October 3–4, 2017

MCM Grandé, Odessa, Texas

ShaleTechPermian.com

SHALETECH™ PERMIAN

Vapor Recovery Made Simple

Mark Lancaster
VP of Operations
Permian Production Equipment, Inc.

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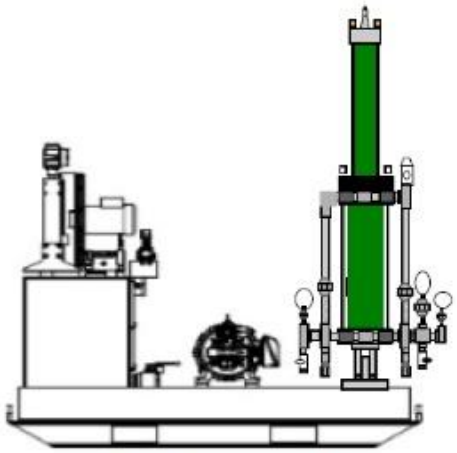
Slide Title

- Bullet 1
- Bullet 2
- Bullet 3

SHALETECH™ PERMIAN

Vapor and Wellhead compression using Hydraulics and the Beam Gas Compressor®



Hydraulic
beamgascompressor®

Permian Production Equipment, Inc.

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How oil is
produced
its just as easy as
...

Shooting at some food….and up thru the ground comes a bubbling crude… Oil that is…..Texas Tea

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People have been relieving back pressure for years
Some on purpose by venting

Others not so much on purpose by a blow out…

The Origin of the BEAM GAS COMPRESSOR®

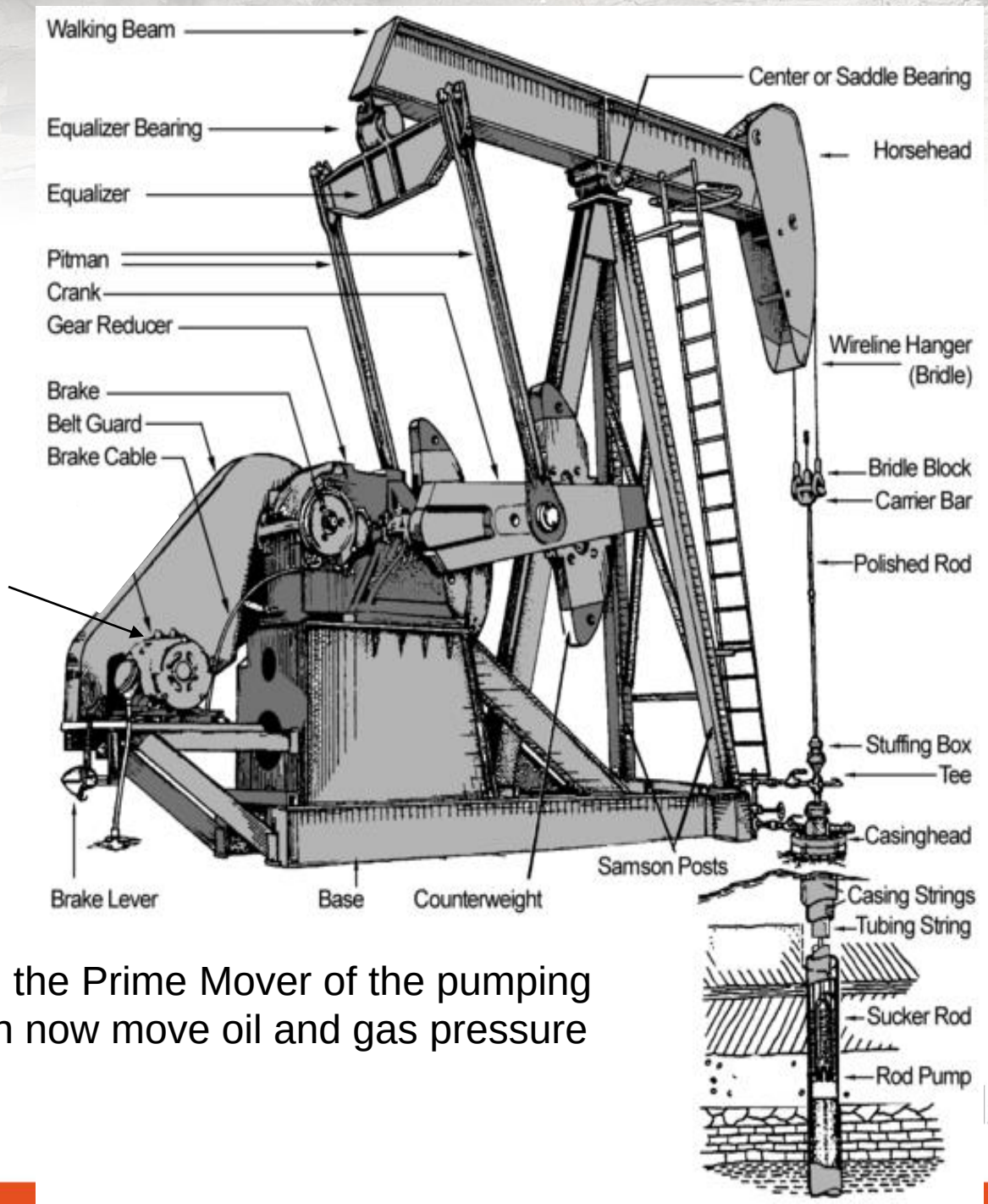
The invention of the Beam Gas Compressor began with just a trip to the oil fields of Monahans, Texas, where Charlie McCoy couldn't believe his eyes. Gas was flowing from the casing of a well between two sand domes, and lying on the ground in the middle of it were dead quail. The operator's engineer accompanying Mr. McCoy said the well had a problem producing because of gas locking (gas interference) in the down hole pump.

"I watched that pumping unit run and thought, 'How can we use the pumping unit as energy to take the gas and pressure off the well casing and not kill the quail?" said Mr McCoy. His response was design of the Beam Gas Compressor®, which he tried out on the well, and soon the operator was buying his design. That was about 1982. Today, Mr. McCoy sells the Beam Gas Compressor throughout the United States, Europe, and Latin America, as well as the Middle East. Since then,over 5600 units sold world wide.

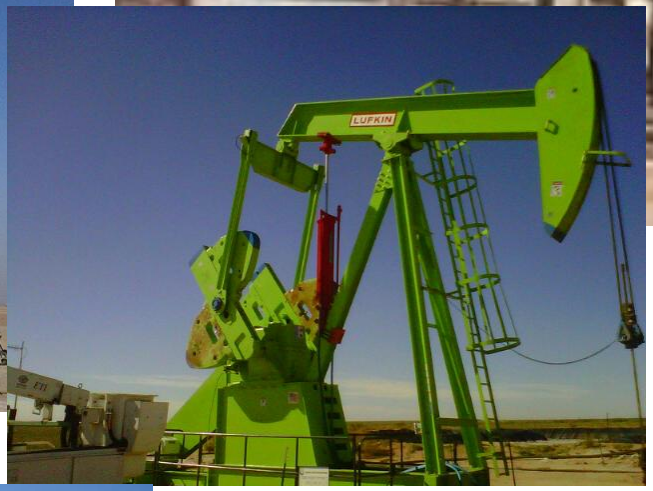
COVEY RISE®

PERMIAN

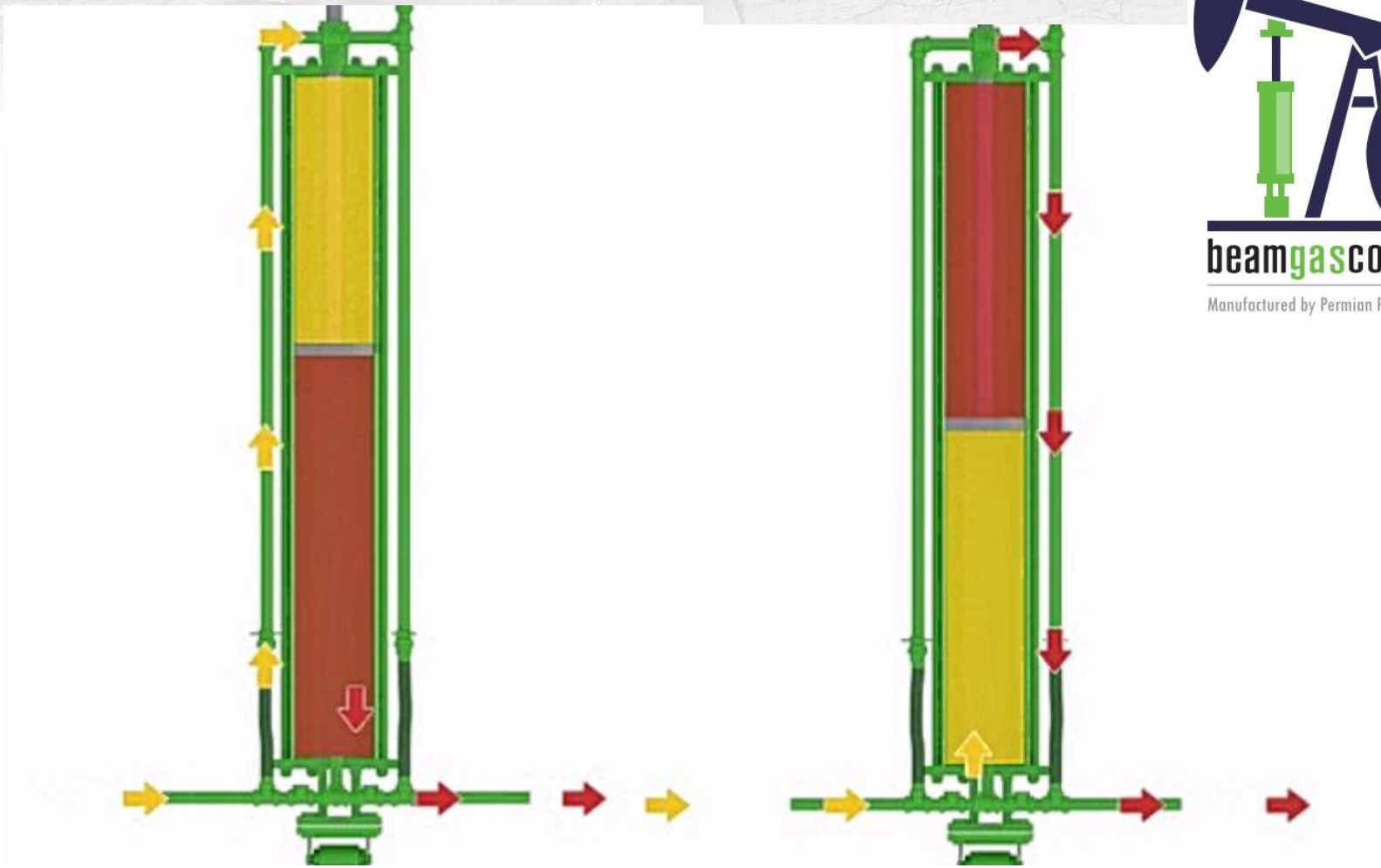
PRIME MOVER



By utilizing the Prime Mover of the pumping unit we can now move oil and gas pressure



Simple to install and operate



beamgascompressor®
Manufactured by Permian Production Equipment, Inc.

Double acting allows for gas compression and pressure reduction as the pumping unit goes up and down

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Agenda:

- Historical Development
- Description/Advantages
- Applications
- Total Cost of Service Economics
- Summary & Pricing

Hydraulic Beam Gas Compressor

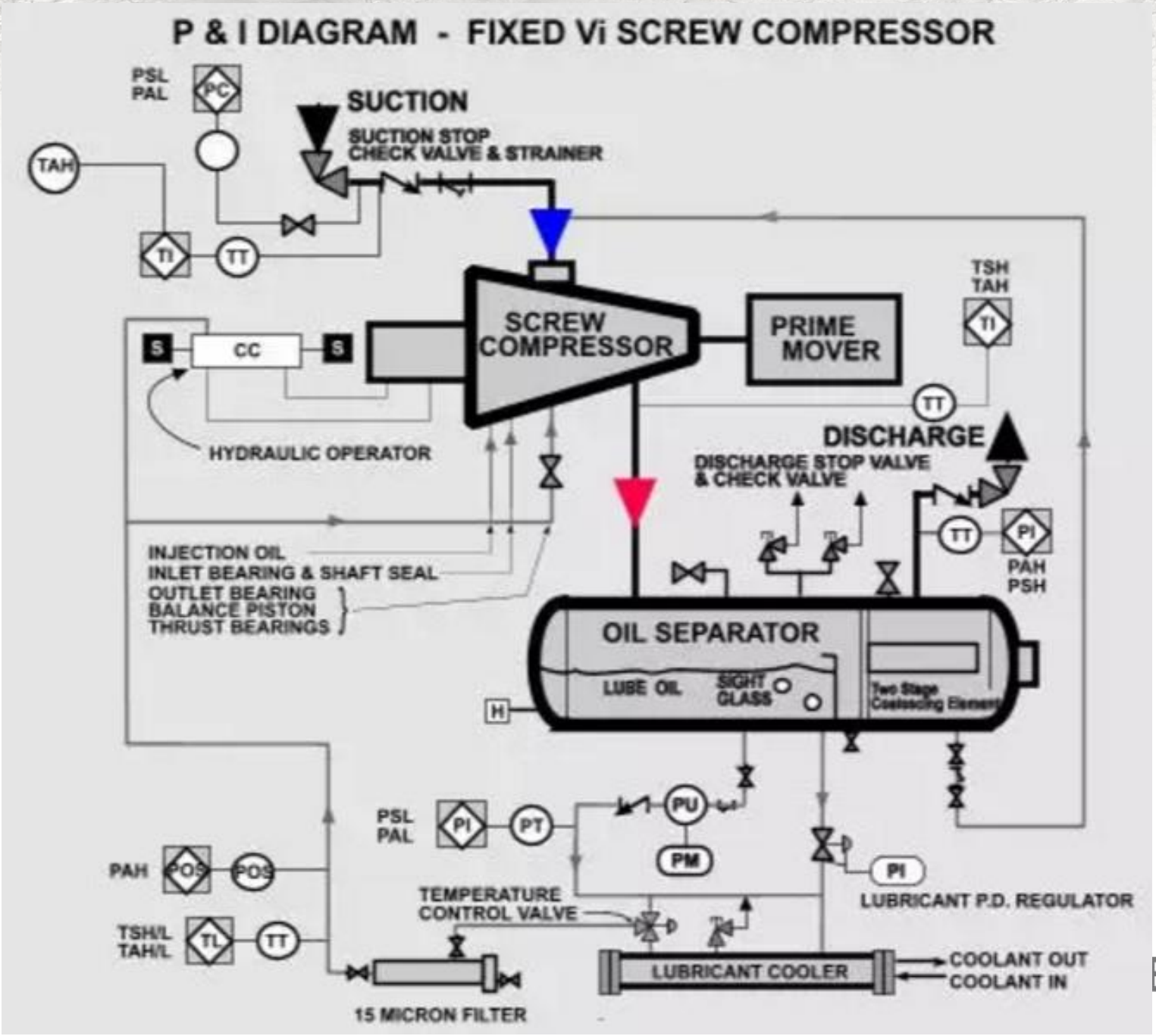
- Utilizing Hydraulic pump and motor as the prime mover the Beam Gas Compressor could now be freestanding
  In 2013, the company looked at VRU applications and did further development.
- It turned out to be very robust and simple….something the VRU world needs.

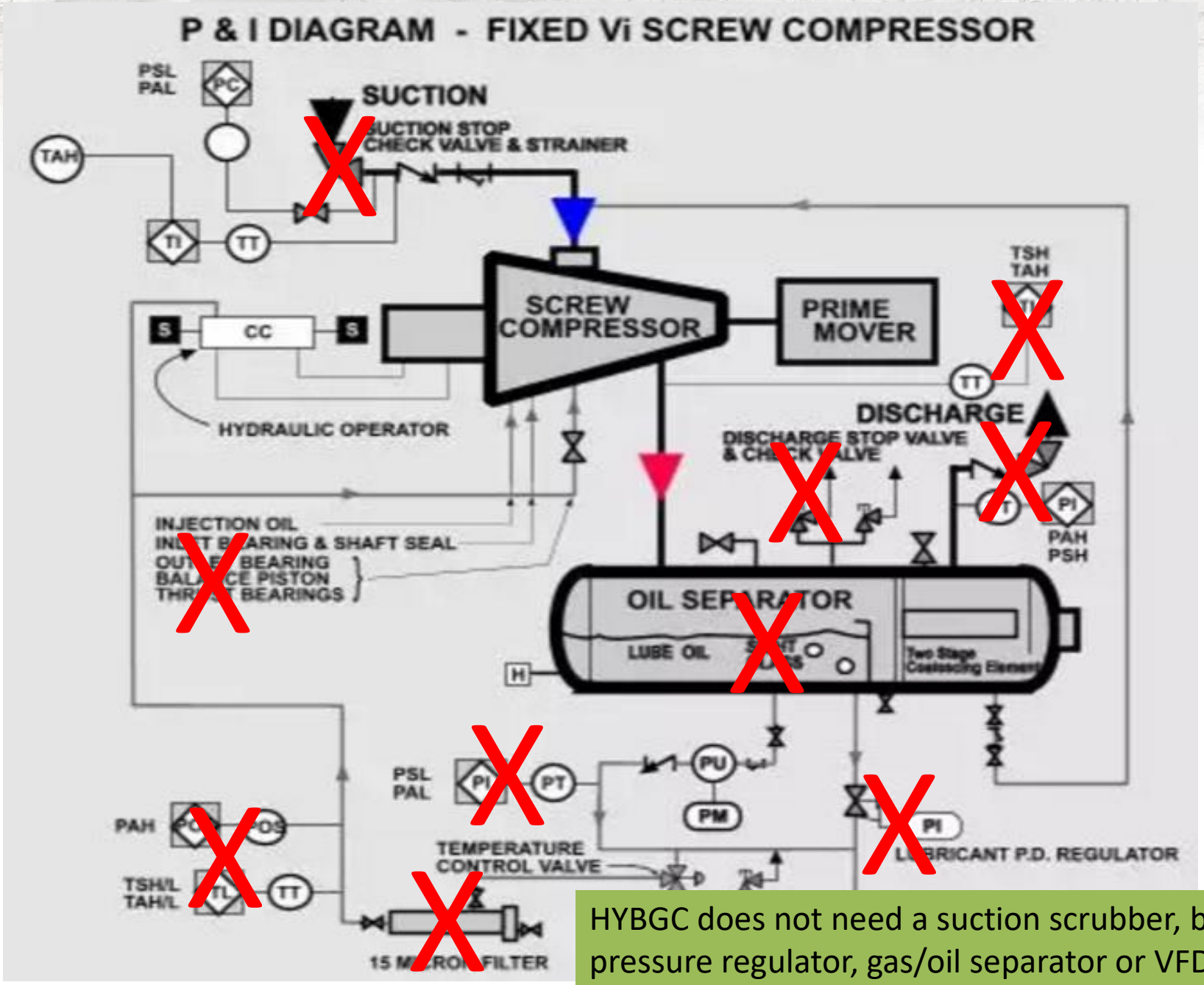
Vapor Recovery is NOT Standard Compression

Three critical factors:

- **Very wet, very high BTU gas** – negatively affects oil systems
- **Large flow variations** including zero flow and frequent complete shut down – very hard on compressors
- **Reduced attention to small compression** – if its too complex and the production volumes are low, the operator uses up too much time and it sits out of service.

While screw, rotary vane and scroll compressors are commonly used in the design of VRU's, they can have serious shortcomings that degrade their usefulness such as complexity, high maintenance costs and downtime, resulting in decreased production and profit potential.

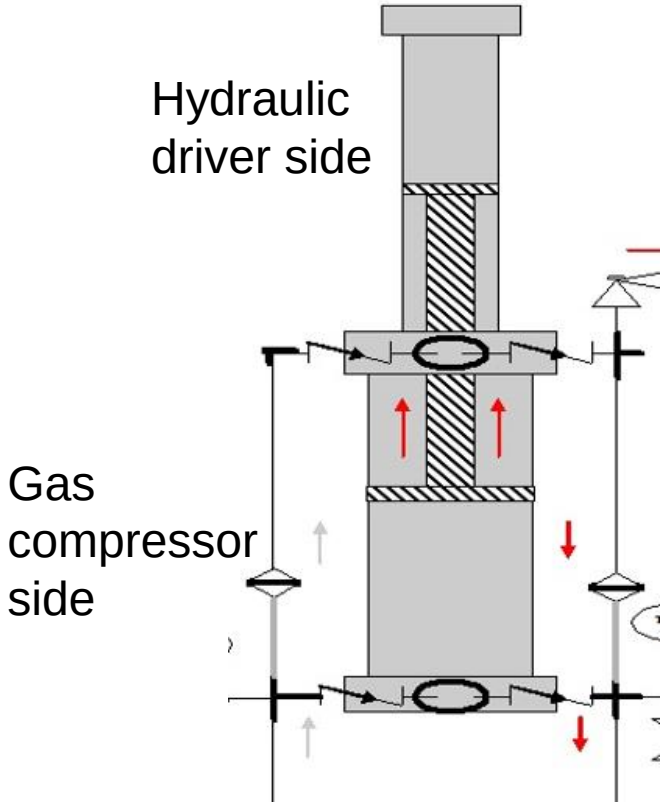

P & I DIAGRAM - FIXED Vi SCREW COMPRESSOR
PSL
PAL
PC
SUCTION
SUCTION STOP
CHECK VALVE & STRAINER
TAH
TI
TT
SCREW
COMPRESSOR
PRIME
MOVER
TSH
TAH
TI
S
CC
S
HYDRAULIC OPERATOR
TT
DISCHARGE
DISCHARGE STOP VALVE
& CHECK VALVE
TT
PI
PAH
PSH
INJECTION OIL
INLET BEARING & SHAFT SEAL
OUTLET BEARING
BALANCE PISTON
THRUST BEARINGS
OIL SEPARATOR
LUBE OIL
SIGHT
GLASS
H
PSL
PAL
PI
PT
PU
PM
PAH
POS
POS
TEMPERATURE
CONTROL VALVE
PI
LUBRICANT P.D. REGULATOR
TSH/L
TAH/L
TL
TT
LUBRICANT COOLER
COOLANT OUT
COOLANT IN
15 MICRON FILTER



HYBGC does not need a suction scrubber, back pressure regulator, gas/oil separator or VFD

The HyBGC Concept

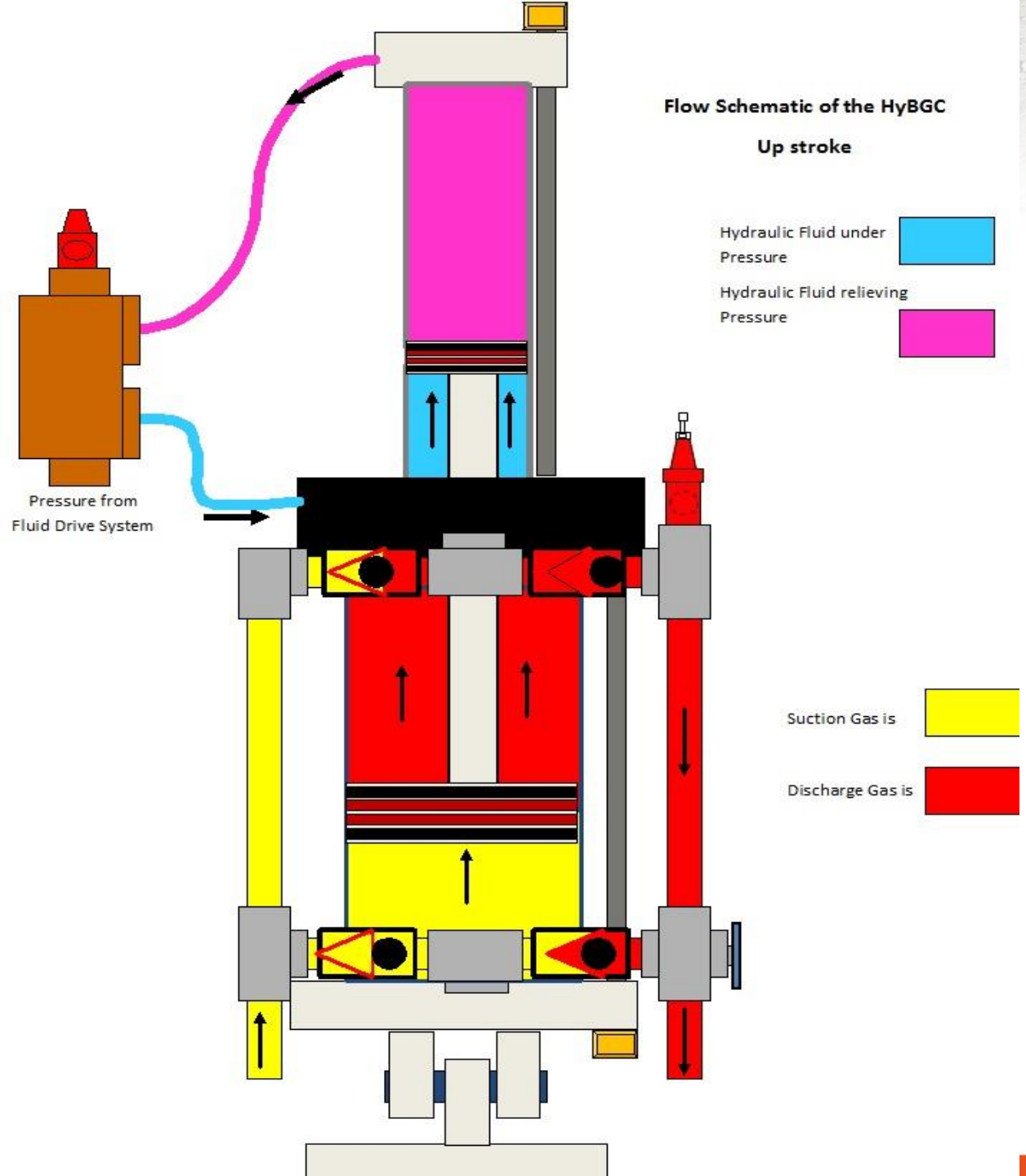
Heart of the Unit



Advantages

- No lube in compression process to foul
- Can take liquids - Liquids are pushed through without damaging compressor
- Gas cooling takes place in compressor due to slow compression (10 cycles/min)
- Very simple
- No issues with multiple starts and stops
- No toxic gas emissions – Seal is between hydraulic cylinder and gas

The Hydraulic Beam Gas Compressor ®
HyBGC



In the upstroke, the directional control valve sends the pressurized fluid in to the lower portion of the drive cylinder, thereby pushing the drive piston up and raising the piston in the gas chamber and causing compression in the top portion and suction in the bottom. When the sensor senses the piston at the top of stroke, the fluid flow is reversed.

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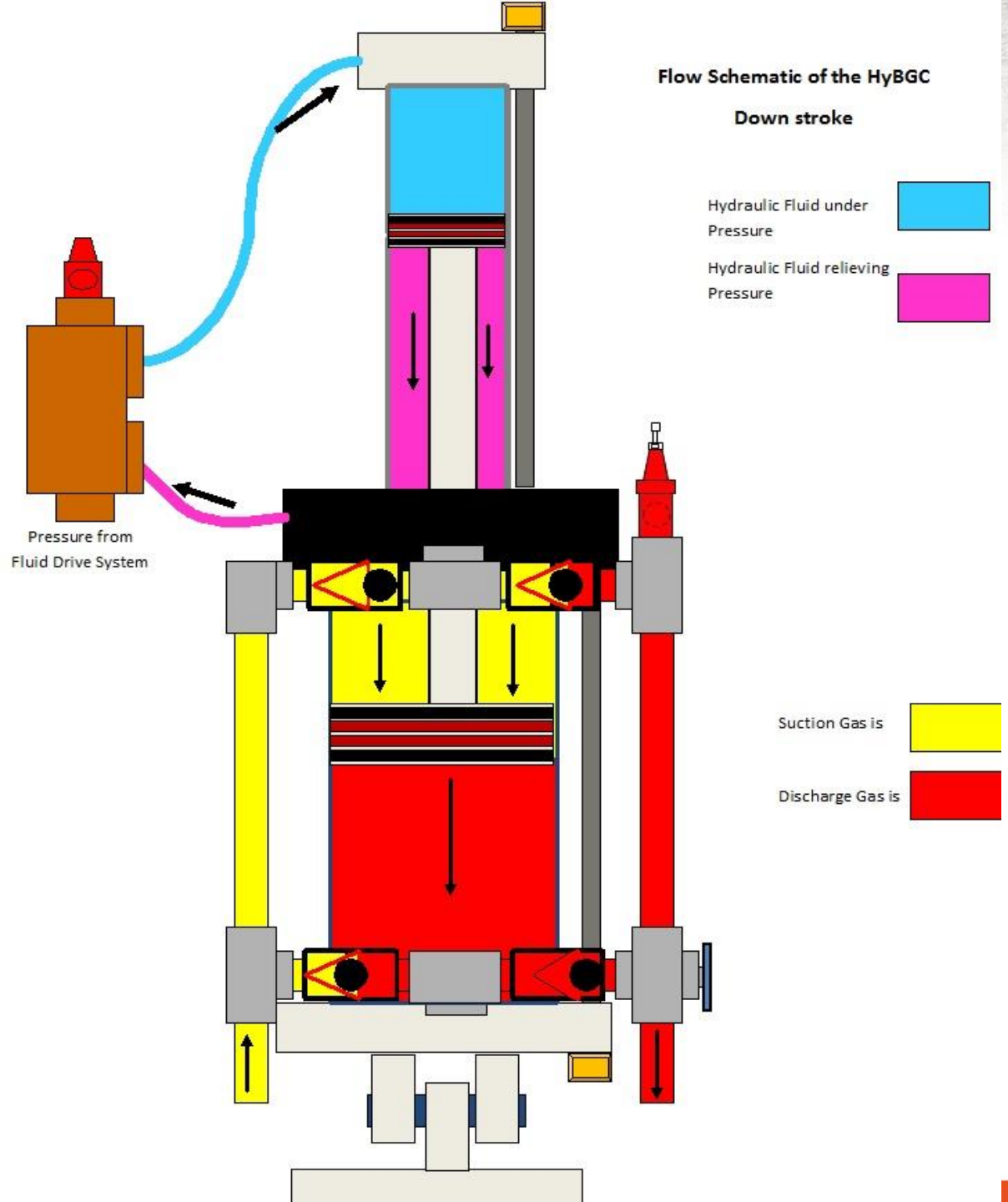
The Hydraulic Beam Gas Compressor ®
HyBGC



As the hydraulic fluid enters the top of the drive cylinder, the pressure forces the piston down thusly forcing the lower piston in the gas chamber down and compressing the gas that was sucked in during the upstroke while at the same time sucking in gas on the top side of the piston.

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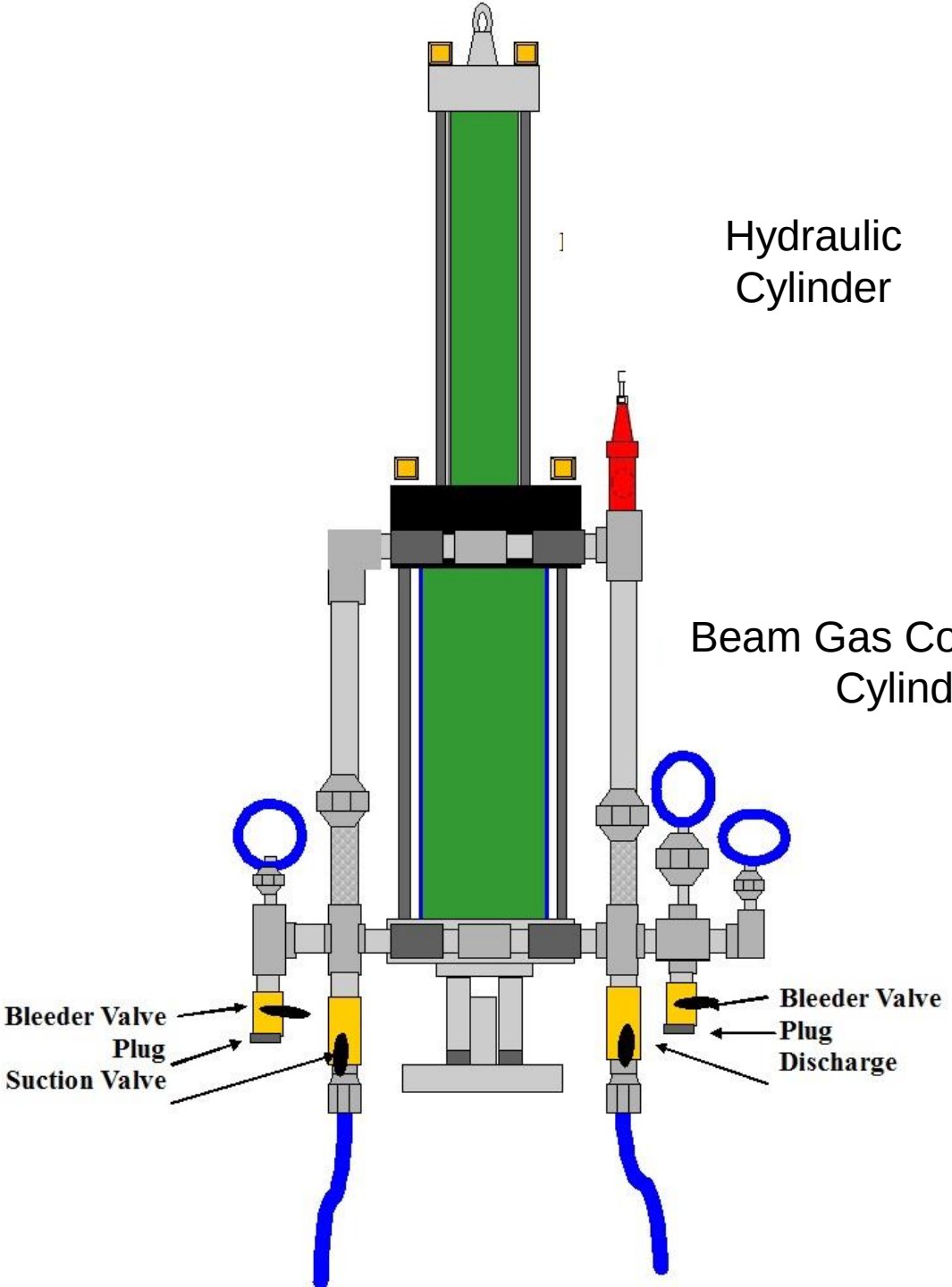
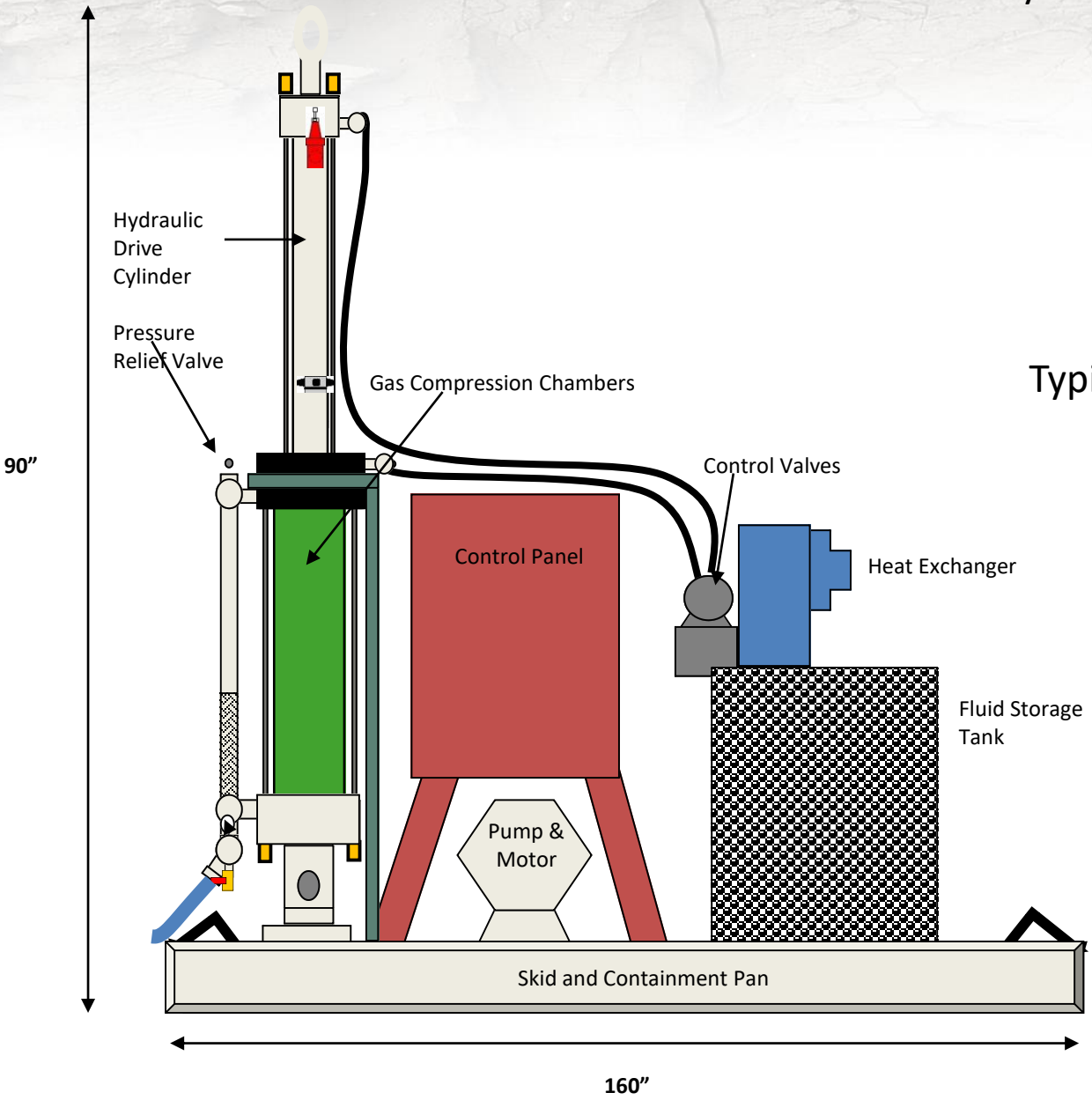
It has no need for a scrubber as it can also pump fluid thru the system to the flow line


Hydraulic Cylinder
Beam Gas Compressor Cylinder
Bleeder Valve
Plug
Suction Valve
Bleeder Valve
Plug
Discharge

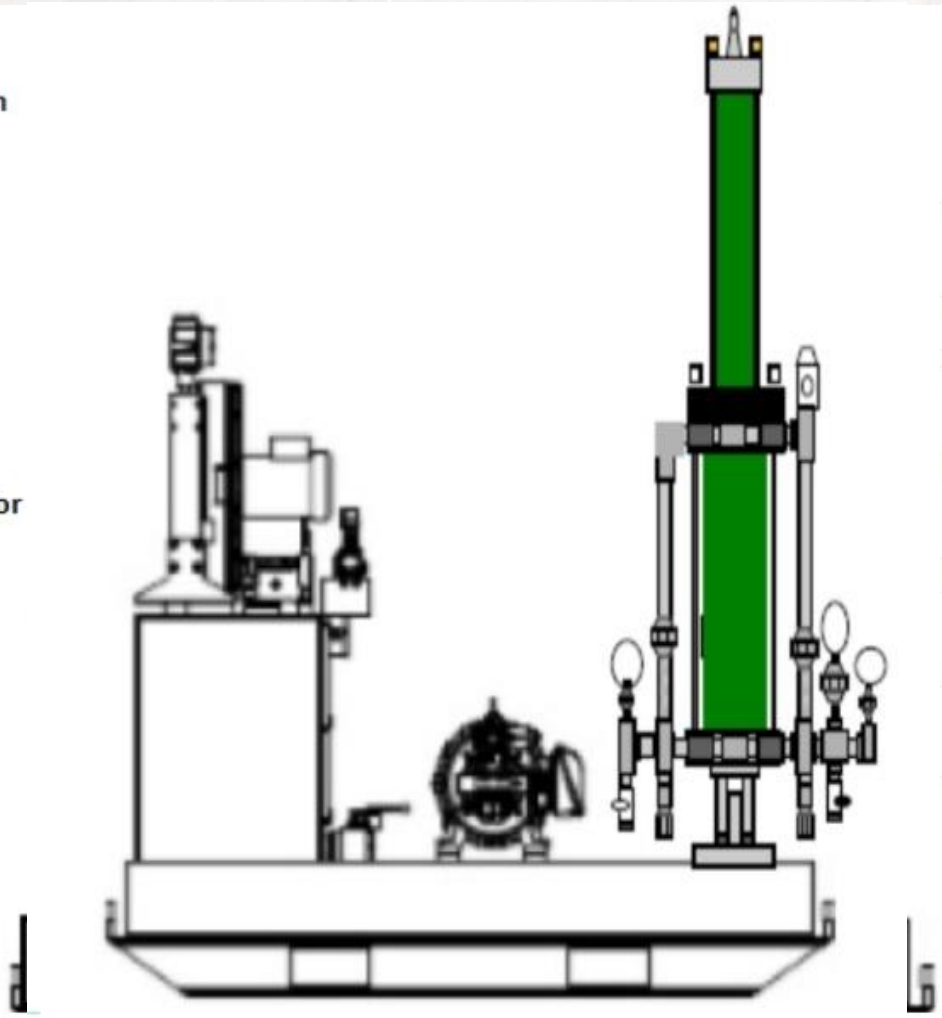
The Hydraulic Beam Gas Compressor ®
HyBGC

Typical Layout of the HyBGC



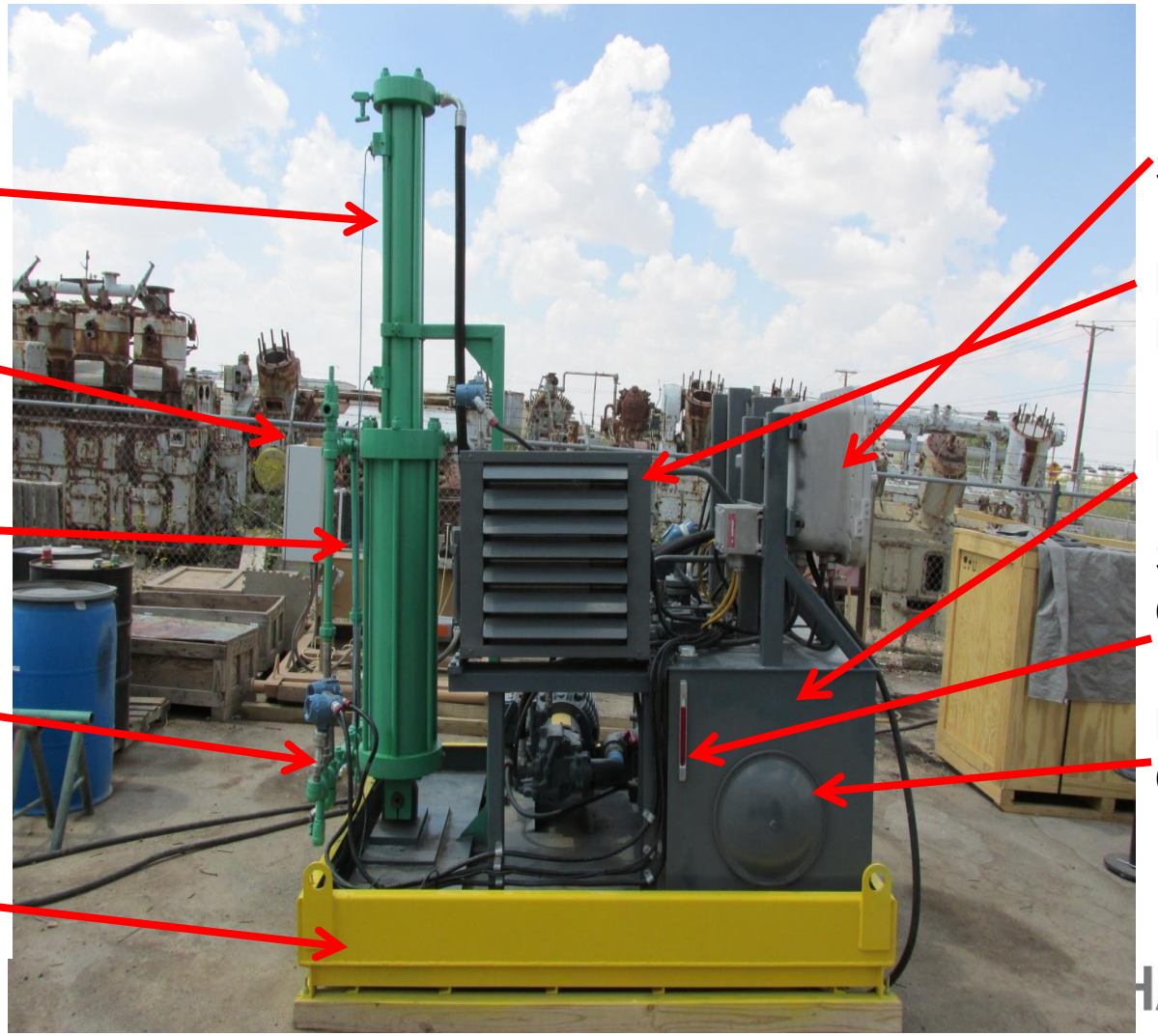
Fluid Drive System consisting of:

- Heat Exchanger
- Fluid Temperature Transmitters
- Oil Filter
- Directional Valve
- Hydraulic Hoses
- Pressure Transmitters for
  - Oil level
  - Oil Filter
  - System
- Tank for fluid
- Visual tank level and temperature
- Motor and Pump
- Ball valve
- Skid

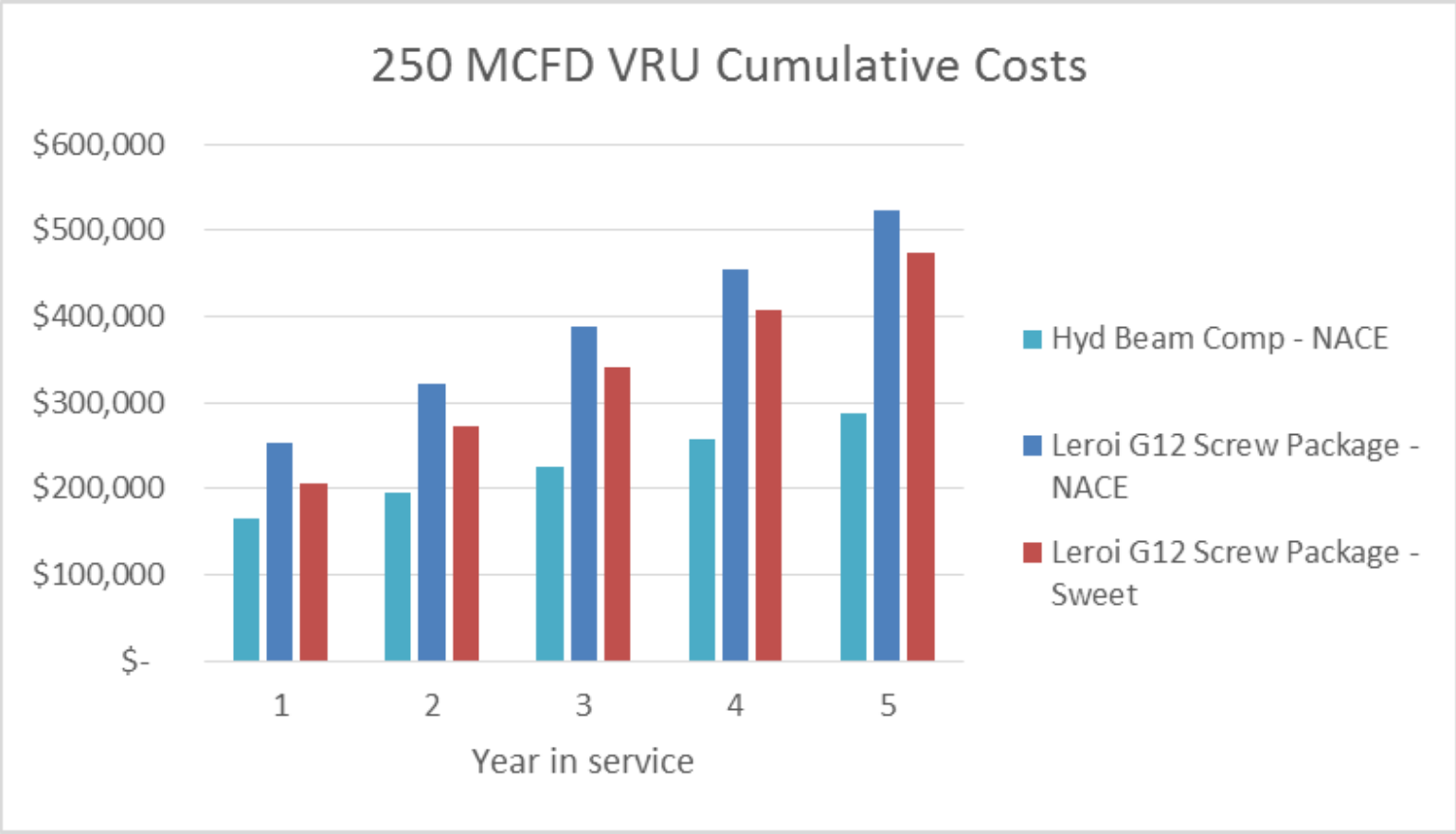


Beam Gas Compressor consisting of:

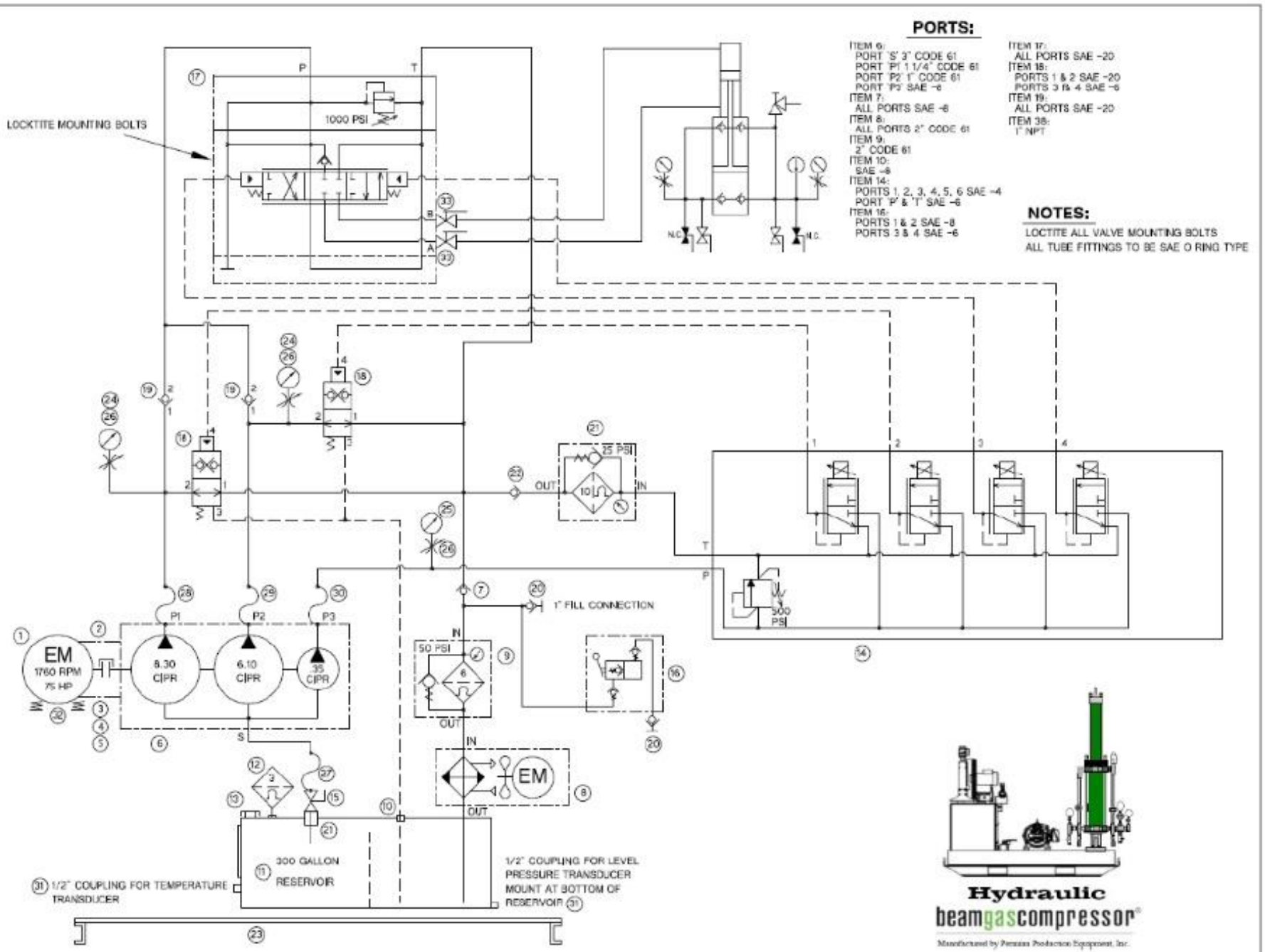
- Hydraulic Cylinder
- Pressure Relief Valve
- Middle Head
- Manifold
- Gas Cylinder
- Trunnion Mount


Hydraulic Cylinder
Dual head Manifold
Gas Cylinder
Suction inlet & Discharge outlet
Skid Drip Pan
Starter Panel
Heat Exchanger
Fluid Tank
Site Level Gauge
Manhole Cover

Costs Compared to Screw Packages



250 mcfd from
4 ounces suction to 100 psi discharge


PORTS:
ITEM 6:
PORT 'S' 3" CODE 61
PORT 'P1' 1 1/4" CODE 61
PORT 'P2' 1" CODE 61
PORT 'P3' SAE -6
ITEM 7:
ALL PORTS SAE -8
ITEM 8:
ALL PORTS 2" CODE 61
ITEM 9:
2" CODE 61
ITEM 10:
SAE -8
ITEM 14:
PORTS 1, 2, 3, 4, 5, 6 SAE -4
PORT 'P' & 'T' SAE -6
ITEM 16:
PORTS 1 & 2 SAE -8
PORTS 3 & 4 SAE -6
ITEM 17:
ALL PORTS SAE -20
ITEM 18:
PORTS 1 & 2 SAE -20
PORTS 3 & 4 SAE -6
ITEM 19:
ALL PORTS SAE -20
ITEM 38:
1" NPT
NOTES:
LOCTITE ALL VALVE MOUNTING BOLTS
ALL TUBE FITTINGS TO BE SAE O RING TYPE
LOCKTITE MOUNTING BOLTS
1000 PSI
25 PSI
500 PSI
50 PSI
1" FILL CONNECTION
EM
1760 RPM
75 HP
8.30 CIPR
6.10 CIPR
3.5 CIPR
300 GALLON RESERVOIR
1/2" COUPLING FOR TEMPERATURE TRANSDUCER
1/2" COUPLING FOR LEVEL PRESSURE TRANSDUCER MOUNT AT BOTTOM OF RESERVOIR
Hydraulic
beamgascompressor
Manufactured by Pennsylvania Production Equipment, Inc.

Advantages over Screw Packages

- Elimination of frequent oil filter changes caused by oil to gas contact
- Significantly reduced possibility of oil loss caused by typical collapsed filter, failed backpressure valve, hydrate formation or cold weather startup
- No VFD required and yet better flexibility with wobble plate option (8:1 turndown)
- No inlet scrubber, gas/oil separator, liquid transfer pump with switches, dumps and seals to fail or freeze and motor to fail.
- Much higher allowable H2S levels (up to 25% experience today). No leak sources from compressor.
- Simple enough to be controlled by tank battery PLC vs its own PLC
- Simple for operators and mechanics to easily pick up the maintenance and operation. No specialized training.
- Gas cooling need reduced – Gas cools in cylinder & downstream pipe on small unit and a cooler is not required (Max of 10 cycles *per minute*). May not need cooler in bigger model.

Discharge Pressure PSI

10 Horsepower HyBGC

Suction Pressure PSI	50	75	100	125	150	175	200	225
0.5	50	30	24					
5	63	41	33	24	20			
10	80	52	41	30	26	22	20	
15	99	63	50	37	32	27	24	20
20	115	74	60	43	38	32	28	24
25	132	85	68	49	44	37	32	27
30		106	77	56	50	42	36	31
35			86	62	56	47	40	35
40				68	62	52	44	39
45					68	57	48	43
50						61	52	47
55							56	51
60								55

20 Horsepower HyBGC

Suction Pressure PSI	50	75	100	125	150	175	200	225
0.5	101	65	50					
5	134	85	65	50	42			
10	169	108	83	65	55	46	42	
15	205	131	100	78	65	56	50	42
20	241	154	118	92	78	66	58	50
25	277	176	136	105	89	78	66	56
30		200	153	118	101	88	75	64
35			172	132	112	96	83	73
40				146	123	105	91	81
45				.	136	115	100	89
50						136	108	98
55							116	106
60								114

40 Horsepower HyBGC

Suction Pressure PSI	50	75	100	125	150	175	200	225
0.5	207	133	103					
5	275	174	133	103	86			
10	346	221	170	133	113	94	85	
15	420	269	205	160	133	115	102	85
20	494	316	242	189	160	135	119	102
25	568	361	279	215	182	160	136	115
30		410	314	242	207	180	153	132
35			353	271	230	197	170	149
40				299	252	215	187	166
45					279	236	204	183
50						279	221	200
55							238	217
60								234

75 Horsepower HyBGC

Suction Pressure PSI	100	125	150
0.5	250		
5	331	257	220
10	420	327	280
15	509	396	339

Application History


Colmesneil
Jasper
190
Newton
69
190
Woodville
96
Spurger
Hillister
Kirbyville
Call
96
Buna
87


CK POWER
CK GAS

Well Information:		
Gas Volume (mcfd)		100
Discharge Pressure (flow line)	*	500
Suction Pressure (desired) Gauge	*	100

Increase in Production
105 bopd or
$1,916,250 per year

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The 3 units were installed in winter of 2014 in New Mexico in high H2S service

Number of service calls mechanical 1

Fan motor blade

Number of service calls automation 4

3 PLC set points

1 Transmitters

Average 1.5 million cycles per year

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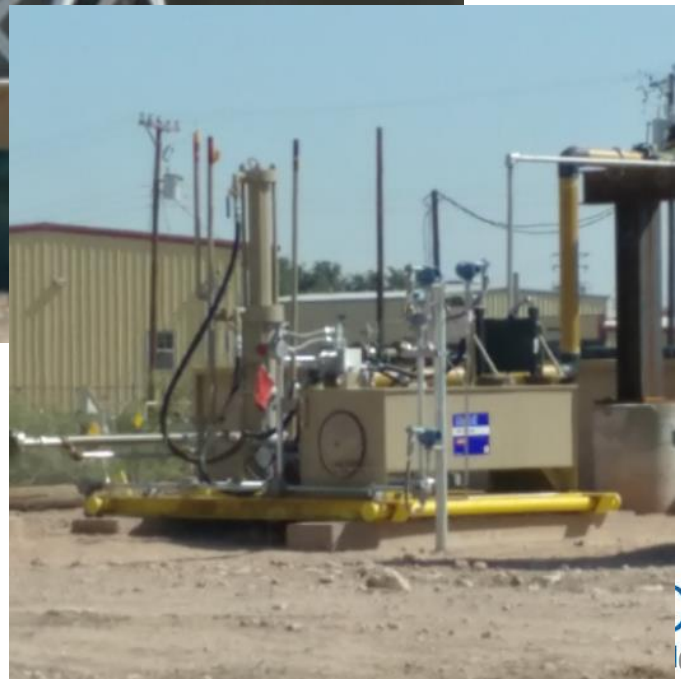
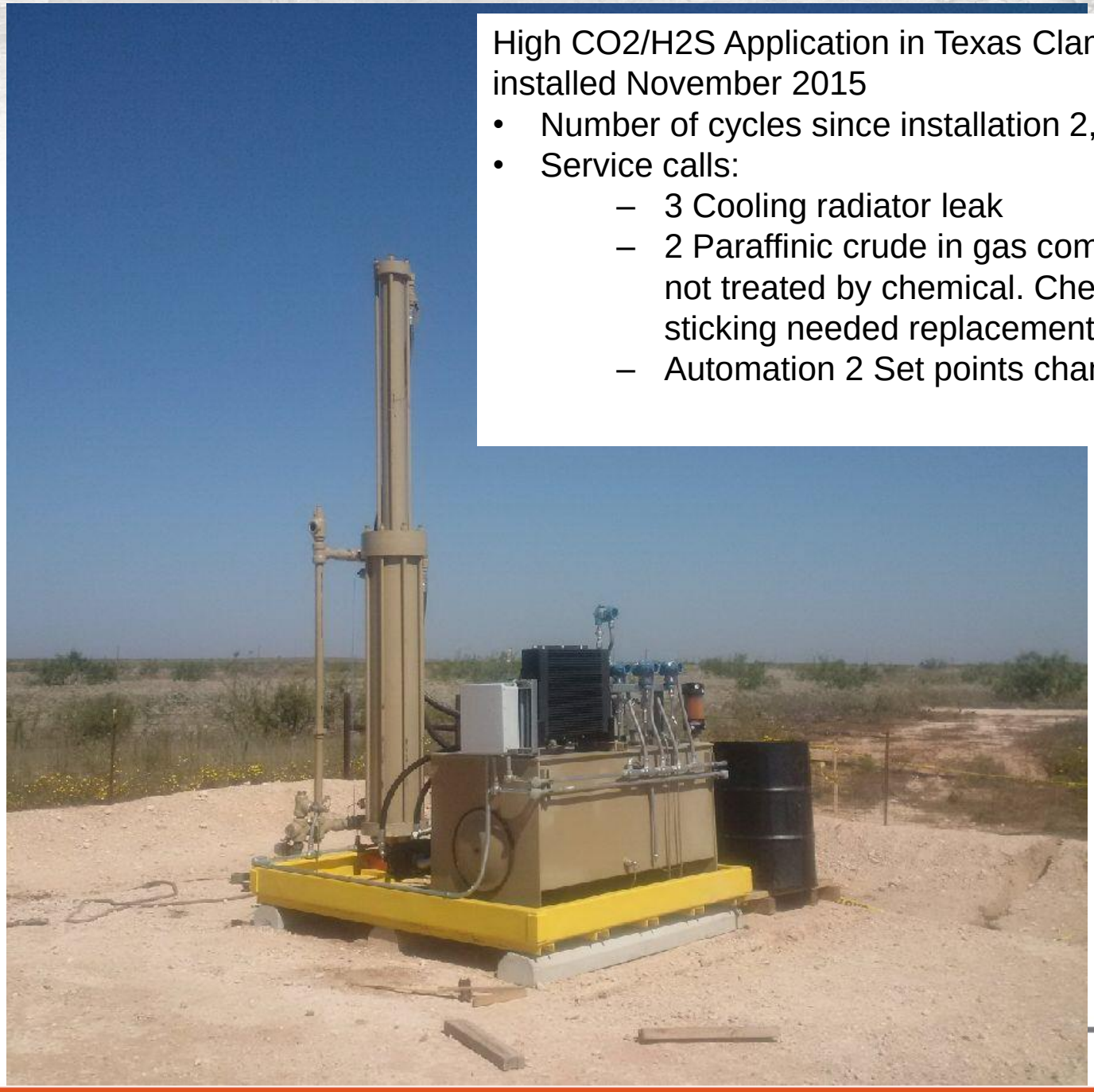
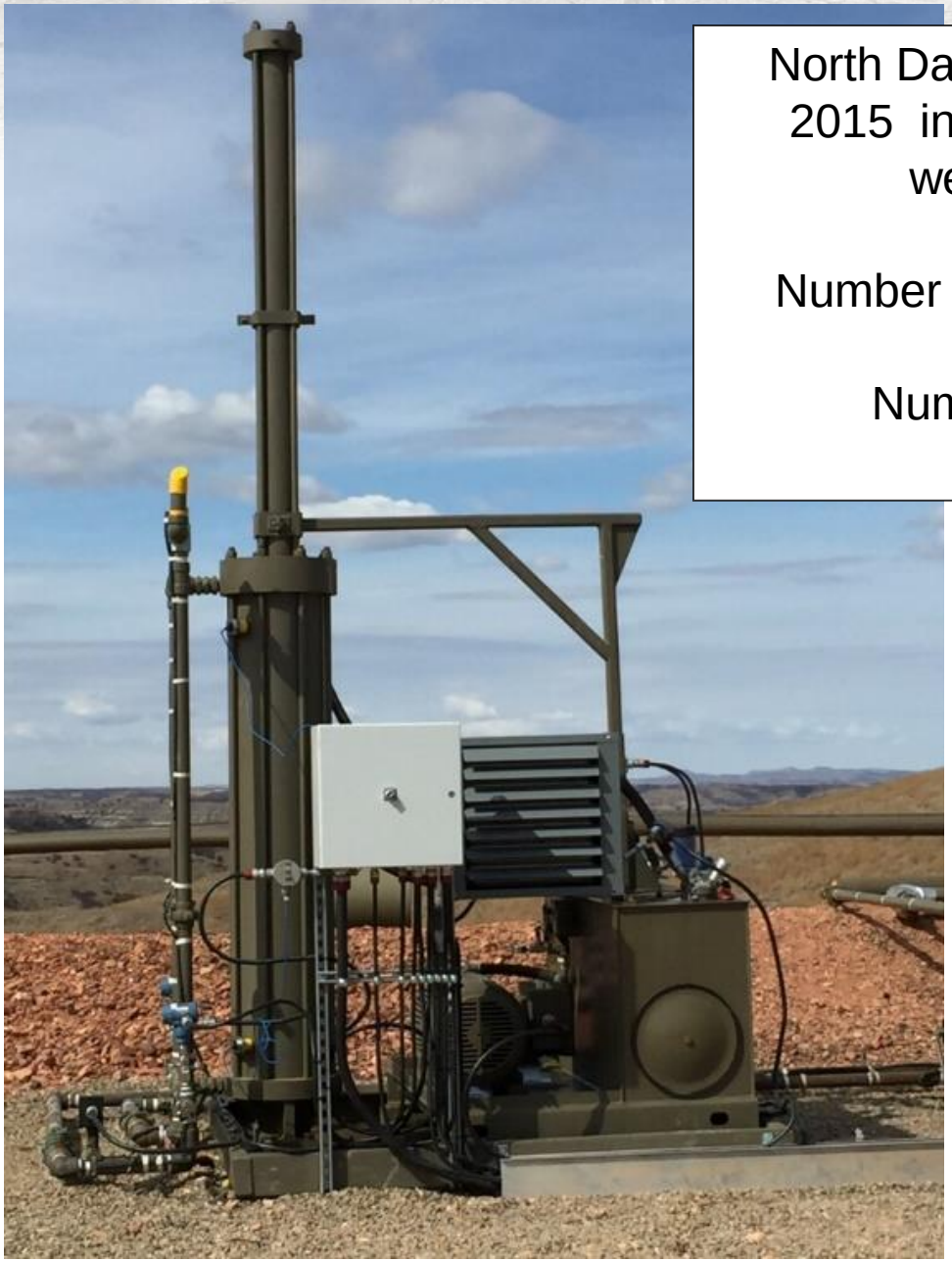


Vapor Recovery Unit
16% H2S



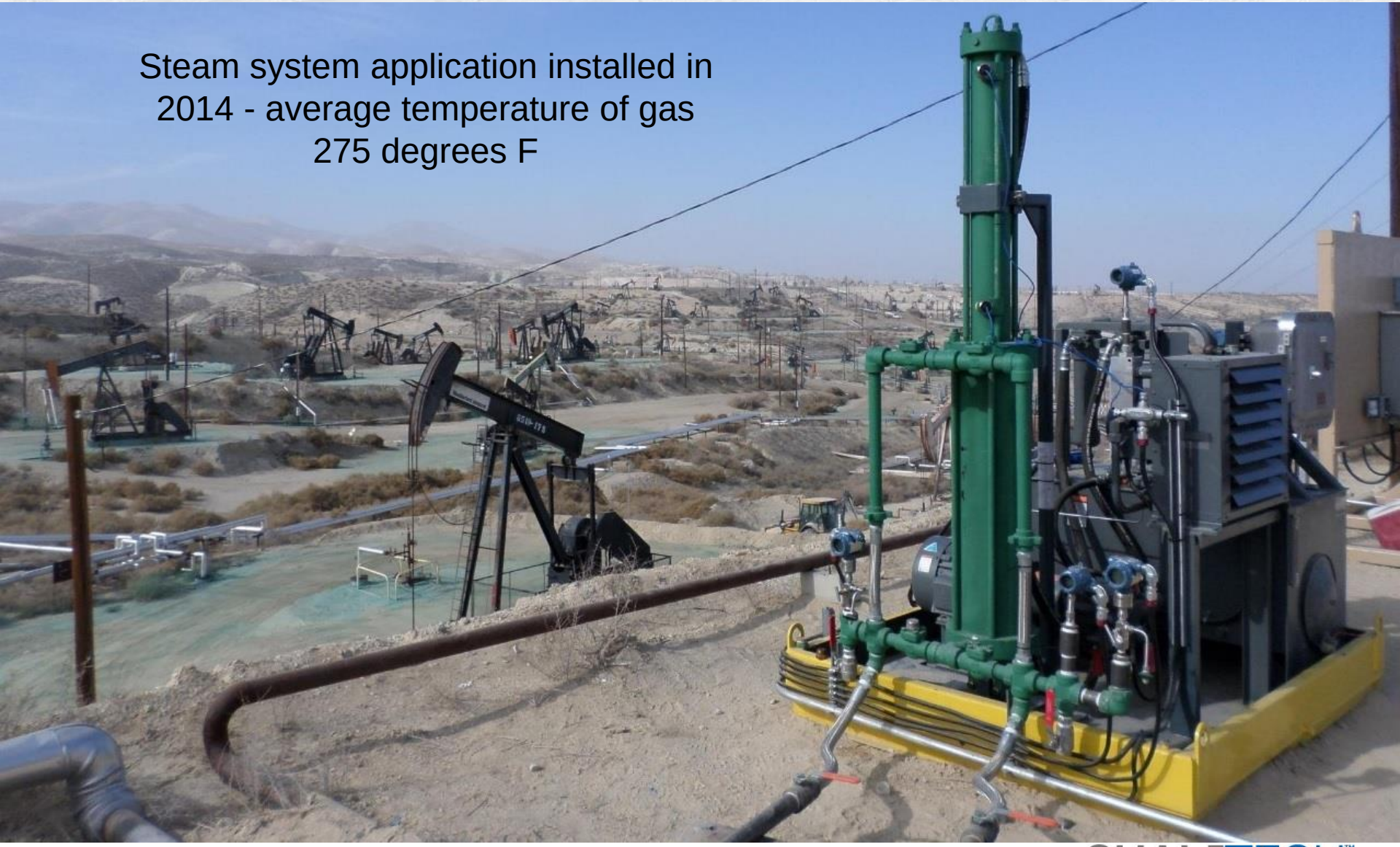
High CO2/H2S Application in Texas Clampett - installed November 2015

- Number of cycles since installation 2,855,452
- Service calls:
  - 3 Cooling radiator leak
  - 2 Paraffinic crude in gas compressor not treated by chemical. Check valves sticking needed replacement
  - Automation 2 Set points changes

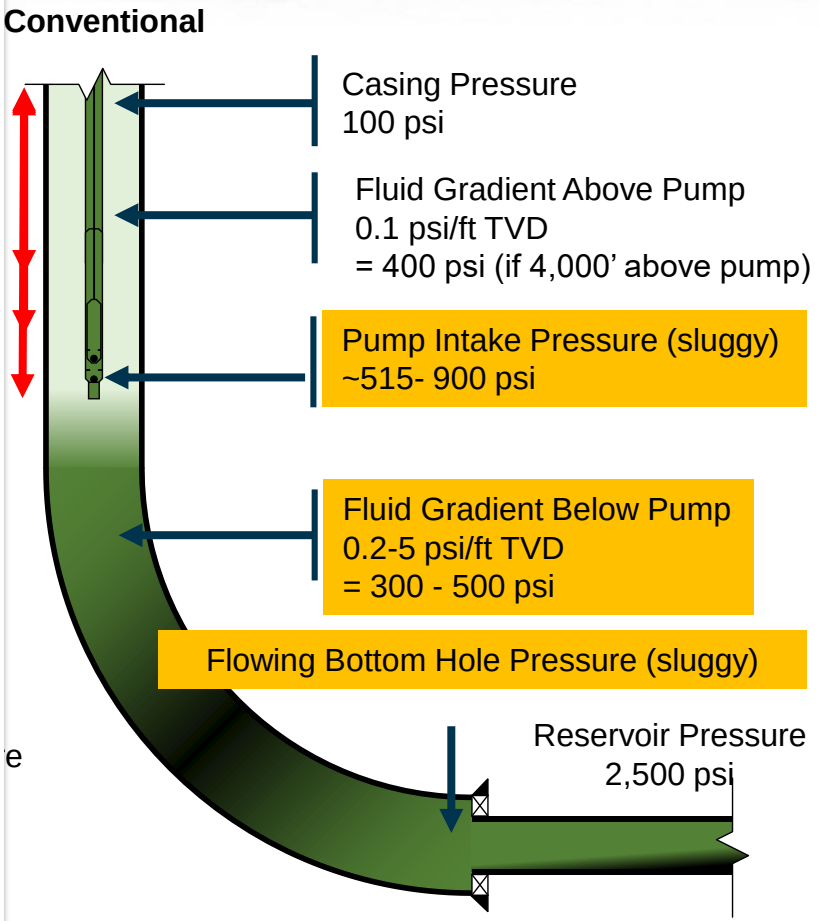


North Dakota – Installed December 2015 in High H2S service in cold weather environment.

Number of cycles since installation 2,325,452
Number of service calls 0


Steam system application installed in
2014 - average temperature of gas
275 degrees F

Conventional
Unconventional well
Add a HyBGC and you can greatly reduce BHP
And increase production



* Individual Well depths, pump landing and fluid rates will impact HEAL System performance

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Portable unit for testing wells in Eastern Europe

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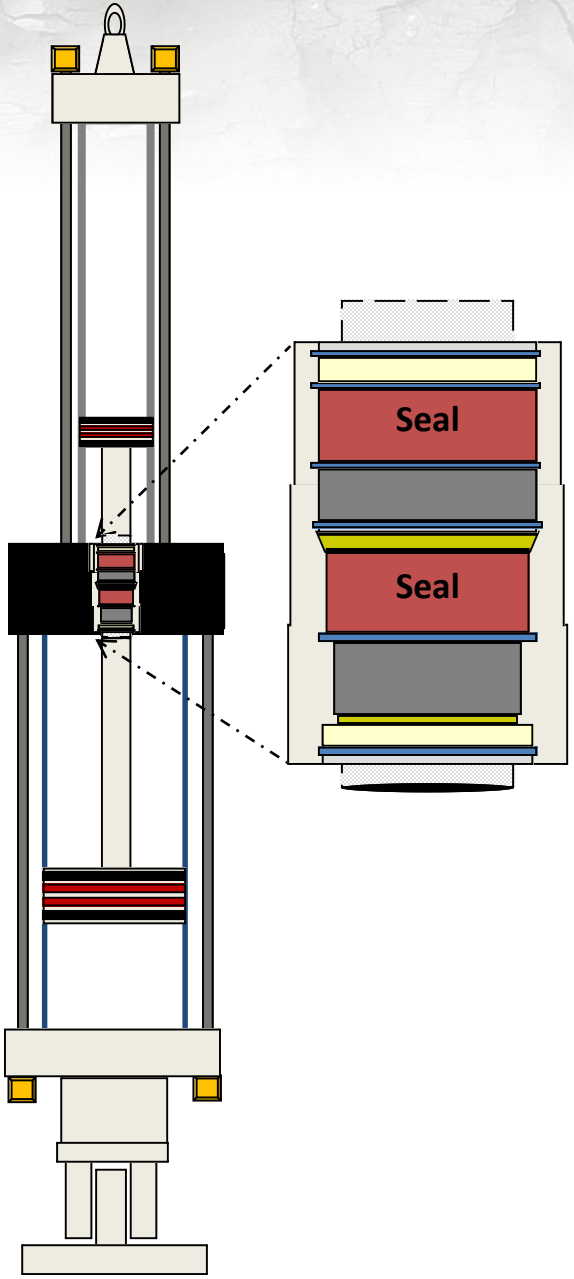
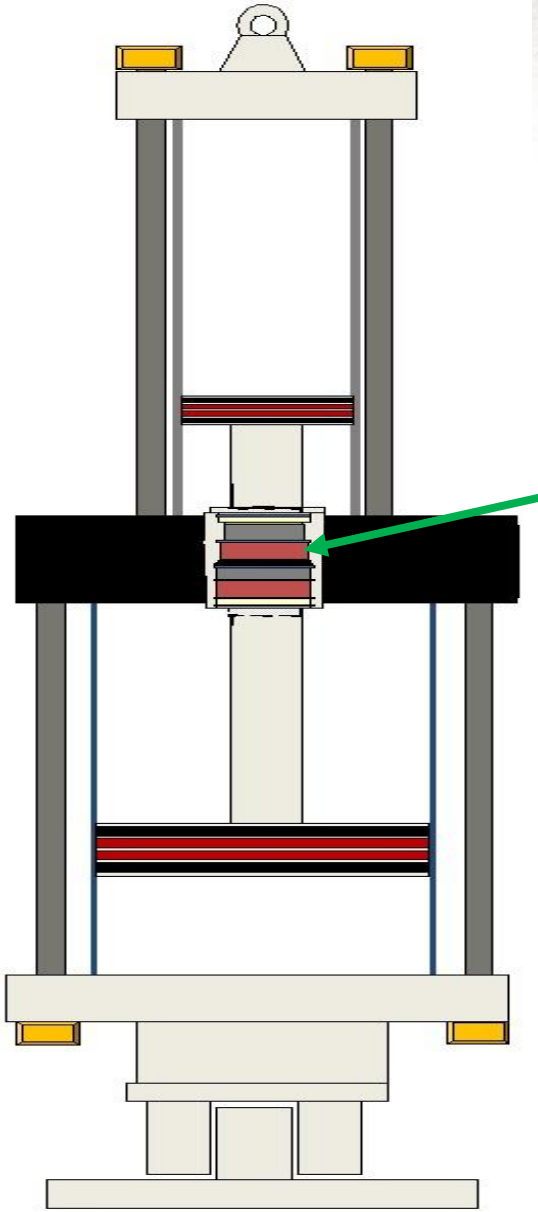
What about the seal between the hydraulic and gas cylinders (is there a risk of blow by and gas contamination)?

The Hydraulic Beam Gas Compressor ®
HyBGC



Emissions are non existent by design

Hydraulic Cylinder
Wog 750 -1400 psi



Seal design zero failures in 3 years on 7 units

Gas Cylinder
Wog 50 -400 psi

Different diameters of gas cylinders are used to attain higher discharge rates

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Application Use Examples

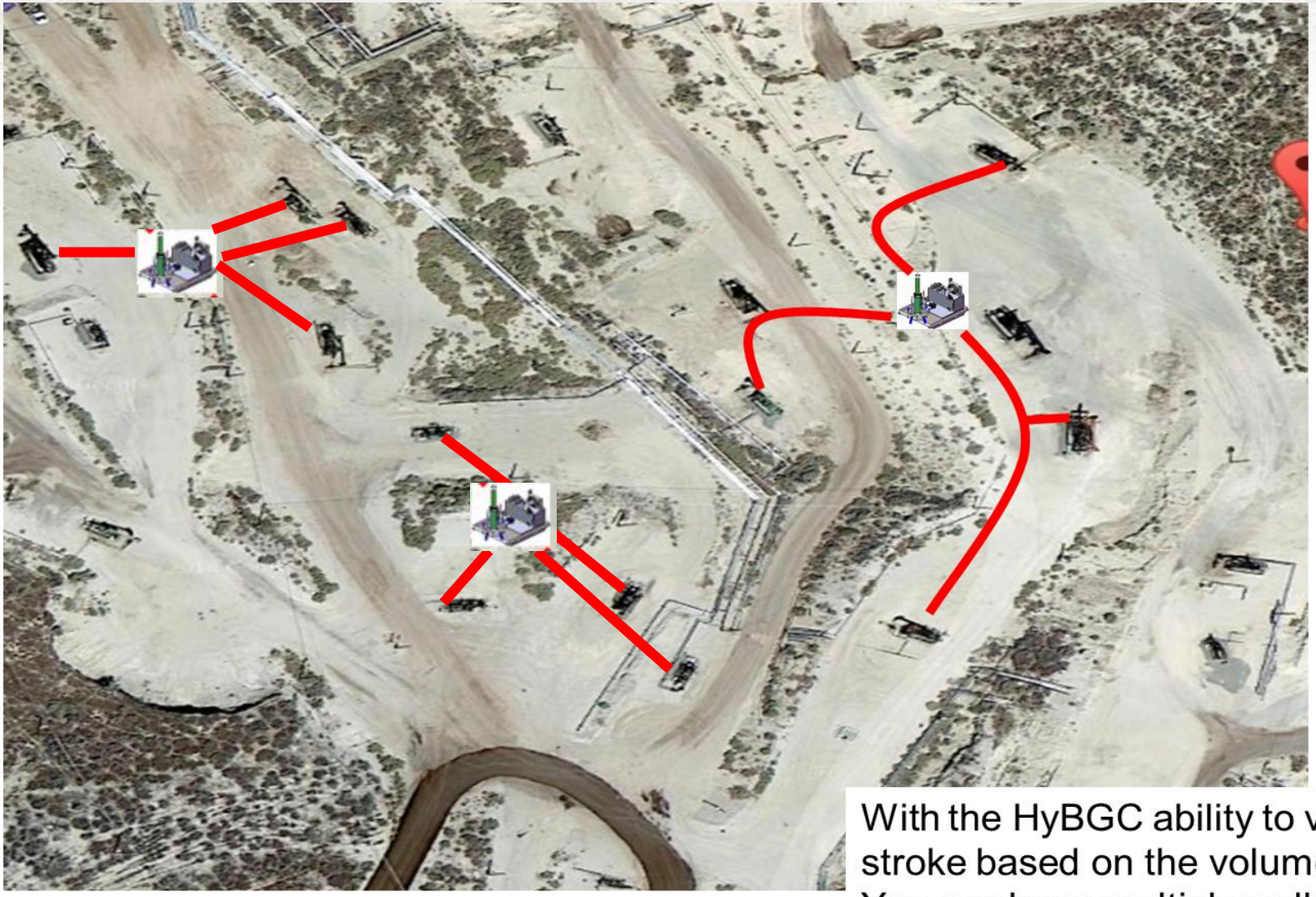
- Relieve restricted back pressure on wells for increased production

- VRU service

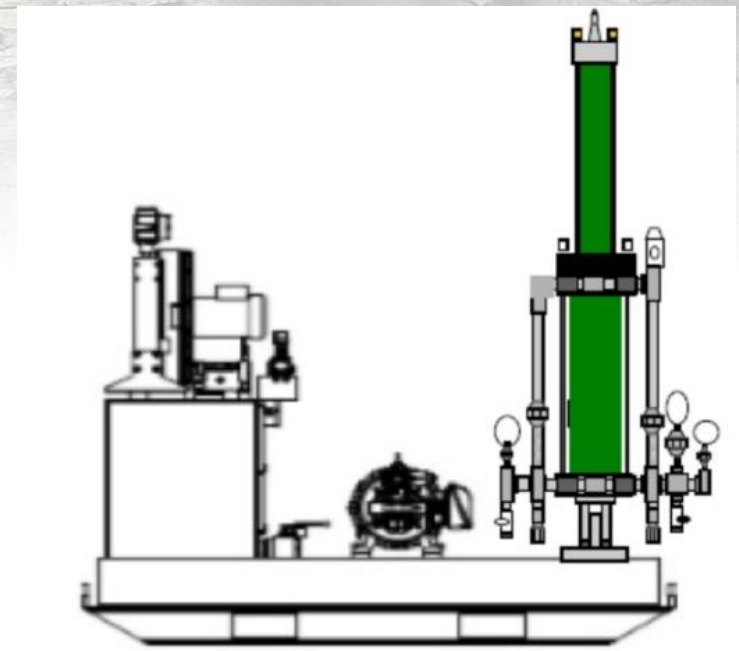
- Gas supply to operate surface equipment such as separators, natural gas engines, etc.

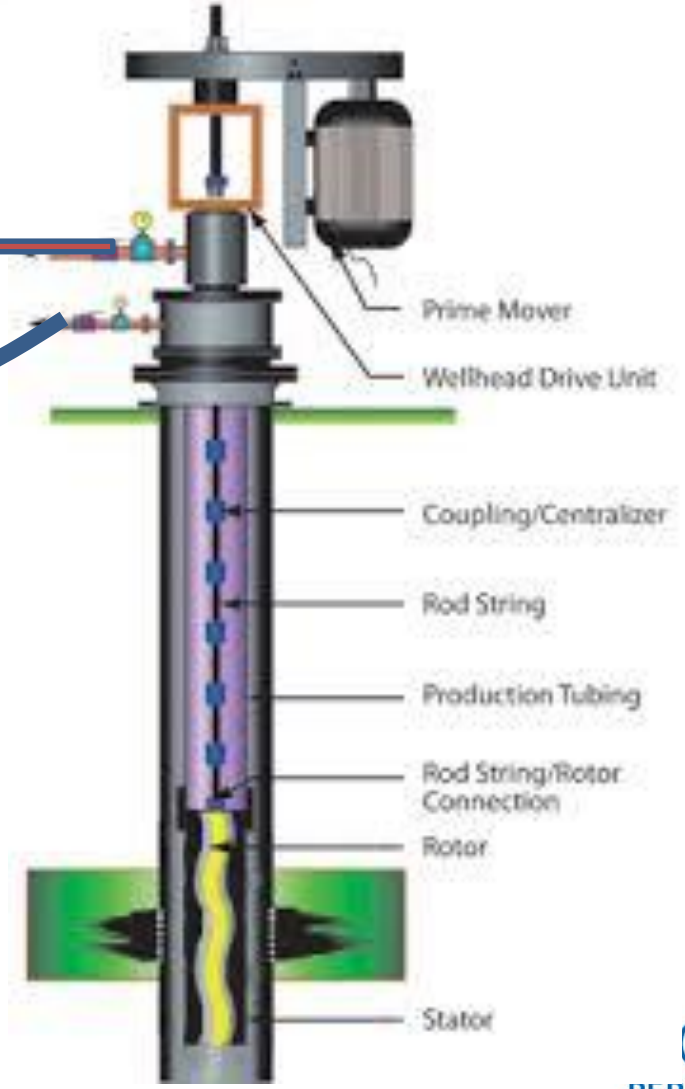
- Small gathering system on high H2S applications

- Operation in extreme sour gas situations and also HIGH TEMPERATURE applications such as steam floods.



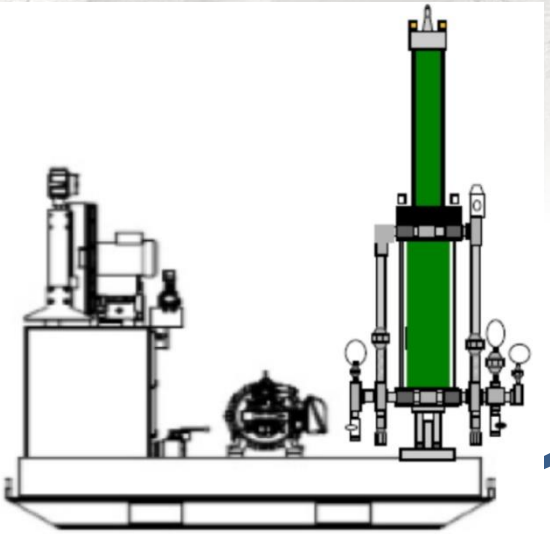
With the HyBGC ability to vary its stroke based on the volume of gas
You can have multiple wells hooked to one unit

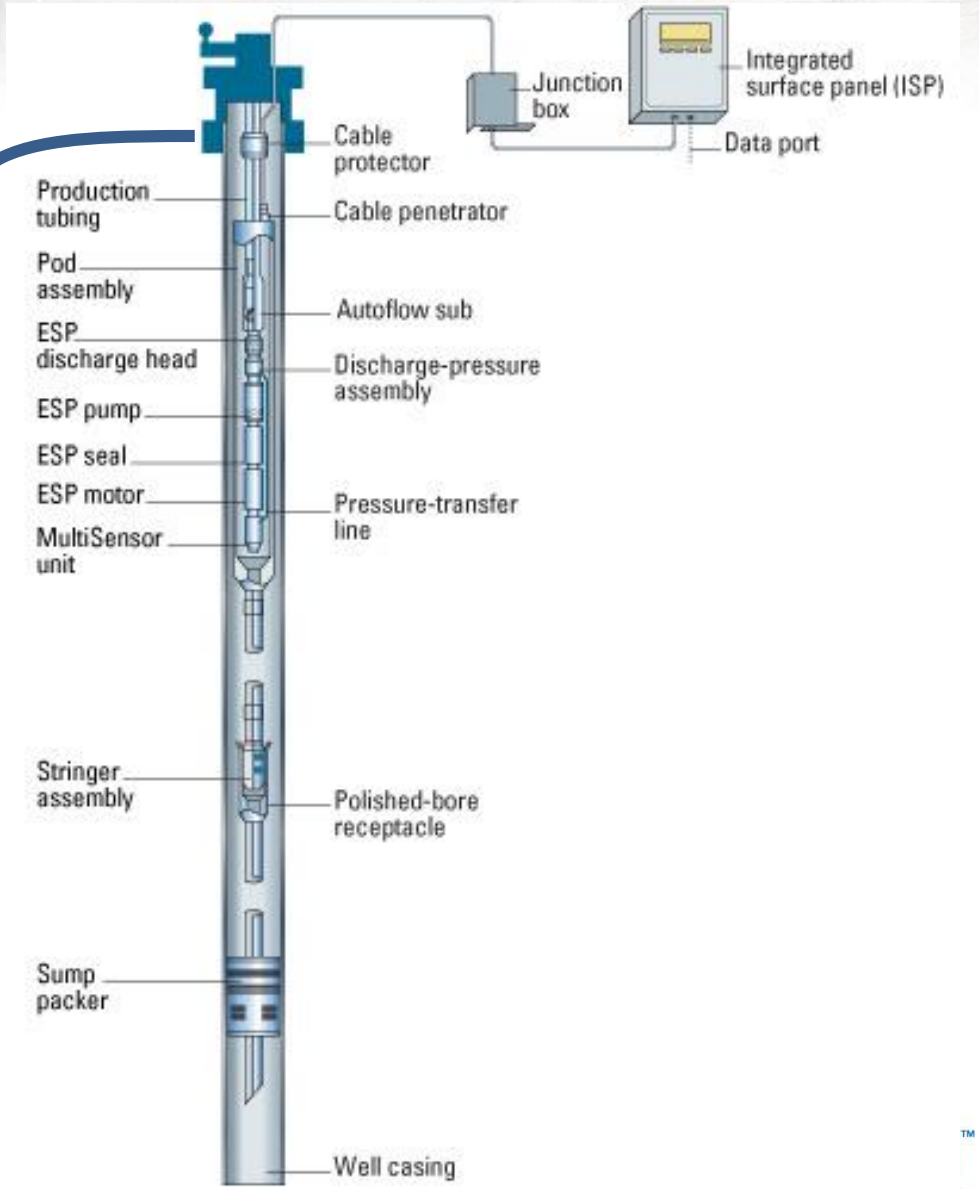




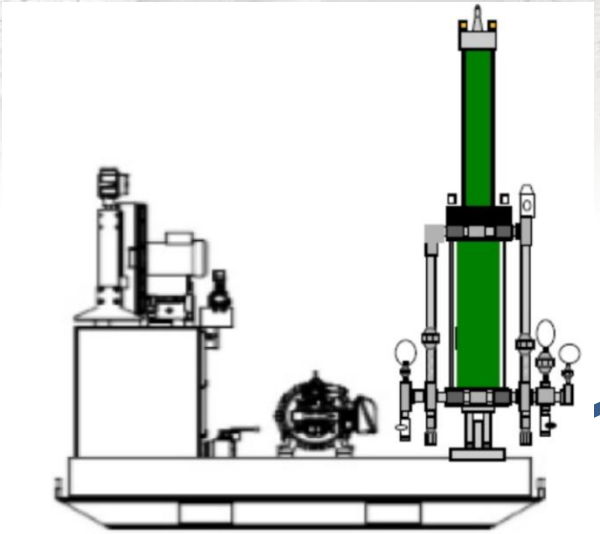
Progressive Cavity Pumps

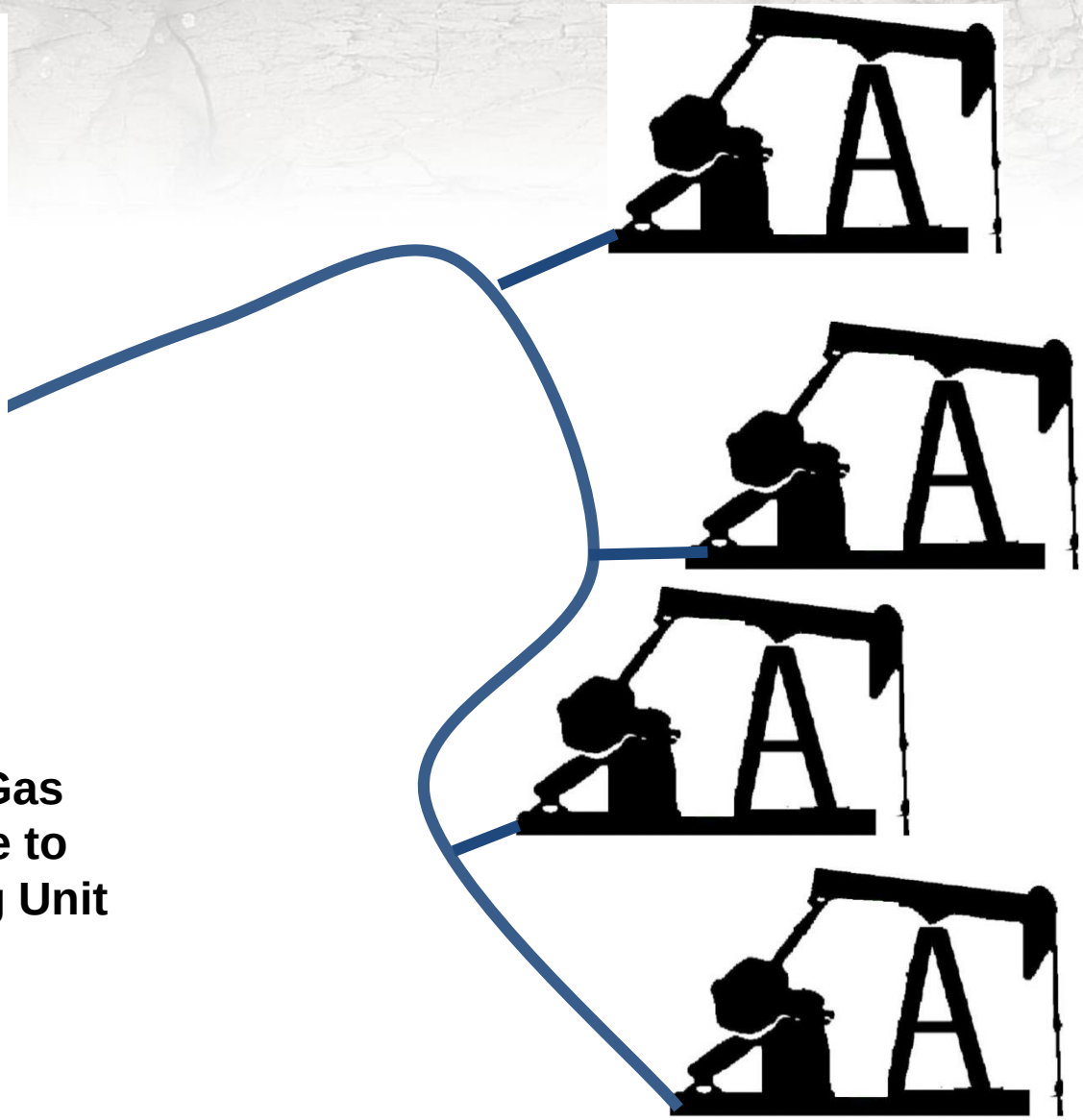
Can benefit with a HyBGC
by relieving the back pressure on the formation and allowing gas to flow up the casing instead of the tubing





Same can be said for ESP





Booster of very wet Gas
Or supplying propane to
Gas Operated Pumping Unit
wells

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Hydraulics a time tested concept has now come to wellhead and vapor compression

Summary of Advantages of HyBGC

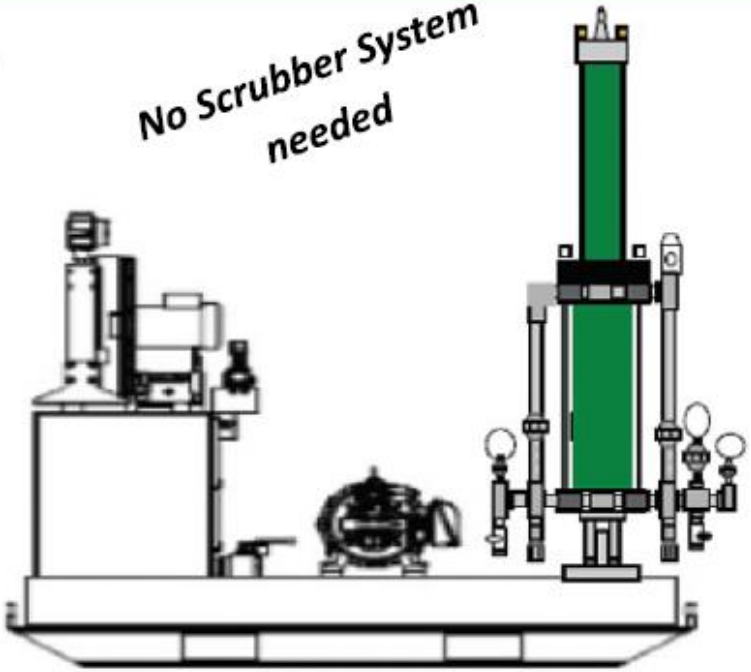
- No process filters to contaminate and replace frequently (typically monthly or quarterly)
- No chance of oil contamination – Happens frequently with screw VRU's in high H2S or very wet service
- Significantly reduced chance of oil loss – screw loses its oil if slugged by water or excessive hydrate formation. These can occur in intermittent service during startup or in poor gas quality service.
- No VFD required and yet better flexibility than VFD. 8:1 turndown with NO recycle- with wobble plate but costs more. Other way is to manually adjust oil bypass (typically done for lower flow models to save money)
- No inlet scrubber, gas/oil separator, liquid transfer pump with switches, dumps and seals to fail or freeze.
- No oil system heaters required because the compressor does not need oil and hydraulic system works down to X degrees.
- Gas cooler – Gas cools in cylinder downstream pipe on small unit and a cooler is not required (Max of 10 cycles per minute). May not need cooler in bigger model.
- Use and control of your own PLC and software
- Much lower operating costs.

THE GREEN MACHINE®

No emissions and environmentally friendly

Impervious to H2S

No Scrubber System needed



Hydraulic

beamgascompressor®

Manufactured by Permian Production Equipment, Inc.

Vapor Recovery

Made Simple in the USA

Hydraulic.beamgascompressor.com

432-638-6749

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