant units for their treatment, are as follows:

a. Unit 4100 - Power Plant Stack Gas Scrubbing

This unit includes the equipment for treatment of the stack gas for SO_2 removal, from the "on-site" 110 MW power plant, Unit 5100. Primary fuel for the boilers of the power plant is approximately 60 tons/hr of spent char from the reactor. The char has a heat value of 9227 BTU/lb. The char has a sulfur content of 2.74%; which amounts to 3288 pounds per hour of sulfur and results in 6570 pounds per hour of SO_2.

Secondary boiler fuel will be "off-gas" from the Coal Pretreatment operation, Unit 1300. The volume of this gas is 200,890 ACFM at 140°F and 0.5 PSIG. Heating value is 39 BTU/SCF. The gas contains 0.452% SO_2, which amounts to 8035 pounds per hour of SO_2.

Coal will be used as a supplementary boiler fuel. Approximately 10 tons/hr of coal will be required.

The coal has a heat value of 12,670 BTU/LB (LHV), and a sulfur content of 4.42%. This amounts to 885 pounds per hour of sulfur, and results in 1770 pounds per hour of SO_2.

The power plant flue gas will amount to approximately 843,900 ACFM, at 300°F and 14.2 PSIA. The flue gas will contain 0.286% SO_2, which amounts to 16,200 pounds per hour of SO_2. The gas volume is calculated on the basis of 33% excess air.

b. Unit 4300 - Incineration and Tail Gas Treatment from the Claus Sulfur Recovery Plant

This unit includes the equipment for treatment (by incineration and scrubbing) of the H_2S and SO_2 gaseous tail gas effluents from the Claus sulfur recovery plant, Unit 3200. The volume of the flue gas from this incinerator will be 26,230 ACFM, at 750°F and 16 PSIA. The flue gas will contain 1.13% of SO_2, which amounts to 1,410 pounds per hour of SO_2.

c. Unit 4400 - Limestone Slurry Supply

This unit includes the equipment for limestone receiving and storage, grinding, slurrying, pumping, and disposal of the gypsum by-product.

The primary concern in the treatment of these gaseous effluents will be to design waste treatment

facilities for removal of sulfur dioxide (SO_2) --- to acceptable limits for atmospheric discharge, from these two gas streams. Removal of the H_2S in the Claus plant tail gas will be by combustion, to form SO_2, and subsequent scrubbing with the balance of the SO_2.

2. DESIGN CONDITIONS

A. Air Pollution Standards

1. Federal and State Standards

It will be required that proper equipment and systems be applied to any and all emissions which exceed the limits established by the Environmental Protection Agency of the Federal Government.

At the present time these requirements have not been definitely established, and have only recently been promulgated[1] by the EPA. The States were requested to make definitive replies on the "plan for implementation, maintenance and enforcement ... of the standards ... etc.,"[2] by January 30, 1972.

[1]Ref: Ambient Air Quality Standards

Federal Register 4/30/71
Volume 36 No. 84
PP 8186-8201

Standards of Performance for New Stationary Sources

Federal Register 12/23/71
Volume 36 No. 247
PP 24876-24895

[2]Ref: Requirements for Preparation Adoption & Submittal of Implementation Plans

Federal Register 8/14/71
Volume 36 No. 158
PP 15486-15506

Federal Register 10/23/71
Volume 36 No. 206
P 20513

It should be pointed out that the federal standards will be the minimum requirements. Any given State may establish criteria which are more severe than the federal standards.

Minimum standards will be established for the emission to the atmosphere of:

- Sulfur Oxides
- Particulate Matter
- Carbon Monoxide
- Nitrogen Dioxide
- Photo-Chemical Oxidants

The State of Illinois Environmental Protection Agency has not announced a date when Illinois standards will be finalized. However, tentative standards are as follows:

(See Pollution Control Board R-71-23. The CO figure was received verbally.)

1. Visual Emission Standard
   1.0 Ringelman
2. Particulate Emission Standard
   0.10 Lbs Particulate/Million BTU of Actual Heat Input
3. Sulfur Standard
   1.20 Lbs SO_2/Million BTU of Actual Heat Input
4. Carbon Monoxide Emission Standard
   200 PPM (Corrected to 50% Excess Air)
5. Nitrogen Oxides Emission Standard
   0.70 Lbs NO_x/Million BTU of Actual Heat Input

NOTE: The above is predicated on a boiler size greater than 250 Million BTU/hr.

2. State of the Technology

It is generally considered that methods and equipment are now available for particulate removal from most gaseous effluents. However, now with the increased interest in pollution from other contaminants, particularly SO_2 removal from stack gases, new methods are being considered for dust control in conjunction with gas pollution control. Wet scrubbing systems for SO_2 removal are also capable of particulate removal although they impose higher pressure drop on the flue gases when designed to perform both functions, than when used with an electrostatic precipitator.

At the present time, there are no full-scale "commercially proven" methods for SO_2 removal from stack gases. However, due to the tremendously expanded interest in emission control of all kinds, particularly of SO_2 gases, numerous processes are being developed at this time. Several large, experimental pilot plant installations are being installed for testing and evaluation purposes for stack gas cleaning in power plants. Similar work is being done in other industrial plants such as refineries, sulfuric acid manufacturing, and the metal ore smelting industries. A large number of other new technologies are still in the design stage. Results of some of the early large test work will become available during 1972.

B. Methods of Air Pollution Control

1. Particulate Removal

System design and equipment required for particulate removal from gaseous effluents is well understood and offers few problems in reaching removal efficiencies in excess of 99% (by weight). Electrostatic precipitators and/or scrubbers, properly sized,will meet any reasonable criteria set by EPA and/or the State of Illinois.

2. SO_2 Removal

With the present state of the technology for SO_2 removal, there are two principal methods that are currently being considered by many industrial and utility plants. These are:

1. Recovery Methods (Systems for the Recovery and/or Production of):
   a. Elemental Sulfur
   b. Sulfuric Acid

2. Throw-away Methods (Systems which require disposal of a by-product called gypsum, or spoil):
   a. Lime Slurry Scrubbing
   b. Limestone Slurry Scrubbing

In general, recovery systems require high capital costs. This can be offset somewhat by the sale of the sulfur or sulfuric acid produced. However, the

market price of sulfur is not presently economically attractive, and this situation is not expected to improve. In addition, freight rates may contribute to the marginal profitability of the sale of the sulfur or sulfuric acid.

One big advantage of the recovery methods, however, is the minimizing of the solids or by-product gypsum which must be hauled away, or removed to a nearby land fill. Thus, both material handling and real estate costs are minimized with recovery methods. Despite this advantage of recovery systems, however, it is believed that the throw-away methods portend to be the best overall system in view of present-day technology. These methods involve lower capital cost, lower operating costs, and are feasible for plants located in less populated areas, and where nearby land fill is available.

For the throw-away method, there are two principal raw materials available for effecting the gas-liquid reaction - these are lime slurry or limestone slurry for use in a gas scrubbing system. Removal efficiencies well above 90% can be obtained with lime slurry and removal up to 90% is possible with limestone slurry. Although lime is more effective and smaller quantities are required, the cost is high - i.e.,

on the order of $20 per ton, delivered. In contrast, limestone is quite generally available and delivered costs range from $4 to $12 per ton. For comparative purposes, and for these percentages of SO_2 removal, operating costs of a limestone scrubbing system are approximately 50% of a lime system. Capital costs are essentially equal.

3. Description of Operation

A. Typical Limestone Slurry Scrubbing System

A typical limestone slurry scrubbing system is shown in Figure 1, attached.

The gas, which may consist of any combination of power plant flue gas, and incinerated Claus tail gas enters the cooling section of the scrubber. Here the gas is brought to an adiabatic saturation temperature (which normally ranges from 115°F to 135°F). Fly ash is also removed in this cooling process, which is done by spraying with recycle liquor and fresh water.

The saturated gas then enters the absorption section of the scrubber, in which the SO_2 content of the gas is reduced. The main reaction taking place in the absorption section of the scrubber is as follows:

$$2CaCO_3 + 2SO_2 + 2H_2O \longrightarrow Ca(HSO_3)_2 + Ca(HCO_3)_2$$

A stoichiometric excess of 50-60% limestone is assumed.

A secondary reaction which may take place is:

$$CaSO_3 + \tfrac{1}{2}O_2 \longrightarrow CaSO_4$$

The extent of this reaction will range from 10-50% of the $CaSO_4$ produced.

This reaction has no effect on the SO_2 removal, however, the $CaSO_4$ may cause scaling problems. In order to prevent this scaling, the slurry concentration in the scrubber recycle stream is kept to 5-10% and provides sufficient seeding of the supersaturated solution of $CaSO_4$ that may be formed in the scrubber. The desupersaturation of the $CaSO_4$ solution occurs in the recycle tank.

The effluent slurry flows to the thickener, or settling pond.

The thickener underflow, which contains 30% solids is pumped to a vacuum filter in which filter cake containing 60% solids is formed, and then sent to disposal. The moisture contained in the filter cake is normally sufficient blow-down for the entire system, and no additional liquid purge is necessary.

The thickener overflow is returned to the scrubbing system.

B. Scrubbing System for Demonstration Plant

A limestone slurry scrubbing system is proposed for the effluent gases of Units 4100 and 4300.

It is not practical to send the gases to be treated to a central scrubbing system. Therefore, a common central location, Unit 4400, for receipt, storage and processing of the limestone raw material seems more economically attractive, with the scrubbers located near the gas source. Auxiliary equipment such as grinding equipment, mixing tanks, makeup tanks, pumps, etc. for slurry preparation and handling, as well as facilities for the disposal of the by-product gypsum or spoil, will be located at this central location.

The system is shown schematically in Figure 2, attached.

The system for the Demonstration Plant will require approximately:

Limestone - 22 Tons/Hr, 93% limestone

Makeup water required = 320 GPM

The gypsum, or spoil, for disposal from the system ($CaSO_3 \times 2H_2O$, $CaSO_4 \times 2H_2O$, $CaCO_3$, etc.) - and moisture will amount to 53 Tons/Hr.

UNIT 4500 - FOUL WATER DISPOSAL

1. SCOPE

This unit covers the waste treatment requirements for the several liquid effluents from the Demonstration Plant which cannot be released directly to natural waterways, due to water pollution standards. These liquid effluents, and the facilities required for their treatment, are as follows. The various liquid effluents and treating systems are shown on Figures 1, 2, and 3, attached.

a. Unit 5300 - Cooling Tower Blowdown

Approximately 800 GPM is discharged from the cooling towers as a control for dissolved solids build-up. Dissolved solids concentration (magnesium and calcium salts, and silica) is estimated at 1000 PPM.

Where a chromate corrosion inhibitor is used in conjunction with cooling tower water conditioning, then a chrome treatment facility is required. This facility will reduce hexavalent chrome (estimated at 20 mg/l) to tri-valent chrome and precipitate out a chromic hydroxide by the addition of lime. Hexavalent and tri-valent chrome must be removed prior to discharge to a natural waterway, and cannot be discharged to the biological treatment system due to the toxic effect of chrome on the biological population. The total cooling tower blowdown of 800 GPM

is treated to prevent contamination of surface and ground water with chrome.

A portion of the treated cooling tower blowdown is used in the limestone slurry system, Unit 4400. The remainder of the treated blowdown will be discharged with the final effluent of the biological system.

b. Unit 1300 - Coal Pretreatment Off-Gas Condensate

Approximately 47 GPM of condensate (containing no pollutants) is produced, all of which is used in the limestone slurry system.

c. Unit 1600 - Char Recovery Centrifuge Centrate

Approximately 495 GPM of highly contaminated wastewater is discharged from these centrifuges. This wastewater contains high concentrations of ammonia, hydrogen sulfide and various hydrocarbons. (Approx. composition: NH_3-1654 mg/l, H_2S-368 mg/l, Benzene-210 mg/l, Toluene-155 mg/l, Naphtha-40 mg/l, Phenol-10 mg/l, Creosol-0.3 mg/l, Oils-21 mg/l, and suspended solids-30 mg/l.)

Stripping of the ammonia and hydrogen sulfide is required to reduce the concentrations of these contaminants to 100 PPM each, so as to render the remaining concentration amenable to economical and efficient biological treatment.

d. Unit 3500 - Ammonia Separation (PHOSAM) Stripper Bottoms

Approximately 38 GPM of highly contaminated wastewater is discharged from the ammonia stripper. This wastewater is high in ammonia (approximately 954 mg/l) and caustic (NaOH) (approximately 1496 mg/l) and must be stripped further prior to subsequent biological treatment. The caustic content will aid in the stripping of ammonia. This wastewater will be combined with the centrate from char recovery prior to stripping.

e. Units 2600 & 3600 - (Rectisol) Methanol Separator Bottoms

Approximately 0.2 GPM (with approximately 100 mg/l Methanol) will be discharged from these units at a pH of approximately 6-6.5. This discharge will be combined with the bottoms from the ammonia stripper (approximately 533 GPM) for subsequent treatment in the biological treatment system.

f. Unit 5200 - Power Plant Water Treatment Regeneration and Backwash Water Discharges

Approximately 36,000 gallons of regeneration water will be discharged from the power plant water treatment facilities once each day. This discharge will take place over a time interval of one (1) hour (average discharge rate = 600 GPM) and will be collected in a holding tank which will also collect the

water softener backwash water. The contents of this tank will then be pumped out at a controlled rate, to be combined with the ammonia stripper bottoms prior to biological treatment. Approximately 168,000 gallons of water softener backwash water will be discharged to the above sump three times per day. The duration of this discharge will also be approximately one hour (average discharge rate = 2800 GPM). The total combined discharge from the sump will be approximately 570 GPM which will allow for increases in volumes or frequency of occurrence for the above discharges. Total dissolved solids content of this stream is estimated at 1000 PPM.

g. Process Units and Boiler Steam Blowdown

A total of approximately 206 GPM will be discharged from various steam generating facilities in the plant. These waters will contain dissolved solids and be at elevated temperatures. (Dissolved solids content of these streams are approximately: Process Units Steam B. D.-4000 PPM; EG Boiler B. D.-3000 PPM; and H. P. Process Boiler B. D.-2000 PPM.)

These discharges will combine with the final effluent of the biological system prior to discharge to a natural waterway.

2. REGULATORY AGENCY STANDARDS

The design of the Foul Water Disposal System, Unit 4500, will be required to meet the standards of the State of Illinois.

These standards are covered in a publication entitled, "TECHNICAL RELEASE 20-22" - Second Edition (Revised April 1, 1968) of the Illinois Pollution Control Board. These standards cover Sewage and Industrial Waste Treatment, Requirements and Effluent Criteria.

The complete standards are too lengthy to be included in this report, however, certain excerpts are included below to illustrate the nature of these requirements.

Technical Release 20-22 - Second Edition

Revised April 1, 1968.

INDUSTRIAL WASTE TREATMENT

1. All industrial facilities for treatment of deoxygenating waste shall provide at least secondary biological treatment, or advanced waste treatment adequate to reduce the organic pollution load of the treatment works effluent at the final treatment structure to a maximum of 40 mg/l of five-day BOD and 45 mg/l suspended solids, or less. (Guide lines to limit of ranges are noted below). Final treatment structure may be considered to be the last point of access before discharge to waters

of the State. This would permit the use of non-polluted industrial water for dilution after waste treatment. Effluents shall meet all criteria expressed in item 2.

2. All facilities for the treatment of municipal wastes, industrial wastes or other wastes shall provide for the following:

   a) Substantially complete removal of settleable solids and removal of suspended solids to a maximum effluent content of 45 mg/l.

   b) Removal of floating debris, oil, grease, scum or sludge solids.

   c) Removal of color, odor or turbidity to below obvious levels.

   d) Removal of heavy metals or toxic and odor-producing substances in accordance with the minimum levels listed below.

CHEMICAL CONSTITUENTS

Effluents as discharged to waters of the State are not to exceed the following specific concentration at any time: (More restrictive limits may be imposed by the Sanitary Water Board for all or portions of specific streams or for specific discharges).

Constituent	Concentration mg/l
Ammonia Nitrogen (N) Not to increase stream content	2.5
*Arsenic	1.0
*Barium	5.0
*Cadmium	0.05
*Chromium-Hexavalent (Chromate or Dichromate)	0.05
*Chromium-Trivalent (Chromic or Chromite)	1.0
*Copper	0.1
Cyanide Reduced at least to Cyanate and approach zero as CN.	0.025
Iron (Total) Free of color, floating or suspended iron.	10.0
*Lead	0.1
Nickel	2.0
Nitrate (as NO_3)	45.0
Oil Substantially free of visible floating oil and not to exceed	15.0
pH 6.0 - 10.0	
Phenols	0.2
*Selenium	0.01
*Silver	0.05
*Zinc	1.0

*Heavy Metals

Dissolved solids added to water supply: Not to exceed 750 mg/l as a monthly average value, nor 1000 mg/l at any time.

STORAGE FACILITIES

Storage facilities for materials which are hazardous to health and welfare, and for oils, gases, fuels or other materials capable of causing water pollution, if accidentally discharged, shall be located so as to minimize or prevent any spillage which might result in water pollution. Engineering measures to entrap spillage, such as catchment areas, relief vessels, or entrapment-dikes,

should be installed at existing facilities and shall be installed at all new facilities so as to prevent accidental pollution of water, and shall be required following any such occurrence of pollution of water.

GUIDELINES REGARDING RANGE OF TREATMENT

Hereafter, secondary treatment is required on the Mississippi, Ohio, and Wabash Rivers. Secondary treatment resulting in effluents ranging from 20 to 30 mg/l five-day BOD and 25 to 35 mg/l suspended solids is acceptable on the Illinois River and lower Des Plaines River. Tertiary (or other advance treatment) or modifications of conventional treatment will be specified for all intermittent streams and small or low flow streams.

Permissive Treatment & Effluent Requirements
Based on Average Strength Municipal Wastes

Type Treatment	BOD Reduction	Effluent BOD	Effluent Suspended Solids	Type Facilities	Stream Requirements
Secondary	80%	40 mg/l	45 mg/l	Biological	Lake Michigan, Mississipi & Ohio Rivers
Secondary	85%	30 mg/l	35 mg/l	Trickling Filter	Illinois and lower Des Plaines Rivers
Secondary	90%	20 mg/l	25 mg/l	*	2 to 1 dilution
* Activated Sludge (or trickling filter & supplemental treatment)					
Tertiary	95%	10 mg/l	13 mg/l	Secondary + Supplemental	1 to 1 dilution
Advanced	98%	4 mg/l.	5 mg/l	Series Units	Less than 1 to 1 dilution

Disinfection with up to 1 mg/l of chlorine residual in the final effluent discharged to the stream to reduce coliform to 5000/100ml or less, or reduce fecal coliform to 400/100ml in primary contact recreation areas or to 2000/100ml in secondary contact recreation areas.

Bypass flows in excess of waste treatment works capacity shall be given primary treatment, and chlorination in auxiliary facilities.

INDUSTRIAL RESIDUE

Waterborne industrial residues generally require treatment before discharge to a watercourse. This may include cooling water and boiler blowdown water. A review of treatment method and design of facilities by the Illinois Sanitary Water Board, and a PERMIT for the construction or use of any new or expanded waste treatment works or use of any new outlet for the discharge of any wastes directly into the waters of the State, is required by the Sanitary Water Board Act (Chap. 19, Para. 145.11, 111. Rev. Stat.). A PERMIT is also required for increase in the discharge of wastes directly into the waters of the State.

Policy, under the Act, is to provide that no waste be discharged into any waters of the State without first being given the degree of treatment necessary to prevent

the pollution of such waters. Because of the diverse nature of industrial waterborne residue, each proposed installation has been considered on its own merit with regard to the nature and strength of the waste and the use and capacity of the receiving waters of the State. In general, this will continue to be the case and conferences with the Sanitary Water Board staff are desirable during the planning and design phases of waste reduction or treatment facilities. Certain basic parameters or criteria have been followed by the staff over the years. Many of these were discussed at conferences and in correspondence, while a few have been incorporated into Technical Releases. These include TR 20-11, Basic Industrial Waste Disposal Requirements; TR 20-12, Mine Drainage Control Measures; TR 20-18, Basic Waste Disposal Requirements for Des Plaines, DuPage, Fox, Kankakee and Rock Rivers; TR 20-19, Rules and Regulations Regarding Cyanide; TR 20-20, Basic Waste Disposal Requirements for Illinois River; TR 20-21, Water Works Effluents; and TR 20-23, Bioassays.

3. DESCRIPTION OF TREATMENT PROCESSES

a. Ammonia Stripper

Approximately 533 GPM of high NH_3 content wastewater will be stripped in the ammonia stripper (to 100 PPM NH_3) using 50 PSIG steam. The stripper bottoms will undergo subsequent treatment in the aerated lagoon and biological treatment system. (The additional ammonia stripping could be done in Unit 3500, the source of this stream. However, for purposes of this study it has been included in Unit 4500.)

b. Aerated Lagoon

This lagoon is designed to treat approximately 1.6 million gallons per day (1104 GPM) with a detention time of approximately two days. The lagoon volume is 3.2 million gallons and has an area of approximately one acre. The lagoon will have a water depth of approximately 10', which will permit the use of floating aerators. Approximately three (3) floating aerators are required to aerate the water for cooling purposes and to raise the dissolved oxygen content for biological treatment.

c. Biological Treatment System

This system is a two-stage activated sludge system using an enriched oxygen atmosphere. The first stage removes H_2S and BOD_5 (biochemical oxygen demand - organic material). The second stage removes NH_3. The H_2S is converted to sulphites and/or sulphates,

organic material is converted to biological cell mass, water and CO_2 and the NH_3 is converted to nitrates. The only difference between this system and a conventional activated sludge system is the use of oxygen instead of air, the covering of the activated sludge tanks and the internal partitioning of the activated sludge tanks. Wasted sludge will be oxidized in aerobic digestion tanks using the waste gas from the activated sludge tanks.

4. FUTURE RECIRCULATION SYSTEM

It is possible that at some future date it would be desirable for the treated effluent to be recycled back to the plant water supply. Normally, the volume of treated wastewater to be recycled would be approximately 31% of the total average water demand. The recycle ratio of treated wastewater to intake water supply required to meet the average demand would be approximately 1:2 (1700 GPM of treated wastewater to 3700 GPM of intake water to satisfy approximately a 5400 GPM average demand).

Exactly how much wastewater would require treatment, and the degree of treatment required would depend on the intended use for the treated water.

UNIT 4700 - SPENT CATALYST DISPOSAL

1. SCOPE

Under this unit number, previously assigned for the Phase I report, are the equipment necessary for disposal of spent catalysts from Units 2400 (Shift) and 2800 (Methanation), and spent reagent from Unit 2700 (Sulfur Cleanup Guard Beds).

It now seems unnecessary that a special unit number was assigned to this function, since no special capital equipment is required for this purpose. The job of disposing of spent catalyst will be done every one or two years, as required, during the annual turnaround, using otherwise idle trucks and manpower.

It is assumed these wastes can be dumped along with the much larger quantities of ash from the power plant, Unit 5100, and gypsum from the limestone slurry scrubbing system, Unit 4400.

2. DESIGN CONDITIONS

a. Shift Conversion Fore-bed. (Unit 2400)
Once-per-year replacement.

b. Shift Conversion After-bed. (Unit 2400)
Biennial replacement.

c. Guard Chamber Beds (Unit 2700)

Zinc Oxide replaced and regenerated by seller at his plantsite once every two years.

d. Methanation Catalyst (Unit 2800)

Predictions as to catalyst life are very uncertain, but for purposes of this report Stage I is assumed to be replaced annually, and the other three stages biennially.

The grand total amounts to approximately 60 tons per year of spent catalyst which must be disposed of. This is negligible compared with the 1000 tons per day of gypsum and a minimum of 600 tons per day of ash, which must be disposed of.

UNIT 4800 - ASH HANDLING

1. SCOPE

(Note: This ash handling system is designed for the large boiler serving the "EG" unit and for the high pressure process steam boiler.)

The ash handling system continuously collects and stores the furnace bottom ash in a water filled slag tank located under each boiler furnace. The stored slag is then periodically sluiced to a dewatering bin.

This system is essentially a closed loop, recirculating type system which minimizes the consumption of water.

Periodically the collected ash is discharged from the slag tanks and the ash and water slurry is pumped to one of the two dewatering bins which may be located up to several thousand feet from the power plant.

After conveying, water is drained from the ash in the dewatering bin, and commercially dry slag ash is then discharged to trucks or railroad cars for disposal by return to the nearby mine. While the dewatering bin is being dewatered, and then emptied of ash, ash from the slag tanks is conveyed to the other dewatering bin.

Fly ash will be collected in the boiler dust collectors, and electrostatic precipitators, and conveyed to a dry storage bin for disposal. Or, fly ash might be collected in the stack gas scrubbing system, Unit 4400, used for SO_2 removal.

2. DESIGN CONDITIONS

The sizing of equipment and the system arrangement is based on the following design conditions and assumptions:

a. The power plant for the Demonstration Plant will utilize one (1) large, slagging type boiler for furnishing the steam for electric power generation for the "EG" unit, and (1) high pressure boiler for furnishing process steam.

b. Total ash produced is estimated at approximately 26 T/HR, or 624 T/Day. Required conveyor capacity from each slag tank will be approximately 80 T/HR, and ash will be discharged sequentially from each tank. Total conveying time will be approximately 8-hours per day, 4-hours from each slag tank.

3. PROCESS FLOW DESCRIPTION

The system is shown on Figure 1, attached. Following is a brief description of the operation:

The slag tanks are floor mounted beneath the boiler, and a pressure seal which allows movement between the boiler and slag tank is accomplished with a water filled seal trough for the slag neck connections fastened to the lower part of the furnace. Molten ash discharges into the slag tanks from the furnace bottom in a continuous stream.

The water filled slag tank is furnished with a maintained level control. High pressure agitating jets continuously agitate the water surface at the point of molten ash entry into the water. Thermal shock and the water agitation cause the molten ash to fracture and solidify into slag particles. The slag is collected in the tank until periodically discharged.

A continuous recirculation pump furnishes water make-up to the slag neck water seal trough, and the slag tank water level controls.

A separate booster pump furnishes water at 100 PSIG for the continuously operating high pressure agitating jets.

The water introduced into the slag tank during non-conveying periods overflows the tank into a sump pit, from which pumps circulate it back into the settling tank.

The settling tank and surge tank are designed to promote the settlement of fines, which collect in the tank bottoms and are periodically removed with sludge pumps to the dewatering bins.

At periodic intervals, probably once a day, the collected slag is emptied from the slag tanks, and the ash water slurry is pumped to one of the dewatering bins, as pre-selected. The slag is discharged through a hydraulically operated gate in the bottom of the slag tank, through a power driven clinker grinder, and into the suction piping of the ash sluice pump. The conveyor recirculating pump is used during the conveying operation.

The ash deposited in the dewatering bin settles to the bottom, and the conveying water overflows, with a minimum of slag carryover, into the settling tank, and then into the surge tank. These tanks are large enough so that the water velocities are low, and allow settling-out of any fines carried out of the dewatering bin.

Ash is conveyed into one bin for a day, and in the meantime, the other bin is first dewatered, and then the commercially dry ash is loaded into trucks or railroad cars for disposal. Dewatering requires several hours, as the discharge velocity must be kept low to prevent carryover of slag particles.

Unloading the slag requires several hours, depending on the size of the disposal vehicles and the speed with which they can be moved in and out.

CUSTOMER: INSTITUTE OF GAS TECHNOLOGY

MASTER ITEM INDEX
UNIT 4800
ASH HANDLING

PROJECT W-1843
DATE 3/1/72
DATE

ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT/#	REMARKS
48.08-01A,B		2-CONVEYOR RECIRCULATING PUMP	2700 GPM EA Δ P=40 PSI					1-SPARE
		WITH MOTOR	100 HP					
48.08-02A,B.		2-CONTINUOUS RECIRCULATING PUMP	700 GPM EA Δ P=40 PSI					1-SPARE
		WITH MOTOR	25 HP					
48.08-03A,B		2-SLUDGE PUMPS	300 GPM EA Δ P=60 PSI					1-SPARE
		WITH MOTOR	20 HP					
48.08-04A,B		2-BOOSTER PUMPS	300 GPM EA Δ P=60 PSI					1-SPARE
		WITH MOTOR	20 HP					
48.08-05A-D		4-ASH PUMPS	2600 GPM EA Δ P=50 PSI					2-SPARE
		WITH MOTOR						
48.08-06A-D		4-SUMP PUMPS	1000 GPM EA Δ P=40 PSI					2-SPARE
		WITH MOTOR	40 HP					

MASTER ITEM INDEX

CUSTOMER: INSTITUTE OF GAS TECHNOLOGY

UNIT 4800
ASH HANDLING

PROJECT W-1843
DATE 3/1/72
DATE

ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT. #	REMARKS
48-33.01A,B		2-SLAG TANKS, WITH WATER						
		SEAL TROUGH, HP AGITATING JETS						20 HP TOTAL
		ASH DISCHARGE GATES,						
		CLINKER GRINDER & ACCESSORIES						
48.33-02A,B		2-DEWATERING BINS						
		WITH OVERFLOW BOXES						
		ASH DISCHARGE GATE,						
		DEWATERING ELEMENTS						
		& ACCESSORIES						
48.33-03		1-30' DIAMETER SETTLING TANK						
48.33-04		1-40' DIAMETER SURGE TANK						

UNITS 5100, 5200, 5300 - WATER & STEAM UTILITIES

1. SCOPE

These units cover the power plant, water treatment, and cooling tower requirements for the Demonstration Plant. The basic design described for the plant includes an "in-plant" boiler-turbine-generator set of 110,000 KW net capacity, for furnishing the electrical requirements for the Electrothermal Gasifier (EG) unit of the main coal gasification reactor.

Purchased power has been assumed for other plant requirements. Process steam is furnished from a separate high pressure boiler.

In the event the plant location requires generation of "in-plant" electric power for all plant requirements, a second turbine-generator set, of approximately 40,000 KW capacity, will be required for operating and plant start-up requirements.

2. DESICN CONDITIONS

A. Design Basis

The design basis for the supply of electrical energy to the HYGAS Demonstration Plant is two-fold, namely:

1. Electric power for the EG Section of the main gasification reactor (15.06-01) will be furnished from an "in-plant" boiler-turbine-generator utilizing spent reactor char as primary fuel, pretreater "off-gas" from Unit 1300 as a

secondary fuel, and supplementary coal as required.

(Note: Final determination as to the feasibility of using the low BTU pretreater "off-gas" as boiler fuel, together with spent char, remains to be confirmed.)

An estimated 116 MW capacity is required for the EG Section, including associated auxiliaries and controls.

2. All other electric power requirements for Process Plant drivers and off-site equipment is supplied from an outside source (purchased power.)

The "in-plant" electric generation system consists of a superheat-reheat type steam boiler-turbine-generator operating at 1800 PSIG, 1000°F/1000°F, steam conditions, and 3.5" Hg. turbine exhaust pressure.

The system is designed to utilize available heat from the process units for feedwater heating, in order to provide increased plant efficiency. Additional work is required for the design presented in this report, to maximize such process heat availability. Of course, an economic balance must be achieved between

additional plant capital investment, and the utilization of low level process heat available for this purpose. Except for boiler feedwater, blowdown, residual process heat absorption and emergency power requirements, the "in-plant" electrical generation unit will be operated as an isolated power generating unit solely for supplying the requirements of the EG section.

As an alternate to the above, and if purchased power is not available, "in-plant" generation of process and off-site electrical energy requirements will be required. However, this alternative is not covered in this study. The purchased power requirement is estimated at approximately 40,000 KW.

B. BOILER FOR PLANT STEAM REQUIREMENTS

Plant process steam is generated in a separate H. P. process boiler to supply requirements for both 1250 PSIG 1000° superheated, and 1250 PSIG saturated steam. The operating capacity for this boiler is estimated at 400,000 pounds per hour of which 110,000 pounds per hour will be saturated steam. However, since the saturated steam produced supplements steam generated in the main reactor water jacket, this boiler is sized for additional steaming capacity for start-up conditions of 500,000 Lb/Hr.

C. WATER SUPPLY & WATER TREATMENT

Inasmuch as a site has not been selected, data regarding the quality of the local water supply is not available. As a result, specific water conditioning and water treatment requirements cannot be specified. It has been assumed that feedwater for the high pressure boilers should be high quality demineralized and deionized water. Softened water will be supplied to the low pressure (250 lb. and lower) process steam generators, and for cooling tower makeup. On this basis, the estimated demineralized (deionized) water requirement is 1130 GPM and the estimated softened water is 4100 GPM. Allowances for demineralizer and water softener regeneration, backwash, and rinse increase the utility and process units water supply to an estimated requirement of 5653 GPM. This figure indicates that a water supply of approximately 5700-6000 GPM is needed for the Demonstration Plant, considering the additional requirements for personnel, sanitary facilities and fire protection.

Since specific information on water supply is not available, it has been assumed that cold (70°F or less), clean water will be available to the Battery Limits at a nominal pressure of 35 PSIG. Requirements for developing this water source, water pretreatment and clarification, treatment for potability, etc., are not included in this report.

Since the "in-plant" electric generating boiler turbine-generator is essentially "self-contained", high quality demineralized water is supplied to the turbine condenser for makeup and will be deaerated and heated along with the condensate returned to the 1800 PSIG boiler. Demineralized boiler feedwater to the 1250 PSIG process steam boiler will be deaerated and heated in a separate deaerator. The latter will be supplied with "clean" 50 PSIG steam which is generated in a selected process heat exchanger (Unit 2800) using demineralized boiler feedwater as makeup.

A separate deaerator is provided to supply makeup water to low pressure (250 PSIG, 105 PSIG, and 50 PSIG) steam generators in the process units. Water to these systems is softened and suitably treated for low pressure steam generation. Softened water is also supplied to cooling towers for makeup.

D. PROCESS STEAM GENERATION

1. 1250 PSIG STEAM

Saturated, 1250 PSIG steam will be generated in the main reactor water jacket (Unit 1500) to provide reactor cooling, and this will also supply process steam requirements for Units 1600, 2400, 2800, and 2900. However, since the steam requirements for the process units exceed the generating capacity of the reactor, 1250 PSIG steam, saturated

and at 1000°F will be generated in an H. P. process boiler to supplement the steam produced at the reactor.

2. 600 PSIG STEAM

Unit 2900 requires 600 PSIG saturated steam for reboiler service. Steam for this requirement is provided via a pressure-reducing station from the saturated 1250 PSIG process steam supply.

3. 250 PSIG STEAM

Process waste heat recovery exchangers at the various units are designed to generate 250 PSIG (normal pressure) steam, some of which will be superheated approximately 50°F in the Coal Pretreater Reactor, in Unit 1300. This 250 PSIG, 456°F plant steam supply will be used for miscellaneous turbine drives and exhaust either to a 50 PSIG plant header or to condensers.

4. 50 PSIG STEAM

Steam requirements for the boiler feedwater deaerators is supplied from the 50 PSIG system.

For the H. P. process boiler feedwater deaerator, 50 PSIG steam will be recovered from flash drums provided from blowdown of the steam generators supplied with deionized boiler feedwater. Residual blowdown enroute to waste recovery from H. P. generation is exchanged with boiler feedwater for maximum heat conservation.

The deaerator for the 250 PSIG steam generator's boiler feedwater is supplied from the 50 PSIG, saturated steam header. A suitable selection of turbine drivers operating between 50 PSIG (saturated) and condensing (8" Hg.) has been made in order to effect a steam balance for the 50 PSIG system.

E. CONDENSATE

Suitable condensate recovery systems will be provided for the maximum practical recovery of heat and the conservation of water.

F. COOLING WATER

Water cooling towers have been provided in this study for (1); the EG "in-plant" steam generator condenser and (2); for process units as follows:

EG Unit - 70,000 GPM

Process Units - 39,500 GPM

Cold water design temperature is 85°F with hot water return temperature at 115°F, for a 30°F range. The cooling towers are envisaged as separate units, for possible advantageous location relative to the units being served, and also because the ultimate operating conditions for the EG Unit may require adjustment for circulating capacity and range. It is possible that the cooling water capacity could be accommodated with a single combined larger cooling tower; on the other hand,

the development of a large storage lake for water supply might economically favor the circulation of lake water for the EG Unit condenser, in which case a cooling tower for this service would not be needed. Obviously, the resources and development of the selected site will have considerable influence on water treatment and cooling tower requirements.

Softened water is supplied to the cooling towers as makeup; cooling tower blowdown is directed to the limestone slurry facilities, Unit 4400, and/or to the foul water disposal system, Unit 4500.

3. DESCRIPTION OF OPERATION

A. A tabulation of steam and water requirements, by units, is shown in Tables 1, 2, 3, 4, and 5 attached.

B. An overall steam and water block flow diagram is shown on Process Flow Diagram #1843-51.00-1G.

C. A tabulation of plant electrical requirements is shown in Table 6, attached.

TABLE 1

STEAM GENERATION & CONSUMPTION - LBS/HR

1250 PSIG STEAM

UNIT	GENERATED		CONSUMPTION	
	Sat.	1000°F.	Sat.	1000°F.
1100,1200				
1300				
1400				
1500	99,200			289,210
1600			23,850	
2100				
2400			146,540	
2500				
2600				
2700				
2800			32,000 (Start-up)	
2900			2,400 (At 600 PSIG)	
3100				
3200				
3500				
3600				
To 250 PSIG System			36,340	
H. P. Boiler Unit 5100 -	109,930	289,210		
Total	209,130	289,210	209,130	289,210

TABLE 2

STEAM GENERATION & CONSUMPTION - LBS/HR

250 PSIG STEAM

UNIT	GENERATED		CONSUMPTION	
	Sat.	456°F	Sat.	456°F
1100,1200				
1300	290,240	327,400		65,600
1400			24,150	
1500				
1600				
2100				64,000
2400				
2500				
2600				
2700				
2800	147,700			60,000
2900				
3100				
3200	15,840			14,000
3500			25,640	
3600			18,100	(At 100 PSIG)
5600				91,700
From 1250 PSIG System		36,340		
To Superheater (-)	327,400			
To 50 PSIG System				68,440
To Utility Area			58,490	
Total	126,380	363,740	126,380	363,740

TABLE 3

STEAM GENERATION & CONSUMPTION - LBS/HR

100 PSIG STEAM

UNIT	GENERATED	CONSUMPTION
	Sat.	Sat.
1100,1200		
1300		
1400		93,100
1500		
1600		
2100	93,100	
2400		
2500		
2600		
2700		
2800		
2900		
3100		
3200		
3500		
3600		
Total	93,100	93,100

TABLE 4

STEAM GENERATION & CONSUMPTION - LBS/HR

50 PSIG STEAM

UNIT	GENERATED		CONSUMPTION	
	Sat.	Exh.	Sat.	Exh.
1100,1200				
1300		65,600	400	180,000
1400	7,790			
1500				
1600				
2100		64,000		
2400	69,730			
2500				
2600				
2700				
2800	31,000	60,000		
2900	540			
3100			17,560	
3200	7,000	14,000		
3500			30,000	
3600	830		30,500	
From 250 PSIG System		68,440		
50 PSIG Steam to Process	92,040	(-) 92,040		
From Utility Area	5,200			
	18,900			
To Utility Area			135,470	
Utility Steam			19,100	
Total	233,030	180,000	233,030	180,000

TABLE 5

CONDENSATE TO COLLECTION SYSTEM - LBS/HR

	Lbs/Hr	Temp-°F
1100,1200		
1300	180,000	150
	400	298
1400	109,460	298
1500		
1600		
2100		
2400		
2500		
2600		
2700		
2800		
2900	1,860	298
3100	17,560	298
3200		
3500		
3600	47,770	298
5600	91,700	110
From Utility Area	108,920	180
Total	557,670	

TABLE 6

ESTIMATED ELECTRIC POWER REQUIREMENTS

(*EXCEPT FOR EG UNIT POWER SUPPLY)

		Normal KW	Connected KVA
1.	PROCESS DRIVERS (Units: 1100-1600, 2100 2400-2900, 3100,3200, 3500,3600)	11,830	20,510
2.	UTILITY AREA DRIVERS (Units: 5100*, 5200, 4500, 4800, 7100)	9,040	11,020
3.	LIGHTING (Units: All above, Buildings, & Offsites)	670	890
	Total	21,540	32,420

UNIT 5600 - REFRIGERATION UNIT

1. SCOPE

This unit supplies the refrigeration requirements for Units 2500, 2600 and 3600 using ammonia as the refrigerant. The major equipment consists of a low stage and a high stage compressor, a refrigerant, a desuperheater vessel, and a refrigerant receiver.

2. DESIGN CONDITIONS

The unit is designed to deliver 1,500 tons of refrigeration at -50°F to Units 2600 and 3600, and 900 tons of refrigeration at +60°F to Unit 2500.

3. PROCESS FLOW DESCRIPTION

The system is shown on Process Flow Diagram #1843-56.00-1G. Ammonia vapor from Units 2600 and 3600 enters the suction side of the low stage compressor. The compressor discharge is desuperheated by contacting it with a low temperature ammonia stream in the desuperheater vessel. Liquid from the vessel is sent to Units 2600 and 3600. The vapor from the vessel is combined with the ammonia vapor from Unit 2500 and fed to the high stage refrigerant compressor. The compressor discharge is condensed and enters the refrigerant receiver. Liquid ammonia from the receiver is sent to Unit 2500 and the desuperheater vessel.

CUSTOMER : INSTITUTE OF GAS TECHNOLOGY

MASTER ITEM INDEX
UNIT 5600
REFRIGERATION UNIT

PROJECT W-1843
DATE 3/1/72
DATE _____

ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT. #	REMARKS
56.06-01		REFRIGERANT DESUPERHEATER VESSEL	6' 0" Ø X 15' 0"	HORIZONTAL				
56.06-02		REFRIGERANT RECEIVER	7' 6" Ø X 18' TT	HORIZONTAL				
56.09-01		LOW STAGE REFRIGERANT COMPRESSOR	12,000 SCFM @-50°F SUCT:7.0 PSIA DISCH:48.5 PSIA					
56.09-02		HIGH STAGE REFRIGERANT COMPRESSOR	18,075 SCFM @ 33°F @ 46.1 PSIA 8,260 SCFM @ 60°F @ 107.6 PSIA DISCH:252 PSIA					
56.092-01		COMMON STEAM TURBINE DRIVE W/SPEED REDUCER	7000 HP					250 PSIG,456°F.STM. 3" HG.ABS.EXH.PRESS. DRIVE FOR ITEMS 56.09-01 & 56.09-02
56.07-51		STEAM CONDENSER						
56.07-52		REFRIGERANT CONDENSER	45 MM BTU/HR 20,600 FT^2					

8-A244

UNIT 5700 - INERT GAS GENERATOR

1. SCOPE

This system is a packaged inert gas generation unit designed to produce an inert gas by the combustion of product pipeline gas, or sweet gas from Unit 2700 with air. The major pieces of equipment will be the inert gas generator, two gas compressors, two drying units (dessicant type), and two receivers.

2. DESIGN CONDITIONS

The inert gas generator will be designed to furnish a maximum flow of 2100 SCFM, by the combustion of pipeline gas, or inert gas from Unit 2700, with air. Fuel gas required will be 14,600 SCFH. After cooling, the gas will be compressed in separate compressors, dried, and then stored. Inert gas will be supplied to the plant at 100 PSIG, and at 1250 PSIG. The inert gas will have an oxygen content of approximately 500 PPM. Cooling water requirements will be approximately 1000 GPM.

3. PROCESS FLOW DESCRIPTION

The inert gas generator should be put in operation about 30-minutes before plant start-up, and runs continuously during plant operation.

The gas from the generator is cooled, compressed separately to 100 PSIG, and 1250 PSIG, dried in dessicant-type dryers, and then stored in receivers of approximately 6000 SCF capacity each.

Consumption of the inert gas supply is estimated as follows:

A. 100 PSIG System

1. Units 1300 and 1400: 675 SCFM during start-up only.
2. Purge of low pressure instrument connections and relief systems: 500 SCFM.

B. 1250 PSIG System

1. Unit 2900: 400 SCFM.
2. Purge of high pressure instrument connections: 320 SCFM.
3. Cooling of catalyst beds, for shutdown: 800 SCFM.

Unit 7100 - YARD LINES & TANKS (STORAGE TANKS)

1. SCOPE

This unit covers a tabulation of the field storage tanks required for the various process materials, and by-products associated with the Demonstration Plant.

This tankage, and the respective requirements are indicated on the following page.

The equipment noted herein does not include field storage of dry sulfur. Two 30-day fields of 3,000 long tons capacity each will be required. Each field will have dimensions of 26' high by 100' long by 20' wide.

UNIT 7100 - STORAGE TANKS

Item No.	Material Stored	Tank Location (Unit)	No. Tanks	Tank Capacity (Gal)	Total Capacity (Gal)	Production (Usage) Gal/Hr	Normal Process Inventory (Gal)	Storage Available
1	Slurry Oil	7100	3	380,000	1,140,000	107,000 (96,500)	40,000	10-Hrs Production (Inventory Plus 5-Hr Feed Supply Plus 48 Production Surplus)
2	Ammonia	7100	6	34,000	204,000	480	-	15-Days' Production
3	Methanol	7100	1	28,200	28,200	(0.42)	90,000	25,000 Gal. Inventor Plus 50 Days' Supply (500 Gal.)
				OTHER STORAGE TANKS				
4	Glycol	2900	1	2,000	2,000	(0.33)	2,000	1,500 Gal. Inventory Plus 60 Days' Supply
5	Phosphoric Acid	3500	1	4,000	4,000	(1.33)	300	Inventory Plus 100 Days' Suppl
6	Caustic	3500	1	10,000	10,000	(12)	-	30 Days' Supply

CUSTOMER: INSTITUTE OF GAS TECHNOLOGY

MASTER ITEM INDEX
UNIT 7100
STORAGE TANKS

PROJECT W-1843
DATE 3/1/72
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ITEM NO.	PROCON NO.	DESCRIPTION	SIZE	TYPE	CU. FT.		WT. **	REMARKS
71.08-01		SLURRY OIL FEED PUMP	1610 GPM					
		& MOTOR	75 HP					
71.08-02		METHANOL MAKE-UP PUMP	10 GPM					INTERMITTENT FLOW (10 GPD REQUIRED)
		& MOTOR	5 HP					
71.09-01		AMMONIA VENT GAS COMPRESSOR						
		& MOTOR						
71.09-02		AMMONIA TRANSFER COMPRESSOR	80 CFM					TRANSFER 15 DAYS STORAGE IN 6 HOURS
		& MOTOR	20 HP					
71.27-01A,B&C		SLURRY OIL STORAGE TANKS	45'-0" IDx32'-0"					STORAGE AVAILABLE-
		W/STEAM COILS	380,000 GAL,					10 HOURS PRODUCTION
71.27-02A-F		AMMONIA STORAGE TANKS	12'-0" ID X	40'-0" TT				STORAGE AVAILABLE -
			34,000 GAL.					15 DAYS PRODUCTION
71.27-03		METHANOL STORAGE TANK	20'-0" ID X	12'-0"				STORAGE AVAILABLE -
			28,000 GAL					50 DAYS SUPPLY PLUS 25,000 GAL. INVENTORY

8-A249

UNIT 8100 - MOBILE EQUIPMENT

1. SCOPE

This is a discussion of the number and types of mobile equipment to be included in the plant motor pool. This equipment will be housed in a common garage, repaired and serviced at a common facility, and depreciated over a five-year period (with certain exceptions) instead of the twenty-year period used for stationary items of plant equipment.

Usage, and the equipment required are outlined below:

a. Ash and Gypsum Disposal*

To haul away 1600-1700 tons per day, seven days per week, day shift only.

Twenty (20) heavy duty off-road dump trucks, 15 tons payload, 18 operating, 2 in shop.

b. Bulk Solids Loading*

To load an average of 100 tons per day of sulfur into rail hopper cars, as empty cars become available. And to unload and transfer a maximum of 550 tons per day of limestone to and from the dead storage pile.

1 - Clam-shell bucket, rail or caterpillar mounted, self-propelled, 3 cu. yd. capacity.

1 - Heavy-duty bulldozer

2 - Payloaders

c. Miscellaneous

1 - Sedan automobile for Plant Manager

2 - Inexpensive sedan automobiles

2 - Pickup trucks

1 - Fire engine*

1 - A-frame, 1½ ton flat bed truck

1 - 1½ ton flat bed truck

1 - Dempster dumpster W/4 bins

1 - Ambulance

* Note:

Hauling of the bulk disposal items as well as fire fighting and ambulance service will be contracted for with local faci ities, if available.

PROJECT SCHEDULE *

The critical path for the project passes through the design, fabrication, erection and piping up of the "Coal Gasification Reactor".

a. We have allowed nine months for obtaining lab and pilot plant data to finalize the design of the reactor.

b. The present design of the reactor has been discussed with manufacturers and time for fabrication, shipping and field erection has been established as 33 months.

c. We have estimated that six months will be required to erect platforms, ready the internals and pipe-up the reactor.

A bar chart illustrating a basic project schedule is shown in this section. This chart indicates a 48-month project schedule

1. ENGINEERING

The first 9 months of the engineering time is expected to be devoted to preparation of final process and equipment specifications. Final design of the main gasification reactor is one of the major items to be resolved, as well as a final evaluation and design of the Electrothermal Gasifier Unit. Some of these design parameters depend on data to be obtained from pilot plant operation.

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*Editor's Note: The time estimates presented here are largely outdated as the final report of the HYGAS Project work to mid-1972 is prepared for publication during 1974; revised estimated of gross time appear in that report.

2. CONSTRUCTION

Construction time is indicated as covering a period of 2½ years. Field construction would begin 18 months after engineering started, at which time approximately 50% of the engineering should be completed.

Average construction manpower is estimated at 1100 men with a peak manpower demand of 1500 - 1600 men.

3. PROCUREMENT

The procurement schedule is basically dictated by the Main Hydrogasification Reactor, which will require approximately thirty-three months for design and field construction.

The boilers and turbine-generator of the power plant will require approximately twenty-one months for delivery and subsequent field erection.

These two items govern the procurement requirements, and the corresponding, overall project schedule.

The numerous other heavy wall pressure vessels, and special pumps and compressors will also require careful scheduling control in engineering, procurement and construction.

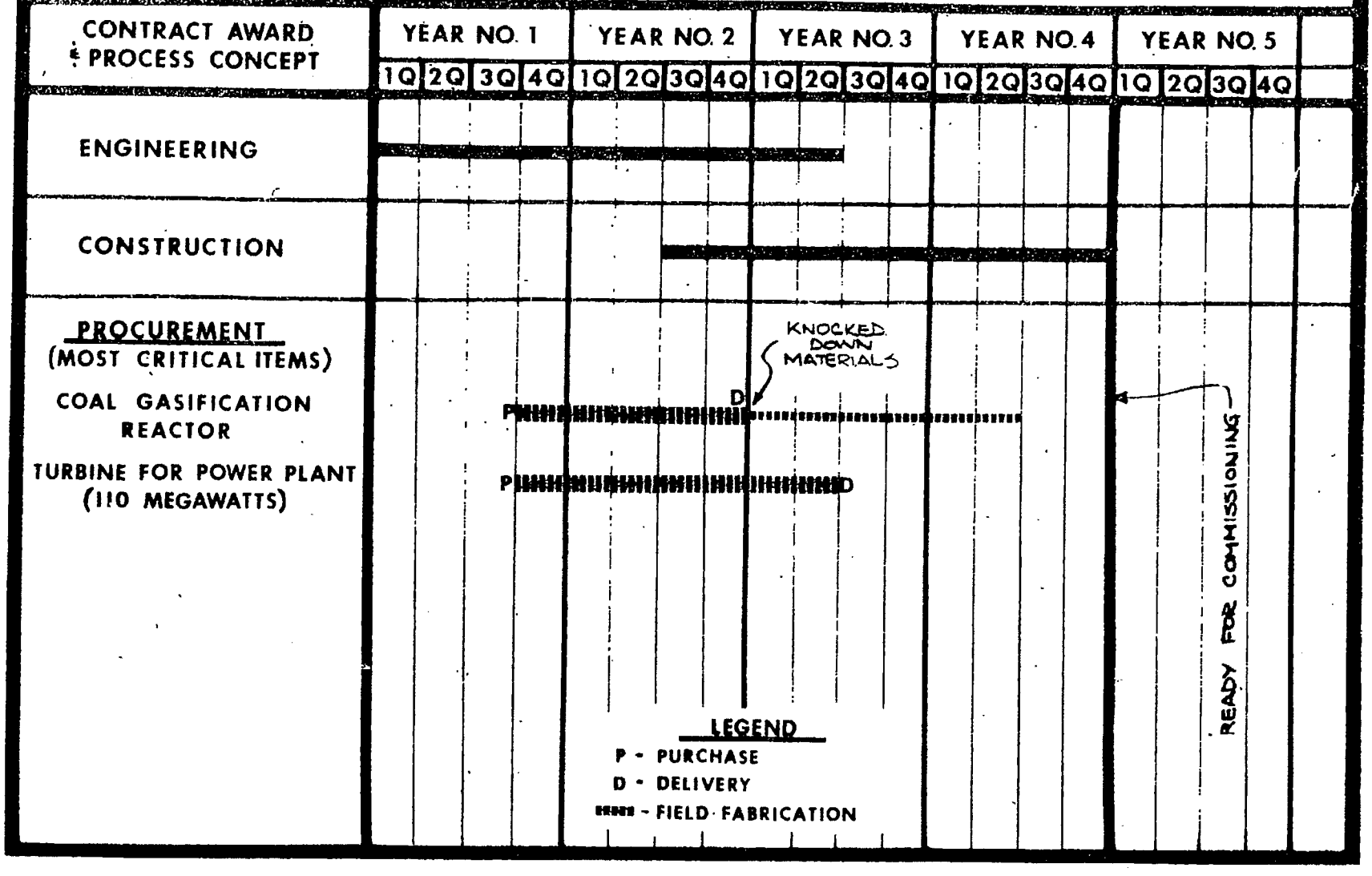
4. GENERAL COMMENTS

In the event that the critical path for the Coal Gasification Reactor can be shortened the Engineering Schedule could be changed with an improvement in schedule.

HYGCOR Incorporated

INSTITUTE OF GAS TECHNOLOGY
DEMONSTRATION COAL GASIFICATION PLANT
CHICAGO, ILLINOIS
SCHEDULE STUDY
JOB NO.-1843

3-1-72



8-A254

PLANT MANNING ESTIMATE

A. INTRODUCTION

This section presents a plant manning estimate for operation and maintenance of the 80 MM SCFD Demonstration Coal Gasification Plant, covered in this report. A Plant Manning Organization Chart is shown in Figure 1, attached.

Personnel for coal mine operation are not involved.

B. GENERAL COMMENTS

The plant manning schedule is based on the following factors:

1. Operating Department

   a. The gasification plant operation is continuous, 24-hours per day, 7 days per week, 365 days per year.

   b. The work schedule for Operating Dept. personnel is:

      (1) Eight (8) hours per day; three (3) shifts required per day.

      (2) Forty (40) hour work week; 5 days per week.

      (3) Classification of workers:

         (a) Operator

         Operators are the team leader for a group of plant units as assigned. They are responsible for operation of these units, and are assisted by "helpers".

(b) Helper

Assist plant operator and work under his direction

(c) Boardman

Monitors operation of the plant from the central control room, makes adjustments to control system settings required for proper plant operation, and logs various instrument readings for records and performance calculations.

(d) Shift Breaker Extraman

Normally works 1-shift per week for every job (in place of the normal 4-men per job). Also fills-in operating shifts during vacations, holidays, and other absences.

2. Maintenance Department

a. The work schedule for Maintenance Department personnel is:

(1) Eight (8) hours per day; one shift required per day.

(2) Forty (40) hour work week; (Monday thru Friday).

(3) Absences are not covered.

(4) Emergency work required during other than normal working hours is done on an overtime basis.

3. Employee Benefits and Other Factors

a. Employee vacations average three (3) weeks per year.

b. Employees have ten (10) holidays per year.

c. Approved and unexcused absences - i.e., illness, funerals, injury, personal business, jury duty, etc. - average 10% of working time. Not all of these absences are compensated.

4. Miscellaneous

a. For shift personnel, shiftbreak and total absences are equal to 25% of the total work time.

b. Shiftbreak-extramen when not at work filling a scheduled job, work wherever needed in the Operating Department.

C. PLANT MANNING ORGANIZATION CHART

An explanation of the organization and duties of the various departments and personnel shown on the organization chart is as follows:

1. Management

a. Plant Manager

Responsible for total plant operation.

b. Office Manager

Responsible for clerical and stenographic services, accounting, payroll, personnel records, purchasing, and warehousing.

Warehouse Supervisor

Responsible for the warehousing operation, including inventory control, issue of material, requisition of material, control of maximum and minimum quantities, and all other warehouse operations.

Warehousemen

Responsible for issue and receipt of materials, warehouse stocking, and issue notifications when supplies are needed.

c. Safety and Inspection Manager

Responsible for fire and safety equipment, instructions and counseling on fire and accident prevention, record keeping of fires and accidents, plant and personnel safety checks, issuance of safe work permits, inspection of equipment, and equipment safety inspection records.

d. Technical Manager

Responsible for technical service; general engineering services, and laboratory services.

In charge of the engineering supervisor and engineer assistants, the technical service supervisor and assistants, and the laboratory supervisor and technicians. The laboratory operates on a three shift basis and there should be two laboratory technicians on duty on each of the second and third shifts.

e. Operating Superintendent

Responsible for operation of plant units and handling of raw materials and products.

Operations Shift Supervisors

Responsible for the daily operation of plant units, scheduling of personnel, maintenance work orders, and keeping records of operations.

Raw Material and Products Handling Supervisor

Responsible for routing, and traffic control of raw materials, and plant products. Responsible for receiving and shipping, tankage and intermediate storage of raw materials and products.

f. Maintenance Superintendent

Responsible for maintenance of plant.

Maintenance Planner

Responsible for planning and scheduling maintenance, repair, and turnaround work.

Maintenance Supervisor Coordinator

Responsible for scheduling priorities of work, allotment of crews to various jobs, and assignment of mobile equipment.

Maintenance Supervisors

Supervisors required in each of the four (4) worker classifications:

1. Pipefitter - Welders
2. Mechanical Repair
3. Electrical - Instrumentation
4. General Utility

D. OPERATING DEPARTMENT PERSONNEL (SHIFTWORKERS - HOURLY)

Following is an estimate of the plant manning requirements of this department:

UNIT	Operator Per Shift	Helpers Per Shift	Board men	Total Operators	Total Helpers	Total Board men	Total Shift break Extra
1100 - Coal Handling 1200 - Coal Preparation	1	3		4	12		5
1300 - Coal Pretreatment 1400 - Char Feed Preparation	1	3		4	12		5
1500 - Reactor Section 1600 - Char Recovery 2100 - Raw Gas Quench 2400 - Shift Conversion 3100 - Oil Stabilization & Scavenge Gas Compression	1	4	1	4	16	4	6 1

UNIT	Operator Per Shift	Helpers Per Shift	Board-men	Total Opera-tors	Total Helpers	Total Board-men	Total Shift breal Extra
2500 - NH_3 Scrub & Gas Preconditioning							
2600 - Methanol Scrub							
3500 - NH_3 Separation							
3600 - Acid Gas Stripping							
4500 - Foul Water Disposal	1	4	1	4	16	4	7
2700 - Sulfur Guard							
2800 - Methanation							
2900 - Gas Dryer							
3200 - Sulfur Plant							
4300 - Incineration & Tail Gas Treatment							
5100 - Power Plant							
5200 - Water Treatment							
5300 - Cooling Towers							
5400 - Electric Substation	1	6	1	4	24	4	9
5500 - Power Conditioning							
4100 - Power Plant Stack Gas Scrubbing							
6100 - Electric Power Distrib.							

UNIT	Operator Per Shift	Helpers Per Shift	Board men	Total Opera-tors	Total Helpers	Total Board men	Total Shift break Extram
4400 - Limestone Supply Slurry							
4700 - Spent Catalyst Disposal							
4800 - Ash Handling							
5600 - Refrigeration							
5700 - Inert Gas Generation	1	4		4	16		6
7100 - Yard Lines & Tanks							
8200 - Sewage Disposal							
8100 - Off Sites	Handled by Maintenance Force.						

Manning Basis:

1. One (1) Central Control Room for all Processing Units except Units 1100, 1200, 1300, 1400, and Units 5100, 5200, 5300, 5400, 5500, 4100, and 6100.
2. Separate Control Room in Power Plant for Units 5100, 5200, 5300, 5400, 5500, 4100, 4800, and 6100.
3. Separate offices and work reporting areas for Units 1100, 1200, 1300, 1400, 4300, 4400, 4700, 4800, 5600, 5700, 7100, and 8200. If any particular instrument or control information from the above units is required in the central control unit, the necessary data is transmitted by dual instrument or by telephone.

Total Manpower

Operators	-	24
Helpers	-	96
Boardmen	-	12
Shiftbreaker Extramen	-	39
Total		171

MAINTENANCE DEPARTMENT PERSONNEL

Following is an estimate of the plant manning requirements for this department:

1.

Classification	Total Personnel
Pipefitter - Welder	20
Mechanical Repair	25
Electrician - Instrumentation	20
General Utility	20
Labor Pool	25
Total	110

a. Pipefitter-Welder responsibilities:

All pipefitting, boilermaker & welding work.

b. Mechanical Repair Responsibilities:

Pumps, compressors, mixers, control valve repairs, turbines, rotating equipment, mobile equipment, conveyors & tool room .

c. Electrician-Instrumentation Responsibilities:

Electrical equipment & devices, motors, pneumatic & electronic instruments, relief valve repair & adjustment, control valve adjustment & repair & adjustment to all control or electrical devices.

d. General Utility Responsibilities:

All types of general work not of a specific craft category, and not covered in the three mechanical classifications; such as, painting, insulation, mason, sheetmetal, carpentry, etc.

e. Labor Pool:

General labor work, janitor, cement work, and helpers for general utility men.

2. Training & Promotion in Maintenance Department

a. General utility men will be preassigned by choice and assignment, five (5) each to the pipefitter-welder, mechanical repair, and electric-instrument department. These men will assist the mechanics as helpers when helpers are required or train with the mechanics when there is a work lull in their work classification. Assigned helpers work and train only in their assigned classification.

Promotion to mechanic status is made when a need for more mechanics is evident or when a vacancy is to be filled. As helpers are promoted, senior general utility men are given vacated helper assignments.

b. Labor pool personnel are promoted either to the general utility classification or to the operating department helper classification as needed to fill vacancies.

Labor pool personnel help general utility personnel when required.

7. OTHER SERVICES

Certain services will be required which should be handled by non-employee personnel. These services are as follows:

1. Guards

Guard services are more efficiently handled and create less internal problems if they are contracted to a service group handling this type of work. The number of guards required will depend upon the extent of coverage wanted. There should be one guard at each open gate. Generally, there are two open gates; one used by the general office employees and the plant employees. The other gate would be at the product and raw materials entry and exit. In some cases it may be desirable to have a periphery patrol during the off-daylight hours and on weekends. These services are generally available on a shared basis with other plants.

2. Medical Services

First aid services for minor cuts and bruises will be administered by the safety personnel during the day shift and by the operating supervisor during the off hour shifts.

Cases requiring more than first aid, or follow-up on first aid are handled by a hospital, clinic or doctor with whom a contract arrangement has been executed.

APPENDIX 8-B

Volume II

of the

Preliminary Engineering Study
HYGAS Demonstration Plant

by

Procon, Inc.,
A Subsidiary of UOP

Procon Note

This book contains preliminary Equipment Data Sheets and Piping and Instrumentation (P&I) Diagrams, part of the Preliminary Engineering Study for a HYGAS Demonstration Plant.

Editor's Note

This Appendix 8-B recreates the entire Volume II of the Procon Preliminary Engineering Study, HYGAS Demonstration Plant. The engineering materials of Volumes I and II of the Procon report (comprising Appendixes 8-A and 8-B, and portions of the body of Part 8) are presented in conformance with contractual obligations of IGT to OCR under Contract No. 14-01-0001-381 and the amendments of June 1967, Contract No. 14-01-0001-381(1), and of March 1972, Contract No. 14-01-0001-381(2).

VOLUME II
TABLE OF CONTENTS

SECTION

INTRODUCTION

Volume II of the Phase II Report includes preliminary equipment data sheets and P & I diagrams. Although preliminary, the equipment data sheets were used in developing equipment pricing. The P & I diagrams include the total quantities of equipment involved, and the basic piping requirements.

It should be noted that the P & I diagrams have not been "engineered" for the actual instrumentation required. The instrumentation shown should be considered very preliminary. Pricing of instrumentation is based on estimated costs.

GENERAL COMMENTS

A. Process Units

The following sections present preliminary equipment data sheets and P & I diagrams for the process units of the coal gasification Demonstration Plant. These are Units 1100 through 3600, in the plant numbering system.

Due to the proprietary nature of several of the process units, no equipment data sheets, or P & I diagrams are included for:

1. Units 2600 & 3600: The design of these units, used for sour gas purification, and solvent regeneration, are part of the LINDE AG "RECTISOL" process.
2. Unit 3200: The design of this unit, for converting H_2S to elemental sulfur, is the property of the Amoco Production Co.
3. Unit 3500: Many features of the design of this unit, for the removal of ammonia from the other sour gases, are the PHOSAM process owned by USS Engineers and Consultants.

Additional design details on these units are available only on completion of the necessary secrecy agreements with the respective owners. All these processes are available under license.

Procon Incorporated

DES PLAINES, ILLINOIS U.S.A.

REQUISITION

ATTACHMENTS

Procon Dwg. No. 1843-11.00-1G, Rev. 1

VENDOR DATA REQUIREMENTS

NO. 1843-11.17-1

SHEET NO. 1

TOTAL SHEETS 6

DATE 11/8/71

APPROVED CCB 11/8/71

MATERIAL INCLUDES – COAL HANDLING SYSTEM
ICT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO

Design and supply one coal handling system in accordance with the requirements specified or referenced herein.

ITEM NO.	CONVEYOR BELT WIDTH	LENGTH	CAPACITY	SERVICE
11.17-01	36"	70 ft. (20' rise)	200 TPH	Refuse Conveyor
11.17-02A	54"	35 ft. (2' rise)	1350 TPH	Breaker Collecting Conveyor
11.17-03	54"	1100 ft. (no rise)	(1)	Conveyor to Stacker
11.17-04	54"	-	(1)	Belt Scale
11.17-05	54"	-	(1)	Traveling Stacker
11.17-06A	42"	800 ft. (2) (90' rise)	900 TPH	Reclaim Conveyor
11.17-06B	42"	800 ft. (2) (90' rise)	900 TPH	Reclaim Conveyor
11.17-07A	42"	-	-	Magnetic Separator
11.17-07B	42"	-	-	Magnetic Separator
11.33-01A	-	-	1350 TPH	Vibrating Feeder to Breaker
11.33-04A	54"	-	1350 TPH	Vibrating Feeder to Collecting Belt
11.33-02A	54"/54"	-	1350 TPH	Transfer Chutes 11.17-02A to 11.17-03

REV.	DATE	APPROVED	REMARKS
1	3/1/72	JCS	ADDITION OF 11.33-03 & 11.33-04B
0	11/9/71	CCB	FOR INQUIRY

Procon Incorporated
DES PLAINES, ILLINOIS U.S.A.

REQUISITION

NO. 1843-11.17-1
SHEET NO. 2
TOTAL SHEETS 6
DATE 11/8 /71
APPROVED

MATERIAL INCLUDES – COAL HANDLING SYSTEM
IGT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO

ITEM NO.	CONVEYOR BELT WIDTH	LENGTH	CAPACITY	SERVICE
		No. Req'd		
11.33-03A	42"	14	225 TPH	Reclaim Conveyor Feeders
		Length		
12.17-01	24"	1000 ft. (100' rise)	75 TPH (225 TPH Future)	Power Plant Supply
12.17-02A	30"	300 Ft. (50' rise)	225 TPH	Pretreater Supply
12.17-03A	42"	60 ft. (no rise)	300 TPH	Transfer Conveyor
12.17-03B	42"	60 ft.	300 TPH	Transfer Conveyor
12.17-04	24"	Belt Scale	75 TPH (225 TPH Future)	Power Plant Supply
12.17-05A	30"	Belt Scale	225 TPH	Pretreater Supply
12.17-07 A,B	42"	Flow Gates	0-150 TPH	Boiler Plant Supply
12.17-08 A,B	42"	Trippers	300 TPH	Pretreater Supply
		No. Req'd		
12.33-01A	30"	1	225 TPH	Pretreater Supply Feeder
12.33-02	24"	1	75 TPH (225 TPH Future)	Power Plant Supply Feeder
12.33-03A&B		2	225 TPH	VIBRATING FEEDERS FOR TRANSFER CONVEYORS

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REQUISITION

NO. 1843-11.17-1
SHEET NO. 3
TOTAL SHEETS 6
DATE 11/8/71
APPROVED

MATERIAL INCLUDES – COAL HANDLING SYSTEM
IGT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

Notes: (1) Initial capacity 1350 TPH, future capacity 2025 TPH.

(2) Belt conveyor shall be designed suitable for extension approximately 600 feet in the future to include additional reclaim hoppers. Motor driver shall be designed for initial conditions unless HP rating for future condition is of small order of magnitude (next HP class) in which case quotation shall provide larger motor and be noted accordingly.

Reference: Procon Drawing No. 1843-11.00-1G

GENERAL CONDITIONS:

All equipment shall be designed for handling size 1½" x 0 Southern Illinois No. 6 Bituminous coal with the following estimated size distribution, except for Items 12.17-02A and 12.17-05A:

Tyler Mesh	% Retained	Cum. %
1½"	1.5	1.5
1"	8.1	9.6
3/4"	9.7	19.3
½"	13.5	32.8
¼"	27.9	60.7
4M	2.6	63.3
6M	6.3	69.6
8M	5.1	74.7
14M	8.3	83.0
28M	6.4	89.4
35M	2.4	91.8
100M	5.0	96.8
Pan	3.2	100.0

Bulk density - approx. 50 lbs per cu. ft.

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REQUISITION

NO. 1843-11.17-1
SHEET NO. 4
TOTAL SHEETS 6
DATE 11/8/71
APPROVED

MATERIAL INCLUDES –

COAL HANDLING SYSTEM
IGT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

GENERAL CONDITIONS CONT'D

Coal for Items 12.17-02A and 12.17-05A will be size ¼M x 0 which is estimated to have the following size.

Tyler Mesh	% Retained	Cum.%
4	5	5
8	14	19
18	19	38
28	20	58
48	15	73
100	10	83
Pan	17	100

Bulk density - approx. 55 lbs per cu. ft.

Ambient temperature range for coal handling system:

Summer 95-100°F
Winter minus 20°F

All conveyors, feeders, and separators shall be furnished complete with motor drivers and recommended drive auxiliaries (belts, sheaves, speed reducers, guards, etc.) Controls for conveyor system shall include necessary interlocks and safety switches (to be recommended by supplier) for a safe and operable system.

The coal handling system shall be controlled by a remotely operated panel with local panel override at the stacker and coal conditioning house for manual control. It is envisaged that the control panels will be by others, however, conveyors and equipment shall be provided with components suitable for remote panel operation.

Feeders at the coal conditioning house shall be suitable for connections to a dust recovery system.

All motor starters except for stacker shall be by others; quotation shall include a list of motors showing their HP requirements and rated HP.

General all belt conveyors shall be enclosed, except Item 11.17-03 in the area of Stacker, in order to minimize dust generation by wind and to minimize effect of snow and rain.

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REQUISITION

NO. 1843-11.17-1
SHEET NO. 5
TOTAL SHEETS 6
DATE 11/8/71
APPROVED

MATERIAL INCLUDES – COAL HANDLING SYSTEM
IGT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

GENERAL CONDITIONS cont'd

Conveyor items 11.17-06A and B are envisaged as non-parallel conveyors having a spacing of 20' to 40' in the reclaim area and converging at the Coal Conditioning House. Consequently in the area of the Coal Conditioning House the two conveyors may utilize common structural supports.

Traveling Coal Stacker

The coal stacker shall be rail mounted suitable for translational movement parallel to the longitudinal axis of the coal pile being served. The stacker shall be designed for (1) an initial capacity of 1350 TPH, and (2) be suitable for increasing capacity to 2025 TPH for future requirements.

Travel of stacker shall be 300 feet initially, to be extended approximately 600 feet in the future (total 900 feet.)

The stacker shall be designed with a suitable boom and belt conveyor for piling coal on one side (i.e. rotation not required) to a height of 77 feet at a distance (reach) of approximately 110 feet (the triangular section of the coal pile to be 77' x 200).

The boom shall be suitable for raising the discharge end the required height to pile coal to a height of 77 feet, and for lowering the discharge end to a height of approximately 30 feet. The boom shall be equiped with suitable probes so that as the coal is piled the probes will provide a signal for automatically raising the boom or cause the stacker to travel depending upon a predetermined mode of operation. The boom shall be supplied with a covered 54' troughed belt conveyor to handle the specified capacities.

The stacker shall be supplied with a tripper and transfer facilities for receiving coal from a troughed feed conveyor running parallel to and between the rails of the stacker near ground level, and for transfering the coal onto the boom belt. Stacker shall be complete with rails, trolley & trolley shoes, motors and starters, pile probes, and control panel. Control panel shall be suitable for extending control functions and operation indicators to a remote (control house) location.

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DES PLAINES, ILLINOIS U.S.A.

REQUISITION

NO. 1843-11.17-1
SHEET NO. 6
TOTAL SHEETS 6
DATE 11/8/71
APPROVED

MATERIAL INCLUDES - COAL HANDLING SYSTEM
IGT HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

Electrical Characteristics

Motor Size	Volts	Phase	Hertz
One-half HP and smaller	115/230	1	60
Above ½ HP to 250 HP	460	3	60
Over 250 HP	4000	3	60

Mode of Operation:

Initial operations will provide for receiving coal at the Breakers during a single shift operation. Thus conveyors and equipment through and including the stacker will be for intermittent operation, i.e. one shift (7 hours) "on"; two shifts "off". Starting with the reclaim stations (Feeders) through the delivery conveyors to the Power Plant and to the Pretreater all operations are to be continuous.

In the future it is conceived that the supply of coal to the Stacker will increase to a two-shift operation.

Painting

All structural steel and equipment to be furnished shall be commercially cleaned in accordance with SSPC-SP6 and receive one coat of shop prime and two coats of finish paint (color specifications later) in accordance with suppliers recommendations.

Inability to adhere strictly to the foregoing specifications shall not deter supplier from making a quotation. However any deviations or recommendations contrary to specifications shall be expressly stated.

Procon Incorporated

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REQUISITION

NO. 1843-11.32-1

SHEET NO. 1

TOTAL SHEETS

DATE 10/13/71

APPROVED

MATERIAL INCLUDES –

COAL BREAKER
IGT - HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO

Design and furnish one (1) rotary type coal breaker in accordance with the requirements specified or referenced herein:

ITEM NO.	SERVICE
11.32-01A	COAL BREAKER

Operating Conditions

Feed Material - Southern Illinois No. 6 Bituminous Coal
Feed Rate - 1350 tons per hour
Hardgrove Grindability Index - Approx. 55-60.
Size - Run of mine (6" x 0 approx.)
Size distribution - Run of mine.
Product size requirement - 1½" x 0, with minimum fines generation. It is anticipated that a sample of coal will be furnished supplier for a test run when specific coal field is nominated. Meanwhile, supplier is requested to furnish his best estimate of product size distribution from his experience with Feed Material specified above.

REV.	DATE	APPROVED	REMARKS
0	10/13	DAS	For Inquiry

BY ACCEPTING THE ORDER FOR THE MATERIALS SPECIFIED HEREIN THE SELLER AGREES TO INDEMNIFY AND HOLD HARMLESS THE PURCHASER AND/OR ITS CUSTOMER FROM ANY LOSS, DAMAGE OR INJURY ARISING OUT OF A CLAIM OR SUIT FOR ALLEGED INFRINGEMENT OF PATENTS RELATING TO THE PROPERTY DESCRIBED HEREIN, AND WILL ASSUME THE DEFENSE OF ANY AND ALL SUCH SUITS AND WILL PAY ALL COSTS AND EXPENSES INCIDENTAL THERETO.

FOR P.O. 486-270, 8/71

Procon Incorporated

DES PLAINES, ILLINOIS U.S.A.

REQUISITION

NO. 1843-11.32-1

SHEET NO. 2

TOTAL SHEETS

DATE 10/13/71

APPROVED

MATERIAL INCLUDES - COAL BREAKER
IGT - HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

General Requirements

Equipment shall be heavy duty type suitable for continuous operation.

Breaker shall be designed for scavenging and removal of rock and debris via a separate discharge.

The Coal Breaker shall be supplied complete with motor and drive train, couplings, guard enclosures, etc. Motor shall be TEFC for base quotation. However, supplier may recommend alternate installation schemes he can supply for using a less expensive motor type affording the necessary protection from dust accumulation.

The Breaker shall be supplied with feed and refuse chutes. All feed hoppers and product removal chutes, feeders, conveyors, etc., and Breaker supports and foundations shall be by others.

Electrical Characteristics

Motors 3/4 HP to 250 HP shall be 460v, 3 phase, 60 cycle. Motors larger than 250 HP shall be 4000v, 3 phase, 60 cycle.

Motor starters by others.

Painting

All external surfaces shall be power or hand cleaned for the removal of oil, grease, dirt, mill scale, rust and foreign matter (Equivalent to SSPC-SP6, Commercial Blast Cleaning) before receiving one coat of shop primer and finish paint in accordance with supplier's standards.

Procon Incorporated

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REQUISITION

NO. 1843-12.32-1

SHEET NO. 1

TOTAL SHEETS

DATE 10/14/71

APPROVED

VENDOR DATA REQUIREMENTS: 1A-7

MATERIAL INCLUDES -

COAL CONDITIONER (CRUSHER)
IGT - HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO

Design and supply one (1) rotary type coal conditioner in accordance with the requirements specified or referenced herein.

ITEM NO.	SERVICE
12.32-01A	Coal Conditioner

Operating Conditions

Feed Material - Southern Illinois No. 6 Bituminous Coal
Feed Rate - 225 short tons per hour
Hardgrove Grindability Index - Approx. 55 to 60 .
Feed Size - 1½" x 0
Feed Size Distribution:

Tyler Mesh	% Retained	Cum %
1½"	1.5	1.5
1"	8.1	9.6
3/4"	9.7	19.3
½"	13.5	32.8
¼"	27.9	60.7
4M	2.6	63.3
6M	6.3	69.6
8M	5.1	74.7
14M	8.3	83.0
28M	6.4	89.4
35M	2.4	91.8
100M	5.0	96.8
Pan	3.2	100.0

REV.	DATE	APPROVED	REMARKS
0	10/14/71	DB	For ordering

BY ACCEPTING THE ORDER FOR THE MATERIALS SPECIFIED HEREIN THE SELLER AGREES TO INDEMNIFY AND HOLD HARMLESS THE PURCHASER AND/OR ITS CUSTOMER FROM ANY LOSS, DAMAGE OR INJURY ARISING OUT OF A CLAIM OR SUIT FOR ALLEGED INFRINGEMENT OF PATENTS RELATING TO THE PROPERTY DESIGNED HEREIN, AND WILL ASSUME THE DEFENSE OF ANY AND ALL SUCH SUITS AND WILL PAY ALL COSTS AND EXPENSES INCIDENTAL THERETO.

FOR O. 843-12.32-1

FORM

Procon Incorporated

DES PLAINES, ILLINOIS U.S.A.

REQUISITION

NO. 1843-12.32-1

SHEET NO. 2

TOTAL SHEETS

DATE 10/14/71

APPROVED

MATERIAL INCLUDES - COAL CONDITIONER (CRUSHER)
IGT - HYGAS PLANT

DESCRIPTION OF MATERIAL	COST ACCOUNT NO.	PURCHASE ORDER NO.

Operating Conditions (cont'd)

Surface Moisture - 6 - 8 % Normal (Design)
Up to 15% Occasional Maximum

Product Size Requirements: 100% minus 4M, not more than 5% 4M-8M, and with a minimum of fines less than 100M. It is anticipated that a sample of coal will be furnished supplier when coal field is nominated, for test runs. Meanwhile supplier is requested to furnish his best estimate of product size distribution based on his experience with Feed Material and Feed Size Distribution given above. Of special interest is supplier's estimate of percent of fines less than 100 mesh.

General Requirements

Equipment shall be heavy duty type suitable for continuous operation.

The coal conditioner shall be supplied complete with motor and drive train, couplings, and guard enclosures. Motor shall be TEFC for base quotation. However, supplier may recommend alternate installation schemes he can supply for using a less expensive motor type which also affords the necessary protection from dust accumulation.

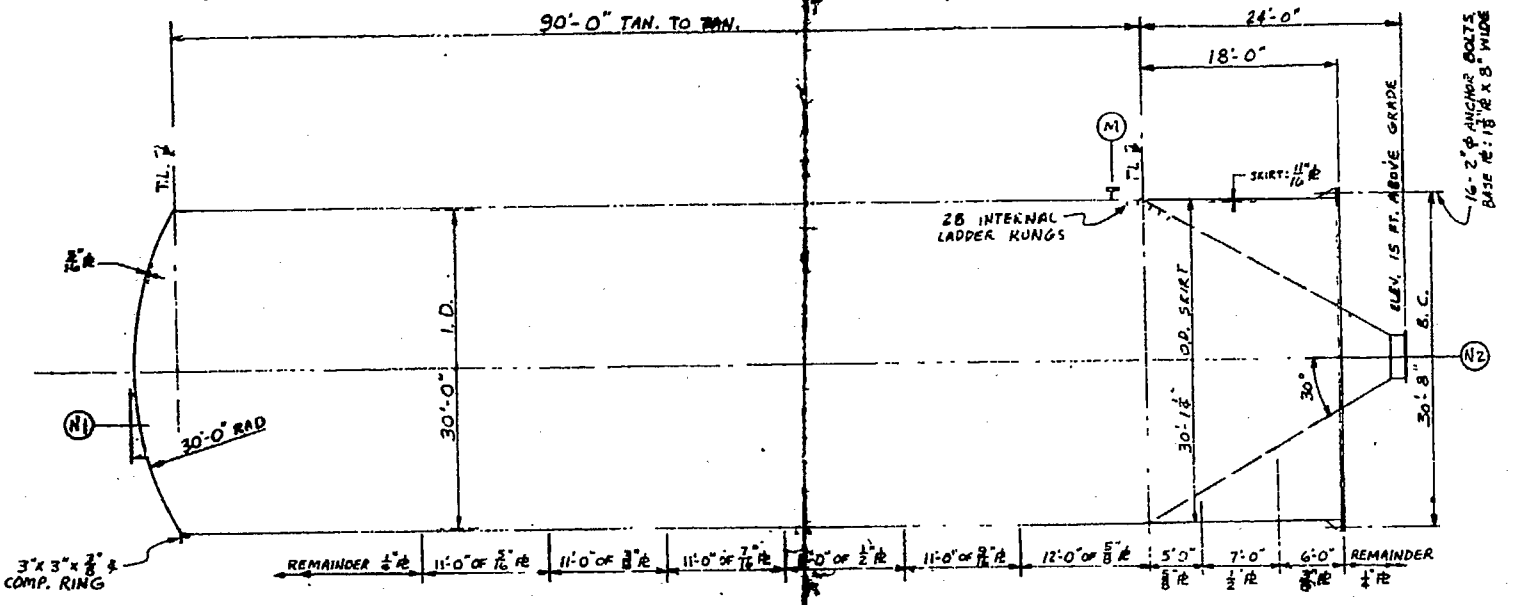
Electrical Characteristics

Motors 3/4 HP to 250 HP shall be 460V, 3 phase, 60 cycle. Motors larger than 250 HP shall be 4000 V, 3 phase, 60 cycle.

Motor starters by others.

Painting

All external surfaces shall be power or hand cleaned for the removal of oil, grease, dirt, mill scale, rust and foreign material (Equivalent to SSPC-SP6, Commercial Blast Cleaning) before receiving one coat of shop primer and finish paint in accordance with supplier's standards.



ESTIMATED LUGS
10 REQ'D. MK P-11
18 REQ'D MK P-13
6 REQ'D MK P-15

DESIGN DATA			
CODE API 620 SPECS.			
DESIGN CONDITIONS	INT.	PSIG@	°F
	EXT.	PSIG@	°F
OPER. PRESS.		PSIG@	°F
RADIOGRAPHY	SPOT	X-RAY	
POST WELD HEAT TREAT	NO		
JOINT EFF.		85%	
CORROSION ALLOWANCE	NONE		
WET PAR. WEIGHT	246,000#		
EMPTY WEIGHT			
OPER. WEIGHT	2,746,000#		
TEST WEIGHT			
@ 1750 TONS ME COAL AT ATMOSPHERIC PRESSURE			

MATERIAL SPECIFICATIONS	
SHELL	SA-285-C
HEADS	SA-285-C
SUPPORT	SA-36
NOZZLE NECKS	
FLANGES	
INTERNALS	
MANWAY (HINGED [redacted])	
NOTES & REF. DWGS.	COAL DENSITY 50 lbs/CU. FT.

ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
INSULATION CLIPS AND RINGS	NO
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	NO
PIPE GUIDE LUGS	NO
FIREPROOFING	NO
INSULATION	NO
PAINT ONE S/C PRIMER	

NOZZLE NOTE
RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTERNALLY REINFORCED NOZZLES OR OTHERWISE SPECIFIED.
SIZE PROJECTION SIZE PROJECTION
THRU THRU
THRU THRU

NOZZLE SCHEDULE

FIGURE NO.	NO. REQ'D.	SIZE	RATING	FACING	SERVICE
N2	1	48"	SPECIAL	FF	OUTLET
N1	1	6"xC	SA.	RTJ'D.	COAL INLET
M	1	24"	SPECIAL	FF	MANHOLE M COVER

NO.	REVISION	DATE	BY	CHD.

Procon Incorporated

PRETREATER FEED STORAGE HOPPER ITEM NO. 13.06-01
HYGAS

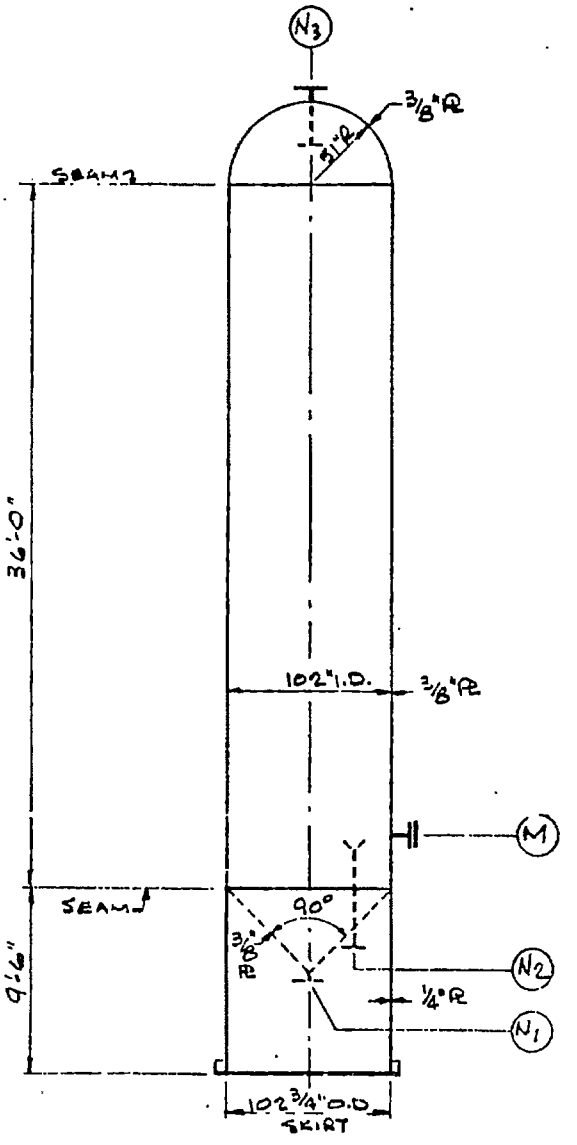
IGT CHICAGO, ILL

DRAWN
CHECKED
APPROVED

DATE 1-6-72
REQ'N. NO. 1843-13.06-01

8-B15

DESIGN DATA		
CODE ASME CONSTR. 1971 SECT. VIII DIV 1		
SPECS.		
DESIGN CONDITIONS	INT.	15 PSIG @ 200 °F
	EXT.	PSIG @ °F
OPER. PRESS.		9 PSIG @ 150 °F
RADIOGRAPHY		NONE
POST WELD HEAT TREAT		NONE
JOINT EFF.		60° SHELL & HEADS
CORROSION ALLOWANCE		1/8"
NET FAB. WEIGHT		25100#
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL		A-285-C
HEADS		A-285-C
SUPPORT		A-36
NOZZLE NECKS		A-53 A OR B
FLANGES		A-181 GR.1
INTERNALS		C.S.
GSKT.		1/16" THK. JM 60 OR EQUAL
MANWAY (BOLTED OR DAVITED)		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS		YES
DAVIT SUPPORTS		NO
PIPE SUPPORT LUGS		YES
PIPE GUIDE LUGS		YES
FIREPROOFING		NO.
INSULATION		NO
PAINT		1-SHOP COAT ZINC CHROMATE



MK.	QTY.	SIZE	RATING	FACING	SERVICE
N3	1	12"	150#	R.F.	OUTLET W/ INT. PIPE & RF FLG.
N2	1	2.0"	150#	R.F.	OUTLET W/INT. PIPE
N1	1	2.0"	150#	R.F.	INLET
M	1	15"	150#	R.F.	MANHOLE W/R.F. STUDS, NUTS & GSKT

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

PRETREATED PRESSURIZED FEED HOPPER

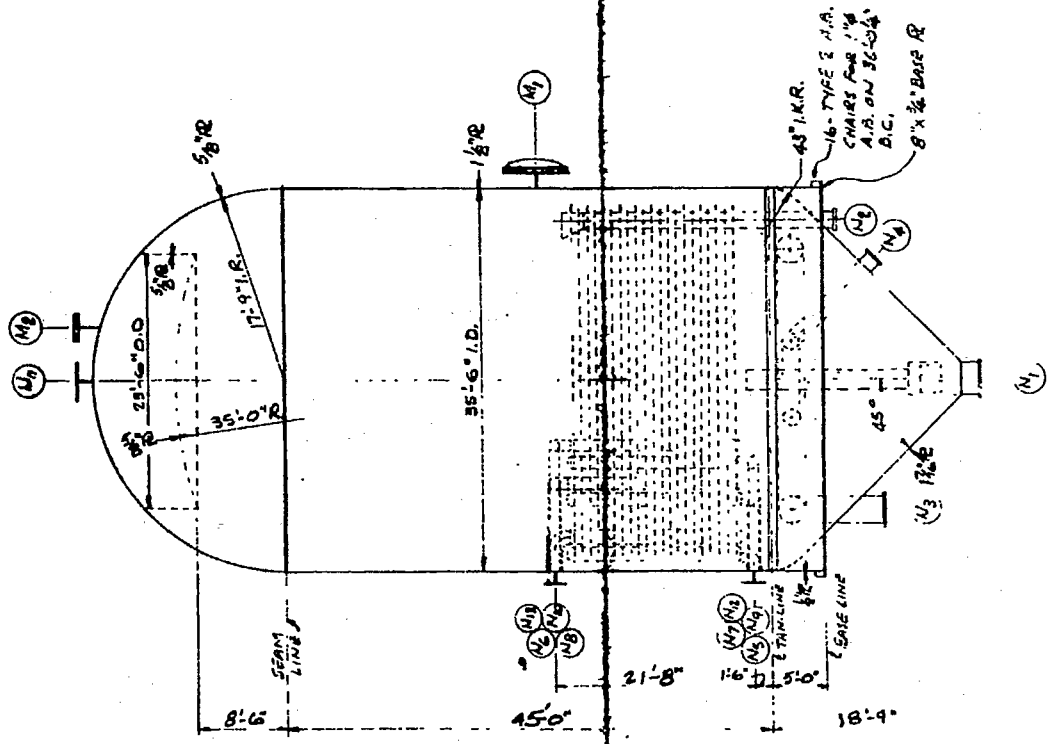
ITEM NO. 13.06-02 UNIT 1300

HYG, A'S

I GT. CHICAGO, ILL

	DATE
DRAWN	
CHECKED	
APPROVED	

DWG. NO A



WEIGHT (BREAK-DOWN)

VES. PROPER	429400#
INT. 3" PIPE COIL	189100#
OTHER INT. PIPING	51800#
PLATE SHPT / SHPT BEAMS	36900#
MISC. INT	11600#
TOTAL NET FAB.	693900

DESIGN DATA		MATERIAL SPECIFICATIONS	
CODE ASME 1971 SECT. VIII DIV. 1 STAMP		SHELL	SA-515-70
SPECS		HEADS	SA-515-70
DESIGN CONDITIONS	INT. 40 PSIG @ 825 °F	SUPPORT	SA-285-C
	EXT. PSIG @ °F	NOZZLE NECKS	SA-106 A OR B
OPER. PRESS. & TEMP.	PSIG @ °F	FLANGES	SA-181 GR I
RADIOGRAPHY SPOT PER CODE & SPECS.		INTERNALS	HD & SKIRT A-285-C
POST WELD HEAT TREAT NO.		INT. PIPING	SA-106 A OR B
JOINT EFF. HEAD, SHELL & CONE 85%		INT. SUPT. BEAMS	A-36
CORROSION ALLOWANCE 1/8"		MANWAY (HINGED & DAVITED)	
		NOTES & REF DWGS.	
NET FAB. WEIGHT	693900#		
EMPTY WEIGHT			
OPER. WEIGHT			
TEST WEIGHT			

ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER AND PLATFORM CLIPS	YES
INSULATION CLIPS AND RINGS	YES
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	YES
PIPE GUIDE LUGS	YES
FIREPROOFING 2" I.S. 40.5.	
INSULATION Bot. T.L. To Top 2½" Cone 4"	
PAINT None	

NOZZLE NOTE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	
10" THRU 18"	10"	20" THRU	

NOZZLE SCHEDULE

MARK NO	NO REQD	SIZE	RATING	FACING	SERVICE
N13	1	16"	300#	R.F.	SUPERHEATED STEAM OUTLET (FOR COIL 'C1')
N11	1	42"	T.F. CLASS 175	R.F.	OUTLET
N10	1	14"	300#	RF	STEAM OUTLET (FOR COIL 'B')
N9	1	14"	300#	RF	WATER INLET (FOR COIL 'B')
N8	1	16"	300#	RF	STEAM OUTLET (FOR COIL 'A')
N7	1	16"	300#	R.F.	WATER INLET (FOR COIL 'A')
N6	1	8"	300#	RF	STEAM OUTLET (FOR COIL 'C1')
N5	1	8"	300#	RF	WATER INLET (FOR COIL 'C1')
N4	1	18"	150#	RF	AIR INLET
N3	1	30"	T.F. CLASS 175	RF	AIR INLET
N2	1	18"	150#	R.F.	PRETREATED PROD. OUTLET
N1	1	42"	T.F. CLASS 175	R.F.	FLUIDIZED AIR INLET
N12	1	16"	300#	R.F.	STEAM INLET (FOR COIL 'C1')
M2	1	20"O	150#	R.F.	MANHOLE W/ STUD OUTL. SPLASH RING
M1	1	20"O	SPECIAL	R.F.	MANHOLE W/ STUD OUTL. SPLASH RING & DAVIT

NO.	REVISION	DATE	BY	CHKD.

Procon Incorporated

PRETREATER REACTOR

ITEM NO 13.06-03 UNIT 1300

HYGAS

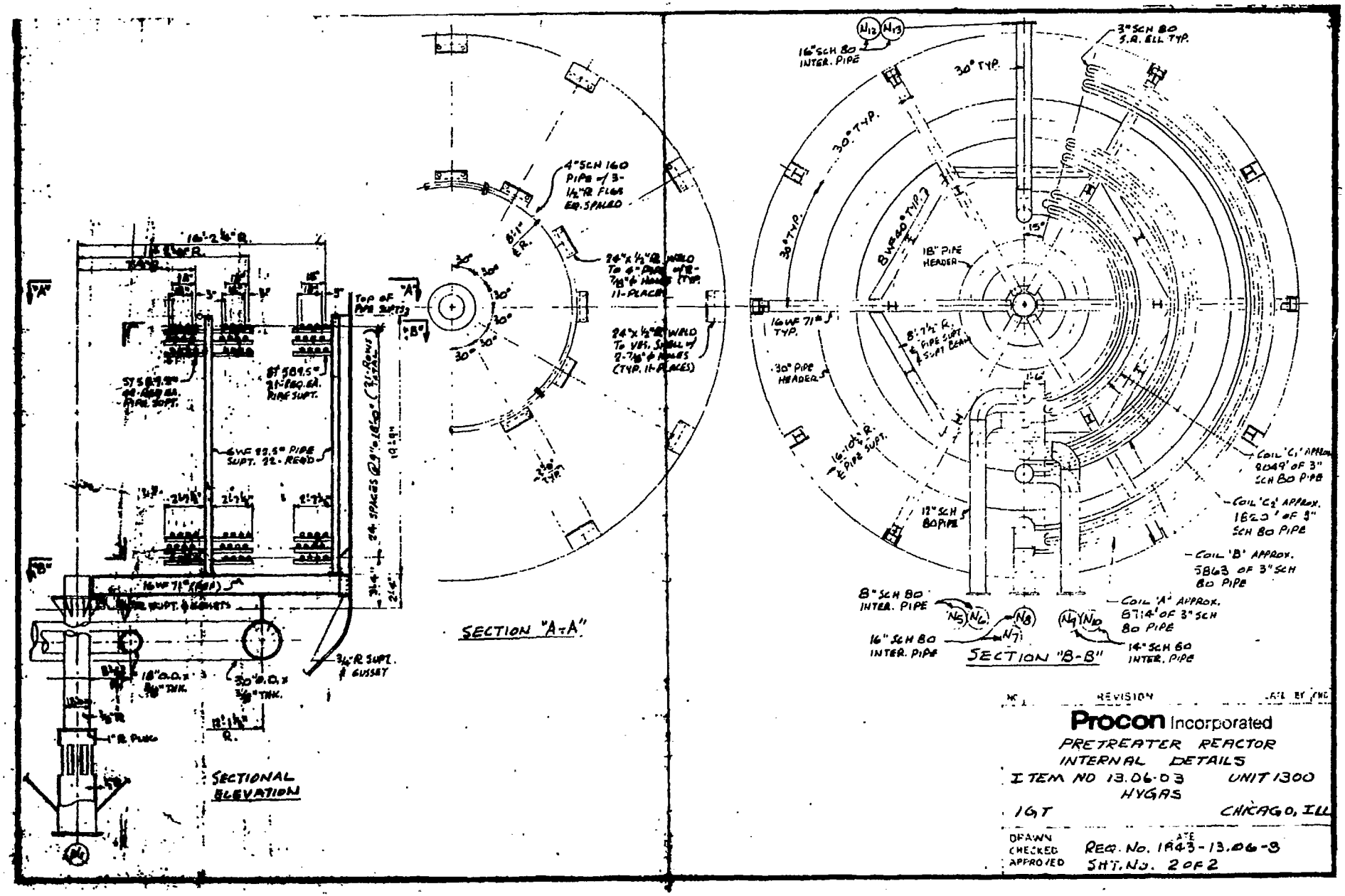
IGT CHICAGO, ILL.

DRAWN
CHECKED
APPROVED

DATE

REQ. NO. 1843-13.06-3

SHT NO 1 OF 2



NO. REVISION APP'D BY / DATE

Procon Incorporated

PRETREATER REACTOR
INTERNAL DETAILS

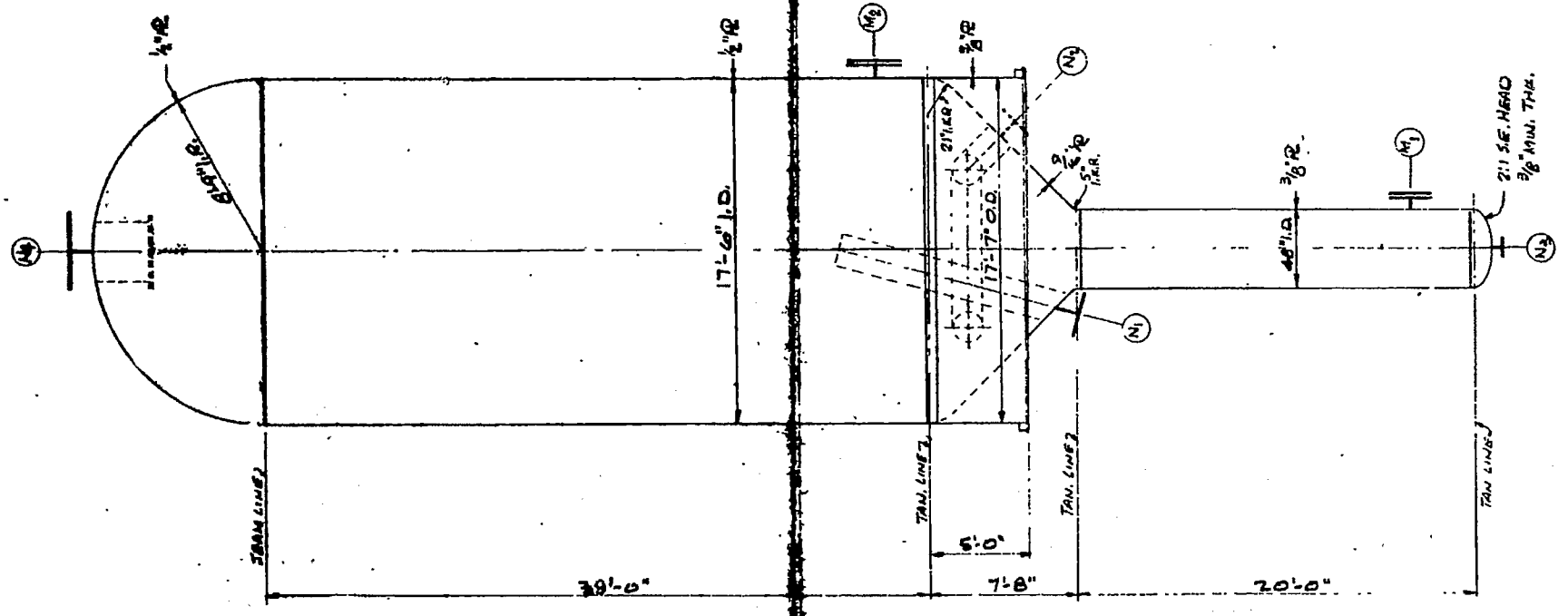
ITEM NO 13.06-03 UNIT 1300
HYGAS

IGT CHICAGO, ILL

DRAWN
CHECKED
APPROVED
DATE

REQ. No. 1943-13.06-3
SHT. NO. 2 OF 2

8-B18



DESIGN DATA		MATERIAL SPECIFICATIONS	ACCESSORIES TO BE SUPPLIED BY FABRICATOR
CODE ASME 1971 SECT. VIII DIV. 1		SHELL SA-285-C	LADDER AND PLATFORM CLIPS
SPECS.		HEADS SA-285-C	INSULATION CLIPS AND RINGS
		SUPPORT SA-36	DAVIT SUPPORTS
DESIGN CONDITIONS	INT. 31 PSIG @ 650°F	NOZZLE NECKS SA-106 A OR B	PIPE SUPPORT LUGS
	EXT. FULL @ °F	FLANGES SA-181 GR I	PIPE GUIDE LUGS
OPER. PRESS.	32 PSIG @ 600°F	INTERNALS C.S.	
RADIOGRAPHY SPOT		GASKET 1/16" AM 160 OR EQUAL	FIREPROOFING 2" I.S. TO S. [illegible] THERE
POST WELD HEAT TREAT NO			INSULATION 1" 8# & THERE
JOINT EFF. 85% SEAMLESS HEADS		MANWAY (MANUFACTURER DAVITED)	PAINT NO
CORROSION ALLOWANCE 0"		NOTES & REF DWGS.	
		NOZZLE NOTE	
NET FAB. WEIGHT	80,540 #	RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTERIOR FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED	
EMPTY WEIGHT			
OPER. WEIGHT			
TEST WEIGHT			
		SIZE PROJECTION THRU THRU	SIZE PROJECTION THRU THRU

NOZZLE SCHEDULE

MARK NO	NO REQD	SIZE	RATING	FACING	SERVICE
N_6	2	2"	150#	R.F.	L.C.
N_5	1	4"	150#	R.F.	
N_4	1	3/4"	T.E.L. 135	R.F.	OUTLET w/ INT. PIPE & R.F. FLG.
N_3	1	20"	150#	R.F.	OUTLET
N_2	1	14"	150#	R.F.	INLET w/ INT. PIPE
N_1	1	20"	150#	R.F.	INLET w/ INT. PIPE
M_2	1	48"	SPECIAL	R.F.	MANHOLE w/ B.F. STUDS, NUTS & GSKT
M_1	1	24"	150#	R.F.	MANHOLE w/ B.F. STUDS, NUTS & GSKT

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

PRETREATER. CHAR COOLER VESSEL

ITEM NO. 13.06-04 UNIT 1300

HYGAS

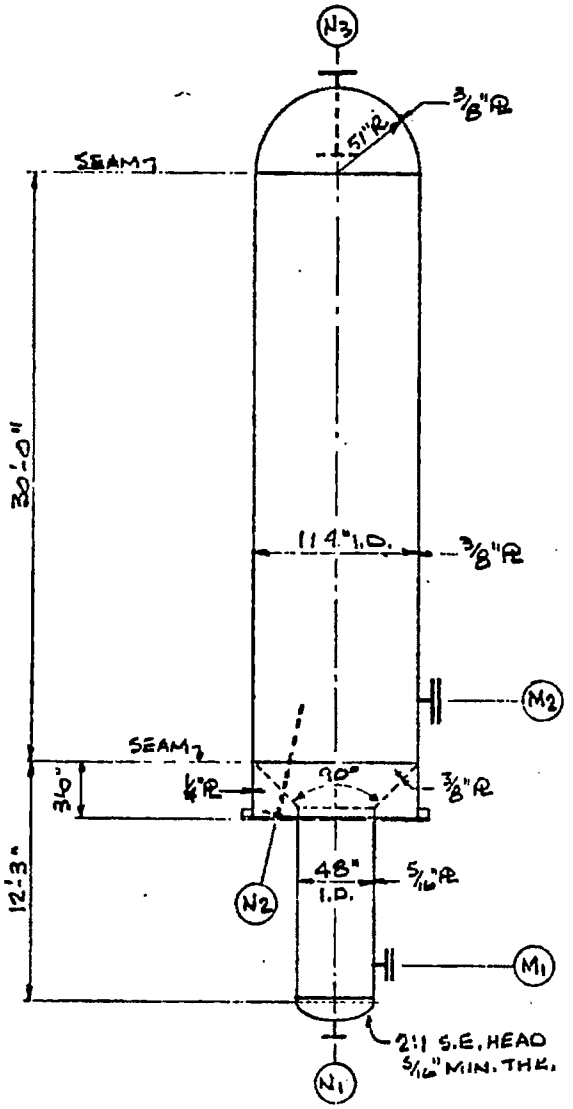
IGT CHICAGO, ILL.

DRAWN DATE

CHECKED

APPROVED

DESIGN DATA		
CODE ASME CONSTR. 1971 SECT. VIII DIV I		
SPECS.		
DESIGN CONDITIONS	INT. 3 PSIG @ 200 °F	
	EXT. PSIG @ °F	
OPER. PRESS.	15 PSIG @ 250 °F	
RADIOGRAPHY	NO	
POST WELD HEAT TREAT	NO	
JOINT EFF.	60% TOTAL VESSEL	
CORROSION ALLOWANCE	1/8"	
NET FAB. WEIGHT	24000#	
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL	A-285-C	
HEADS	A-285-C	
SUPPORT	A-36	
NOZZLE NECKS	A-53 A OR B	
FLANGES	A-181 GR 1	
INTERNALS	C.S.	
GSKT. 1/16" THK.	JM 60 OR EQUAL	
MANWAY (FINISED ~~COVENTED~~)		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	NO.	
PIPE SUPPORT LUGS	YES	
PIPE GUIDE LUGS	YES	
FIREPROOFING	2" I.S & O.S.	
INSULATION	1" BY OTHERS.	
PAINT	NONE	



MARK	QTY	SIZE	RATING	FACING	SERVICE
Lift Lg	2	2"	150#	RF	LC
N6	1	2"	150#	RF	
N5	1	6"	150#	RF	
N4	1	6"	150#	RF	
N3	1	14"	150#	RF	OUTLET w/ INT. PIPE & R FLG.
N2	1	20"	150#	RF	INLET w/ INT. PIPE
N1	1	20"	150#	RF	OUTLET
MH 2	2	24"	150#	RF	MANHOLE w/ B.F., STUDS, NUTS & GSKT

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM OD OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
___ THRU ___	___	___ THRU ___	___
___ THRU ___	___	___ THRU ___	___

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

ATMOSPHERIC CHAR COOLER - STRIPPER VESSEL

ITEM NO 13.06-05 UNIT 1300

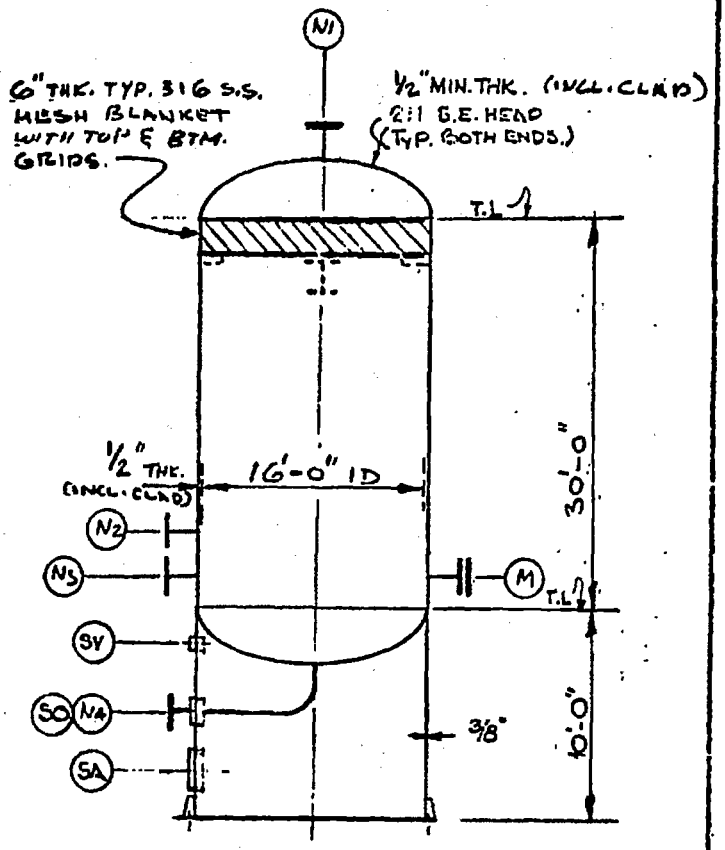
HYGAS

IGT CHICAGO, ILL

DRAWN	DATE	
CHECKED		
APPROVED	DWG. NO	A

DESIGN DATA			
CODE	ASME SECT VIII DIV 1		
SPECS.			
DESIGN CONDITIONS	INT. 40	PSIG @ 600°F	
	EXT. —	PSIG @ — °F	
OPER. PRESS.	15	PSIG @ 250°F	
RADIOGRAPHY	SPOT		
POST WELD HEAT TREAT	NO		
JOINT EFF.	SHELL 85%	HEADS 85%	
CORROSION ALLOWANCE	1/8"		
NET FAB. WEIGHT	66,410 #		
EMPTY WEIGHT			
OPER. WEIGHT			
TEST WEIGHT			
MATERIAL SPECIFICATIONS			
SHELL	SA-285-C	FBQ *	
HEADS	SA-285-C	FBQ *	
SUPPORT	SA-283-C		
NOZZLE NECKS	SA-106-B *		
FLANGES	SA-181-Gr I *		
INTERNALS	TP. 316 S.S.		
GSKT. - 1/16" THK. COMPR. ASB			
MANWAY (HINGED ~~BOLTED~~)			
ACCESSORIES TO BE SUPPLIED BY FABRICATOR			
LADDER AND PLATFORM CLIPS	YES		
DAVIT SUPPORTS	NO		
PIPE SUPPORT LUGS	YES		
PIPE GUIDE LUGS	YES		
FIREPROOFING	BY OTHERS		
INSULATION			
PAINT	1 SHOP COAT	PRIMER	
LIFTING LUGS	YES		

* CLAD SHELL AND HEADS WITH TP. 316 S.S. PER ASTM A-264 (0.125" MIN.); NOZZLES LINED & FACED WITH TP. 316 S.S.



MARK NO.	NO. REQ'D	SIZE	RATING	FACING	SERVICE
SV	2	4"	—	—	SKIRT VENT
SA	2	18"	—	—	SKIRT ACCESS
SO	1	40"	-	—	SKIRT OPENING
M	1	18"		&	MANWAY W/BF, STUDS, NUTS & GSKT.
N4	1	36"	CL.175		
N3	1	10"	150#		
N2	1	2"	CL.175		
N1	1	42"	CL.175	RF	

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTERGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
THRU		THRU	
THRU		THRU	

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

VENTURI SCRUBBER SEPARATOR

ITEM NO. 13.06-06 UNIT 1300

HYGAS

IGT CHICAGO, ILL.

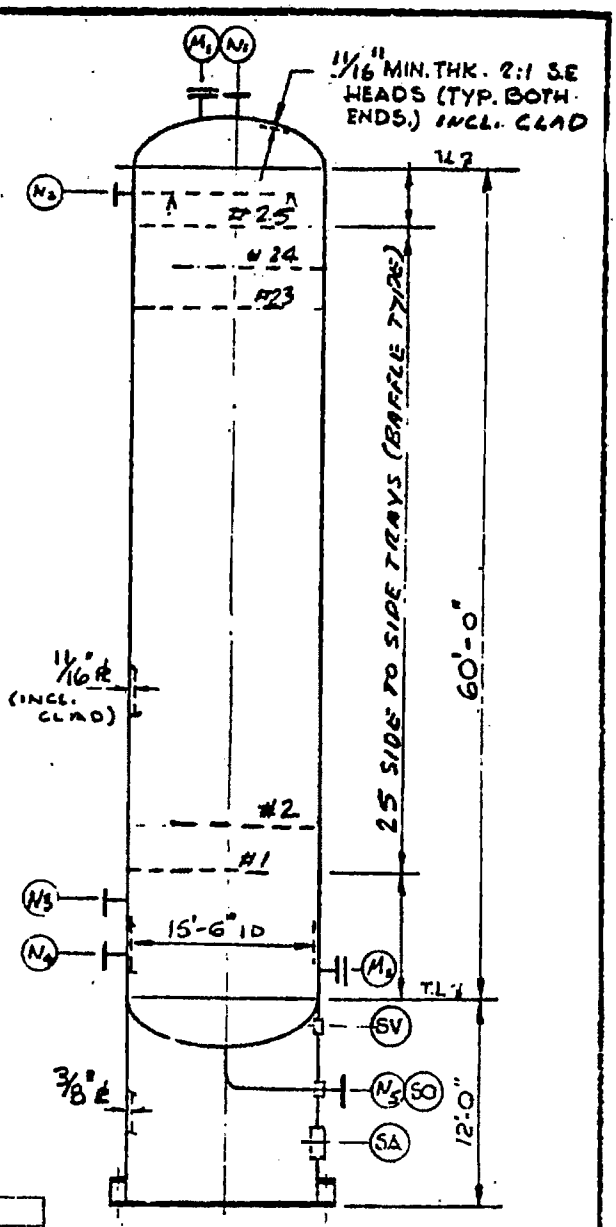
DRAWN T.G. DATE 1/4/72

CHECKED

APPROVED DWG. NO A

DESIGN DATA		
CODE ASME SECT VIII DIV 1		
SPECS.		
DESIGN CONDITIONS	INT. 70 PSIG @ 300 °F	
	EXT. – PSIG @ – °F	
OPER. PRESS. 45 PSIG @ 250°F		
RADIOGRAPHY SPOT		
POST WELD HEAT TREAT NONE		
JOINT EFF. SHELL 85%	HEADS 85%	
CORROSION ALLOWANCE 1/8"		
NET FAB. WEIGHT 117,500 lb		
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL SA-285-C FBQ *		
HEADS SA-285-C FBQ *		
SUPPORT SA-283-C		
NOZZLE NECKS SA-106 A or B *		
FLANGES SA-181-GRI *		
INTERNALS TP. 316 S.S.		
GSKT. - 1/16" THK. COMPR. ASBESTOS		
MANWAY (PINNED [redacted])		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	YES	
PIPE SUPPORT LUGS	YES	
PIPE GUIDE LUGS	YES	
FIREPROOFING	YES, BY OTHERS.	
INSULATION	YES, BY OTHERS	
PAINT 1 SHOP COAT PRIMER		
LIFTING LUGS	YES	

* SHELL AND HEADS CLAD WITH 0.125" MIN. TP. 316 S.S. PER ASTM A-264. NOZZLES LINED & FACED WITH TP. 316 S.S.



MARK NO.	NO. REQ'D	SIZE	RATING	FACING	SERVICE
SV	1	4"	–	–	SKIRT VENT
SO	1	34"	–	–	SKIRT OPENING
SA	1	15"	–	–	SKIRT ACCESS.
M1,2	2	18" ID	150#		MANWAY W/ BF, STUDS, NUTS & GSKT
N5	1	30"	CL. 175		
N4	1	10"	150#		
N3	1	42"	CL. 175		
N2	1	18"	150#		
N1	1	36"	CL. 175	RF	

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
1" THRU 3"	7"	4" THRU 8"	8"
10" THRU 18"	10"	20" THRU OVER	12"

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

PRE TREATER QUENCH TOWER

ITEM NO 13.06-07 UNIT 1300

HYGAS

IGT CHICAGO, ILL.

DRAWN T.G. DATE 1/4/72

CHECKED

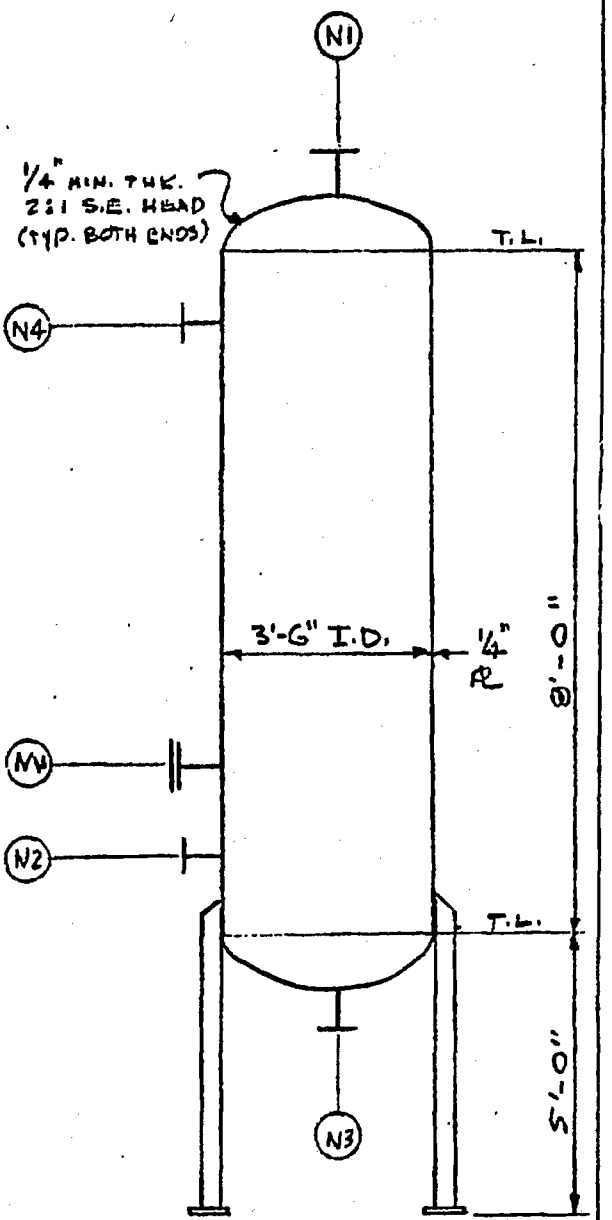
APPROVED VR DWG. NO A

DESIGN DATA					
CODE ASME SEC. VIII - DIV. 1				STAMP	YES
PER SPEC.					
DESIGN CONDITIONS	INT.	40	PSIG @	150	°F
	EXT.		PSIG @		°F
OPER. PRESS. / TEMP.		12	PSI @	130	°F
POST WELD HEAT TREAT		NO			
RADIOGRAPHING		SPOT			
JOINT EFFICIENCY	SHELL	85%	HEADS	100%	
CORR. ALLOWANCE	SHELL	1/8"	HEADS	1/8"	
NET FABR. WT. (LESS TRAYS)					lbs.
EMPTY WEIGHT					lbs.
OPERATING WT.					lbs.
TEST WEIGHT					lbs.
SHELL	SA-285-C				
HEADS	SA-285-C				
SUPPORT	SA-36				
NOZZLE NECKS	SA-106-A				
FLANGES	SA-181-I				
GASKETS	1/16" THK. COMPR. ASB.				
INTERNALS	C.STL.				
COUPLINGS					
LINING					
WIND	M_W =				FT. LBS.
EARTHQUAKE	M_E =				FT. LBS.
MANWAY HING'D [redacted] W/BF, STUDS, NUTS & GSKT					
FIREPROOFING	—		THK		
INSULATION	—		THK		

MK.	NO. REQ'D.	SIZE	RTG.	FCG.	SERVICE
M1	1	18"ID			MANWAY
N4	1	4"			
N3	1	6"			
N2	1	12"			
N1	1	12"	150#	RF	

NOZZLE SCHEDULE

ACCESSORIES TO BE SUPPLIED BY FABRICATOR	
LADDER & PLATFORM CLIPS	NO
DAVIT SUPPORTS	NO
PIPE SUPPORT LUGS	NO
PIPE GUIDE LUGS	NO
FIREPROOFING ATTACHMENTS	NO
INSUL. CLIPS & RINGS	NO
LIFTING LUGS	NO
PAINT	1 COAT COAT PRIMER

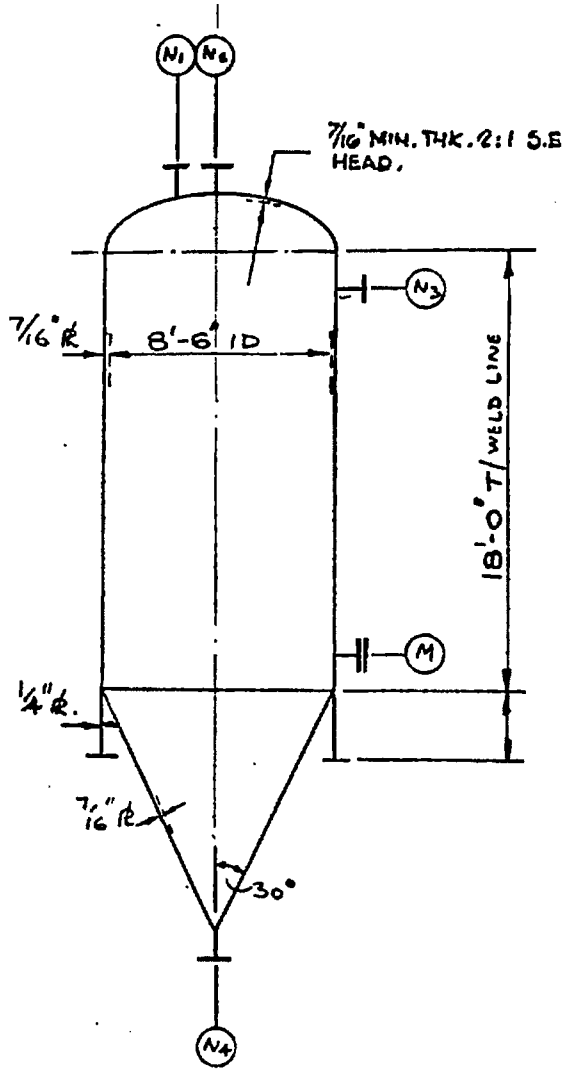


DRAWN BY	B.K.
DATE	3.22.72
CHK'D	
APP'D	

Procon Incorporated
INERT GAS QUENCH DRUM
ITEM NO. 13.06-41 UNIT 1300
HYGAS
IGT CHICAGO, ILL
REQ. NO.

HOP-21-2030

DESIGN DATA		
CODE	ASME SECT VIII DIV 1	
SPECS.		
DESIGN CONDITIONS	INT. 15 PSIG @ 200 °F	
	EXT. 15 PSIG @ 200 °F	
OPER. PRESS.	-10" WG PSIG @ 170 °F	
RADIOGRAPHY	SPOT	
POST WELD HEAT TREAT	NO	
JOINT EFF.	SHELL 85% HEADS 100%	
CORROSION ALLOWANCE	1/8"	
NET FAB. WEIGHT	19,100#	
EMPTY WEIGHT		
OPER. WEIGHT		
TEST WEIGHT		
MATERIAL SPECIFICATIONS		
SHELL	A-285-C FBQ	
HEADS	"	
SUPPORT	A-36	
NOZZLE NECKS	A-106-A	
FLANGES	A-181-Gr I	
INTERNALS		
MANWAY (HINGED OR [illegible])		
ACCESSORIES TO BE SUPPLIED BY FABRICATOR		
LADDER AND PLATFORM CLIPS	YES	
DAVIT SUPPORTS	NO	
PIPE SUPPORT LUGS	YES	
PIPE GUIDE LUGS	YES	
FIREPROOFING	BY OTHERS	
INSULATION		
PAINT 1 SHOP COAT	PRIMER	
LIFTING LUGS	YES	



4 - VACUUM STIFFENING RINGS REQ'D

MARK NO.	NO. REQ'D	SIZE	RATING	FACING	SERVICE
M	1	18"ID			MANWAY W/BF, STUDS, NUTS & GSKT
N6	1	20"			
N3	1	8"			
N2	1	20"			
N1	1	4"	150#	RF	

NOZZLE SCHEDULE

RADIAL NOZZLE AND MANHOLE PROJECTIONS ARE FROM O.D. OF VESSEL TO EXTREME FACE OF FLANGE EXCEPT FOR INTEGRAL REINFORCED NOZZLES OR OTHERWISE NOTED

SIZE	PROJECTION	SIZE	PROJECTION
___ THRU ___	___ ___	___ THRU ___	___ ___
___ THRU ___	___ ___	___ THRU ___	___ ___

NO.	REVISION	DATE	BY	CHK.

Procon Incorporated

DRIED FEED SURGE DRUM
ITEM NO. 13.06-42 UNIT 1300
HYGAS

IGT CHICAGO, ILL.

DRAWN T.G. DATE 1/4/72
CHECKED
APPROVED VR DWG. NO A