ConocoPhillips Canada	**PURGING** ALL-HSE-PRC-182	**Retention Code:** *CG01 - CA* **Revised:** *March 2015*
Owner: *HSE Performance Assurance*	**Approved By:** *Manager, HSE Performance Assurance*	**Review Frequency:** *Five years or less*

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1.0 Purpose

This procedure ensures the safe removal of air, combustibles, chemicals, and toxic or other reactive gases or liquids from vessels, equipment and piping. It applies to all ConocoPhillips Canada (CPC) operations when purging wellbores, surface equipment, flow lines, piping, vessels, compressors, processing equipment etc.

This includes:

- Purging into service – air to gas (before hydrocarbons are introduced).
- Purging out of service – gas to air (before hydrocarbons are removed).

2.0 Hazards to Mitigate

Hazards may include, but are not limited to, the following:

- Asphyxiation.
- Loss of inert atmosphere.
- Noise.
- Blowdown fumes.
- Oxygen deficiency.
- Extreme cold temperatures.
- Hydrate formation. See Hydrate Management Procedure.
- Explosions.
- Pressure.
- Exposure to controlled products.
- Static electricity.

3.0 Procedure-Specific Roles and Responsibilities

3.1. Work Supervisor

- Ensure applicable work permit or hazard assessment is completed.
- Ensure associated procedures are followed (e.g. Gas Detection, Positive Isolation).
- Ensure adequate supply of the selected purging media.
- Ensure effective flow of the purge media.
- Ensure adequate venting of the purged gas.
- Manage interactions with work in adjacent areas.
- Identify personal protective equipment (PPE) requirements.
- Ensure Material Safety Data Sheets (MSDSs) are available and understood.

3.2. Worker

- Ensure applicable work permit or hazard assessment is followed.
- Ensure adequate supply of the selected purging media.

- Develop and follow the purging plan.
- Ensure adequate gas tests are performed.
- Wear appropriate PPE.
- Ensure Material Safety Data Sheets (MSDS) are understood.

3.3. Permit Issuer

- Determine gas testing requirements (e.g. interval or continuous).

4.0 Procedure

4.1. Preparing to Purge

- Ensure the scope of the purge is clearly defined.
- Develop a purge plan. Establish:
  - The equipment and piping to be purged.
  - Purge method (e.g. dilution, displacement).
  - Isolation methods. See Positive Isolation and Lockout and Tagout procedures.
  - Purge medium (e.g. steam, nitrogen, CO_2, water, or fuel gas).
  - Flow rate(s).
  - Temperature(s).
  - Number of pressure and depressure cycle.
  - Appropriate sequence (if purging more than one vessel etc.).
  - Where the purge medium will be introduced.
  - Where the purged gas will be vented.
  - The method of testing and the end-point test location.
- Ensure effective means of communication (e.g. cell phone or 2-way radio).
- Ensure the applicable hazard assessment or work permit is complete.
  - Identify atmospheric testing requirements (e.g. lower explosive limits (LEL) and oxygen content). See Gas Detection procedure.
- Ensure use of appropriate personal protective equipment (PPE) and safety equipment.
  - Personal monitors may not be used when continuous monitoring is required.
  - Also see Personal Protective Equipment Specification and Gas Detection Procedure.
- Ensure purge pressures and purge media flow rates can be kept within safe limits.
- Ensure gauges are in working order and sized for the job requirements.
- Ensure vents are sized to:
  - Allow positive pressure is maintained in the facility being purged.
  - Prevent the infiltration of air (if flammable gas is in the environment).
  - Ensure gas velocity at the outlet of the pipe vent is greater than the rate of travel of the flame in the event the emerging gas mixture ignites.

- Check the work area to:
  - Ensure system components are grounded and bonded.
  - There are no unusual sounds or leaks.
  - Remove any ignition sources.
  - Ensure all valves function properly and are in the proper position.
  - Ensure onsite personnel are aware of purging activity.
  - Determine possible impacts purging may have on adjacent work areas and vice versa.
  - Determine the wind direction.
- Ensure purging pressures to be used are within the normal operating pressure range.
- Ensure to vent to a safe location (i.e. if equipment is indoors or a congested area it might require longer vent lines). Isolate all piping, vessels and equipment:
  - Depressurize.
  - Drain liquid contents.
  - Secure blinds/ isolations.
- Extinguish the flare pilot before purging a flare system (turn off power to auto-igniter if applicable).

  Note: When purging p-tanks or vessels with H_2S through the flare stack, the flare pilot may stay lit to burn off H_2S.

  Also see Positive Isolation procedure and Lockout and Tagout procedure.

4.2. Purging

4.2.1. General

- Purging must comply with the Hydrogen Sulphide (H_2S) procedure, Lockout and Tagout procedure, Controlled Products procedure and Positive Isolation Procedure.
- Ideally the replacement of gas or air:
  - Is solely by displacement.
  - Will only require one volume of purge gas.
- To keep mixing and dilution to a minimum:
  - Control input velocity to ensure static build-up is minimized.
  - Minimize interruptions or flow variations in purge gas input.
  - Use large input connections.
  - Introduce purge gas at the appropriate location with respect to gas densities.
  - Avoid differences and sharp changes in temperature.
  - Ensure vents are adequately sized to permit ready escape of displaced gas.
- Keep pressure safety valves (PSVs) as installed while purging.
- Vent valves should be fully open and flow rates controlled on the inlet.
- All equipment must remain properly grounded.

Note: All equipment (e.g. sight glasses, level columns etc.) must be open to ensure purge of complete system.

- For sour sites:
  - Also follow the Hydrogen Sulphide procedure.
  - Set up the pipeline valves at the start and end points of the purge as required.
  - Ensure the vent valve is hooked up to flare or vent system
  - Ensure there are no offsite odors. (A scrubber system and chemicals may be required to neutralize the odors).

When choosing the purge medium consider pros and cons, availability, economics and the vessel and piping to be purged.

4.2.2. Purging with Steam

Advantages	Disadvantages
• Inexpensive. • Effective when high temperature and moisture are acceptable. • Provides direct displacement. • High temperature (volatization of light oils etc.). • Steam distillation - ideal carrier of volatized vapors. • Cleaning effect. Heating softens and melts deposits. • Appreciable quantity of the steam condenses. As steam condenses it carries with it loosened solid particles. • May be used in conjunction with inert gases.	• Interruptions can be hazardous (result from cooling, condensing and sudden pressure drops). • Difficult to predict the quantity of steam required (due to appreciable condensation). • Potential for water hammer. • Liquid waste generated needs to be collected and disposed of.

- Pump or depressurize the vessel or system as much as possible.
- Drain remainder of liquids to a suitable facility (e.g. blowdown or slop system).
- Open vent on the top of the vessel.
- Inject steam near the bottom of the vessel.
- Vent a visible steam plume for 4-6 hours.
- Drain accumulated condensation from the bottom of the vessel.
- Gas test inside the vessel. See Gas Detection procedure.
- After steaming, leave the vessel vented to the atmosphere to prevent a vacuum from forming when cooling.
- Keep the drain open to avoid steam condensate buildup.
- If unable to open the vessel immediately:
  - Maintain the correct pressure level to avoid creating a vacuum as the vessel cools.
  - Keep vent valve open.
- Ensure that related equipment and vessels (float columns, gauge glasses, etc.) are also drained and vented.

- Ventilate the purged vessel or pipe with air.

4.2.3. Purging with Nitrogen or CO_2

Nitrogen

Advantages	Disadvantages
• Availability. • Inert gas. • Easily adaptable to different systems. • Relatively inexpensive. • Non-hazardous. • Environmentally benign. • Not prone to condensing at atmospheric conditions. • Consistent quality.	• Less effective than CO_2 because of mixing with air.

CO_2

Advantages	Disadvantages
• Relatively inexpensive. • Environmentally benign. • Non-hazardous. • Not prone to condensing at atmospheric conditions.	• May solidify depending on the let-down pressure, creating a static charge which may ignite hydrocarbons. • May be corrosive if water is present. • May not be readily available or a cost effective choice

- Introduce N_2 or CO_2 through a disconnect drain or other bottom connection.
- Close, vent and drain valves prior to purging.
- Inject N_2 or CO_2, pressurizing the vessel to 10% of maximum operating pressure (MOP).
- Purging plans may require higher pressures (e.g. purging NGL systems using a cycle purging plan). In such cases, hot N_2 can be used.
- When the purge pressure has been reached, close the nitrogen inlet valve and vent the vessel and piping. More than one purge cycle may be required.
- When purging to remove air, gas test using a continuous monitor until oxygen content is less than 2%.
- When purging to remove hydrocarbons, continue purging until the LEL is <10% (unless specified otherwise in the work permit or hazard assessment).
- For multiple branch systems, test all extremities of the system (e.g. parallel paths).
- Run exhaust out the top of the vessel.
- Ventilate the purged vessel or pipe with air.

4.2.4. Purging with Water

Advantages	Disadvantages
• Availability. • Fills every space in the vessel or system. • Washing effect. • Inspirating action. Can be used to draw final contents into the vessel or system.	• Weight. • Disposal (due to contamination). • Not adaptable to all equipment. • May not completely remove residues. • Hydrates may be formed at high temperatures and low pressures if used with natural gas. • Potential to freeze. • Moisture may not be permissible. • May absorb toxic gases which will be released when pressure is reduced.

- Pump or depressurize the vessel or system as much as possible.
- Drain the remainder of liquids to a suitable facility.
- Vent the vessel or system.
- Install an overflow hose in the top of the vessel and run the hose to a suitable container. Pump fresh water into the bottom of the vessel - verify structural elements can handle additional weight.
- Overflow the vessel or system.
- Keep the vessel open to the atmosphere to avoid creating a vacuum.
- Drain the vessel to a suitable facility. Allow the vessel to air out, or use blowers.
- Gas test the vessel before entry to determine if additional purging is required.

4.2.5. Purging with Fuel Gas

Advantages	Disadvantages
• Availability. • Relatively inexpensive.	• Explosive mixture will be present in the vessel or pipe. • Flow rate must be kept low, so purging a large system will take time.

- Use to purge into service – air to gas only
- Fuel gas (methane) can be used to deoxygenate small vessels and 10.2 cm (4 in.) and smaller pipes to bring them back into service. (Preferred method is to use N_2 or Co_2)
- All equipment must be properly grounded.
- Purging should progress without interruption.
- Slow purge rates must be followed to ensure static electricity is not generated.
- Gas detection monitor must be used to verify that the air has been displaced. See Gas Detection procedure.
- Continue to purge until oxygen content is ≤ 5% or vented gas is confirmed to be 100% fuel gas. Also see Gas Detection procedure.

- Once the above is attained, the purge can be shut in, pressure increased and the system tested for leaks.

5.0 References

- American Gas association Purging Principles and Practices.
- NFPA 54: National Fuel Gas Code.
- NFPA 69: Standard on Explosion Prevention Systems.

- Gas Detection ALL-HSE-PRC-170
- Hydrate Management All-HSE-PRC-174
- Hydrogen Sulfide ALL-HSE-PRC-176
- Positive Isolation ALL-HSE-PRC-181.
- Lockout and Tagout All-HSE-PRC-179.
- Pre-Job Hazard Assessment / Permit to Work All-HSE-PRC-387.

6.0 Document Retention

Records must be retained in accordance with ConocoPhillips' Document Retention Schedule.

Record	Owner	Classification	Retention
Permit/Hazard Assessment Form (ALL-HSE-FRM-2105)	Applicable BU or Functional Unit	HE11-CA	2 years
Purge Plans and any calculations	Applicable BU or Functional Unit	CG01-CA	Completion +10 years

Appendix A – Acronyms

kPag	Kilopascals gauge
LEL	lower explosive limit
MOP	Maximum Operating Pressure
PPE	Personal Protective Equipment
PSV	Pressure Safety Valve
Psig	Pressure per square inch gauge

Appendix B – Definitions

Dilution	A form of purging in which replacement or one substance by another is accomplished by mixing.
Displacement	A form of purging in which replacement of one substance by another is accomplished without appreciable mixing.
End-point	Attainment of concentration (% by volume) of inert substance in the closed vessel or pipe system.
Exhaust Gas	The products of combustion (primarily carbon dioxide and nitrogen) from an inert gas generator used as an inert gas for purging.

Appendix C – Revision Record

Page#	March 25, 2015	Previous Information	Change Assessment
All	No new requirements – detail added.		low