GAS LIQUIDS ENGINEERING

Workshop on Future Large CO_2 Compression Systems

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Gas Processing – GLE

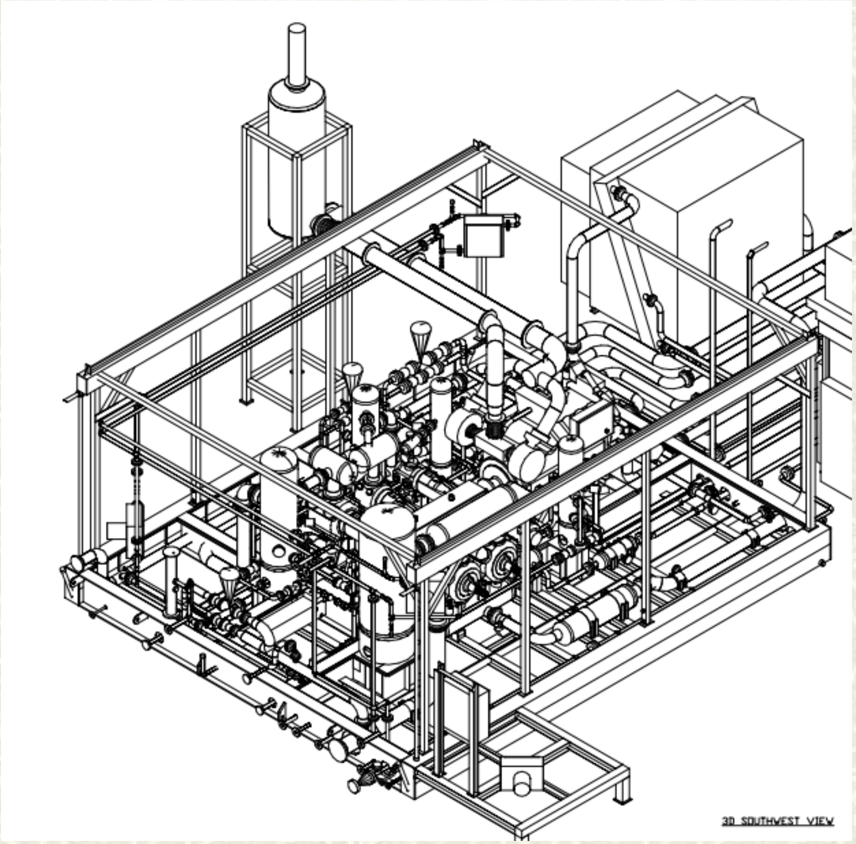
- Over 120 gas processing projects completed in the last 20 years.
- Capacity from 5 MMSCFD to > 2 BSCFD
- Multiple projects with refrigeration and liquids recovery
- Multiple sour gas projects with amine plants and sulphur facilities or acid gas injection.
- Typically 1-2 cryogenic plants with turbo expanders each year.
- Typically 2-4 acid gas injection projects each year.

Acid Gas Injection - GLE

Acid Gas Injection Projects

- Originally consisted of small scale H_2S/CO_2 injection projects designed to minimize SO_2 emissions, ease resident concerns and speed regulatory approval.

- Small scale sulphur plants were considered capex/opex intensive and still resulted in emissions.



Acid Gas Injection Projects

- Over 50 acid gas injection (for disposal) projects in North America
- Primarily for H_2S disposal but all streams contain CO_2. A few projects are primarily CO_2 injection.
- Injection rates range from <1 MMSCFD to 18 MMSCFD in Canada
- ExxonMobil at LaBarge injects about 90 MMSCFD
- Process components after amine plant are either compression with integrated partial dehydration or compression and standard dehydration
- Various conceptual projects are in the design stages in the Middle East for acid gas injection rates to exceed 400 MMSCFD.

Acid Gas Compression

- Typical existing installations are reciprocating compressors.
- Larger volume conceptual projects in Middle East are being designed with centrifugal compressors.
- Injection pressures can range from 500 psi to over 3000 psi depending upon the depth and permeability of the formation.
- Formations are typically depleted reservoirs or deep aquifers.
- These “relatively” small projects can be designed and operated safely with existing technology.

CCS – an engineering perspective

- Within the natural gas industry the challenge is to scale up the facilities including injection schemes to handle larger volumes >300 MMSCFD.
- Within the power industry the challenge is to adapt/improve on the existing technology for larger scale CCS.

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CCS – an engineering perspective

- A simple **natural gas** combined cycle power plant making 750 MW can produce 2.59 e^6 ton/yr of CO_2.

- After CO_2 recovery at 90% we would need to inject about 110 MMSCFD of nearly pure CO_2.

- Although dependent upon location and formation it can be estimated that around 34-40,000 BHP of compression will be required. This can be reduced with sub-critical subcooling and liquid CO_2 pumping.

- Each CCS project will require extensive multiple stages of compression power, dehydration, water handling, and controls.

- Wet CO_2 is very corrosive – interstage wet piping, coolers and vessels will require extensive use of stainless steel.

CCS – an engineering perspective

- Major engineering challenges include:
  - Considerable capital expense, equipment and utility requirements.
  - Integration within an existing facility.
    - Space and footprint issues.
    - Parasitic power demands of 25-35% (varying estimates)
  - Equipment challenges including sealing, turndown, maintenance, redundancy, efficiency.
  - Phase behaviour and confidence in EOS predictions.
  - Moisture content, water control and water disposal.
  - Materials and corrosion engineering
  - Access to sequestration zones and/or pipelines
  - Regulatory Issues
    - Residents and public management
    - Pipeline integrity and management
    - Wellbore and sequestration integrity – can we guarantee sequestration and not migration?