

Proposed Gas STAR Gold Partnership

Roger Fernandez
Natural Gas STAR Program
U.S. EPA

August 6, 2014
Chicago, IL

Gas STAR Gold Considerations



- ▶ **Methane is a potent greenhouse gas and a clean energy source**
 - ▶ Reducing methane emissions has important cross-cutting benefits including reducing climate impacts, Volatile Organic Compounds (VOCs) and hazardous air pollutants (HAPs) and thereby improving local air quality, improving industrial efficiency/safety, increasing domestic energy supply, and generating revenue.

- ▶ **Oil and gas sector is a key focus of the President's 2013 Climate Action Plan and the Strategy to Reduce Methane Emissions (March 2014)**
 - ▶ Interagency methane strategy recognizes oil and gas as a key sector and highlights the opportunity to bolster the Natural Gas STAR Program

- ▶ **Significant and diverse stakeholder interest in oil and gas-sector methane emissions**

- ▶ **Opportunity to leverage existing frameworks**
 - ▶ EPA NSPS and State regulations have established control technologies and practices that could be used in a voluntary context to address sources at existing facilities.
 - ▶ Greenhouse Gas Reporting Program facility-level data is available for verification/tracking purposes.

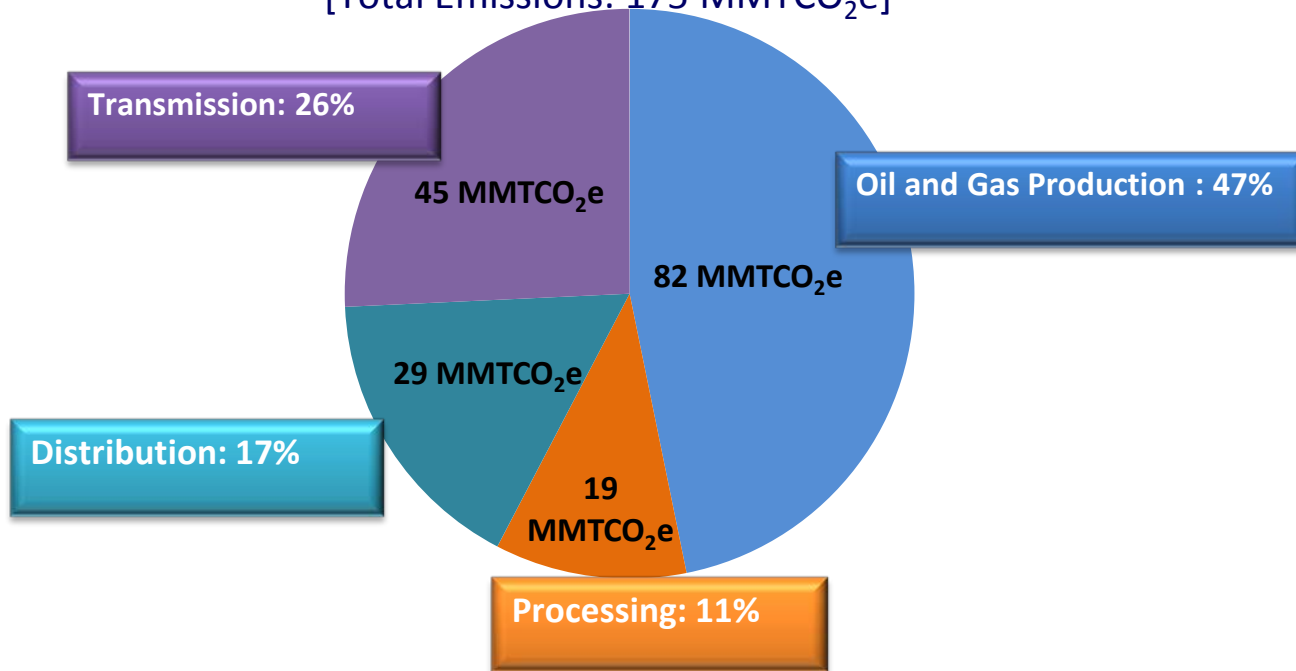
- ▶ **Mature program**
 - ▶ Gas STAR Program began in 1993 and has never been significantly updated. Program enhancement can provide new opportunities for partners and EPA.

Opportunities for Future Action

- ▶ While progress has been made, opportunity remains to further reduce methane emissions.
- ▶ Viable low-cost technologies and practices exist today. Remaining low-cost abatement potential estimated at over 60 million metric tons of CO₂e.
- ▶ Opportunity for greater participation beyond current Program flexible framework.

Projected US Methane Emissions from Oil and Gas Industries in 2015*

[Total Emissions: 175 MMTCO₂e]



* Post 2012 New Source Performance Standards

Source: Global Non-CO₂ Mitigation Report and Global Non-CO₂ emissions and projections report

Gas STAR Gold Program Objectives



- ▶ The existing Gas STAR Program will remain in place with a primary focus on technology transfer.
- ▶ The proposed Gas STAR Gold Program creates a framework under which facilities will be recognized by EPA for implementing, at the facility level, methane reduction activities for all major methane emission sources. Major goals include:
 - ▶ Showcase the achievements of U.S. oil and gas operations at the facility-level by offering a standard set of best protocols to be implemented at the facility-level.
 - ▶ Achieve greater methane emissions reductions across the entire value chain (production through distribution) by encouraging additional facilities to achieve Gold- level performance.
 - ▶ Create a verifiable and transparent mechanism to demonstrate achievements and acknowledge high performers.
 - ▶ Complement existing regulatory requirements - such as applying control techniques required for new sources under NSPS Subpart OOOO to existing facilities.
 - ▶ Publically recognize participating companies' emission reduction.

Gas STAR Gold Program Overview



- ▶ Under the proposed Gas STAR Gold Program, companies can achieve Gold status at a facility by implementing all specified reduction protocols for all applicable methane sources at the facility level.

- ▶ **To achieve Gold status, companies would:**
 - ▶ **Submit a Letter of Intent** outlining list of proposed facilities working toward Gold status.
 - ▶ Develop an **Implementation Plan** for each facility seeking Gold status.
 - ▶ **Implement all applicable Gold protocols** at a minimum of one facility.
 - ▶ **Submit an Annual Report** for each Gold status facility demonstrating achievement of all protocols and plans for maintaining facility-level Gold status.
 - ▶ Continue the process of implementing the Gold status protocols **at least one new facility** each year.

- ▶ **To achieve Platinum status, companies would:**
 - ▶ Achieve Gas STAR Gold status for a high percentage (to be specified) of their facilities. For example, when a company attains Gold status for 90% of its facilities, they would achieve Platinum recognition at the corporate level.

Benefits to the Oil and Gas Industry

- ▶ **EPA recognition of clear, comparable, verifiable and transparent** data on a facility's methane emissions performance.
 - ▶ **Facility emission data transparency** through public disclosure of all relevant data to verify Gold status.
- ▶ **EPA recognition** of facility performance.
 - ▶ EPA will publicize facility progress on our website and through workshops.
 - ▶ EPA will give facilities permission to use the EPA Gas STAR Gold logo.
 - ▶ EPA will publicly track company progress by listing Gold facilities and indicate percentage of operations that these facilities represent.
- ▶ Facility **revenue generation** through the sale of reduced methane emissions.
- ▶ Reduced **VOC and HAPs** emissions in upstream oil and gas sector.
- ▶ Increased **safety** at the facility level.
- ▶ Better **local and state** relationships.

Proposed Gold STAR Protocols



Protocol	Emission Source	Off P	On P	GB	Pc	T	S	LNG S	LNG I&E	D
1	Associated Gas	Y	Y	Y						
2	Casinghead Gas		Y							
3	Centrifugal Compressors - Wet and Dry Seals	Y	Y	Y	Y	Y	Y	Y	Y	Y
4	Compressor Blowdowns	Y	Y	Y	Y	Y	Y	Y	Y	Y
5	Compressor Starts	Y	Y	Y	Y	Y	Y	Y	Y	Y
6	Equipment Fugitives above Ground	Y	Y	Y	Y	Y	Y	Y	Y	Y
7	Flares	Y	Y	Y	Y	Y	Y	Y	Y	Y
8	Gas-driven Pneumatic Devices	Y	Y	Y	Y	Y	Y	Y	Y	Y
9	Glycol Dehydrators	Y	Y	Y	Y	Y	Y	Y	Y	
10	Hydrocarbon Storage Tanks	Y	Y	Y	Y	Y				
11	Liquids Unloading		Y							
12	Pipeline Venting and Blowdowns		Y	Y	Y	Y	Y	Y	Y	Y
13	Pipeline Inspection and Repair (including low pressure distribution and gathering lines and high pressure pipelines)		Y	Y	Y	Y	Y			Y
14	Pressure Relief Valves - System Upsets	Y	Y	Y	Y	Y	Y	Y	Y	Y
15	Reciprocating Compressors Rod Packing	Y	Y	Y	Y	Y	Y	Y	Y	Y
16	Vessel Blowdowns	Y	Y	Y	Y	Y	Y	Y	Y	Y
17	Cast Iron Distribution Pipeline and Unprotected Steel Pipeline									Y

Gold Protocol 3: Centrifugal Compressors – Wet and Dry Seals



▶ **Definition of Centrifugal Compressor**

- ▶ Raises the pressure of natural gas by means of mechanical rotating vanes or impellers.
- ▶ Uses wet or dry sealing system to prevent compressed gas escape to the atmosphere.
- ▶ Does not include rotary screw, rotary vane, or scroll compressors.

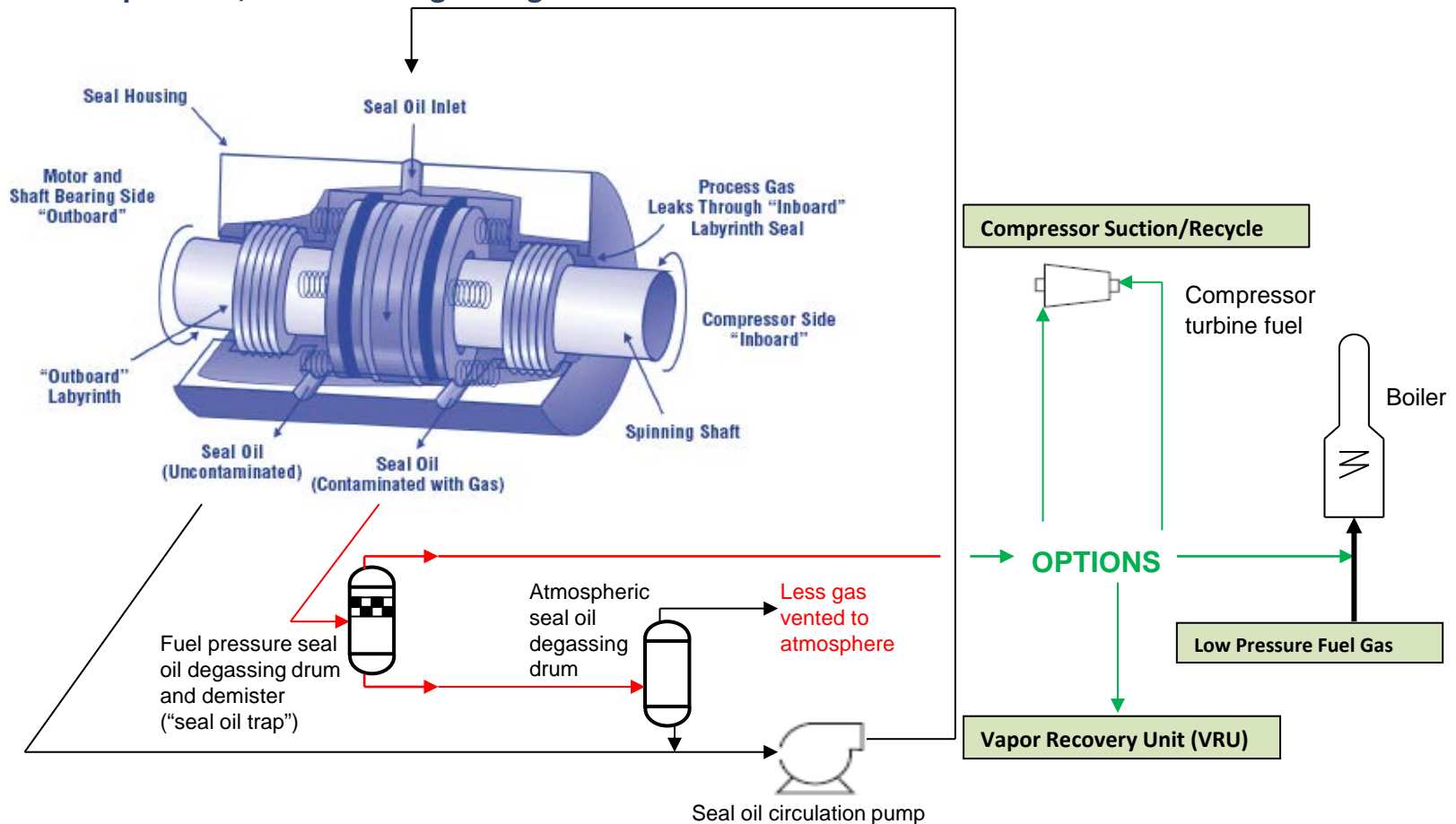
▶ **Description and Location of Emissions**

- ▶ Dry seals utilize a thin gap of high pressure gas between the rings through which little gas can leak. Gas is released to the atmosphere where the compressor shaft exits the compressor case.
- ▶ Wet seals use oil under pressure to prevent gas from escaping along a compressor shaft. Seal oil is degassed to the atmosphere.

▶ **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 3: Centrifugal Compressors – Wet and Dry Seals

- ▶ **Dry Seal Systems:** It is proposed that operators maintain venting emissions from dry seals within 10% of the *initial design vent rate*.
 - ▶ Obtain *initial design vent rate* from the seal manufacturer or measure *initial design vent rate* when the compressor commences operation.
- ▶ **Wet Seal Systems:** It is proposed that operators achieve 95% recovery of uncontrolled methane emissions for all compressors, without using flaring.



Gold Protocol 4: Compressor Blowdowns



▶ Definition of Compressor Blowdown

- ▶ When a compressor is taken offline, the high pressure gas within the compressor is vented to the atmosphere.

▶ Description and Location of Emissions

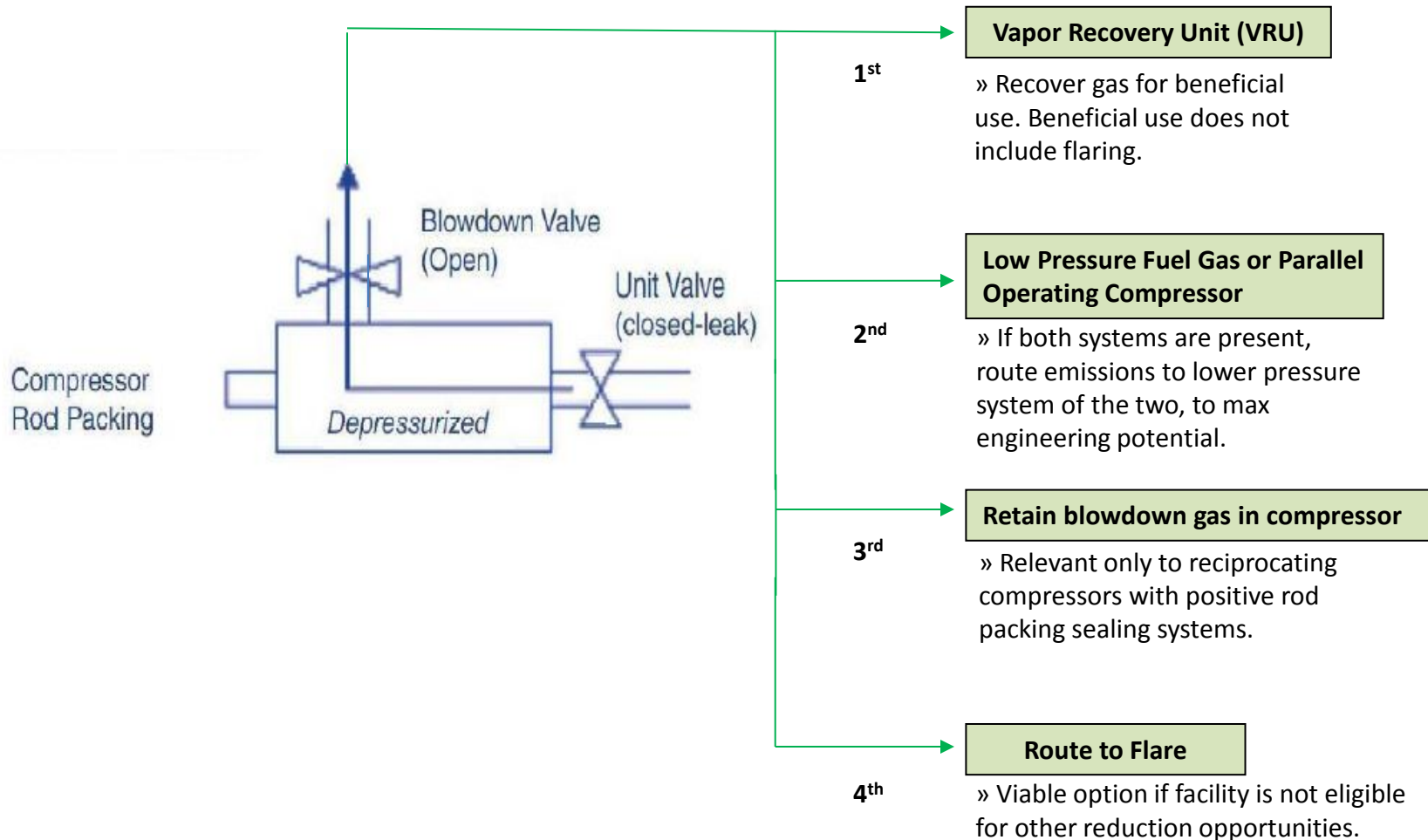
- ▶ Emptying gas from compressor and connected piping and vessels between closed isolation valves and venting it to the atmosphere.

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 4: Compressor Blowdowns

- ▶ Protocol application hierarchy for a reciprocating compressor are displayed below.

PROTOCOL HIERARCHY



Gold Protocol 5: Compressor Starts



▶ Definition of Compressor Start

- ▶ Compressors driven by internal combustion engines are often equipped with gas expansion starters.
- ▶ Pressurized gas expands across the starter turbine that initiates engine startup.

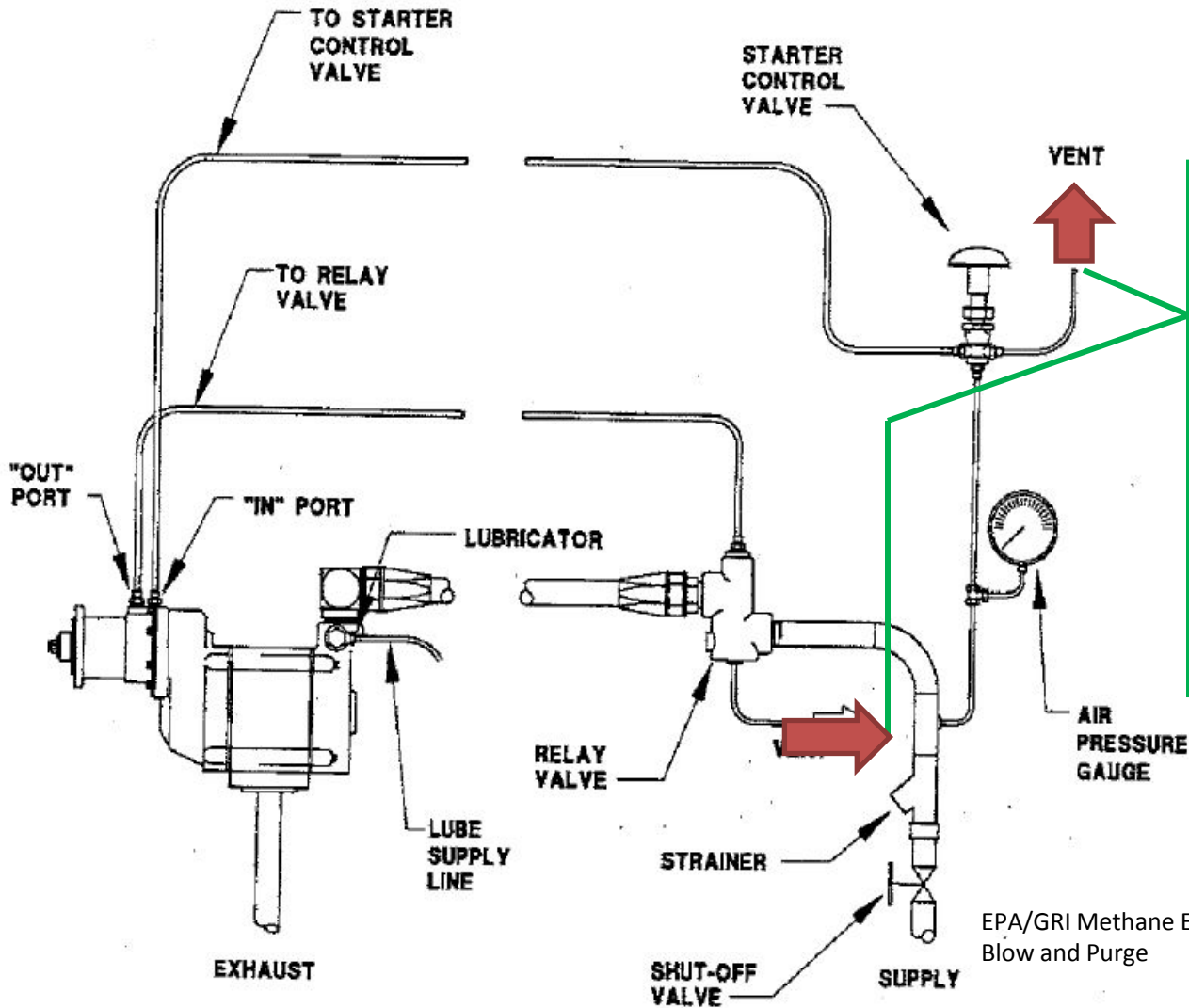
▶ Description and Location of Emissions

- ▶ The pressurized starter gas used to drive the turbine motor starter is vented to the atmosphere.

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 5: Compressor Starts

► Protocol hierarchy is outlined in the gas starter schematic below.



Protocol Hierarchy

1st - Replace gas starters.

» Replacement options include instrument air, electric, or nitrogen

2nd - Route vent gas to gas capture system for beneficial use.

» Beneficial use does not include flaring.

3rd - Route starter vent gas to flare.

» Applicable to sites with existing flares or flares being installed for another protocol.

EPA/GRI Methane Emissions from the Natural Gas Industry Volume 7: Blow and Purge

Gold Protocol 10: Storage Tanks



▶ Definition of a Storage Tank

- ▶ Vessel designed to contain an accumulation of crude oil, condensate, intermediate hydrocarbon liquids, or produced water that is constructed of non-earthen materials.

▶ Description and Location of Emissions

- ▶ Sources of emissions include tank vents, designed tank openings, and any tank defects .
- ▶ Increased flashing emissions due to leaking or stuck open gas/oil separator liquid level control valves as well as vortexing when separator liquid level is low (and no vortex breaker is installed).

▶ Sector Eligibility: On/Off P GB Pc T

▶ Emission Reduction Hierarchy:

1. Route Emissions to Gas Capture
2. Route Emissions to Flare

Tanks with average annual hydrocarbon emissions ≥ 60 g/h of natural gas are eligible for reduction opportunities.

Gold Protocol 10: Storage Tanks

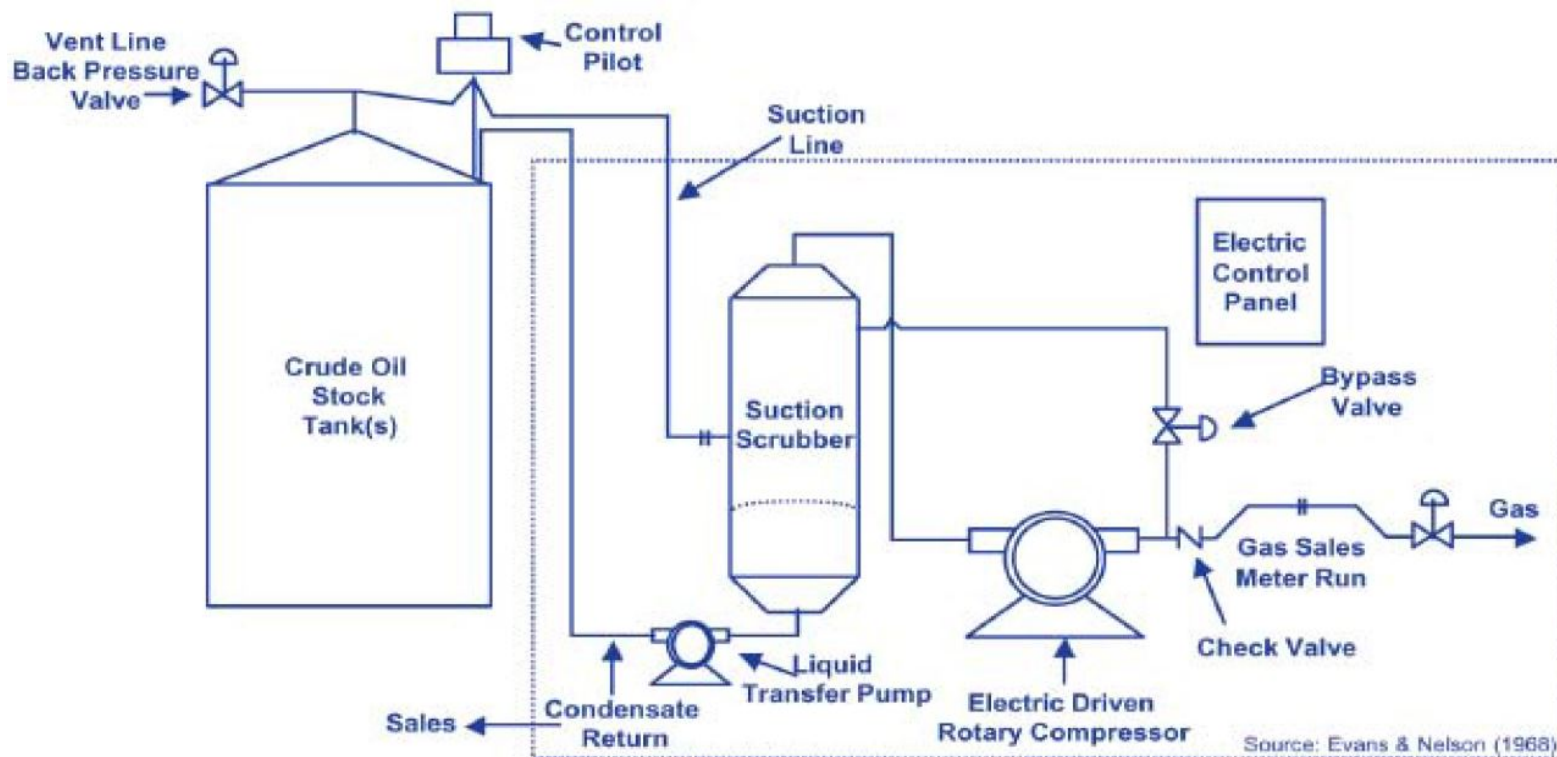
PROTOCOL HIERARCHY

1st - Vapor Recovery Unit (VRU)

» Recover gas from storage tanks for beneficial use. Beneficial use does not include flaring.

2nd - Route to Flare

» Viable opportunity for sites w/o gathering or sales line(s) in place or existing gas capture system(s)



Gold Protocol 12: Pipeline Venting and Blowdowns

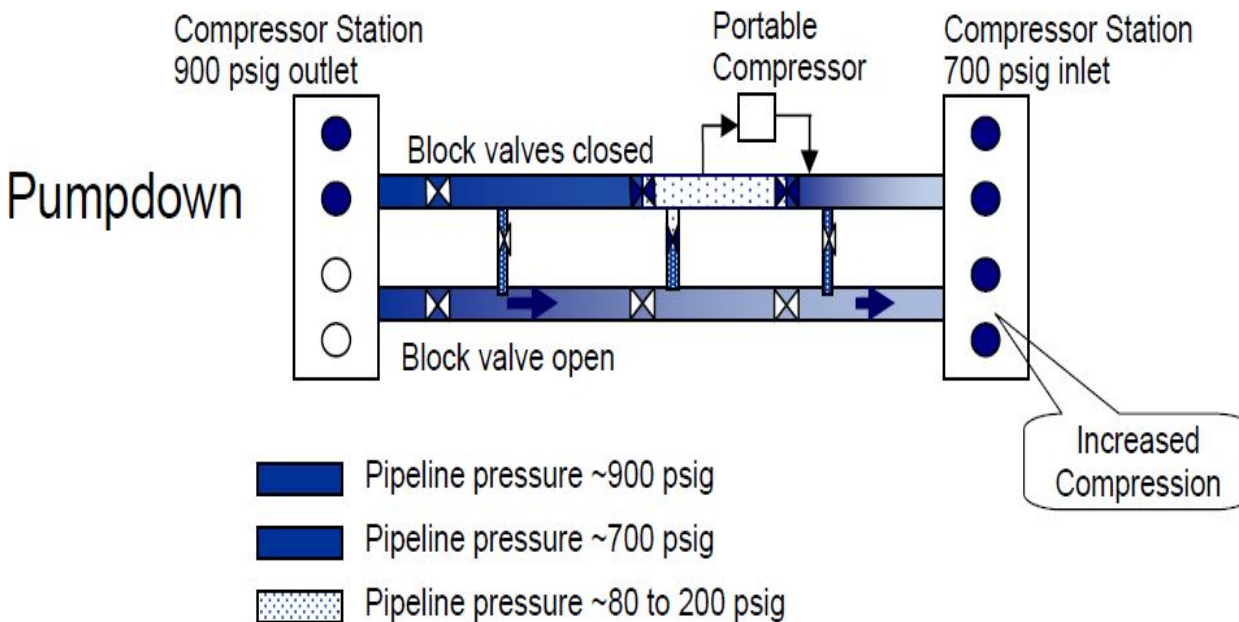


- **Definition of pipeline venting**
 - Planned or unplanned release of gas to the atmosphere from pipelines to reduce line pressure.
- **Description and Location of Emissions**
 - Vented sections of pipe to ensure safe working conditions during planned repairs and maintenance, installation of new parallel pipe, or an emergency repair.
 - Done by blocking the smallest possible linear section of the pipeline and depressurizing it through venting natural gas to the atmosphere.
- **Sector Eligibility:** On P GB Pc T S LNG S LNG I&E D

Gold Protocol 12: Pipeline Venting and Blowdowns

- ▶ An image of portable compression to reduce pipeline blowdown emissions is shown below.

REDUCTION HIERARCHY



1st - Use inline compression to max engineering potential

» Applicable if facility has ownership or operatorship of the compressor downstream from pipeline venting and blowdown operations.

» Recover gas amount comparable or higher to fuel used during inline compression (CO₂ eq. basis).



2nd - Use portable compression

» Breakeven or higher value of gas should be recovered in comparison to cost of using portable compression.

Gold Protocol 13: Pipeline Inspection and Repair



- **Definition of pipeline**
 - Pipeline consists of above and below ground pipe and associated connectors.
 - Used to form infrastructure to transport natural gas within a facility boundaries.
- **Description and Location of Emissions**
 - Leaks are considered to be any source, such as small openings, gaps, and cracks in a pipeline and/or associated component connectors, allowing an unintentional natural gas release.
- **Sector Eligibility:** On P GB Pc T S LNG S LNG I&E D
- **Gold Protocol**
 - 1) Conduct comprehensive leak detection annually and retain records; and
 - 2) Perform leak repair for leaks ≥ 60 grams/hour

Gold Protocol 15: Reciprocating Compressor Rod Packing



▶ Definition of Reciprocating Compressor Rod Packing

- ▶ A series of flexible rings in machined metal cups that fit around the reciprocating compressor piston rod.
- ▶ The rings create a seal, limiting the amount of compressed natural gas that escapes to the atmosphere.

▶ Description and Location of Emissions

- ▶ Emissions from packing systems originate from mainly four components; the nose gasket, between the packing cups, around the rings and between the rings and the shaft.
- ▶ A set of two to three flexible, segmented rings in a packing cup are pressed against the rod to and oscillate back and forth in the cup with the rod's reciprocal movement, sealing against the cup faces to prevent leakage around the rings, but a little gas slips around the rings with each stroke.
- ▶ Rod packing emits a small amount of gas into the distance piece and/or through a vent line connected to the packing box.

▶ Emission Reduction Hierarchy

- 1) Gas Capture
- 2) Economical Rod Packing Replacement
- 3) Route rod packing emissions to flare

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gas STAR Gold Program – Request for Feedback



EPA seeks feedback from stakeholders regarding all aspects of this proposed program, including:

- ▶ For gas transmission, please provide feedback on performance goals for specific sources, especially regarding pipeline leak detection and inspection?
- ▶ For gas transmission, are there any specific incentive programs that Federal or the States could leverage in order to promote further methane emissions reductions in this sector?
- ▶ How can EPA best engage FERC and other regulatory bodies to further methane emissions mitigation in the gas transmission sector?
- ▶ How, and how frequently, should protocols or other program elements be updated to reflect evolving state of the art?
- ▶ Are appropriate emissions sources targeted in these protocols? Should EPA consider any additional emissions sources and/or associated protocols?
- ▶ Are appropriate best management practices, technologies and/or emission mitigation targets used in the protocols?

Contact us!



We look forward to working with you and hope that you will consider joining the Gas STAR Gold Program!

For more information about Gas STAR Gold:
www.epa.gov/gasstar/gold/index.html

We welcome your feedback!
www.epa.gov/gasstar/contactus.html

Roger Fernandez
Fernandez.roger@epa.gov
(202) 343-9386

Detailed Protocol Appendix

Gold Protocol 1: Associated Gas



▶ Definition of Associated Gas

- ▶ Natural gas produced during the production of crude oil or condensate from an oil well.
- ▶ Does not include natural gas produced during completion flow-back or emitted from equipment leaks. These sources are captured under another protocol.

▶ Description and Location of Emissions

- ▶ Associated gas venting or flaring to the atmosphere after gas-liquid separation phase.
- ▶ Facilities without existing infrastructure to transport produced gas to useful outlet.
- ▶ Does not include emissions produced from wildcat/delineation wells or as a result of system failures/emergencies.

▶ Sector Eligibility: On/Off P GB

▶ It is proposed that operators recover all associated gas for beneficial use at a facility

- ▶ Beneficial use does not include flaring.
- ▶ Potential options for use of any recovered gas include natural gas reinjection, electricity generation, natural gas liquefaction, and gas capture for sale.

Gold Protocol 2: Casinghead Gas



- ▶ **Definition of Casinghead gas**

- ▶ Gas that collects in the annular space between the casing and tubing in oil and gas wells.

- ▶ **Description and Location of Emissions**

- ▶ Casinghead gas is usually vented to the atmosphere at or near the wellhead.

- ▶ **Sector Eligibility:** On P

Gold Protocol 2: Casinghead Gas



Protocol Hierarchy

1. Facilities with gas capture system.



Route emissions to recovery system for beneficial use. Beneficial use does not include flaring.

2. Facilities without gas capture system.



Install gas capture system if possible from an engineering standpoint.

3. Facilities with no flare.



Install flare if CO₂ equivalent combustion emissions from flare pilot gas \leq CO₂ equivalent casinghead gas venting emissions.

Gold Protocol 3: Centrifugal Compressors – Wet and Dry Seals



▶ **Definition of Centrifugal Compressor**

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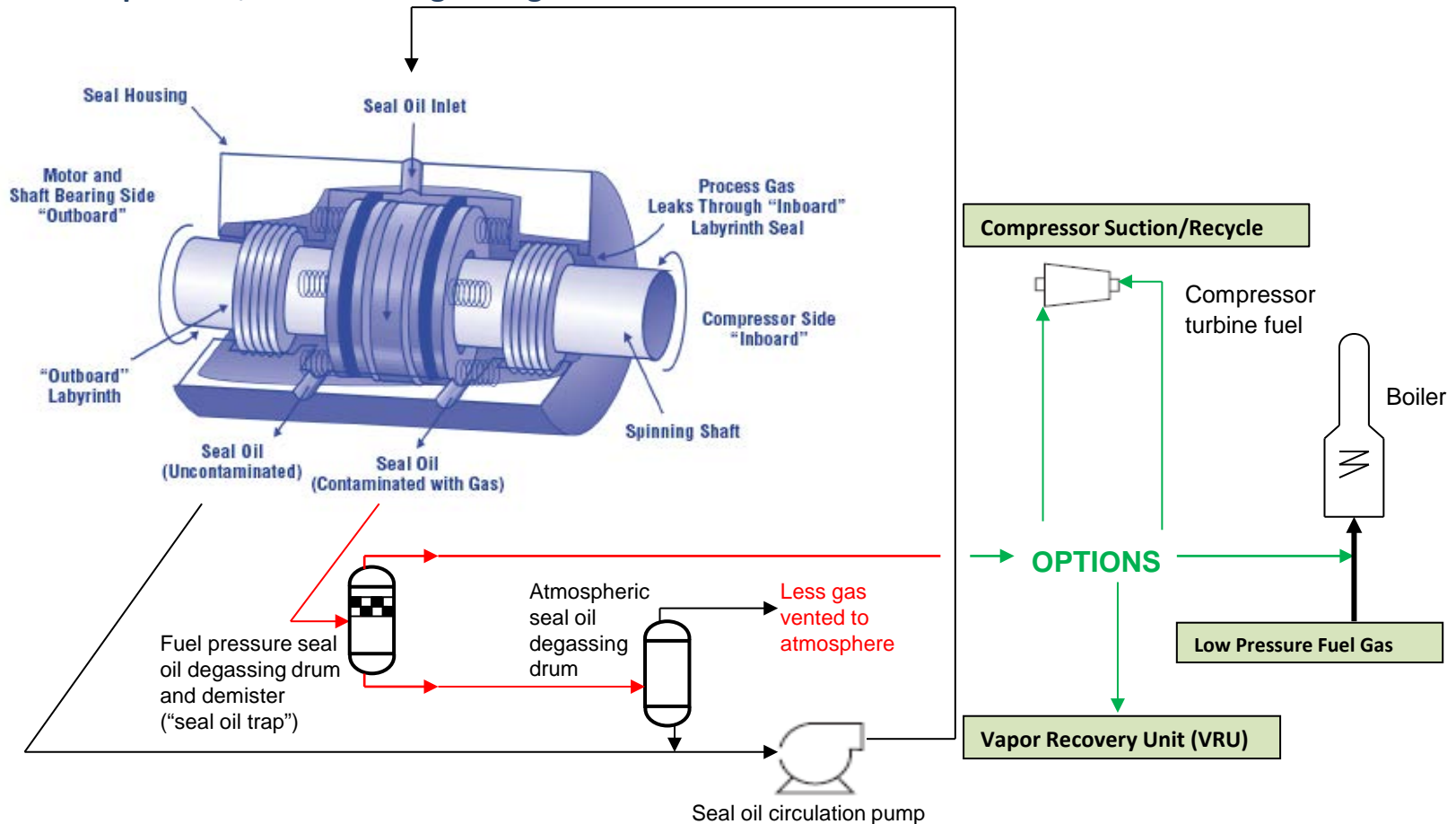
▶ **Description and Location of Emissions**

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▶ **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 3: Centrifugal Compressors – Wet and Dry Seals

- ▶ **Dry Seal Systems:** It is proposed that operators maintain venting emissions from dry seals within 10% of the *initial design vent rate*.
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Gold Protocol 4: Compressor Blowdowns



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▶ Description and Location of Emissions

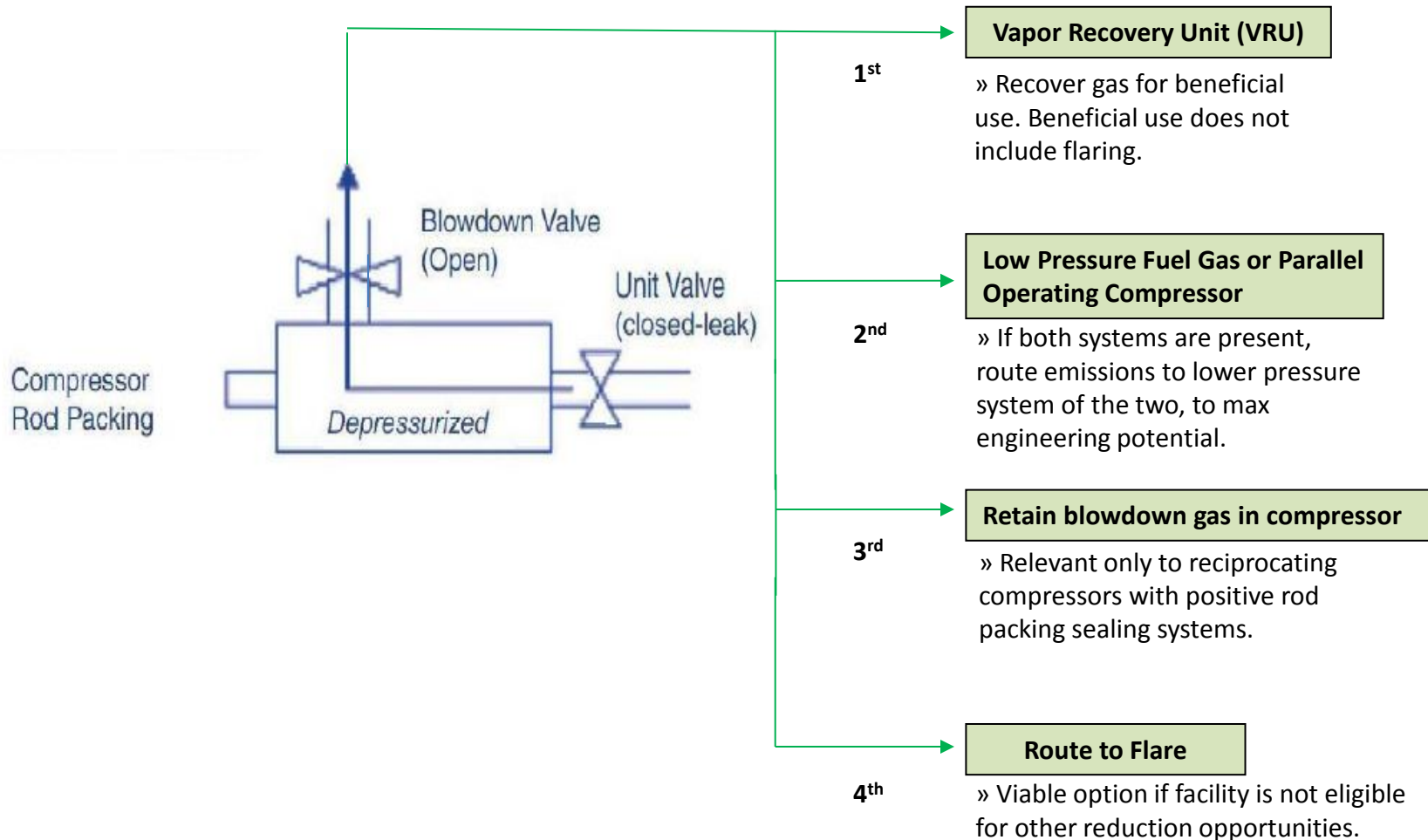
- ▶ Emptying gas from compressor and connected piping and vessels between closed isolation valves and venting it to the atmosphere.

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Gold Protocol 4: Compressor Blowdowns

- ▶ Protocol application hierarchy for a reciprocating compressor are displayed below.

PROTOCOL HIERARCHY



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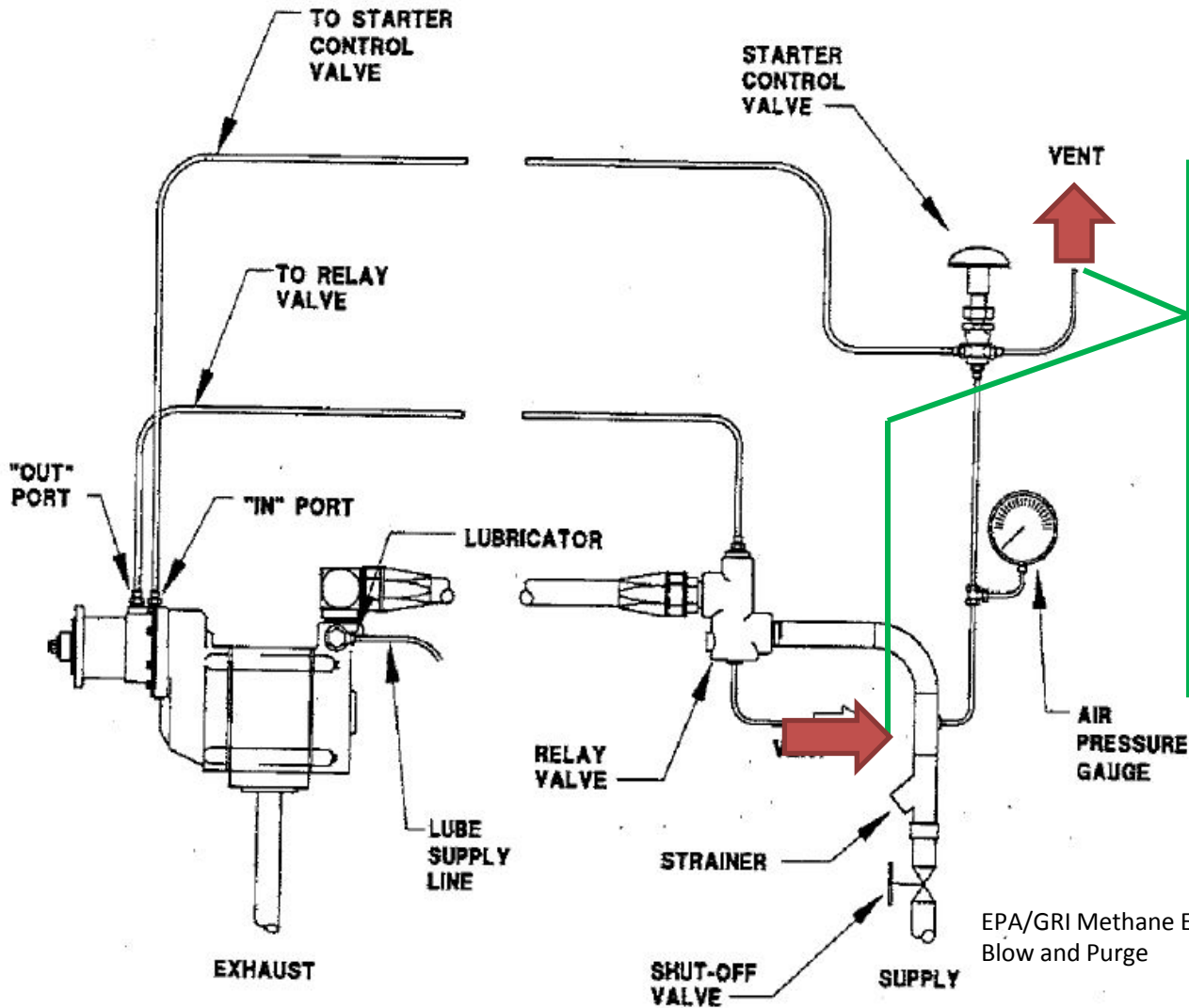
▶ Description and Location of Emissions

- ▶ The pressurized starter gas used to drive the turbine motor starter is vented to the atmosphere.

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 5: Compressor Starts

► Protocol hierarchy is outlined in the gas starter schematic below.



Protocol Hierarchy

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» Beneficial use does not include flaring.

3rd - Route starter vent gas to flare.

» Applicable to sites with existing flares or flares being installed for another protocol.

Gold Protocol 6: Equipment Fugitives Above Ground



► Definition of Fugitive or “Leak”

Sectors	Approved Instrument Monitoring Method		Infra-red Camera and Audio/Visual/Olfactory (AVO) monitoring
	Existing Facility	New Facility	New and Existing Facilities
Off P, Pc, T, S, LNG S, LNG I & E, D	any concentration of hydrocarbon above 2,000 parts per million (ppm) not associated with normal equipment operation	any concentration of hydrocarbon above 500 ppm not associated with normal equipment operation	a leak is any detectable emissions not associated with normal equipment operation
On P, GB	any concentration of hydrocarbon above 500 parts per million (ppm) not associated with normal equipment operation		

► Description and Location of Emissions

- Can occur through many types of connection points (e.g. flanges, seals, threaded fittings) or through moving parts of valves, pumps, compressors, and other types of process equipment.
- Due to the high number of equipment components, fugitive leak emissions can become a significant source of emissions.

► **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 6: Equipment Fugitives Above Ground



▶ Leak Detection Protocol:

- ▶ Conduct comprehensive leak detection according to the tables below:

Table A: Production and Gathering and Boosting Inspection Frequency Chart				
Potential Fugitive Natural Gas Emissions (Tonnes per Year of Natural Gas)	Approved Instrument Monitoring Method Inspection Frequency	AVO Inspection Frequency	Time First Inspection Should be Completed after Submission of Implementation Plan for New Facilities	Time First Inspection Should be Completed after Submission of Implementation Plan for Existing Facilities
>0 and ≤ 400	Annually	Monthly	No sooner than 15 days and no later than 30 days after facility commences operation	Within 90 days
> 400	Bi-Annually	Monthly		

Table B: Offshore Production, Processing, Transmission, Underground Storage, LNG Storage, LNG Export and Import, and Distribution Inspection Frequency Chart ²			
Potential Fugitive Natural Gas Emissions (Tonnes per Year Natural Gas)	Approved Instrument Monitoring Method Inspection Frequency	Time First Inspection Should be Completed for New Facilities	Time First Inspection Should be Completed for Existing Facilities
>0 and ≤ 12	Annually	Within 30 days of commencing operation	Within 30 days from submission of implementation plan
> 12 and ≤ 50	Quarterly		
> 50	Monthly		

▶ Leak Repair Protocol:

- ▶ Repair Leak within 5 working days for all identified leaks unless a good cause, or shutdown is required for which leak must be repaired within 15 days of resolving issue or at next shutdown.

Gold Protocol 7: Flares



- ▶ **Definition of a Flare**
 - ▶ Combustion device that uses an open flame to burn combustible gas.

- ▶ **Description and Location of Emissions**
 - ▶ Direct emissions from gas combusted in pilot flame.

 - ▶ Combination of low flowing lesser BTU gas with a high cross wind (flare out).

- ▶ **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E D

- ▶ **It is proposed that operators install reliable and continuous ignition systems for all flaring existing within or adjacent to the facility.**

Gold Protocol 8: Gas-Driven Pneumatics



▶ Definition of Pneumatic Device

- ▶ Automated or manual instruments and pumps used for flow regulation to maintain a process condition.
- ▶ Pressurized natural gas is used as the source of power.

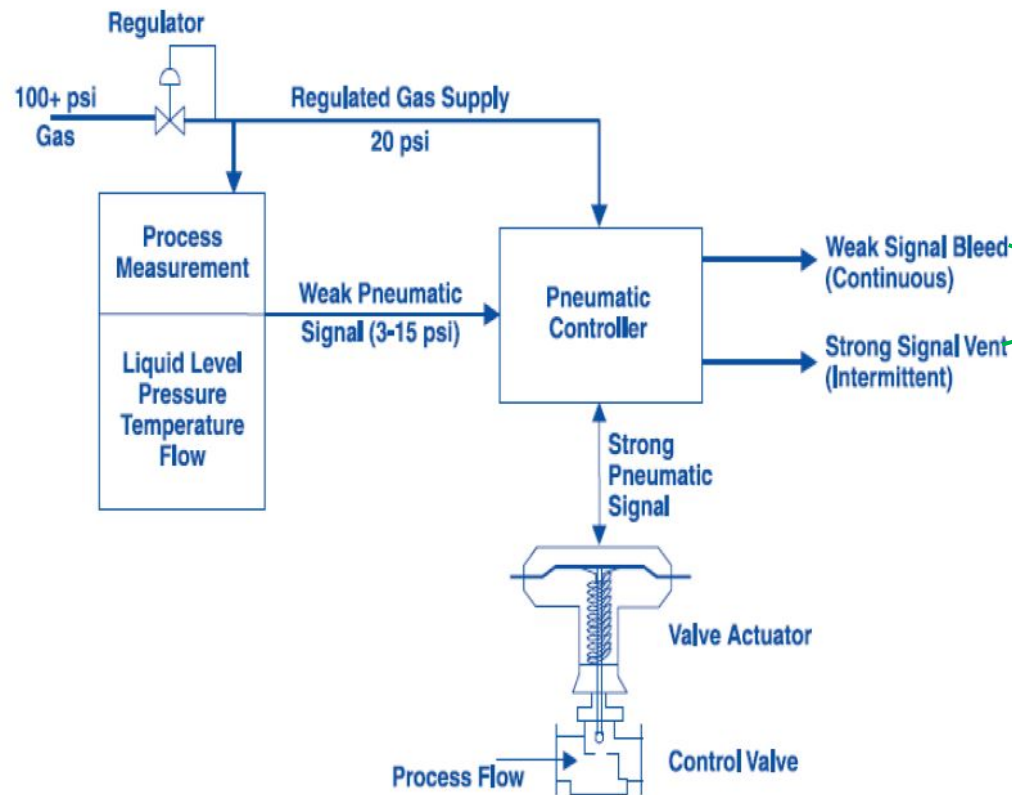
▶ Description and Location of Emissions

- ▶ Devices are designed to vent gas as part of normal operation.
- ▶ Three basic configurations:
 - Continuous-bleed
 - Intermittent bleed
 - Self-contained devices

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 8: Gas-Driven Pneumatic Devices

Protocol Hierarchy



1st - Instrument Air, Nitrogen, or Electricity

- » Where instrument air or nitrogen are available, install devices powered by these.
- » Where electricity is available, replace pneumatic pumps with electric pumps

2nd - Leak Rate Reduction

- » For devices used in processing facilities, reduce leak rate to zero
- » For devices used outside of processing facilities, reduce leak rate below 6 standard cubic feet per hour (scfh).

Gold Protocol 9: Glycol Dehydrators



▶ Definition of a Glycol Dehydrator

- ▶ Device in which a liquid absorbent (glycol, diethylene glycol, or triethylene glycol) directly contacts a natural gas stream to absorb water vapor.

▶ Description and Location of Emissions

- ▶ Liquid absorbent (e.g. glycol) removes water as well as methane, VOCs, and HAPs from natural gas.
- ▶ Saturated or “rich” absorbent is routed to a reboiler where these compounds evaporate along with water, resulting in emissions.
- ▶ Methane emissions are directly proportional to a dehydrator’s glycol circulation rate.

▶ **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E

▶ Emission Reduction Options:

1. Route Emissions to Gas Capture
2. Route Emissions to Low Pressure Gas System
3. Route Emissions to Flare
4. Glycol Circulation Rate Optimization

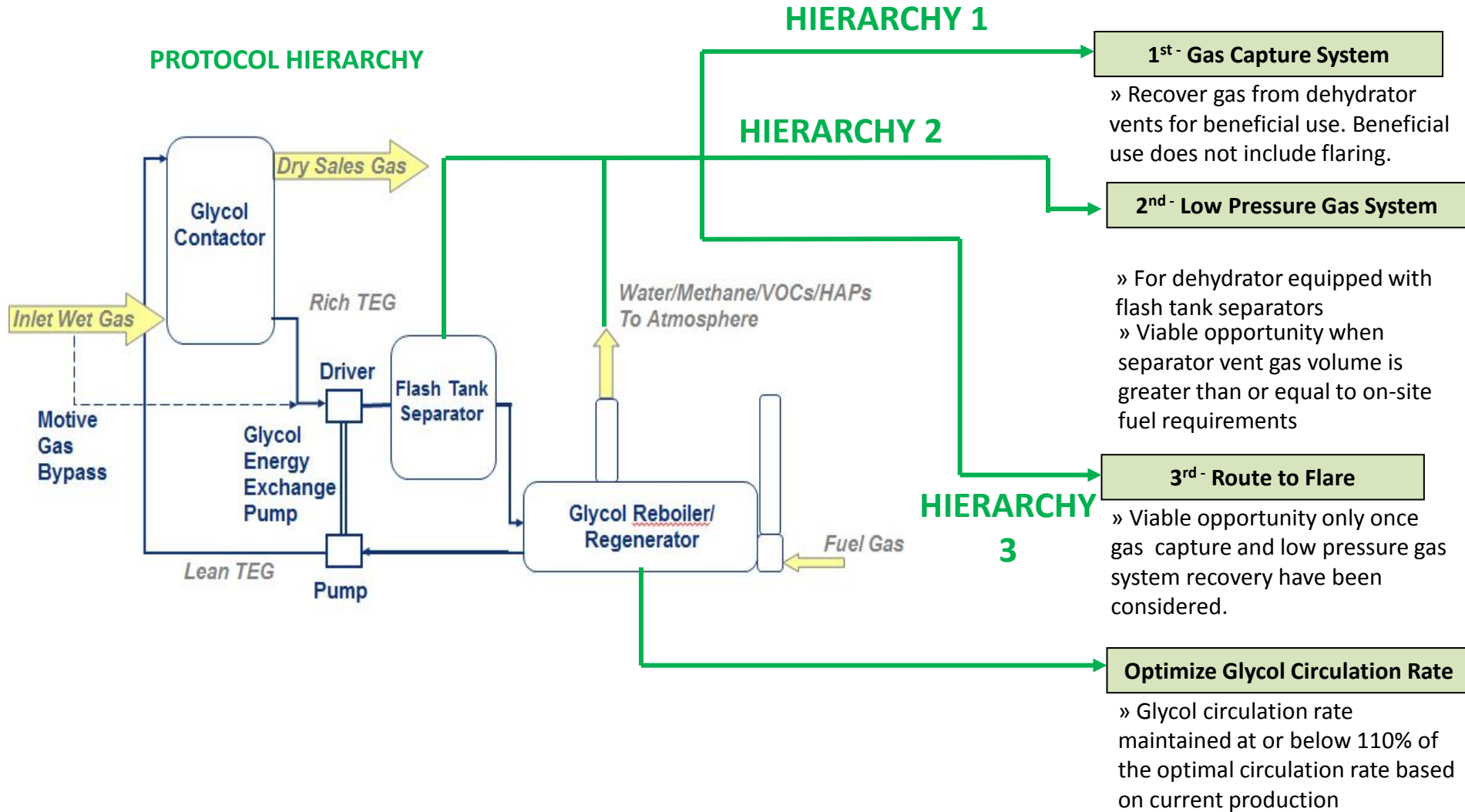
Requirement 1, 2, 3 apply to dehydrators with emissions $\geq 7,080$ g/hr and annual avg. daily throughput ≥ 0.4 MMSCFD

Requirement 4 applies to dehydrators with emissions $\geq 7,080$ g/hr and annual avg. daily throughput < 0.4 MMSCFD

Gold Protocol 9: Glycol Dehydrators



► Protocol hierarchy for an example device is displayed below.



Gold Protocol 10: Storage Tanks



▶ Definition of a Storage Tank

- ▶ Vessel designed to contain an accumulation of crude oil, condensate, intermediate hydrocarbon liquids, or produced water that is constructed of non-earthen materials.

▶ Description and Location of Emissions

- ▶ Sources of emissions include tank vents, designed tank openings, and any tank defects .
- ▶ Increased flashing emissions due to leaking or stuck open gas/oil separator liquid level control valves as well as vortexing when separator liquid level is low (and no vortex breaker is installed).

▶ Sector Eligibility: On/Off P GB Pc T

▶ Emission Reduction Hierarchy:

1. Route Emissions to Gas Capture
2. Route Emissions to Flare

Tanks with average annual hydrocarbon emissions ≥ 60 g/h of natural gas are eligible for reduction opportunities.

Gold Protocol 10: Storage Tanks

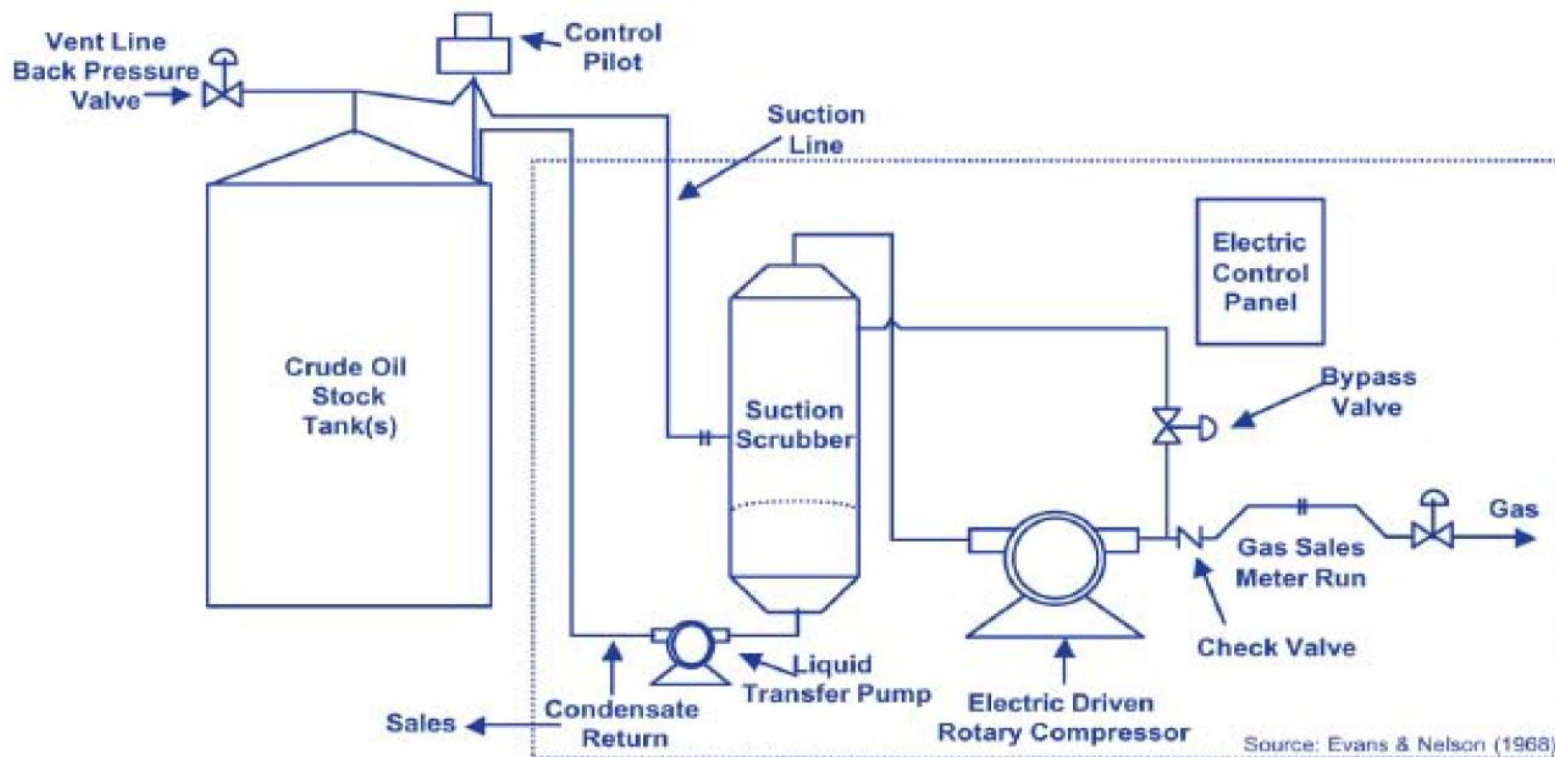
PROTOCOL HIERARCHY

1st - Vapor Recovery Unit (VRU)

» Recover gas from storage tanks for beneficial use. Beneficial use does not include flaring.

2nd - Route to Flare

» Viable opportunity for sites w/o gathering or sales line(s) in place or existing gas capture system(s)



Gold Protocol 11: Liquids Unloading



▶ **Definition of Liquids Unloading**

- ▶ Removal of fluids required to maintain production in mature wells when accumulated liquids slow or halt gas production (liquids loading).

▶ **Description and Location of Emissions**

- ▶ Liquids unloading can be performed through manual or automated techniques.
- ▶ Atmospheric emissions from liquids unloading can occur from direct gas venting or flaring.

▶ **Sector Eligibility:** Onshore Production

Gold Protocol 11: Liquids Unloading



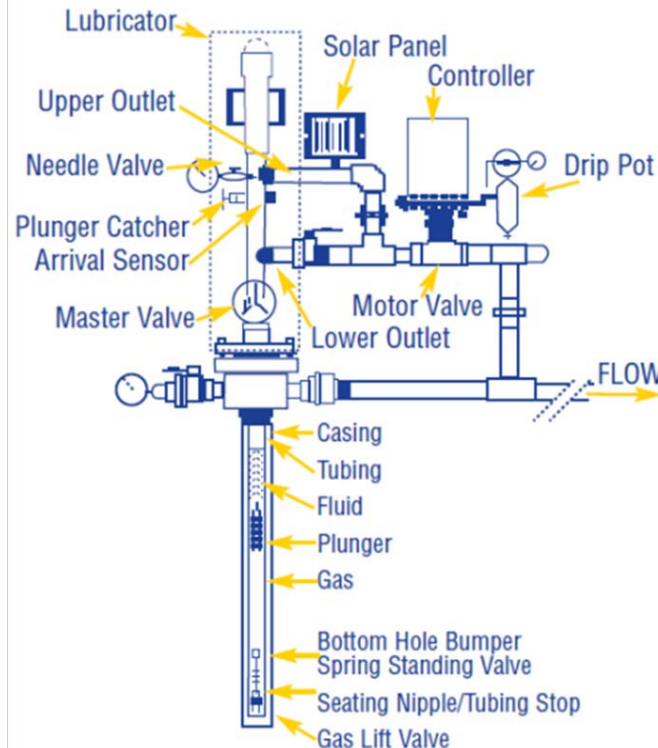
- ▶ It is proposed that operators maintain a closed loop liquids unloading system that eliminates all methane emissions.
 - ▶ Control of emissions during system failures or emergency situations is not proposed.
- ▶ Emission reduction options for liquids unloading while maintaining a closed loop system are described below (image shows a well installed with a plunger lift).

REDUCTION OPTIONS

Plunger Lift Systems

» Equipment which uses well's gas pressure to drive accumulated liquids to the surface.

» Well gas should be directed to a separator that routes to a sales line or other beneficial use (not including flaring) during plunger lift cycling.



Foaming Agents

» Soaps or surfactants which aid in phase separation and reduce critical velocity required to lift/remove fluids from a well.

Velocity Tubing

» Smaller diameter production tubing which increases gas production velocity without venting emissions.

Downhole Reciprocating or Rotating Pumps

» Pumps used to propel accumulated well liquids to the surface.

Gold Protocol 12: Pipeline Venting and Blowdowns

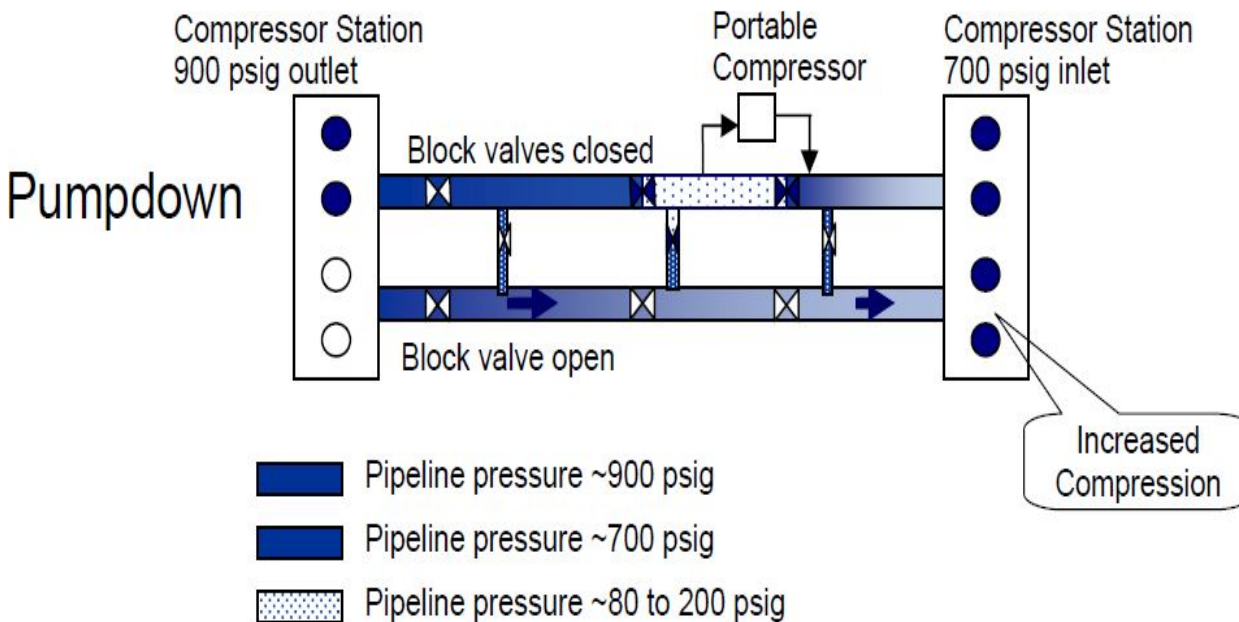


- **Definition of pipeline venting**
 - Planned or unplanned release of gas to the atmosphere from pipelines to reduce line pressure.
- **Description and Location of Emissions**
 - Vented sections of pipe to ensure safe working conditions during planned repairs and maintenance, installation of new parallel pipe, or an emergency repair.
 - Done by blocking the smallest possible linear section of the pipeline and depressurizing it through venting natural gas to the atmosphere.
- **Sector Eligibility:** On P GB Pc T S LNG S LNG I&E D

Gold Protocol 12: Pipeline Venting and Blowdowns

- ▶ An image of portable compression to reduce pipeline blowdown emissions is shown below.

REDUCTION HIERARCHY



✓ **1st - Use inline compression to max engineering potential**

» Applicable if facility has ownership or operatorship of the compressor downstream from pipeline venting and blowdown operations.

» Recover gas amount comparable or higher to fuel used during inline compression (CO₂ eq. basis).

✓ **2nd - Use portable compression**

» Breakeven or higher value of gas should be recovered in comparison to cost of using portable compression.

Gold Protocol 13: Pipeline Inspection and Repair



- **Definition of pipeline**
 - Pipeline consists of above and below ground pipe and associated connectors.
 - Used to form infrastructure to transport natural gas within a facility boundaries.
- **Description and Location of Emissions**
 - Leaks are considered to be any source, such as small openings, gaps, and cracks in a pipeline and/or associated component connectors, allowing an unintentional natural gas release.
- **Sector Eligibility:** On P GB Pc T S LNG S LNG I&E D
- **Gold Protocol**
 - 1) Conduct comprehensive leak detection annually and retain records; and
 - 2) Perform leak repair for leaks ≥ 60 grams/hour

Gold Protocol 14: Pressure Relief Valves (PRVs) – System Upsets



▶ Definition of pressure relief valves

- ▶ Self-regulating safety devices used to ensure normal equipment/pipeline operating pressure and prevent any pressure increases above the maximum allowable working pressure of process equipment.

▶ Description and Location of Emissions

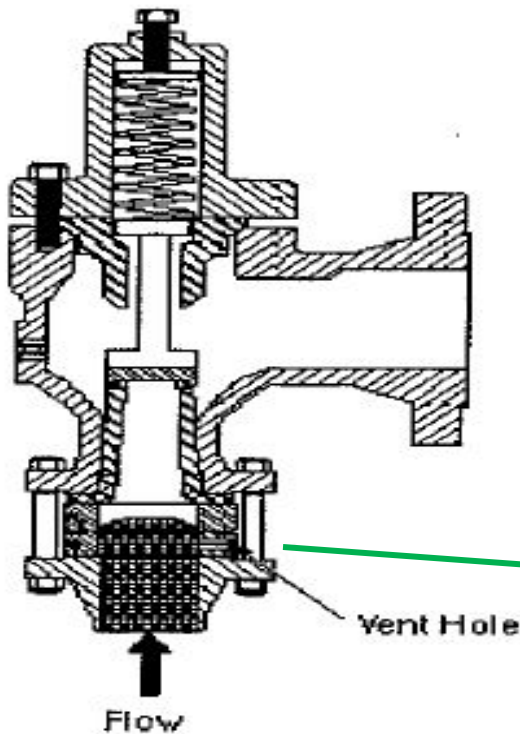
- ▶ During system upsets, PRVs vent process gas to maintain a set pressure value.

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

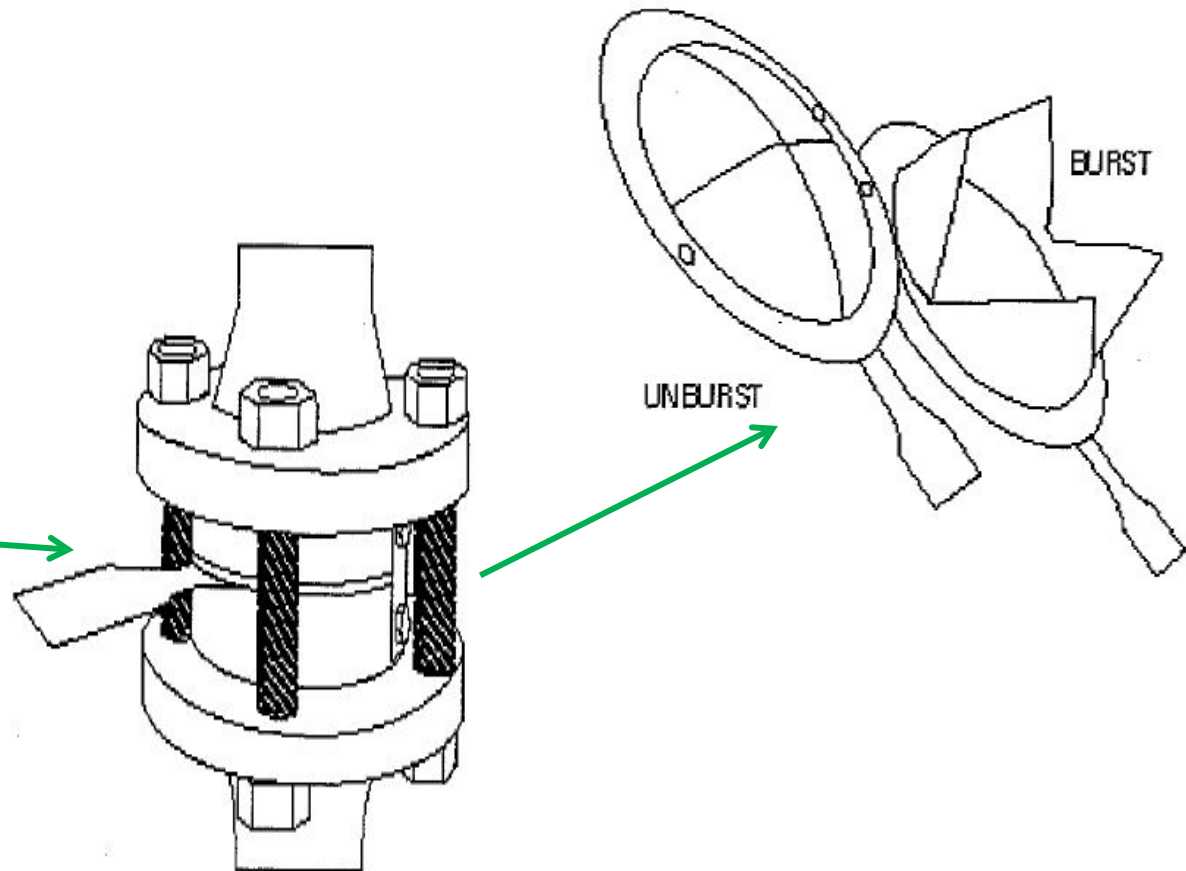
Gold Protocol 14: Pressure Relief Valves (PRVs) – System Upsets



- ▶ It is proposed that operators install rupture disks on all gas pressure relief valves (PRVs)
 - ▶ One-time use calibrated metal membranes which break at excessive gas pressures, allowing system stabilization.
 - ▶ Does not apply to PRVs in closed systems connected to flare headers



Pressure Relief Valve



Rupture Disk Installation

Gold Protocol 15: Reciprocating Compressor Rod Packing



▶ Definition of Reciprocating Compressor Rod Packing

- ▶ A series of flexible rings in machined metal cups that fit around the reciprocating compressor piston rod.
- ▶ The rings create a seal, limiting the amount of compressed natural gas that escapes to the atmosphere.

▶ Description and Location of Emissions

- ▶ Emissions from packing systems originate from mainly four components; the nose gasket, between the packing cups, around the rings and between the rings and the shaft.
- ▶ A set of two to three flexible, segmented rings in a packing cup are pressed against the rod to and oscillate back and forth in the cup with the rod's reciprocal movement, sealing against the cup faces to prevent leakage around the rings, but a little gas slips around the rings with each stroke.
- ▶ Rod packing emits a small amount of gas into the distance piece and/or through a vent line connected to the packing box.

▶ Emission Reduction Hierarchy

- 1) Gas Capture
- 2) Economical Rod Packing Replacement
- 3) Route rod packing emissions to flare

▶ Sector Eligibility: On/Off P GB Pc T S LNG S LNG I&E D

Gold Protocol 16: Vessel Blowdowns



▶ Definition of Vessel Blowdown

- ▶ The act of emptying or depressurizing a vessel of natural gas.

▶ Description and Location of Emissions

- ▶ Intentional vents usually from elevated vent stacks controlled by a manual or pneumatic actuated valve connected to the vessel.
- ▶ Blowdowns can be from planned maintenance, operational needs, or due to an emergency.

▶ **Sector Eligibility:** On/Off P GB Pc T S LNG S LNG I&E D

▶ Emission Reduction Hierarchy:

1. Route Emissions to Gas Capture
2. Route Emissions to Low Pressure Gas System
3. Route Emissions to Flare

Gold Protocol 17: Cast Iron Distribution Pipeline and Unprotected Steel Pipeline



▶ **Definition of Cast Iron Distribution Pipeline**

- ▶ Iron that is heated to melting point and poured into molds.
- ▶ Applies to gray cast iron, which is a ferrous material.
- ▶ Cannot be welded or screwed.
- ▶ Also includes wrought iron.

▶ **Definition of Unprotected Steel Pipeline**

- ▶ Steel pipeline with no form of corrosion protection.

▶ **Description and Location of Emissions**

- ▶ Manufacturer defects, improper design/installation, and internal/exterior protective coating damage can all lead to natural gas pipeline leaks.

- ▶ Common leakage points in these materials are joints and stress cracking in cast iron pipes and corrosion holes in unprotected steel piping.

▶ **Sector Eligibility:** D

Gold Protocol 17: Cast Iron Distribution and Unprotected Steel Pipelines



- ▶ **All cast iron or unprotected steel pipe being replaced:**
 - ▶ It is proposed that operators replace, line, or otherwise seal joints in 10% of existing cast iron pipeline, wrought iron pipeline and unprotected steel pipeline per year.
 - ▶ Additionally it is proposed that operators perform an annual leak survey as per requirements in this protocol pertaining to pipeline inspection and repair.

- ▶ **If 400 feet or more of pipe is being replaced:**
 - ▶ It is proposed that operators conduct a pressure drop survey on the replaced main line to measure the leakage immediately after all service connections have been transferred over to the new main, and the ends of the replaced pipeline are sealed before the pipeline is abandoned or removed.

