

Mobile Compression Solutions for Gas Pipeline Evacuation



Natural Gas STAR Annual Implementation Workshop

November 16-18, 2015
Sheraton Pittsburgh at Station Square
Pittsburgh, PA

Gas Evacuation - method

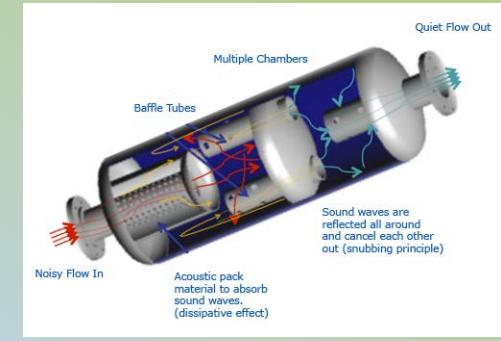
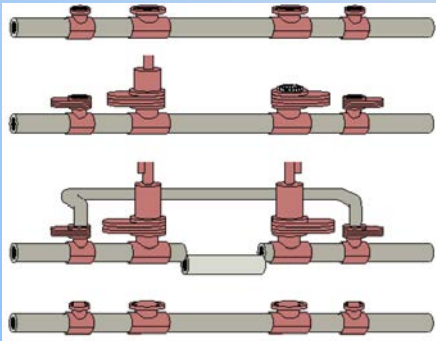
Hot Tapping & Plugging



Flaring



Release to Atmosphere



Gas Evacuation product portfolio

Mobile Units for Gas Pipeline Evacuation

LMF P-Pack 475



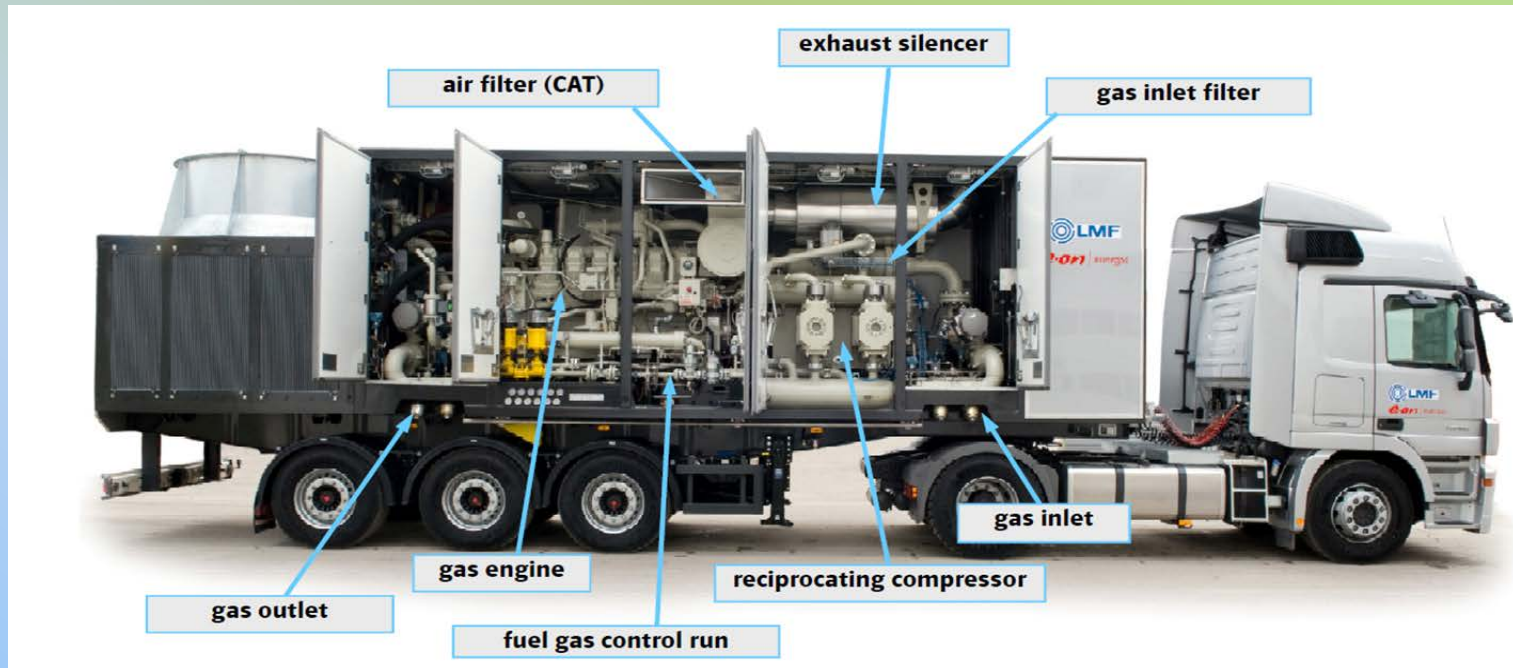
LMF P-Pack 750



LMF P-Pack 100



System description – LMF P-Pack 750

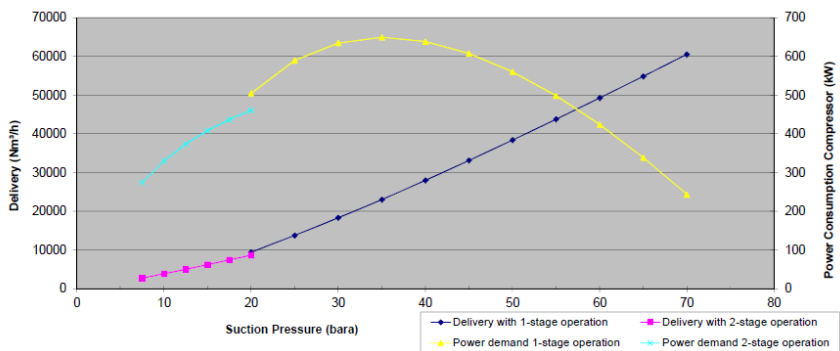


- ⊗ LMF compressor BS604-213 S7.5, rated power 638 kW
- ⊗ Total weight incl. truck and trailer 38 t
- ⊗ Electric power supply: 24V 2x60A
- ⊗ Overall length 13,427 mm
width 2,520 mm / height 4,000mm
- ⊗ Gas engine CAT3512G, 1400 rpm, 750 kW
- ⊗ Cooling fan driven by CAT via gear box
- ⊗ Suitability for – 40°C to + 35°C

Motivation for Pipeline Evacuation Technology LMF P-Pack 750

Pipeline section of 28 km (17 miles) , 1420mm (56“) diameter and filled with 70 bar (1015 psi)

Gas transfer process from 70 bar (1015 psi) to 10 bar (145 psi)



Environmental Aspect:

- 🌐 Emission of Methane is #1 in greenhouse gas effect

1 Nm ³ CH ₄ (35,32 ft ³)	~0.671 kg (1,48 pounds)
Volume saved gas – 2.419.475 m ³ (85.443.034 ft ³)	~1.623.468 kg CH ₄ (3.579.134 pounds)
Greenhouse Gas Equivalencies faktor CH ₄ to CO ₂	21
Saved CO ₂	34.092.828 kg CO ₂ (75.161.819 pounds)
Actual market price for Emission Allowance	5.27 € / to CO ₂
Summ Emission Allowance	~179.670 €

pipeline pressure bara	Vn_pipeline Nm ³	Delta Vn Nm ³	delivery of compressor Nm ³ /h	average delivery of compressor Nm ³ /h	time to evacuate between pressure h	Total Time to pressure all Units h
70	2822721		60589.57			
65	2621098	201623	54896.49	57743	3.49	1.75
60	2419475	201623	49309.69	52103	3.87	3.68
55	2217852	201623	43808.46	46569	4.33	5.85
50	2016229	201623	38416.54	41113	4.90	8.30
45	1814607	201623	33151.26	35784	5.63	11.12
40	1612984	201623	28014.29	30583	6.59	14.41
35	1411361	201623	23050.07	25532	7.90	18.36
30	1209738	201623	18344.49	20697	9.74	23.23
25	1008115	201623	13802.56	16074	12.54	29.50
20	806492	201623	9437.51	11620	17.35	38.18
Time single stage compression					76.36	
20	806492	100811	8656.72	8045	12.53	38.18
17.5	705680	100811	7433.39	6830	14.76	44.44
15	604869	100811	6226.84	5634	17.89	51.82
12.5	504057	100811	5040.49	4481	22.60	60.77
10	403246	100811	3881.66	3313	30.43	72.07
7.5	302434	100811	2743.82			87.29

Motivation for Pipeline Evacuation Technology LMF P-Pack 750

1 Nm ³ CH ₄ (35,32 ft ³)	~0.671 kg (1,48 pounds)
Volume saved gas – 2.419.475 m ³ (85.443.034 ft ³)	~1.623.468 kg CH ₄ (3.579.134 pounds)
Greenhouse Gas Equivalencies faktor CH ₄ to CO ₂	21
Saved CO ₂	34.092.828 kg CO₂ (75.161.819 pounds)

3,836,258



gallons of gasoline consumed

7,177



Passenger vehicles

81,173,400



Miles/year driven by an average passenger vehicle

12,220



Tons of waste sent to the landfill

79,286



barrels of oil consumed

3,111



homes' energy use for one year

36,619,579



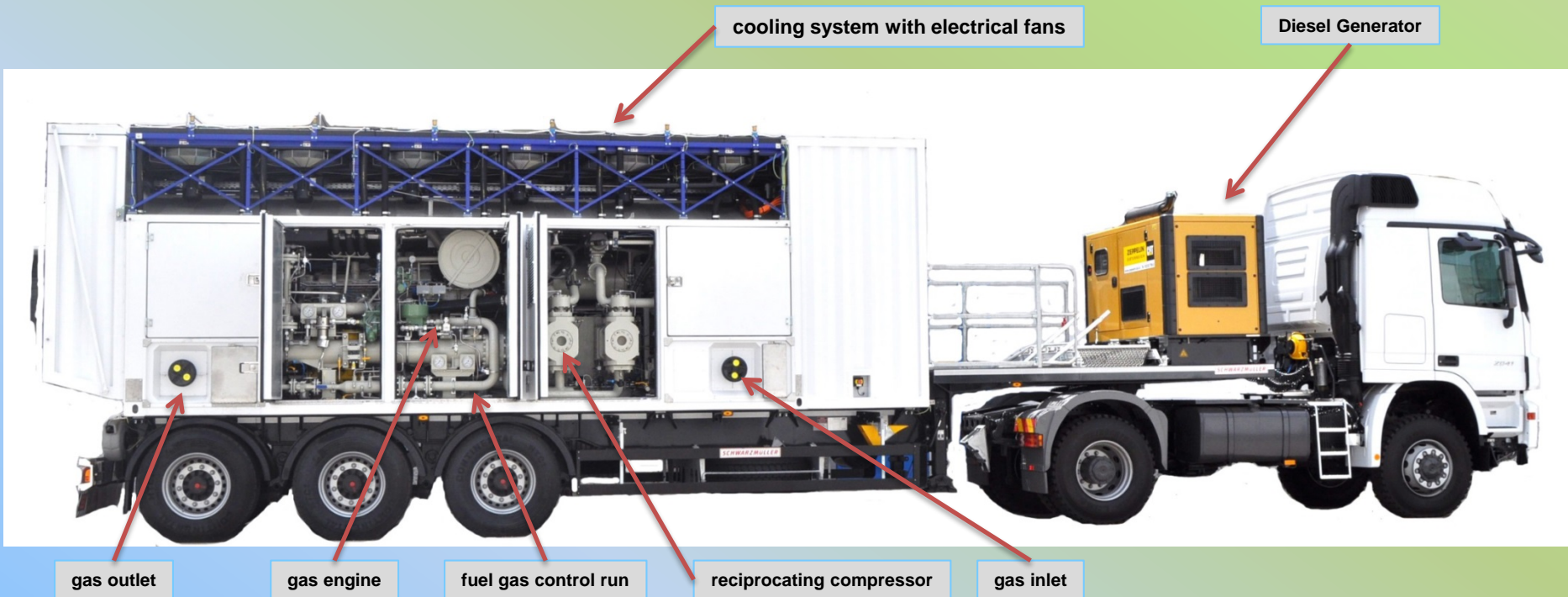
Pounds of coal burned

4,690



homes' electricity use for one year

System Description – LMF P-Pack 475



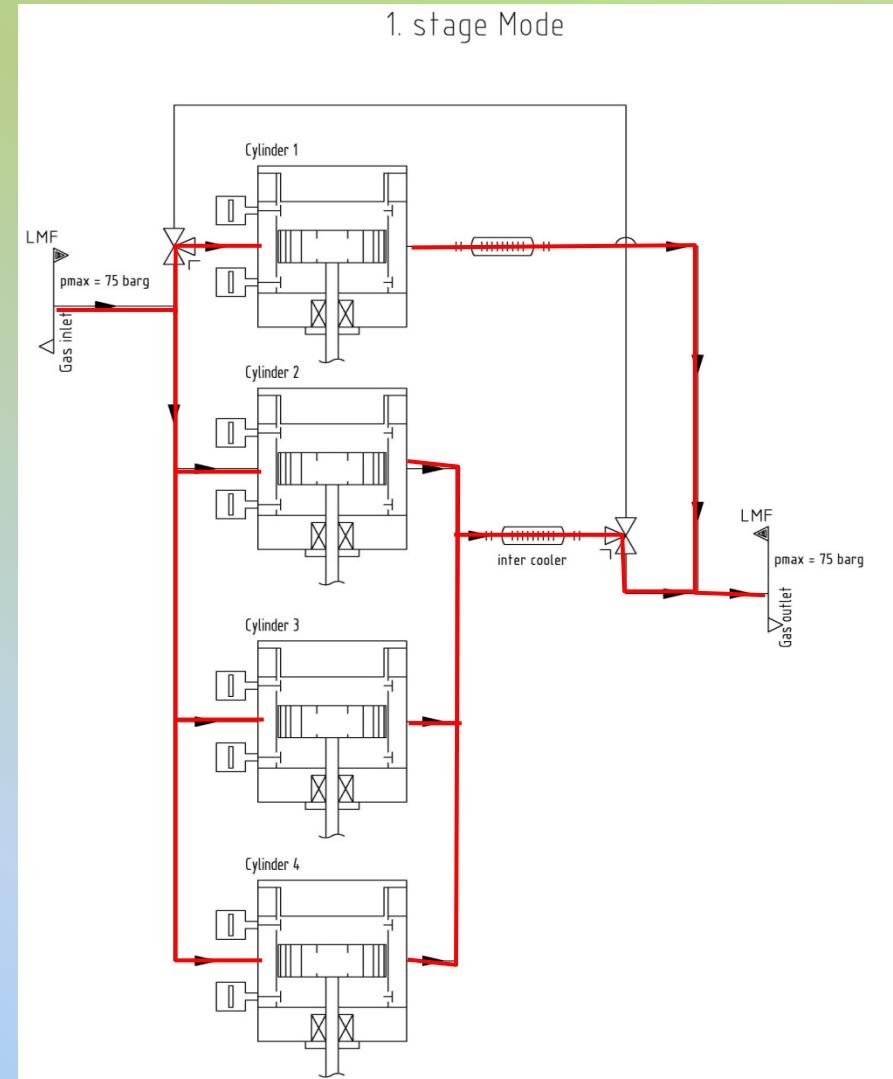
- ☉ LMF compressor BS604-213 S7.5, rated power 450 kW
- ☉ Gas engine CAT3412G, 1800 rpm, 475 kW
- ☉ Cooling fan electrical driven by Diesel Genset
- ☉ Suitability for – 40°C to + 50°C (- 40°F to + 122°F)
- ☉ Total weight incl. truck and trailer 38 t (83.776 pounds)
- ☉ Overall length 14,860 mm (48.75 ft) width 2,543 mm (8.33 ft) / height 4,000mm (13.12 ft)

LMF P-Pack 475 & 750; 1- Stage Operation

- For optimized efficiency the compressor is operating as a single stage compressor in the beginning of the evacuation process

Single Stage Operation:

- 4 cylinder operation for high volume delivery
- ratio in compression up to 1:3,5
- high efficiency in volume for the beginning of the evacuation process



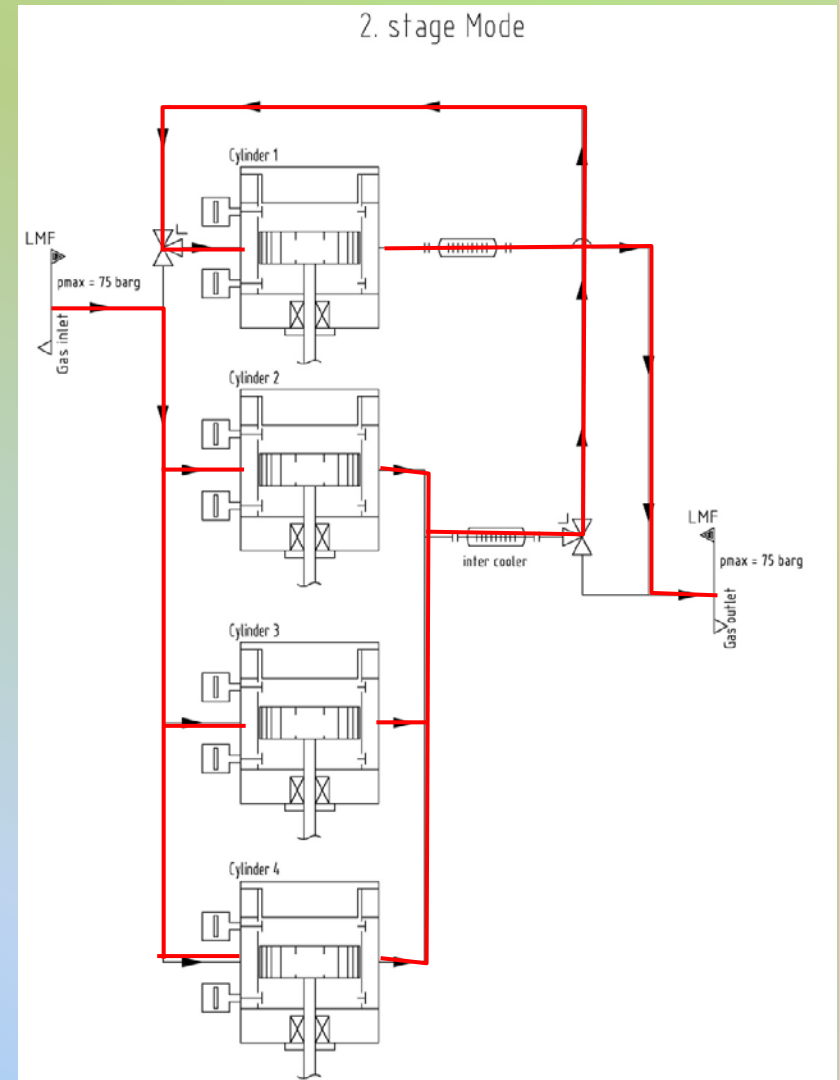
LMF P-Pack 475 & 750; 2- Stage Operation

- For optimized efficiency the compressor is operating as a 2-stage compressor at the end of the evacuation process

Two Stage Operation:

- 1st stage / 3 cylinder,
2nd stage / 1 cylinder for high pressure delivery ratio in compression up to 1:12
- high pressure efficiency at the final phase of the evacuation process

LMF patent for better performance

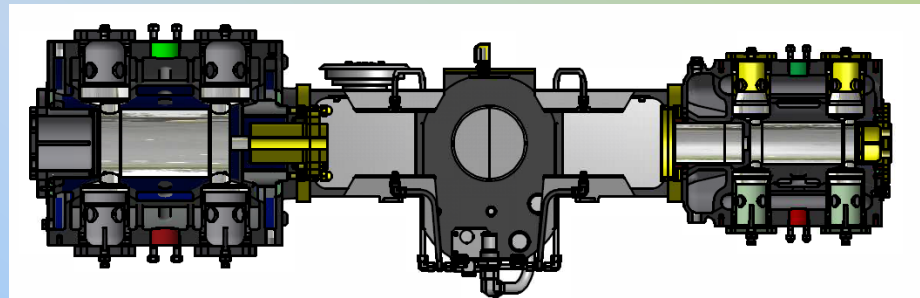
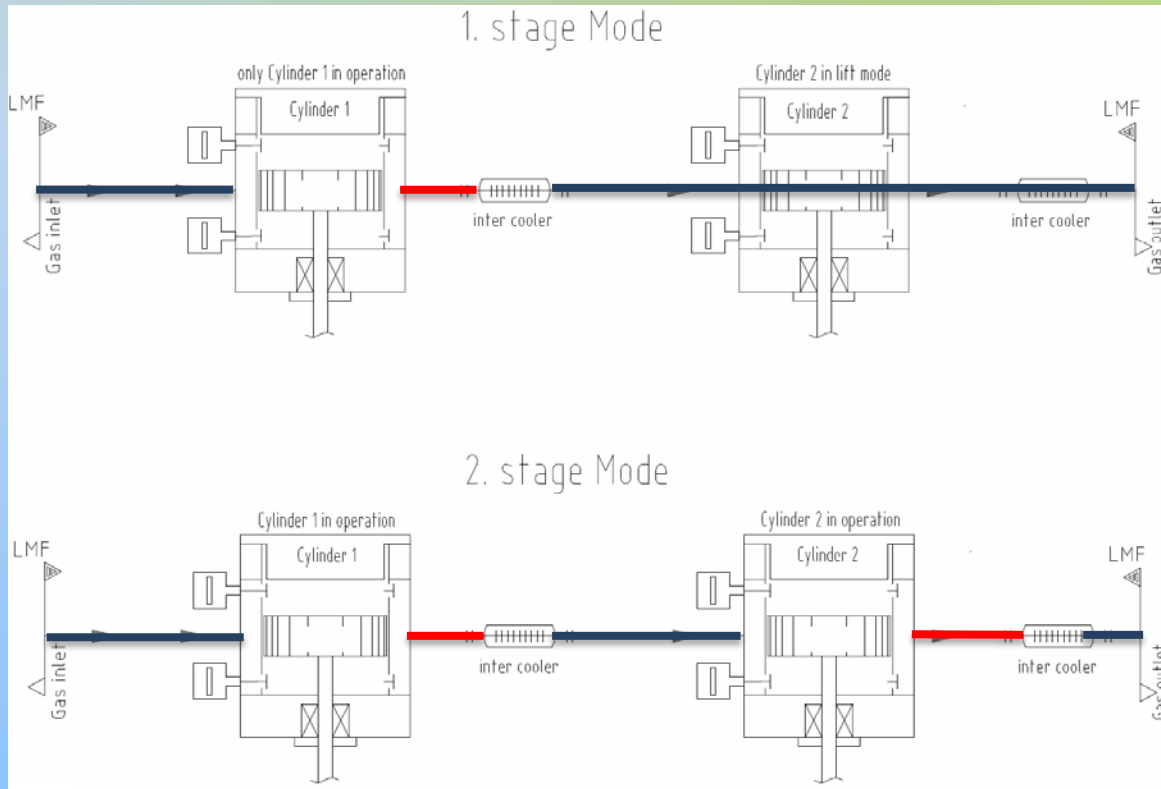


System Description – LMF P-Pack 100



- ☉ LMF compressor BS102, rated power approx. 100 kW
- ☉ Gas engine CAT3306G, Diesel engine CAT or similar, Electrical motor WEG or similar
- ☉ Cooling fan direct driven by main drive
- ☉ Suitability for -5°C (-40°C) to $+50^{\circ}\text{C}$ (-40°F to $+122^{\circ}\text{F}$)
- ☉ Total weight approx. 15 t (33.069 pounds)
- ☉ Overall length 6,058 mm (19.88 ft) / width 2,543 mm (8.33 ft) / height 2,500 mm (8.20 ft)
- ☉ Pressure range 30 bar (435 PSI) to 1 bar (14,5 PSI) [0.1 bar] [1,45 PSI]

LMF P-Pack 100 1 & 2-Stage Operation





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Certified Company ISO 9001:2008 - ISO 14001:2004 - OHSAS 18001:2007
Certificates N° ER-0274/2006 - GA-2012/0248 - SST-0143/2012

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prepared by M. Bettoni

CUSTOMERS



**GAS
&
OIL**



ACTIVITY



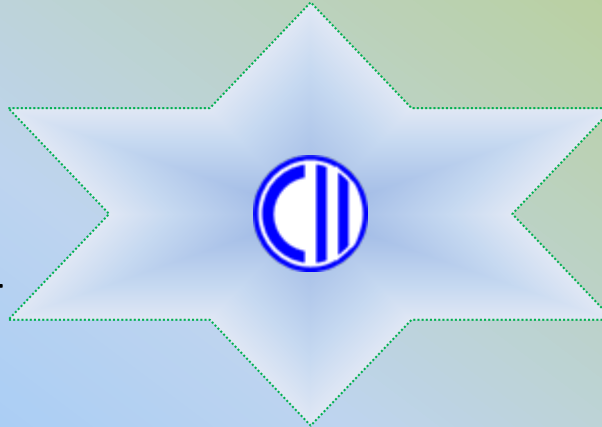
CALIPER PIG



EVACUATION PIPELINE



PIPELINE



ENVIRONMENT

H.D.D.



MICRO TUNNEL



EVACUATION



Evacuation 2013/2014/2015

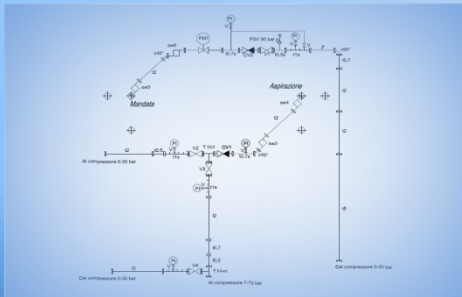


EVACUATION PIPELINE

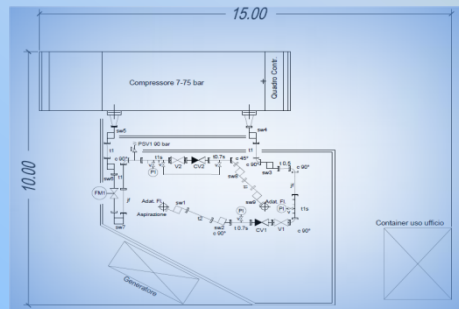


Equipment

P&I connection and photos



Layout



Sketch connection



prepared by M. Bettoni

EVACUATION COMPRESSORS



7 – 75 bar
102 – 1.088 PSI

0 – 30 bar
0 – 435 PSI

FLOW

- min. 1500 Nm³/h (52.980 ft³/h)
- max. 50000 Nm³/h (1.766.000 ft³/h)
- medium**
- 9000 Nm³/h (317.880 ft³/h)
- 11000 Nm³/h (388.520 ft³/h)

ADVANTAGES

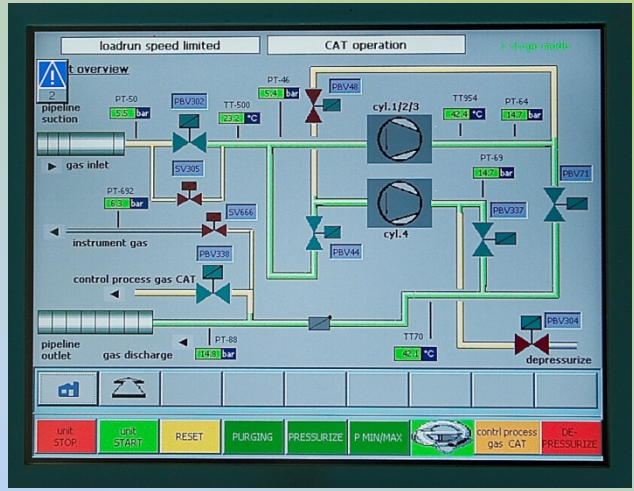
- **Big Reduction Pollutants Gas** in atmosphere through utilizes of engines natural gas
- **Big Reduction Jobsite Spaces** through utilizes mobile compressors of little dimensions
- **Big Reduction Noise** through soundproofing mobile compressors

EVACUATION



CONTROL BOX

REMOTE PANELS



EVACUATION



ELECTRIC GENERATORS METHANE GAS

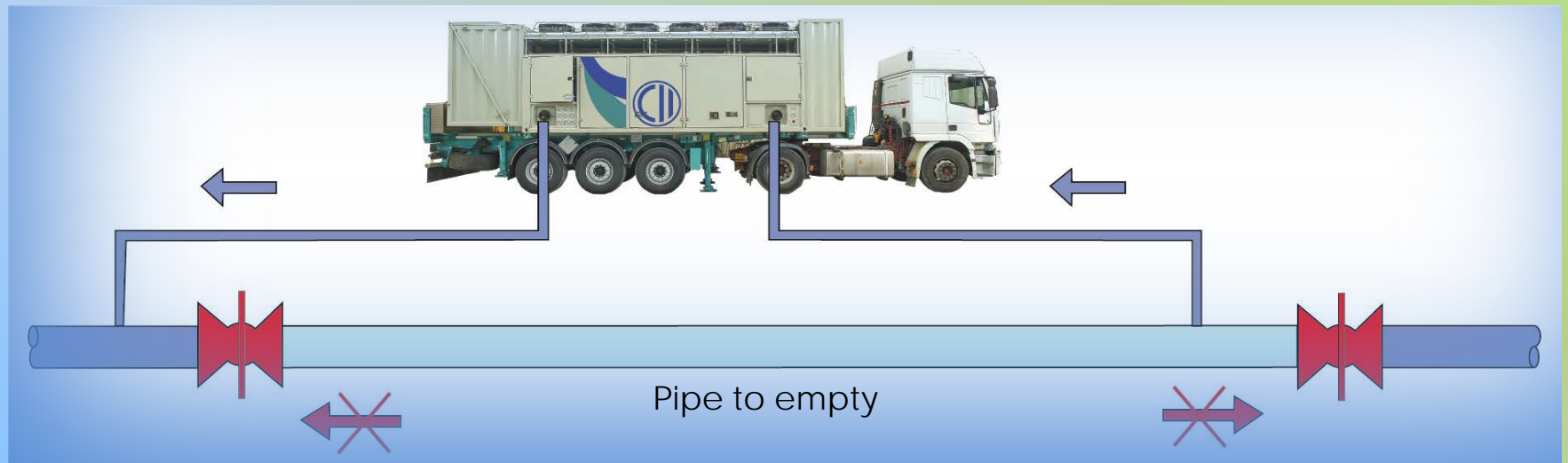
380 V 90 KW

Compressor's engine
and
Electric Generator
takes natural gas
from the line of transfer

EVACUATION

LAYOUT

Sketch connection N° 1 compressor



Pipe in operation

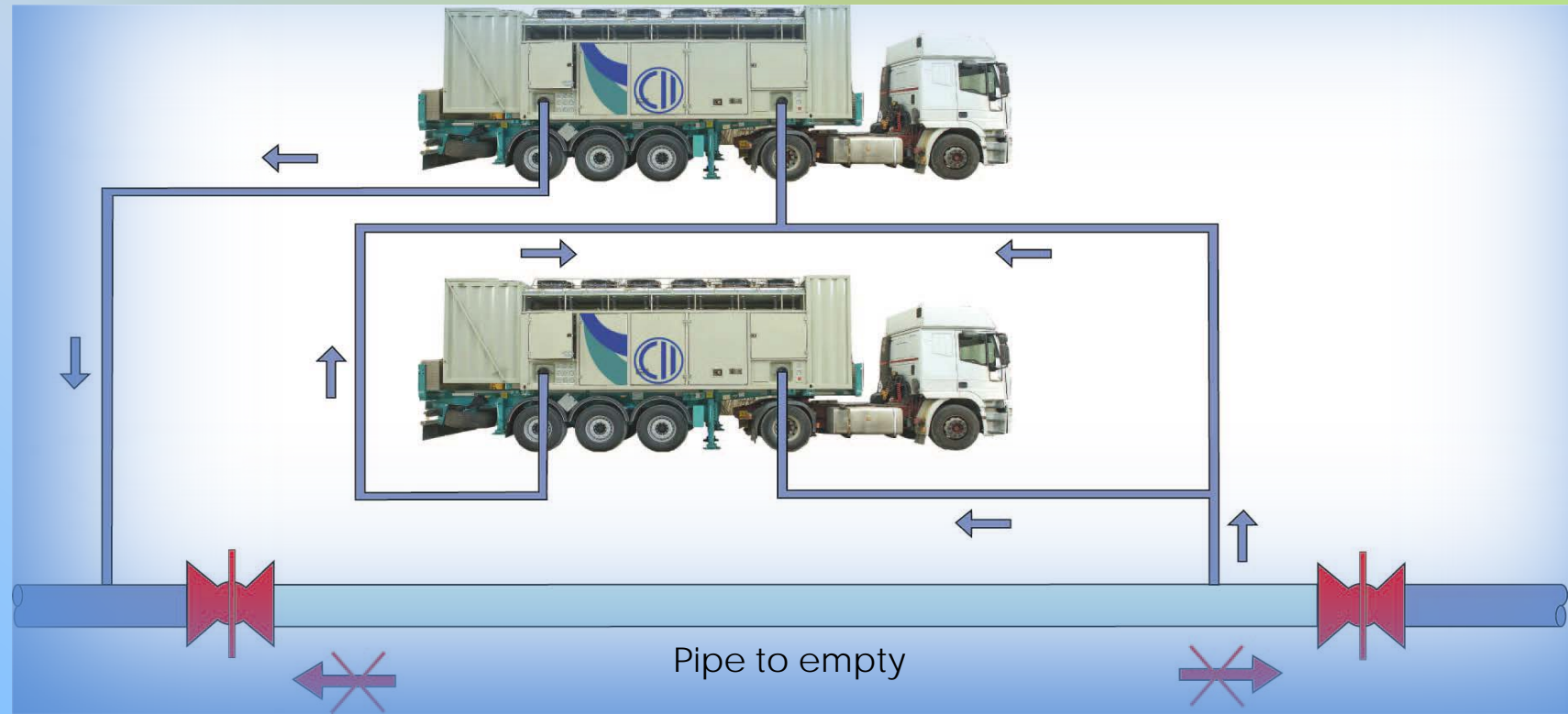
Pipe in operation

Pressure 75 bar (1.088 PSI) → 7 bar (101 PSI)
Medium Flow 10.000 m³/h (353.200 ft³/h)

EVACUATION

LAYOUT

Sketch connection N° 2 compressors -SERIAL-



Pipe in operation

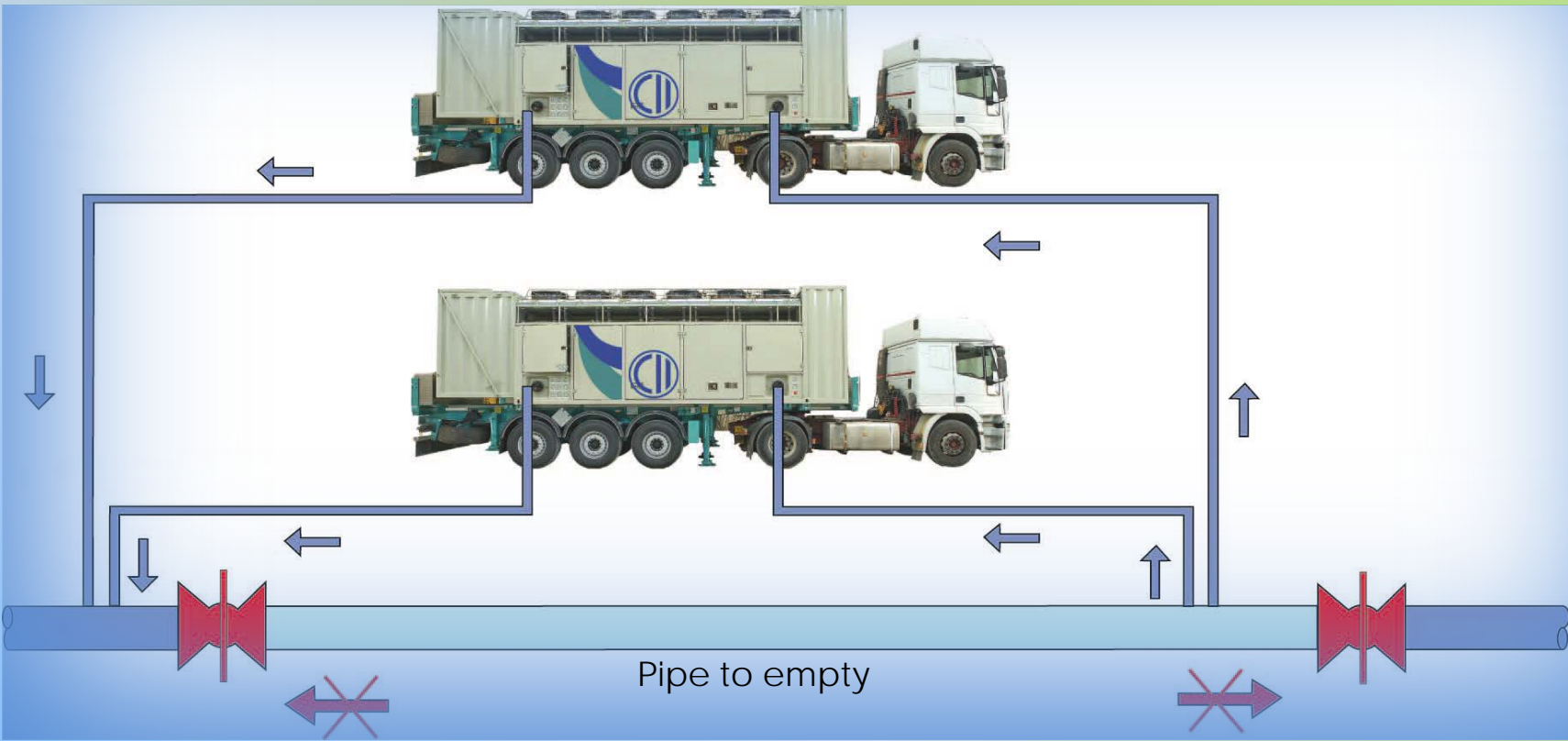
Pipe in operation

Pressure 75 bar (1.088 PSI) → 0,5 bar (7 PSI)
Medium Flow 10.000 m³/h (353.200 ft³/h)

EVACUATION

LAYOUT

Sketch connection N° 2 compressors -PARALLEL-



Pipe in operation

Pipe in operation

Pressure 75 bar (1.088 PSI) → 7 bar (101 PSI)
Medium Flow 20.000 m³/h (706.400 ft³/h)

EVACUATION

P&I N°1 COMPRESSOR



prepared by M. Bettoni

EVACUATION

P&I N°2 COMPRESSORS



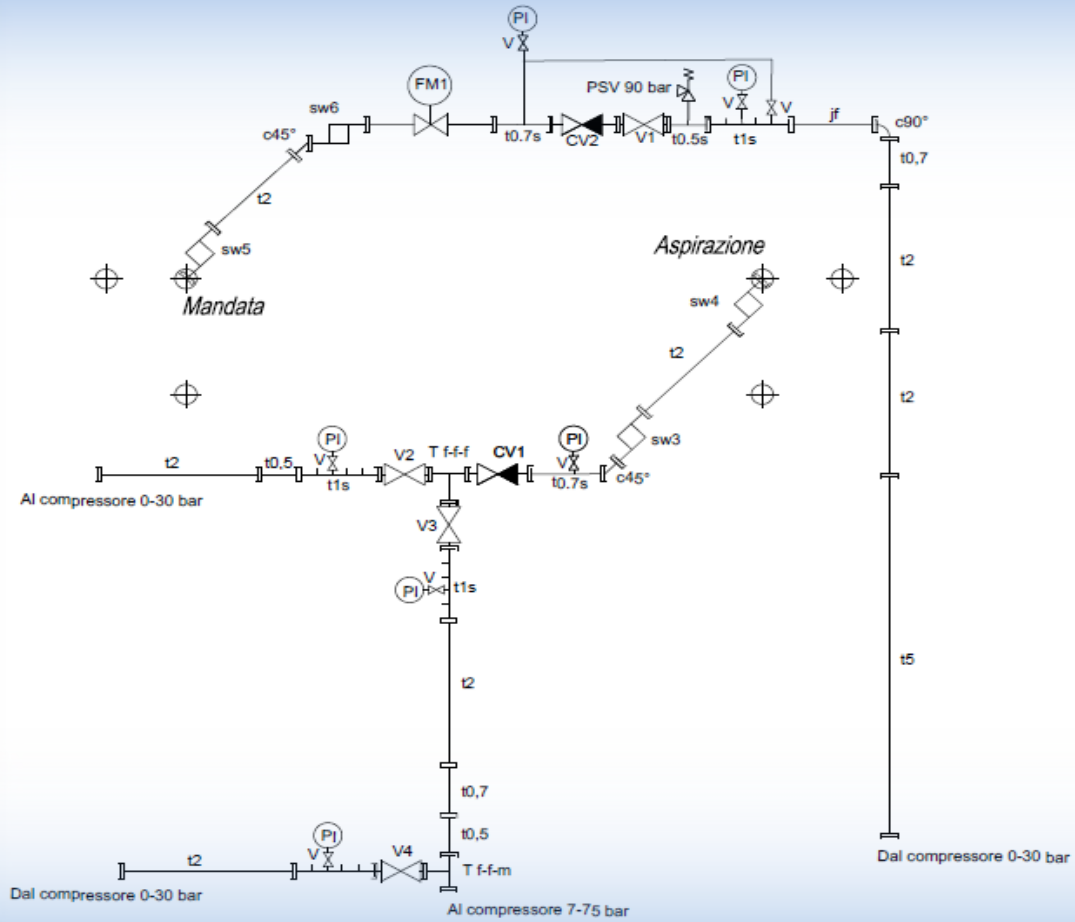
EVACUATION

P&I N°2 COMPRESSORS



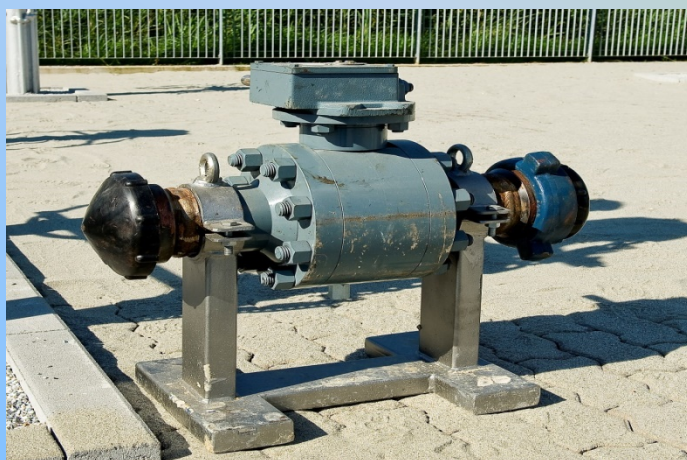
EVAQUATION

P&I N°2 COMPRESSORS



EVACUATION

VALVE and CHECK VALVE



EVACUATION

PRESSURE SAFETY VALVE 90 BAR



EVACUATION

FLOW METER



EVACUATION

SWIVEL



EVACUATION 2013



N° 9 Evacuations Methane transferred

Coriano	81.237 Nm ³ (2.869.291 ft ³)
Casalborsetti	400.000 Nm ³ (14.128.000 ft ³)
Ponte Rio	200.000 Nm ³ (7.064.000 ft ³)
Sergnano	580.000 Nm ³ (20.485.600 ft ³)
Porto S. Elpidio	155.000 Nm ³ (5.474.600 ft ³)
Cattafi	1.061.875 Nm ³ (37.505.425 ft ³)
Serro	462.000 Nm ³ (16.317.840 ft ³)
Larino	150.209 Nm ³ (5.305.382 ft ³)
Misano	177.609 Nm ³ (6.273.150 ft ³)




**Total Methane Transferred 3.267.930 Nm³
115.423.288 ft³**

Motivation for Pipeline Evacuation

2013

1 Nm ³ CH ₄ (35,32 ft ³)	~0.671 kg (1,48 pounds)
Volume saved gas – 3.267.930 m ³ (115.423.288 ft ³)	~2.192.781 kg CH ₄ (4.834.249 pounds)
Greenhouse Gas Equivalencies faktor CH ₄ to CO ₂	21
Saved CO ₂	46.048.401 kg CO₂ (101.519.226 pounds)

6,168,507ⁱ



gallons of gasoline consumed

130,522,679ⁱ




Miles driven by an average passenger vehicle

127,487ⁱ



barrels of oil consumed

58,882,411ⁱ



Pounds of coal burned

19,649ⁱ



Tons of waste sent to the landfill

EVACUATION 2014

N° 8 Evacuations

Methane transferred



Zimella

129.000 Nm³ (4.556.280 ft³)



Pressana

217.300 Nm³ (7.675.036 ft³)



San Sebastiano

343.200 Nm³ (12.121.824 ft³)



Itri

254.772 Nm³ (8.998.547 ft³)



Furci

811.392 Nm³ (28.658.365 ft³)



Sergnano

143.000 Nm³ (5.050.760 ft³)



Potelle

517.447 Nm³ (18.276.228 ft³)



St. Pourcain

700.000 Nm³ (24.724.000 ft³)



Total Methane Transferred

3.116.111 Nm³

110.061.040 ft³

Motivation for Pipeline Evacuation

2014

1 Nm ³ CH ₄ (35,32 ft ³)	~0.671 kg (1,48 pounds)
Volume saved gas – 3.116.111 m ³ (110.061.040 ft ³)	~2.090.911 kg CH ₄ (4.609.664 pounds)
Greenhouse Gas Equivalencies faktor CH ₄ to CO ₂	21
Saved CO ₂	43.909.131 kg CO₂ (96.802.944 pounds)

5,881,937ⁱ



gallons of gasoline consumed

124,458,988ⁱ




Miles driven by an average passenger vehicle

121,565ⁱ



barrels of oil consumed

56,146,912ⁱ



Pounds of coal burned

18,736ⁱ



Tons of waste sent to the landfill

EVACUATION 2015



N° 8 Evacuations Methane Transferred



Ronco all'Adige 373.819 Nm³ (13.203.287 ft³)



Sergnano 2.043.000 Nm³ (72.158.760 ft³)



St. Pourcain 460.000 Nm³ (16.247.200 ft³)



Chagny 502.500 Nm³ (17.748.300 ft³)



Roussines 399.238 Nm³ (14.101.086 ft³)



Cerville 243.582 Nm³ (8.603.316 ft³)



St. Pourcain 696.158 Nm³ (24.588.301 ft³)



Grafendorf 444.950 Nm³ (15.715.634 ft³)



**Total Methane Transferred 5.163.247 Nm³
182.365.885 ft³**

Motivation for Pipeline Evacuation

2015

1 Nm ³ CH ₄ (35,32 ft ³)	~0.671 kg (1,48 pounds)
Volume saved gas – 5.163.247 m ³ (182.365.885 ft ³)	~3.464.539 kg CH ₄ (7.637.992 pounds)
Greenhouse Gas Equivalencies faktor CH ₄ to CO ₂	21
Saved CO ₂	72.755.319 kg CO₂ (160.397.832 pounds)

9,746,087
gallons of gasoline consumed




206,222,560
Miles driven by an average passenger vehicle



201,427
barrels of oil consumed



93,032,734
Pounds of coal burned



31,044
Tons of waste sent to the landfill



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