Workshop on Future Large CO$_2$ Compression Systems
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 Projects

- Originally consisted of small scale H₂S/CO₂ injection projects designed to minimize SO₂ 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 H₂S disposal but all streams contain CO₂. A few projects are primarily CO₂ 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.
CCS – an engineering perspective

• A simple **natural gas** combined cycle power plant making 750 MW can produce $2.59 \times 10^6$ 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?