TURBOMACHINERY HYDROCARBON LOSS RECOVERY SYSTEMS

Sergio Cipriani1†, Catiuscia Fiumicelli1†, Giacomo Pampaloni1†, Andrea Gabbrielli1†

1† Baker Hughes

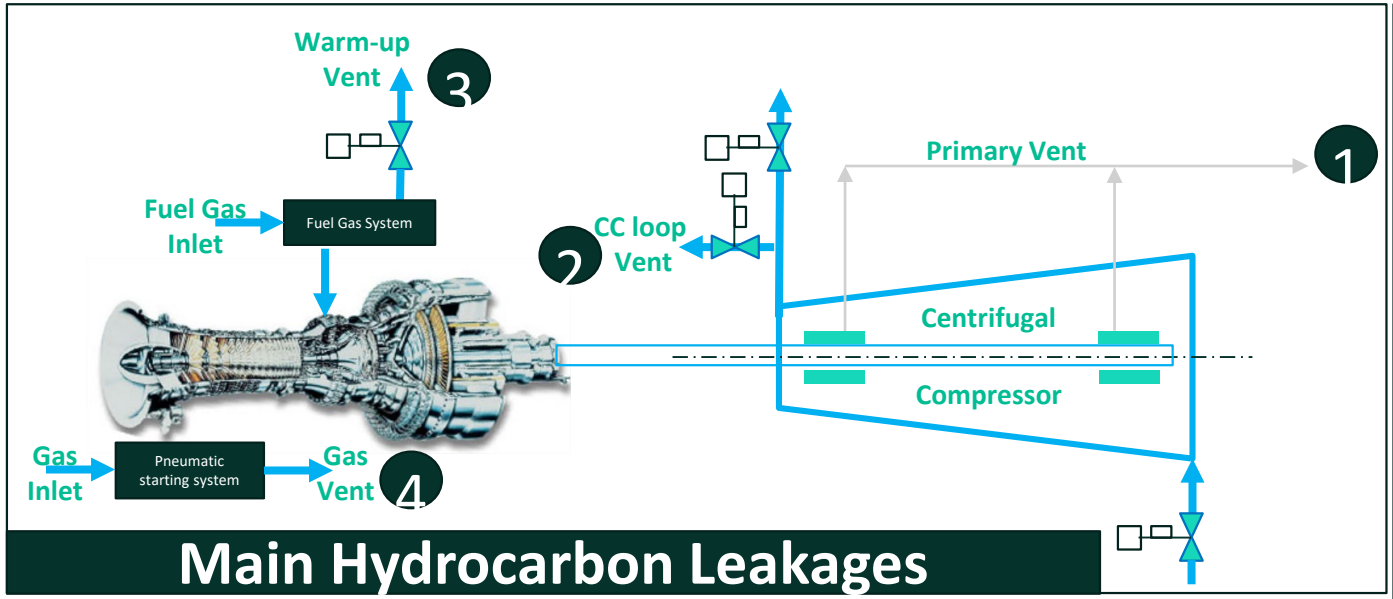
Via Felice Matteucci 2,

50127, Firenze, Italy

sergio.cipriani@bhge.com
catiuscia.fiumicelli@bhge.com
giacomo.pampaloni@bhge.com
andrea.gabbrielli@bhge.com

October 24, 2019

INTRODUCTION



Main Hydrocarbon Leakages

Global Warming Potential (GWP) Value: a measure of how much heat a greenhouse gas traps in the atmosphere up to a specific time horizon, relative to carbon dioxide.

$$tCO2e\ [tons] = CH4\ [tons] * GWP$$

tCO2e: tons of CO2 equivalent

Worldwide carbon pricing initiatives (2019)

57

28 emissions trading systems (ETSs)

29 carbon taxes

Covered 11 Gtons of carbon dioxide equivalent (GtCO2e)
About 20% global greenhouse gas (GHG) emissions

Thanks to the CP initiatives, the recovery and valorization of small amount (compared to the main process stream entity) of hydrocarbons leakages is now becoming economically viable, which was not the case in years past

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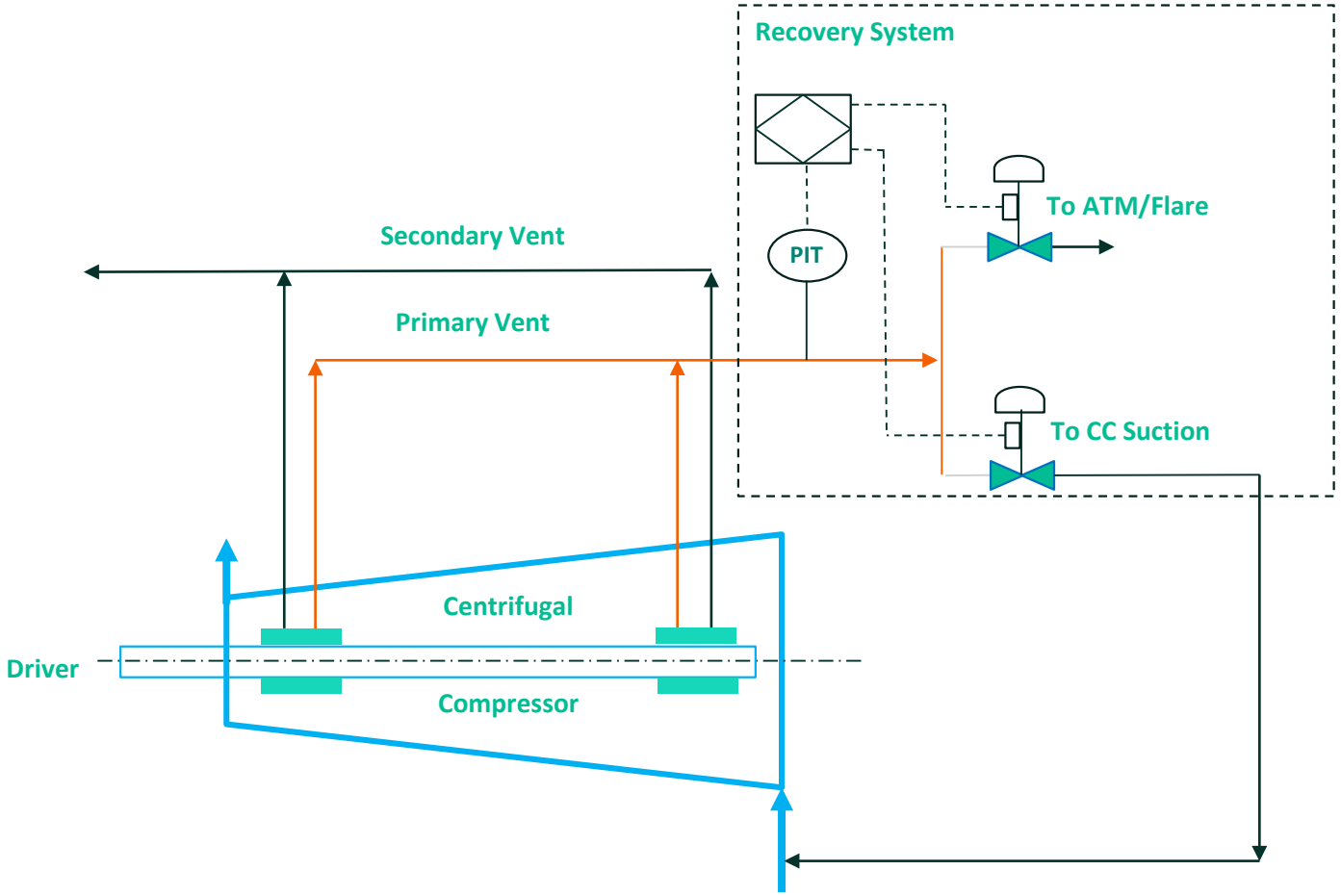
Primary Vent – Suct P< 2 bar-a



Primary vent gas is routed directly to the compressor inlet

- suction pressure below 2 barg
- Directly injected into the compressor suction
- DGS Primary vent (PV) is collected through a control valve
- Applies to low compressor suction pressure (Typical for LNG)

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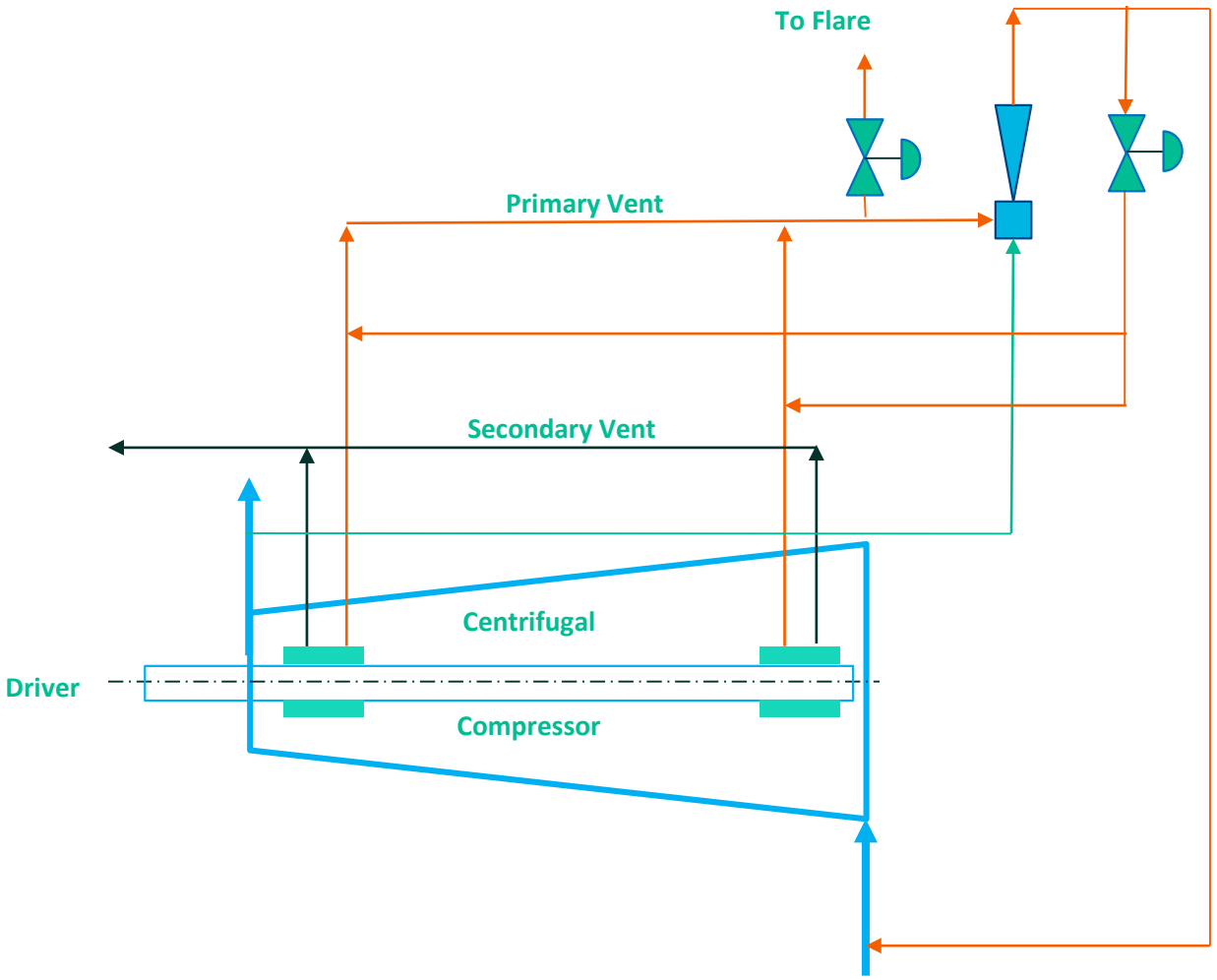
Primary Vent – Suct P< 6 bar-a



Pump-jet to recycle DGS vent into the compressor suction

- Compressor has a suction pressure lower than 5-6 barg
- Primary vent is injected into the compression inlet through a pump-jet
- An extraction from CC discharge acts as motive fluid to ejector for pressurizing gas to the recycling channel
- Flow rate of the pump-jet driving stream is controlled by a recycling circuit

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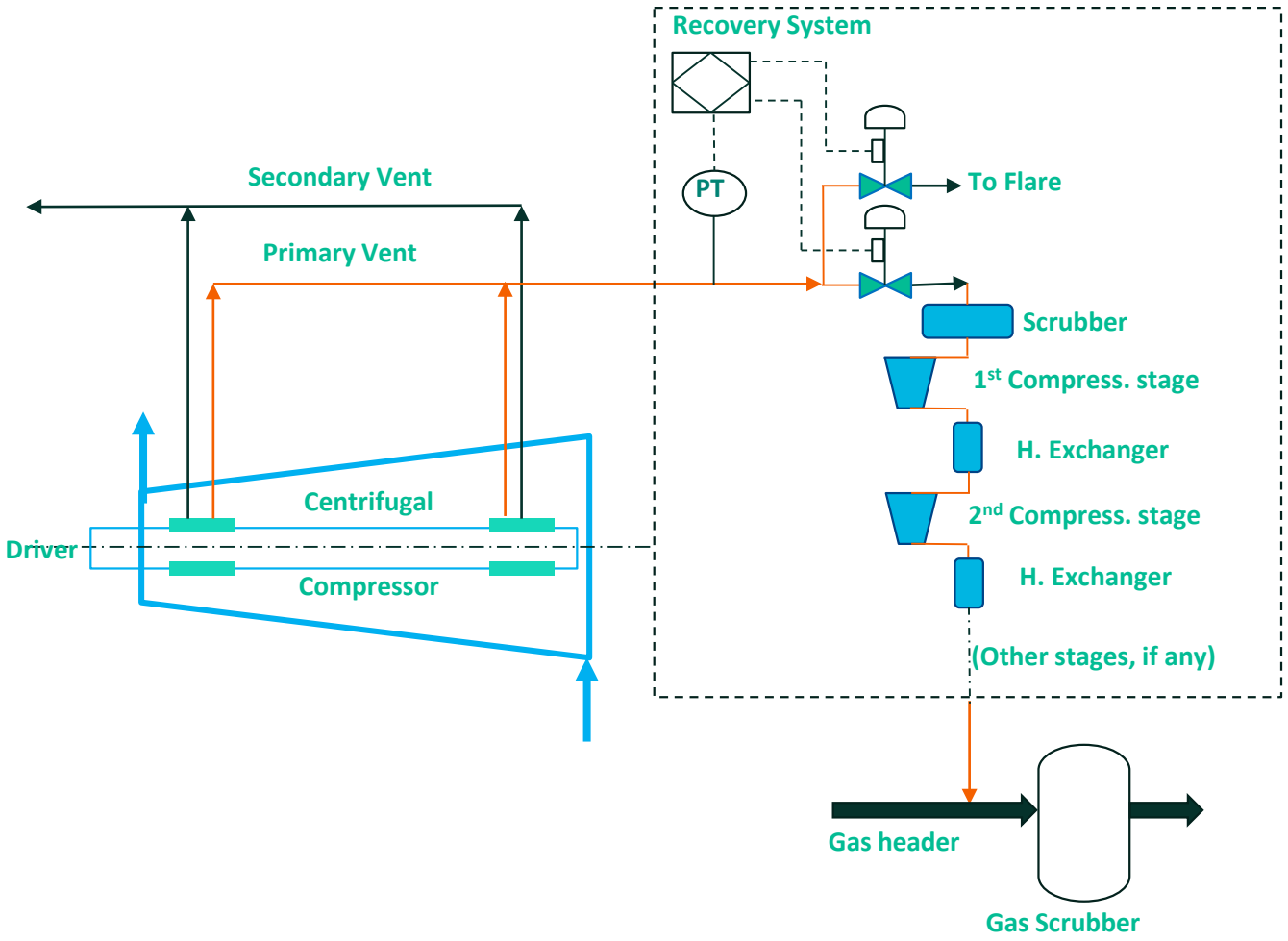
Primary Vent – Suct P> 6 bar-a



RC compressor to injection in LP compressor suction

- DGS leakages recycled through a small booster compressor
- Typical compressor absorbed power is <35kW
- The sizing of gas booster depends on primary vent flow and pressure ratios
- For large pressure ratios, may are required two or more intercooled stages

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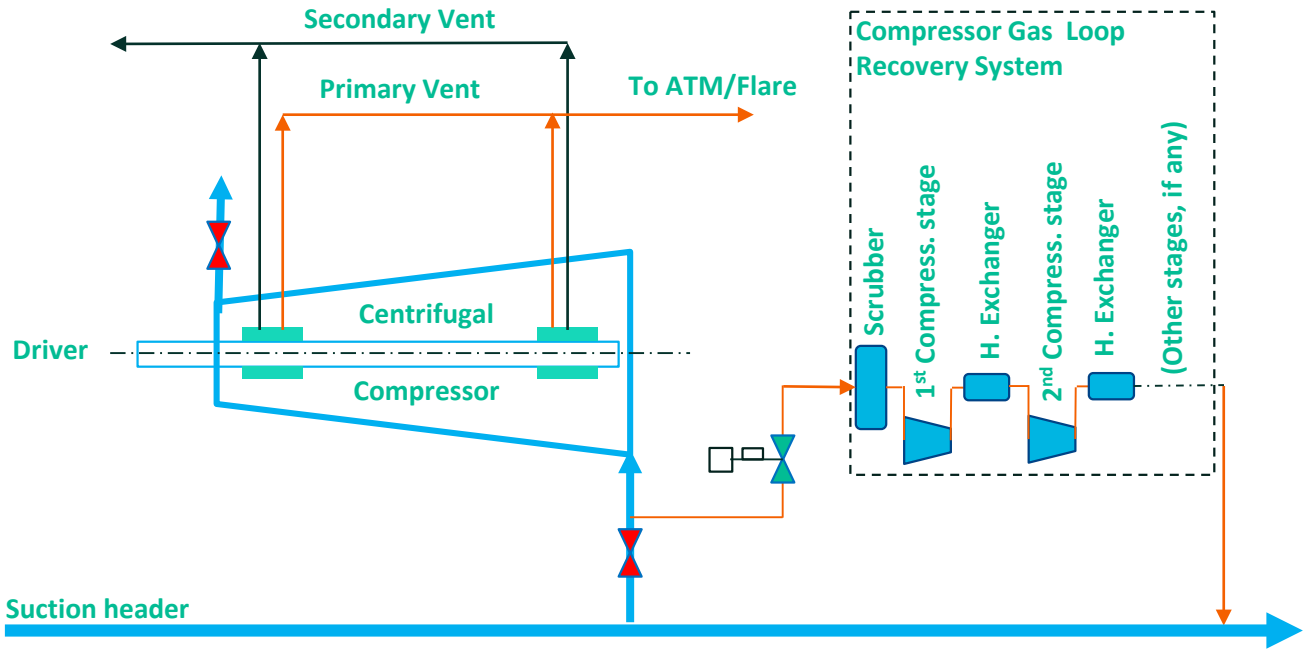
Process gas recovery System

Gas extraction from the compressor loop after a maintenance shutdown



RC compressor to move process gas to suction header

- Gas extraction from the compressor loop (between inlet and outlet process valves) after a maintenance shutdown instead of venting it to atmosphere
- Typical compressor absorbed power is <75 kW
- The sizing of gas booster depends on process gas volume and emptying time
- For large pressure ratios, may are required two or more intercooled stages

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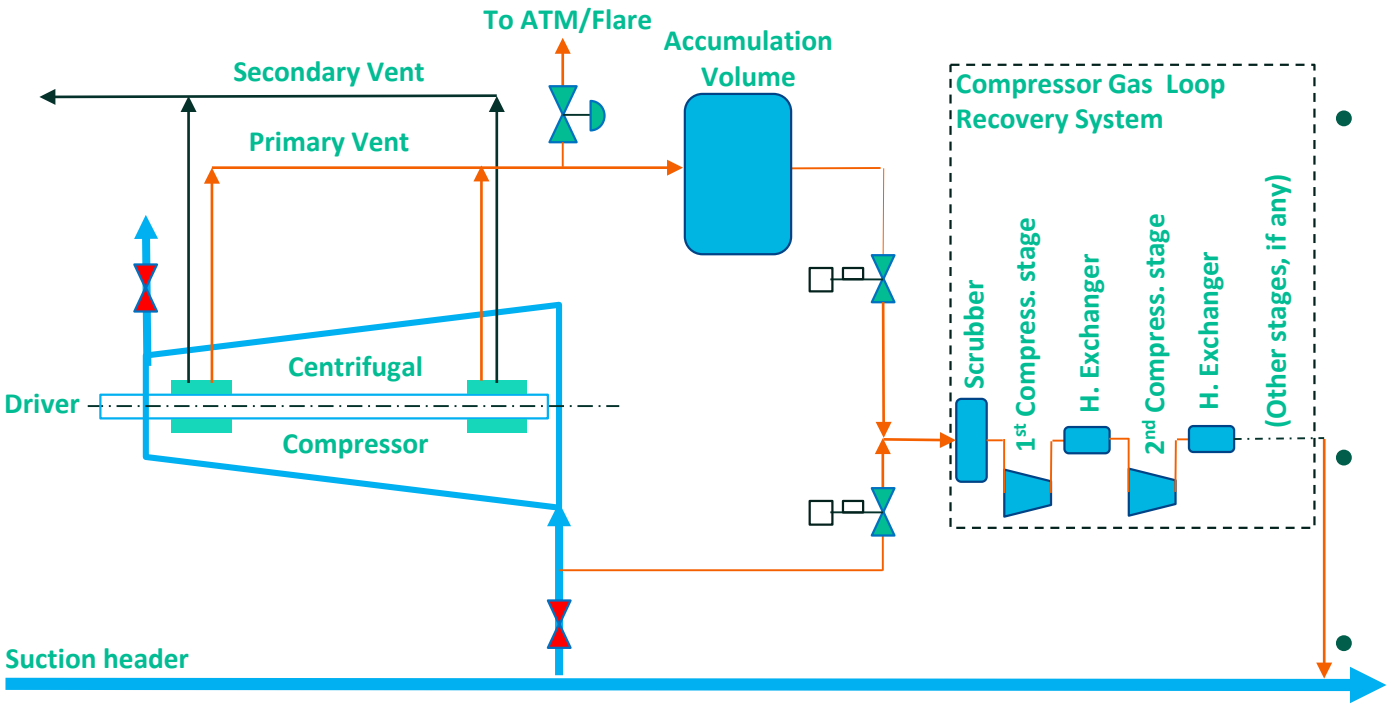
Combined recovery System

Combined DGS primary vent and process gas recovery



RC compressor to move process gas and DGS vent to suction header

- The sizing of gas booster is driven by process gas recovery
- A volume, working in a limited pressure range (≈1.3÷3 bara), will be filled by primary vent flow, and will be intermittently emptied by booster compr.
- RC typical startup frequency on DGS leakage recovery mode is once an hour
- Typical compressor absorbed power is <75 kW

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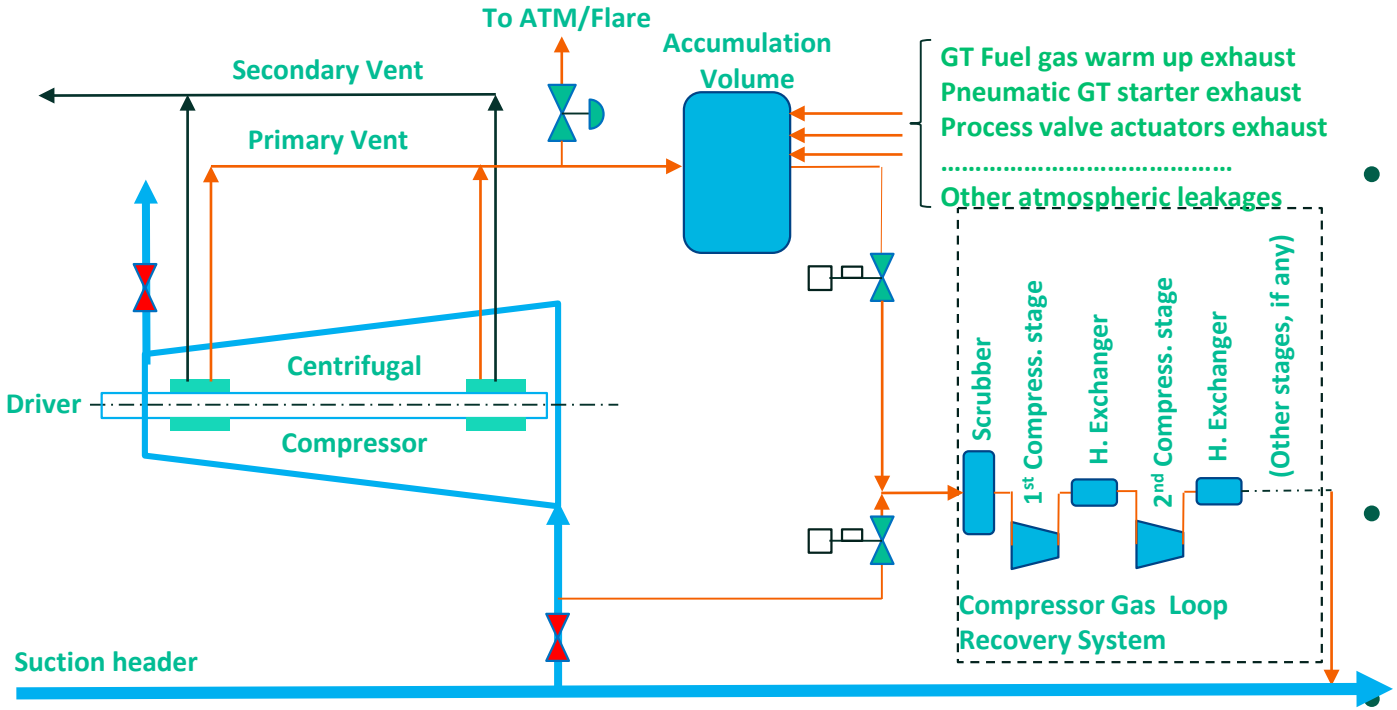
Extended Combined recovery System

Combined atmospheric hydrocarbon leakages recovery



RC compressor to move atmospheric vents to suction header

- The sizing of gas booster is driven by process gas recovery flow rate. Absorbed power is typically <75 kW
- An accumulation volume, operating in a limited pressure range, will be filled by ATM vents, and will be intermittently emptied by booster
- GT fuel gas warm-up and pneumatic started exhaust could be recovered
- Generically ATM hydrocarbon vents could be recovered

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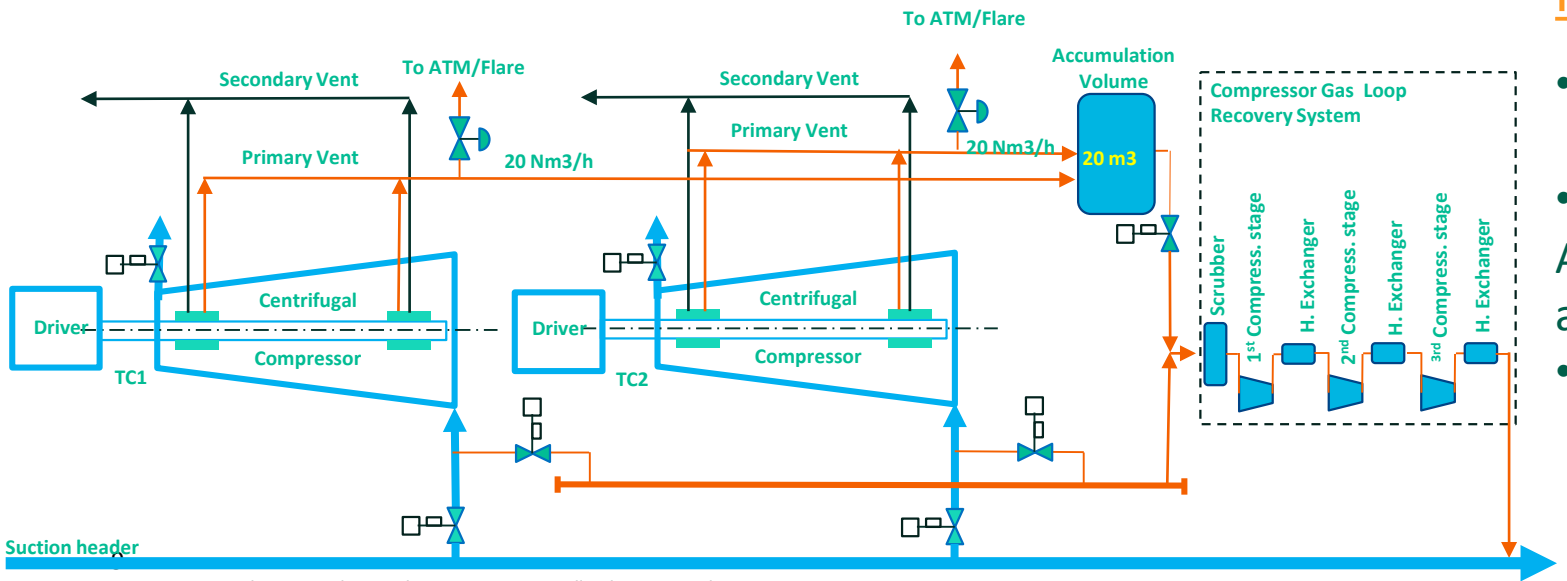
Case Study – Pipeline Station

Assumption:

- Gas composition: Natural Gas
- TC1 will run 8000 hrs/year with no stops
- TC2 will 3000 hrs/years mainly into the winter time with 2 (two) depressurized stops.
- The DGS primary vent leakages is 20 Nm3/h for each compressor
- Each centrifugal compressor gas loop (between CC suction and discharge isolation valve) is 100m3
- Suction header pressure = 75bar-a

Description:

- A three-stage reciprocating compressor (RC) driven by a 55kW LV electric motor
  A 20 m3 accumulation volume to recover the PV. RC start-up frequency approximately each 2 hours, in a pressure range of 1.3÷2.3 bara
- Five additional process valves to select the wanted gas loop and/or the primary vents to recover
- Remote PLC to control the RC and process valves
- Interconnecting piping, cables, instruments



RESULTS in 1year operation:

- 170 tons of reduced natural gas emission equivalent to 4200 tons of CO2e (GWP 25)
- ≈14k CAD$ of recovered gas (1.6CAD$/GJ)

Assuming a Carbon tax of 40CAD$/tCO2e applied in the future to these types of emissions:

- 170k CAD$ in Carbon tax saving

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Conclusion

- Continuous increase in regulatory emissions constraints
- Increased public attention on green house gas emissions
- Carbon pricing (CP) initiatives

→ Boosted the search for technical solutions to reduce the release of contaminants into the atmosphere

Baker Hughes solutions **help to recover a consistent part of the atmospheric hydrocarbon leakages** present in a Turbomachinery O&G plant.

- Carbon Tax Savings (if it will be applied in the future to these types of emissions)
- Recovered Gas value

→ Hydrocarbon Recovery Solutions **Payback 2÷5 years**

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