Rangeland Engineering Canada Corp.

Hydrocarbon Dehydration Presentation

October 13, 2020

RANGELAND ENGINEERING

Experts.Partners.Innovators.

GPAC
Gas Processing Association Canada

Introduction

- GPAC is a non-profit organization formed to promote the interaction and exchange of ideas and technology to those involved with or affected by the hydrocarbon processing industry, which is exactly why we are here today.

- GPAC has operated in Alberta since 1959 because of the support of our membership and generous sponsors. A big thank you to:

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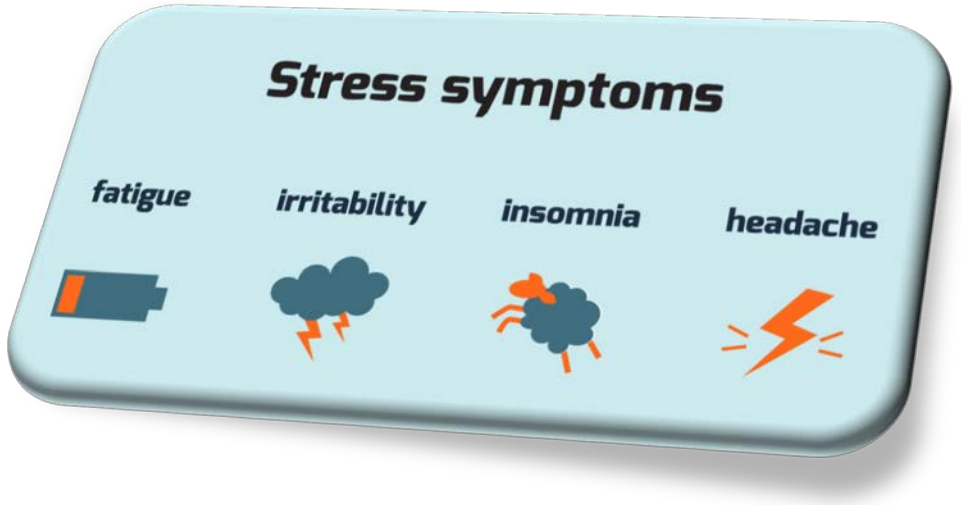
Safety Moment: Stress Management

Stress is part of everyday life. If left unchecked, it can cause physical and emotional distress that can affect your health and peace of mind, as well as personal and professional relationships.



Everyone handles stress differently; if you feel you have overwhelming stress in your life, it will be helpful to talk to a physician.

Suggestions for Managing Stress

1.	Take one thing at a time, prioritize your tasks and tackle each one separately.
2.	Be realistic. If you feel overwhelmed by some activities or tasks, learn to say No.
3.	Don’t give into the 'Superman/woman’ syndrome. No one is perfect, do not expect this from yourself and others.
4.	Meditation for 10-20 minutes daily has been shown to be helpful.
5.	Find a hobby that will give you a break from worries and distractions.
6.	Balance your work and life with activities that are good for your well-being
7.	Try to live a healthy lifestyle (good nutrition, adequate rest, regular exercise, limit caffeine and alcohol).
8.	Visualize how you can manage a stressful situation more successfully.
9.	Give in occasionally...be flexible. Don’t have the attitude of “My way or the Highway ”
10.	Share your feelings with family and friends. Don't try to cope alone.

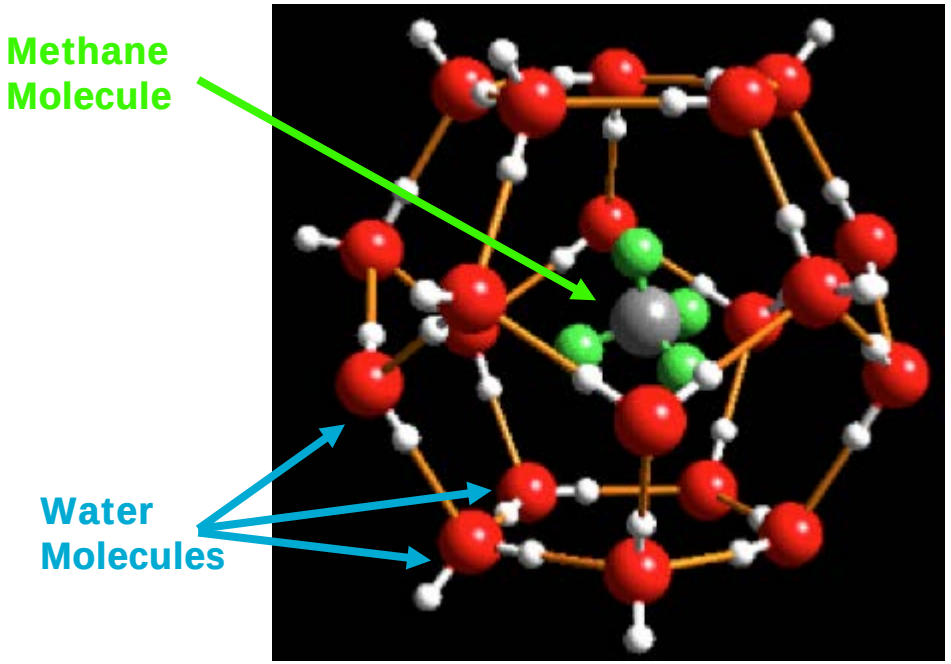
Definition and Requirements

- Dehydration is the process to remove water from natural gas and natural gas liquids (NGLs)

- Dehydration is required to:
  - Prevent hydrates formation and condensation of free water in processing and transportation
  - Meet water content specifications of products
  - Prevent corrosion in equipment, pipelines, users and combustion systems

Hydrates Formation

Hydrates is a physical combination of water and other small molecules to produce an ice-like appearance, but it is a different molecular structure than ice.



Hydrate Inhibition without Dehydration

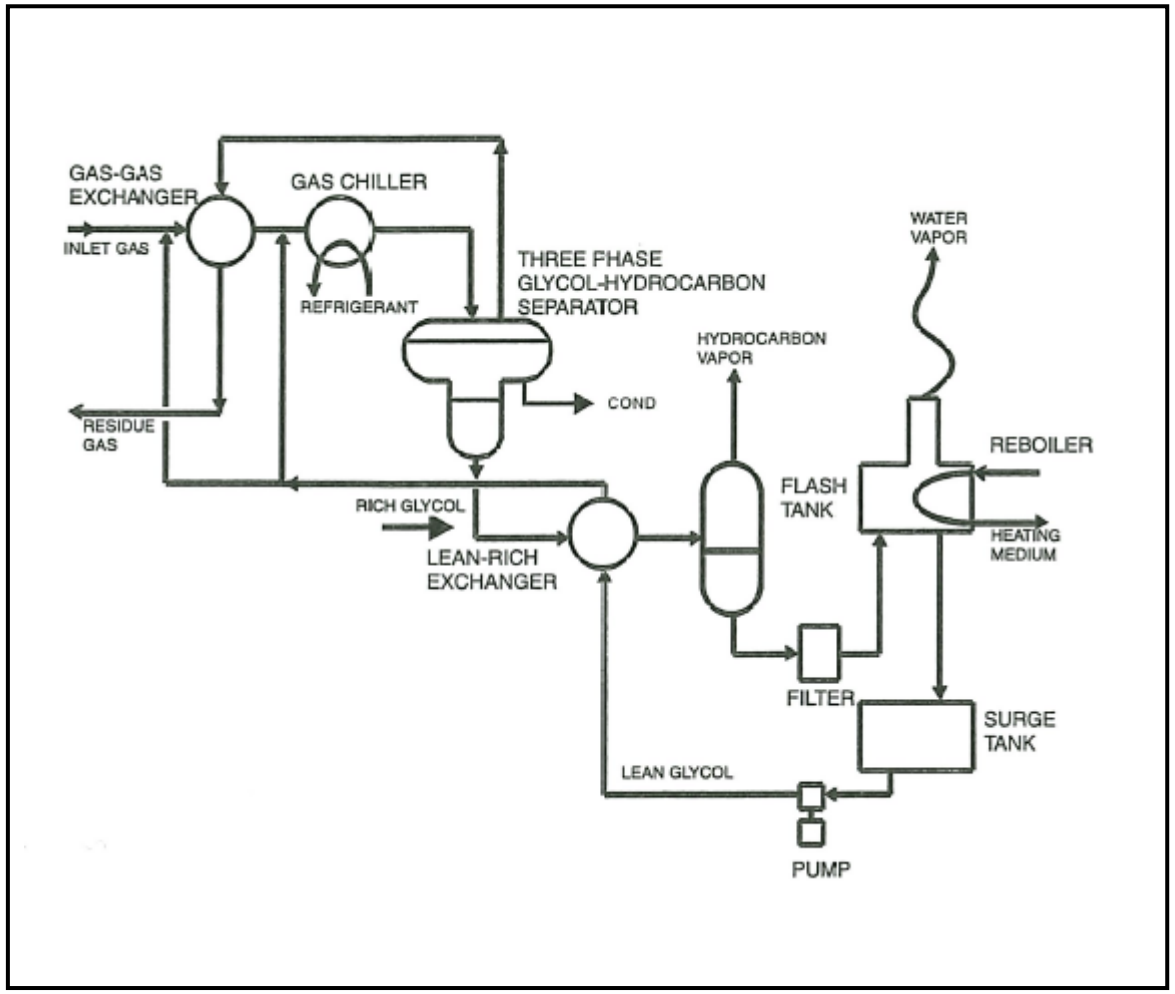
- Thermodynamic Inhibitors (Glycols and Methanol)
- Kinetic Hydrate Inhibitors
- Antiagglomerant Inhibitors

Dehydration Techniques for Natural Gas & NGLs

- Absorption using liquid desiccants (Glycols)
- Adsorption using solid desiccants (Mole Sieve)
- Dehydration with CaCl2
- Dehydration by refrigeration (using Methanol)
- Dehydration by membrane permeation
- Dehydration by gas stripping
- Dehydration by distillation

Glycol Dehydration System

Typical Glycol Injection System



Source: GPSA Fig 20-57

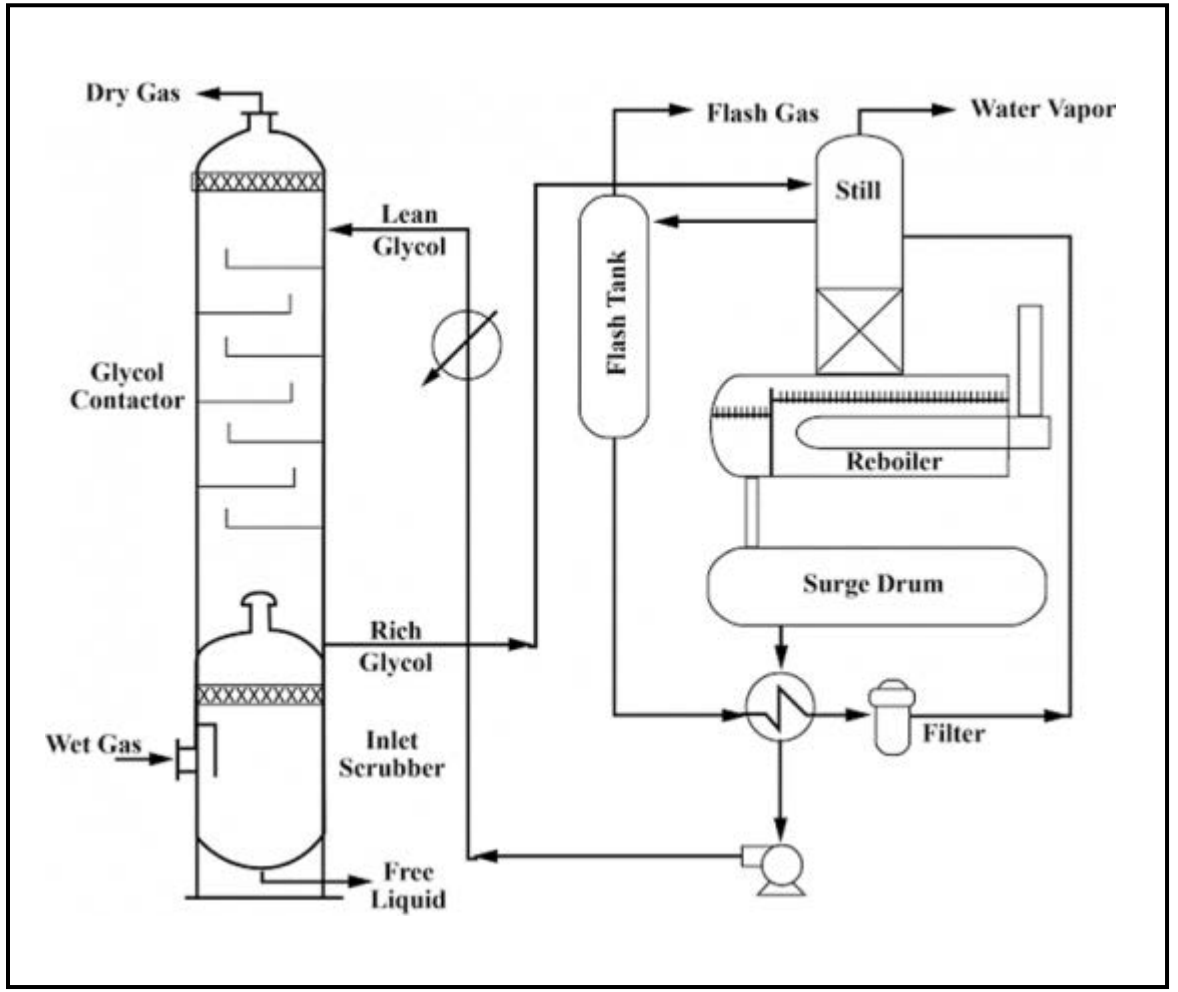
Glycol Dehydration System

Glycols used for dehydration are:

- Diethylene Glycol (DEG)
- Triethylene Glycol (TEG)
- Tetraethylene Glycol (TREG)

Glycol Dehydration System

Process Flow Diagram for Glycol Dehydration Unit



Source: GPSA Fig 20-67

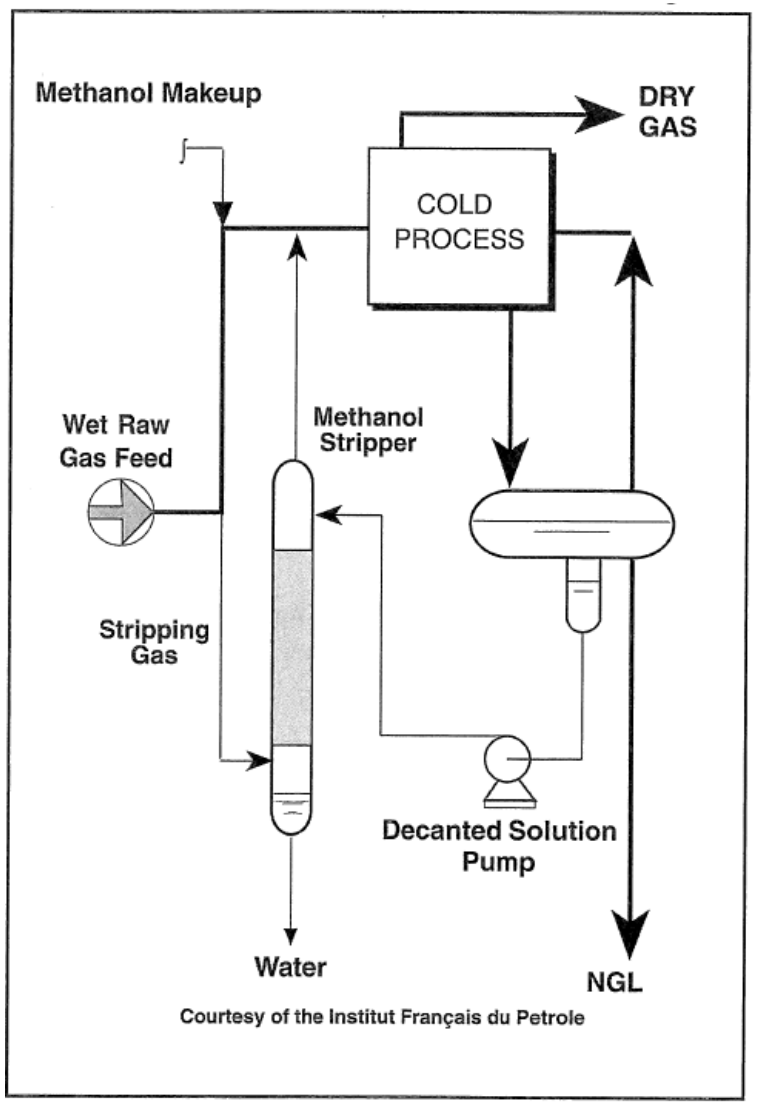
Enhanced Glycol Concentration Processes

- Efficiency of Triethylene Glycol (TEG) dehydration depends on the TEG purity

- Methods of regeneration to acquire more than 98.6 mass% purity:
  - Using stripping gas or operating reboiler under vacuum
  - **Drizo**™ technology (patented and achieves 99.9 mass% purity)
  - Coldfinger technology (patented and achieve 99.7 mass% purity)

Methanol and Refrigeration Dehydration System

IFPEX-1 ® Dehydration Process Flow Diagram

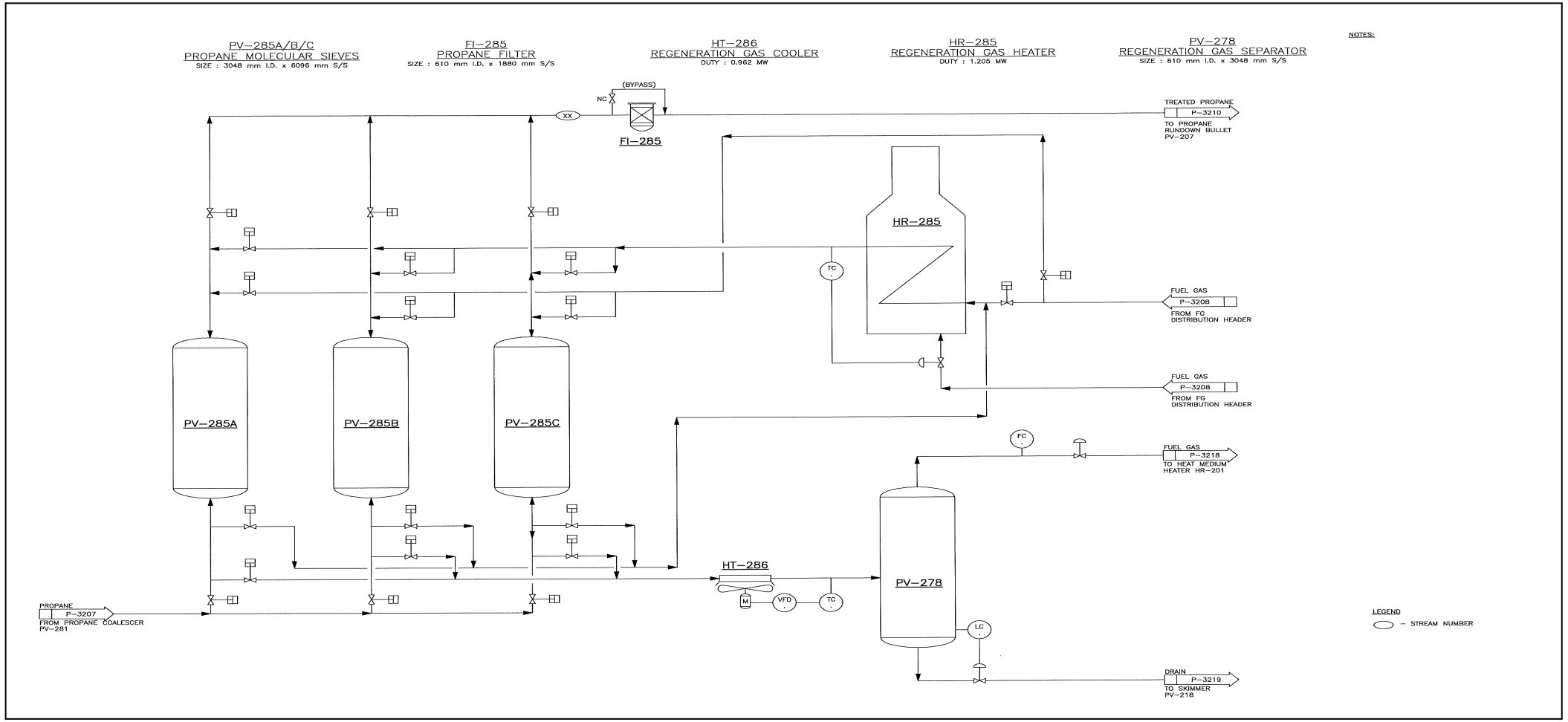


Source: GPSA Fig 20-90

Solid Desiccant Dehydration

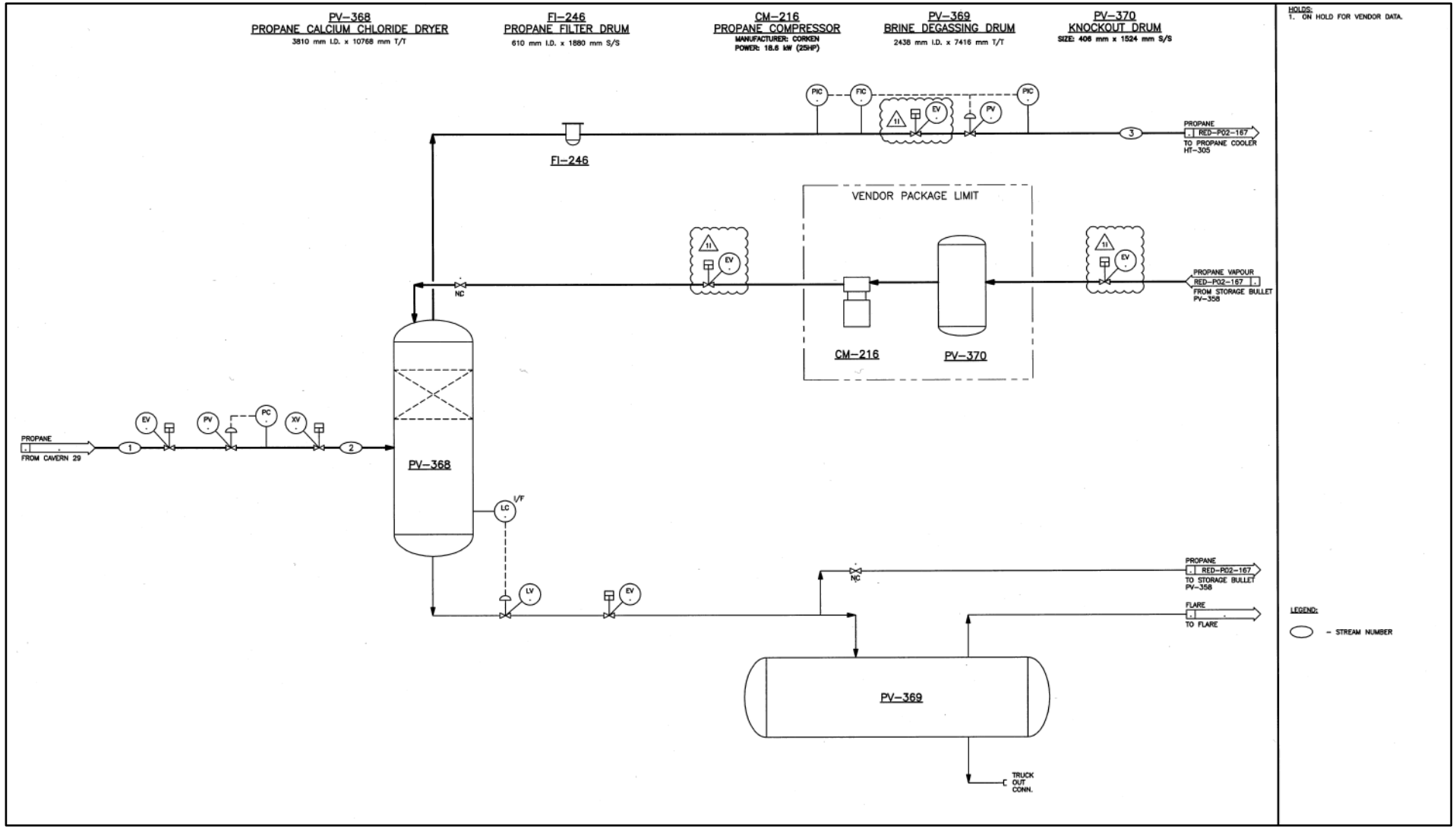
- Solid desiccants are typically used to attain low water dewpoint.
- There are three categories of common commercial solid desiccants:
  - Gels: Alumina & Silica gels (manufactured)
  - Alumina (manufactured or naturally available)
  - Molecular Sieves (manufactured or naturally available)

Molecular Sieve Dehydration System



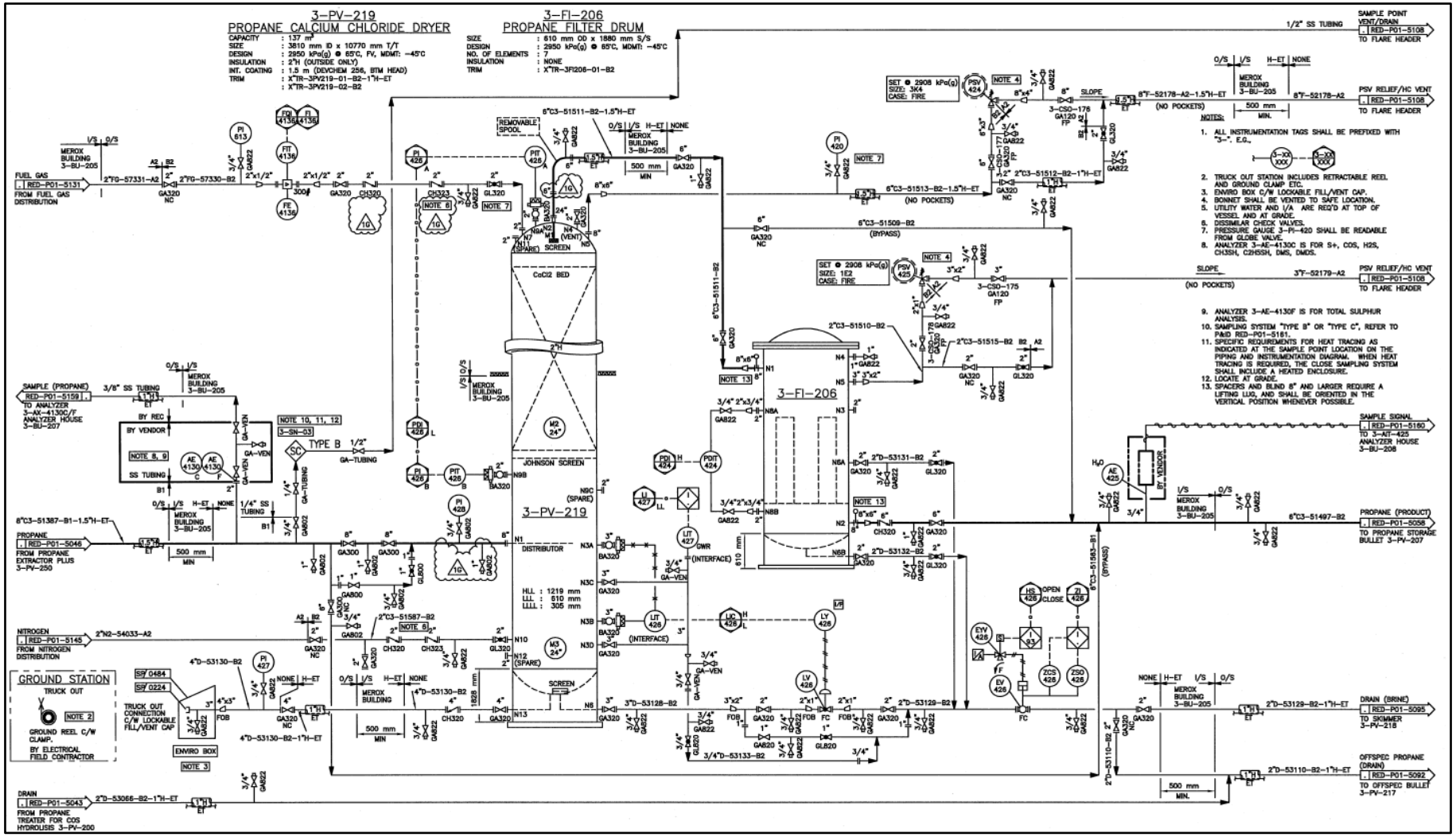
Source: Rangeland Engineering Canada Corp.

CaCl2 Dehydration System



Source: Pembina PFD

CaCl2 Dehydration System



Source:

Pembina P&ID

Dehydration by Membrane Permeation

- Contaminants removed according to their permeabilities.
- Can remove water and CO_2 from NG
- Permeated components are collected at low pressure

Liquid Hydrocarbons Dehydration

- Gas Stripping
- Solid Desiccants
- CaCl2 Bed
- Distillation

Water Content Measurement Methods

- Valve Freeze Method for LPG (ASTM D2713)
- Cobalt Bromide Method
- Bureau of Mines Dew Point Tester
- Karl Fischer Reagent (ASTM E700)

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Thank You

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