ConocoPhillips Canada	**HYDRATE MANAGEMENT** ALL-HSE-PRC-174	**Retention Code:** *CG01 - CA* **Revised:** *May 2016*
Owner: *HSE Performance Assurance*	**Approved By:** *Manager, Regulatory & HSE Performance Assurance*	**Review Frequency:** *Five years or less*

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Bullet points with a '**!**' indicate a critical step. Critical steps with respect to HRO is something that could have severe consequences if missed.

1.0 Purpose

This Procedure is to establish minimum requirements to manage hydrates across all ConocoPhillips Canada (CPC) operations.

2.0 Hazards to Mitigate

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

- Toxic, flammable materials and atmospheres
- High pressure
- Hydrogen sulfide (H_2S)
- Hazardous fluids and gases
- Flammable and explosive gases
- Impact or over-pressure causing failures in equipment, valves, flanges and piping
- Stored energy or trapped pressure
- Excessive noise
- Line of fire

Note: Ensure body placement does not place a worker in the line of fire.

3.0 Procedure-Specific Roles and Responsibilities

3.1. Supervisor (Operator in Charge)

- Must have full understanding of the hydrate management procedure.
  - Only trained personnel, as validated by the company's competency assessment process, are permitted to manage hydrates.
- Ensure hydrate occurrences are investigated and discussed with engineering to prevent reoccurrence.
- Ensure understanding of the systems/locations and the characteristics of the products this procedure applies to (e.g. piplines, process equipment, methane, CO_2, etc.).
  - Clarification of system/location specific hydrate management practices and procedures.
- Identify contingency plan requirements when managing hydrates.
- Identify required PPE and safety equipment when performing hydrate management related activities.

3.2. Workers

- Follow this procedure and discuss hydrate handling with operator in charge.

Note: Workers not directly involved with the hydrate management operation are not allowed in the immediate area of operation.

4.0 Procedure

4.1. Hydrate Prevention

- Hydrates can be minimized or prevented by:
  - Eliminating free water in the gas stream by dehydrating the gas or elevating the temperature to vaporize more water.
  - Increasing the gas temperature above temperature indicated in the hydrate formation curve for the given operating pressure.
  - Decreasing the pressure below the pressure indicated on the hydrate formation curve for the given operating temperature.
  - Following recommended chemical injection rates.
  - Redesigning piping systems (e.g. low points, restrictions).
- Equipment and methods to be used:
  - Line heaters and insulated/heat traced lines and at risk items (valves, orifices and other restriction devices).
  - Dehydrators (including glycol, molecular sieve, silica gel, and calcium chloride towers).
  - Supplemental glycol/methanol injections.
  - Determine safe shut-in periods for lines to avoid pressure buildup.

4.2. Hydrate Recognition

- Hydrates, like any other obstruction in a line, can be detected by the consequences they create. The following may indicate the presence of hydrates:
  - Reduced flow rates.
  - Reduced pressure.
  - Increase back pressure on a system.
  - Increased differential pressures.
  - Temperature drops.

4.3. Job Preparation

- Complete a hazard assessment.
- Ensure a contingency plan is in place that considers how to handle unexpected events.
- Ensure an emergency response plan (ERP) is in place to handle a situation in which a pipe ruptures, resulting in a gas release fire or injury.
- Ensure the pumping unit relief valve setting does not exceed maximum allowable working pressure (MAWP) or maximum operating pressure (MOP) of pipeline, piping and equipment.
- Ensure required resources are available to assist.
- Ensure non-essential personnel are removed from the work area.
- Notify Integrated Operations Centre, if applicable.

- Follow the Hydrogen Sulphide (H_2S) procedure, for sour sites.
- Ensure flare knockout and liquid containment tanks have adequate space to contain expected fluid.

4.4. Removing Hydrates

4.4.1. Depressurizing

- The most effective method for the removal of a hydrate plug is shutting in and depressurizing.
- The hydrate plug must be depressurized equally from both sides below the hydrate point, but not to zero.
- When depressurizing requires hot tapping, refer to Hot Tapping procedure.

! **CAUTION:** Do not attempt to remove hydrates by force through independently increased or decreased pressure on either side of the hydrate plug as this may rupture pipes and vessels.

! **CAUTION:** When attempting to eliminate hydrates, avoid placing yourself where there are potential rupture points, for example behind ends of pipes or turns in pipes.

- **CAUTION:** Where hydrates are suspected while the line is being depressurized and opened, the hydrates may plug the line and trap pressure as well as dissolve and release hydrocarbons and toxic gases under pressure.

4.4.2. Heating

- Open flames (e.g. torches, fires, etc.) **must not** be used for hydrate removal.
- The use of vehicle exhaust for heating must follow the Hot Work procedure.
  - The area must be well ventilated due to the danger of carbon monoxide and attention must be paid to the possibility of gas ignition (including the presence of gas and the condition of the vehicle engine and ignition system for possible sources of ignition).

4.5. Process Equipment Hydrates

- Shut down and isolate the affected process equipment, e.g. the refrigeration compressor to allow process flow temperature to rise.
- Adjust temperature and pressure parameters to below the conditions of the hydrate curve by one or both of the following:
  - Equally depressurize the equipment on both sides of the hydrate to below the hydrate formation curve, allowing no more than 10% pressure differential across the hydrate, if possible (see Figure 1).
    - At no point in time, allow pressure on either side of the hydrate to go to zero.
  - Allow the equipment to warm up higher than the hydrate formation curve.

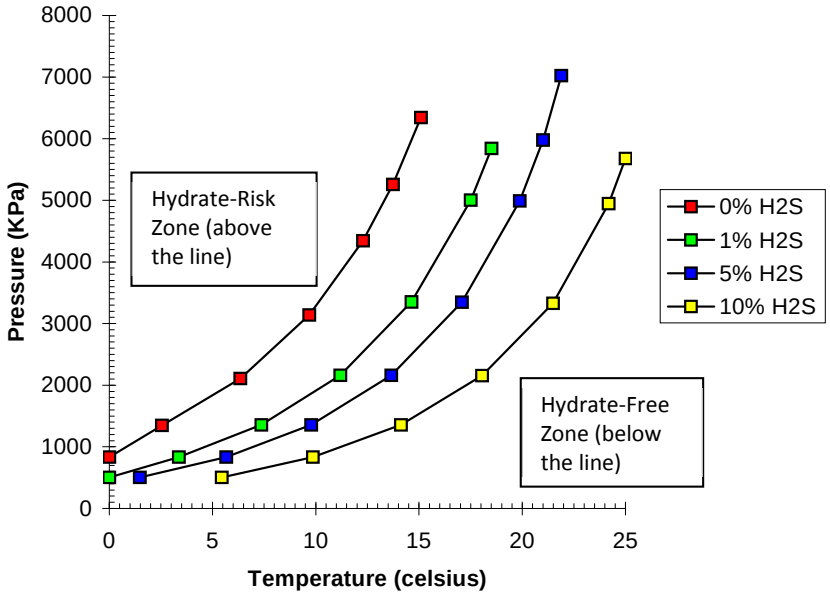

Figure 1: Hydrate Formation Curve

- Troubleshoot the reason for the hydrate or ice plug formation and remedy the problem, if possible.
- Confirm hydrate has been cleared by:
  - Slowly increasing upstream pressure and ensuring downstream pressure increases at the same rate; or
  - Re-establishing flow and ensuring downstream flow increases at the same rate.

    CAUTION: Stay out of line of fire while re-pressuring system.
- Start up the equipment according to the equipment-specific procedure, if required.
- Place the equipment on line.
- Monitor the equipment as required to ensure the problem is solved.

4.6. Well Site Hydrates

- Check the pressure across the site to determine the hydrate location.
- Shut the wellhead master and pipeline valves.
- Equally depressurize the well site equipment on both sides of the hydrate to below the hydrate formation curve, allowing no more than 50% pressure differential across the hydrate, if possible (see Figure 1).

CAUTION: Stay out of line of fire while de-pressuring system.

- At no point in time, allow pressure on either side of the hydrate to go to zero.

- Allow time (depending on hydrate size and composition) for the hydrate to disintegrate.
  - Be patient.
- Add a small amount of methanol (based on size of equipment) upstream of the hydrate.
- After enough time has elapsed, depending on severity of hydrate formation, introduce gas upstream of the hydrate location.

CAUTION: Stay out of line of fire while re-pressuring system.

- Confirm the pressure across the site is equal to ensure the hydrate has cleared.

If the pressure is not equal across the site:

  - Troubleshoot potential hydrate causes and remedy, if possible.
  - Repeat the steps in section 4.4.

4.7. Pipeline Hydrates

- Check the pressure across the pipeline system to determine the hydrate location.

CAUTION: Be aware there could be more than one hydrate in the pipeline.

- Shut in the wells feeding the pipeline system.
- Isolate the pipeline on both sides of the hydrate.
- Take the required equipment, e.g. tank truck or blowdown trailer, to each isolation location to depressurize the pipeline and to collect any trapped liquids.
- Equally depressurize the pipeline on both sides of the hydrate to below the hydrate formation curve, allowing no more than 10% pressure differential across the hydrate, if possible (see Figure 1).

! **CAUTION:** Over pressure of blowdown equipment and/or misting may be created by too high of a velocity while blowing down the pipeline. ***This relies on human experience and coaching.***

CAUTION: Stay out of line of fire while de-pressuring system.

  - At no point in time, allow pressure on either side of the hydrate to go to zero.
- Remain on site while de-pressuring.
- Allow time, depending on the severity of the hydrate, for the hydrate to disintegrate.
  - Be patient.
- Troubleshoot the reason for the hydrate or ice plug formation and remedy the problem, if possible.
- Add a small amount of methanol (based on size and length of pipeline) upstream of the hydrate.
- After enough time has elapsed (depending on severity of hydrate formation), introduce gas upstream of the hydrate location.

CAUTION: Stay out of line of fire while re-pressuring system.

- Confirm the pressure across the pipeline is equal to ensure the hydrate has cleared.

If the pressure gauges do not respond the same:

- Repeat the steps in section 4.5 until the pressure gauges respond the same.

! **CAUTION:** When leaving site for extended period ensure that hydrate has been isolated on both sides and left de-pressured at safe pressure, see fifth solid bullet in this section.

4.8. Downhole Hydrates

- For plunger lift wells, use extreme caution.
  - If possible, equalize the tubing and casing pressure
- Isolate the tubing and casing from production equipment or the flow line.

If the wellbore configuration allows:

- Using a pressure pump, pump appropriate quantity of methanol down the required production string based on well history and configuration.
- Allow the production string pressures to return to normal operating conditions.
- Bring the well on line.

CAUTION: Stay out of line of fire while bringing well on line.

- After the well has stabilized and the methanol has flowed up the production string, increase the gas flow from the well in order to increase the temperature and decrease the pressure of the gas to below the hydrate curve, if possible (see Figure 1).
- Inject the hydrate inhibitor down the casing, depending on the wellbore history and configuration to prevent future hydrates, if required.

If the hydrate does not clear:

- Consult your supervisor or an optimization technician.

5.0 References

- Hydrogen Sulphide Procedure (ALL-HSE-PRC-COP-176)
- Hot Work Procedure (ALL-HSC-PRC-175)
- Hot Tapping Procedure (OLS-HSE-PRC-215) or (WCBU-HSE-PRC-216)
- CAPP Information Bulletin, Prevention and Safe Handling of Hydrates

Appendix A – Revision Record

Page#	May 18, 2016	Previous Information	Change Assessment
ALL	Reformatted		
ALL	More detail in requirements to become a Canada All procedure	Contained high level information; more of an educational document than a procedure	Low – procedure requirements already being followed
ALL	Reviewed for HRO alignment		Low – no new requirements