



Automation | Valves | Measurement | Process Control

SlipStream® - Low Pressure Emissions Capture



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SOUTHWEST RESEARCH INSTITUTE

Oil & Gas Machinery Lecture Series: Emissions Reduction

The banner features a background image of an industrial facility with tall smokestacks and complex piping, illuminated by warm lights against a sunset sky.

SlipStream® - Low Pressure Emissions Capture

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Presented by: Mike Ladobruk Spartan Controls
 Greg Brown Spartan Controls



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Part 1: SlipStream® Technology and Field Results

About Spartan Controls



Emerson Impact Partner



Approximate Location of Spartan Control Panel



Burnaby | Calgary | Edmonton | Fort McMurray | Fort St. John | Grande Prairie | Midale | Prince George | Regina | Saskatoon | Whitecourt

CANADA

UNITED STATES



Part 1: SlipStream® Technology and Field Results

Challenge, Solution and Value



Challenge 	Solution 	Value 
• Increased regulation around monitoring/controlling methane (CH₄) and volatile organic compounds (VOC). (Inflation Reduction Act / U.S Clean Air Act) • Finding a clear path to positive Environment, Social and Governance (ESG) goals. • Lowering Green House Gas (GHG) emissions footprint. • Near atmospheric pressure emissions capture and utilization.	• Patented SlipStream® technology. • Redirects vented hydrocarbon emissions, including CH₄ and VOCs, to a natural gas engine to be used as a secondary fuel source.	• Return on investment through fuel savings, carbon credit offset programs, and reduced exposure to carbon tax. • Continuous monitoring and destruction of vented emissions. <u>LESS TESTING!!!</u> • No recompression requirement of vented gas. • High destruction efficiency of CH₄ and VOCs. • Engine air-fuel ratio control performance, emissions and reliability are unaffected.

Burnaby | Calgary | Edmonton | Fort McMurray | Fort St. John | Grande Prairie | Midale | Prince George | Regina | Saskatoon | Whitecourt

Part 1: SlipStream® Technology and Field Results

Applications and Vent Gas Sources



Applications

SlipStream® can be installed on most industrial natural gas carbureted 4-cycle engines. The system is not applicable on most fuel injected and all 2-cycle engines.

Vent Gas Sources

Vented emissions are found at most compression facilities involved in the production, processing and transportation of natural gas. Methane is one of the most common vented gases found at these facilities. At this time SlipStream® is not suitable for use with vent gasses containing H₂S.

Sources include:

- Instrument gas vents
- Petroleum liquid storage tanks
- Compressor crankcase and packing vents
- Dehydrators
- Pneumatic pumps

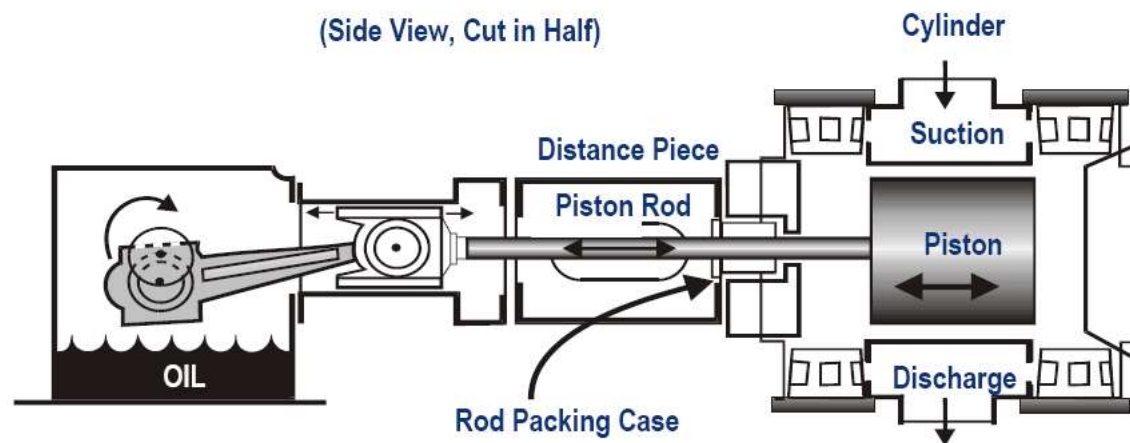


Part 1: SlipStream® Technology and Field Results

Applications and Vent Gas Sources Continued

Compressor Packing Vents

- All compressor packing vents leak – but which ones in the fleet are the worst emitters?
- Leaks gradually get larger with time.
- Regulatory requirements regarding packing vent emissions.
- Ariel compressors specify, per throw, that a packing vent leaks approximately 7 - 13 scf/hour (0.3 - 0.5 lb/hour) when new, and up to 120 - 180 scf/hour (5.0 - 7.5 lb/hour) when worn.
- Spartan has observed that typical packing vent leak rates for a 4-cylinder reciprocating compressor range from 29 - 147 scf/hour (1.2 - 6.1 lb/hour).



Part 1: SlipStream® Technology and Field Results

Benefits of Combusting Vented Gas in Engines



Fuel Replacement

- SlipStream® has the capability to supply up to 10% of the total fuel used by an engine.

Methane (CH₄) Destruction; Green House Gas Reduction

- Vented gas typically consists of 95% methane.

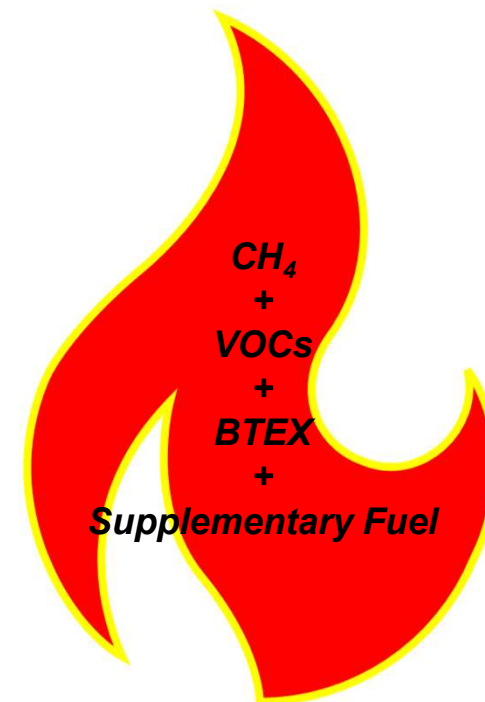
Volatile Organic Compounds (VOC) Destruction

- > 99% destruction.

Benzene, Toluene, Ethylbenzene and Xylene (BTEX) Destruction

- > 99% destruction.

Odour Elimination!



Part 1: SlipStream® Technology and Field Results

Results and Value



Typical results shown are averaged from over 60 SlipStream® sites.

Vent Source	Average Flow [lb/hr]	Estimated Average Flow [scfm]	Methane [%]	CO ₂ (e) [ton/hr]	CO ₂ (e) [ton/y]	Car-year Equivalent*
Instrument Gas	17.9	7.2	95	0.18	1512	274
Compressor Packing	6.0	2.4	95	0.06	504	91
Liquids Tank	16.1	6.5	30 to 50%	0.07	578	105

*1 Car-year is equivalent to 5.5 tons of CO₂(e)

Totals**

Annual Fuel Replacement	CO ₂ (e) [ton]	Car-year Equivalent*
> \$335,000	> 83,335	> 15,120

Value

Vent Source	Annual fuel replacement	Annual CO ₂ (e) Credits	Annual Total
Instrument Gas	\$8,671	\$68,580	\$77,251
Compressor Packing	\$2,890	\$22,857	\$25,747
Liquids Tank	\$7,865	\$26,193	\$34,058

Fuel Value = \$2.23/MMBTU

CO₂(e) = \$45.00/ton

**Assuming 95% uptime and 90% CH₄ content in SlipStream® fuel

Part 1: SlipStream® Technology and Field Results

SlipStream® Technology Overview

- Can utilize multiple vent sources.
- No vent gas compression required.
- Measures vent gas flow and records totals and averages.
- Can provide up to 10% of total engine fuel required.
- Minimal back pressure on vent gas source(s).
- No impact on engine reliability and emissions.
- Multiple process hazard reviews completed.



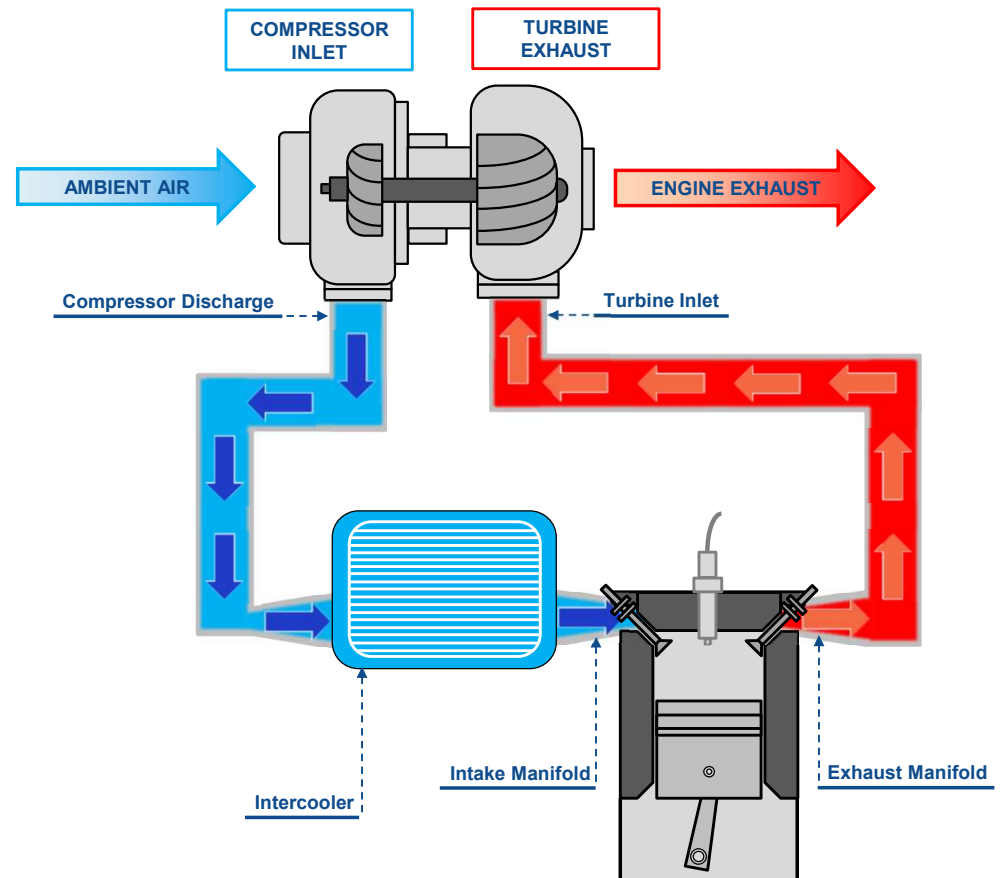
Get a Free Boost!

Part 1: SlipStream® Technology and Field Results

SlipStream® Technology Overview Continued

Concept Overview: Turbo Chargers and 4-Stroke Engines

- Intake
- Compression
- Combustion
- Exhaust

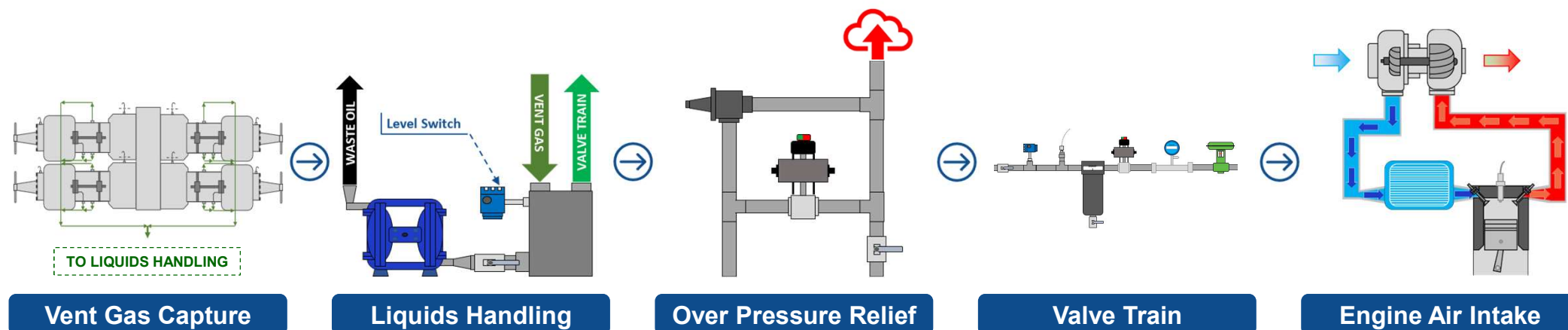


Part 1: SlipStream® Technology and Field Results

SlipStream® Technology Overview Continued

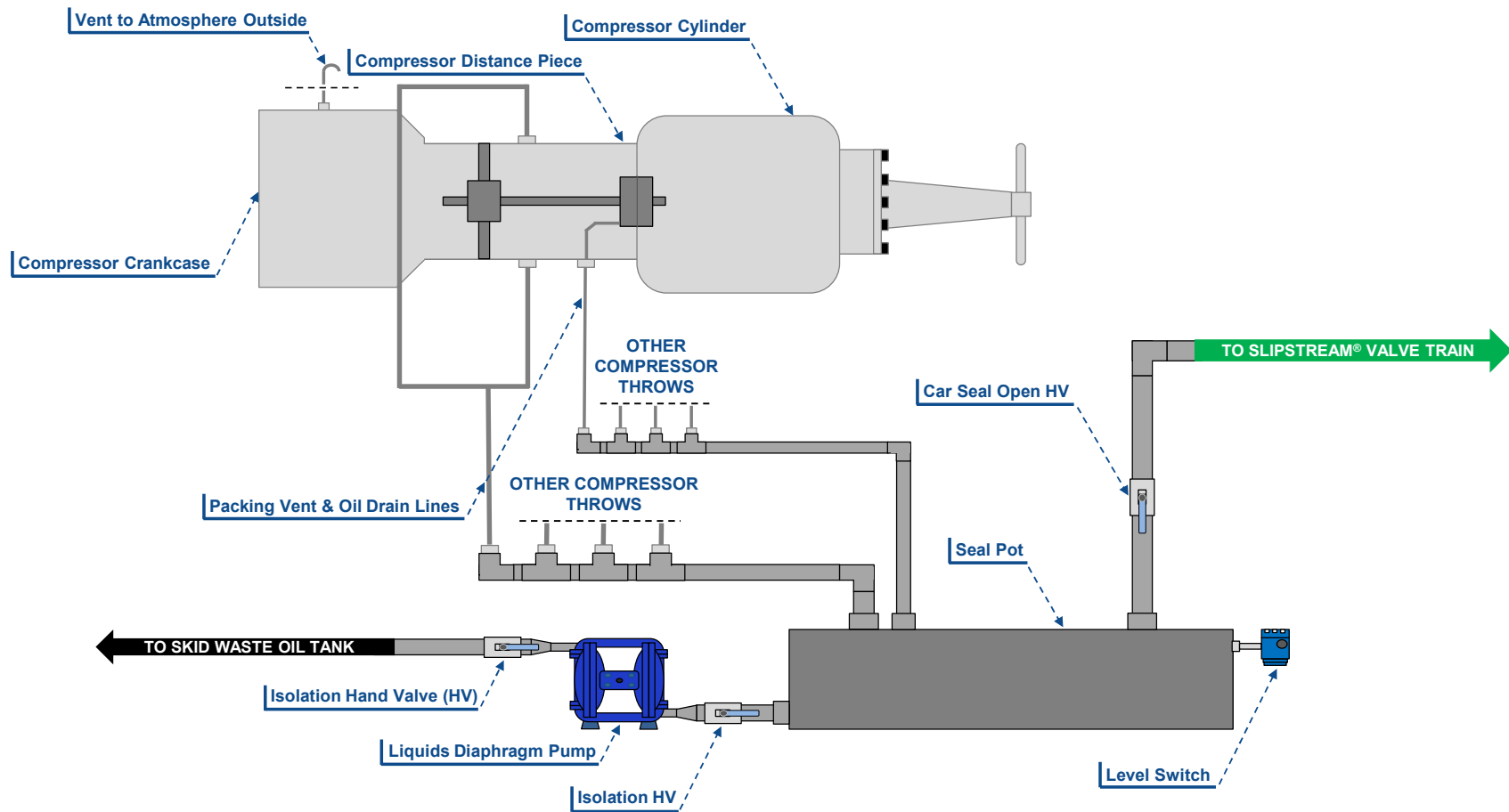


Vent Gas Capture	Liquids Handling	Over Pressure Relief	Valve Train	Engine Air Intake
Captures vent gasses from hydrocarbon sources and directs them to the liquids handling system.	Captured vent gasses are directed through a vessel where liquid dropout occurs. A level switch controls liquids pump out.	Provides over pressure protection for the vent source and SlipStream® valve train.	Monitors and controls the delivery of vent gas to the engine based off of vent gas pressure and flow rate.	Vent gas delivered to the low pressure side of the engine air intake allowing for the entrainment of near atmospheric pressure vent gas.



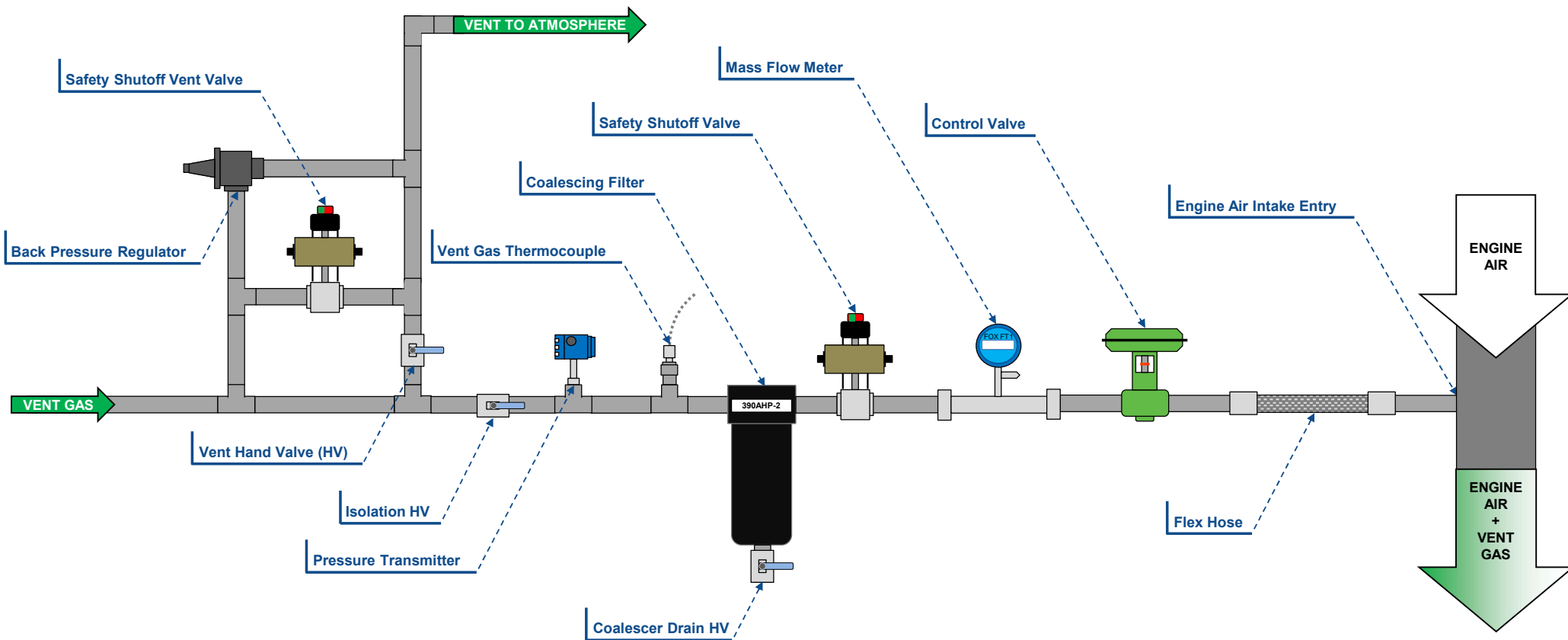
Part 1: SlipStream® Technology and Field Results

SlipStream® Technology Overview Continued



Part 1: SlipStream® Technology and Field Results

SlipStream® Technology Overview Continued



Part 1: SlipStream® Technology and Field Results

SlipStream® Design and Safety



STARTING / RUNNING

- No change to normal engine starting procedure
- Valves remain closed until SlipStream® Permissives are met:
 - Engine Speed and Load
 - SlipStream® Pressure
 - PLC and Engine Communications
 - Air-Fuel Ratio Control Status
- Extended purge suggested



Part 1: SlipStream® Technology and Field Results

SlipStream® Design and Safety



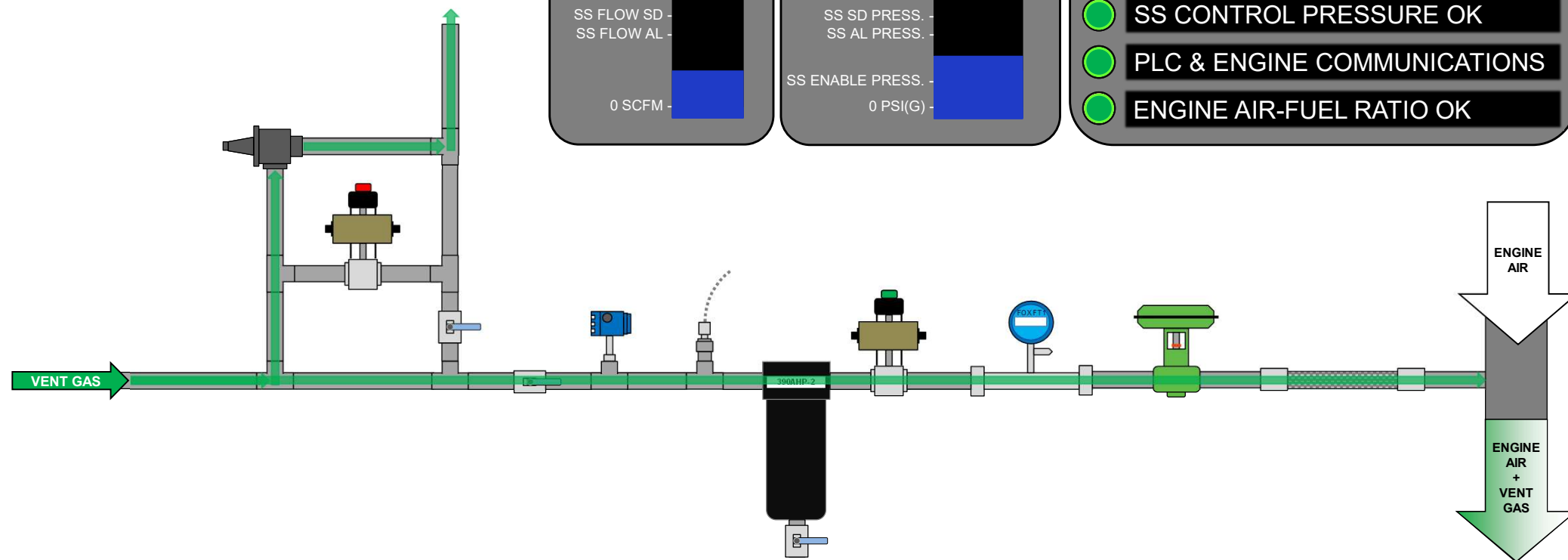
SLIPSTREAM® STATUS
SLIPSTREAM ACTIVE

ENGINE SPEED
LOADED

SLIPSTREAM® FLOW
SS FLOW SD -
SS FLOW AL -
0 SCFM

SLIPSTREAM® PRESSURE
SS SD PRESS. -
SS AL PRESS. -
SS ENABLE PRESS. -
0 PSI(G)

- SS READY TO START (SD CLEAR)
- ENGINE SPEED & LOAD
- SS CONTROL PRESSURE OK
- PLC & ENGINE COMMUNICATIONS
- ENGINE AIR-FUEL RATIO OK



Part 1: SlipStream® Technology and Field Results

SlipStream® Design and Safety



STOPPING

- No change to engine stopping procedure
- Control valve ramps closed when permissives are not met
- Once the control valve closes the shutoff valve is closed
- If speed < idle speed – 25 rpm valves close immediately

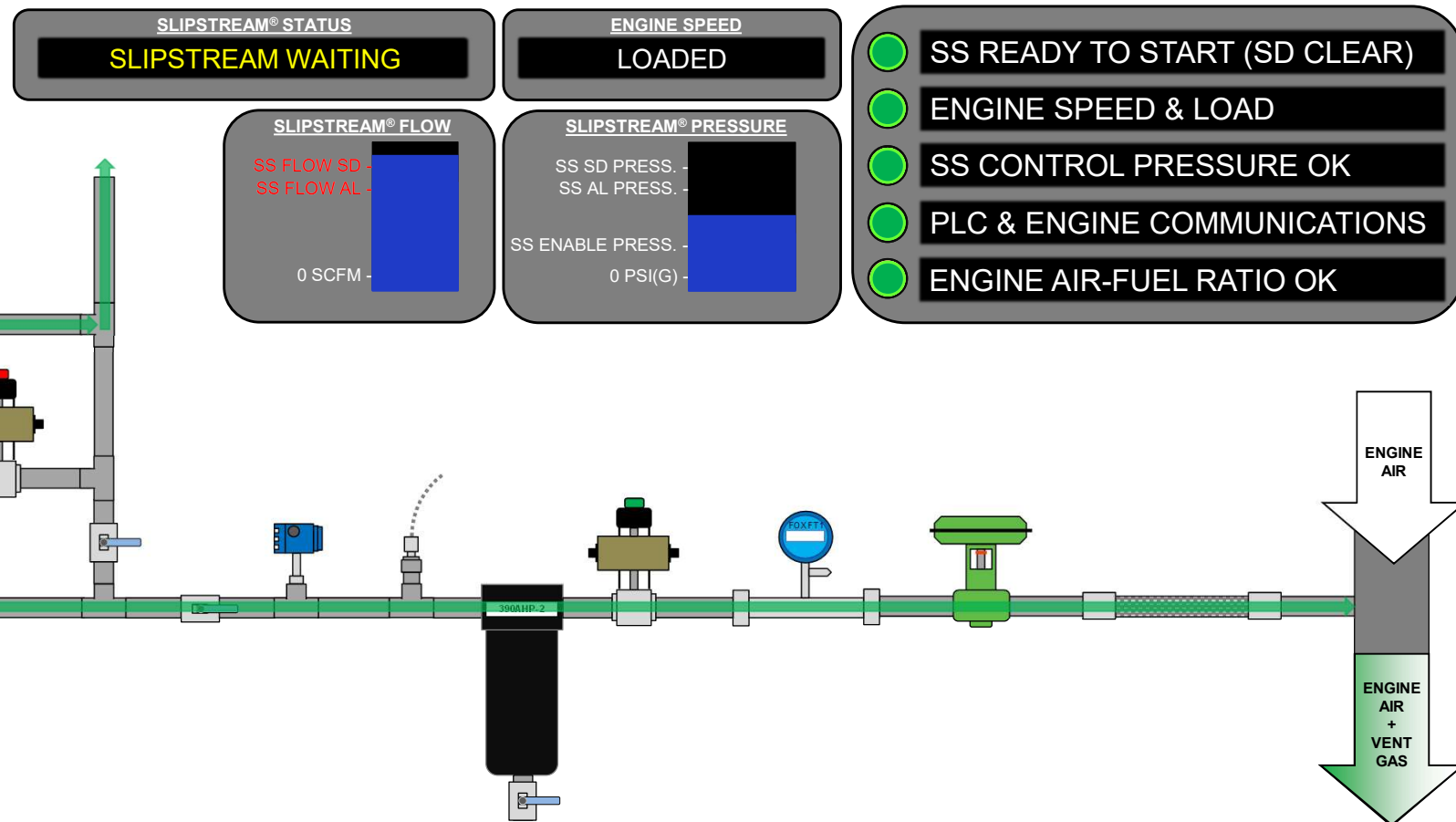
SLIPSTREAM® ALARMS AND SHUTDOWNS

- Specific to the SlipStream® system (SSD)
- Do not affect normal operation of the unit
- Indication only / soft shutdown / hard shutdown
- Current and historic alarm logs



Part 1: SlipStream® Technology and Field Results

SlipStream® Design and Safety



Part 1: SlipStream® Technology and Field Results

SlipStream® Design and Safety



▪ Flow Control

- SlipStream® limits fuel supplied to 10% of total engine fuel flow.
- 110% flow override and high flow shutdown.

▪ LEL in Engine Air Intake

- Typical SlipStream® LEL concentrations are less than 20-25%, at 10% of total engine fuel flow.
- Draw through natural gas engines operate under more extreme LEL conditions.



▪ Over Pressure Relief

- Relief pressures typically set to 0.5 – 1.0 psi.

▪ Other

- Temperature Monitoring
- Cylinder Misfire Detection



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join the conversation

