

Liquids Natural Gas (LNG) Facilities typically includes pretreatment of the raw gas to remove impurities and by-products which will impair or prevent the liquefaction processes. The pretreatment processes will typically include a combination of inlet separation, sour gas (CO<sub>2</sub>) removal, dehydration (H<sub>2</sub>O) or conventional refrigeration to remove water, CO<sub>2</sub>, H<sub>2</sub>S, and to separate heavier hydrocarbons.

LNG facilities typically use a Mixed Refrigeration Liquefaction process to produce LNG, fuel gas, and an intermediate stage NGL (C<sub>5+</sub>) product.

Gas Liquids Engineering Ltd. is experienced in all phases of LNG process design including:

- Cryogenic Processing
- Refrigeration
- CO<sub>2</sub> removal
- Dehydration
- Fractionation

A partial listing of relevant projects is as follows:

### *Cryogenic Projects*

#### Apache Canada Ltd. - Leafland Gas Plant

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- Study the potential for increasing the flowrate from the current 20 MMSCFD.
- Debottlenecking study of the cryogenic section of the plant.
- Resolved problems with brazed aluminum heat ex-changer.
- Rectifier column optimization study.
- Coldbox performance evaluation.

#### Atco Gas Services Ltd. – Villeneuve

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- Troubleshooting of expander and coldbox freezing problems which resulted in operating parameter adjustments and mechanical modifications to the mole sieve driers.

### B.P. Resources Canada Ltd. - Chetwynd, BC

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- Optimization and costing of modification scenarios to a 70 MMSCFD gas plant.
- 3800 B/D oil, 2065 B/D LPG, nitrogen removal, and 250 MW power generation.

### Canadian Hunter - Elmworth

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- Process study regarding reduction of CO<sub>2</sub> in ethane product by optimizing 575 MMSCFD expander pressure ratios and demethanizer temperatures. Resulted in recommendation to add a CO<sub>2</sub> rectification column to the demethanizer center feed liquid.

### Gas Liquids Engineering Ltd. - Various

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- Simulation studies with the Bryan Research and Development Company's software including: Improving the C<sub>3+</sub> and C<sub>2+</sub> recovery performance of existing natural gas processing plants based on turboexpander refrigeration and/or absorption. Nitrogen removal from natural gas by cryogenics or absorption. Helium separation by cryogenics. Modeling and simulation of natural gas dehydration with molecular sieves. Modeling and simulation of hydrocarbon separation on activated carbon.

### PDVSA/Tivenca - Maracaibo

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- Conceptual design of multiple processing options for 1200 MMSCFD gas stream including CO<sub>2</sub> removal, ethane recovery, turbo-expander facility, mercury removal, and a nitrogen rejection facility.

### Western Decalta Petroleum (1977) Limited - Diamond Valley

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- Coldbox performance review and troubleshooting.
- Expander wheel modification recommendations for alternate plant flowrates.
- Performance of numerous operating parameter reviews over several years as gas composition and flow rates changed.
- Consulting, supervision, and project management of several plant modification projects resulting from changes in plant feed composition over several years, including mercaptan removal, excess CO<sub>2</sub> in feed gas, and feed pre-cooler heat exchanger installation.
- Gas chilling (4000 BBL/D debutanizing) and Turbo Expander Study (20 MMSCFD).

## *Refrigeration Projects*

### Anderson Exploration Ltd. - Normandville

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- Permitting, engineering, drafting, and project management of a sour gas plant: 20 MMSCFD, 3000 HP compression (total inlet & sales), 200 HP refrigeration, 20 USGPM amine sweetening, 50 HP acid gas (75% H<sub>2</sub>S) re-injection compression.

### Anderson Exploration Ltd. - North Cecil

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- Permitting, engineering, drafting, and project management of a sour gas plant: 45 MMSCFD, 6000 HP compression, 450 HP refrigeration, 65 USGPM amine sweetening, recycle compression, acid gas incineration.

### Anderson Exploration Ltd. - Puskwaskau

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- Design and project management of a sour gas plant: 20 MMSCFD, 1,478 HP compression, 200 HP refrigeration, 20 USGPM amine sweetening, 100 HP (58% H<sub>2</sub>S) acid gas re-injection compression, 50 HP water disposal pump, and 40 HP recycle compression.
- Permitting and public consultation process for a 20 MMSCFD sour gas facility.

### Anderson Exploration Ltd. - South Eaglesham

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- Design and project management of a 20 MMSCFD sweet gas plant including gas gathering, inlet separation, compression, refrigeration, liquids fractionation, and NGL and LPG storage producing 400 BBL/D LPG mix, 465 BBL/D oil.

### Anderson Exploration Ltd. - Valhalla

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- Design and project management of a 40 MMSCFD gas refrigeration facility including 4500 HP compression.

#### Anderson Exploration Ltd. - West Culp

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- Design and project management of a 20 MMSCFD sour gas plant including 125 USGPM amine sweetening, 350 HP refrigeration, LPG production, oil battery modifications, solution gas compression, 3000 HP primary gas compression, 250 HP acid gas injection, and power generation.

#### APL Oil & Gas Ltd. - Niton

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- Design and project management of a refrigeration plant: 27 MMSCFD, 624 B/D LPG mix.

#### Canada Northwest Energy Limited - Gorzyca, Poland

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- Conceptual design and project budgeting for a 24 MMSCFD gas plant (57.9 % N<sub>2</sub>) involving 1200 B/D oil, 450 B/D LPG, and a 15 USGPM amine plant.

#### Canada Northwest Energy Limited - Ró a sko, Poland

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- Conceptual design and project budgeting for a 120 MMSCFD gas plant (42 % N<sub>2</sub>) involving 3800 B/D oil, 2065 B/D LPG, nitrogen removal, and 250 MW power generation.

#### Canadian Natural Resources Ltd. - Greencourt

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- 35 MMSCFD optimization study of liquid recovery improvement options.

#### Canrock Pipeline Company - Fourth Creek

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- Project management of the design, procurement, and construction of a sour gas plant, 69 MMSCFD, 10t/d sulphur inlet, two 30 & 45 GPM mixed amine processes, 200 HP (-10 deg F) and 500 HP (-45 deg F) refrigeration units, 1800 HP Paddy compression scheme, 3,000 HP plant sales compression, 150 HP acid gas (30% H<sub>2</sub>S) re-injection compression.
- Equipment and piping layout for a refrigeration skid addition.
- Design and project management of a 2145 HP installation.
- Design and project management of a pipeline installation.

#### Gascome Oils Ltd. - Turin

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- Design and project management of a 25 MMSCFD gas plant, 430 gpm DEA amine plant, and 200 B/D LPG mix.

#### North Canadian Oils Limited - Knopcik

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- Expansion of 32 MMSCFD refrigerated J-T plant, addition of depropanizer, debutanizer systems, mole sieve unit for removal of methanol from propane product, product storage, chromatography, and control systems.

#### Northstar Energy Corporation - Turin

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- Design and project management of a plant expansion from 30 to 55 MMSCFD: screw compressor, condenser, low temperature separator, and gas/gas exchanger.

#### Pan Canadian Petroleum Ltd. - Dimsdale

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- Design and project management of a 30 MMSCFD, 1200 HP compression sweet gas facility including dehydration and hydrocarbon dew point control.
- Three field dehydrators - design and installation management.

#### Pembina Resources Limited - Diamond Valley

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- 400 B/D debutanizer performance upgrade and 20 MMSCFD turbo-expander performance review.
- Sulphur plant facility review and appraisal.

#### Petrorep (Canada) Ltd. - Provost

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- Design and project management of a 25 MMSCFD gas plant: 2,400 HP compression, refrigeration, desiccant dehydration, 105 B/D LPG mix.
- Design for the non-destructive desiccant screen modification thereby permitting continued operation of the existing unit.

### Polish Oil and Gas Company - Dębno, Poland

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- Design basis memorandum and project specifications for a 45,000 SCM/Hr sour gas plant including fractionation and sulphur plants. Economic evaluation of 200 cum/d fractionation train options.
- Project management of a US \$70 million gas plant development involving 21 wells and the production of 45 MMSCFD gas, 6000 BPD oil, 120 t/d sulphur, 600 BPD LPG, and 200 BPD condensate.
- Fabrication and construction inspection.
- Pipeline system design and evaluation.
- HAZOP evaluation. Start-up and operations support.
- Training – plant management and Dębno Plant Operations personnel.

### Rio Alto Exploration Ltd. - Galloway

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- Responsible for the process design, specification, and the procurement of mechanical equipment for a 75 MMSCFD gas plant expansion including inlet facilities, inlet and sales compression, refrigeration unit, condensate stabilizer and recycle compressor, hot oil heating package, flare stack, NGL bullet, and condensate storage tanks.

### Rio Alto Exploration Ltd. - Smoky

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- Responsible for the process design, specification, and the procurement of mechanical equipment for a 40 MMSCFD gas plant expansion including inlet facilities, inlet and sales compression, a future refrigeration unit, dehydration unit, condensate stabilizer and recycle compressor, glycol heating package, flare stack, NGL bullet, and condensate storage tanks.

### S. E. G. I. - Al Khobar, Saudi Arabia

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- Process and mechanical design for an ethylene glycol injection unit for a 320 MMSCFD refrigeration system.

## *Sour Gas Projects*

### Amerada Hess Canada Ltd. - Olds

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- 84 MMSCFD amine sweetening facility performance study and plant relief system analysis.

### Anderson Exploration Ltd. - Leland

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- Engineering review of a 60 MMSCFD sour dehydration facility (31% H<sub>2</sub>S).

### Atco Gas Services Ltd. - Golden Spike

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- Preliminary engineering and technical auditing of the detailed design for a 40 MMSCFD sour gas plant involving 50 HP acid gas (50% H<sub>2</sub>S) injection, turbo expansion and coldbox, ethane extraction, mole sieve, and mercaptan removal. Project management and engineering management, EPC contract development and administration, and start-up services.

### Husky Oil Operations Ltd. - Blackstone

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- Air dispersion modeling and environmental approval for a 200 MMSCFD acid gas facility.
- VRU and acid gas compression addition.

### Industrie Meccaniche Scardellato s.p.a. - Petrex, Italy

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- Design review and equipment sizing for 350 MMSCFD amine plant (two trains - 100 GPH of DEA each); sizing of mole sieve unit including 200 cyclone separator units.
- Amine plant (60 GPM MDEA) and 15 MMSCFD refrigeration plant design.

### Solex Energy Inc. - Edmonton

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- Conceptual process design for purification (COS and mercaptans) and fractionation of a 30,000 B/D condensate stream to yield propane, butane, and heavier fractions.

### Texaco - Alberta HUB

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- Design and project management of an underground gas storage plant capacity increase from 250 MMSCFD to 500 MMSCFD.
- Installation of 9 km of 16" pipeline and tie-in of two storage wells.
- Addition of inlet separation and 3335 HP compression.
- Executed heat and material balance for 400 MMSCFD hydrocarbon dewpoint control unit. P&ID Development. Equipment Specification.

### Total Austral S. A. - Aguada Pichana, Argentina

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- Design/fabrication co-ordination, commissioning, and performance testing for a 280 MMSCFD dew point control plant with refrigeration and 9 MW power generation.

## *Dehydration Projects*

### Anderson Exploration Ltd. - Nig Creek, BC

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- Permitting, process design, and project management for the installation of a second compression train at an existing 40 MMSCFD compressor station.
- Modifications included the addition of inlet separator, compression (2215 HP), dehydration with dual sales line flowcontrol, a sales pipeline, and power generation.

### Antrim International - Czech Republic

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- Dehydrator fabrication inspection and installation supervision.
- Operator training.

### Denimex (Canada) Ltd. - Cherhill

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- Troubleshooting of dehydration system.

### Enar Petroleum Services Pvt. - Karachi, Pakistan

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- Design review of a 9 MMSCFD dehydration facility.



### Numac Energy Inc. - Martin Creek, BC

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- Design and project management of a 30 MMSCFD compressor station including inlet separation, glycol dehydration, 3200 HP compression, heat medium, and power generation.

### Pipestone Petroleum Inc. - Big Jedney / Highway

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- Process design and project management for the installation of 16 "Ø to 24 "Ø glycol dehydration facilities at three (3) wellsites.
- Pipeline permitting for the tie-in of all three (3) wells.

## *Fractionation Projects*

### Bankeno Resources Ltd. - Knopcik

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- 1,500 B/D C<sub>3</sub>, C<sub>4</sub>, C<sub>5+</sub> fractionation train addition. Provided permitting, engineering, and project management of gas processing facilities, including mechanical design, equipment specification, purchasing, expediting, critical path scheduling, reporting, cost control, instrumentation, and controls system design.

### Numac Energy Inc. - Ferrier

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- Simulation, rating and evaluation of a 20 MMSCFD sweet gas plant.
- Design and costing for a 20 MMSCFD fractionation train involving 1200 B/D NGL recovery.
- Design and costing for a 20 MMSCFD refrigeration system.
- A number of process simulations were developed to examine the merit of various process improvements yielding higher revenue streams through increased liquids recoveries.
- Project engineering for the optimization, debottlenecking, and reconfiguration for a gas plant totaling 5,000 HP.

## TransCanada Midstream - Cutbank

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- Review process requirements, upgrade inlet liquids handling capacity by installing new controls for the low and high pressure inlet separators, redesign the feed to the deethanizer, revise the controls and flow pattern of the hot oil system, prepare schedule, and provide shutdown supervision.
- In addition, design and install three parallel interconnecting underground pipeline storage buffers totaling 6,000 cu ft including liquid dump controls.
- Rated performance of a 75 MMSCFD sweet gas plant at existing and proposed conditions.