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Reducing Methane and VOC Emissions

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Why Reduce Methane and VOC Emissions?

- VOCs are a precursor to local ozone
  - Regulated
- Methane is a potent green-house gas
  - 21 times that of CO_2
- VOCs may contain BTEXs which are carcinogenic
- Methane and VOC venting is a loss
  - Energy
  - Economic

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Vented Gases – Destroying and/or Using

- **Burning gas in flares**
  - Needs a pilot flame or automatic ignition
  - Produces no useful energy
  - Restricted in some jurisdictions

- **Recompression (VRU)**
  - Needs specialized equipment
  - Costly for small releases

- **Addition to engine fuel (SlipStream® technology)**
  - No gas compression required
  - Displaces engine fuel
  - High methane and VOC destruction ratio
  - Can deal with variable releases
  - Measures and records vented amounts

SlipStream® Technology†

- **No pressurization or recompression required**
  - Vent gases pass through a valve train and specially designed low-loss demister
  - Vented gas enters intake air after the engine air filter
  - Minimal increase in vent system pressure (< 0.2 psig)
- **Accommodates rapid flow changes**
  - Controller makes adjustments
  - Controller prevents excessively high flows
- **High VOC and methane destruction factor**

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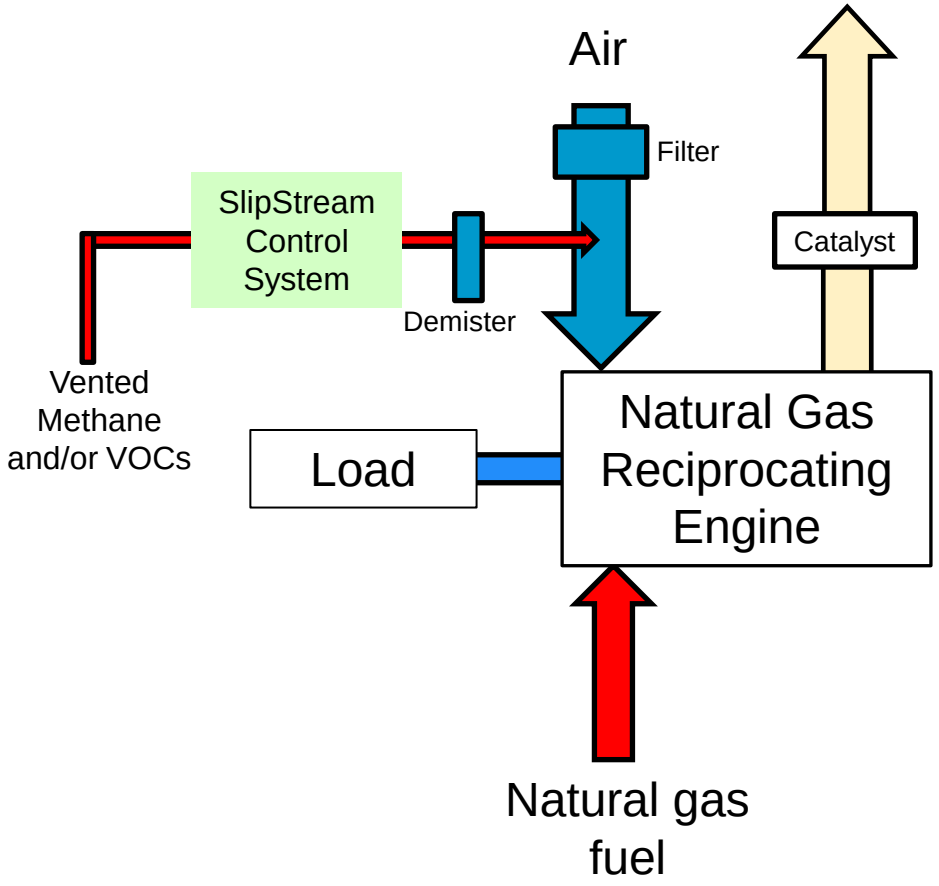
† Patented; other patents pending

Efficiency of Destruction

- An internal combustion engine is very efficient in combusting fuel
- VOC destruction > 99%
- For most systems the added fuel is < 10% of engine fuel
- Advanced systems take up to 50% of engine fuel
- No catalyst fouling



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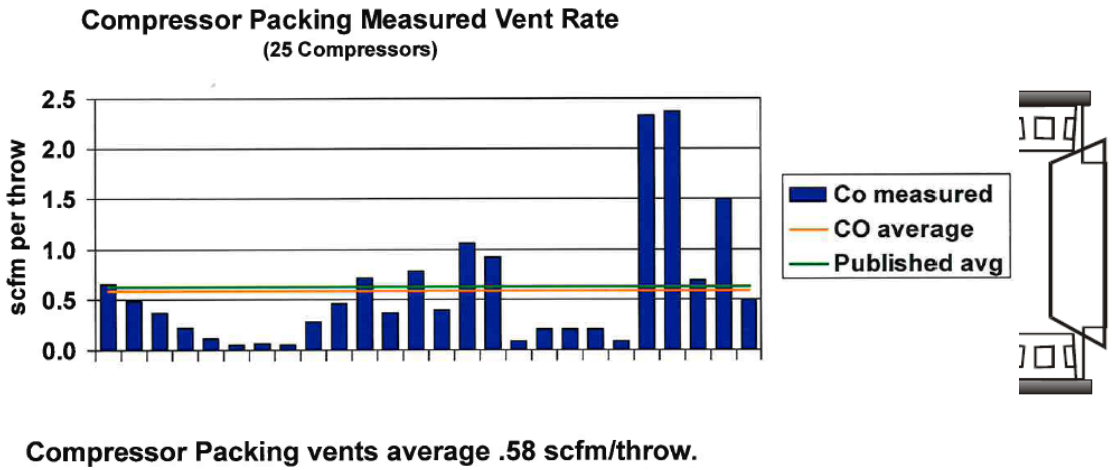
Compressor Packing Gases

- **Problem:**
  - All reciprocating compressor rod packing glands leak
  - Most leak at a low rate, but a few leak at a high rate



Compressor Packing vents average .58 scfm/throw.

Solution:

- ✓ Collect and use all of the packing vent gas – as supplemental fuel
- ✓ Monitor and record flow rate with a thermo mass flow meter
- ✓ Take corrective action when packing vent flow rate alarms at high flow

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SlipStream® SA – Installation on Compressor Pressure Packing Vent

The following slides illustrate how vented hydrocarbons/VOC's are captured in a compressor pressure packing vent application.

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How is pressure packing vented emissions captured ?

Common header in most cases vents to atmosphere

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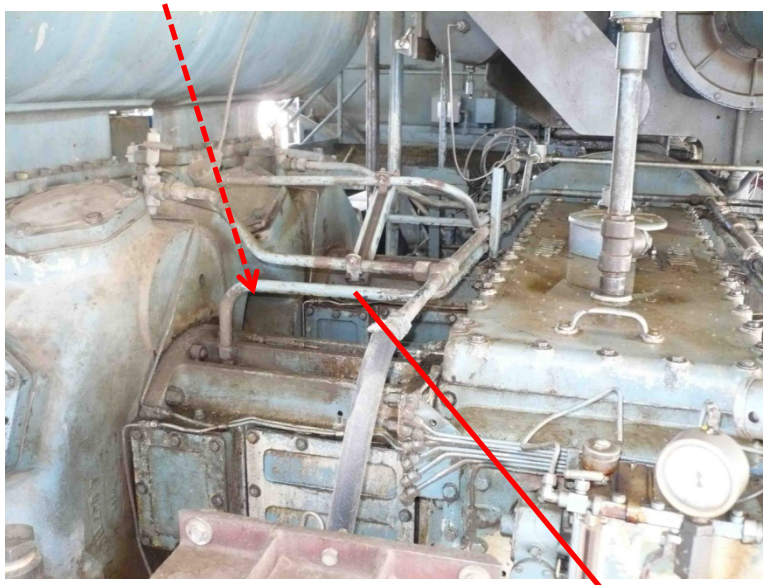
Compressor Packing Gases

Pipe from compressor cylinder packing vents



Engine air intake duct

Gas composition:

- 43% methane
- 16% ethane
- 41% VOC

SlipStream® Control System

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How are pressure packing vented emissions captured ?

Common header to
Outside of
building.
SlipStream
Manifold
Is tied in.

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SlipStream SA from Packing Vents to Air Intake

Line to Air Intake After air Filter, before Turbo

Flow rate entering air-intake line

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SlipStream Panel with additional REMonitor Features

Valve train
In background

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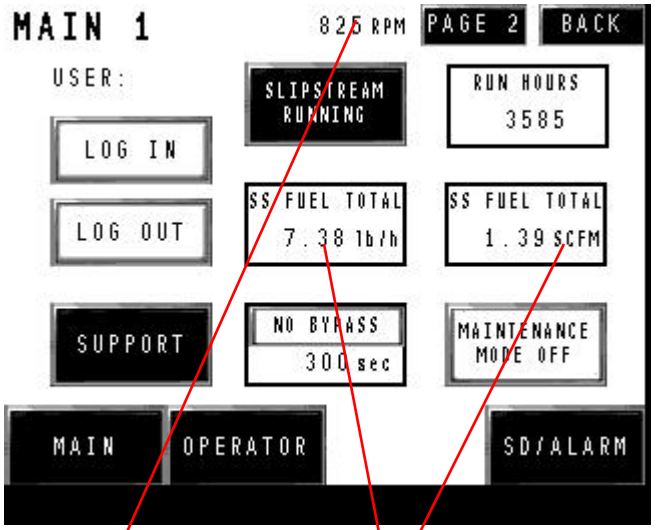
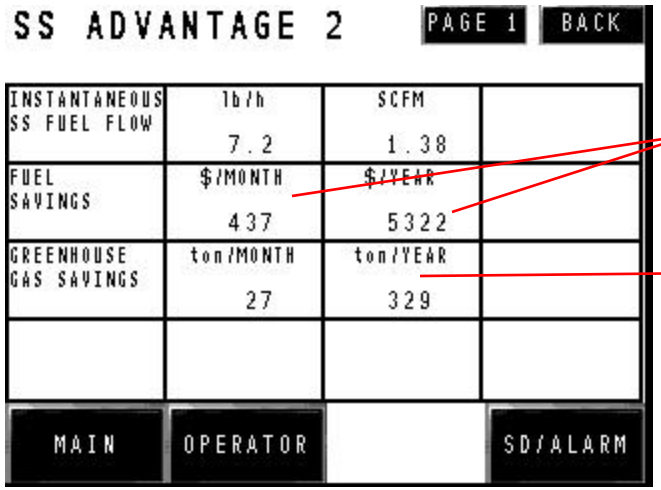
SlipStream® SA Environmental Benefits and Fuel Cost Savings



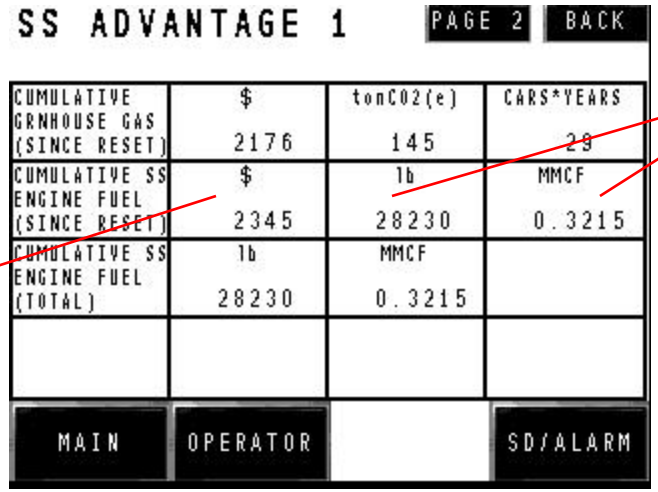
Flow rate fluctuates with RPM

Flow rate at time of snap shot



Based on $3.85/mcf and flow rate at time of snap shop

CO2(e)



Actual totals

Actual
Fuel gas savings to
Date of snap shot

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Alarm Settings and Benefits

- Flow rate is continuously measured
- A high flow rate alarm is set at 6 SCFM, (customer specified), to notify operators when pressure packing leak rate increases.

- This allows for scheduled maintenance to be performed, possibly at time when other maintenance tasks are due. Unscheduled down time, and lost production is avoided.

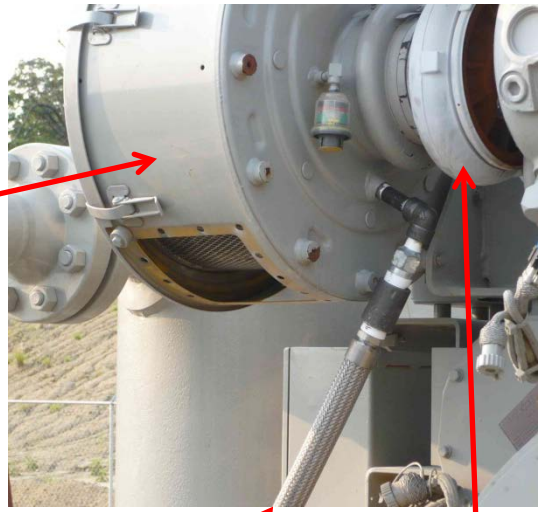
- Vented hydrocarbons are eliminated and compliance is meet at all times.
- The vented hydrocarbons are used as supplemental fuel. The entire time the pressure packing is leaking, SlipStream is capturing and burning in the engine as fuel.

Gas Boil-off from Liquids Tanks

Liquids tanks

Boil-off gas collection pipe

Engine air intake and filter



Turbo-charger

SlipStream ® Control System

Gas from SlipStream control system added to engine intake air – max is < 10% of total engine fuel

Boil-off gas has high VOC content

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SlipStream® SA on CAT 3516LE

SlipStream Panel

3” line to SlipStream

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Regulations

- Accepted as a VOC destruction method by many states air quality regulators
- Meets Class I Div 2 Hazardous area regulations
- Can be used as an alternative method to packing change out at regular intervals
- Accepted for green-house gas credits (Canada)

Re-Cap

- SlipStream®:
  - Efficiently destroys vented methane and VOCs
  - Deals with various vent sources
  - Provides continuous and accurate measurement of vented flow
  - No need for recompression
  - Reduces engine fuel needs
  - Is field proven for many different sources
  - Is safe and reliable

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Thank You

QUESTIONS ?

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