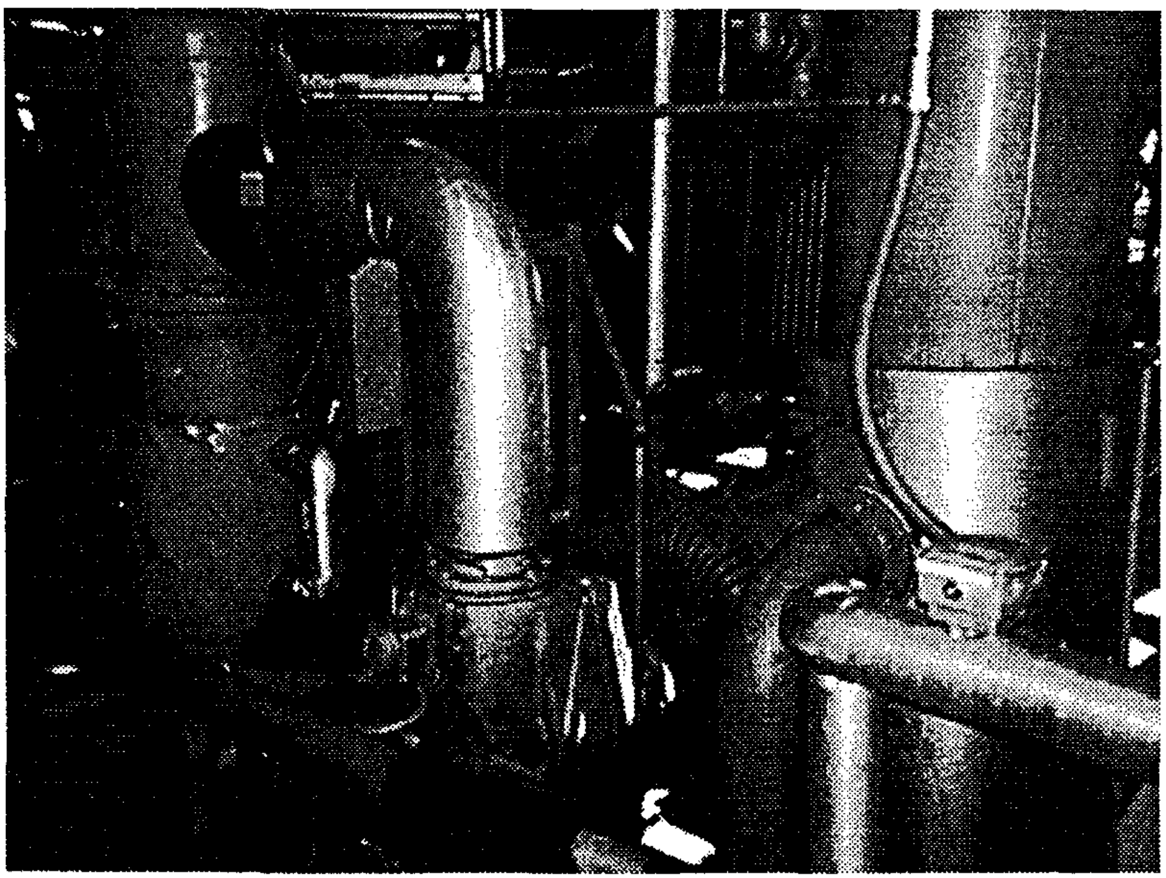
ACCP Inert Gas System

Design and Operation Description

October 1997
Rev. 0

Prepared For: Rosebud SynCoal Partnership



Prepared By: Jeff Richards, P.E.

1.0 System Description

The Inert Gas System (IGS) was designed to compress stack gas at the ACCP, mainly for the purpose of SynCoal® product storage inerting.

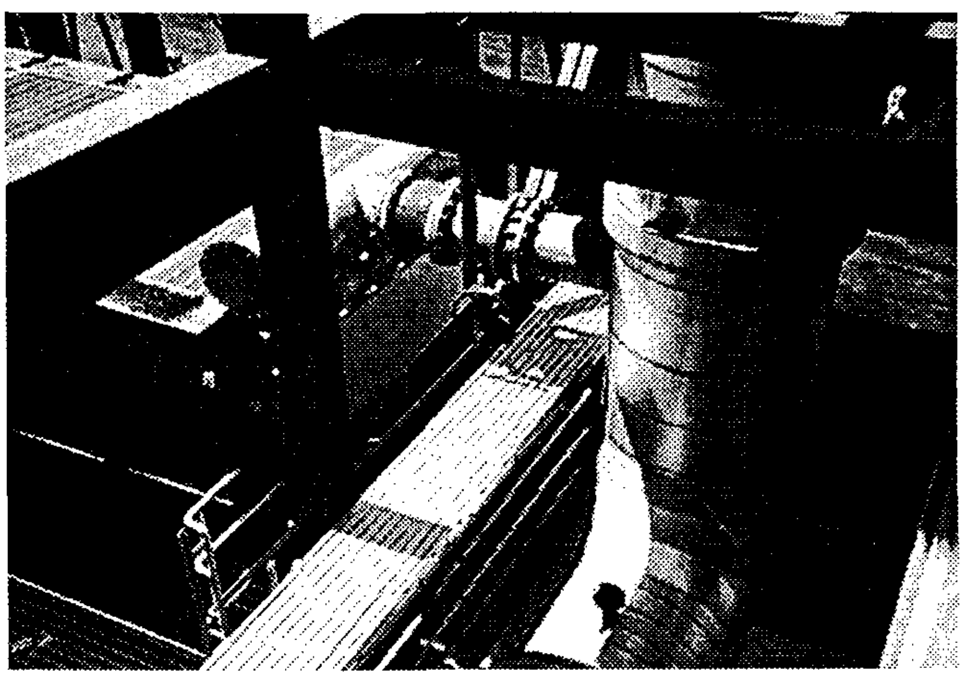
The IGS is shown on UniField P&ID Diagram Number 93-378-000 Rev. 1, which follows on the next page. Referring to the P&ID, the IGS is comprised of a stack connection (take-off), gas cooling heat exchanger, water knock-out drum, particulate removal, compressor, compressed gas desiccant dryer, gas receiver, and distribution piping.

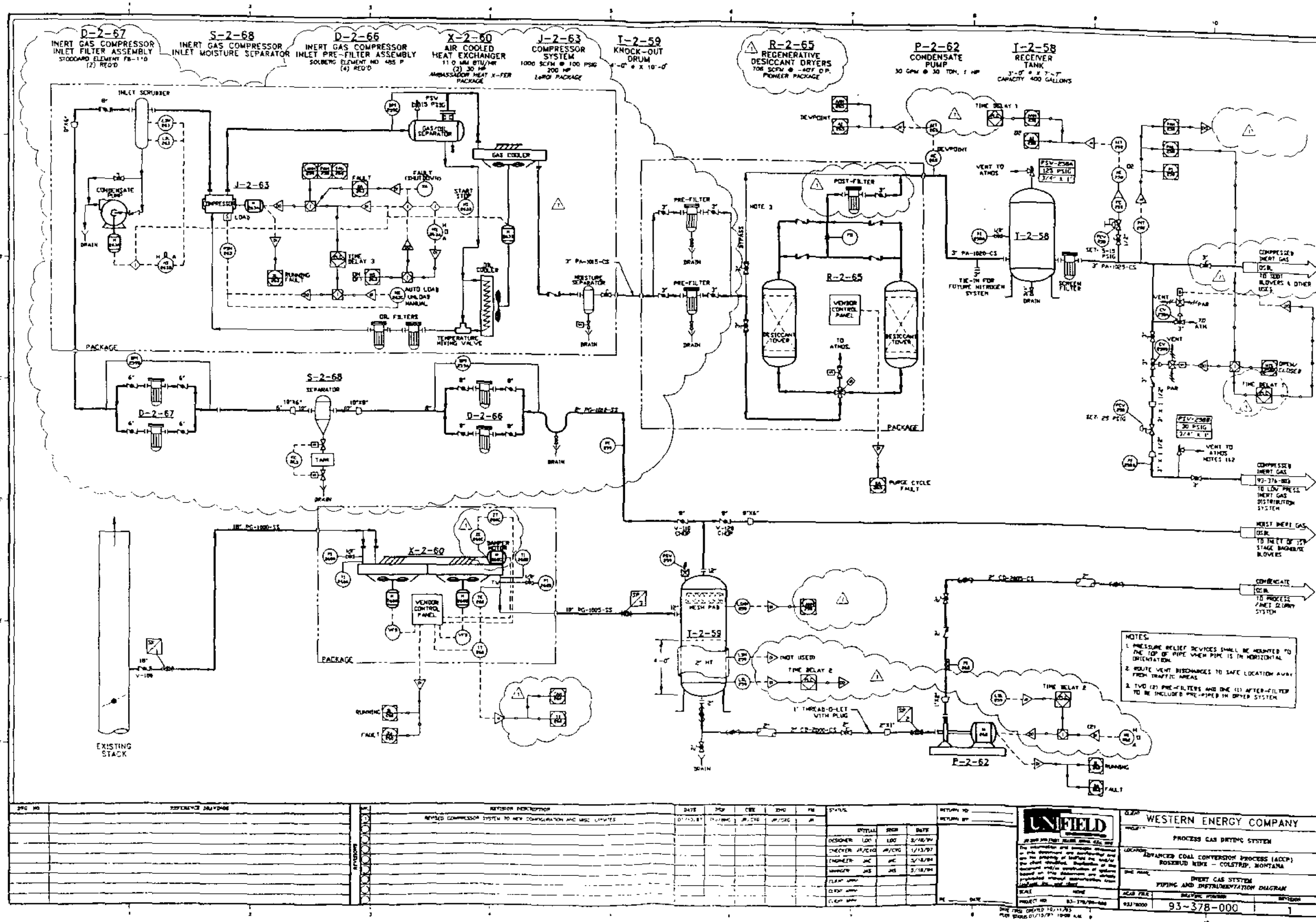
2.0 Specifications

The specifications for the IGS included two specifications provided by UniField Engineering which are appended to this document. UniField Specification No. PS-0-002 dated 11/5/93 "Specifications for Air Cooled Heat Exchanger and Condensate Knock-Out Drum" appears as Appendix A, and Specification No. PS-0-001 dated 11/5/93 "Specifications for Gas Compressor and Dryer System" appears as Appendix B.

3.0 Inert Gas System Take-off and Cooling

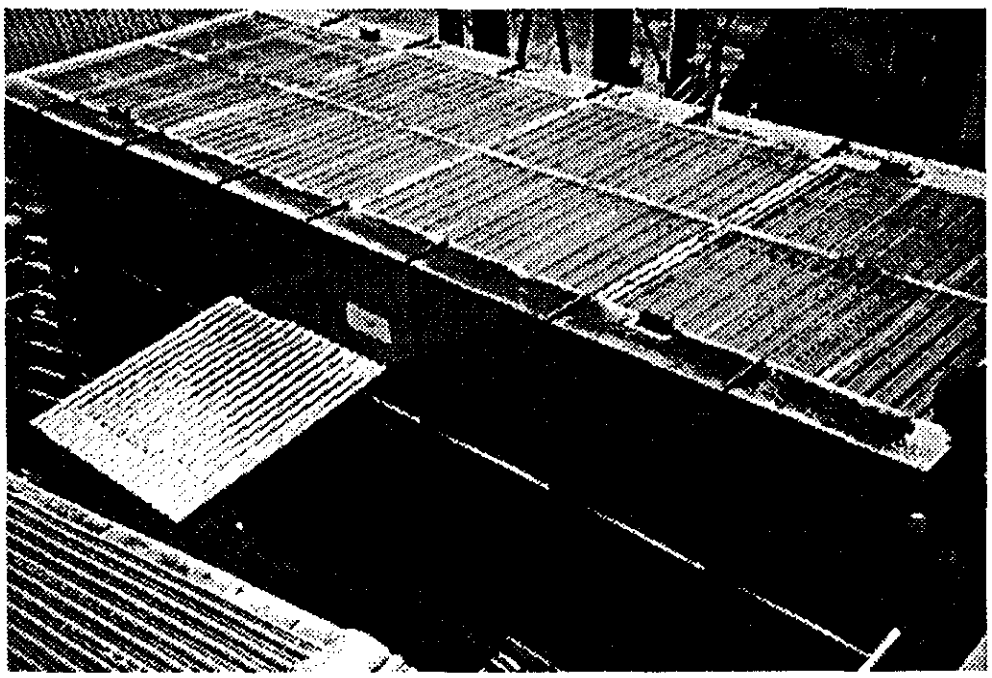
The IGS starts at the ACCP plant stack and is connected via an 18" diameter pipe.




D-2-67
INERT GAS COMPRESSOR INLET FILTER ASSEMBLY
STODDARD ELEMENT FB-110 (2) REQ'D
S-2-68
INERT GAS COMPRESSOR INLET MOISTURE SEPARATOR
D-2-66
INERT GAS COMPRESSOR INLET PRE-FILTER ASSEMBLY
SOLBERG ELEMENT NO 485 P (4) REQ'D
X-2-60
AIR COOLED HEAT EXCHANGER
J-2-63
COMPRESSOR SYSTEM
1000 SCFM @ 100 PSIG
200 HP
T-2-59
KNOCK-OUT DRUM
R-2-65
REGENERATIVE DESICCANT DRYERS
PIONEER PACKAGE
P-2-62
CONDENSATE PUMP
T-2-58
RECEIVER TANK
CAPACITY 400 GALLONS
INLET SCRUBBER
CONDENSATE PUMP
DRAIN
PACKAGE
GAS/OIL SEPARATOR
GAS COOLER
OIL COOLER
OIL FILTERS
TEMPERATURE MIXING VALVE
MOISTURE SEPARATOR
PRE-FILTER
POST-FILTER
VENDOR CONTROL PANEL
DESICCANT TOWER
PURGE CYCLE FAULT
TIME DELAY 1
TIME DELAY 2
TIME DELAY 3
DEWPOINT
RUNNING
FAULT
START STOP
AUTO LOAD UNLOAD MANUAL
VENT TO ATMOS
TIE-IN FOR FUTURE NITROGEN SYSTEM
SCREEN FILTER
COMPRESSED INERT GAS TO SOOT BLOWERS & OTHER USES
COMPRESSED INERT GAS TO LOW PRESS. INERT GAS DISTRIBUTION SYSTEM
MOIST INERT GAS TO INLET OF 1ST STAGE BAGHOUSE BLOWERS
CONDENSATE TO PROCESS FINES SLURRY SYSTEM
EXISTING STACK
MESH PAD
(NOT USED)
1" THREAD-O-LET WITH PLUG
NOTES:
1. PRESSURE RELIEF DEVICES SHALL BE MOUNTED TO THE TOP OF PIPE WHEN PIPE IS IN HORIZONTAL ORIENTATION.
2. ROUTE VENT DISCHARGES TO SAFE LOCATION AWAY FROM TRAFFIC AREAS.
3. TWO (2) PRE-FILTERS AND ONE (1) AFTER-FILTER TO BE INCLUDED PRE-PIPED IN DRYER SYSTEM.
UNIFIELD
WESTERN ENERGY COMPANY
PROCESS GAS DRYING SYSTEM
ADVANCED COAL CONVERSION PROCESS (ACCP)
ROSEBUD MINE - COLSTRIP, MONTANA
INERT GAS SYSTEM
PIPING AND INSTRUMENTATION DIAGRAM
93-378-000
1

A hand valve is used to operate the inert gas into the main process heat exchanger (X-2-60). The heat exchanger inlet manifold is located to the left (South) of the process connection.

The process heat exchanger is a two-cell fin-tube exchanger, 30 feet Long and 12 feet wide with approximately 81,850 ft^2 of heat exchange surface area. The heat exchanger was designed and manufactured in May, 1994 by Ambassador Heat Transfer Company, and was designated Model Number PCS-315. Two fans are driven each by a 30 HP variable frequency drive (VFD) based on process temperature of the gas exiting the exchanger. A picture of the exchanger appears below.



The exchanger was designed to cool a wet gas stream, 1506 SCFM (dry basis) from 270°F to approximately 100°F. The temperature of the inert gas is designed to be no higher than 115°F but in actuality a 10°F approach temperature is all that could be expected. The cooling air supplied to the exchanger fans which is in the location of the first stage fans, has at times been at temperatures exceeding 115°F. The inert gas temperature to the inlet of the compressor could be expected to exceed 125°F at times. Also, when ambient conditions approach -40°F, it is necessary to close supplied louvers on the exchanger to allow a bypass of cooling gas through the exchanger to actually warm the gas and prevent freeze-up in the exchanger tubes.

The inert gas, after cooling, passes through a knock-out (KO) drum (T-2-59) complete with mist eliminator (demister pad) packing. Water droplets and liquid condensate are contained in the lower portion of the KO drum which allows storage of the liquid and delivery to pump (P-2-62) delivering the condensate liquid to the slurry system.

Dry Inert Gas proceeds to either the IGS compressor or the ACCP first stage PRS baghouse blowers.

4.0 Inert Gas Moisture and Particulate Removal

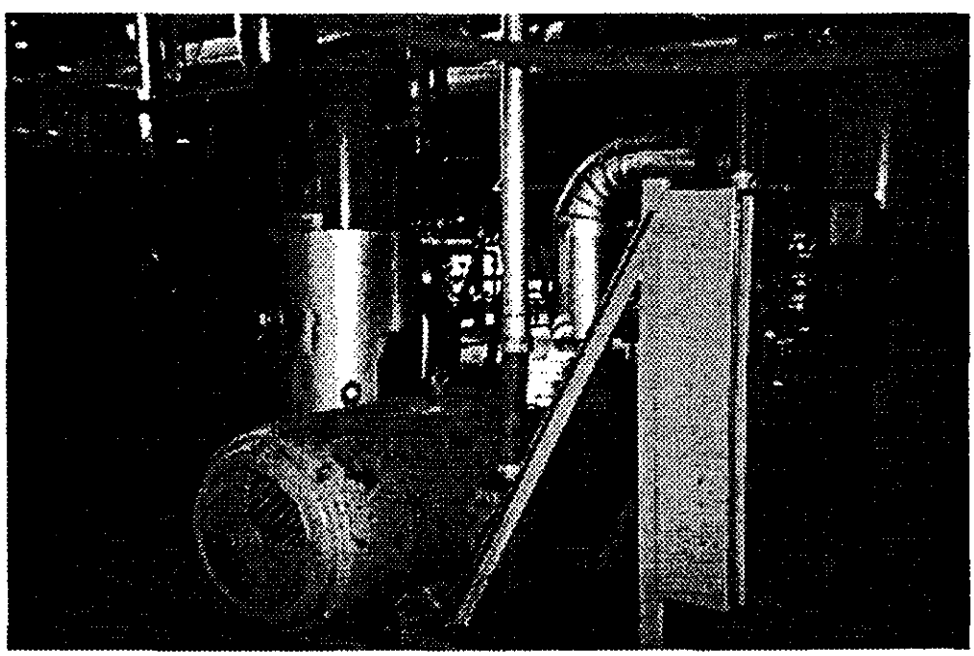
There are two filtration systems. The first particulate filter (D-2-66) is located above the IGS skid and consists of parallel filter canisters, Solberg Model CSL-485P (2)-1200F. The original elements were designed for 10 micron particulate removal, but have been replaced with elements removing 5 micron particulate.

The second particulate filter (D-2-67) is located at the inlet to the compressor, and consists of two Stoddard F65V-6 canisters in parallel, complete with bypass valving. The elements used are Stoddard F64-6, 99% efficient at 1 micron particulate removal.

During operation, the longevity of the filters are directly proportional to the integrity of the first stage baghouse bags. If the bags in the first stage PRS are breached, the filters for D-2-66 and D-2-67 will plug up more quickly.

5.0 Inert Gas Compressor

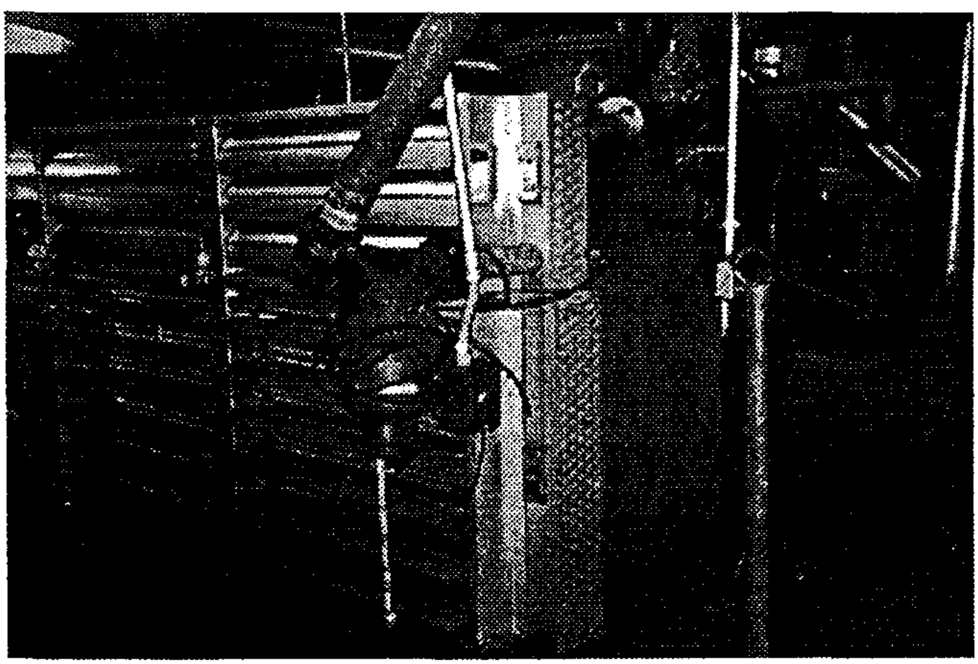
The inert compressor skid system (J-2-63) is a self contained unit and is shown below.



The package was supplied by Energy Equipment and Supply of Casper, Wyoming and is comprised mainly of LeROI components. Referring to UniField drawing 93-378-000, the inlet gas first flows through an inlet scrubber to remove any remaining moisture prior to the compressor.

The compressor is a G series LeROI oil flooded single screw compressor (Model No. 2A219-131). A 200 HP, 4160V motor is supplied with the compressor. Approximately 983 ICFM (actual cubic feet per minute at the compressor inlet) of inert gas flows into the screw compressor along with lubricating oil returning from the air/oil separator sump. The compressed gas flows to the air/oil separator, where the oil disengages the compressed gas. The approximately 703 SCFM of gas is kept at 100 psig as it passes through the Kimray regulator prior to gas cooling.

The gas and the oil are cooled through individual sections of a Fin-X, Incorporated fin-fan heat exchanger with air actuated shutters. A 5 HP fan supplies the cooling air through the heat exchanger. On the picture below, note that the top 1/3 section is for gas cooling and the bottom 2/3 section is for compressor lubrication oil cooling.



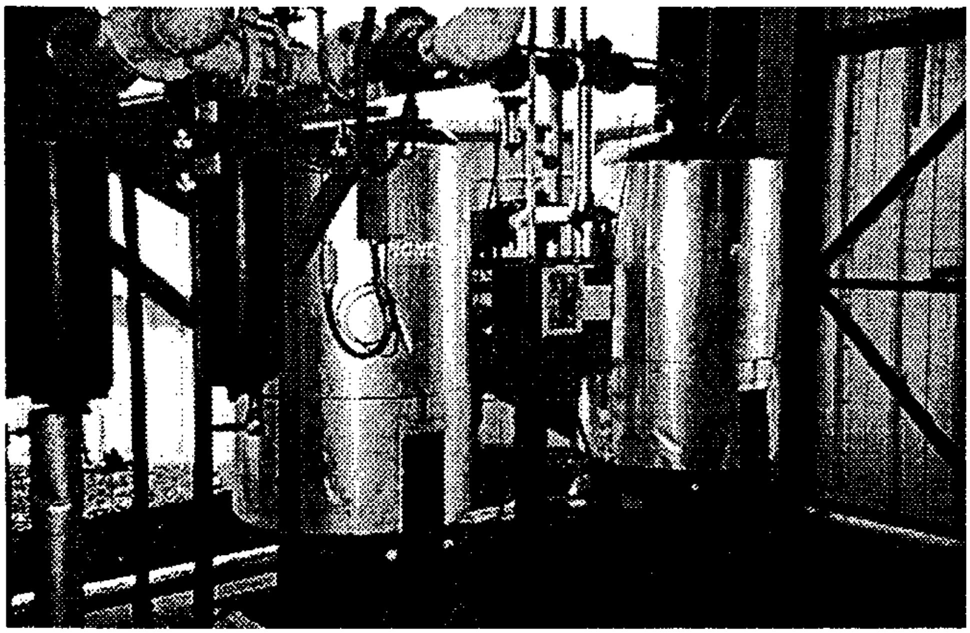
The gas passes through a final moisture separator after the cooler, shown centrally in the above photo. The removed moisture is discharged to the floor drain.

After the compressor moisture separator, the compressed gas proceeds to the regenerative desiccant drying system.

The lubricating oil used for this application is a non-hazardous custom blended polyol-ester synthetic (PE). It was specifically chosen for its higher temperature operation, oxidative stability, and low temperature properties.

6.0 Inert Gas Drying/Surge Capacity

The inert gas regenerative desiccant drying system (R-2-65) supplied by Pioneer Air Systems Inc. is shown below. The unit consists of twin Pioneer PHE-1000 desiccant towers. One unit is always in service, while the other tower is in the drying mode. The PHE dryer is equipped with an external heater to aid in drying the desiccant.

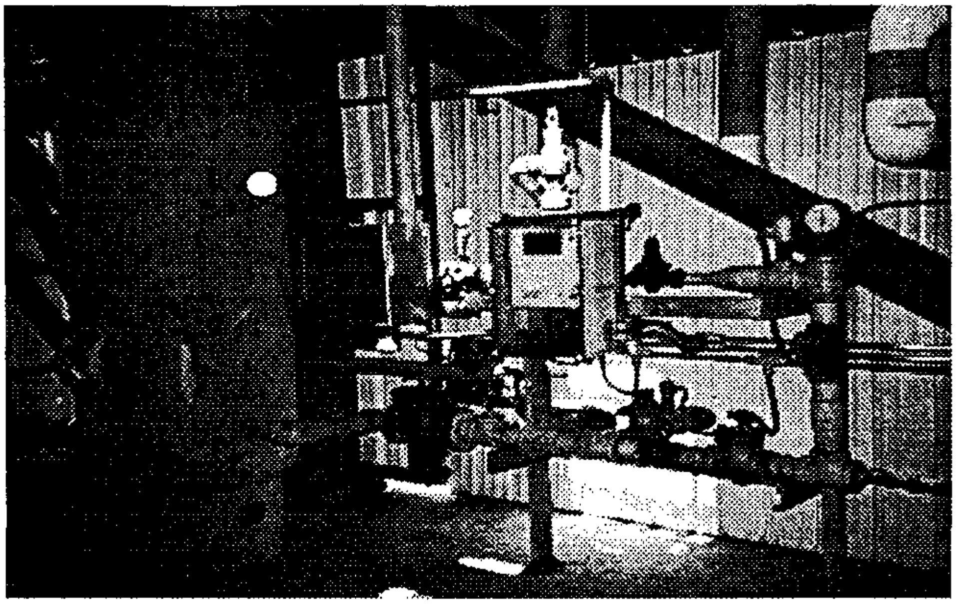


The unit is supplied with pre and post coalescing filters to eliminate the carry over of droplets and mists of both liquid water and compressor lubricant, as well as particulate from the regenerative drying system.

7.0 Inert Gas Distribution

After the regenerative desiccant dryer system, the inert gas is stored in a 400 gallon receiver tank (T-2-58). The inert gas is controlled and distributed through the distribution manifold system located at the North end of the plant. This distribution manifold incorporates oxygen measurement and control such that if the inert gas oxygen content is higher than allowed, a valve shuts stopping the inert gas from flowing to the point of end-use.

The inert gas pressure is controlled at 25 psig prior to the low pressure distribution at either the plant location or the silo. The receiver tank and distribution manifold system is shown in the following photograph.



7.1 In-Plant Distribution Piping

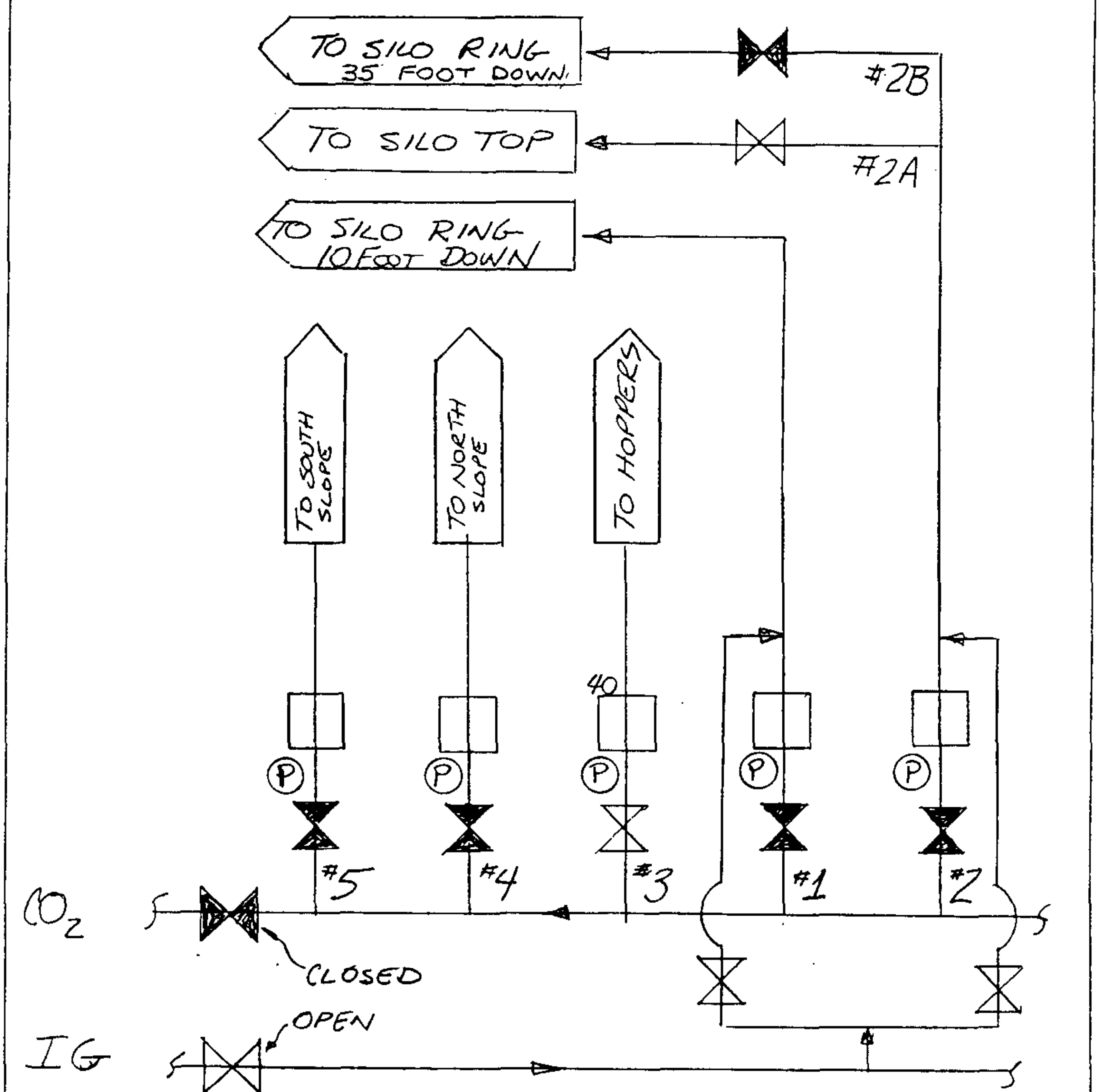
The inert gas is available to the soot blowers and the infeed rotary air-locks at system pressure of 80 psig. After the 25 psig control point at the regulator, low pressure inert gas is available for purging at the second stage reactor deck located centrally to the plant, or to the silo.

7.2 Silo Distribution Piping

Each silo has five locations with 2" diameter piping for inerting:

1. The No. 1 silo pipe feeding the top ring consisting of 16 each 3/4" pipe penetrations located at 10 foot from the top of the silo.
2. The No. 2 silo pipe feeding the top ring consisting of 16 each 3/4" pipe penetrations located at 35 foot from the top of the silo.
3. The No. 3 silo pipe feeding the hoppers (three each per silo).
4. The No. 4 silo pipe feeding the mid-point of the silo on the south side, and
5. The No. 5 silo pipe feeding the mid-point of the silo on the north side.

On top of the silo, Line location No. 2 has valving to supply either the 35 foot ring (No. 2B), or distribution to the very top of the silo (No. 2A). A sketch of which follows.

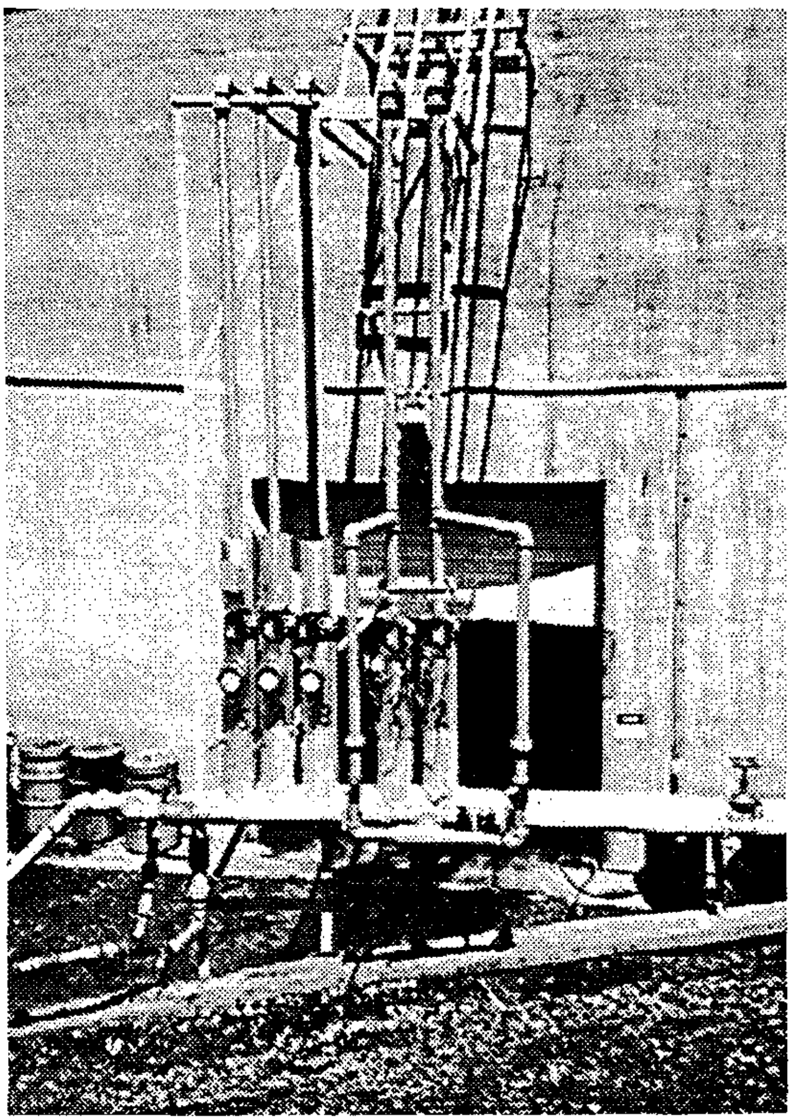


NORMAL PLANT RUNNING
INERT GAS VALVE POSITION
WHEN CO IS LESS THAN 850 PPM

The low pressure silo distribution manifolds are fed either inert gas or CO_2 . When CO_2 is delivered to the silo, the gas is fed through valves, with flow meter indication of the amount of CO_2 supplied. (See UniField drawing No. 93-376-003) Typically, the CO_2 pressure supplied to the piping is 35 psig at the regulator located downstream of the CO_2 storage tanks and vaporizers. With and inert gas pressure of 25 psig at the plant, the silo distribution manifold typically operates at about 10 psig.

The inert gas piping allows a bypass of inert gas around the CO_2 to No. 1 and No. 2 valves and provides inert gas to either of these two locations while supplying CO_2 to the other locations. When operated on inert gas, approximately 250 SCFM of inert gas flows through each of locations No. 1 and No. 2.

A picture of the inert gas and CO_2 piping for silo T-95 appears below.



8.0 Operational Procedure SOI-06

The system is operated to ensure that all of the upstream components are in operation prior to the down stream components coming on stream. The heat exchanger must be in operation prior to starting the compressor, prior to starting the dryer, and so on. While the compressor is starting up, the inert gas is bypassed to atmosphere until the oxygen content is below 5%. At that time, the inert gas is fed to the low pressure manifold and ultimately to the silos. Operational procedure SOI-06, which delineates the operation of the system is included as Appendix C of this document.

APPENDIX A

Engineering Specifications for Air Cooled Heat Exchanger and Condensate Knock-Out Drum

SPECIFICATIONS FOR
AIR COOLED HEAT EXCHANGER
AND CONDENSATE KNOCK-OUT DRUM

WESTERN ENERGY COMPANY
ACCP PROCESS GAS DRYING SYSTEM
SPECIFICATION NUMBER PS-0-002

November 5, 1993

ENGINEER

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PURCHASER

Western Energy Company
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SPECIFICATIONS FOR
AIR COOLED HEAT EXCHANGER
AND CONDENSATE KNOCK-OUT DRUM

WESTERN ENERGY COMPANY
ACCP PROCESS GAS DRYING FACILITY
SPECIFICATION NUMBER PS-0-002

TABLE OF CONTENTS

1. SCOPE

A. This specification, together with the Special Conditions for Standard Purchases, details the performance, design, and manufacturing requirements for furnishing and delivering an air cooled heat exchanger and condensate knock-out drum.

B. The air cooled heat exchanger and condensate knock-out drum will be installed at a coal drying facility located at the Western Energy mine site in Colstrip, Montana.

C. The heat exchanger will be used to cool a wet gas stream (1506 dscfm basis) from approximately 270°F to 100°F. The condensate knock-out drum will be used to separate condensate from the cooled gas and entrained water droplets.

D. The Seller shall furnish and deliver to the jobsite equipment, material, and services as follows:

1. Air cooled heat exchanger
2. Electric motors and starters
3. Single loop control system
4. Control panel
5. Necessary protective devices
6. Variable frequency drives for cooling control
7. Temperature measurement and transmitter equipment
8. Condensate knock-out drum

E. The equipment furnished shall be a complete package of components required to develop the performance conditions outlined herein.

F. The heat exchanger shall be fully assembled and prewired at the factory and shipped to the site as a single, complete unit. The overall length of the heat exchanger shall be no greater than 30'-0" and the overall width shall be no greater than 12'-0".

G. The condensate knock-out drum shall be of vertical orientation and shipped to the site as a single, complete unit.

H. Special requirements of performance or design that effect the equipment are specified in herein.

2. RELATED WORK

A. The purchaser will provide the following:

1. Unloading, storage and installation
2. Supporting structural steel
3. Plant Control System (PCS)
4. External connections to piping and electrical systems, power and instrumentation
5. Electrical Power Supply:
   a. 480 V ± 10%, 60 Hz, 3 phase
   b. 120 V ± 10%, 60 Hz, 1 phase

3. REFERENCE STANDARDS

A. The following reference standards are applicable to this specification. The latest issue, based on the date of this specification, and any subsequent addenda, shall apply.

B. If there is, or seems to be, a conflict between this specification and a referenced document, the matter shall be referred to the Engineer.

American Institute of Steel Construction

AISC	Manual of Steel Construction

American Petroleum Institute

API Std 661	Air-Cooled Heat Exchangers for General Refinery Services

American Welding Society (AWS)

AWS D1.1	Structural Welding Code

American Society of Mechanical Engineers

ASME Sect. VIII, Division 1	Boiler and Pressure Vessel Code,

Mine Safety and Health Administration

30 CFR, Part 77	Mandatory Safety Standards, Surface Coal Mines and Surface Work Areas of Underground Coal Mines

Institute of Electrical and Electronic Engineers

IEEE No. 85	Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery
IEEE 112	Standard Test Procedures for Polyphase Induction Motors and Generators

National Electrical Manufacturers' Association

ICS 6	Enclosures for Industrial Controls
NEMA MG 1	Motors and Generators

Manufacturer's Standardization Society

MSS SP55	Quality Standards for Steel Castings - Visual Methods

4. GENERAL REQUIREMENTS

A. The heat exchanger will be used to cool a gas stream being drawn from an existing vent stack at a coal drying facility. This gas stream will have the following characteristics:

- Gas Stream Composition (by volume) and flow rates:
  - H_2O = 70.0% - 9,805 lb/hr
  - N_2 = 25.0% - 5,447 lb/hr
  - CO_2 = 3.0% - 1,041 lb/hr
  - O_2 = 1.7% - 423 lb/hr
  - Ar = 0.3% - 93 lb/hr
  - SO_2 = 7 ppm - 0.11 lb/hr
  - Particulate - 0.61 lb/hr
- Inlet Gas Temperature = 270°F
- Inlet Gas Pressure = 13.1 psia
- Total Gas Flow Into Heat Exchanger = 1506 SCFM (dry basis)

- Desired Outlet Gas Stream Temperature = 100°F

B. The heat exchanger shall include a control system capable of maintaining the outlet temperature at 100°F ± 5% given an ambient temperature no greater than 85°F. The control system shall insure that no freezing problems will occur during periods of cold weather.

C. All materials of construction used in the heat exchanger shall be compatible with the constituents of the gas stream listed above. Stainless steel tubes and headers shall be used.

D. The knock-out drum shall be capable of removing all condensate entering with the cooled gas stream. A mesh pad demister shall be used at the exit of the knock-out drum to remove entrained water droplets from the exiting gas stream.

E. The knock-out drum shall be vertically oriented and self-supporting.

5. EQUIPMENT DESIGN & FABRICATION REQUIREMENTS

A. General:

1. The location and orientation of any specified connections for nozzles, thermowells and pressure gauges shall be approved by the Purchaser.

2. Nozzle connections shall be provided with ANSI Class 150 flanges.

3. Outside nozzle projection shall be sufficient to ensure access to and for rear removal of flange bolts and nuts.

4. A hail guard screen shall be placed over the heat exchanger.

5. Louvers shall direct air away from platforms and maintenance points.

B. Heat Exchanger Tubes:

1. The Seller shall optimize bundle size and configuration to effectively utilize all of the available tube-side pressure drop without exceeding the maximum tube-side velocity or tube length.

2. Corrosion allowance shall not be added to the tubes.

3. Tubes shall be supported to prevent sagging and vibration and to maintain proper spacing and slope for drainage.

4. Removable tube bundles shall be utilized in the heat exchanger construction. Withdrawal distances for removing tube bundles or tubes from the heat exchanger shall be clearly indicated on outline drawings to be furnished by the Seller.

5. Flanged and gasketed joints in heads and at tube sheets shall be designed so that water cannot leak into air spaces. Tubes shall be rolled into both tube sheets and U-tubes shall not be employed. Heads and water boxes shall be easily removed for cleaning without disturbing connecting piping, and when removed, the tubes shall be accessible for brushing through without removing the tube bundle.

C. Heat Exchanger Fans and Drivers:

1. On multi-fan units, each fan shall have an individual plenum chamber to prevent recirculation of air through idle fans.

2. Fans shall be of the automatically variable or manually adjustable pitch type (axial flow) with either fiberglass (preferred) or aluminum blades. Fiberglass blades are limited to air temperatures no greater than 200°F.

3. Fan tip speed shall be limited to 10,000 fpm.

4. Fan units shall be equipped with vibration switches to shut down units on excessive vibration. Contacts shall be provided to connect with the existing plant control system indicating when a fan unit has shut down.

5. The fan and driver shall be arranged to permit lubrication of the equipment without shutdown. Suitable grease lines shall be provided only if bearings are not accessible.

6. Fans of 8 feet diameter and larger shall have six or more blades.

D. Knock-Out Drum Materials:

All materials for construction of this vessel, components, and accessories shall be new, suitable for the service, and meet the requirement of the codes and standards as given below.

1. Steel:

Structural Shapes	ASTM A240
Steel Plate	ASTM A240

2. Bolts, Nuts and Washers:

High Strength Bolts for Structural Joints	ASTM A325F
Unfinished Bolts	ASTM A307

3. Shop Paint:

Of make and type specified herein

E. Knock-Out Drum Design

1. The design and fabrication of the welded carbon steel shell shall conform to the manufacturer's standard specifications. These specifications shall incorporate the appropriate requirements of the AISC specifications, API Standard 650 and the ASME Pressure Vessel Code.

2. The drum shall be designed to be gas tight to prevent both leakage into and out of the drum.

3. The duty cycle shall be continuous.

4. The vessel shall be equipped with a manway located on the roof.

5. The vessel shall be provided with a mist eliminator to remove entrained water droplets from the exiting gas stream. The M.E. shall be removable from the exterior of the vessel.

6. The vessel shall be provided with a three inch drain connection for condensate removal.

7. The vessel shall be provided with three 1/2" NPT connections for level switch mounting. Orientation shall be detailed by the Purchaser on shop drawings.

6. ELECTRICAL

A. Seller's design and selection of material, components, and equipment shall be furnished in accordance with the requirements of the latest edition of the National Electrical Code.

B. Electrical and control equipment enclosures shall be suitable for outdoors and hazardous areas as applicable, in accordance with National Electrical Code Article 502, and as a minimum shall be NEMA 4X. the Bidder shall provide the enclosures classification information in the bid for all electrical/control equipment furnished.

C. The heat exchanger system shall be constructed to require a single 480 VAC power feed. All distribution and control transformers shall be supplied with the system.

7. MOTORS

A. Motors shall be as specified in the Special Conditions for Standard Purchases.

8. DRIVES

A. Variable frequency drives shall be Magnetek (preferred), Toshiba or Allen-Bradley.

9. INSTRUMENTATION AND CONTROLS

A. The heat exchanger shall be automatically controlled sufficient to maintain a discharge gas temperature of 100°F ± 5%. The system shall utilize a thermocouple in the exit manifold and a transmitter, transmitting a 4-20 ma dc signal to a single loop controller programmed to control a variable frequency drive on each fan motor, modulating the speed of the fans to control gas temperature. Control shall be effected over a 0 - 100% gas flow turndown, and over the entire range of anticipated ambient air temperatures.

B. Local pressure and temperature gauges shall be located in a visible location in the inlet and discharge piping.

C. Pressure gauges shall be 4 1/2 inch stainless steel case size, 1/2 inch NPT connection bourdon tube type, with solid front and type 316 stainless steel measuring element, Dwyer or approved equal.

D. Temperature gauges shall be 4 1/2 inch stainless steel case size, 1/2 inch NPT connection bulb type, Ashcroft or approved equal.

E. Thermocouples shall be Type J (Iron-vs-Constantan) duplex, ungrounded, spring loaded, with metallic, weather proof aluminum protection head and terminal block, 1/2 inch NPT conduit and connection size, Thermo Electric or approved equal. Thermocouples shall be furnished with thermowells as a complete assembly.

F. Transmitters shall be electronic and shall employ 2-wire transmission 4-20 ma dc signal, and shall have a minimum load resistance capability of 300-800 ohms at a corresponding power supply voltage of 23 - 32.7 volts dc per ISA S50.1 (ISA Class U). Calibrated accuracy shall be plus or minus 0.25 percent of calibrated span or better. Transmitters shall be Ronan or approved equal.

G. All motors and drive units shall be furnished with local control panels containing LOCAL-REMOTE and ON-OFF switches/pushbuttons, indicating lights, terminal blocks, relays, etc.. Panels shall be surface mounted with front access doors and bottom cable entry, with NEMA 4X water tight dust tight enclosures per paragraph 6.(B.).

H. Control Panel Fabrication:

1. Pushbuttons, selector switches, and similar devices shall be Allen-Bradley 800T or 800H series.

2. Control relays shall be Allen-Bradley #700 series.

3. Terminal strips shall be Allen Bradley #1492 H6 fused switch blocks.

4. All wires shall be clearly identified with typewritten , slip-on, heat shrunk Brady wire tags.

5. Color coding of conductors shall comply with NEC and Western Energy Company standards.

6. Non-metallic wiring gutters with removable covers shall be sued for conductor raceways inside cabinets.

7. Plastic wire ties shall be provided where appropriate for wire position control.

8. All equipment and devices shall be mounted on removable back and side panels.

9. All control wiring shall be stranded copper with "SIS" type insulation. Voltage rating as required.

10. All signal wiring shall be shielded type with type "TC" rating. Quantity and size of conductors as required.

11. Control cabinets shall be manufactured by Hoffman Enclosure or approved equal.

12. All individual wiring shall terminate in approved lugs of proper size and rating. Provide covers where required to meet MSHA "Dead Front" requirements.

I. Skid Electrical Work:

1. Raceways shall be galvanized steel type "GRC" or "IMC".

2. Couplings shall be threaded type.

3. Flexible conduit shall be liquid tight type with steel compression fittings.

4. All junction and terminal boxes shall be a minimum NEMA 4X rated.

14. SPARE PARTS

A. The Seller shall recommend any spare parts required.

15. SCHEDULE

A. Within one (1) week of Contract award, the Seller shall submit a written schedule to the Engineer for approval. The schedule shall delineate the following milestones, at a minimum:

1. Shop drawing completion date
2. One (1) week Engineer review period
3. Start and completion of steel fabrication
4. Start and completion of mechanical assembly
5. Dates of all submittals
6. Delivery date - (no later than February 8, 1994)

B. Upon receiving approval of schedule, the Seller shall commence submitting written schedule updates every 7 calendar days. Schedule updates shall be submitted via facsimile and note any deviation from approved schedule.

16. SUBMITTALS

A. The Seller shall submit the following information to the Engineer:

1. Three (3) sets of shop drawings for approval
2. Initial construction schedule and 7-day updates
3. Operation and maintenance manuals in conformance with the Special Conditions for Standard Purchases
4. Shipping data
5. Cut sheets on all instrumentation
6. Controls narrative for system operation
7. Final equipment design drawings in conformance with the Special Conditions for Standard Purchases

UNIFIELD ENGINEERING

Air Cooled Heat Exchanger

|uipment No. X-2-60 ______ Contract No. 93-376

Item Name Air Cooled Heat Exchanger ______ No. Req'd 1 Page 1 of 2

References ______

Proecess Made ______ Checked ______ Approved ______

Engineering Made ______ Checked ______ Approved ______

Revision 0

Service Process Gas Cooling and Condensation

Size ______ Type ______

Bare Tube Surface - Area (Sq. Ft) ______ Surface Area / Unit (Sq.Ft) ______ Heat Exchange (BTU/HR) ______

Bare Tube Surface - Service (RTU/HR. Sq.Ft°F) ______ Effective MTD (°F) ______

Bare Tube Surface - Clean (BTU/HR. Sq.Ft°F) ______ Transfer Rate (External Service) ______

PERFORMANCE DATA (TUBE SIDE)

Fluid Circulated ______

Total Fluid Entering ______ Lbs/Hr

Total Vapor Entering ______ Lbs/Hr

Total Liquid Entering ______ Lbs/Hr

Total Steam Entering ______ Lbs/Hr

Total Non-Condensables ______ Lbs/Hr

Total Vapor Condensed ______ Lbs/Hr

Total Steam Condensed ______ Lbs/hr

Density Vapor ______ Lbs/Cu.Ft.

Conductivtiy ______ BTU Ft/Hr. Sq.Ft. °F

Fouling Resistance I.S. ______ Hr. Sq. Ft. °F BTU

Temp In ___ °F Temp Out ___ °F Inlet Pressure ___

Gravity-Liquid ______ @ ______ °F

Viscosity ______ @ ______ °F

Viscosity ______ @ ______ °F

Molecular Weight ______

Specific Heat BTU/Lb °F ___ Latent Heat BTU/Lb ___

Allowable Pressure Drop ___ Design Pressure Drop ___

PERFORMANCE DATA (AIR SIDE)

Air Quantity/Item ___ SCFM Air Quantity/Fan ___ ACFM

Static Pressure ___ In. H_2O Altitude ______ Ft.

Temp In ______ °F Temp Out ______ °F

MECHANICAL EQUIPMENT

FAN: Manufacturer ______

HP/Fan ______ Fans/Unit ______

RPM ______ Diameter ______ Ft.

No. Blades ______ Pitch ______

Blade Material ______

Hub Material ______

DRIVER: Manufacturer ______

Driver Type ______

HP/Driver ______ Drivers/Unit ______

RPM ______

Enclosure ______

SPEED REDUCER: Manufacturer ______

Type ______ Model ______

Reducers/Unit ______ Ratio ______

AGMA HP Rating ______

UNIFIELD ENGINEERING

Process Equipment Data Sheet

Air Cooled Heat Exchanger

quipment No. X-2-60 Contract No. 93-376

Item Name Air Cooled Heat Exchanger No. Req'd 1 Page 2 of 2

CONSTRUCTION

Design Pressure ______ PSI

Test Pressure ______ PSI

Design Temp ______ °F

SECTION: Size __ Ft. __ In. BY __ Ft. BY __ Rows

No./Unit __ Section side Frames ______

Sect. in Parallel ____ in Series ______

Units in Parallel ____ in Series ______

MISC: Structure ______ Ladder ______

Hood ______ Walkway ______

Shutters ______ Vibration Switch ______

HEADER: Type ______

Material ______

No. Passes ______ Slope ______

Plug design ______ Material ______

Gasket Material ___ Corrosion Allowance __In

Inlet Nozzle ____In. Outlet Nozzle ______In.

Rating ______ Code ASME ______

TUBE: Material ______

Outside Diameter In. ___ BWG. Avg. Min. Wall

No./Section ______ Length ______Ft.

Pitch ______

FIN: Material ______

Outside Diam __In. No./In. ______

Fin Type ______

Shipping Weight ______ Lbs.

Proposal Drawing No. ______

Plot area ______

NOTES: The Following Items are located in one common structure:

NOTICE: This information is not to be disclosed except in authorized connection with this project.

APPENDIX B

Engineering Specifications for Gas Compressor and Dryer System

SPECIFICATIONS FOR GAS COMPRESSOR AND DRYER SYSTEM

WESTERN ENERGY COMPANY
ACCP PROCESS GAS DRYING SYSTEM
SPECIFICATION NUMBER PS-0-001

November 5, 1993

ENGINEER

UniField Engineering, Inc.
320 South 24th Street, Billings, Montana 59101
Telephone: 406-245-4455 Fax: 406-245-7112

PURCHASER

Western Energy Company
P.O. Box 99, Colstrip, Montana 59323
Telephone: 406-748-2366 Fax: 406-748-4974

SPECIFICATIONS FOR
GAS COMPRESSOR AND DRYER SYSTEM

WESTERN ENERGY COMPANY
ACCP PROCESS GAS DRYING FACILITY
SPECIFICATION NUMBER PS-0-001

TABLE OF CONTENTS

1. SCOPE

A. This specification, together with the Special Conditions for Standard Purchases, details the performance, design, and manufacturing requirements for furnishing and delivering a gas compressor system, a dryer system and a receiver.

B. The equipment will be installed at a coal drying facility located at the Western Energy mine site in Colstrip, Montana. The system will be used to supply a minimum 100 psig dry inert gas for facility distribution.

C. The Seller shall furnish and deliver to the jobsite equipment, material, and services as follows:

1. Skid mounted gas compressor unit with accessories
2. Electric motors and motor starters, as required
3. Inlet air receiver
4. Inlet gas particulate filter
5. Gas/Oil receiver and separation system
6. Air cooled gas aftercooler and oil heat exchanger
7. Control system including control panel
8. Sound attenuation enclosure
9. Capacity controls and protection devices as specified
10. Skid mounted air dryer unit with accessories
11. 400 gallon vertical air receiver for Purchaser's mounting

D. The equipment furnished shall be a complete package of components required to develop the performance conditions outlined herein.

E. The compressor and dryer shall be fully assembled and prewired at the factory and shipped to the site as a single, complete skid-mounted unit requiring only supply of power and connection of inlet and discharge piping for operation.

F. In order to provide process optimization, in addition to the preferred system sizing detailed in this specification, bids are requested on the following alternative system configurations:

Alternative 1: one (1) compressor and one (1) dryer sized to provide 1,000 SCFM process gas capacity with system specifications as detailed herein.

Alternative 2: two (2) compressors and one (1) dryer sized to provide 1,000 SCFM process gas capacity with system specifications as detailed herein.

G. Special requirements of performance or design that effect the equipment are specified herein.

2. RELATED WORK

A. The purchaser will provide the following:

1. Unloading, storage and installation
2. Concrete foundation, grouting and anchor bolts
3. Plant control system (PCS)
4. External connections to piping and electrical systems, power and instrumentation
5. Electrical Power Supply: a. 480 VAC ± 10%, 60 Hz, 3 phase
   b. 120 VAC ± 10%, 60 Hz, 1 phase

3. REFERENCE STANDARDS

A. The following reference standards are applicable to this specification. The latest issue, based on the date of this specification, and any subsequent addenda, shall apply.

B. If there is, or seems to be, a conflict between this specification and a referenced document, the matter shall be referred to the Engineer.

<u>Mine Safety and Health Administration</u>

30 CFR, Part 77 Mandatory Safety Standards, Surface Coal Mines and Surface Work Areas of Underground Coal Mines

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Institute of Electrical and Electronic Engineers

IEEE No. 85	Test Procedure for Airborne Noise Measurements on Rotating Electric Machinery

National Electrical Manufacturers' Association

ICS 6	Enclosures for Industrial Controls
NEMA MG 1	Motors and Generators

Manufacturer's Standardization Society

MSS SP55	Quality Standards for Steel Castings - Visual Methods
ASME	American Society of Mechanical Engineers, ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1
TEMA	Tubular Exchanger Manufacturers Association

4. GENERAL REQUIREMENTS

A. The compressor system shall draw process gas from an exhaust stack in a coal drying process through an air-cooled tubular exchanger and moisture knock-out vessel, both external to the compressor system, compressing this gas for discharge to a regenerative desiccant dryer, from which dried gas will discharge to a receiver for facility distribution. The inlet gas composition and flow rate to the compressor, and required compressor performance are presented on the Rotary Screw Compressor Specification Sheet, attached.

B. The compressor shall be designed for continuous full-load duty and 0% - 100% turndown capability in an outdoor location.

C. The gas compressor and dryer system will be located outdoors, in an unheated area.

D. The maximum surface temperature for all equipment shall be limited to 302°F in accordance with MSHA standards.

E. All materials of construction shall be those proven by service in similar designs and shall be suitable for the specified condition of service including gas stream constituents and condition of pressure, temperature or relative humidity. Metallurgy of all major components shall be clearly stated in the Seller's submittal.

F. Equipment tag numbers shall be as follows:

V-2-63	Compressor system
R-2-65	Dryer System
T-2-58	Receiver Tank

5. COMPRESSOR DESIGN & FABRICATION REQUIREMENTS

A. Inlet Air Receiver:

1. The compressor system shall be equipped with an inlet air receiver for removal of entrained water due to condensation occurring in the ductwork ahead of the compressor. The gas is anticipated to arrive at the compressor inlet at a maximum temperature of 115°F. For purposes of air receiver sizing, it may be assumed that the gas will cool a maximum of 10°F in the ductwork preceeding the compressor, in a saturated state (125°F to 115°F, with corresponding condensation).

2. The air receiver shall be equipped with an automatic drain valve/trap, accessible for Owner routing of pipe for discharge.

B. Inlet Air Filter:

1. The compressor system shall be equipped with an inlet air filter of heavy-duty construction limiting passage of 10 micron and larger particles. The filter shall be located such that easy access for cartridge replacement is available.

2. The inlet air filter assembly shall be equipped with a service indicator to provide an indication of differential pressure.

C. Compressor:

1. The compressor shall be of single stage rotary screw-type configuration, flood-lubricated and cooled.

D. Air and Oil Separator System:

1. The separator system shall be constructed with sufficient storage capacity to handle the compressed gas/oil throughput at full load operating conditions.

2. The separator shall be constructed with sufficient surface area to limit oil carryover to a maximum of 2 ppm at full load operating conditions.

3. The separator shall be equipped with a sightglass, providing visual confirmation of fluid level in the receiver.

4. The Seller's submittal shall include information on the Seller's standard compressor fluid (oil). This information shall include fill capacity of the compressor system, fluid cost, and anticipated fluid life, in operating hours, under normal operating conditions.

E. Air and Oil Cooling Systems:

1. The compressed gas aftercooler and the oil heat exchanger shall be of air-cooled design. No water-cooled designs will be acceptable. The design shall address the use of these heat exchangers during extended periods with ambient temperatures of -40°F.

2. The aftercooler shall be capable of reducing the discharge compressed air temperature to within 15°F of ambient.

F. Control Piping:

1. The control piping shall be of stainless steel construction.

G. Sound Attenuation and Freeze Protection:

1. The compressor shall be provided with a sound attenuating enclosure for location in a high traffic area. The Seller's submittal shall include noise levels (DBA) of the compressor system with and without the sound attenuating enclosure.

2. Due to the possibility of extended periods of low ambient temperature and the intention to locate this unit outdoors, if the bidder deems that heating or insulating is required for the unit to prevent freezing problems, these elements shall be incorporated into the bid.

H. Capacity Control:

1. The bidder shall supply a description of the mechanism by which capacity modulation will be effected. This description shall include equipment cut-sheets illustrating the corresponding mechanical components. Accompanying this description shall be a graph indicating percent of full load horsepower on the ordinate axis and percent of full load capacity on the abscissa axis. This graph shall be graduated with a minimum of 10 percent steps for both variables.

I. Mounting Skid:

1. The compressor system shall be provided with all associated equipment pre-mounted, piped and wired on a heavy gauge steel frame. This frame shall be equipped with forklift access for lifting, and shall be of robust enough construction to be dragged into place.

2. Installation of this compressor system shall be within an area with limited access, and as such, shall be mounted and sized to pass through an 8'-0" high by 8'-0" wide opening. If these space constraints are problematic, the Bidder shall provide costs and manhour estimates for assembly of the compressor system in the field from a loose piece shipment.

3. Foundation and anchoring requirements shall be included in the Seller's submittal.

6. DRYER DESIGN & FABRICATION REQUIREMENTS

A. General:

1. The dryer shall be an on-line, desiccant type, with the capability of drying gas to a -40°F dewpoint at the pressure and temperature at the discharge of the compressor system. The dryer system shall be prewired and prepiped and mounted on a heavy gauge steel skid. Piping shall also be supplied between the compressor system and the dryer system, assuming the receiver tank will be located after the dryer.

2. The dryer vessels shall be designed and constructed according to the latest ASME Code. Materials of construction shall be compatible with constituents of the gas stream as identified above. Safety relief valves shall be provided on each tower in accordance with ASME Code.

3. Heaters used in the towers shall be stainless steel flexible type designed with a low watt density. Individual heater elements inserted in stainless steel pressure tight tubes shall be able to be removed without disturbing the desiccant and while the tower is under pressure.

4. The desiccant bed support shall be constructed of stainless steel screen.

5. The tower inlet shall incorporate a removable stainless steel screen nozzle.

6. Desiccant shall be preloaded at the factory. A material safety data sheet for the desiccant shall be included with the Seller's proposal.

7. Moisture indicators shall be of the color changing type.

8. Purge flow shall be adjustable and a flow measuring device shall providing which the amount of gas being purged.

9. The individual towers shall automatically repressurize once the desiccant has been regenerated.

10. Orifice control for slow depressurization shall be used in the towers during regeneration to protect the desiccant.

11. A muffler shall be provided on the outlet of the purge gas stream to attenuate sound associated with the purging process.

12. The Seller shall provide with the proposal a data sheet containing the following information at a minimum:

    - Quantity of desiccant required to fill each tower
    - Anticipated life of the desiccant in hours and/or number of cycles
    - Dryer cycle and desiccant regeneration times
    - Pressure loss through the dryer

13. A valved bypass of the dryer system shall be prepiped on the dryer system for servicing of the dryer without compressor system deactivation. A pressure relief device shall be supplied in the this piping prior to the valves, between the compressor and the dryer.

14. Refer to paragraph 5.(I.)2. above for mounting constraints.

15. No particulate after filter will be required in the dryer system.

7. RECEIVER DESIGN & FABRICATION REQUIREMENTS

A. A 400 gallon vertical air receiver shall be furnished, designed, constructed, tested and stamped in accordance with the ASME VIII and local governing codes.

B. The receiver shall be provided with a manhole, safety relief valve, automatic moisture drainage, and connections for instruments.

8. ELECTRICAL

A. Seller's design and selection of material, components, and equipment shall be furnished in accordance with the requirements of the latest edition of the National Electrical Code.

B. Electrical and control equipment enclosures shall be suitable for outdoors and hazardous areas as applicable, in accordance with National Electrical Code Article 502, and as a minimum shall be NEMA 4X. The Bidder shall provide the enclosures classification information in the bid for all electrical/control equipment furnished.

9. MOTORS

A. Motors shall be as specified in the Special Conditions for Standard Purchases.

10. INSTRUMENTATION AND CONTROLS

A. The compressor system shall contain instrumentation sufficient to protect itself from damage. Fault and running alarm contacts, as well as remote start and stop capability, shall be provided at the system to allow for connection with the existing facility control system. Local compressor instrumentation shall include, at a minimum:

1. Discharge gas temperature
2. Air filter differential pressure
3. Inlet and discharge gas pressure

Control system interlocks providing system protection shall include, at a minimum:

1. High discharge gas temperature
2. High discharge gas pressure
3. High oil temperature

B. The dryer system shall contain instrumentation sufficient to automatically control the desiccant regeneration cycle. Failure to cycle alarm contacts shall be provided from the system to allow for monitoring in the existing facility control system.

11. PAINTING

A. The equipment shall be painted with the manufacturer's standard prime and finish paint.

12. EXAMINATION AND TESTS

A. The compressor system shall be fully assembled and the Seller's standard shop mechanical running test shall be performed prior to shipment, including those systems, which, if required, will be shipped disassembled. Documentation relating to, and the results of, this test shall accompany the compressor system during shipment. The test shall be run for a period of not less than one hour. The functioning of all controls shall be checked.

B. The compressor and pressure-retaining auxiliary parts shall be hydrostatically tested in accordance with the following schedule:

Compressor casing	1 1/2 times maximum allowable working pressure
Piping, pressure vessels coolers, etc.	1 1/2 times maximum allowable working pressure or in accordance with applicable code

C. The dryer system shall be fully assembled and electrical and controls testing shall be completed prior to shipment.

13. QUALITY ASSURANCE

A. The Seller shall have in effect at all times a QA Program which is in compliance with the requirements of the Special Conditions for Standard Purchases.

14. SHIPMENT AND STORAGE

A. Packaging, shipping and storage of all equipment and materials shall be in compliance with the requirements of the Special Conditions for Standard Purchases.

UNIFIELD ENGINEERING

Process Equipment Data Sheet
Rotary Screw Compressor

Equipment No. V-2-63 Contract No. 93-378

Item Name Rotary Screw Compressor No. Req'd 1 Page 1 of 1

References ______

Process Made ______ Checked ______ Approved ______

Engineering Made ______ Checked ______ Approved ______

Revision ______

ROTARY SCREW COMPRESSOR SPECIFICATIONS

Service ______ Manufacturer ______

Type ______ Model ______

OPERATING CONDITIONS

Gas SCFM @ Suction 706 Mass Flow 3,354 Lbs./HR

Compressibility Factors: Suction ______ Discharge ______

Composition @ Inlet Conditions:

Constituent	Volume %	Wt%	Mass Flow Rate (lb/hr)
N_2	80.3	76.1	2,552
CO_2	9.9	14.7	492
H_2O	3.4	2.1	70
O_2	5.4	5.8	196
Ar	1.0	1.3	44
SO_2	7 ppmv	15 ppmw	0.05

Average Molecular Weight 29.6

Suction: Pressure PSIA 12.3 Normal ______ Guarantee ______ Max. ______

Temp °F 115 Normal ______ Guarantee ______ Max. ______

Discharge: Pressure PSIA 112.3 Normal ______ Guarantee ______ Max. ______

Temp °F 115 Normal ______ Guarantee ______ Max. ______

ΔP Aftercooler ______ PSI

COMPRESSOR DETAILS

Screw Type ______ Size ______ Rated RPM ______ Casting Test Pressure ______

Intake Flange Size ______ ASA ______ lbs Facing ______

Disc. Flange Size ______ ASA ______ lbs Facing ______

Bearings: Journal Babbited Sleeve ______ Thrust ______ Make ______

Coupling: Make ______ Class ______ Type ______

Aftercooler: Type ______ Heat Transfer ______ BTU/HR

Tube material ______ Size ______

COMPRESSOR DRIVER

Horsepower ______ Type ______ Class ______ Volts ______ Phase ______ Cycles ______

Gear: Make ______ Rated BHP ______ Model ______ Red'n Ratio ______

COMPRESSOR MATERIAL

Case: ______ Shafts ______ Screws ______ Sleeves ______

LUBRICATION SYSTEM

Oil Separator ______ After Separator Carryover ______ ppm

Oil Cooler: Type ______ Heat Transfer ______ BTU/HR Tube Material ______

Size ______ Oil Tubing Material ______ Size ______

Oil Tubing Material ______

Sealing System

Type of Seals ______

Remarks

Gas is saturated at compressor inlet

APPENDIX C

SOI-6 System Operating Instructions For: Inert Gas System

SOI-6

REVISION - 2

System Operating Instructions for:

INERT GAS SYSTEM

Prepared - [signature]

Date - 1/10/97

Reviewed By: - [signature] **Facility Maintenance Supv.**

Reviewed By: - [signature] **Facility Superintendant**

SOI-6 REVISION HISTORY

REVISION 0 --	September 30, 1994; Original Issue
REVISION 1 --	June 22, 1995; Added instruction to drain the U line upstream of the compressor inlet filter. Added reference to SOI-4 for purge flow rates.
REVISION 2 --	January 10, 1997; Changed J-2-63 compressor skid to LeRoi unit. Added additional filtration system.

SYSTEM OPERATING INSTRUCTION FOR THE INERT GAS SYSTEM

1.0 PURPOSE

1.1 To provide instructions for starting, operating, and shutting down the inert gas system, which includes the inert gas compressor.

2.0 REFERENCES

2.1 Ambassador Heat Exchanger manual for X-2-60 (Model PCS-315)
Phone Number: (513) 792-9800

2.2 Energy Equipment and Supply/LeRoi Compressor manual for J-2-63 Skid, For D-2-67 Stoddard Filter, and for S-2-68 Moisture Separator
Contact: Harlan (800) 331-9101

2.3 Pioneer Desiccant Dryer manual for R-2-65 Skid
Phone Number: (615) 346-6643

2.4 D-2-66 - Solberg Filter Set/Catalogue
Contact: Brett (800) 451-0642

2.4 UniField Drawing 93-378-000 Rev. 1

3.0 PRECAUTIONS AND LIMITATIONS

3.1 Process Operating Limitations

System Pressure	110 psig	Max.
X-2-60 Heat Exchanger Outlet Temp	115 °F	Max.
X-2-60 Heat Exchanger Outlet Temp	50 °F	Min.
D-2-66 - Compressor Inlet Pre-Filter - DP	20 iwcd	Max.
D-2-67 - Compressor Inlet Filter - DP	15 iwcd	Max.
J-2-63 Gas Discharge Temp.	125 °F	Max.
J-2-63 Oil Cooler Discharge Oil Temp.	160 °F	Max.
J-2-63 Gas/Oil Separator Delta Pressure	10 psid	Max.
R-2-65 Gas Desiccant Dryer Dew Point	-40°C	Max.

3.2 Do not start the desiccant dryer without the compressor on and the dryer inlet and outlet valves open. Starting the desiccant dryer without a supply of pressurized inlet gas risks damaging the desiccant regeneration heater.

CAUTION: THE PLANT MUST BE OPERATING ON COAL AND STABLE PRIOR TO START-UP OF THE INERT GAS SYSTEM

4.0 STARTUP PROCEDURE

4.1 INITIAL CONDITIONS

4.1.1 System is shutdown and drained.

4.1.2 480 and 4160 volt circuits are energized

4.1.2.1 Ensure all heat tract circuits are energized.

4.1.3 Initial Checks on Heat Exchanger Package X-2-60:

4.1.3.1 Bump Fan motors to check for any binding in the drive. Visually observe that clearance between fan venturi ring and blade tips is adequate.

4.1.3.2 Verify louver operation - Turn recirculation louver selector switch to "closed" position and observe louvers on top to verify they are closed then "open"

4.1.3.3 Verify electric heater operation - turn plenum heater selector switch to "On" position. With main fans off the operation of the heater fans can be heard.

4.1.3.4 Check to ensure that all guards are in place and fasteners are secure.

4.1.3.5 Check all lights in the Control Panel by push-to-test

4.1.4 Initial Checks on Compressor Package J-2-63:

4.1.4.1 Check Oil Level in the Gas/Oil Separator Tank - visible from sight glass.

4.1.4.2 Check inlet scrubber liquid level. If level is high, use manual valve to drain liquid around the pump to drain.

4.1.4.3 Turn local/remote switch to remote - Clear alarms if condition exists, inspect system indicated and correct the fault.

4.1.4.4 Press the alarm- reset button to clear the control system.

4.1.4.5 Ensure all motor guards are in place and secure.

4.1.4 Initial Checks on Desiccant Dryer Package:

4.1.4.1 Verify desiccant is installed.

4.1.4.2 Verify Control Power is off

4.1.4.3 Verify purge pressure is set at 35 psig

4.1.5 Initial Checks on the Balance of System:

4.1.4.1 Verify Filter Elements are clean or new in D-2-66 and D-2-67.

4.1.4.2 Verify Condensate level is low in T-2-59 and valves are lined up to P-2-62 for flow to slurry system.

4.1.4.3 Verify no liquid level in the S-2-68 moisture separator

4.1.4.4 Verify PCV-258 regulator has been calibrated and is ready for service.

4.1.4.5 Verify AE-258 Oxygen analyzer has been calibrated and is ready for service.

4.2 STARTUP

4.2.1 Open or verify open the heat exchanger, X-2-60, inlet valve, V-100, at the stack.

4.2.2 Start the inert gas heat exchanger by placing the all control switches in Auto.

4.2.3 Open or verify open the knockout drum, T-2-59, gas discharge valve V-110. Lineup the first stage baghouse blowers to receive inert gas through V-120; close the cooler loop gas isolation valve above R-72.

4.2.4 Verify that the condensate pump, P-2-62, inlet and outlet valves are open. Place the condensate pump control in Auto.

4.2.5 Open the inert gas compressor skid (J-2-63) outlet valve and place the compressor in Remote at the panel.

4.2.6 Open the low pressure inert gas isolation valve upstream of CV-258B and the globe valve downstream of PCV-258. Also open the inert gas isolation valve at the 3348' elevation just south of R-52.

4.2.7 Start the inert gas compressor, J-2-63 as follows:

4.2.7.1 From the compressor panel, turn the load/unload switch to "Auto-Load" position. Place the Remote/Local to "Remote" position

4.2.7.2 From the control board, start the compressor. Ensure that the compressor accelerates to full RPM.

4.2.7.3 The compressor will run for 1 minute to warm the oil in the system, prior to loading.

4.2.7.4 The unit should develop between 80 and 100 psig. If not, then a leak has developed. Refer to the Energy Equipment and Supply, O&M Manual for the LeRoi Compressor package.

4.2.8 Open or verify open the inlet and outlet valves on the inert gas desiccant dryer, R-2-65, skid and close or verify closed the bypass valve. Place the desiccant dryer power switch and demand cycle to On.

4.2.9 When the oxygen level falls below, 5%, CV-258A closes and inert gas is available for use in the storage silos. Open CV-258B.

4.2.10 At the silos, lineup T-95, T-96, and T-90 to use inert gas and secure the CO_2 flow per instructions. Align Inert Gas for use in soot blowers and rotary air locks.

5.0 NORMAL OPERATIONS

5.1 Check the local control panels for proper equipment operation:

5.1.1 The heat exchanger, X-2-60, should maintain an outlet temperature of between 50°F and 100°F.

5.1.2 The condensate pump, P-2-62, should cycle on and off according to the level switch LS-259.

5.1.3 The inert gas compressor, J-2-63, should maintain between 80 and 107 psig outlet pressure.

5.1.4 The desiccant dryer should maintain a dewpoint temperature of -40°C or less.

5.1.5 PCV-258 should maintain 25 PSIG in the low pressure portion of distribution system.

5.1.5 AE-258 should read below 3.5% O_2 at all times.

5.2 Operations and Maintenance Schedule:

Every Day (24 hour period)

5.2.1 Observe the automatic drain on the compressor for proper operation.

5.2.2 Drain the desiccant dryer inlet filters.

NOTE: **Depending on conditions, the necessary intervals may be adjusted. For example - depending on the amount of water drained, the Draining operations may be required 2 times per shift rather than once a day.**

5.2.3 Drain the knockout U upstream of the compressor inlet pre-filter (D-2-66) during the winter months.

5.2.4 Take data listed on Daily Data Sheet attached.

Maintenance Schedule

5.2.5 Perform maintenance per the Maintenance Schedule attached.

6.0 SHUTDOWN PROCEDURE

6.1 For a short duration shutdown usually less than 2 days or if the heat exchanger is to provide the baghouse blower gas:

6.1.1 Shut off the desiccant dryer.

6.1.2 Stop the inert gas compressor as follows:
Press the stop button from the control room. The unit should run for 1 minute in unload to cool the system and fully unload, then the compressor will stop.

6.1.3 CV-258B should close automatically.

6.1.4 Close the supply valve V-110 on top of T-2-59.

6.1.5 The heat exchanger should be allowed to continue supplying the baghouse blowers.

6.2 For longer system shutdowns with the cooler loop supplying baghouse blower gas:

6.2.1 Shut off the desiccant dryer.

6.2.2 Stop the inert gas compressor as described in 6.1.2

6.2.3 Close CV-258B.

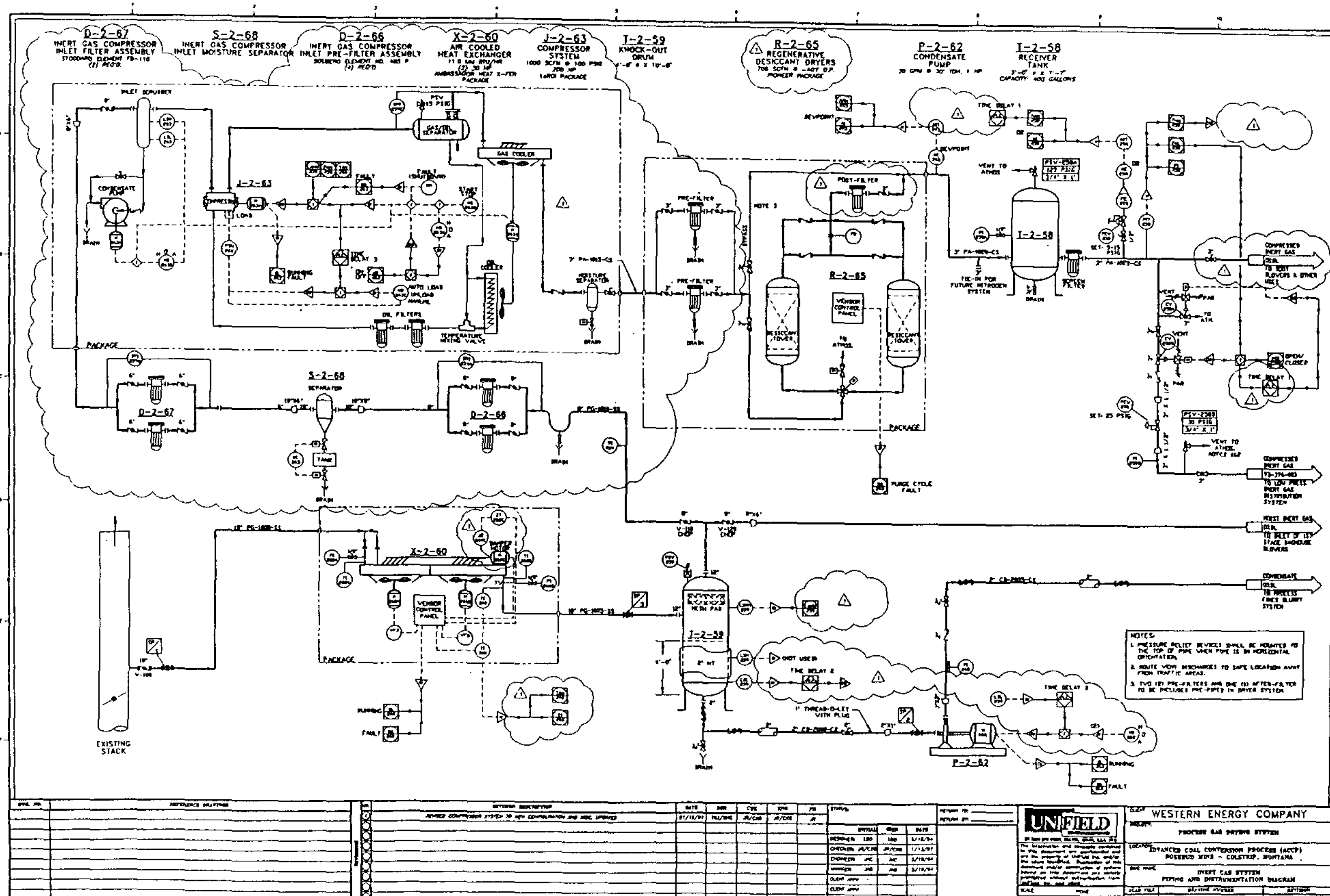
6.2.4 Close the heat exchanger inlet valve, V-100, at the stack.

6.2.5 Stop the inert gas heat exchanger by placing the all control in OFF.

6.2.6 Close the knockout drum gas discharge valves, V-110, and V-120. Lineup the first stage baghouse blowers to receive inert gas from the cooler loop by opening the cooler loop gas isolation valve above R-72.

6.2.7 Open the drain valves on the knockout drum, condensate pump, compressor, and the desiccant dryer inlet filters.

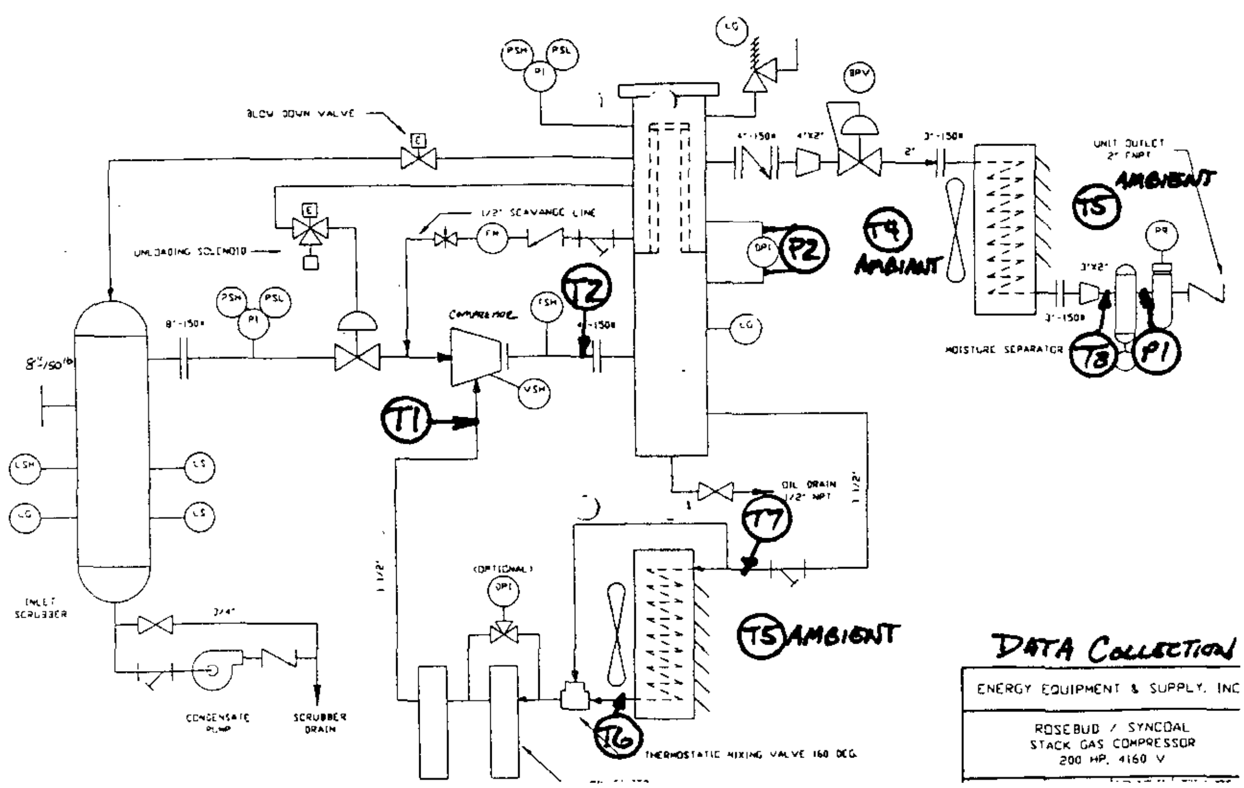
END SOI-6



D-2-67
INERT GAS COMPRESSOR
INLET FILTER ASSEMBLY
S-2-68
INERT GAS COMPRESSOR
INLET MOISTURE SEPARATOR
D-2-66
INERT GAS COMPRESSOR
INLET PRE-FILTER ASSEMBLY
X-2-60
AIR COOLED
HEAT EXCHANGER
J-2-63
COMPRESSOR
SYSTEM
I-2-59
KNOCK-OUT
DRUM
R-2-65
REGENERATIVE
DESICCANT DRYERS
P-2-62
CONDENSATE
PUMP
I-2-58
RECEIVER
TANK
INLET SCRUBBER
GAS COOLER
PACKAGE
PRE-FILTER
POST-FILTER
NOTE 3
DESICCANT TOWER
VENDOR CONTROL PANEL
MOISTURE SEPARATOR
OIL FILTERS
TEMPERATURE MIXING VALVE
SEPARATOR
DRAIN
EXISTING
STACK
RUNNING
FAULT
TIME DELAY 1
TIME DELAY 2
DEWPOINT
PURGE CYCLE FAULT
VENT TO ATMOS
TIE-IN FOR FUTURE NITROGEN SYSTEM
SCREEN FILTER
COMPRESSED INERT GAS
TO LOW PRESS INERT GAS DISTRIBUTION SYSTEM
TO INLET OF 1ST STAGE BAGHOUSE BLOWERS
CONDENSATE
TO PROCESS FINES SLURRY SYSTEM
1" THREAD-O-LET WITH PLUG
NOTES:
1. PRESSURE RELIEF DEVICES SHALL BE MOUNTED TO THE TOP OF PIPE WHEN PIPE IS IN HORIZONTAL ORIENTATION.
2. ROUTE VENT DISCHARGES TO SAFE LOCATION AWAY FROM TRAFFIC AREAS.
3. TWO (2) PRE-FILTERS AND ONE (1) AFTER-FILTER TO BE INCLUDED PRE-PIPED IN DRYER SYSTEM.
UNIFIELD
WESTERN ENERGY COMPANY
PROCESS GAS DRYING SYSTEM
ADVANCED COAL CONVERSION PROCESS (ACCP)
ROSEBUD MINE - COLSTRIP, MONTANA
INERT GAS SYSTEM
PIPING AND INSTRUMENTATION DIAGRAM
93-378-000
1

INERT GAS
Daily Inspections and Data Collection

Data to be taken	Point	Value	Max.	Action if Max. Exceeded
J-2-63 Compressor Skid				
Oil Injection Temp.	T-1	_____	160°F	Refer to manual
Airend Discharge Temp.	T-2	_____	220°F	Refer to manual
Skid Discharge Temp.	T-3	_____	125°F	Clean Gas Cooler Tubes
Skid Discharge Pressure	P-1	_____	107 psig	Check Back Pressure Reg.
Gas/Oil Separator Delta Pressure	P-2	_____	10 psid	Change Separator Element
Ambient Air Temp. At skid	T-4	_____	N/A	
Air Temp. At Cooler Discharge	T-5	_____	135°F	N/A - if no other high temps.
Oil Temp. At Cooler Discharge	T-6	_____	160°F	Clean Oil Cooler Tubes
Oil Temp. Into Cooler	T-7	_____	205°F	N/A - if no other high temps.
Check Skid Discharge Moisture Drain		_____	Yes or No	If No, then clean needle valve
Check for Oil in Scavenge Sight Glass		_____	Yes or No	If Yes, check P-2 above again
D-2-66 Filter Delta Pressure		_____	20 iwcd	Bypass Can - Replace Element
D-2-67 Filter Delta Pressure		_____	15 iwcd	Bypass Can - Replace Element
R-2-65 Dryer Dew Point		_____	-40 °C	Check/Replace Desiccant

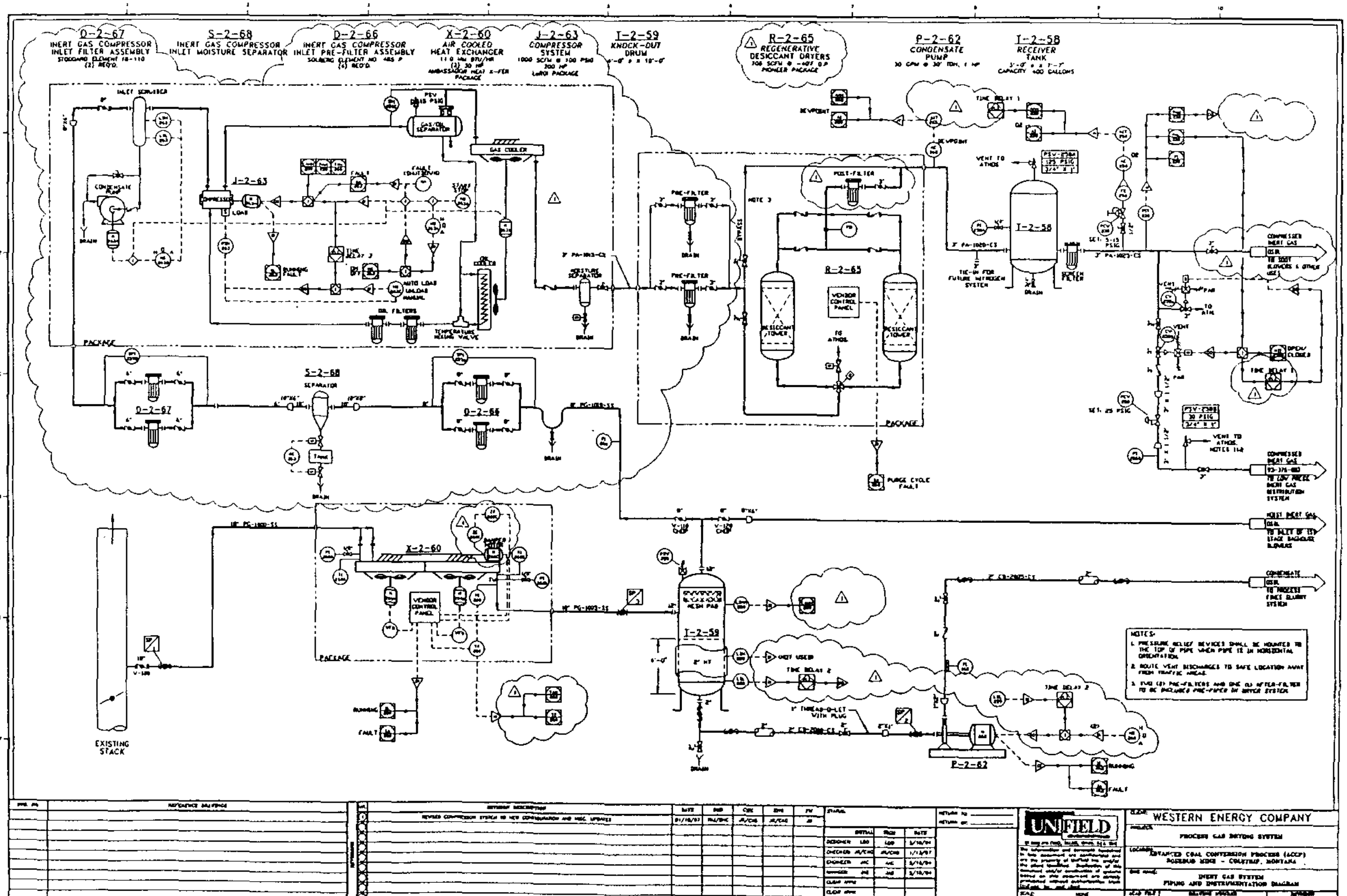


Inert Gas System Maintenance Schedule

Equipment	Work Item	Interval
X-2-60 Air Cooled Heat Exchanger		
Cooling Sections	Inspect fins, headers	4 months
Fans	Lube Fan Bearings	4 weeks
	Lube Fan Motors	6 months
	Belt Tighten/Check	4 months
T-2-50 Inert Gas Knock-out Drum		
Demister Mesh Pad	Inspect Mesh Pad	4 months
D-2-66 Inert Gas Compressor Inlet Filter Assembly		
Filter	Change Element	20 iwcd
D-2-67 Inert Gas Compressor Inlet Filter Assembly		
Filter	Change Element	15 iwcd
V-2-63 Inert Gas Compressor Skid		
Compressor Lubrication	Change Oil Filter	1st - 5 hours
	Sample Oil	1st - 5 hours
	Change Oil Filter	2nd - 150 hours
	Sample Oil	2nd - 150 hours
	Sample Oil	500 hours
	Change Oil Filter	720 hours
	Change Oil	8000 hrs or by analysis
	Grease Fittings	720 hours
Compressor Separator	Change Element	1st - 1500 hrs or 10psid
	Change Element	4000 hours or 10 psid
Oil Cooler	Inspect/Clean Sections	720 hrs or 160°F Oil Temp.

Inert Gas System Maintenance Schedule

Equipment	Work Item	Interval
Gas Cooler	Inspect/Clean Sections	720 hrs or 125°F Gas Temp.
Gas Moisture Separator @ Discharge	Inspect/Clean Needle Valve	720 hrs or if not draining
Compressor	Check Fan Bolt Torque	1st - 2 weeks or 300 hrs
	Check Motor Alignment	1st - 2 weeks or 300 hrs
	General Inspection	720 hours
	Overhaul	25,000 hours
R-2-65 Inert Gas Regenerative Dryer Skid		
Pre-Filters	Change Filter	4 months or high delta P
Post-Filters	Change Filter	4 months or high delta P
Control Air Filter	Change Filter	4 months or high delta P
Valves	Inspect Purge & Solenoid	4 months
Desiccant	Change Desiccant	Unable to make dew point
PCV-258 Inert Gas Regulator	Calibrate/Inspect	4 months
AE-258 Oxygen Analyzer	Calibrate/Inspect	4 months


D-2-67
INERT GAS COMPRESSOR INLET FILTER ASSEMBLY
S-2-68
INERT GAS COMPRESSOR INLET MOISTURE SEPARATOR
D-2-66
INERT GAS COMPRESSOR INLET PRE-FILTER ASSEMBLY
X-2-60
AIR COOLED HEAT EXCHANGER
J-2-63
COMPRESSOR SYSTEM
I-2-59
KNOCK-OUT DRUM
R-2-65
REGENERATIVE DESICCANT DRYERS
P-2-62
CONDENSATE PUMP
I-2-58
RECEIVER TANK
INLET SCRUBBER
GAS COOLER
PACKAGE
SEPARATOR
DRAIN
PRE-FILTER
POST-FILTER
DESICCANT TOWER
VENDOR CONTROL PANEL
PURGE CYCLE FAULT
DEWPOINT
TIME DELAY 1
TIME DELAY 2
VENT TO ATMOS
SCREEN FILTER
COMPRESSED INERT GAS
MOIST INERT GAS
CONDENSATE
EXISTING STACK
RUNNING
FAULT
NOT USED
1" THREAD-O-LET WITH PLUG
NOTES:
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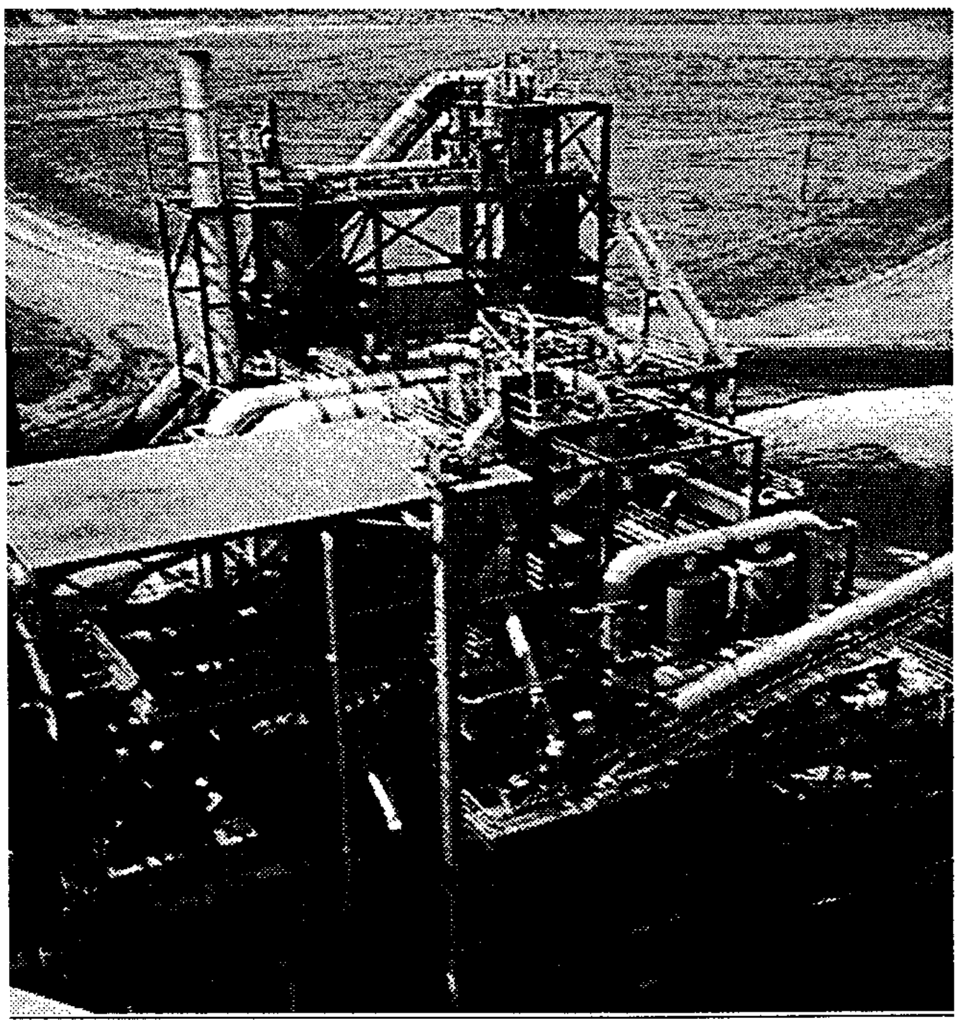
93-378-000

Test Report - DEMO9704
Silo Inert Gas Efficiency Testing

10/01/97
Rev. 0

Prepared For: Rosebud SynCoal Partnership



Prepared By: Jeff Richards, P.E.

Covenant Engineering Services

Table of Contents

Executive Summary

Purging the silos at the ACCP with Carbon Dioxide (CO_2) has been the method used to prevent spontaneous combustion of stored SynCoal® product since early 1993. The cost of purging with CO_2 has been over $500,000 per annum, with significant time, manpower and expenditures in trying to reduce this cost.

An Inert Gas System (IGS) was developed at the ACCP by the Western SynCoal® Company Engineers in late 1994, but had never operated effectively due to problems with the inert gas compression components (REF. 1). The initial testing (REF. 2) did not yield significant results.

In November 1996, a new LeROI compressor was purchased and installed to replace the first compressor, and modifications were made to the IGS and to the silos (REF. 3). This report discusses the efficiency gains that were realized as a function of the testing which occurred between July 15 and September 15, 1997 of the IGS.

The results indicate that approximately $211,000 to $250,000 can be saved per year as a result of the modifications and operation of the IGS.

Recommendations for further modifications include:

1. Automation of the valving which controls both CO_2 and Inert Gas (IG) - the cost for implementation are approximately $15,000 for a further saving of $12,000 per annum, and

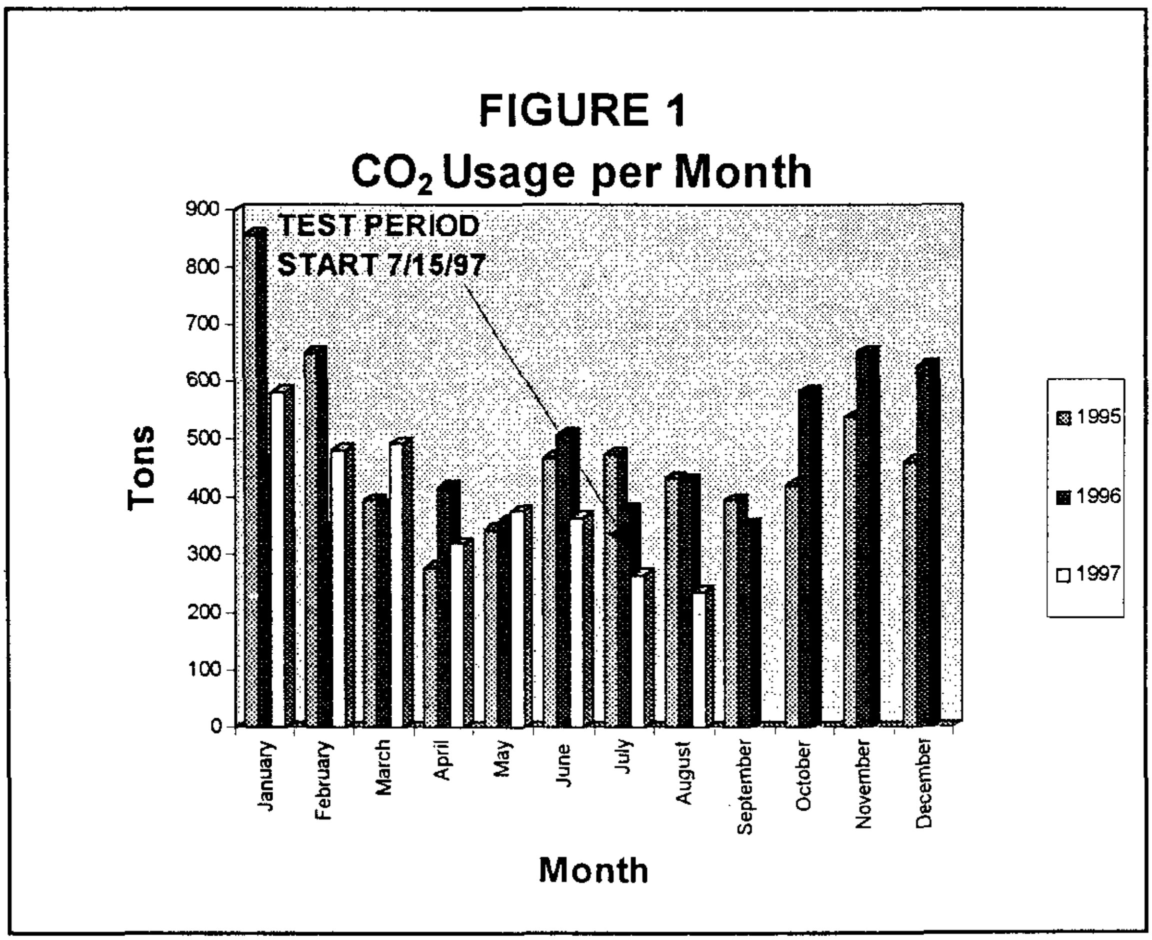
2. The safety and operation of the existing CO_2 system is questionable for any length of time, due to the temporary nature of the installation in January 1993 as well as the age of the components (over 25 years old). Also, during the test period with low CO_2 system use, the tanks would relieve pressure that built up due to insufficient refrigeration at the tank, resulting in lost CO_2. Replacing the old existing CO_2 storage and vaporizer tankage with new equipment is recommended. The expected $100,000 capital expenditure will provide a $1900/month savings in lease costs (REF. 7).

1.0 System Description

The Inert Gas System (IGS) was designed to compress stack gas at the ACCP, mainly for the purpose of product storage inerting. A detailed description of the system exists as a separate document (REF. 3). The system checkout was accomplished with the LeROI compressor prior to the test. Throughout this document, inert gas is referred to as "IG".

2.0 Test DEMO9704

The test was accomplished between the dates of July 15, 1997 and September 15, 1997. During the test, the monthly purchase of CO_2 at the ACCP was the lowest ever. This is depicted graphically as Figure 1 below:



Usage of CO_2 during the month of July would have been more dramatic if the test had started prior to the 15th of the month, but the amount used was still lower than at any time previously. During the month of August, two weeks of compressor operation was stopped due to lack of lubricating oil. Even so, the month of August continued to trend toward lower and lower CO_2 usage.

2.1 Test Procedure/Methods

The detailed test procedure appears as Appendix A. The idea of the test was to utilize inert gas to prevent air infiltration while CO_2 continued to be used as a reactant. This approach varied from the original intent of inert gas, as the originally test work included utilization of the inert gas as a reactant. During the initial IG testing in 1995, the test engineers learned that IG will cause some low level combustion resulting in high CO concentrations in the silo, and heating (REF. 2). For the majority of the test, IG was placed in two locations in the silo, while CO_2 was fed to one location at substantially reduced rates.

Every six (6) hours during the test, the gas chemistry inside the silo was measured and recorded. If the value of either CO or O_2 exceeded a pre-defined "trip-point" then inert gas was suspended and CO_2 usage was increased. The trip points are defined on Table 1. If during the test, either the IGS or the ACCP plant was down, CO_2 usage reverted to 120 SCFM (40 SCFM in three locations) in the silo. Also reflected in Table 1 is the "background level" of CO concentration in the silo. Prior to the test, the background value for CO concentration in the silo analysis resulting only from the inert gas was measured to be approximately 250 ppm. This defines a 250 ppm increase in objectionable CO levels, over those values with CO_2 alone.

Before the test was started, several employees were concerned with their personal exposure to IG. Therefore, the hazards to employees were evaluated using a "Sensidyne" gas analyzer in the areas of exposure. The documented results (REF. 4) indicate that employees can work safely around IG.

TABLE 1
Inert Gas Operational Guide

Condition	[CO]	[O_2]	Line #1 10 foot ring	Line #2A Silo Top	Line #2B 35 foot ring	Line #3 Hopper	Line #4 or 5 Slopes	Notes
Start	< 850 ppm	<6%	IG	IG	Off	40	Off	1
Rising [CO]	< 850 ppm	> 6%	IG	Off	40	40	Off	
	< 1000 ppm	< 6%	IG	Off	40	40	Off	
	< 1000 ppm	> 6%	IG	Off	80	40	Off	
	> 1000 ppm	< 6%	IG	Off	80	40	Off	
	> 1000 ppm	> 6%	80	Off	80	40	A/R	2
Falling [CO]	> 1000 ppm	> 6%	40	Off	80	40	Off	
	> 1000 ppm	< 6%	IG	Off	40	40	Off	
	< 1000 ppm	> 6%	IG	Off	40	40	Off	
	< 1000 ppm	< 6%	IG	IG	Off	40	Off	
	< 850 ppm	> 6%	IG	IG	Off	40	Off	
Plant Down			40	Off	40	40	Off	

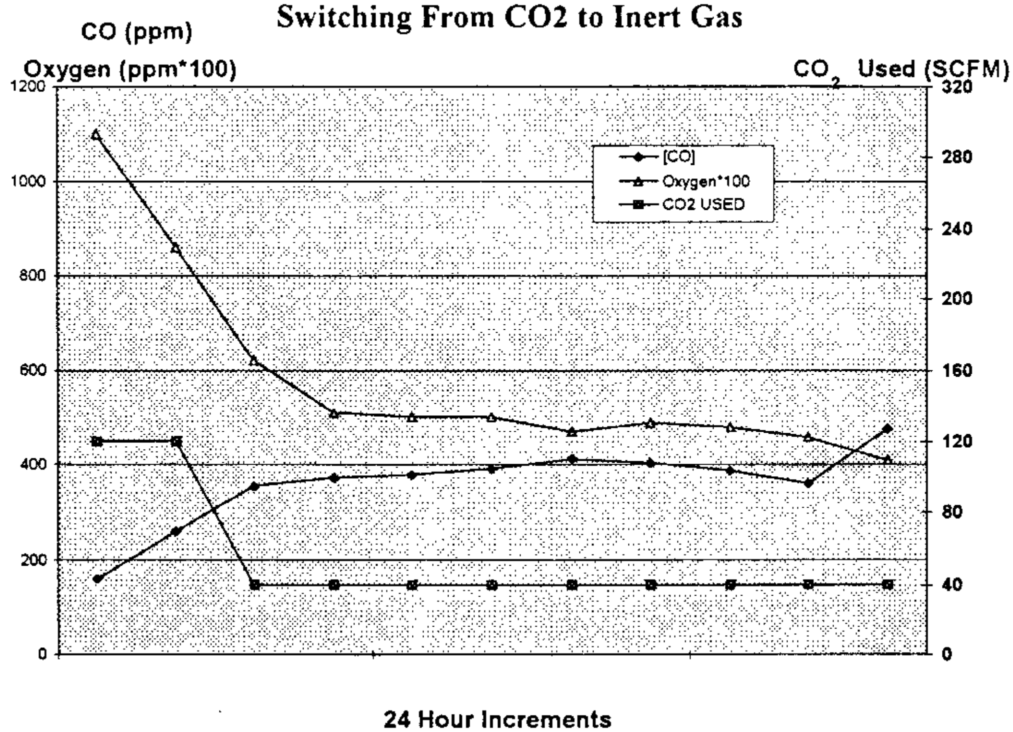
Note 1 - "IG" means that the Inert Gas is wide open for that port; Numerical values are SCFM for CO_2 only.
Note 2 - If the silo [CO] indicates increased combustion, then inundate the silo with CO_2 as directed

2.2 Test Conduct

The test proceeded as expected with immediate reductions in CO_2 use. From the onset of the test, there appeared to be a gradual trend toward decreasing O_2 in the silo with a concurrent increase in CO concentration. A graphic representation of the trend appears as Figure 2. Calculating straight-line values for CO and O_2 concentrations in the silo after 37 six hour periods revealed a 190 ppm average increase in CO concentration and a 195 ppm average decrease in O_2 concentration. This calculation indicates that even though the O_2 content in the silo is low, and typically less than 4%, there is a possibility that the inert gas is reacting with the SynCoal® to increase the silo CO concentration.

FIGURE 2

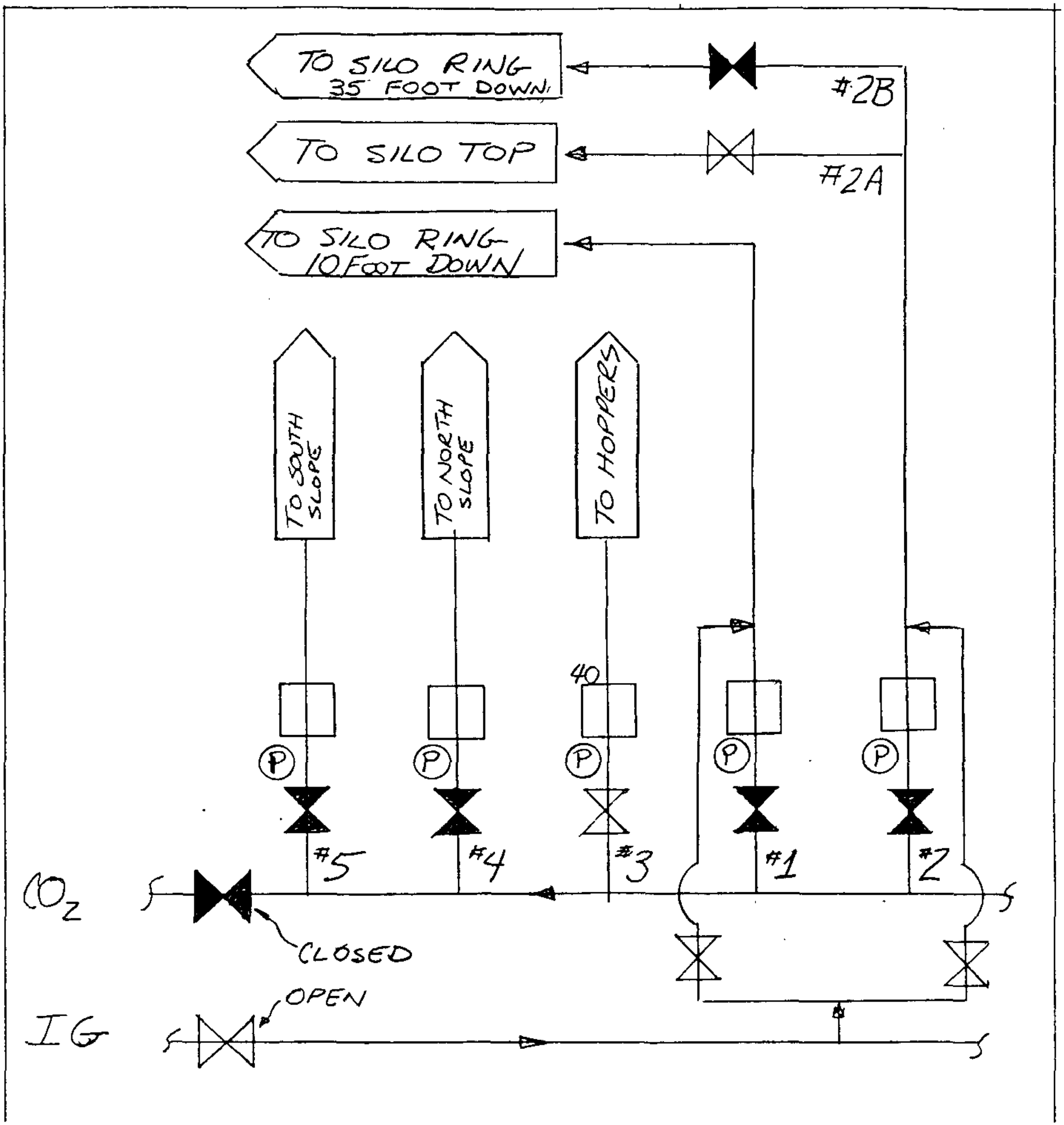
Switching From CO2 to Inert Gas

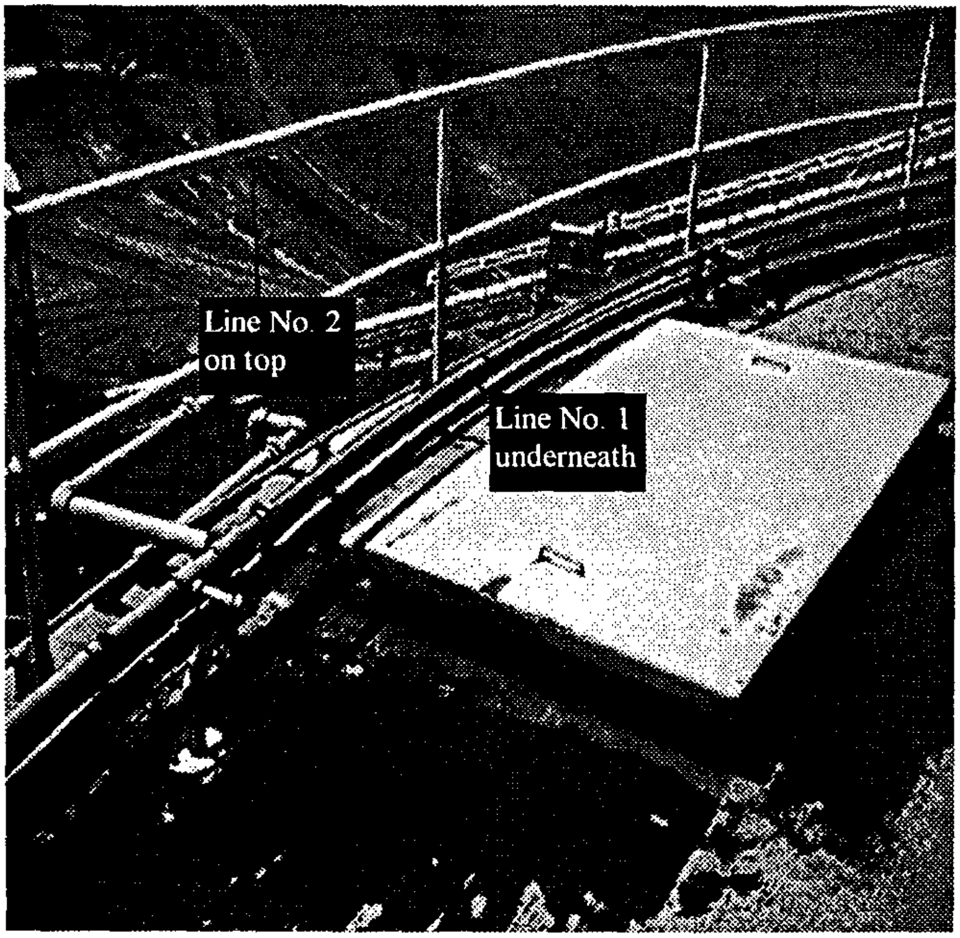


On July 30, 1997 the CO concentration started to increase rapidly in the silo. Simultaneously, the silo level was the highest it had been prior to that date. The top two entry ports for either inert gas or CO_2 were located 10 feet from the top of the silo and 35 feet from the top of the silo respectively. The top ring, shown on the following picture is the one that was located with 16 each 3/4" diameter pipes 35 feet down from the top of the silo.

A piping modification was made such that Line #2 could either place the inert gas 35 feet down, or place it right on the top. This is shown in the sketch which appears as Figure 4. The flow of inert gas was discontinued to the 35 foot ring which was covered in product, and the CO level immediately was reduced. This further indicates that inert gas should not be used as a reactant, or in other words not flow through the product, but should only be used as a source of gas for air infiltration prevention. Since over 400 SCFM of inert gas can be added to the silo, the amount of air in contact with the product is substantially reduced by inhibiting air infiltrating in the silo.

Figure 4


TO SILO RING
35 FOOT DOWN
#2B
TO SILO TOP
#2A
TO SILO RING
10 FOOT DOWN
TO SOUTH SLOPE
TO NORTH SLOPE
TO HOPPERS
40
P
#5
#4
#3
#1
#2
CO2
CLOSED
OPEN
IG



After the piping modification was made, the plant utilized inert gas except for a 2-week stretch when the compressor remained idle. This was due to a lack of oil on-site for the compressor. During the periods of time when either the entire plant or the IG compressor were down, approximately 40 SCFM of CO_2 was supplied to the silo through three ports for a total usage of 120 SCFM of CO_2.

During the week of August 18th, both the plant and the IGS were operational. A test of IG to the top of silo only (Ports #1 and #2A) was accomplished with approximately 40 SCFM of CO_2 to the bottom hopper. This test proceeded for a week and was followed by shutting off all of the CO_2 to the silo. During periods that the plant and IG compressor were running, the CO concentration in the silo was kept low by ensuring that IG was used exclusively to prevent air infiltration. The results of these test conditions indicated that inert gas can be used to substantially reduce CO_2 usage as a silo inertant.

Problems and resolutions encountered during the test appear as follows:

Problem Encountered	Resolution
1. Oil all over ground when filters are changed.	Re-plumb the Filters.
2. Oil warehousing selected wrong trip point.	Fixed
3. Actuators on IGS Heat Exchanger louvers set-up incorrectly.	Fixed
4. Silo gas requires distinct IGS and CO2 plumbing	Installed pipe and valves on silo.
5. Inert Gas System exhibits spurious trips	Un-resolved - believed to be Plant PLC related
6. IGS scrubber pump never comes on	Wait for cooler weather to troubleshoot
7. No water appears in pre-cyclone	Wait for cooler weather as above.
8. Loss of pressure on inlet and outlet of compressor	Clean de-mister pad in knock out drum. - Should be yearly maintenance item.

2.3 Test Results

The test results can be summarized graphically by reviewing Figure 3. Figure 3 presents a plot of the CO concentration in the silo over time, plotted with the CO_2 usage, measured in SCFM. During the previous 3 years, the CO_2 usage has averaged approximately 135 SCFM continuously. During the majority of the time when the IGS was in operation, only 40 SCFM of CO_2 was used.

During a two week period, all CO_2 was turned off to the silo. During this period of time, the majority of savings were found. It was shown that for a significant period of time, all CO_2 could be shut off to the silos.

FIGURE 3

T-95 Carbon Monoxide Concentration During Test 9704

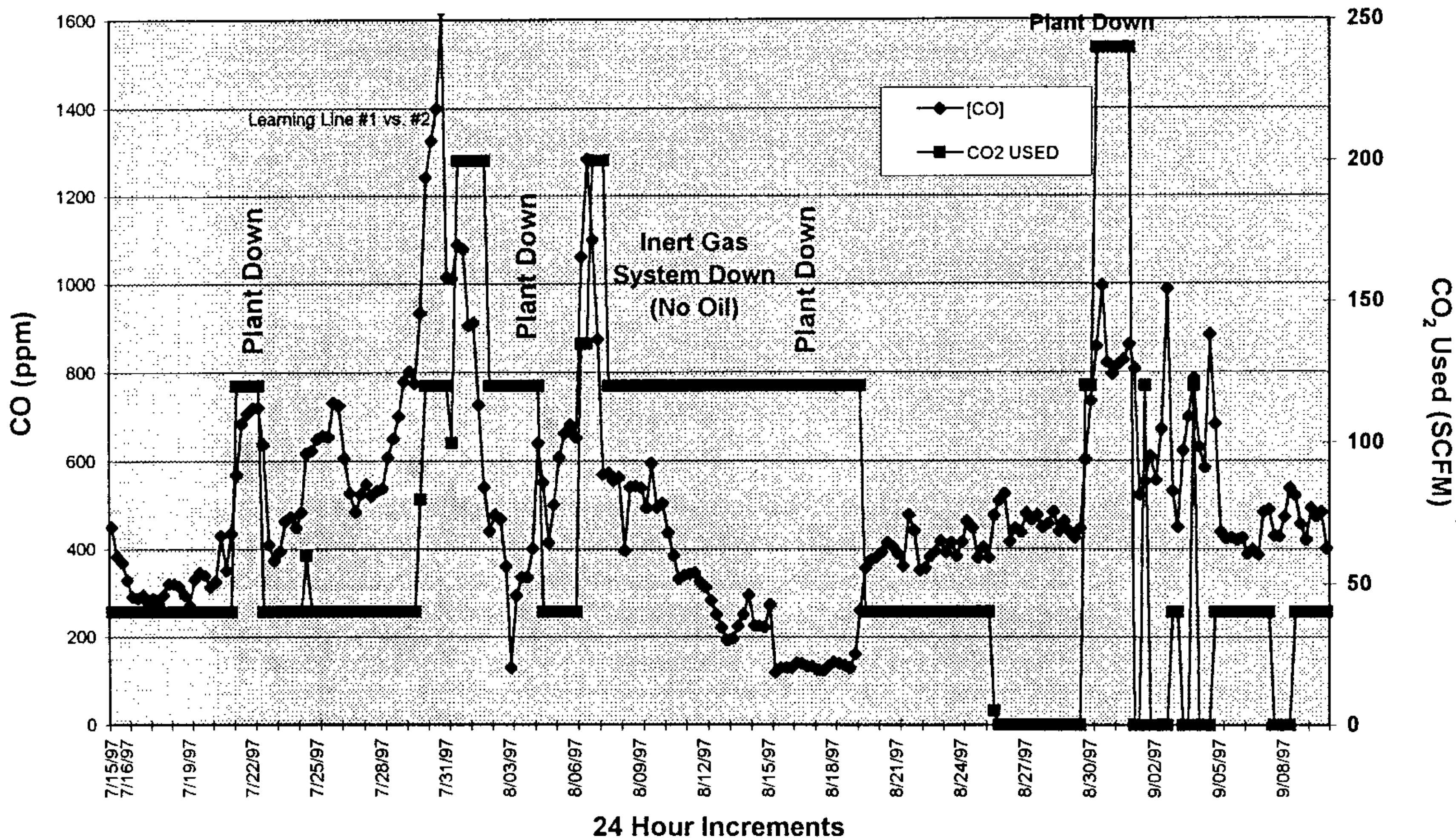
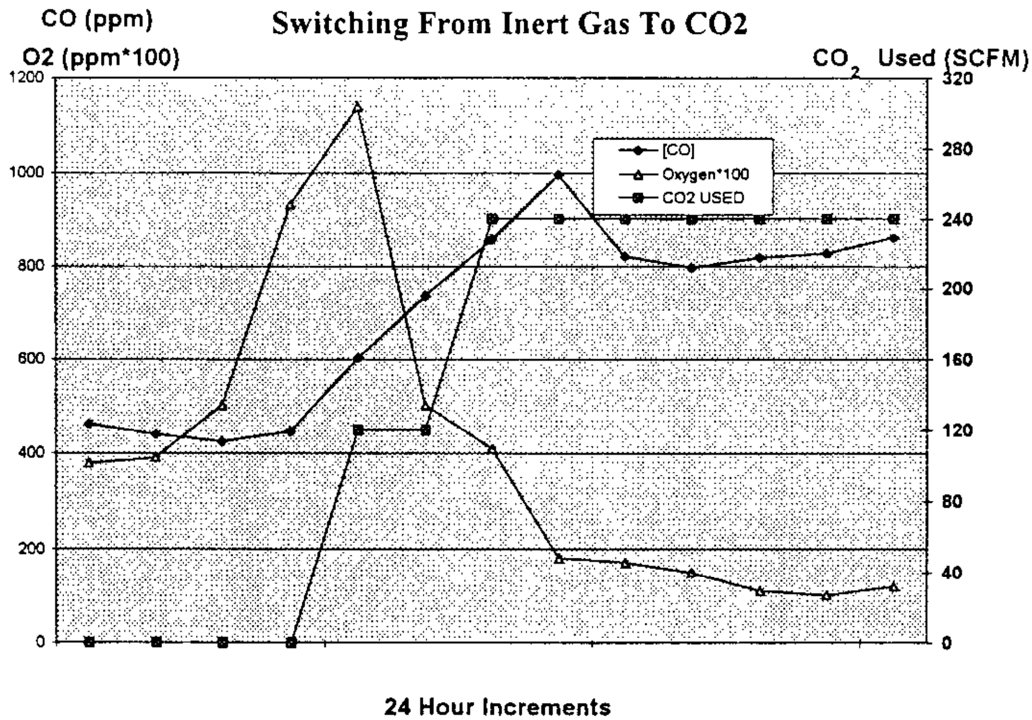


FIGURE 5
Switching From Inert Gas To CO2



A puzzling phenomenon occurs repeatedly when the silos are fed CO_2 after an extended use of IG in the silos; as shown on Figure 5. This phenomenon, which can not be explained well, occurs after IG is turned off and when CO_2 flow is initiated. This is followed by a steady rise in the silo CO concentration. The CO level continues to increase and eventually rises past the normal trip point. When CO_2 is turned on, the O_2 concentration in the silos appears to increase due to air infiltration. However, the rise in oxygen will not totally explain the resulting increase in CO. A possible explanation for the magnitude of CO concentration could be that CO may be trapped in the interstitial spaces of the coal particles and lightly attached to the coal during silo filling, in the same locations as the sites that preferentially adsorb CO_2. As the CO_2 is poured into the silo, the CO may be "squeezed" out of the coal by the much heavier CO_2 gas, starting at the bottom of the silo and working up towards the top. As the CO_2 continues to flood into the silo, the other gases are forced to the top of the silo. This would be consistent with the fact that after a high value of CO occurs, a subsequent drop in CO also occurs; as if all of the CO lightly attached to the coal had 'floated' out. No smoke has ever accompanied the increased readings in CO. This phenomenon will continue to be monitored over time.

3.0 Economic Assessment

During the two (2) month test period, a total savings in avoided CO_2 usage resulted in \$32,000 at a value of \$100/ton of CO_2 delivered. This savings occurred in 6 weeks of actual operation. The ACCP plant usually has 49 operating weeks per year, therefore a savings of approximately \$261,000 will be realized by avoiding CO_2 purchases based on the test results. However, as indicated by the test progress, additional savings are possible with familiarity and increased understanding over time. A savings of \$300,000 of avoided CO_2 may be possible.

The following contributions to the economic analysis of utilizing inert gas include the following expenditures of \$76,000 per year:

1) The power required to operate the 200HP compressor and cooling fan motors @ \$0.035/KWH results in approximately \$46,000 cost per annum.
2) The maintenance items; specifically lube oil, filters, and gas particulate removal filters, results in approximately \$10,000 cost per annum.
3) The additional maintenance manpower to operate the IGS, results in approximately \$20,000 additional cost per annum.

The avoided costs of operating the Carbon Dioxide System are estimated at \$287,000 to \$326,000 include the following:

1) The avoidance of CO_2 deliveries, estimated at \$261,000 to \$300,000 per annum.
2) The avoidance of the twelve (12 each) electrical vaporizers, operating at half time, 20 kW per each results in \$26,000 per annum .

The resulting yearly savings for operation of the IGS for purging the silos should be between \$211,000 to \$250,000. (\$287K-\$76K and \$326K-\$76K)

4.0 Recommendations

Recommendation Number 1

Silo control of inert gas and CO_2 should be accomplished with control valves in the control room. The valves would operate automatically in response to the following parameters:

1. Whether the plant is running or not
2. Whether the IGS is running or not

3. Whether the CO concentration in the silo is less than or greater than pre-described values. (850 ppm and 1000 ppm)

A usual occurrence during normal plant operations is operators forgetting where the manual valves were left when the plant is in a state of emergency. Several times per year, the CO_2 valves purging the silos have inadvertently been left at a high flow condition, and up to $2000 additional CO_2 per day was accidentally provided to the silo for 3 days over a weekend. The automatic valves recommended would automatically set the appropriate amount of CO_2 into the silos, leaving the operations personnel to the more important tasks around the plant. This could result in approximately $12,000 of CO_2 savings per year. The modification to incorporate these automatic valves will cost approximately $15,000.

Recommendation Number 2

In addition, the safety and operation of the existing CO_2 system is questionable for any length of time. During the test period, with low CO_2 system use, the tanks would relieve pressure that built up due to insufficient refrigeration at the tank. This resulted in lost CO_2 due to the old rickety equipment that has been installed in a temporary fashion in early 1993. A memorandum (REF. 5) was issued to address the response operators should perform if the tanks blow off. A new tankage system would not relieve as readily as the existing system.

Also, the safety of the existing system has been questionable for over 2 years. A memorandum (REF. 6) was issued addressing the issues surrounding the existing system as follows:

- Old, unsafe and unreliable
- Possible catastrophic failure and loss of stored product
- Temporary Power Installation since January 1993

The system should be replaced. Costs for replacing the inert gas system have been compiled and indicate a $100,000 initial installation cost, followed by a $1900/month lease savings (REF. 7).

REFERENCES

1. Internal Memorandum, Richards to Novasio, 06/20/96, "Summary of Findings on J-02-63 Inert Gas Compressor System as of Date"
2. Internal Memorandum, Viall to Richards, 02/21/96, "Silo CO_2 Testing - Initial Notes"
3. ACCP Report, Rosebud SynCoal Partnership, "ACCP Inert Gas System Design and Operation Description", October 1997, Rev. 0
4. Internal Memorandum, Richards to Novasio, 07/17/97, "Employee Exposure to Inert Gas"
5. Internal Memorandum, Richards to Novasio, 07/25/97, "CO_2 Tank Safety Relief"
6. Internal Memorandum, Viall to Richards, 02/07/95, "CO_2 System Evaluation"
7. Internal Memorandum, Richards to Sheldon, 09/29/97, "BOC Tank Installation/Lease Economics"

Appendix A

"Test Procedure - DEMO9704"

MEMORANDUM

Western SynCoal Company - ACCP Colstrip, MT

7/14/97

To: The Lead Men and Shifters of the ACCP

From: Jeff Richards

C: Don Ball, Joe Novasio, Ray Sheldon

Subject: Inert Gas Test - DEMO9704

The subject test procedure is attached and the test will start tomorrow, Tuesday 7/15/97. Hopefully the test will run for the next month, and immediate savings in CO_2 money can be realized.

We need to make sure that we do everything possible to keep the inert gas compressor and system running per SOI-06. There should be enough filters in stock and ordered on the way to complete the test.

The test requires data collection of [CO] and [O_2] measurements twice per shift, and adjustments in T-95 purge flows twice per day.

Joe Novasio, Don Ball and I discussed the need for me to come out once per day during the test to offer support, look at the data, and make adjustments to the plan if necessary. I would like to meet with every shifter and lead man on day shift at 0900, except on Sunday, when I would like to meet with you at 1500. If I am out of town, I will make arrangements to call in and discuss the data and operations.

Please feel free to contact me if you have any questions, otherwise I look forward to meeting with each of you when you are on day shift, and look forward to a successful test.

Test Procedure - DEMO9704

Silo Inert Gas Efficiency Testing

Test Objective:
Reduce silo purging costs to a minimum.

Knowledge Goal Questions:
1. What is the value or advantage of inert gas?
2. What is the best mode of operation for utilizing the available equipment?
3. What improvements can be made with economical feasibility?
4. Can we get the system to the point that the human element is out of it?

Products of Test:
1. A written procedure for purging the silos.
2. Recommendations for improvements.

Test Method:
1. All testing will be conducted in T-95.
2. A mode of operation will be initiated and held for up to 30 days, if possible.
3. Silo chemistry will be recorded twice per shift.
4. Silo purge gas rates will be recorded and adjusted (if necessary) twice per day.
5. Silo heat up will be investigated and recorded. If a heat up occurs, as indicated by increasing CO levels with increase O_2 levels or increased temperature, the test will be shifted to total CO_2 inerting.

Test Conduct:
1. Sufficient backup exists as to the amount of CO_2 purging used at the ACCP, as monthly usage appears as Figure 1, which includes data for the last 2 years.
2. The first test will attempt to baseline inert gas purging in-lieu of CO_2 purging in the top ports. In general, CO_2 purging was left at about 40 SCFM per each of two top silo ports and 40 SCFM in the hopper, unless there was a significant increase in CO and O_2 together. The first test will remove the two top 40 SCFM CO_2 purging with wide open (about 200 SCFM per port) inert gas purging.
3. The second test will establish baseline CO_2 purging at a minimum level by utilizing only the top purge ports.
4. The third test will baseline a possible blending of CO_2 /inert gas purging.
5. Operate such that the inert gas O_2 concentration is at 3.5% or less.
6. Any other tests, if necessary, will consist of attempts to isolate heat-up causes and development of methods to minimize costs. They will be planned after the baseline tests.

TRIAL 1

1. Purge T-95 with CO_2 prior to the test. This test will use a combination of CO_2 and Inert gas.. 100% CO_2 will be used for this test only if there is a runaway with combustion as indicated by heat up and high [CO].
2. Operation of the inert gas for 7 days to T-96, wide open yielded a background level of CO for the test of 250 ppm. This value will be added to each of the levels that were expected to be operation points previously.
3. Operate based on Table 1 "Inert Gas Operational Guide for Trial 1" which requires an operational response based upon the concentrations of both CO and O_2. The values allow for the background CO level found in step 2 as follows:
   - ⇒ Set purge rates for Inert Gas and CO_2 per the Operational Guide.
   - ⇒ When the CO level is greater than 1000 ppm and the O_2 level is above 6%, then inert gas is not on, but only CO_2 until the CO and O_2 levels drop.
   - ⇒ When the CO level falls back below 1000 ppm or the O_2 level is below 6%, then return to the initial purge settings and resume with inert gas.
4. Top purge and hopper should be the only purge ports necessary
5. Record data on the data sheets for 30 days, twice per shift each day.
6. Attach all CO_2 delivery reports, and correlate when T-95 is being fed with product.

TRIAL 2

1. Purge T-95 with CO_2 only. No inert gas will be used for this test.
2. Operate Trial 2 in the same manner as Trial 1 except that Inert Gas is not running. The same limits that were used during Trial 1 will be used, and CO_2 alone will be used to control the CO level.
3. The Hopper and the Top purge should be the only purge ports necessary for the test.
4. Record data on the data sheets for 30 days.
5. Attach all CO_2 delivery reports, and correlate when T-95 is being fed with product.

TRIAL 3

1. Purge T-95 with CO_2 and inert gas alternating during the test.
2. This trial operational conditions will be based upon the data and the results obtained during the first two trials.
3. Record data on the data sheets for 30 days.
4. Attach all CO_2 delivery reports, and correlate when T-95 is being fed with product.

<u>Post-Test Work</u>

A report will be issued outlining any improvements that could be made.
An SOI procedure for maintaining a safe inert atmosphere within the silos using inert gas will be issued.

Inert Gas Operational Guide for Trial 1

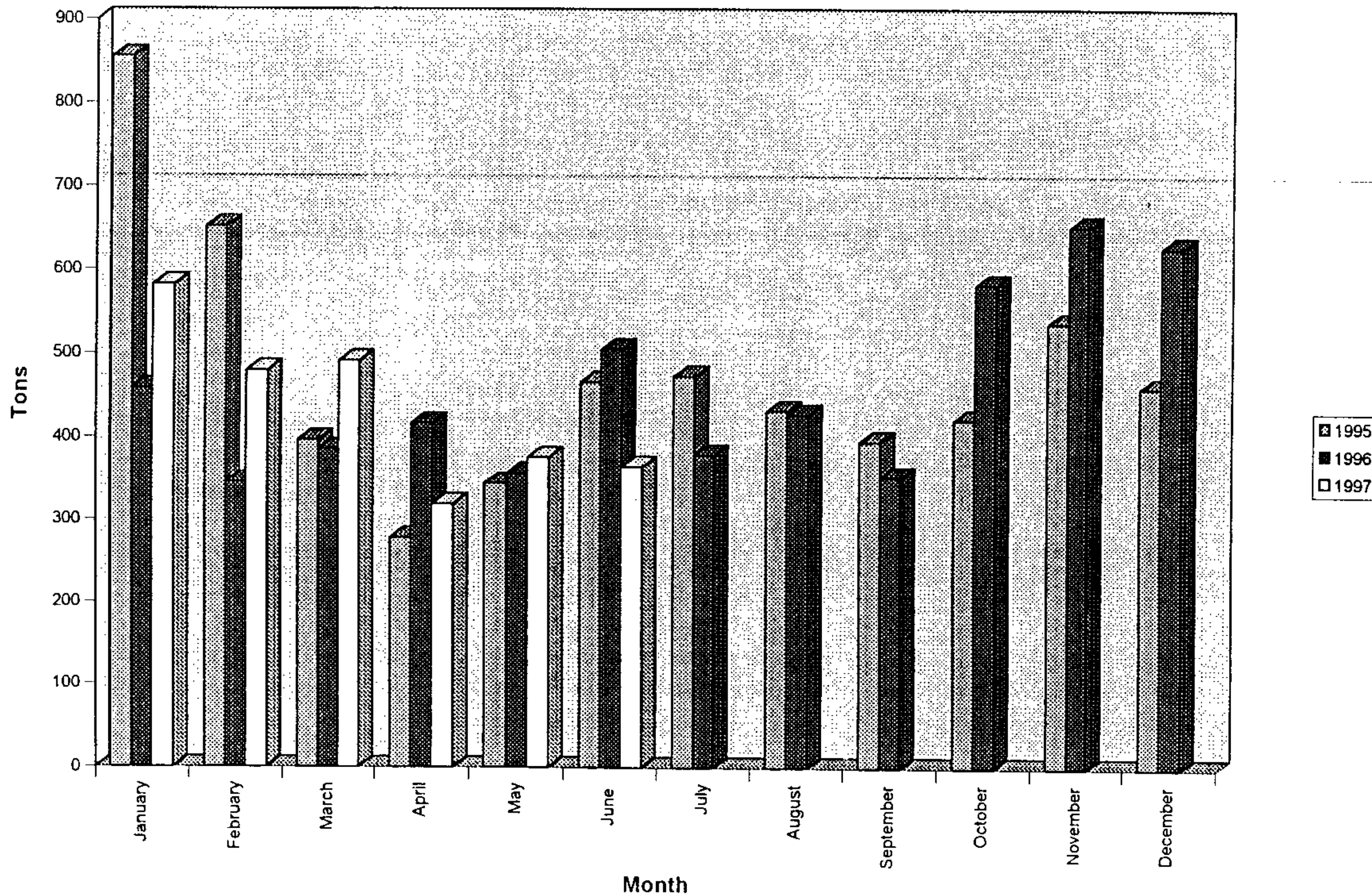
Condition	[CO]	[O_2]	Line #2 Top Port	Line #1 Top Port	Line #3 Hopper	Line #4 Slope S	Line #5 Slope N	Notes
Start	< 750 ppm	<6%	IG w.o.	IG w.o.	40 SCFM	0	0	1
Rising [CO]	< 750 ppm	> 6%	IG w.o.	40 SCFM	40 SCFM	0	0	
	< 1000 ppm	< 6%	IG w.o.	40 SCFM	40 SCFM	0	0	
	< 1000 ppm	> 6%	IG w.o.	80 SCFM	40 SCFM	0	0	
	> 1000 ppm	< 6%	IG w.o.	80 SCFM	40 SCFM	0	0	
	> 1000 ppm	> 6%	80 SCFM	80 SCFM	40 SCFM	0	0	2
Falling [CO]	> 1000 ppm	> 6%	40 SCFM	80 SCFM	40 SCFM	0	0	
	> 1000 ppm	< 6%	IG w.o.	40 SCFM	40 SCFM	0	0	
	< 1000 ppm	> 6%	IG w.o.	40 SCFM	40 SCFM	0	0	
	< 1000 ppm	< 6%	IG w.o.	IG w.o.	40 SCFM	0	0	
	< 750 ppm	> 6%	IG w.o.	IG w.o.	40 SCFM	0	0	

Note 1 - "IG w.o." means that the Inert Gas is wide open for that port; SCFM values are for CO_2 only.

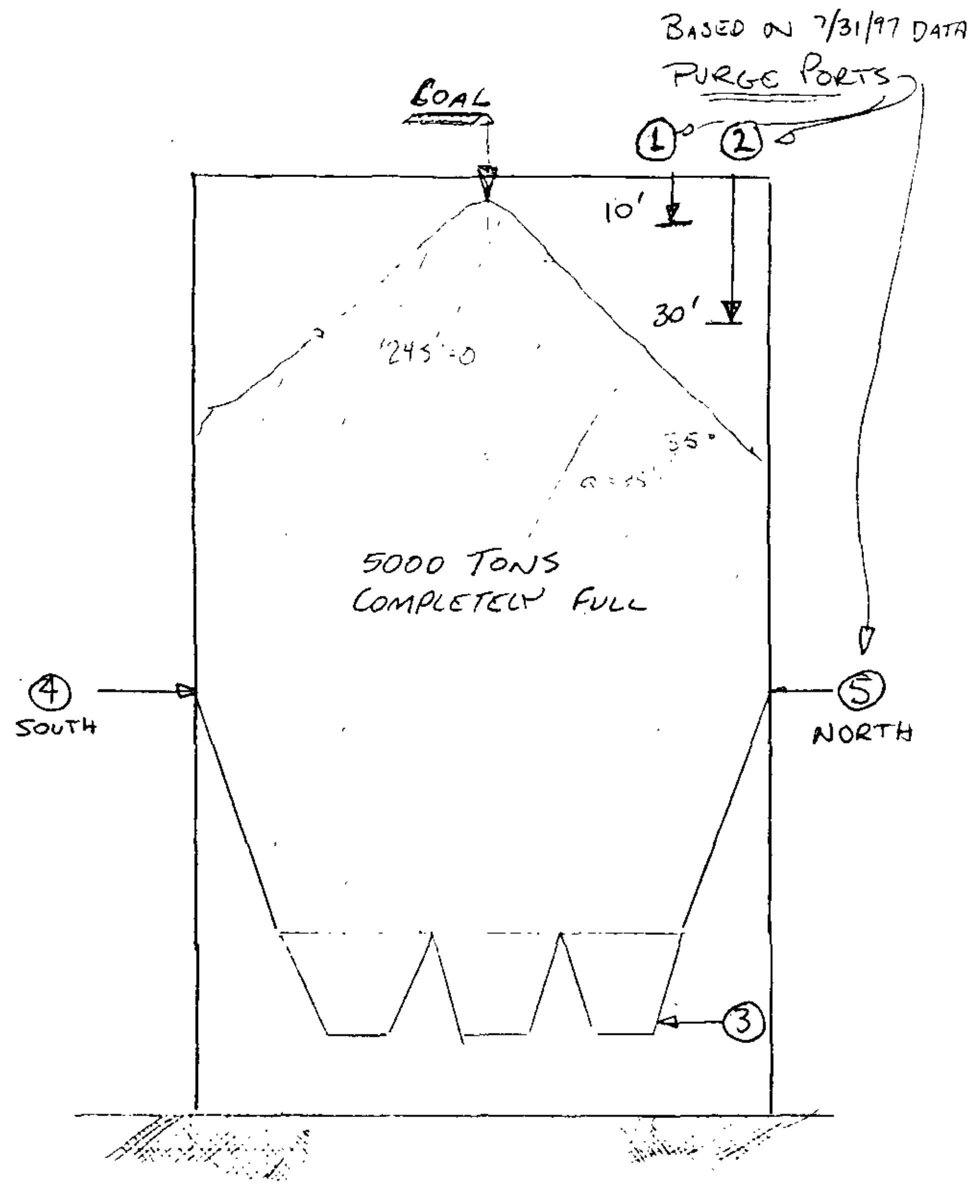
Note 2 - If the silo [CO] indicates increased combustion, then inundate the silo with CO_2 as directed

DEMO 97-04 Test Data Sheet - Trial No. ____									
Silo Inert Gas Efficiency Test									
			Silo	T-95 Purge Flows			Chemistry		Notes
Date	Time	Initials	Level	Line #1	Line #2	Line #3	O_2	CO	Temps., etc.

CO_2 Usage per Month



T-95 Inert Gas/CO_2



Total Volume of Silo = 320,000 ft^3

SynCoal Volume (ϵ = 40%) = 250,000 * .6 = 150,000 ft^3

Gas space Vol = 170,000 ft^3

Appendix B

References

REFERENCES

1. Internal Memorandum, Richards to Novasio, 06/20/96, "Summary of Findings on J-02-63 Inert Gas Compressor System as of Date"
2. Internal Memorandum, Viall to Richards, 02/21/96, "Silo CO_2 Testing - Initial Notes"
3. ACCP Report, Rosebud SynCoal Partnership, "ACCP Inert Gas System Design and Operation Description", October 1997, Rev. 0
4. Internal Memorandum, Richards to Novasio, 07/17/97, "Employee Exposure to Inert Gas"
5. Internal Memorandum, Richards to Novasio, 07/25/97, "CO_2 Tank Safety Relief"
6. Internal Memorandum, Viall to Richards, 02/07/95, "CO_2 System Evaluation"
7. Internal Memorandum, Richards to Sheldon, 09/29/97, "BOC Tank Installation/Lease Economics"

MEMORANDUM

06/20/96

To: **Joe Novasio**
From: Jeff Richards
C: Duane Ankney
Subject: **Summary of Findings on J-02-63 Inert Gas Compressor System as of Date**

The following is offered for discussion and direction planning. Due to schedule constraints, I would like to discuss this on Monday 6/24/96 at your convenience, if possible.

1) Summary

- Technically, the gas coming out of the stack would be considered process gas (since it is not air) which would force specification of a more heavy duty compressor. A reciprocating or centrifugal type process compressor will cost upwards of 10 times more than the present compressor. I have been unable to find a compressor representative that can give me a reason why a standard air compressor will not work with our gas chemistry, and the required outlet conditions fall in-line with a standard helical lobe, or screw type air compressor .

- Your operators report that coal dust continues to show up in the compressor components, though the oil analysis does not indicate coal dust contamination. I can not offer an explanation for why that is.

- We should be able to make the existing oil-flooded screw compressor (Atlas-Copco GA-160) work if we perform a few modifications to the gas system:
  1) Additional filtration prior to the compressor - we are supposed to be filtering to 10 micron, but maybe due to the Atlas-Copco ability to trap particulate in the oil, we should filter down to 3 microns or so right in front of the compressor inlet.
     The dryer filters after the compressor have not been replaced often, which seems to indicate that the Atlas-Copco compressor is doing a good job of trapping particulate in the oil and providing a clean gas to the air dryer.
  2) Heat trace and insulation of the inlet line after the first filter - to prevent water drops from entering the compressor gas after the drain that is upstream of the existing filter, and
  3) Tighter operational procedures and controls - right now, there are no filters in the east canister. How do we garantee that we always have a filter in the canisters, and that nothing falls into the inlet line when we are replacing filters?

- According to my Ingersoll-Rand compressor book, a dry helical lobe compressor would be better suited for the possibility of dirty wet gas, but the compression ratios are lower (limited to about 50 psig) and should be base-loaded. In other words, if we are using the compressor for inert gas to the silos, a dry screw would probably work well, but not for soot blowing when we need 100 psig. We should probably review the requirements for inert gas one more time prior to making a decision. I am in the process of getting costs for this type of compressor.

- The burnt hoses on the compressor are most likely due to an air/oil separator fire. The very first page of the Atlas-Copco Instruction Book warns the user to make sure that you are not compressing flammable vapors (like solvents). Is the Varnasolv used by Industrial Tool in the compressor oil flammable when compressed?

- I have asked a compressor factory rep. to check if the gas chemistry of the Inert Gas will react with the compressor oil in a deleterious fashion. This has not been completed yet.

2) **History**

- UniField designed the system in November 1993, and component selection was completed by January of 1994. The original Specification for the Inert Gas Compressor System required that the compressor "be equipped with an inlet air receiver for removal of entrained water due to condensation occurring in the ductwork ahead of the compressor." The UniField specification also called for the "compressor system shall be equipped with an inlet air filter of heavy-duty construction limiting passage of 10 micron and larger particles." Somehow, both of these requirements were waived by the project engineer.

- An Atlas-Copco compressor was bid to meet the requirements of the Inert Gas. Other standard air compressors were bid by other suppliers as well based on the stack gas specification. One bidder supplied a bid for a compressor that cost about 10 times more than the Atlas-Copco. Recent discussions with this supplier indicated that the reason that a more exotic compressor was bid, was because it was not air, but could not give definitive reasons why a standard air compressor would not work. According to my Ingersoll-Rand book, the flooded screw compressor should be all right for this application provided that the following is adhered to:
  1) There is nothing corrosive in the gas - to the best of my knowledge, there is not sufficient amount of Sulfur compounds to be corrosive at 2 PPM, and the stack gas condensate pH show neutral.
  2) There is sufficient gas particulate removal - the 10 micron filters should be adequate provided that no material gets into the compressor inlet when the filters are being changed, and that there is no flooding due to condensation that could solubilize the particles and carry them through the filter.

3) <u>There is no liquid water in the inlet gas</u> - there have been reports that large quantities of water have been found in the compressor inlet line upstream of the filters, and that there has been large quantities of water in the oil at times.

- The installation was started-up and ready to operate in October of 1994, but the engineer in charge of the installation waived the specification for an inlet air receiver and inlet filters. When this was found out, an air filter was purchased for the compressor inlet.

- By December of 1994, the first air-end was shot and had to be replaced due to failure. The cause was insufficient water and particulate removal prior to compression. Additional gas filtration was installed in between the knock-out tank and the inlet of the compressor.

- In January of 1995, the compressor drive gearbox failed due to lack of lubrication of the bearings. During installation of the second air-end, it is believed that the oil system was not adequately cleaned out prior to installation of the new air end, and the oil flow to the gear box was stopped due to dirty oil pluggage and caused the bearing to fail. Atlas-Copco stated that they believed that the gear box failed as a result of a large piece of stainless steel pipe (a piece of which was found in the inlet piping) proceeded through the air-end and caused the gear box to fail.

- In February of 1995 the entire compressor (air-end No. 3 and drive) was replaced.

- In December of 1995, after several months of operation, the compressor system kept shutting down due to High Element Outlet Temperature. The cause of which took over 5 months to determine (see Industrial Tool Report dated 5/24/96) and was ultimately due to particulate plugging the oil cooling system of the compressor.

- In February of 1996, a new air-end was installed (air-end No. 4) because the cause of the High Element Outlet Temperature was not determined at the time, and thought that the air-end just might be the problem. The representative noted how clean the replaced air-end was, and estimated that between 10,000 and 15,000 hours should be obtainable for an air-end in our inert gas service.

- Finally in early May of 1996, due to continued particulate plugging of the oil filters, Varnasolv was placed in the compressor oil and left by the Atlas-Copco representative and Industrial Tool. The compressor stayed down because the plant stayed down until May 29, 1996. The plant came up and the Inert Gas Compressor was started, and shut down within an hour. One hour later, with the standby air compressor in service, smoke was found at J-02-63 and all of the oil lines show signs of high temperatures.

NOTE: It was thought that the standby compressor may have caused the J-02-63 compressor to turn backwards, but this is impossible because the minimum pressure valve will prevent back flow to the compressor. If we assume that the minimum pressure valve was stuck open, the compressor outlet check valve would also prevent back flow, and the worst that could happen would be oil shoved out of the air/oil separator and into the air-end. Since the fire seems to be isolated to the hoses carrying oil, the only explanation that is plausible is a separator fire due possibly to compression and subsequent ignition of a flammable substance.

MEMORANDUM

TO: Jeff Richards

FROM: Art Viall
DATE: February 21 1996

RE: *Silo CO2 Testing - Initial Notes*

Demo test 96-01 has been in progress for 48 days. The data from the first test involving CO2 is not conclusive but the following observations can be made:

- Overall CO2 usage has averaged 14 TPD.
- T-90 uses between 3.5 and 4.5 TPD.
- T-96 only used CO2 for about 6 days last week.
- By difference, I'm estimating we have expended an average 9 TPD of CO2 in T-95.
- *At our current usage rate, we would end the year with a* $433K CO2 bill. But *this is* running a single silo and with T90 empty some of the time.
- My guess is that between 5 and 8 of the 9 TPD is going out the bottom which translates to $150-$250K/yr. The majority of the bottom leakage could be saved with good shutoff gates. A large fraction of the bottom leakage might be saved by simply utilizing inert gas efficiently.
- Since we began taking data, there have been four occasions when the CO level has climbed dramatically to over 1000 ppm. Such CO ramps result in purge rates about 25% above average, but are usually either proceeded or followed by a period of very low CO2 usage. I'm not sure if the average usage rate will drop by much more than 1-2 TPD even if we do get to the point where we can prevent CO ramps.
- It appears that two main situations can exist requiring two different purge methods.

  When coal is being loaded into the silo and a complete cone has been developed (i.e. *the outside surface of the coal is being continuously covered*), we do not get CO ramps unless the oxygen level is above 14%.

  When stagnant coal is present either from not loading the silo or from drawing down the *silo and the elapsed time until a complete cone is reestablished*, we do not get CO ramps unless the oxygen level is above 5%.

- I estimate that about 100 cfm of air is being drawn into the silo while it is being loaded. About 30 cfm of entrained air is unavoidable, but the remainder could be avoided by completing the installation of rotary airlocks at the silo inlets. This would increase the effectiveness of both inert gas and CO2.

- It appears that purging the top with lots of inert gas to keep the oxygen level down below 14% while loading along with just enough inert gas or CO2 purge at the hoppers should result in a net savings over CO2 alone.

Reference 3 refers to this entire report "ACCP Inert Gas System Design and Operation Description", October 1997, Rev. 0

MEMORANDUM

Western SynCoal Company - ACCP Colstrip, MT

7/17/97

To: Joe Novasio

From: Jeff Richards

C: Don Ball, Jerry Morris, Ray Sheldon

Subject: Employee Exposure to Inert Gas

A continuing issue related to the "Inert Gas" system is the complaint that the gas itself causes shift workers to get heart burn, nausea, or upset stomachs. Based on WECo's commitment to respond to employee safety concerns, you directed me to analyze the area on the silo, to determine if there is anything in sufficient amount to cause the symptoms described. I contacted Jerry Morris, who supplied Wes Sessions and myself with the Sensydyne® gas analyzer (draeger) tubes and fume blocking 3M respirator cartridges.

Gas Analysis

Wes and I went to the top of silo T-95, this morning at about 0900. T-95 had been fed with Inert Gas for over 2 days. We analyzed the atmosphere inside the C-10 conveyor cover at the head chute, and the catwalk next to C-10 which had odiferous emanations. Please note that a person could not get their head into the area where we took readings inside the cover. The analyses for various compounds follow:

Chemical Species	In Cover	@ Catwalk	TLV
Carbon Dioxide (CO_2)	0.6%	0.13%	0.5%
Hydrogen Sulfide (H_2S)	---	---	10 ppm
Carbon Monoxide (CO)	23 ppm	2 ppm	25 ppm
Petroleum Distillates	---	---	
Hydrocarbons	0.01%	trace	
Unknown Gasses	---	---	

There are a few other species that we need to test when the gas detection tubes come in. These include methyl-mercaptan (CH_3SH), which is known to smell in extremely low concentrations. Based on these results, I do not know what could be causing nausea other than the smell, and do not believe that anyone can be exposed to TLV's of the known compounds on top of the silo. I too do not like the smell of the Inert Gas.

Nausea/heartburn Prevention

While up on the silo, I wore the 3M respirator with No. 2047 cartridges used for welding. This cartridge is known to block fumes and mists. While using the No. 2047 cartridges, I could not smell the inert gas even though Wes was complaining that the smell made him uncomfortable. After the readings were taken Wes took silo readings while I, wearing the respirator with 2047 cartridges, got my face into the escaping inert gas. Only after I was in it for a long while could I faintly smell the inert gas, but it did not make me ill. I would recommend that anyone who feels uncomfortable with smelling the inert gas, should wear the 3M No. 2047 respirator cartridge.

MEMORANDUM

Western SynCoal Company - ACCP Colstrip, MT

7/25/97

To: Joe Novasio

From: Jeff Richards

C: Shifters and Lead Persons, Don Ball, Ray Sheldon

Subject: CO_2 Tank Safety Relief

During the last 2 weeks, we have been using very low amounts (about 1/3) of CO_2 compared with the last 4 years due to our Inert Gas Test (9704). Twice we lifted the safety relief valves on the CO_2 tanks, so we had to learn about them again. Here is some information for you.

The Cause of CO_2 Relief

1. Low CO_2 Usage
2. Heat from the day
3. Only one refrigeration unit is working
   - The refrigeration unit can not keep up with low CO_2 usage when it is hot outside.
   - The refrigeration unit comes on at 305 psig, and stops when the pressure in the tank drops below 290 psig.
   - Once the pressure in the tank is over 335 psig, the relief valves lift.

What Happens when the Relief Valves Lift?

1. We loose lots of CO_2
2. The Relief Valves freeze open
   - The relief valves are suppose to reset at 280 psig, but ice keeps them open until they thaw out.

What do we do if the Relief Valve Lifts and doesn't Re-seat?

1. There is a "tee" valve on the top of the North tank that directs flow to either of two relief valves.
   - When a relief valve is lifted and the pressure in the tank is about 310 psig or lower, switch to the other relief valve.
   - Move the position of the horizontal valve stem on the tee valve from either all the way in to all the way out, or from all the way out to all the way in.

What if I have a problem that I don't understand? Who can I call?

Mr. Jim Sisco, Service Technician Extraordinaire, Air Liquide America, Casper WY

Cell Phone	1-(307) 267-1530	Home	1-(307) 234-1818
Pager	1-(307) 237-0501	Dispatch	1-(801) 972-1700

MEMORANDUM

TO: Jeff Richards

FROM: Art Viall

DATE: February 7, 1995

RE: C2 system evaluation

Background

The existing CO2 system was installed as a test in February, 1993. We have been renting the equipment from Liquid Air. It consists of two 60 ton tanks and twelve vaporizers. The equipment is in poor condition. The tanks are over 20 years old and numerous vaporizers do not operate properly. One of the refrigeration units does not operate and the second unit is not reliable. The system was wired and piped in a temporary fashion due to the test nature of the installation. I do not consider the system to be a safe or reliable system.

The power supply for this system was installed on a temporary basis with cables suspended between the silos and the CO2 system. Although legal for a temporary system, it may be challenged by an inspector if he judges it to be a permanent system.

If we where to experience a catastrophic failure of the CO2 system, it would cause a significant upset in our operations. If the system were unavailable for more than two days we would dump the silos resulting in a loss of revenue due to dumping into a low value market and it would cause interruptions to all of our customers.

Liquid Air does not properly service these tanks. Their nearest service representative is located in Casper WY, but he is often between Casper and Denver on other calls.

In addition, Liquid Air has recently increased our rental on the equipment.

Design Alternative

Airco, our current CO2 supplier, has offered to supply us with a replacement system. I have attached copies of the specifications for the tanks that would be supplied and for the pad we will install along with copies of the correspondence related to the proposed project. This system would be much more reliable and cost effective.

Economics

Airco's monthly charge will be about $1,175 per moth less than the Liquid Air charges ($3,100 vs $4,275). This will mean at least a $14,000 savings each year not including losses due to faulty equipment (e.g. relief valves stuck open), but the installation charges will be about $42,000. The installation costs are estimated on the following table.

This project will pay off in between two and four years and will supply us with a safer and more reliable system. I recommend renting and installing a new CO2 system.

Replacement CO2 System Installation Cost Estimate			
Description	Quantity	Unit Cost	Total
Freight	3 truck loads	3,000	9,000
Rigging	16 Unit hours	96	1,544
Concrete	60 yds	200	12,000
Wiring	Lot		10,000
Piping	By Vendor		0
Contingency	30%		9,800
Total			42,344

AIR LIQUIDE
MERCHANT GASES

Friday, July 29, 1994

Western Energy Co.
P.O. Box 99
Colstrip, MT 59323

Attn: Mr. Art Viall

Air Liquide America Corp. has made significant efforts to control costs and continue to provide the quality of service and product that you expect.

While some of these efforts have produced positive results, we still find it necessary to partially offset increased costs for maintenance, and new capital investments.

As such, Air Liquide America Corp. finds it necessary to make price adjustments. Therefore, effective **September 01, 1994**, your pricing is revised as follows:

EQUIPMENT DESCRIPTION	EQUIPMENT RENTAL	
11 ea. 24K VAPS. @ 100.00 each	**sub-total**	**$1100.00**
2 ea. 58 Ton. Vessels @ 1725.00 ea.	**sub-total**	**$3450.00**

	TOTAL	**$4550.00**

Account # 403431L007

We sincerely thank you for your business and your continued loyalty. Should you have any questions regarding the above please contact Account Manager Forrest Marsh , or the undersigned.

Sincerely,

Lynn Benson
Region Manager

Martin Lee

cc: Forrest Marsh

1676 SOUTH 700 WEST, SALT LAKE CITY, UT 84104-1610, (801) 972-5892, FAX (801) 972-5896

AIRCO

Airco Gases
1588 Doolittle Drive
P.O. Box 1753
San Leandro
California 94577

Telephone: 510-297-5525
FAX: 510-352-8132

August 4, 1994

Mr. Art Viall
Senior Process Engineer
WESTERN SYNCOAL COMPANY
P.O. Box 99
Colstrip, Montana 59323

Dear Mr. Viall:

In accordance with your request the following includes lease/buy options on both vertical and horizontal carbon dioxide receivers. (Unfortunately, we do not make a 75 ton vessel.)

Horizontal 50 ton

Monthly Lease..$1050.00 310
Purchase Price...$ 68,000.00

Vertical 50 ton

Monthly Lease..$1175.00 3350
Purchase Price...$ 76,000.00

If you have any questions on this give me a call at (206) 283-9853 or (206) 953-5077. We are still prepared to furnish you with a proposal on an inert gas generator. We place a high value on your business and we are happy to be of service.

Best regards,

BOC GASES

Joe Eide
Sales Representative

cc: Steve Dziak

AIRCO

Airco Gases
1588 Doolittle Drive
P.O. Box 1753
San Leandro
California 94577

Telephone: 510-297-5525
FAX: 510-352-8132

August 17, 1994

Mr. Art Viall
Senior Process Engineer
WESTERN SYNCOAL COMPANY
P.O. Box 99
Colstrip, Montana 59232

Dear Mr. Viall:

Re: Letter of August 4, 1994 to A. Viall from J. Eide

The lease/buy numbers quoted in the letter of August 4 are accurate with the lease option extended in exchange for a three year term.

We would propose to replace your existing heat exchange system (twelve 24 KVA pressure builders, six per vessel) with five 60 KW direct to process electric vaporziors. The vaporizors can be purchased for $6,000.00 per unit or leased on a monthly basis for $200.00 apiece. The lease of the vaporizers would be under the same three year term as the receivers.

For easy reference, the fifty ton horizontal vessels would sell for $68,000.00 per tank and lease for $1050.00 per month per vessel. The vertical option was $76,000.00 per unit and $1175.00 monthly.

The other costs to the switch out would be the freight and rigging. We would bill you the actual costs incurred, at this time an estimate of the charges would be $15,000.00. We would also like to install a Telemetry unit if the change is made. This would require you to provide a phone line to the pad but it has many benefits for both parties. This feature can be added for $80.00 per month. (See attached Telemetry cuts.)

Please contact me with any further questions at (206) 283-9853. We look forward to working with you on a smooth transition of equipment.

Best regards,

BOC GASES

Joe Eide
Sales Representative

cc: Steve Dziak
Robert Glaser

SynCoal® Western SynCoal Company

August 19, 1994

Joe Eide
Airco
1588 Doolittle Drive
San Leandro, CA 94577

Dear Joe:

I have the following questions related to the two quotes you have made for a CO_2 storage and vaporization system:

- Do the tanks include a refrigeration system? One will be necessary once our inert gas system is installed.
- What kind of foundation do the tanks require?
- What would be the maximum volume of CO_2 vapor produced by five 60 kw vaporizers?
- How would the control system be set up (ie low pressure alarms, low pressure cut outs, high pressure control)?
- Is the equipment you propose to install new? If not, what is its current condition?
- What service arrangements would be in place?
- The existing system has regulators for cutting the supply vapor pressure down to 15-50 psig. The regulators belong to Liquid Air. Do your quotes include pricing for a new regulator.
- Can we apply a portion of the lease charges to a purchase at some future date?
- You have estimated $15,000 for freight and rigging. What about installation once the equipment is on the ground including piping and wiring?
- Who pays for shipping the tanks out at the end of the lease?

This system will most likely be in service for at least three years. It would seem more sensible for Airco and WECo to split the installation costs for the system.

I do not expect to change out our CO_2 system before October 1994, but we would like to get the process in motion in September.

Please contact me if you have any questions.

Sincerely,

Art Viall, PE
ACCP Senior Process Engineer

BOC GASES

BOC Gases
1588 Doolittle Drive
P.O. Box 1753
San Leandro CA 94577

Telephone 510 297 5000
Fax 510 352 8132

September 2, 1994

Mr. Art Viall
Senior Process Engineer
WESTERN SYNCOAL COMPANY
Rosebud Mine
PO Box 99
Colstrip, Mt 59323

Dear Mr. Viall:

Pursuant to your letter of this past August 19, we will address each item below as they were listed in your inquiry.

1. Refrigeration systems. Each tank will come completely equipped with it's own refrigeration system.

2. Tank foundations. The foundations in place should be adequate as they support sixty ton vessels now. Attached you will find foundation specifications and the dimensions of a fifty ton vessel, I would be surprised if the current pads were inadequate.

3. Five 60 kW vaporizers will produce 7500 pounds per hour of carbon dioxide vapor.

4. Control systems. The pressure within the vessel is controlled via temperature. This is all automated, if the pressure drops the heat of the product increases until the desired pressure level is attained. If the pressure increases past a desired set point the temperature falls to correct.

5. Age of storage vessels. If new equipment is not specified the tanks will be used. If the system is not new it will be refurbished and in perfect working order upon arrival to your facilities. The system is under a one year warranty and any service calls after that time will be billed at $75.00 per hour and $0.60 per mile.

6. Regulators. Our systems are supplied with regulators and our quote includes these costs.

7. Lease/Buy options. Fifty percent (50[illegible] the rentals may be applied to the purchase price for a period of one year afte[illegible] installation.

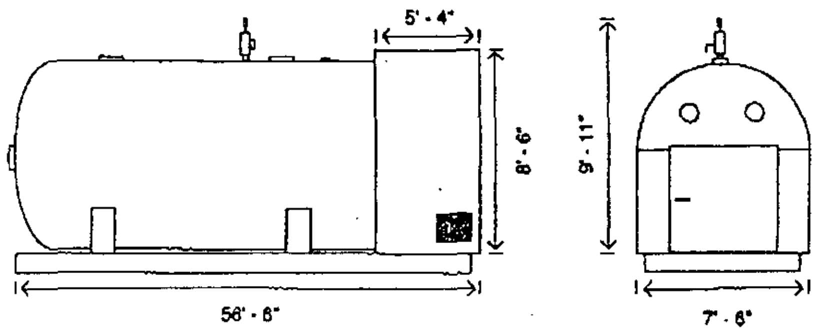
8. Piping and wiring are not included in the freight and rigging. Piping and wiring are the responsibility of the customer.

9. The customer pays for systems removal costs at the end of the lease.

AIRCO
SPECIFICATIONS

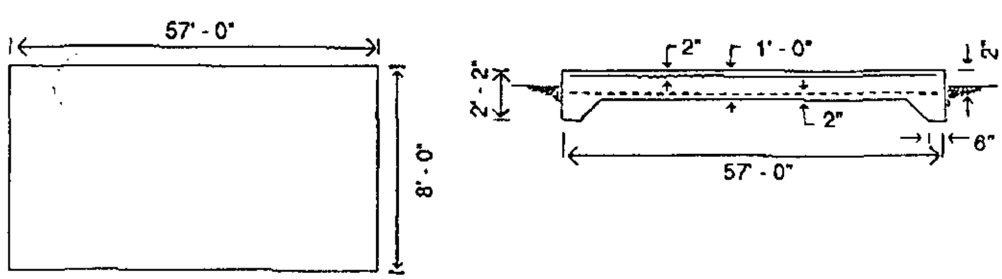
50 Ton Receiver
TOMCO Design

Capacity	100,000 lbs. of carbon dioxide
Maximum Design Pressure	350 Psig
Operating Pressure Range	200 Psig to 300 Psig
Weight of Empty Receiver	55,000 lbs.
Insulation	3" Polyurethane



50 Ton Receiver Pad Specifications

Foundation Service	50 Ton Tomco
Reinforcing Rods	Length #6 @ 4" C.C. ASTM A-615 GR 40 Width #5 @ 5" C.C. ASTM A-615 GR 40
Minimum Compressive Strength	2500 psi @ 28 days
Concrete	American Concrete Institute 318
Minimum Required Soil Bearing	2000 PSF



footings
pad
57' + 57' + 32' x 1 x
55 x 14 x 1 = 770
18 x 6 x 1 = 10
1170
43
54 yds

ACD 1015

MEMORANDUM

Western SynCoal Company - ACCP Colstrip, MT

09/29/97

To: Ray Sheldon

From: Jeff Richards

C: Don Ball, Jack Rosander, Joe Novasio, Duane Ankney

Subject: BOC Tank Installation/Lease Economics

Reference: Richards/Ball memo to Sheldon, dated 17 Sept. 1997, "CO_2 system evaluation" (Memorandum Attached)

Don Ball and I spoke with Joe Eide of BOC gases today concerning the installation and lease of two (2) new 50 ton capacity CO_2 tanks, two (2) direct to product vaporizers, and two (2) pressure build tank vaporizers to replace the existing old temporary tankage at the ACCP.

The terms are as follows:

⇒ BOC Gases will supply the equipment for a lease payment of $2750/mo, with a three (3) year buy-down.

⇒ RSCP procures installation of the following items estimated as follows:

1.	Shipping of Equipment from point of origin; BOC Start-up	$ 7,950
2.	Foundation Installation (incl. placing piles on the weekend)	$ 55,000
3.	Electrical and Piping Installation	$ 36,000
4.	WECo crane; WECo rigging labor	$ 2,400
	TOTAL BUDGET ESTIMATE	$101,350

The current lease fee for the old existing equipment is $4650/month, with no buy-down value. A simple payback of the installation procurement, estimated at $101,350 would be in approximately 4-1/2 years based on the $1900/month savings generated by the new lease. ($4650/mo. - $2750/mo. = $1900/mo. savings)

The reference memorandum lists the disadvantages of retaining the existing system without replacement. Safety, being of primary concern to RSCP and WECo, would dictate that the replacement of the existing old tanks be undertaken immediately. An economic value for new lease equipment must include the risk of failure of the existing system. A very possible scenario would be failure of the existing system, requiring wastage of an entire silo full of product to prevent spontaneous combustion and fire. This scenario would cause delay of customer shipments, and could severely damage customer relations. The value of an entire silo full of product would be over $100,000.

BOC GASES

BOC Gases
2389 Lincoln Avenue
Hayward CA 94545
Telephone 510 786 2611
Fax 510 786 5906

Mr. Don Ball
Site Representative

Mr. Jeff Richards
Project Engineer

September 29, 1997

Rosebud Syncoal Partnership
PO Box 99
Colstrip, Montana

Gentlemen:

The attached includes three agreements; a product agreement for carbon dioxide, an equipment rental agreement, and a Purchase Security Agreement. Please accept the PSA as a substitute for the Lease to Buy option we discuss earlier today. The PSA is not a true Lease to Buy option but rather a time purchase option.

These three documents include all costs incurred via BOC Gases, with the exception of the one time charges for systems installation. In our proposal this past April, Kelly Leitch outlined the scope of responsibilities. Since Western Syncoal is doing the foundation, electric, and piping from the pad to the point of application, the freight for the shipment of the equipment and the installation supervision are the only line items to be billed to Western Syncoal by BOC Gases. Estimated costs for shipping and BOC supervision are as follows;

follows;	Freight	$4,200.00
	Project Management/Training	$3,750.00

I will be faxing this data to you immediately and will look forward to hearing from you at your earliest convenience. My office phone is (360) 571-8778, my mobile is (360) 606-0671. Thank you.

With best regards,

BOC GASES

Joe Eide
Sales Representative

CARBON DIOXIDE EQUIPMENT RENTAL AGREEMENT

BOC GASES, a division of The BOC Group, Inc., a Delaware Corporation, (hereinafter called "BOC" and Rosebud Syncoal Partnership (hereinafter called "User"), having a plant at Colstrip, Montana (hereinafter called ("Location"), hereby agree as follows:

1. BOC hereby leases to the User, and the User hereby rents from BOC, the equipment identified below (hereinafter called the "Equipment"). The User, without charge, shall furnish appropriate space for the installation, operation, and maintenance of the Equipment, and BOC shall have access to such space for all purposes of this Agreement. The User shall also reimburse BOC for all excess costs arising out of local conditions that are incurred by BOC in the performance of any installation or other construction work hereunder.

2. The term of this Agreement shall begin on the date upon which the Equipment shall be completely installed and ready for use and shall continue in effect until the third (3rd) anniversary of such date and, unless terminated by either party as of such third (3rd) anniversary date by giving at least ninety (90) days prior written notice of termination to the other party, shall continue in effect from anniversary date to anniversary date thereafter, unless and until terminated as of any such anniversary date by either party by giving at least ninety (90) days prior written notice of termination to the other party.

3. The Equipment shall be furnished and installed completely by BOC, at the Location, at the expense of BOC, except that the User, at its expense, shall furnish such foundations, carbon dioxide supply lines, extended fill lines, telephone lines and such electric, steam, water, gas and other connections as, in BOC's opinion, are necessary for the installation, operation and/or maintenance of the Equipment. User shall pay freight charges for the Equipment from the location of manufacture or storage to the Location, and User shall pay all rigging costs associated with the installation.

4. BOC will provide its standard preventative maintenance procedures once per year within the term hereof at no additional charge to User. Upon notification by either party to the other that the Equipment requires additional maintenance or repair, BOC shall provide normal and reasonable maintenance or repair at the expense of User at BOC's normal charges for such service. Nothing contained herein shall be construed to authorize User or any other person to maintain or repair the Equipment.

5. $2,750.00 per month, payable in advance commencing on the date upon which the Equipment shall be completely installed and ready for use, shall be the aggregate rental payable by the User to BOC for the use of the Equipment, as provided herein. A list of the Equipment and a breakdown of the aggregate rental is as follows:

Equipment	Rental
2 - 50 ton vertical VJ receivers	
2 - 60 kW Direct to Process Vaporizers	
2 - 9 kW Pressure Build Vaporizers	
1 - Tel Tank Telemetry System	$2,750.00

6. BOC shall have the right to revise the rental of the Equipment hereunder by giving the User at least fifteen (15) days prior written notice of such revision. If, within fifteen (15) days after the giving of any such notice by BOC, the User shall furnish BOC with a copy of a bona fide, firm, written offer from a responsible seller, offering to lease to the User comparable equipment at a more favorable rental, and, if within fifteen (15) days thereafter BOC shall not agree either (a) to meet such more favorable rental, or (b) to reinstate the rental in effect at the time of said notice of revision, whichever is higher, the User shall have the right to terminate this Agreement, by giving BOC written notice of its election to do so within twenty (20) days after the effective date of said revision.

7. BOC hereby consents and grants the User permission to put into the Equipment carbon dioxide obtained from sources other than from BOC. The User shall indemnify BOC with respect to any damages resulting from the exercise of such permission and BOC shall be held harmless from any liability arising as a result of such exercise if the carbon dioxide obtained from other sources is not of like grade and quality to that of BOC. The User shall have the burden of proving that the carbon dioxide obtained from other sources is of like grade and quality to that of BOC.

8. In the event that this Agreement shall be terminated for any reason, prior to a date which shall be thirty six (36) months after the effective date hereof, the User shall pay to BOC all expenses incurred by BOC at the time the Equipment was installed. The Amount of such expense shall be reduced by one thirty-sixth (1/36) for each month that rental has been paid by the User for the use of the Equipment. Upon any termination of this Agreement, the User agrees to pay to BOC the cost of removing, rigging and shipping the Equipment to BOC's nearest storage facility.

9. The Equipment shall be operated in strict conformity with all applicable laws or ordinances, or applicable orders or regulation of public authorities and the User, at its expense, shall obtain all permits, licenses and site drawings required by any such laws, ordinances, orders or regulations for the installation and operation of the Equipment. The User shall keep the Equipment free from dust and other foreign substances.

10. The user shall not deface or permit to be defaced any of the markings on the Equipment, and the Equipment shall not be altered or changed by the User and shall be operated by the User in strict accordance with the operating instructions furnished by BOC. User shall be responsible for all damage to and loss of the Equipment occurring during the term hereof. At the termination of this Agreement for any reason, the User shall surrender the Equipment to BOC in its original condition, ordinary wear and tear excepted.

11. The User shall not remove the Equipment from the Location without the prior written consent of BOC. If the User desires to change the location of the Equipment after its original installation, because of any alteration or relocation of the User's plant or for any other reason, said Equipment shall be relocated under the supervision of a representative of BOC and all costs of such relocation shall be paid by the User.

12. The User covenants and agrees that it will not assign this Agreement without the prior written consent of BOC and it will not create any charges, liens or encumbrances on the Equipment.

13. In the event that the User fails to observe or perform any of the provisions of this Agreement on its part to be observed or performed, and if any such default shall not be cured within ten (10) days after BOC gives the User written notice thereof, BOC may terminate this Agreement upon giving the User written notice.

14. If the User shall fail to surrender the Equipment upon any termination of this Agreement, BOC may take possession of the Equipment with or without legal process and for such purposes may enter upon the premises of the User. The User shall pay to BOC, in such case, in addition to any other sums which may be due to BOC hereunder, all legal expenses, including counsel fees, incurred in any such taking of possession of the Equipment.

15. Any termination of this Agreement shall be without prejudice to the settlement of any rights and obligations which may, as of the date of termination, exist hereunder.

16. In addition to the rental specified in this Agreement, the User shall pay to BOC or, at its election, to the appropriate taxing authorities, the amount of all governmental taxes, excises or other charges, present or future, imposed upon or payable or collectible by BOC with respect to or which is ascertained by reference to any rental payments of the Equipment or the possession or use thereof, including, without limitation, real and personal property taxes applicable thereto, except taxes imposed upon or measured by BOC's net income unless User provides BOC with an applicable tax exemption certificate.

17. The Equipment shall remain the sole property of BOC at all times and User shall have no interest therein except the right to use the same as specifically provided herein. BOC warrants that at the time of delivery the Equipment shall be free from defects in materials and workmanship. BOC's liability and User's remedy under this warranty are limited to the repair or replacement at BOC's election, of Equipment or parts thereof which are shown to BOC's reasonable satisfaction to have been defective; provided that written notice of such defect shall have been given to BOC within ninety (90) days from the date of delivery of such Equipment by BOC. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE AND THERE ARE NO OTHER WARRANTIES, EXPRESS OR IMPLIED THAT EXTEND BEYOND THE FOREGOING WARRANTY.

18. Except to the extent specifically provided otherwise elsewhere herein, BOC shall not be liable for any claim, liability, damage, loss or expense, whether consequential, special, incidental, direct or otherwise, (including, without limitation, lost revenues and/or profits, loss of use or loss of production), caused by, arising out of or connected with any failure of or use of the Equipment during the time User has the right to possession or use of the same hereunder (or while the same is on the Location or any other Location as a result of any act, request or consent of User) whether or not resulting from negligence or from breach of contract on the part of BOC.

19. The provisions of this Agreement constitute the entire agreement between BOC and the User relating to the use of the Equipment. No modification or waiver of any of said provisions shall be binding upon BOC unless set forth in writing and accepted by a duly authorized representative of BOC and no modification of any of said provisions shall be effected by the acknowledgement or acceptance by BOC of any purchase order, acknowledgement or other form submitted by the User with delivery or installation instructions and containing different or additional provisions. USER ACKNOWLEDGES THAT (A) IT HAS READ AND UNDERSTANDS THE PROVISIONS OF THIS RENTAL AGREEMENT AND HAS HAD AN OPPORTUNITY TO HAVE THE SAME REVIEWED BY AN ATTORNEY OF ITS CHOICE AND (B) THE INDIVIDUAL EXECUTING THIS RENTAL AGREEMENT ON BEHALF OF USER HAS THE FULL AUTHORITY TO DO SO.

______________________ (Purchaser)	**BOC GASES, a division of The BOC Group, Inc.**
By: ______________________	By: ______________________
Title: ____________ Date ________	Title: ____________ Date ________
	Submitted By: ______________________