



- Methane to Markets Partnership Expo
- 30 October – 1 November 2007
- Beijing, China

- J. Michael Onifer
- Senior Vice President Established Business Units



**CBM/CMM Extraction:
A Winning Proposition for both Gas and
Coal**



- Engaged in the exploration, development, and production of natural gas in the Appalachian Basin
- Leading developer of coalbed methane (CBM)
- WWW.CNXGAS.COM



CNX GAS

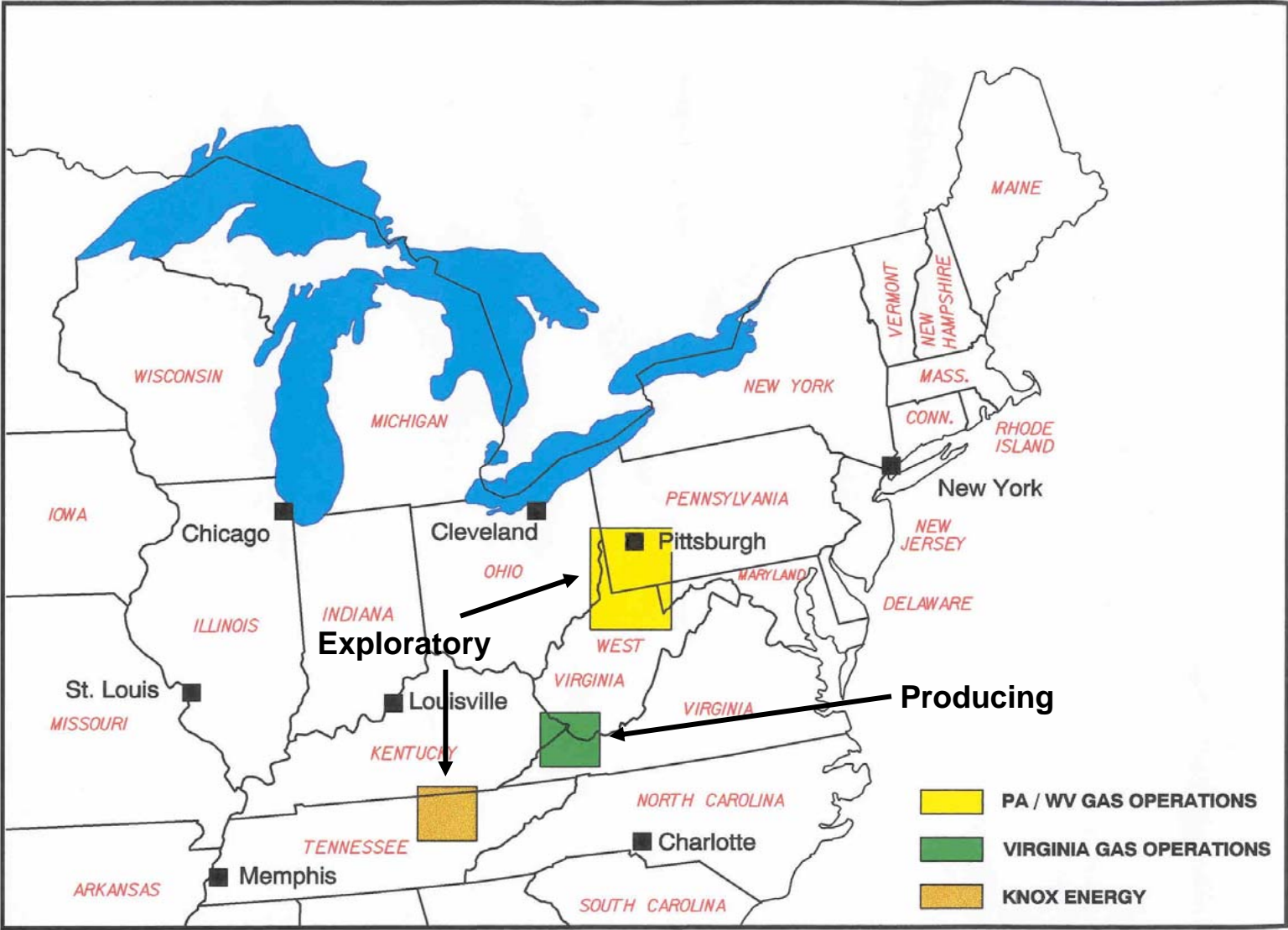
- **Safety is our Top Priority**
- CNX GAS employees have worked 2,374,604 hours without a lost-time accident
- Last lost-time 06-94
- Contractor I.R. 0.30
- Calendar year 2006 0.20
- One ten month period the contractors worked over 1 million hours without a LTA



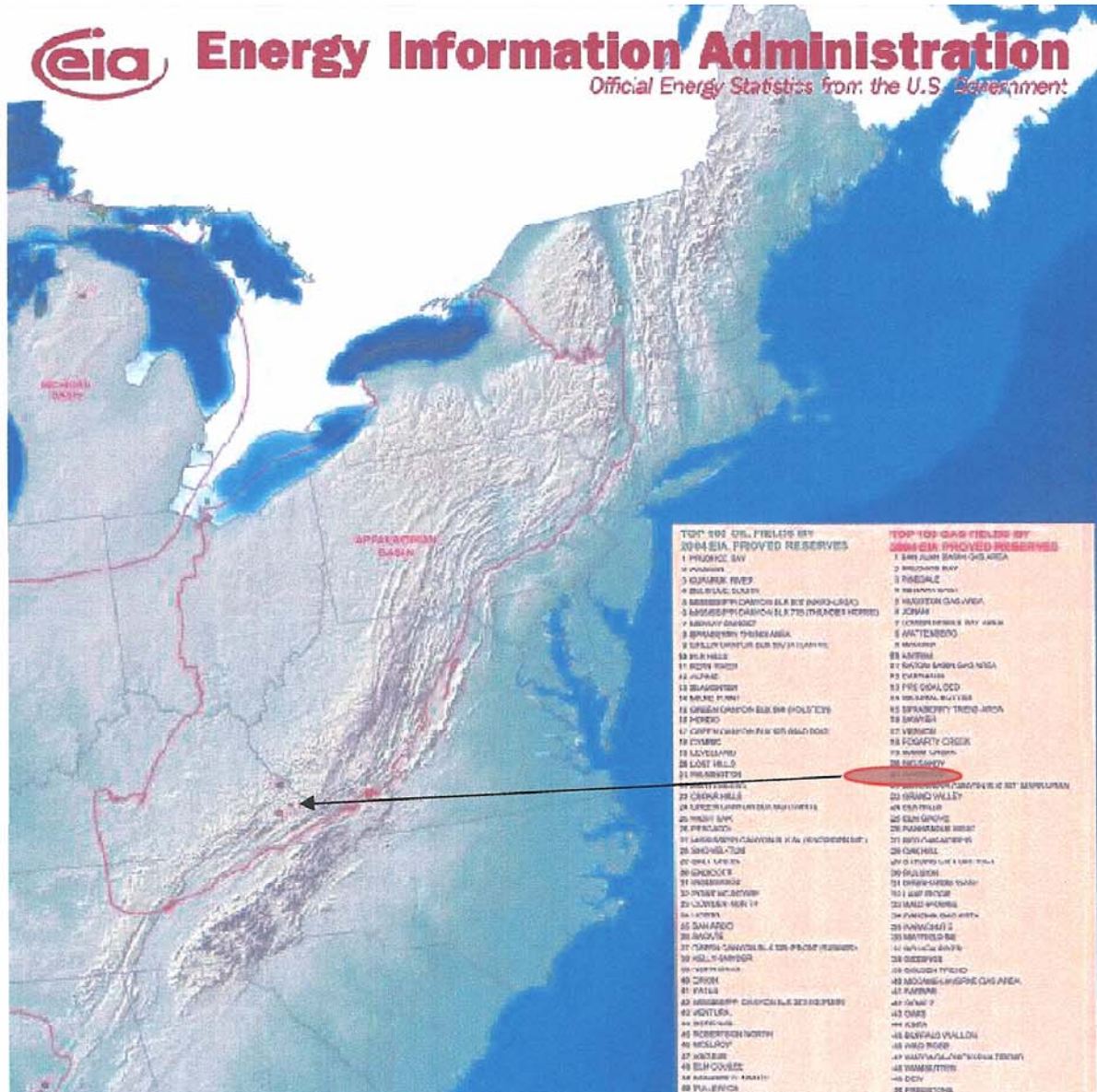


Firefighting training

Geographical Location



CNX Gas Profile – Oakwood Field



DOE Lists CXG's Oakwood Field as the 21st largest gas field in the U.S.



- First priority is mine safety
- Key element is open communication between Mine Management and CNX GAS personnel
- Strategic location of frac wells and gob wells
- Continuous monitoring of the bleeder check points underground

Advance degasification of coal seams has the following benefits:

- Improved mine safety
- Improved mine productivity
- Generates additional revenue
- Significantly reduces methane emissions (greenhouse gas) into the environment

CBM Production Methods

- Frac Wells – Vertical Degasification
- Horizontal “short holes”
- Horizontal “long holes”
- Gob Wells
- Sealed Gob Wells

Mix of Production

- Frac Production – 1,459 wells 70%
- In-mine Horizontal 2%
- Active Gob – 184 wells 12%
- Sealed Gob – 552 wells 16%

Southwest Virginia Stratigraphic Section

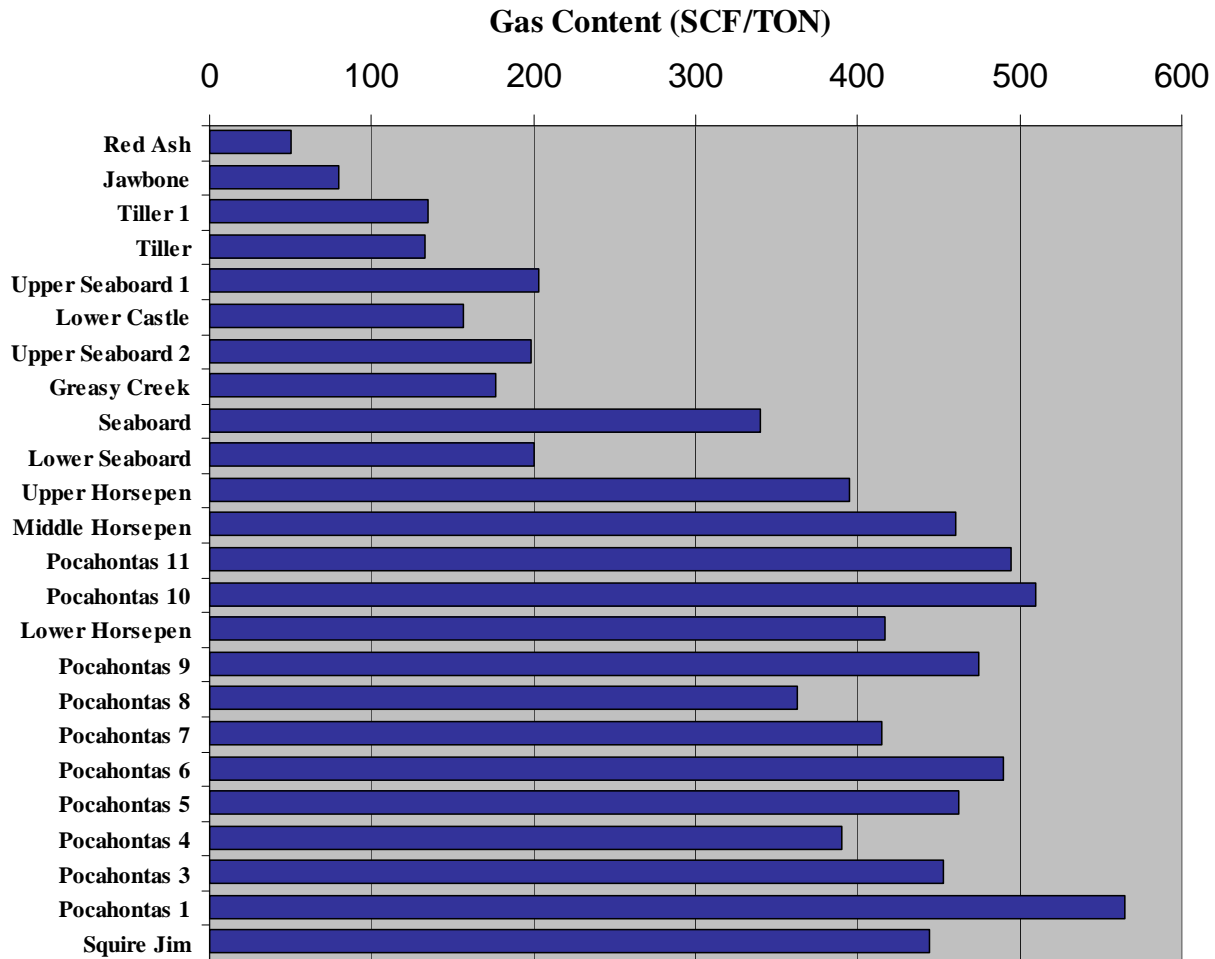
Age	Formation	Coal Seam Name
PENNSYLVANIAN	NORTON	Norton
		Hagy
		Splashdam
		Upper Banner
		Lower Banner
		Kennedy
		Aily
	NEW RIVER & LEE	Red Ash
		Jawbone
		Tiller
		Upper Seaboard No.1
		Lower Castle
		Upper Seaboard No.2
		Greasy Creek
		Seaboard
		Lower Seaboard
		Upper Horsepen
		Middle Horsepen
		Pocahontas No.11
		Pocahontas No.10
		Lower Horsepen
Pocahontas No.9		
POCAHONTAS	Pocahontas No.8	
	Pocahontas No.7	
	Pocahontas No.6	
	Pocahontas No.5	
	Pocahontas No.4	
	Pocahontas No.3	
	Pocahontas No.2	
	Pocahontas No.1	
Squire Jim		
MISS.	BLUESTONE	Red & Green Shales

❑ Up to 51 Completable Coals Seams or Stringers

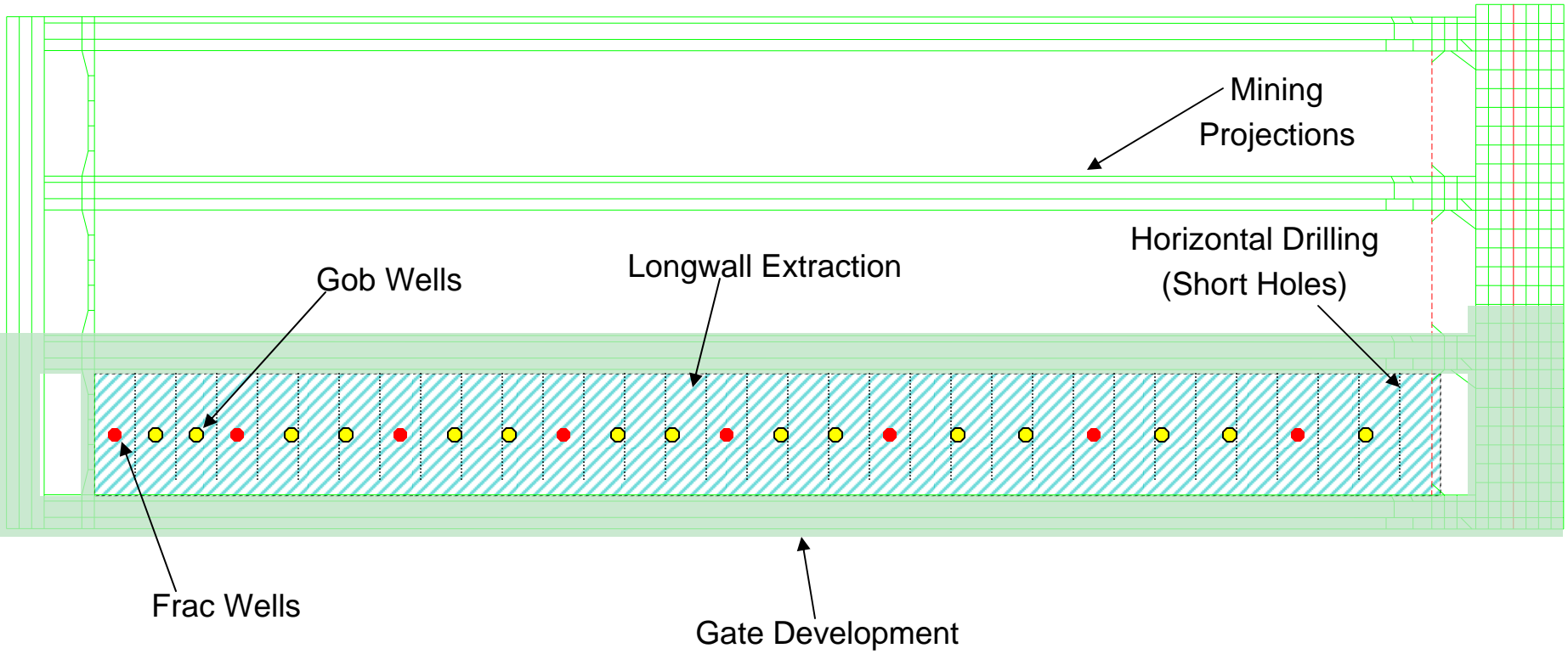
❑ Individual Coal Thickness: 0.5 - 5.5 ft

❑ Total Completable Coal Thickness: 15 - 40+ ft.

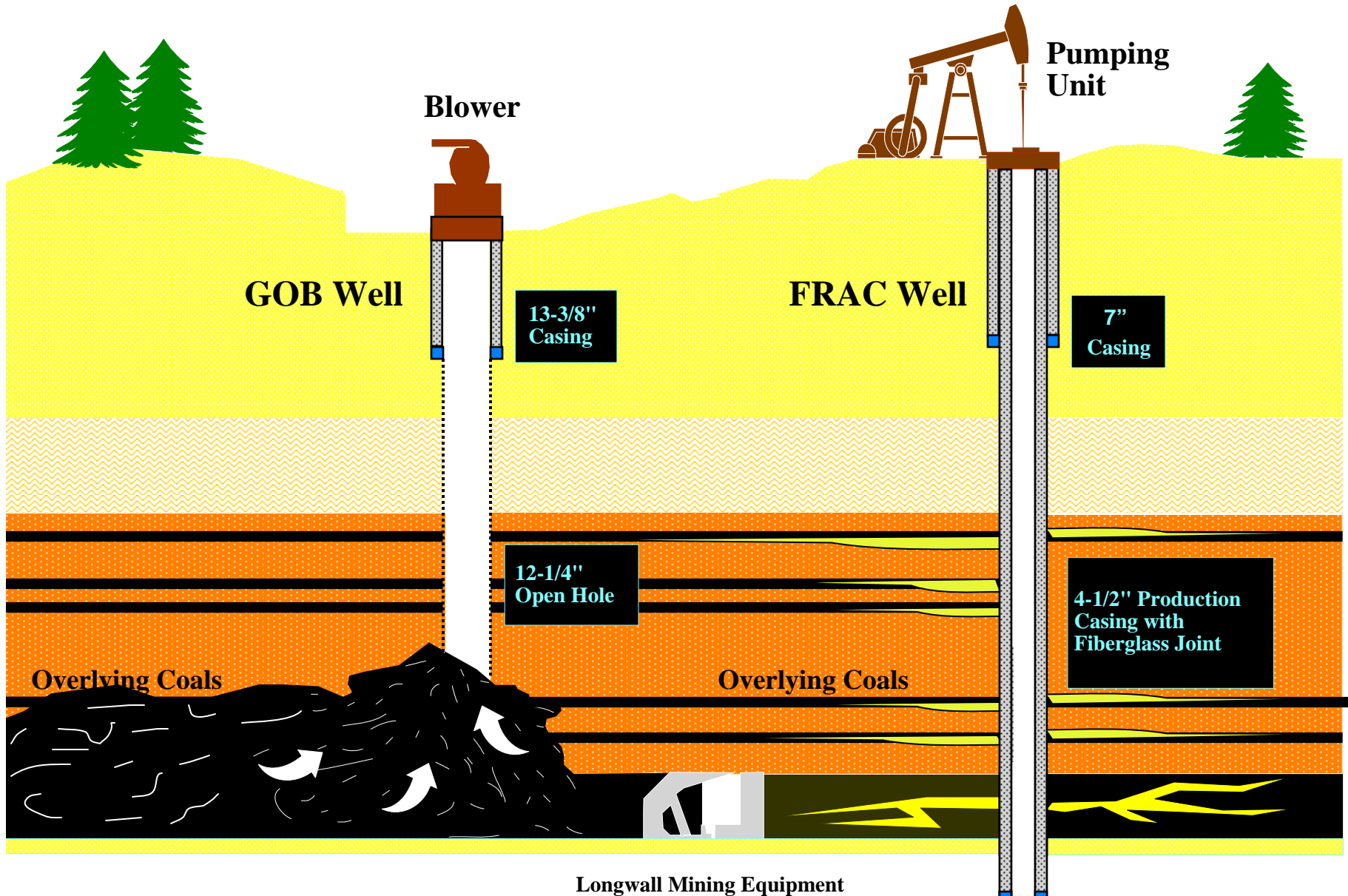
Stratigraphy vs. Average Gas Content

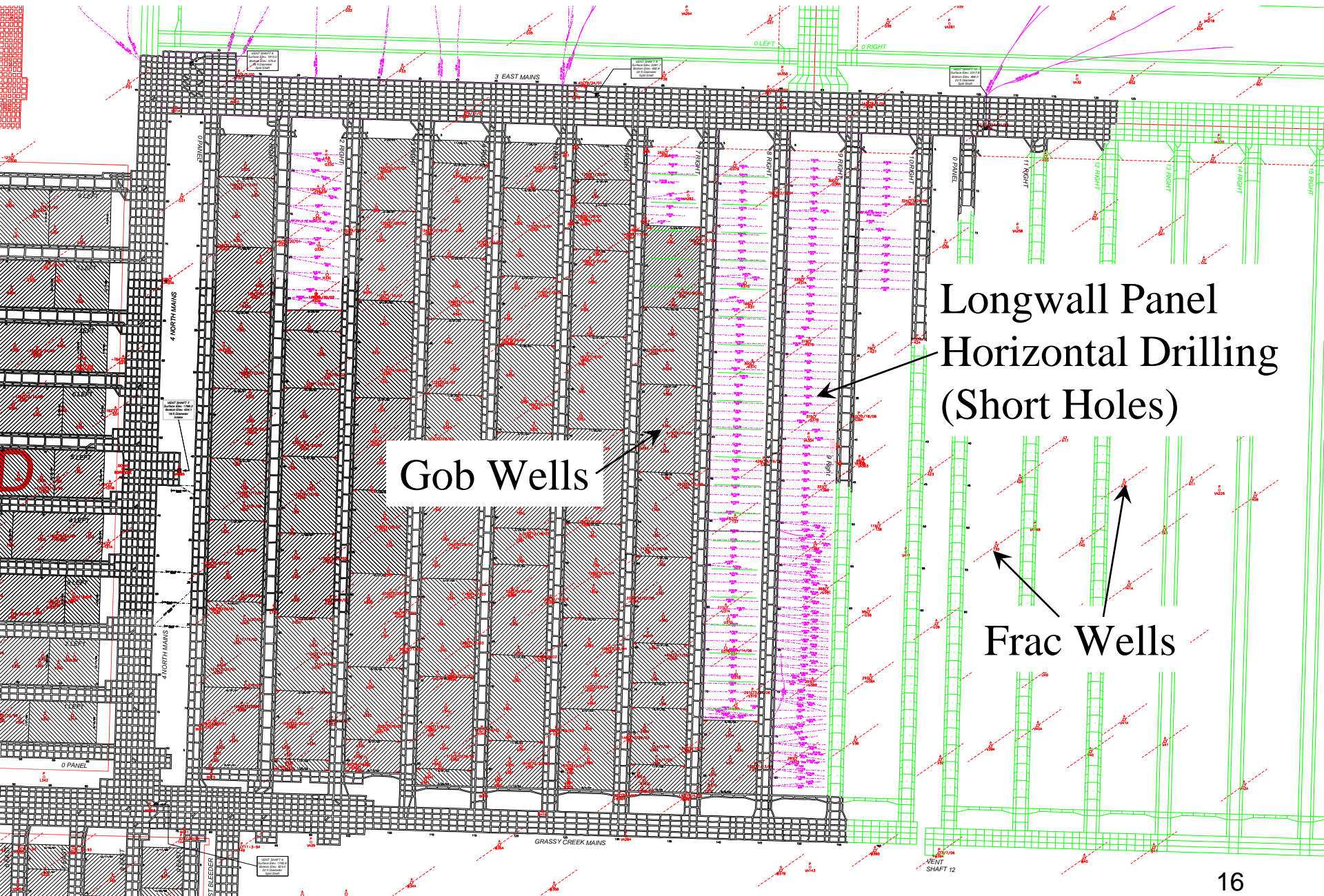


TYPICAL LONGWALL PANEL DEVELOPMENT



Vertical Degasification Techniques





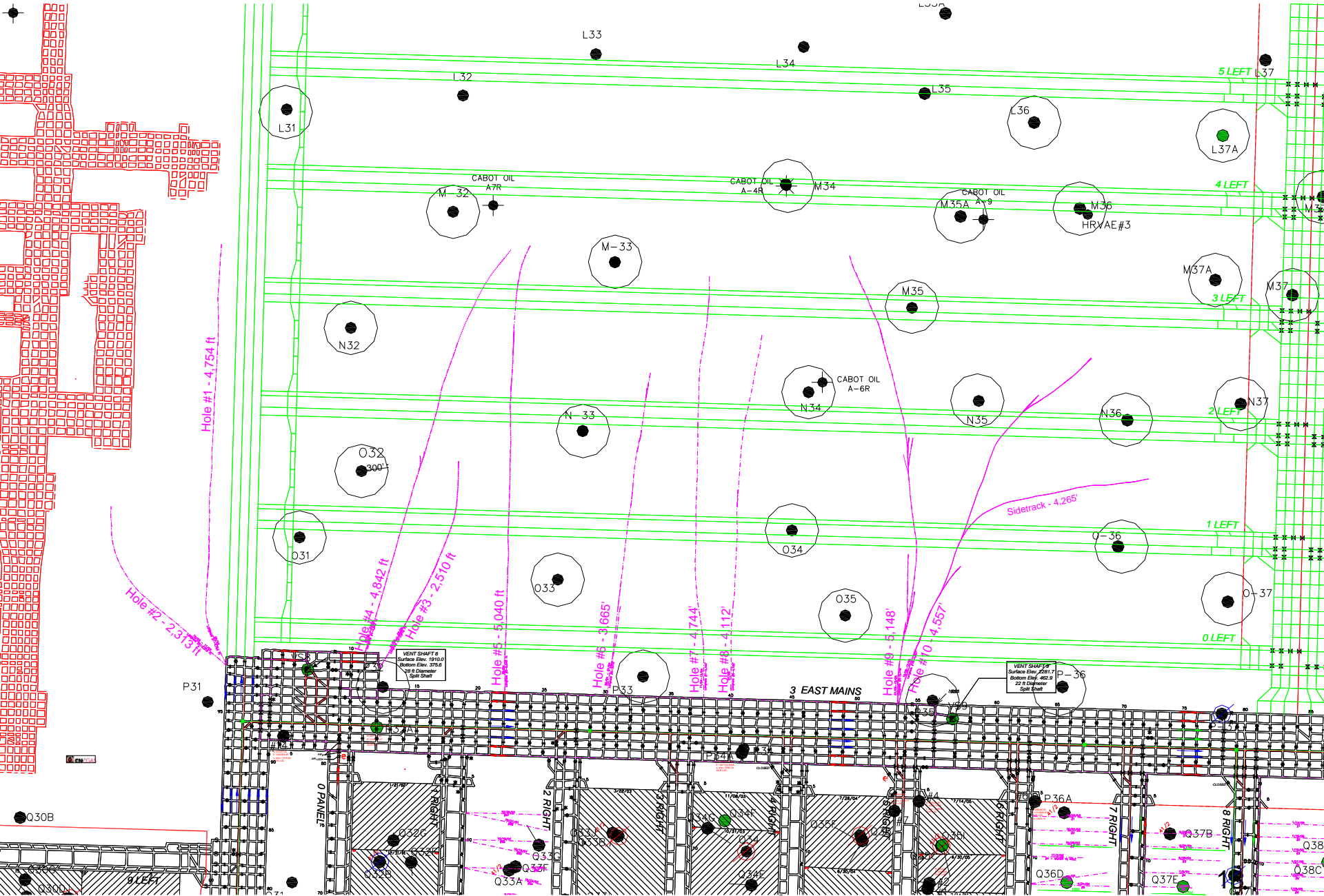
Gob Wells

Longwall Panel
Horizontal Drilling
(Short Holes)

Frac Wells

Horizontal Drilling In-Seam Long Holes

- Long hole drilling contracted with REI Drilling
- Drilled depths up to 5,148 feet (1,569 meters)
- 13 producing holes
- 75,327 feet (22,960 meters) drilled
- 1,114,285 mcf produced.
- No negative impact on frac well volumes.





Typical underground horizontal well set-up

Typical Gob well site

- Booster blower
- Compressor
- Ability to flow into a gathering line or go to vent
- Oxygen measured and relayed back to a command center
- Command center can remotely start and stop blower/compressors and regulate volumes
- Water – gas separator and storage tank on site with high level alarms to command center
- 6-7 holes in the first 1000' and then 500' spacing on the panel
- Not uncommon to have 4-5 million per day from the lead gob well.



Gob well blowers and compressors

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Typical Active Gob Quality

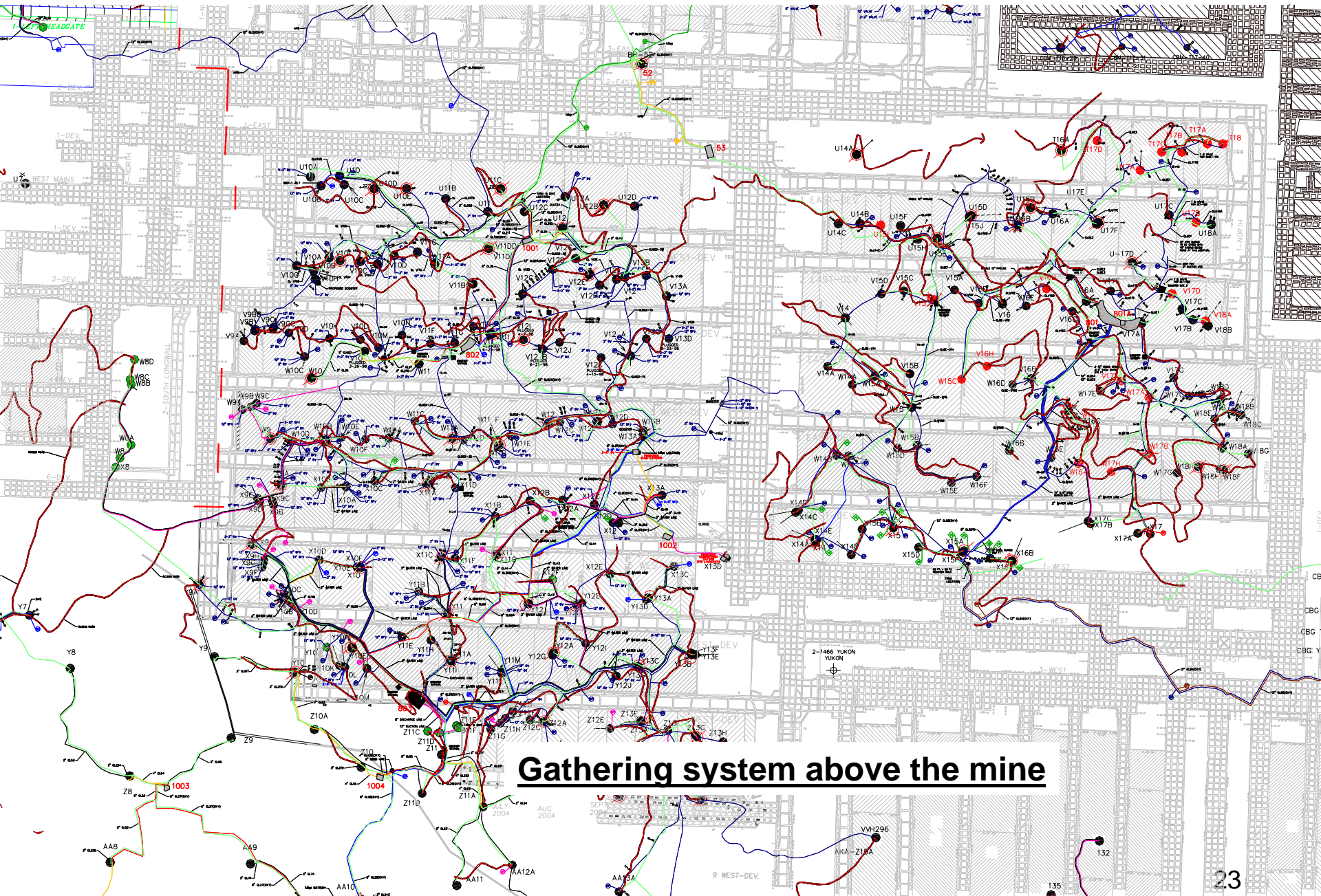
<u>Component</u>	<u>Mole %</u>	<u>BTU</u>	<u>GPM</u>
Carbon Dioxide	0.8267	0.00	0.0000
Oxygen	1.8806	0.00	0.0000
Nitrogen	9.2462	0.00	0.0000
Methane	85.2429	862.95	0.0000
Ethane	2.3527	41.73	0.6288
Propane	0.4510	11.37	0.1242
Totals	100.0000	917.78	0.7530

Specific Gravity from Composition 0.6272

BTUs @ 14.73 Saturated 901.81

BTUs @ 14.73 Dry 917.78

Compressibility 0.99812



Gathering system above the mine

Sealed Gob Well

- Wells found in sealed mines or sealed areas of an active mine
- Physically the same as active gob well
- No wellhead equipment necessary to produce
- A sealed gob well typically produces anywhere from 50,000 cf/day – 70,000 cf/day
- Gas is contaminated primarily with nitrogen and carbon dioxide

Typical Sealed Gob Quality

<u>Component</u>	<u>Mole %</u>	<u>BTU</u>	<u>GPM</u>
Carbon Dioxide	2.6134	0.00	0.0000
Oxygen	0.2414	0.00	0.0000
Nitrogen	7.8179	0.00	0.0000
Methane	88.8364	899.32	0.0000
Ethane	0.4122	7.31	0.1102
Propane	0.0788	1.99	0.0217
Totals	100.0000	910.34	0.1319

Specific Gravity from Composition	0.6165
BTUs @ 14.73 Saturated	894.49
BTUs @ 14.73 Dry	910.34
Compressibility	0.99812



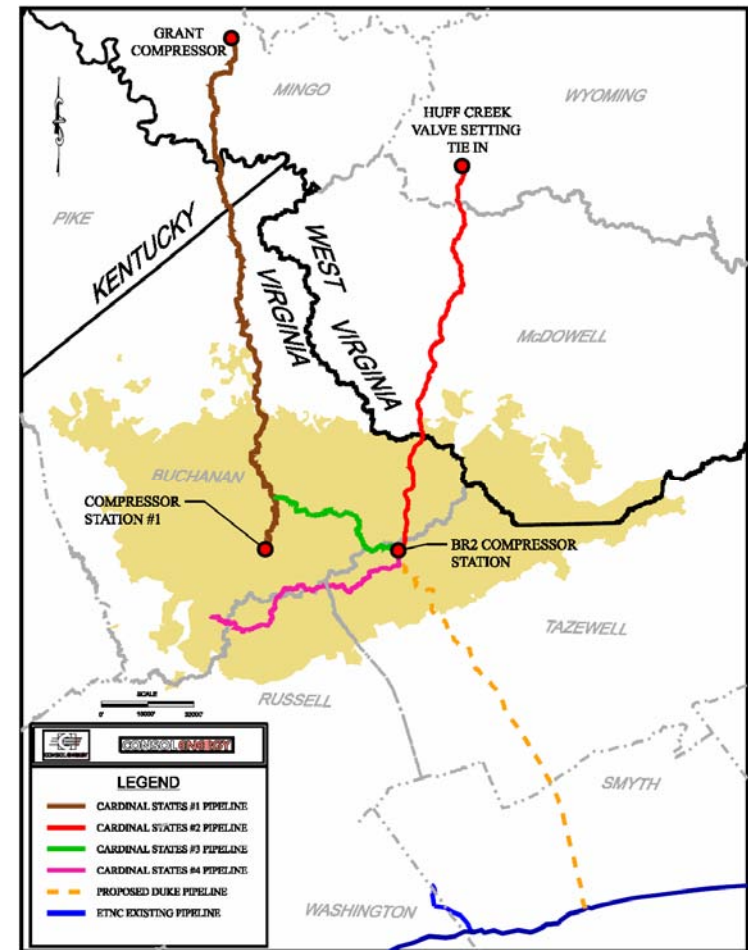
Remote controlled valves operated from the command center

Gathering System

- Low pressure pipeline – HDPE pipe 4” to 8” in conjunction with 2” water line operating 8 to 22 psi
- Intermediate pressure pipeline– Steel lines with operating pressure of 150 psi
- High Pressure pipeline – Steel lines operating at 650 to 1250 psi

Gathering System

- Cardinal 1 line
50 miles 16"
Frac, Horizontal,
Sealed and Active
Gob gas
- Cardinal 2 line
30 miles 20"
Frac Gas
- Jewell Ridge Line
30 miles 20"
Frac Gas



Command Center



- 24/7 operation
- Monitor bleeders in the mine
- Monitor shearer amps on the longwall
- Start and stop compressors remotely
- Monitor gas quality
- Monitor barometric pressure

← Back
Forward →
🔔 Alarms
🏠 Main
📖 Display Directory
📄 FIFO
🖨️

MINE STATION Flow	44066	HOG RIDGE	3108.91	STATION 1	36923	Station 3	14305.69	Station 5	1391.61	Station 7	3973.43	Thermal Dryer	2581.01	Geomet RT.83	6907.39
PSIG	703.31				705.13										
NIT	4.56				6.81		2.48							NIT	5.08
CO2	1.31				1.54		1.03							CO2	1.35
CH4	92.76				88.93		94.19							CH4	91.65
O2	0.39				0.86		0.45							O2	0.4995
H2O	4.71						3.49							H2O	2.25
TOTAL INERTS (ST1& MINESITE)				7.66								TOTAL INERTS RT83 = 7.00			

COLUMBIA 1 FLOW MMBTU 94899
COLUMBIA 2 FLOW MMBTU 52211

Cardinal Line Value PSI: 692
Cardinal Line Shutdown: 715

TOTAL SENT TO GRANT 99864.16 + **C2 CNX** 52054.56 =

TOTAL PRODUCTION 154499.73

MINE STATION SUCTION HEADER PSig 33.00
MINE STATION DISCHARGE HEADER PSig 722.00
MINE STATION RECYCLE 00
STATION 1 SUCTION PRESSURE: 89 psia
STATION 1 BOOSTER FLOW: 6.029

GRANT DISCHARGE TO COLUMBIA FLOW MCF 98984
GRANT DISCHARGE TO COLUMBIA PSI 1108
GRANT SUCTION PSI 540

MINE STATION	GRANT	STATION 1
K110 RUNNING	98 K210 STOPPED	#1 RUNNING
K120 RUNNING	97 K220 RUNNING	#2 RUNNING
K130 RUNNING	93 K230 RUNNING	#3 RUNNING
K140 RUNNING	96 K240 RUNNING	#4 RUNNING
K160 RUNNING	K250 RUNNING	#5 RUNNING

Command center control screen

PEAKER LINE FLOW 00.0
PEAKER BOOSTERS: * STOPPED *
0 **37**
NETWORK STATION1: NORMAL

Production

- Producing approximately 170 mmcfd
- Treating 100 mmcfd

Types of Treatment

- Dehydration
- Oxygen Removal (Platinum Catalyst)
- Carbon Dioxide Removal (Amine)
- Mole Sieve (Nitrogen Rejection)



Gas processing site

Oxygen Removal

- $\text{CH}_4 + \text{O}_2 + \text{platinum catalyst} = \text{CO}_2 + 2\text{H}_2\text{O}$
- 100 MMCFD
- 5,500 ppm inlet oxygen
- 20 – 30 ppm outlet oxygen
- 0.2% increase in CO_2
- Exothermic process
- Exchanger used to raise inlet gas to 700 degrees along with a gas heater
- Product gas is saturated after O_2 removal

Amine Process

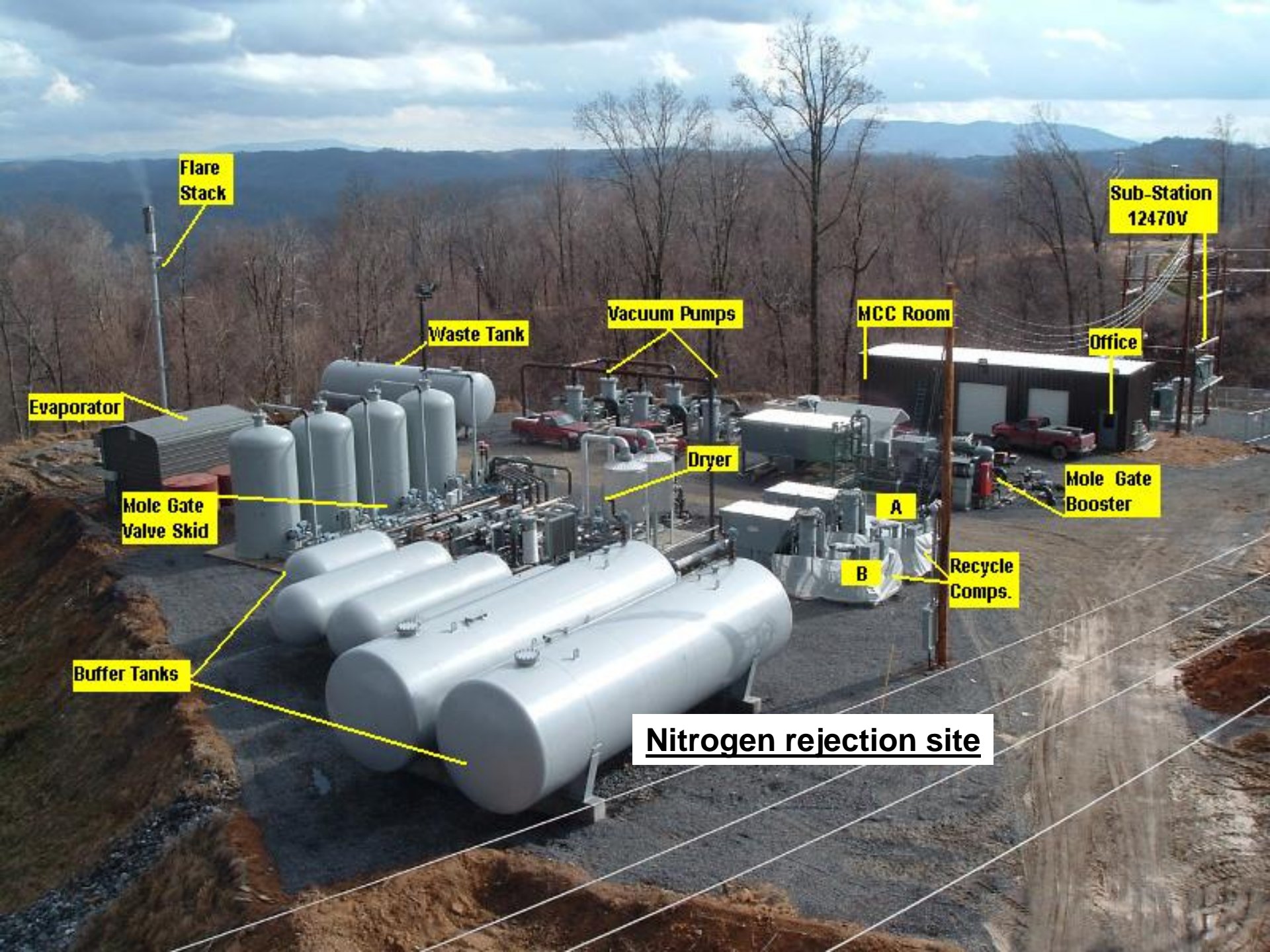
- Method of removing Carbon Dioxide from sealed gob (inactive areas)
- Amine is an alkaline solution that absorbs acidic gas (carbon dioxide)
- Results in increased production from the sealed units without negatively impacting the quality of the product.
- 100 mmcf/d capacity unit located at the Grant Process Facility
- On-line January 5th 2004
- System allows collection of future sealed areas

Amine Process

- Inlet CO₂ – 1.60%
- After oxygen removal – 1.80%
- Capability to reduce CO₂ levels to 3 ppm
- Typical discharge of 0.9%

Nitrogen Rejection Unit

- Englehard Molecular Sieve
- Primary purpose is to remove excess nitrogen
- Nitrogen is an inert gas that needs to be removed from the final product.
- Also removes oxygen and carbon dioxide
- Inlet gas must be dry



Flare Stack

Sub-Station 12470V

Waste Tank

Vacuum Pumps

MCC Room

Office

Evaporator

Dryer

Mole Gate Valve Skid

Mole Gate Booster

A

B

Recycle Comps.

Buffer Tanks

Nitrogen rejection site

Molecular Gate® Design Material Balance

	Raw Feed	MG Product	Tail Gas
Flow, MM SCFD	1.50	1.13	0.37
Pressure, psig	110	95	5
Temperature, F	80	80	150
Composition, Mole %			
C1	78.60	94.84	28.77
N2	16.19	4.00	53.58
CO2	3.20	-	13.03
C2	0.91	0.89	0.98
C3	0.07	0.02	0.23
O2	1.03	0.25	3.41
H2O	Dehydrated	Dry	Dry

Product heating value = 974 BTU/ft³
 Tail gas heating value = 314 BTU/ft³
 The methane recovery rate is 91%.

88 Megawatt Peaker Power Plant

