NGL EXTRACTION
SPE - BACK TO BASICS

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DEFINITIONS

- NGL - C_{2+}
- LPG - C_3 and C_4
- LNG - C_1
- Condensate - plant inlet separator hydrocarbon liquid
- Pentanes-Plus - C_{5+} (stabilized condensate)

TYPICAL GAS ANALYSIS

Component	Mol Fraction	Liquid Recovery L/1000m³
H2	0.0000	
He	0.0001	
N2	0.0166	
CO2	0.0356	
H2S	0.0000	
C1	0.7151	
C2	0.1206	428.6
C3	0.0573	210.6
IC4	0.0089	38.9
NC4	0.0149	62.7
IC5	0.0048	23.4
NC5	0.0049	23.7
C6	0.0059	32.4
C7	0.0153	94.2
TOTAL	1.0000	914.5

Source	Date	Notes

NGL

LPG

C_{5+}

CHARACTERIZATIONS

- Dry Gas
- Lean Gas
- Rich Gas
- Wet (hydrocarbon) Gas
- Solution Gas
- Sales Gas or Residue Gas

TYPICAL GAS COMPOSITIONS, MOLE PERCENT

Component	Dry Gas	Rich Gas	Wet Gas (reservoir comp.)	Solution Gas	Sales Gas
H_2	0.02	0.01	0.00	0.01	0.01
He	0.00	0.00	0.00	0.00	0.00
N_2	0.68	0.94	0.23	0.51	0.55
CO_2	0.89	0.86	1.08	0.82	0.88
H_2S	0.00	0.00	0.00	0.00	0.00
C1	92.32	81.62	70.10	77.70	87.92
C2	3.25	8.17	10.10	10.35	5.25
C3	1.80	4.49	5.28	6.85	3.34
iC4	0.43	1.44	1.40	0.77	0.71
nC4	0.61	1.54	2.15	1.73	1.02
iC5	0.00	0.28	1.01	0.36	0.25
nC5	0.00	0.45	0.99	0.41	0.08
C6	0.00	0.11	2.91	0.25	0.00
C7+	0.00	0.09	4.75	0.24	0.00
Total	100.00	100.00	100.00	100.00	100.00

WHY EXTRACT NGL?

- Meet Sales Gas Specifications (TCPL)
  - -10 degrees C (at 5 000 kPa)
- Make Money

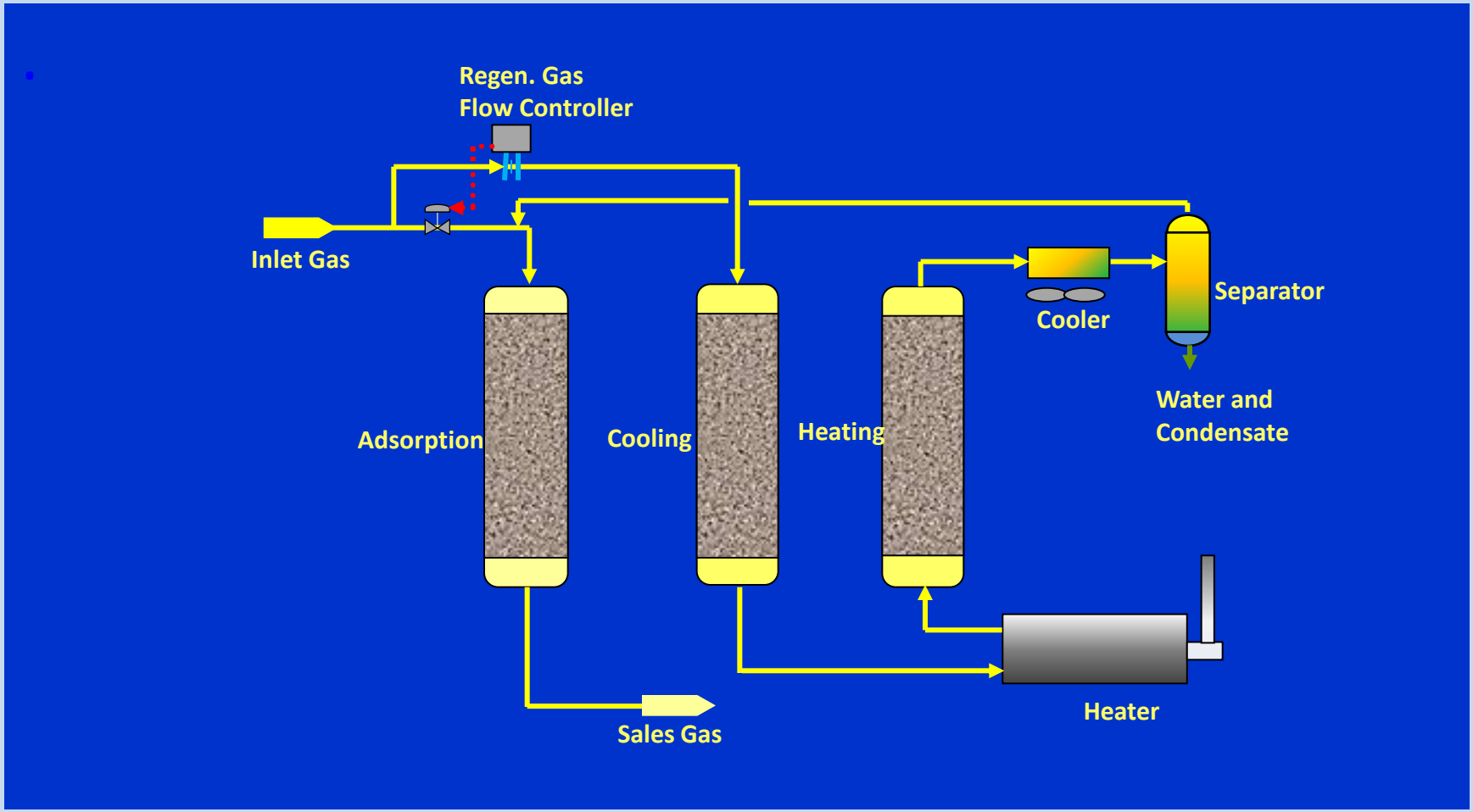
NGL EXTRACTION METHODS

- Short Cycle Dry Desiccant Adsorption
- Cooling
  - Joule-Thomson Expansion
  - Refrigeration
    - With glycol
    - With methanol
  - Turbo-Expander
- Lean Oil Absorption

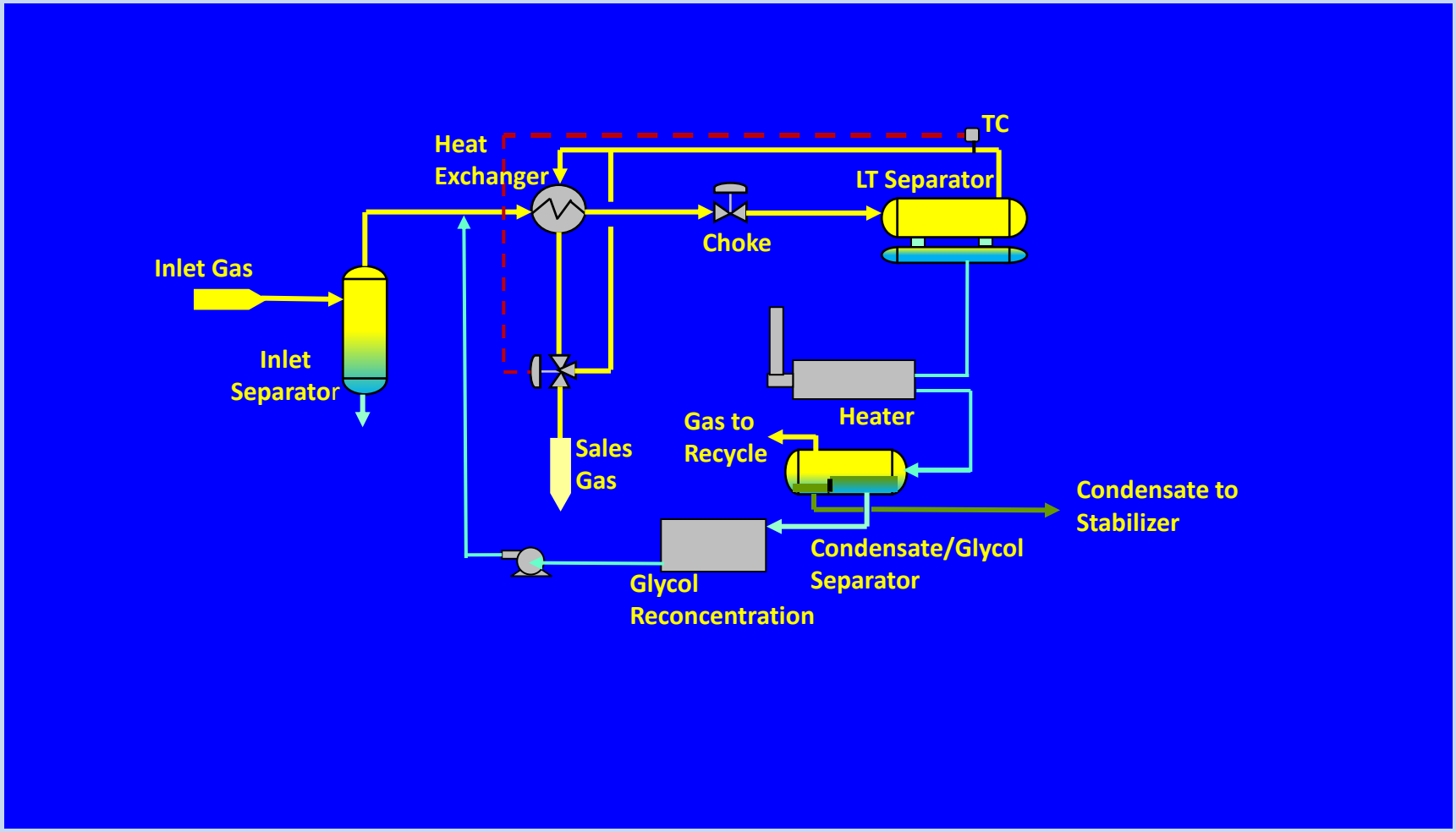
RULES OF THUMB REGARDING EXTRACTION PROCESSES

- For hydrocarbon dewpoint control only:
  - Short cycle adsorption
  - Joule-Thomson expansion
  - Refrigeration to about – 20 ^{o}C
- For basic NGL recovery:
  - Refrigeration to about – 20 ^{o}C
  - Lean oil absorption at ambient temperature
  - Turboexpander without external refrigeration
- For high NGL recovery, including ethane:
  - Turboexpander
  - Refrigeration to about -30 ^{o}C
  - Refrigerated lean oil absorption (not suited for ethane recovery).
- All require economic comparisons

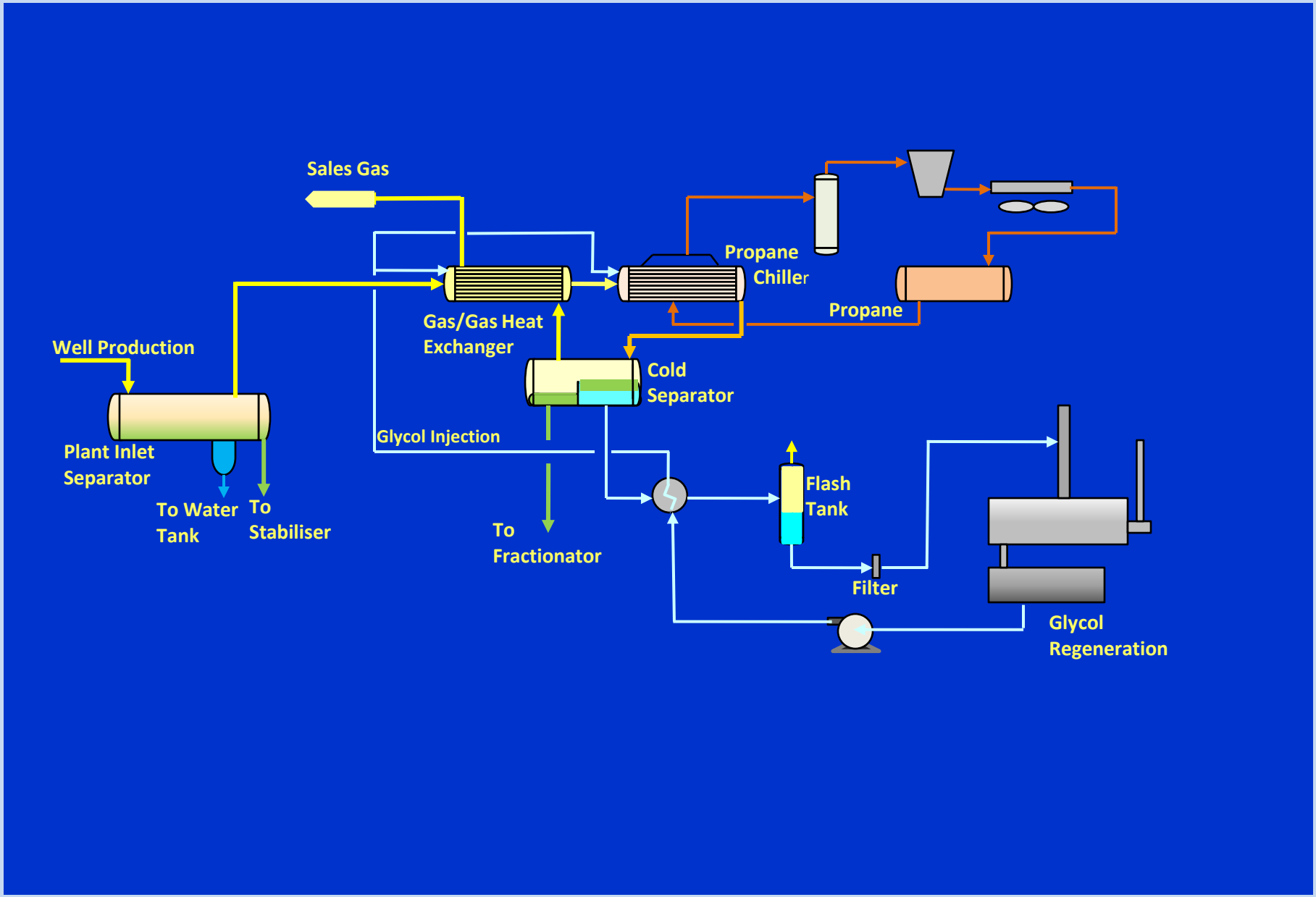
SCHEMATIC OF SHORT CYCLE ADSORPTION PROCESS EQUIPMENT



SCHEMATIC OF JOULE-THOMSON PROCESS EQUIPMENT

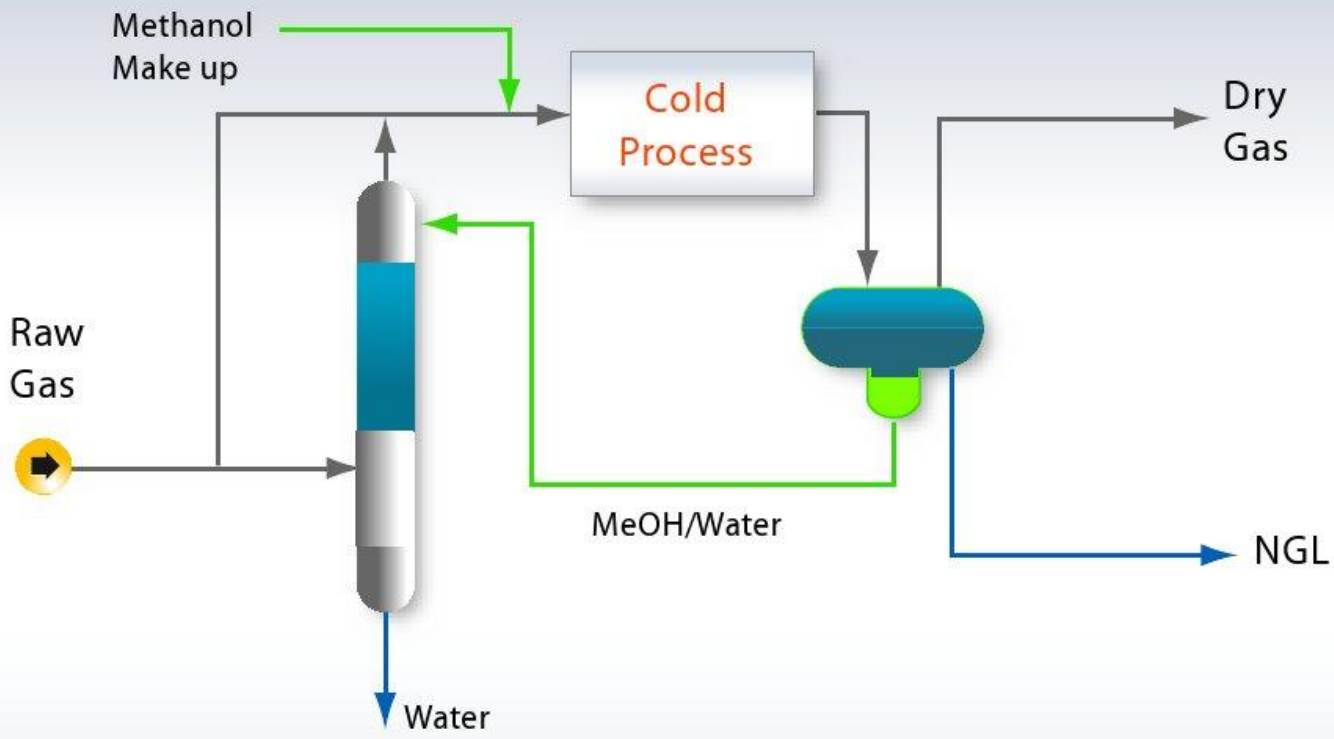


SCHEMATIC OF REFRIGERATION PROCESS EQUIPMENT



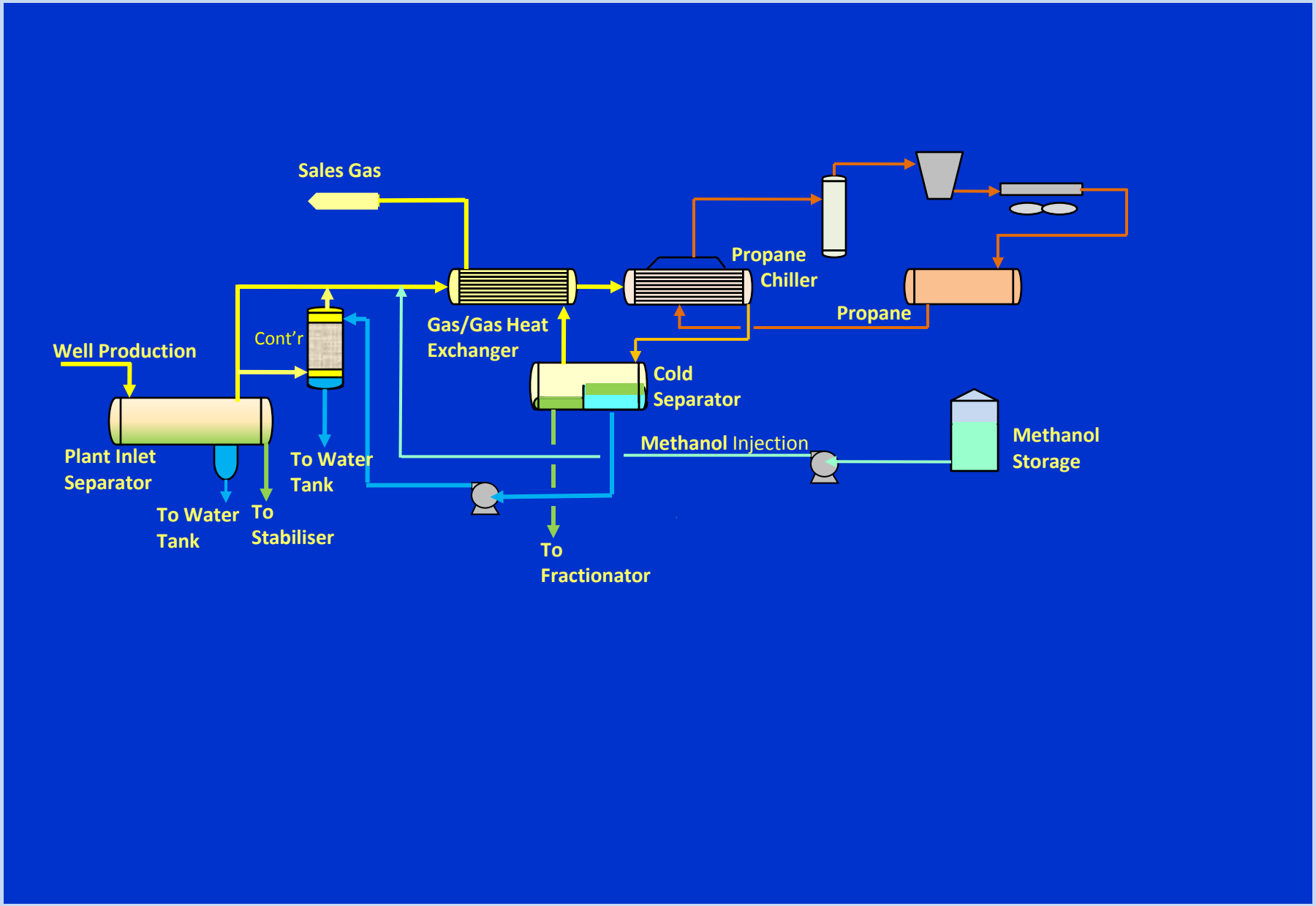
TYPICAL HEAT EXCHANGE AND PROPANE CHILLER EQUIPMENT

Ifpex-1 : Simultaneous Water & HC Dewpointing

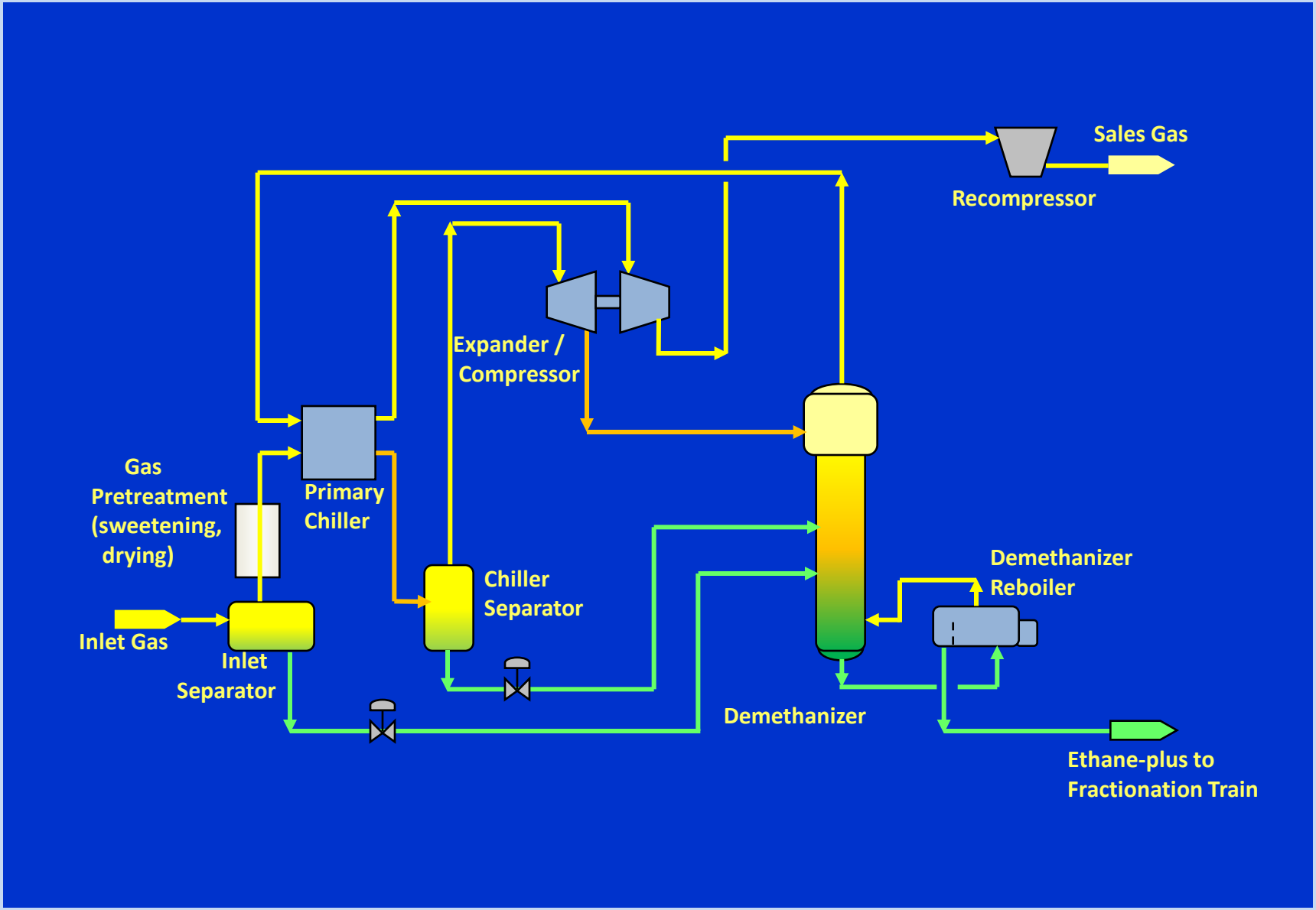


Prosernat/IFP Group Technologies, Wikipedia

SCHEMATIC OF IFPEXCOL PROCESS EQUIPMENT



SCHEMATIC OF TURBOEXPANDER PROCESS EQUIPMENT



SCHEMATIC OF TURBOEXPANDER PROCESS EQUIPMENT

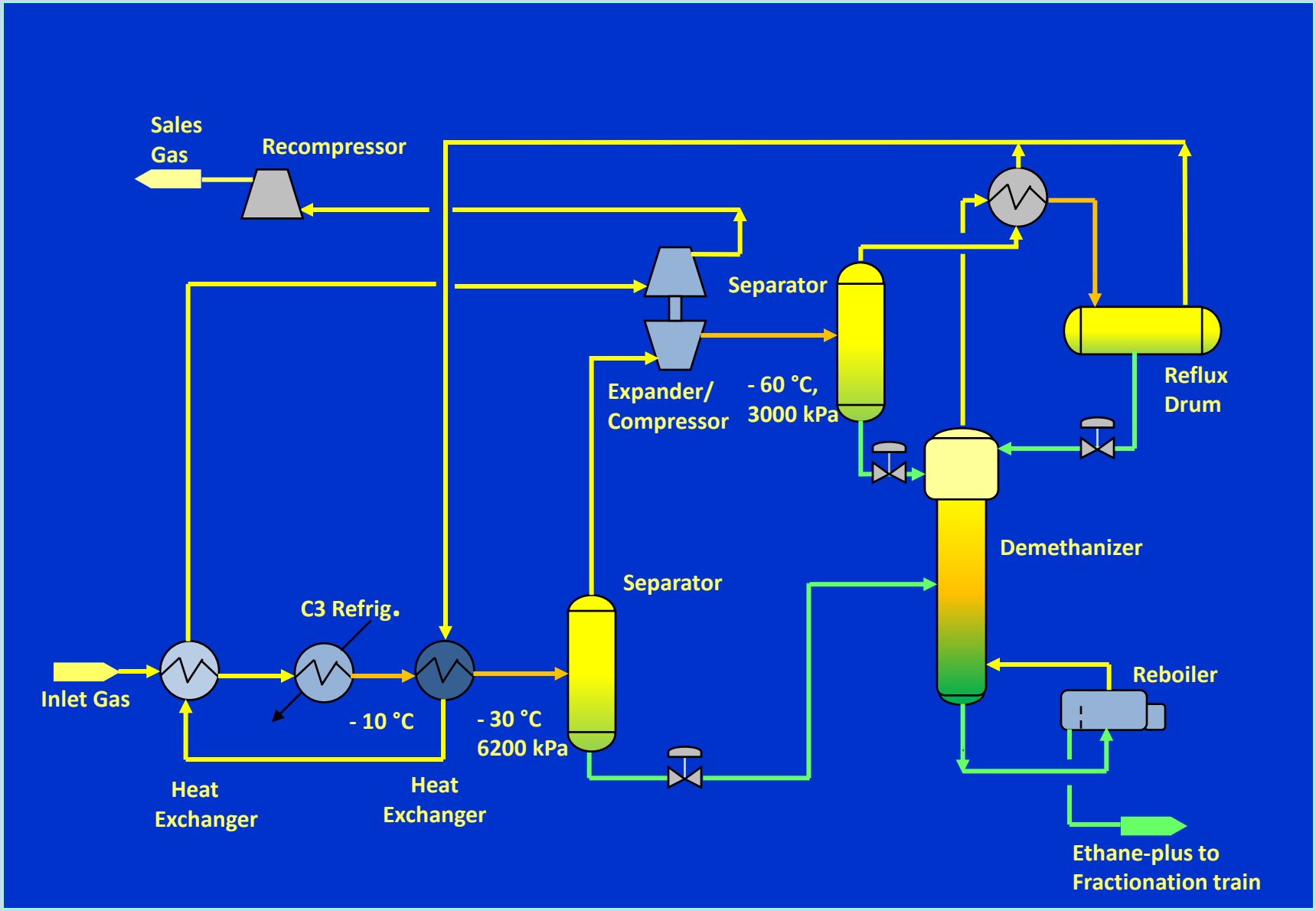
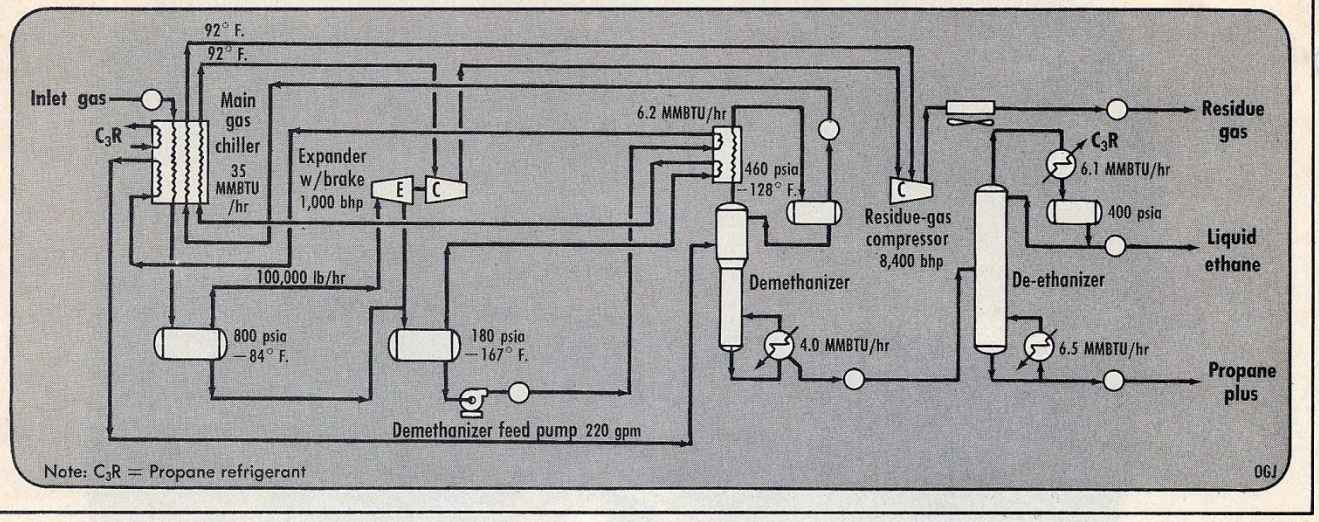


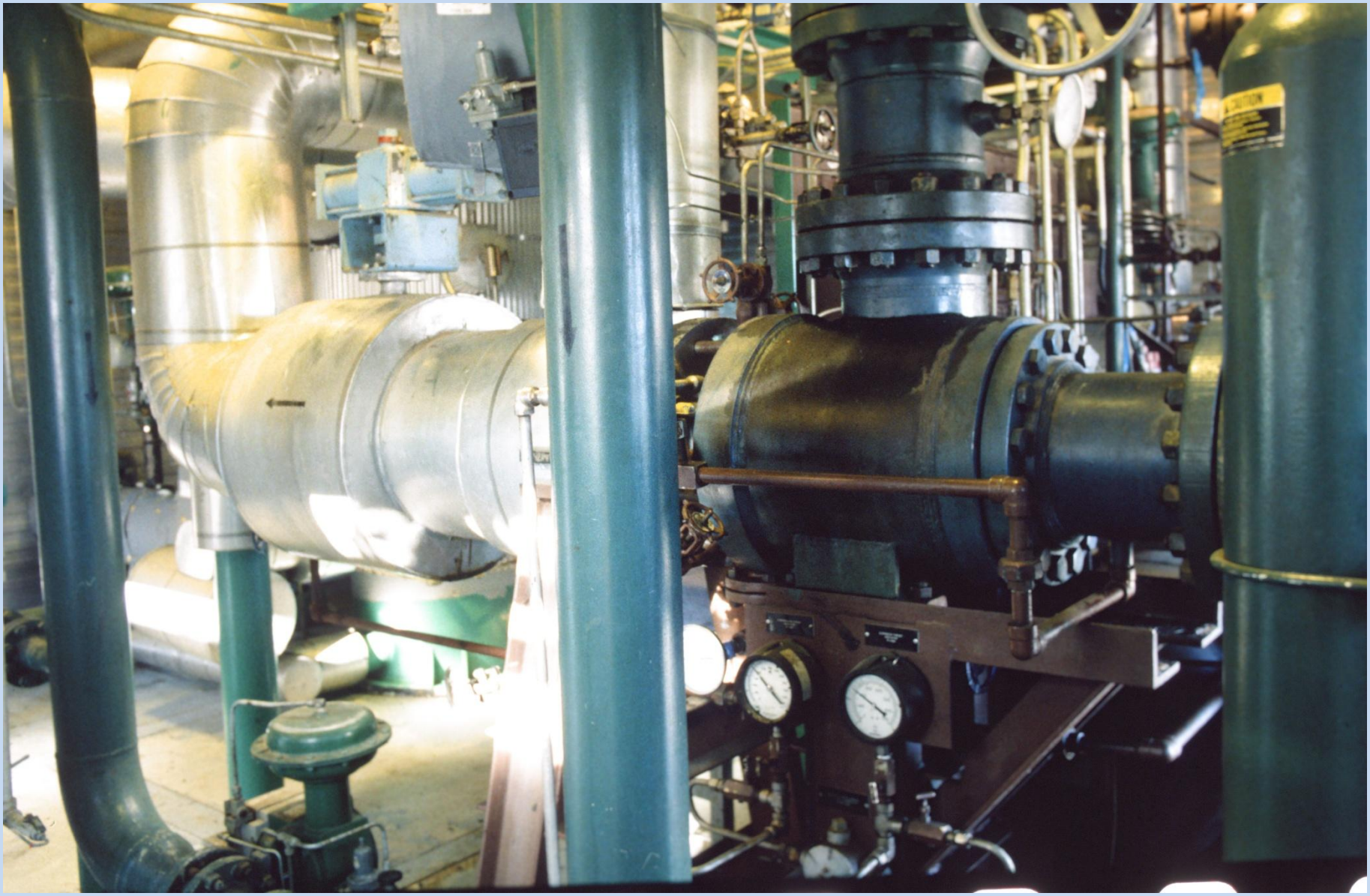
Fig. 2

Expander-process scheme



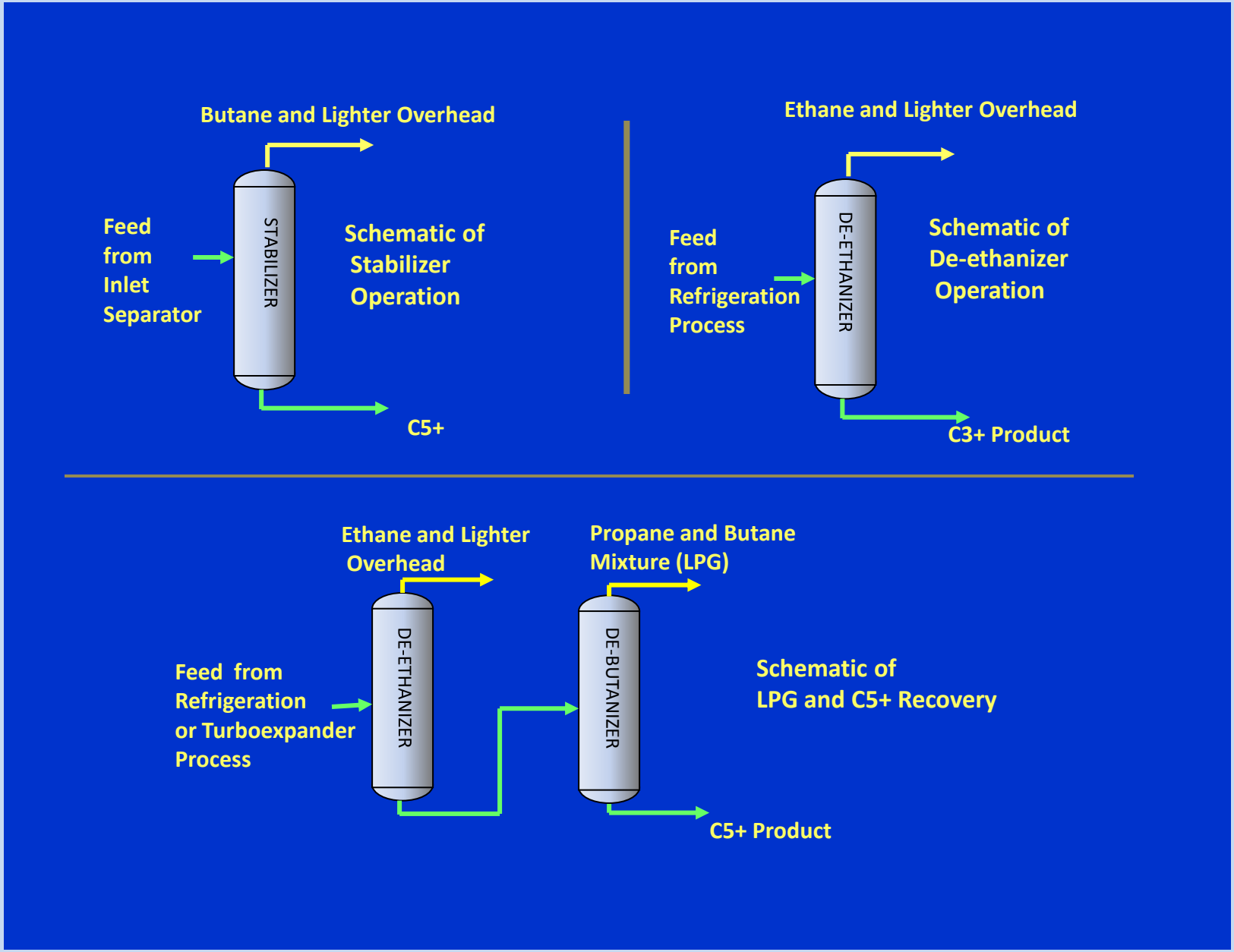
D. J. Morgan, O&GJ May 3/76 pp.230-243.

VIEW OF TURBOEXPANDER EQUIPMENT

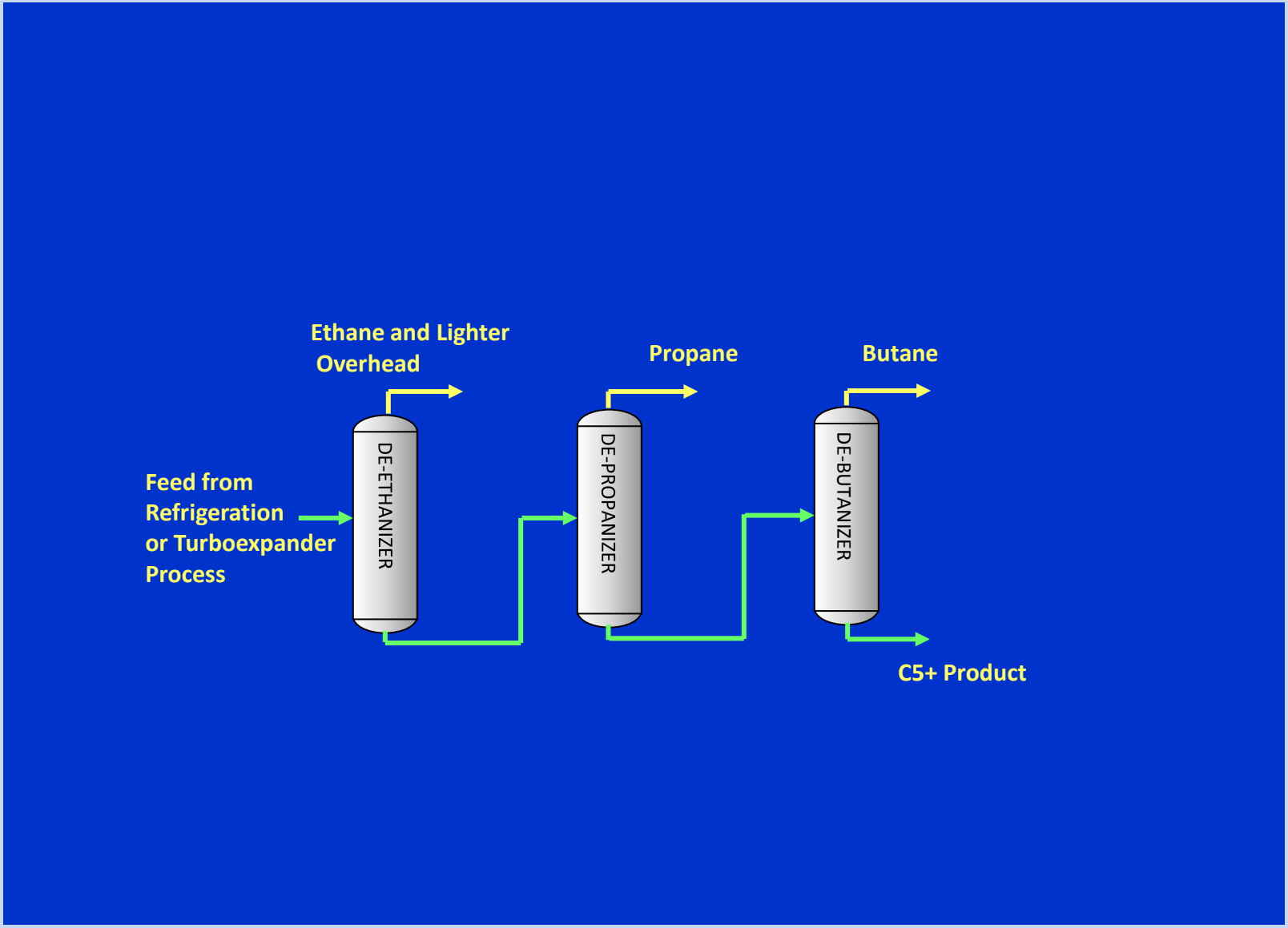


VIEW OF TURBOEXPANDER EQUIPMENT

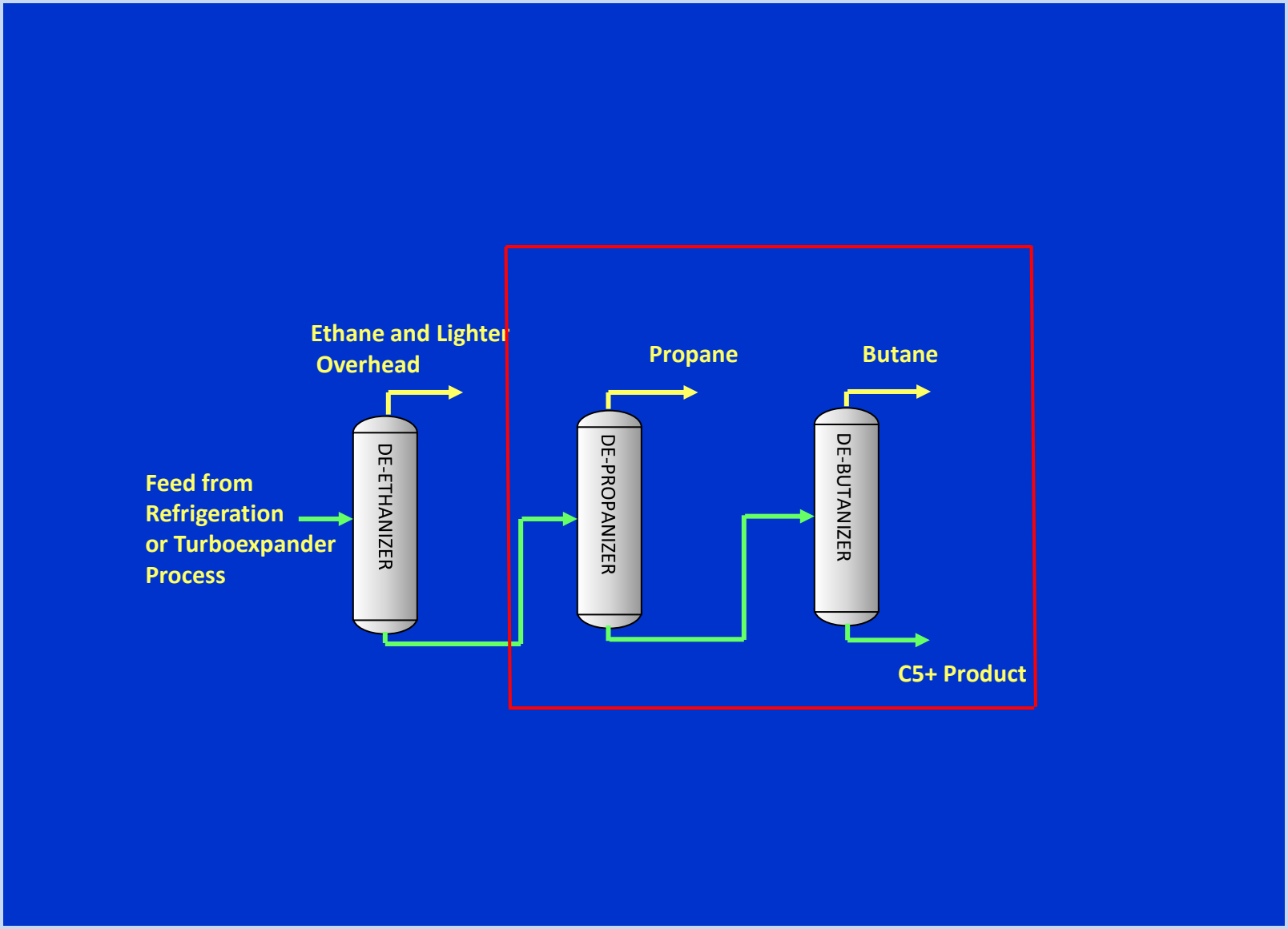
SCHEMATIC DRAWINGS OF DIFFERENT FRACTIONATION PROCESSES



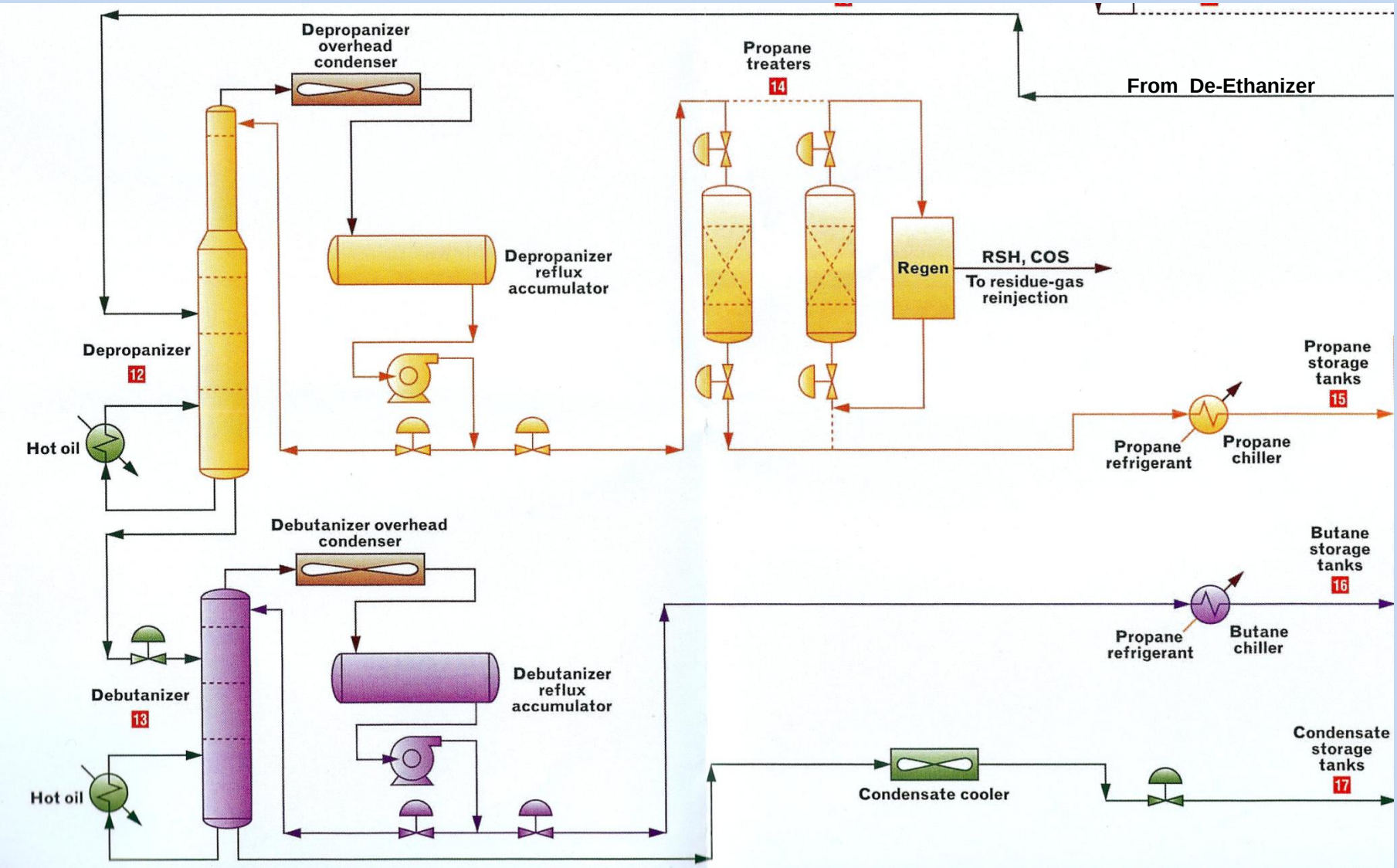
SCHEMATIC DRAWING OF DIFFERENT FRACTIONATION PROCESSES (cont'd)



SCHEMATIC DRAWING OF DIFFERENT FRACTIONATION PROCESSES (cont'd)



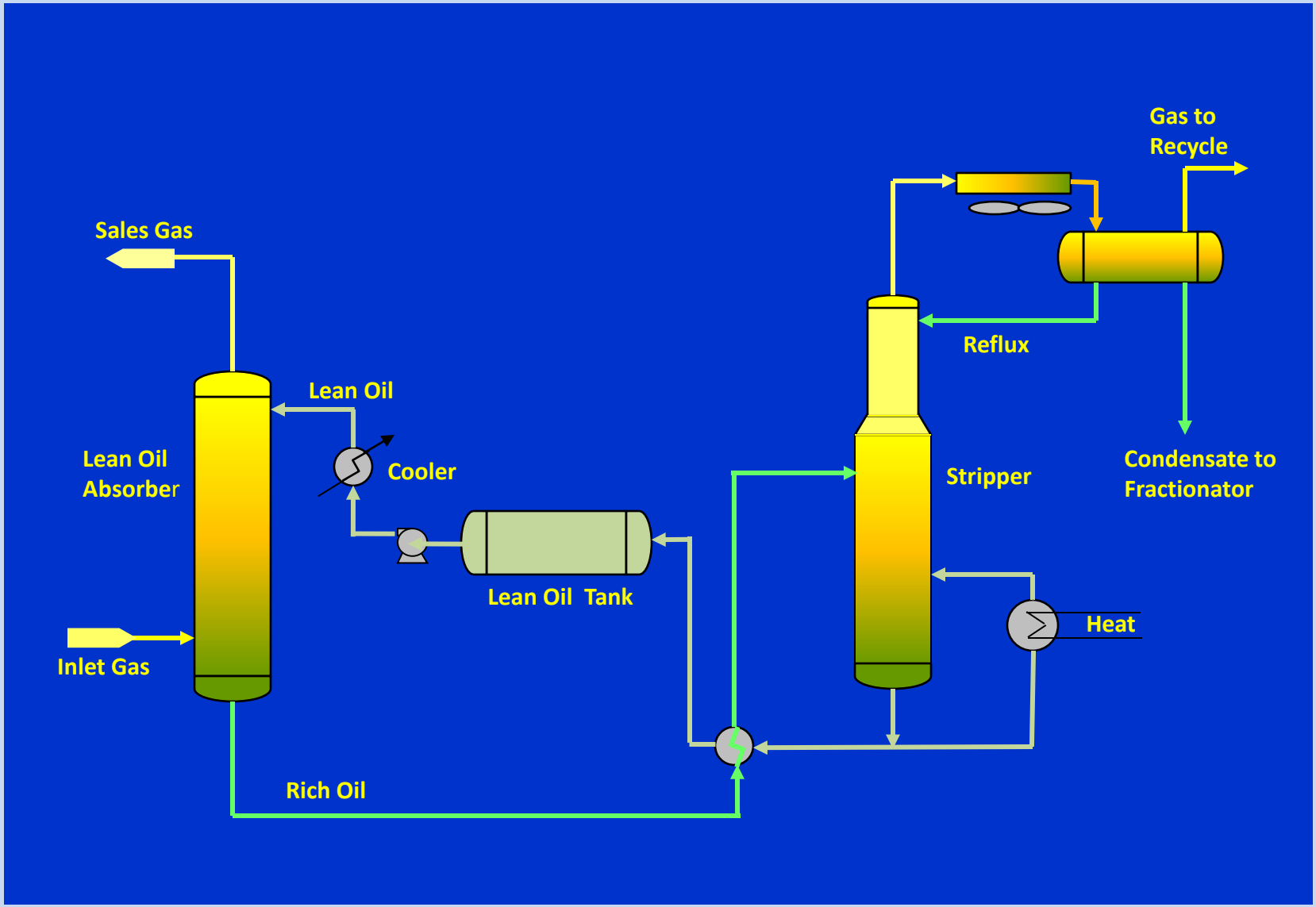
SCHEMATIC DRAWING OF FRACTIONATION PROCESS EQUIPMENT



Source: Part of Chart
in O&GJ, June 6, 2011

Picture of fractionation tower

SCHEMATIC DRAWING OF LEAN OIL ABSORPTION PROCESS



PHASE DIAGRAMS

- Representation of dewpoint, bubblepoint and liquid fractions versus pressure and temperature for a gas composition
- Quickly visualize the level of liquid formation for selecting the desired operating conditions of pressure and temperature for refrigeration

TYPICAL GAS COMPOSITIONS, MOLE PERCENT

Component	Dry Gas	Rich Gas	Wet Gas (reservoir comp.)	Solution Gas	Sales Gas
H_2	0.02	0.01	0.00	0.01	0.01
He	0.00	0.00	0.00	0.00	0.00
N_2	0.68	0.94	0.23	0.51	0.55
CO_2	0.89	0.86	1.08	0.82	0.88
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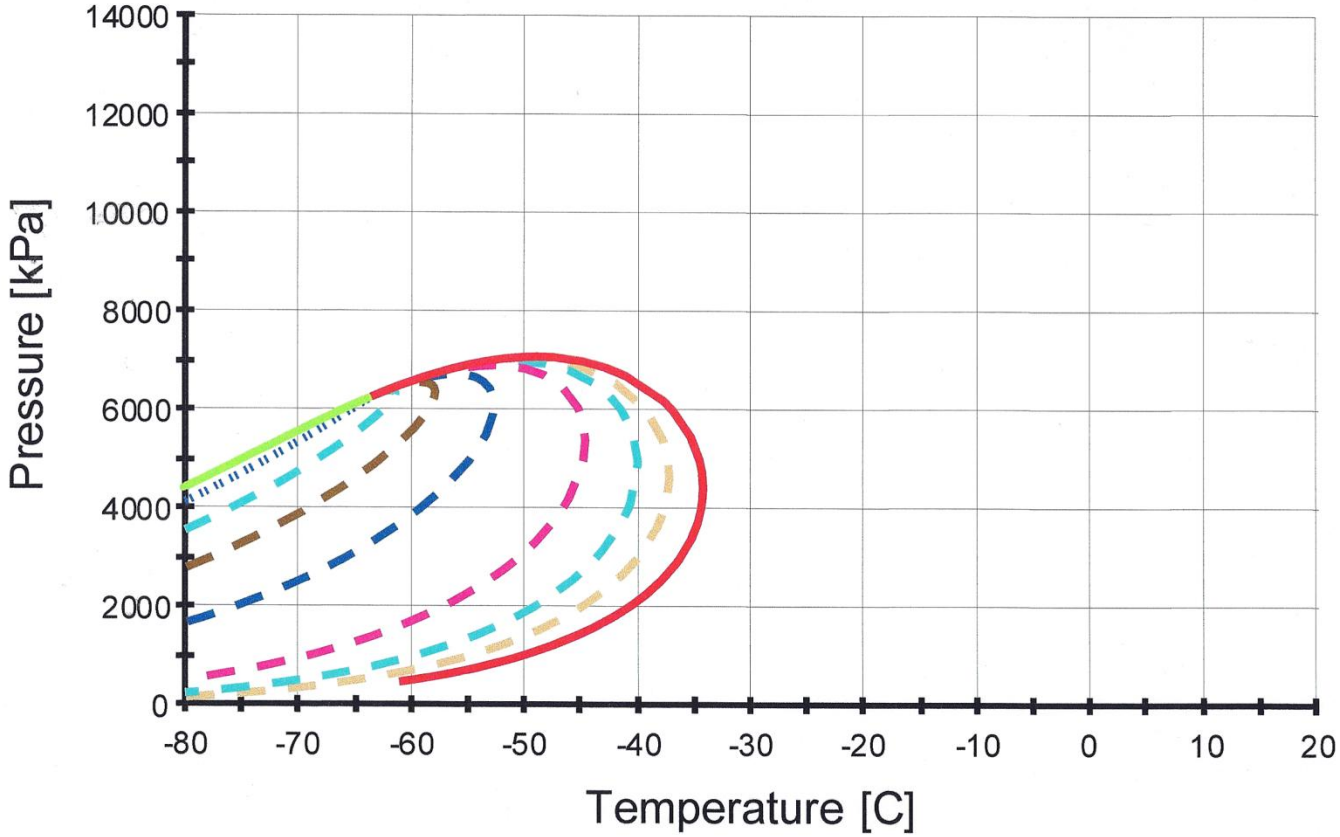
C6	0.00	0.11	2.91	0.25	0.00
C7+	0.00	0.09	4.75	0.24	0.00
Total	100.00	100.00	100.00	100.00	100.00

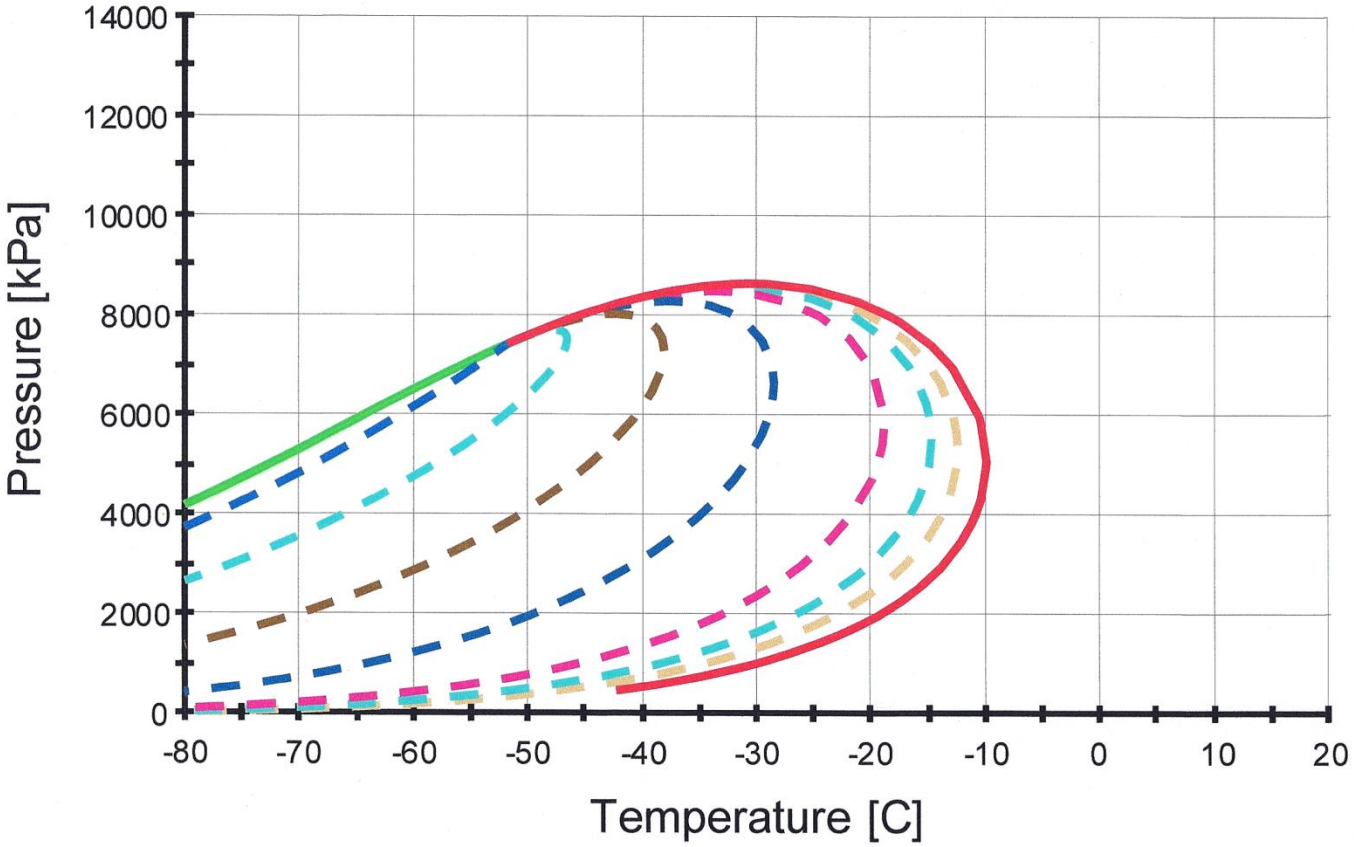
Company: Virtual Materials Group
Customer:
Project:

Dry Gas, showing Phase Envelope, and Quality Lines for 0.5,1,2,5,10,20 and 50 % Liquid



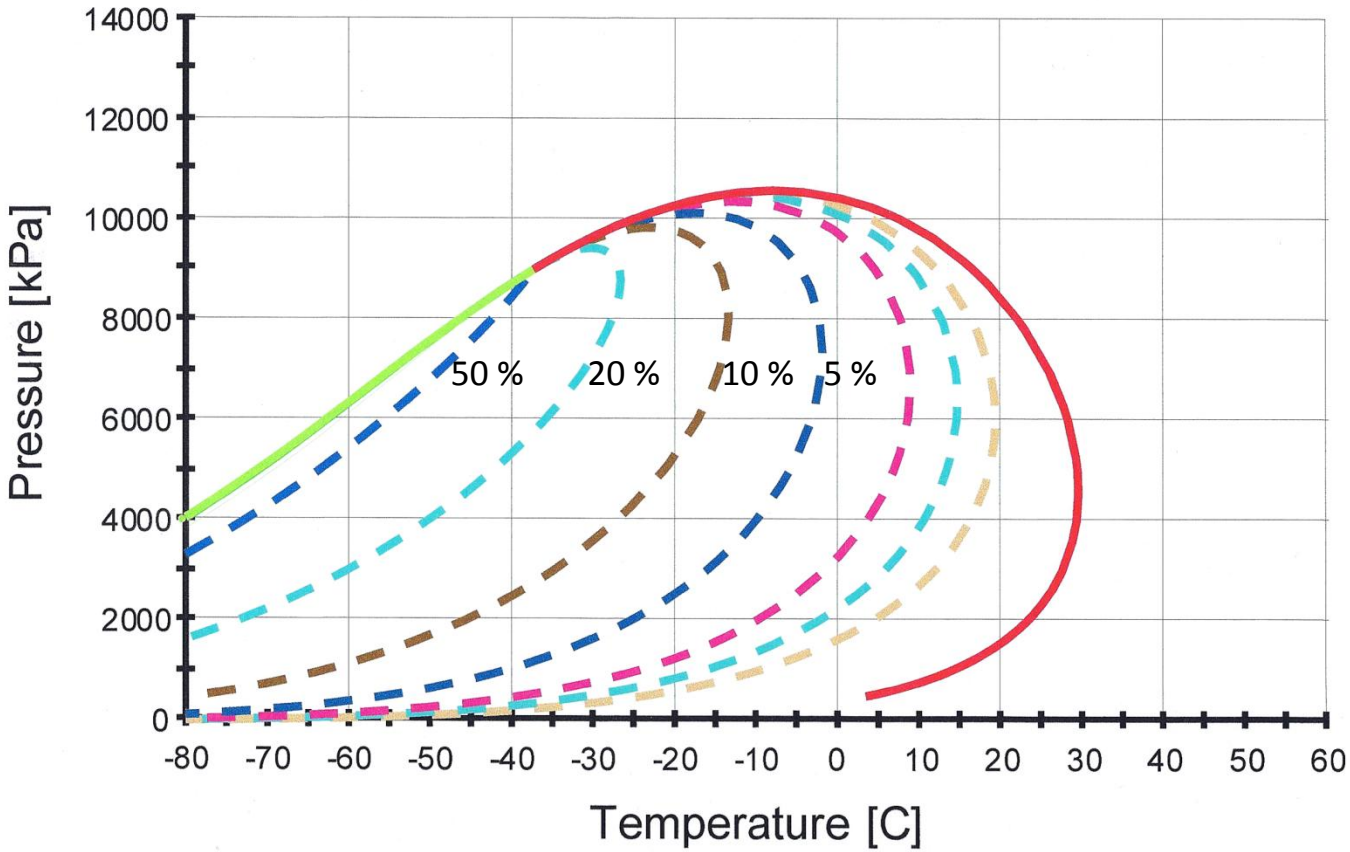
Company: Virtual Materials Group
Customer:
Project:

Sales Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid



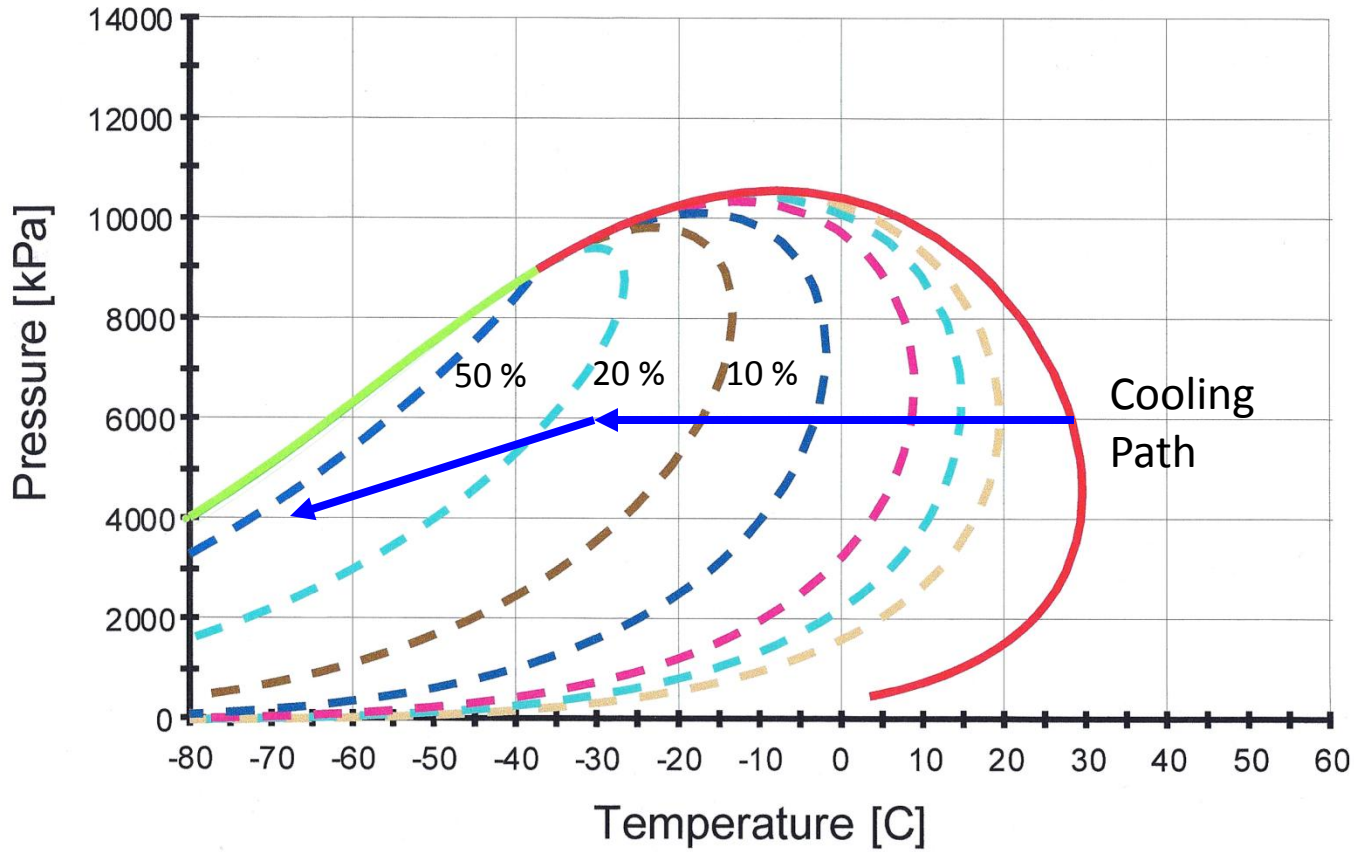
Company: Virtual Materials Group
Customer:
Project:

Rich Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid



Company: Virtual Materials Group
Customer:
Project:

Rich Gas, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 50 % Liquid



WHY EXTRACT NGL?

- Meet Sales Gas Specifications (TCPL)
  - -10 degrees C (at 5 000 kPa)
- Make Money
  - Demonstrate NGL value with Excel Spreadsheet

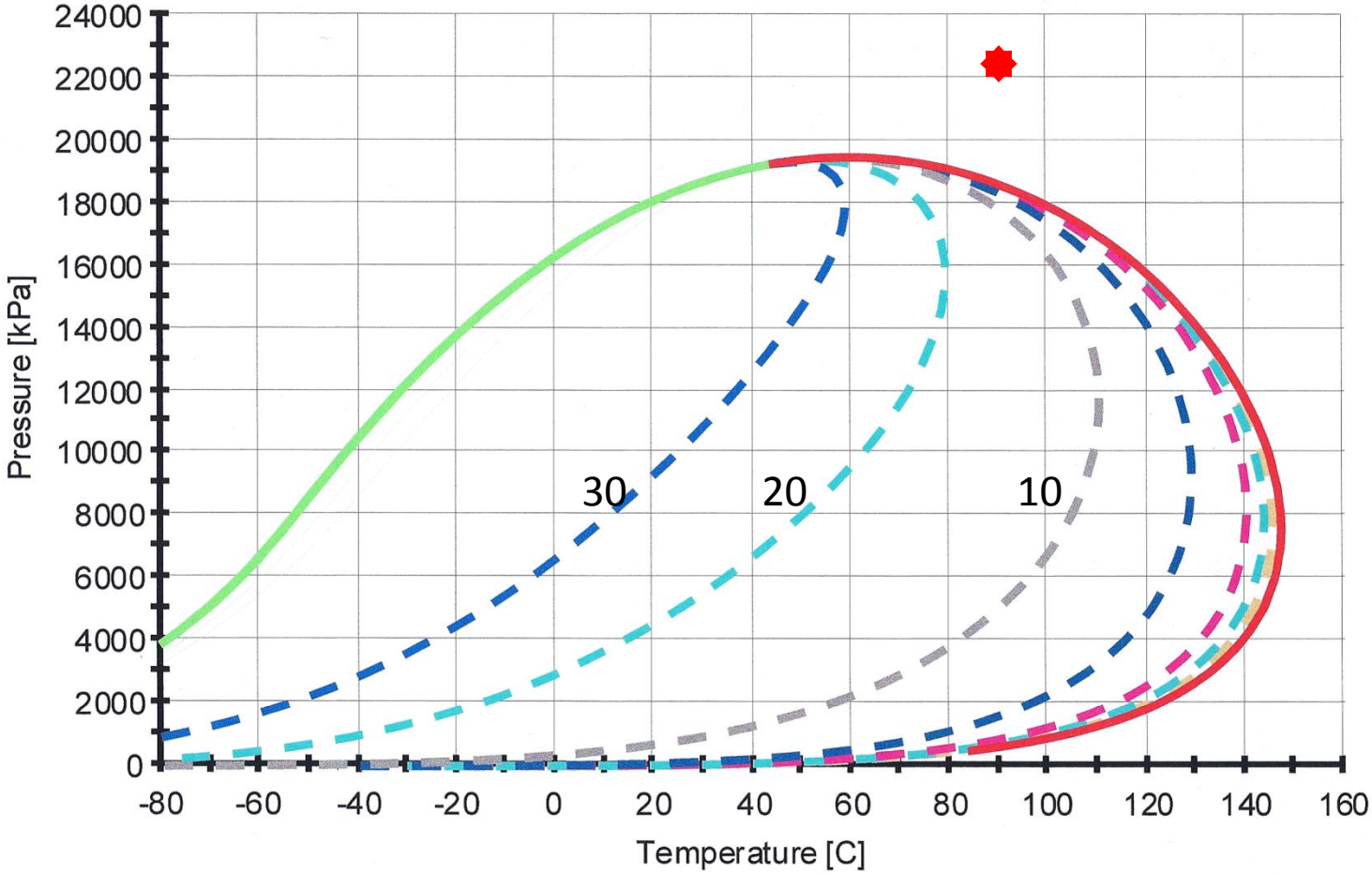
WHAT ABOUT RESERVOIR CYCLING?

- Reservoir pressure will drop with production
- Pressure will drop below dewpoint pressure at reservoir temperature, resulting in loss of heavy components
- Enhance recovery of NGL's by reservoir cycling

Company: Virtual Materials Group
Customer:
Project:

JobNo:
Prepared by:

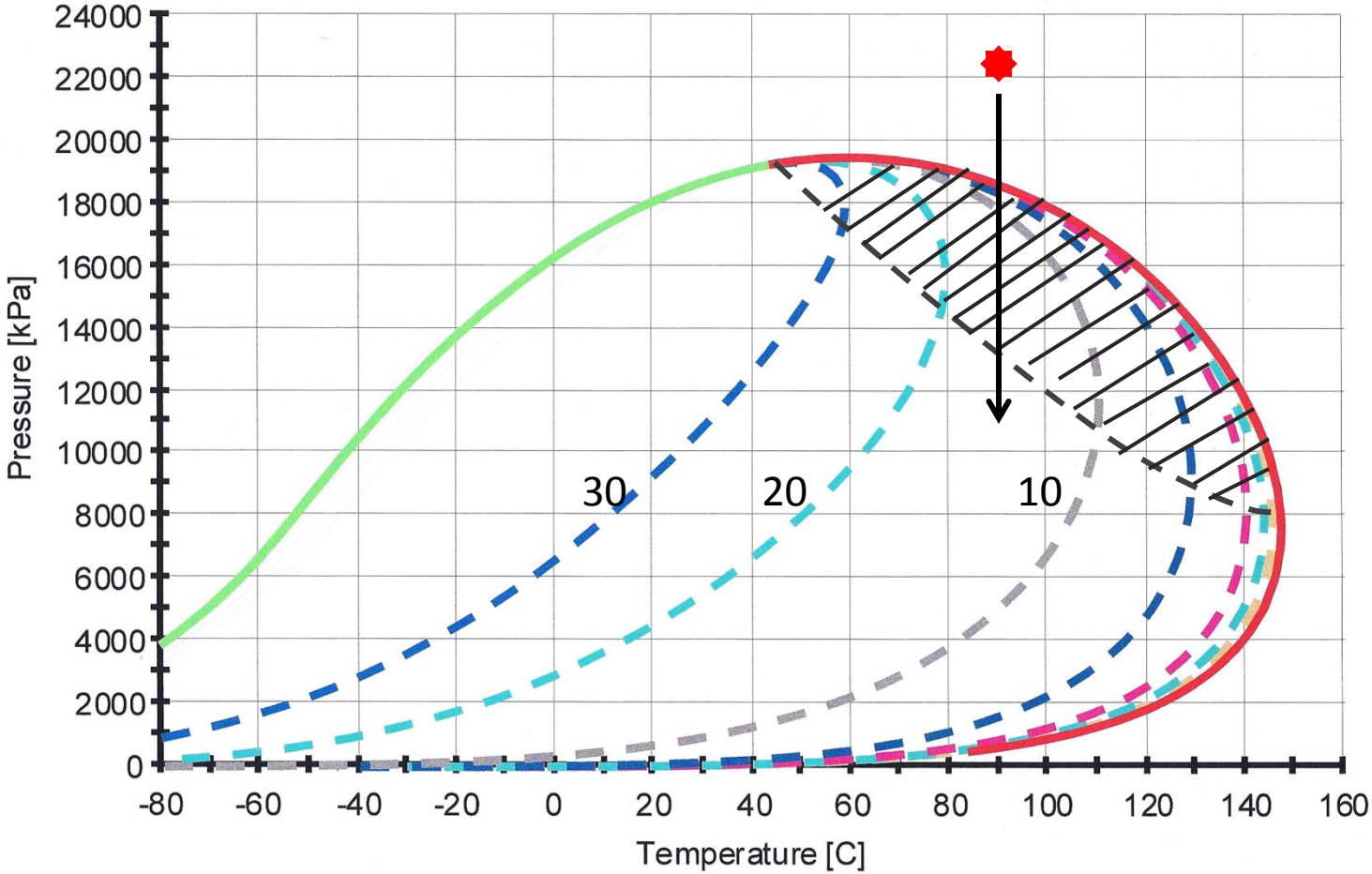
Wet Gas, Reservoir Composition, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 30 % Liquid



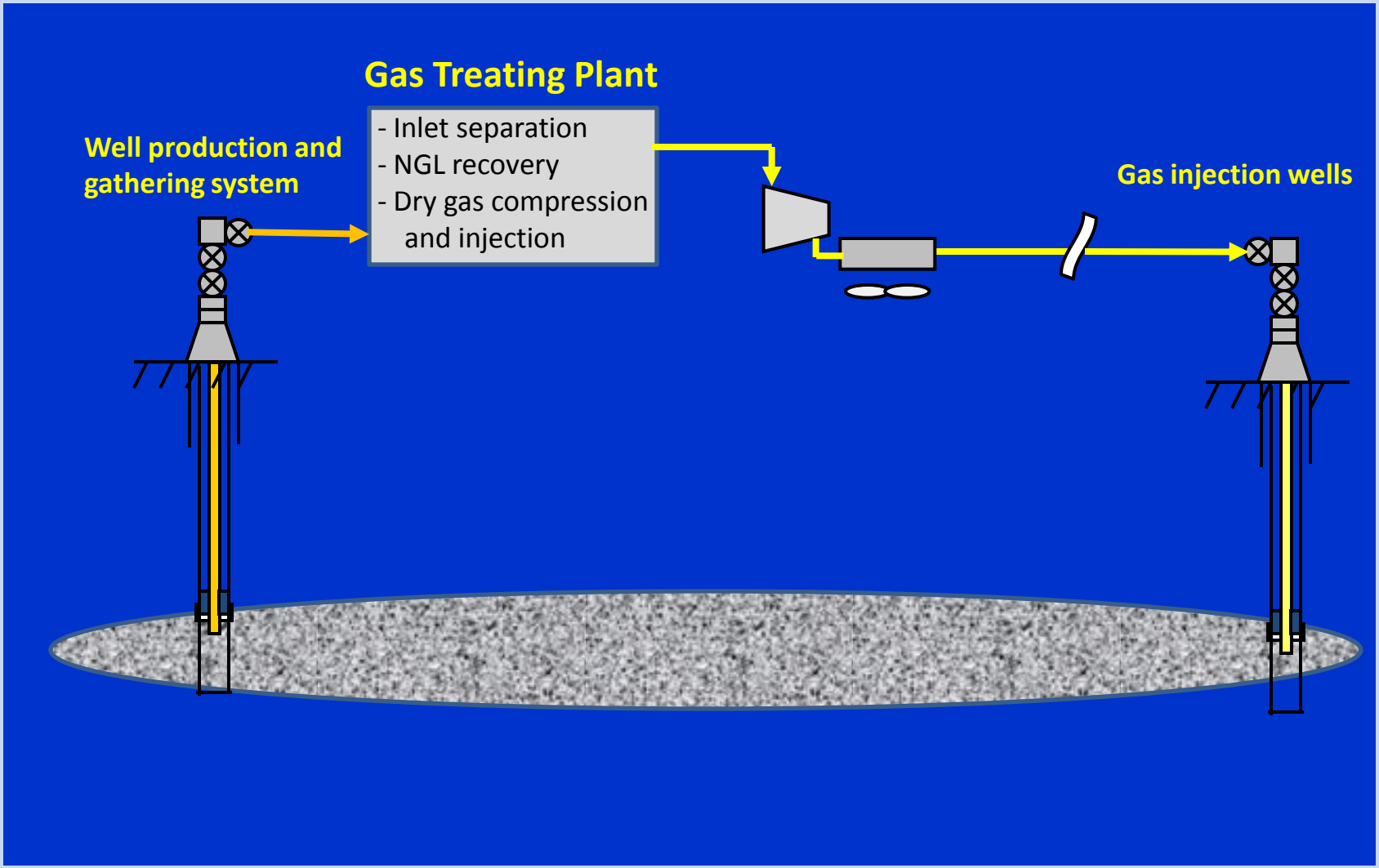
Company: Virtual Materials Group
Customer:
Project:

JobNo:
Prepared by:

Wet Gas, Reservoir Composition, showing Phase Envelope, and Quality Lines for 0.5, 1, 2, 5, 10, 20 and 30 % Liquid



SCEMATIC OF TYPICAL RESERVOIR CYCLING SYSTEM



RESERVOIR CYCLING SCHEMES

- Major reservoir cycling schemes of the past
  - Kaybob Units 1, 2 and 3
  - Carson Creek
  - Windfall
  - Brazeau
- Requirements
  - Wet (hydrocarbon) gas
  - Reservoir quality
  - Large price difference between gas and NGL's

CONCLUSIONS

- Different methods are available for extracting NGL's from natural gas
- All of the highlighted methods are being used in Alberta
- At current price difference between oil and gas it is profitable to extract NGL's
- Energy equivalence: 1 Bbl of oil ≈ 6 Mscf of gas (BOE)
- Monetary equivalence: 1 Bbl of oil ≈ 20 Mscf of gas (currently).

THE END