

ADNOC – Abu Dhabi, UAE

- Technical consulting and participation in a multi-company bid evaluation team to evaluate the submitted bids from major oil, gas and energy companies opposite tenders from the Abu Dhabi National Oil Company (ADNOC) for development of two, world-scale, highly sour gas fields. Included scope to cover gas field development, reservoir management, sour gas and condensate processing facilities (500 – 1500 MMSCFD), acid gas injection and/or sulphur production, and pipelines for delivery of gas and liquid products to custody transfer points.

AEUB - Alberta

- Software design to predict physical properties and phase equilibrium for acid gas mixtures.

Agave Energy Company - New Mexico, USA

- Preliminary design calculations for a 0.5 MMSCFD acid gas injection scheme including water content, hydrate formation and phase envelopes. The acid gas composition challenge was 52% H₂S, 46% CO₂ and 2% hydrocarbons.

Allen Energy - Como, Texas, USA

- Preliminary design calculations for a 2 MMSCFD (60% H₂S, 40% CO₂) injection scheme including water content and phase envelopes.

ATCO Midstream - Golden Spike

- Engineering and technical auditing of the detailed design for a 40 MMSCFD sour gas plant involving 450 HP acid gas (50% H₂S, 49% CO₂) injection, turbo expansion and coldbox, ethane extraction, mole sieve, and mercaptan removal. Project management and engineering management, EPC contract development and administration, start-up services.
- AENV permit application. EUB permit applications and audit manuals.
- Study of third party gas processing options.
- Process design, permitting and project management for a 12 MMSCFD sacrificial sweetening system. Project included Solar compressor upgrades, replacement of trays with structured packing and construction management.
- Acid gas volume: 212 m³/d. Acid gas compression: 450 HP.

Bear Cub Energy – Texas, USA

- Troubleshooting of suspected hydrate formation and high wellhead pressures in a sour AGI process on the tail end of a gas plant.
- The team conducted an on-site investigation of current operations combined with process simulation to replicate suspected hydrate formation conditions and provided recommendations.
- The AGI process section consisted of 2 x 100% 5-stage motor driven 600 BHP reciprocating compressors with acid gas feed conditions of 3.0 MMSCFD gas containing 55% H₂S and 43% CO₂ with a discharge pressure of 1280 psig.

Border Midstream Services - Alberta

- Acquisition evaluation of multiple gas plants processing 1,000 MMSCFD of primarily sour gas including amine plants, sulphur plants, acid gas injection and turbo-expanders.

Chesapeake Energy – Grady County, Oklahoma, USA

- Conceptual design, process engineering, basic engineering and equipment specifications for a 80 MMSCFD sour gas facility including inlet gas compression, amine sweetening, hydrocarbon dewpoint control, liquids recovery and 450 HP acid gas injection.
- Revamping of Knox Arbuckle Facility including process optimization, replacement of amine towers and addition of dewpoint control unit.

Chevron Canada Resources - Bigoray

- Preliminary design and process review for a 0.9 MMSCFD acid gas (20% H₂S, 80% CO₂) low-pressure acid gas injection scheme, including injection pressure estimation and water content calculations.
- Design of a novel dehydration unit for acid gas using low temperature methanol injection.

Devon Canada Corp (formerly Anderson)

Normandville

- Permitting, engineering, drafting and project management of a sour gas plant: 20 MMSCFD, 3000 HP compression (inlet & sales), 200 HP refrigeration, 20 USGPM amine sweetening, 50 HP acid gas re-injection compression.
- 2002 Expansion: Stabilizer, LPG bullet and pump skid.
- Acid gas composition: 10% H₂S and 90% CO₂. Acid gas compressor: 50 HP @ 2000 psig discharge. Acid gas pipeline: 1.5km with wellhead pressure of 1750 psig. Acid gas rate: 135 kg/hr.
- 2004 Expansion: Installation of condensate flash tank.

Puskwaskau

- Design and project management of a sour gas plant: 20 MMSCFD, 1,478 HP compression, 200 HP refrigeration, 20 USGPM amine sweetening, 125 HP (57% H₂S, 43% CO₂) acid gas re-injection compression, 50 HP water disposal pump, and 40 HP recycle compression.
- Permitting and public consultation.
- Plant modifications including incinerator installation and replacement of heat exchangers.

Rycroft

- Design and project management of a 676.2 e³m³/day (24 MMSCFD) sour gas plant including 125 USGPM amine sweetening, 350 HP refrigeration, C₅₊ production, 2220 kW (3000 HP) primary gas compression, 185 kW (250 HP) acid gas injection, recycle compressor, VRU and 1200 kW power generation.
- Acid gas composition: 70% H₂S, 29% CO₂. Acid gas compression: 250 HP at 1220 psia discharge.
- Acid gas pipeline: 500m with 1218 psia wellhead pressure.
- The equipment supply included the piping, instrumentation and controls, compressors, towers, heat exchangers, pumps and vessels.
- Responsible for commissioning and start-up.

West Culp

- Design and project management of a 563.5 e³m³/day (20 MMSCFD) sour gas plant including 28.4 m³/hr (125 USGPM) amine sweetening, 350 HP refrigeration, LPG production, oil battery modifications, solution gas compression, 2220 kW (3000 HP) primary gas compression, VRU, 185 kW (250 HP) acid gas injection and 1200 kW power generation.
- AENV permit application.

- AEUB permit application and audit manual.
- Acid gas rate: 2190 lb/hr. Acid gas composition: 53% H₂S, 45% CO₂.
- Acid gas compression: 250 HP at 1220 psig. Wellhead pressure 800 psi.
- The equipment supply included the piping, instrumentation and controls, compressors, towers, heat exchangers, pumps and NGL storage vessels.
- Responsible for operating manuals, commissioning and start-up.

Encana

Deep Panuke, Nova Scotia

- Preliminary design of an offshore acid gas injection scheme to inject 4.5 MMSCFD of acid gas with an approximate composition of 25% H₂S and 75% CO₂.
- Study included compressor design (1200 HP), phase equilibrium calculations and water content.
- Scenarios studied included blending the acid gas with condensate prior to injection.

Weyburn, Saskatchewan

- Evaluation of the water content of the CO₂-rich stream and the potential for the formation of an aqueous phase or hydrates in the injection gas distribution system.

Encore Operating - Alberta

- Preliminary engineering for injection of 2 MMSCFD of 50% H₂S mixture with variable speed drive electric compressors and acid gas dehydration.
- Decommissioning of auxiliary steam handling and Claus plant.

Enerpro - Bigoray

- Review of acid gas injection scheme due to changes to acid gas composition.

Gulf Canada Resources Limited - Brazeau

- 1 - 2 MMSCFD acid gas injection study involving a process and cost analysis for various options.

Hanover Russell - Tulsa, OK, USA

- Design and optimization of an acid gas injection scheme for the disposal of up to 9 MMSCFD of acid gas (55% H₂S, 45% CO₂) including injection pressure calculation, water content optimization and compression design.
- Design and fine tuning of an acid gas injection scheme to dispose 0.3 MMSCFD of about 55% H₂S and 45% CO₂ including injection pressure estimation, compressor sizing, phase equilibrium calculations, and water content and knockout.

Harmattan Gas Process LP - Harmattan

- Basic engineering of acid gas injection facility that will compress and dehydrate 260 e3m3/day of acid gas from amine sweetening plant to inject it in adjacent reservoir. Optimized the process simulations by using ProMax and simulated the reservoir. Studied the impact of 2nd and 3rd stage refrigeration on the process, product and equipment efficiencies.

Husky Oil Operations Ltd

Blackstone

- Air dispersion modeling and environmental approval for a 200 MMSCFD sour gas facility.
- VRU and acid gas compression (300 HP) addition.

Rainbow Lake

- Engineering and process evaluation/audit of existing acid gas injection facility which includes 2 x 1000 HP four-stage compressors.
- Acid gas composition: 76% H₂S, 23% CO₂. Acid gas rate: 2.7-4 MMSCFD. Acid gas compressor discharge at 1490 psig into a 200m pipeline.
- Project management including engineering, procurement, construction management, operation training and commissioning for a third acid gas compressor unit.
- Process review for sales oil tank odour issues.
- Interstage cooler hydrate formation prediction and estimation of methanol injection requirements.
- Prediction of the condition of hydrate formation in the interstage cooler of an acid gas injection scheme. Estimation of the methanol injection rate in order to prevent the formation of said hydrate.
- Engineering and safety audit for acid gas injection system, system revamp and continued operations support specifications for 3rd AGI compressor.
- Retrofit of the existing acid gas injector (AGI) system with a 10 km, 4 in diameter. AGI pipeline handling up to 95% H₂S.
- DBM, design, material specs and procurement for a 10 km. 4 in diameter acid gas injection pipeline, which runs from a 10-10-109-8W6M to 3-12-110-8W6M. Design flow rate of 7.4 MMSCFD. The project also included modifications at Rainbow Gas Plant to re-route the acid gas the new pipeline. The licensed max H₂S content of the pipeline is 95% and MOP 9850 kPa.
- Acid gas injection study and HAZOP review.

Iranian Offshore Oil Company – Kharg Island, Iran

- Acid gas injection front end engineering and design (FEED) study. The study was part of a gas gathering and NGL recovery project. The NGL plant on Kharg Island will process 600 MMSCFD of sour gas, produce 460 MMSCFD of sweet gas, 48,000 bbl/d of hydrocarbon liquids and inject 85 MMSCFD of acid gas (55% H₂S, 45% CO₂) into a reservoir. Developed the acid gas compression P&ID's and equipment data sheets, and prepared the process basis of design for the acid gas pipeline. Sour water treatment was included in the scope.
- Acid gas injection training course.
- Management of core and reservoir studies to support acid gas injection design.

IRASCO spA – Genoa, Italy

- Preliminary design and project management planning for 85 MMSCFD acid gas injection project.

IRASCO S.R.L. – Kharg Island, Iran

- Acid gas injection and sour water treatment. Review of corrosion protection philosophy, materials specification, paint specification material selection study, insulation specification, pipeline corrosion study, pipeline cathodic protection study, onshore plant layout philosophy, pipe stress analysis philosophy, specification for chemical cleaning of pipework.

Jacobs Canada - Alberta

- Acid Gas Injection Training course
- Review of acid gas injection design and drawings.

James E. Smith & Associates - Tyler, Texas, USA

- Design of an acid gas injection scheme for the disposal of up to 3 MMSCFD of acid gas including injection pressure calculation, water content optimization and compression design.

John Brown Hydrocarbons – London, UK

- Wellhead and wellbore completion; management of core and reservoir studies undertaken by IOOC in Canada.
- Conceptual design, preliminary equipment selection and project budget for an 85 MMSCFD acid gas (55% H₂S, 45% CO₂) injection project on Kharg Island.
- Front end engineering and design of 85 MMSCFD acid gas injection facility including acid gas compression (45,000 HP), sour water treatment, acid gas pipeline, wellhead and wellbore completion. Management of core and reservoir studies undertaken by IOOC in Canada.
- Acid gas injection training course.

KCS Resources - Texas, USA

- Preliminary design calculations for a 2.5 MMSCFD acid gas (50% H₂S, 50% CO₂) injection scheme.

Long Petroleum - Louisiana, USA

- Design calculations for a proposed scheme for the injection of 1.5 MMCFD of sour gas (6% H₂S, 6% CO₂) including injection pressure estimation, water content, compressor sizing and hydrate calculations.

Moiibus - Achesen

- Preliminary design of a sour gas plant (7 MMSCFD) and acid gas injection scheme (80% CO₂, 20% H₂S).

Murphy Oil Corp. – Tupper West, N.E.B.C.

- Engineering, procurement and construction management (EPCM) currently underway for a 180 MMSCF/d sour natural gas processing plant near Dawson Creek, British Columbia. Design features of the plant include:
 - Inlet slug catching and separation on three separate inlet gathering systems
 - Inlet and sales compression – Four (4) 3-stage Ariel JGZ/6 packages, each with 6500 HP electric drives
 - Amine sweetening – 215 USGPM of MDEA circulation
 - Dewpoint control utilizing mechanical refrigeration (300 USTR and 700 HP refrigeration compressors) and glycol injection (17.5 USGPM of 80/20 ethylene glycol)
 - Condensate stabilization and condensate storage (800 BBL of storage)
 - Sour water stripping and produced water storage (10000 BBL of storage)
 - Acid gas compression – 300 HP electric drive, 5-stage reciprocating compressors
 - Acid gas dehydration – 0.5 USGPM of TEG circulation, stainless steel construction
 - Mixing of acid gas and sweet sales gas to produce a sour sales gas stream including sweet mix compressors (250 HP reciprocating compressors)

- Vapor recovery (tank and dehydrator still vents) and recycle compression (200 HP electric drive)
- High pressure, low pressure and acid gas flare systems
- 25 km long 18" diameter sweet sales gas pipeline and a 5 km long 3" diameter sour sales gas pipeline
- Full plant utilities including:
 - High and low pressure fuel gas
 - Process heat medium – 1125 USGPM of 60/40 TEG, heater duty of 22 MMBtu/hr
 - Utility heat medium – 265 USGPM of 50/50 EG, heater duty of 6 MMBtu/hr
 - Instrument air and nitrogen purge systems
 - Underground drain and storage systems for closed hydrocarbon drains, floor drains, amine drains and glycol drains
 - Integrated plant control system, including plant DCS, unit control systems and ESD system
 - Plant 13800 V, 6900 V, 600 V, 208 V, 24 V electrical systems including switchgear, MCCs, VFDs and distribution
 - Site civil design and work including grading plans, retention pond design, office/warehouse buildings, site roads, foundations and structural steel
 - Integration with the nearby 23 MW power generation station

O’Ryan Oil & Gas – Odessa, Texas, USA

- Design of an acid gas injection scheme (1 MMSCFD and 80% H₂S, 20% CO₂)
- Evaluated the potential of simultaneous injection of produced water and acid gas, and made recommendations.

PetroHunt LLC – North Dakota, USA

- Concept development, preliminary engineering and +/- 30% cost estimation for conversion of a 12 MMSCFD sour gas processing facility from sulphur production to acid gas injection.
- \$ 6M USD cost estimate included scope for new electrical facilities, acid gas compression, acid gas injection pipeline, acid gas injection well, process control upgrades and isolation of the obsolete sulphur plant.

Petro Operating Company - Florida, USA

- Acid gas injection data analysis.

Regency Gas – Dallas, Texas, USA

- Design of an acid gas injection scheme for the disposal of 2 to 4 MMSCFD of gas (10% H₂S, 87.5% CO₂ and light hydrocarbons).

Samson Canada Ltd. - Innisfail

- Optimization of a 1,200 BOPD, 8,800 BOPD, 2.5 MMSCFD oil battery (14% H₂S, high paraffin content, saturated brine). The shell/tube exchangers were removed and the inlet separator was modified. The result of the work was improved water retention time, reduced fuel consumption, reduced facility maintenance requirements, and improved recycle treating flexibility.
- Conceptual simulation of proposed pipeline looping and compression expansion.
- EUB regulatory application and technical support for a 10 MMSCFD sour gas plant. Compression, amine sweetening, refrigeration, liquids recovery and acid gas injection.
- Filter/separator design.

Software Development

- Primary developer and programmer of GLEWpro 1.1, a simulation tool for acid gas injection wellbore flow.

Spectra Energy

Fort Nelson, B.C.

- Design basis memorandum, project specifications, engineering for a 100 MMSCFD acid gas recovery, transportation and injection system.

Fourth Creek (when owned by Duke Midstream, formerly Canrock)

- Project management of the design, procurement and construction of a sour gas plant, 69 MMSCFD, 10 t/d sulphur inlet, two 30 & 45 GPM mixed amine processes, 200 HP (-10° F) and 500 HP (-45° F) refrigeration units, 1800 HP Paddy compression scheme, 3,000 HP plant sales compression, 150 HP acid gas (30% H₂S) re-injection compression.
- Acid gas pipeline: 3830m.
- 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.
- MOC approvals.

Nevis

- Scoped a future 500 HP acid gas injection scheme.

Suncor Inc. - Rosevear

- Preliminary and detailed engineering, procurement and construction of a 140.8 e3m3/day (5 MMSCFD) acid gas (50% H₂S) injection facility requiring two 600 kW (800 HP) variable speed electric drive compressors, acid gas chilling, associated pipelines and the addition of an auxiliary steam boiler and Sour Water Flash Tank. Responsible for regulatory, project management, construction management, commissioning, and operations support.
- Installation of 2nd stabilizer and associated equipment from the North Rosevear facility.
- Detailed design of the two (2) 800 HP acid gas injection compressors.

Tecna S.A. - El Porton, Argentina

- Basic engineering of acid gas injection compressor facility.

Training and Software development provided by Gas Liquids Engineering Ltd- Calgary

Acid Gas Injection

- Southwest Petroleum University – Chengdu, China
- Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia.
- PDVSA, Caracas, Venezuela.
- Jacobs Canada
- Exxon Mobil
- Iranian Offshore Oil Company, Tehran, Iran.
- Foster Wheeler, London, England
- Qatar Petroleum, Doha, Qatar.
- Enterprise Training (Frankfurt, Doha, Abu Dhabi)