



Carbon Storage and Management

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CO₂ Injection Project in Australia

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SLB

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Project Background

Australian Operator

Small-scale CO₂ injection test

- First step of large-scale CCS project
- Utilised existing 43-year-old well in depleted gas reservoir
- Prove ability to inject into operators depleted & aging assets
- Secure funding partners
- Secure CO₂ for disposal
- Enable government CCS legislation

Multi-Disciplined, Multi-National Team

Digital and Integration

- Project management
- System Design
- Flow Assurance and Process Engineering
- Well Engineering
- Site management

Reservoir Performance

- CO2 pumping standards and operation expertise
- Well testing and fluid heating package expertise



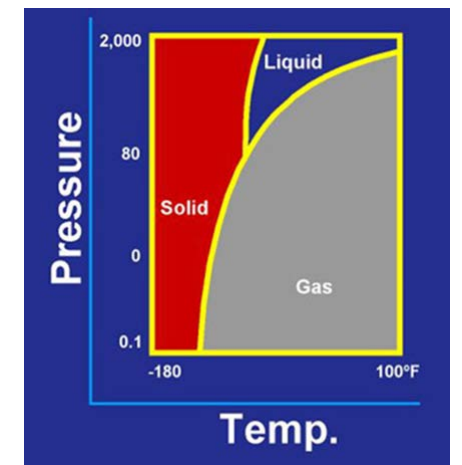
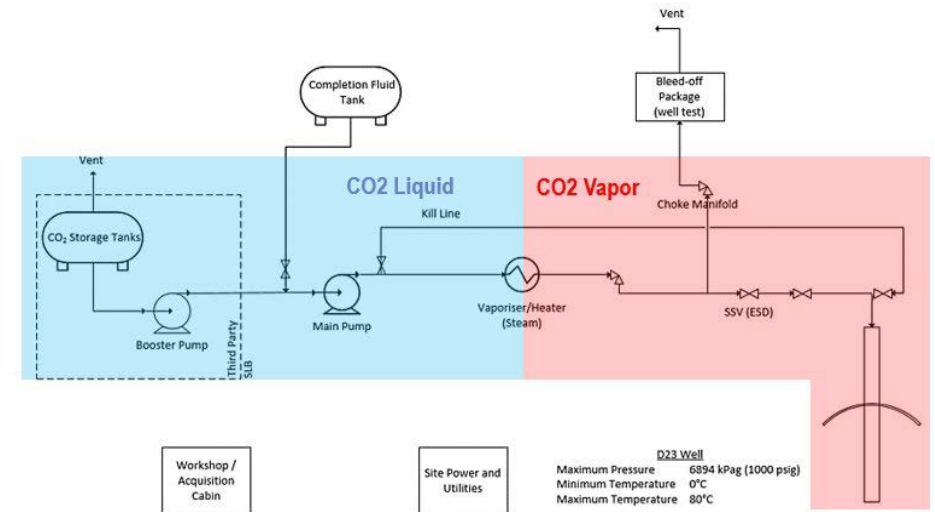
Solution Package

Integrated engineering and execution package

- Injection modeling
- System design and integration
- Well engineering
- Fit for purpose pumping package
- Integrated project management
- Post job analysis and evaluation

Safe handling and pumping of liquid CO2

Controlled vaporization and heating



Injection Package

Off the shelf equipment

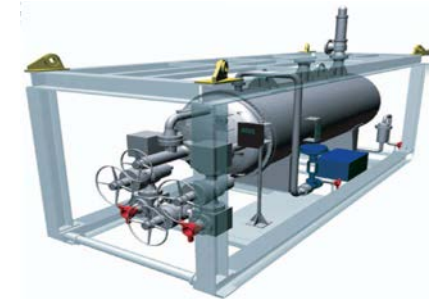
- Standard SLB "oilfield" pumping and well testing equipment packages utilised
- Standard cryogenics package applied with pressure management

Bespoke system design & integration

- Seal and consumable selections
- Startup and shutdown procedures
- CO2 phase conversion
- Merging of pumping and testing standards
- Job specific contingency plans



HP Pump



Steam Exchanger



Choke Manifold



SSV

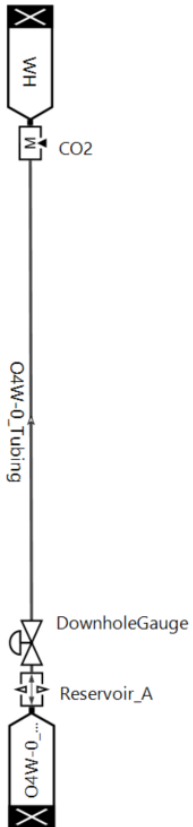
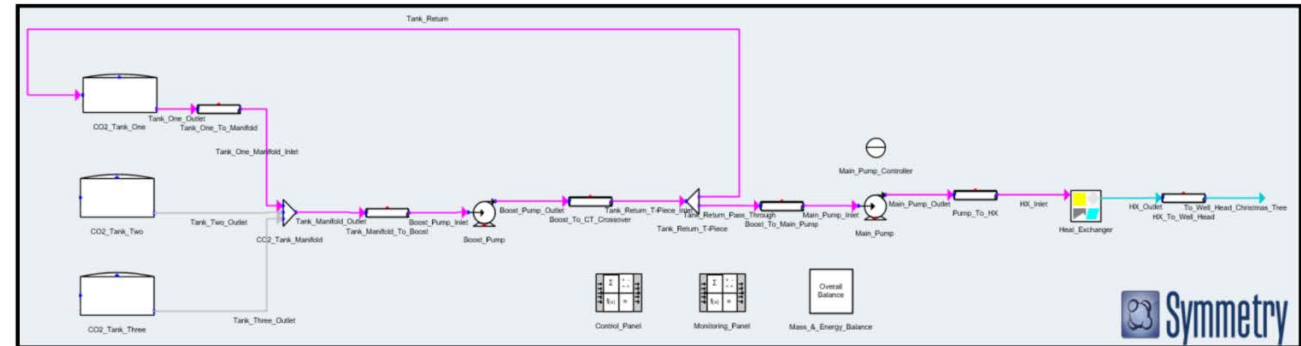


CO2 ISO's



CO2 Booster

System Modeling, Design and Injection Program Optimization



Flow assurance & process modelling critical for safe operations

- Injectivity risk evaluation and mitigation
- CO2 Vaporization and phase management
- Hydrate & Dry Ice mitigation
- Size and spec equipment
- Optimize injection parameters and develop full program from start-up to well kill
- Evaluate worst-case scenarios

Execution

Bespoke Operations Program developed

1. Rig up and commission system (pressure tests)
2. Start up system, cooldown and prime up
3. Pump liquid CO₂, adjust phase as desired
4. Kill well and return back to initial state
5. Retrieve, process, and analyze surface + downhole data
6. Pressure match / compare pre job simulations with downhole data



Safety is our priority

CO2 Dispersion Study

- Evaluate HSE risk of CO2 venting to atmosphere through priming, PRV release, and bleed off
- Establish appropriate controls (exclusion zones, procedures, etc.)

Trapped Pressure Expansion

- Evaluate worst case scenario – liquid CO2 trapped in high pressure lines

HAZOP / HAZID & Industry Expert Review

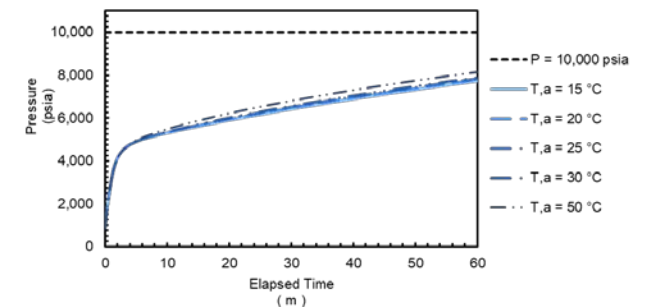
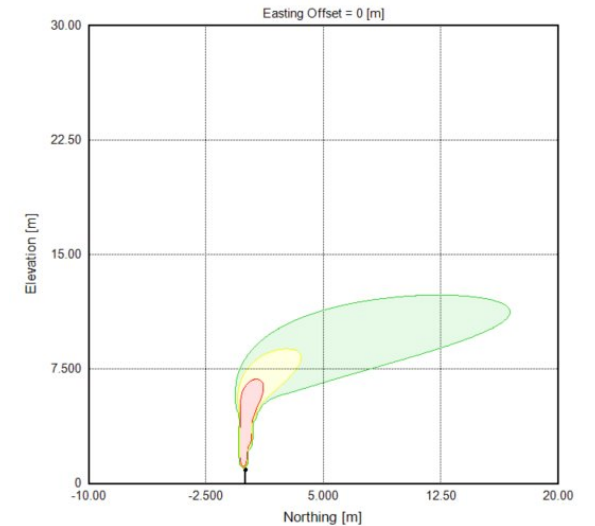
- Best practice taken from high CO2 activity locations (KSA, Oman, China)

Hazardous Area Layout

- CO2 specific and general hazards considered

Remote system operation outside of red zones

- Remote valves, pump controls.
- Automated chokes and steam control a possibility going forward



Findings & Lessons Learnt for industry

Optimized Injection Package & Program exceeded all Injection test criteria

- Provided confidence to the client, partners and project stakeholders
- Safely handled CO2 phase change and risks
- Provided quality steady-state and step rate injection data
- Flow assurance model found to be very reliable at predicting well response

DAS (Distributed Acoustic Sensing) & DTS (Distributed Temperature Sensing)

- Determine which zones CO2 is being injected
- Ability calibrate models across whole wellbore
- Crucial for MMV



Milestone for our Industry

An innovative solution **designed & delivered by SLB**

- Sustainable & scalable CO2 injection system with recordable CO2 offset
- Allows safe injection into depleted reservoirs with small temperature and pressure windows
- Completed operations safely, meeting all client objectives
- Enabled client to derisk large scale CCS project

