Re-using offshore infrastructure – some things to consider

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May 3rd 2018

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Agenda

○ Introduction

○ Infrastructure

○ Case study

○ Insights
Introduction

The reuse opportunity

Infrastructure Characteristics
- Condition
- Remaining life
- Exploitation history
- Location
- Timing

Project Specification
- Storage capacity
- Throughput
- Operating envelope
- Longevity
- Timing
Infrastructure

CO₂ transportation and storage business “limits”
Infrastructure

CO₂ transport & storage – a functional spec

- Reservoir
  - Sufficient pore space & pressure margin to meet needs of project
  - CO₂ containment

- Jacket & Topsides
  - Minimal facilities - receive CO₂ & distribute it to wells
  - Different operational hazards – CO₂ is denser than air

- Pipelines
  - > 120 – 140 bar rating throughout life
  - Metallurgy

- Wells
  - Bottom-hole location as an injection point
  - Casing design, materials and CO₂

- Subsea Infrastructure
  - Suitability of subsea valves
  - Capability of umbilical
Infrastructure Platforms

- **Aims**
  - Safe operations
  - Reduce development and operations cost

- **Implications**
  - Minimal facilities - receive CO₂ & distribute it to wells
  - Different operational hazards
  - Brown-field modifications project

- **Considerations**
  - Structural integrity
  - Life extension requirements
  - Equipment replacement & removal
  - Suitability of wells & well bay area
Infrastructure

Pipelines

- **Aims**
  - Maximise throughout by transporting in dense phase
  - Minimise offshore facilities by transporting above required injection pressure

- **Implications**
  - > 120 – 140 bar rating throughout life
  - 0 – 10°C

- **Considerations**
  - Corrosion, particulates
  - Hydrates
  - Free-spans
  - Remaining design life
  - Throughput capacity

Photo courtesy Himipex Oil
Infrastructure

Wells

○ Aims
  ● Inject at desired rate for appropriate period
  ● Not be a significant potential leakage pathway

○ Implications
  ● Long life required
  ● Xmas tree, completion tubing and equipment unsuitable

○ Considerations
  ● Bottom-hole location as an injection point
  ● Casing design & constraints on tubing size
  ● Casing materials and CO₂
  ● Integrity of cement bonds to CO₂
Infrastructure
Subsea

- **Aims**
  - Power, control and monitor operations

- **Implications**
  - Long life required
  - Xmas trees unsuitable

- **Considerations**
  - Design life
  - Suitability of subsea valves
  - Capability of umbilical

Photo courtesy Aker Solutions
Acorn Case study
Overview

Spare FEEDER 10 line to connect to future Central Scotland Industrial emissions

Additional local incremental capture opportunities

Carbon Capture plant operating since 1994 to extract CO2 from SAGE gas stream and vent before onpass gas to NGTS

Three offshore gas pipelines available for CO2 transport currently at threat of decommissioning – routing to high quality storage sites

Short link to Peterhead Harbour for shipping interchange
Acorn Case Study
Infrastructure re-use options

Atlantic Pipeline
Miller Pipeline
Goldeneye Pipeline
Goldeneye Platform

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus
Facility screening – location & required capability

○ Platform
  ● Located at eastern edge of storage area
    ○ Implications for pressure management of store
  ● Modifications (£61m ex wells)
    ○ Life extension – minor structural work
    ○ Capability - CO₂ filters, pipework, methanol
  ● Overall considered more costly
  ● Decommissioning cost

○ Subsea
  ● Location flexible
  ● Minimal facilities required – protection, control, manifold
  ● No filters required
  ● Lower decommissioning cost
  ● No liabilities inherited from previous hydrocarbon activity
Acorn Case study
Pipeline screening of integrity & throughput

Atlantic pipeline has a thicker wall than Goldeneye, but slightly smaller diameter. This means that Atlantic operating pressure is higher and has slightly greater throughput capacity than Goldeneye due to its higher pressure rating.

Atlantic 5MT/yr
- 16”
- 170bar MAOP
- 12.5mm Wall
- 97% of length trenched & buried
- Trenched and buried apart from 2.5km near shore section at 50m manifold approach

Goldeneye – 4MT/yr
- 20”
- 125bar MAOP
- 11.3mm Wall
- 19% of length trenched & buried
- Laid on the seabed from 19.4 km to Goldeneye

Diagram showing mass flow rate and outlet pressure comparison between Atlantic and Goldeneye pipelines.
Storing CO₂ within the Saline aquifer which hosts the gas fields increases storage resource to well over **150MT** – 5 x the total gasfield storage resource.

Wells at Atlantic are cheaper than at Goldeneye due to shallower target.
Key Findings

Insights

- Re-purposing oil & gas infrastructure is suitable for some CO₂ operations
  - Involves cost and risk

- Understanding functional requirements of CO₂ transportation & storage project is key
  - Safety, longevity, location

- Pipelines are more likely to be re-used than platforms
Contact Information

- Register for ACT Acorn Webinar on 20\textsuperscript{th} June 2018

Acorn 2025: a pathway to decarbonisation, will explore the options being developed for building out from the initial stages of Acorn, in a future where hydrogen use and CO\textsubscript{2} utilisation gain momentum.

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Reference

CO₂ Phase Management

[Temperature vs. Pressure Diagram]

- CO₂ solid
- CO₂ liquid
- CO₂ vapour/gas
- Super critical CO₂ dense phase CO₂

- Triple Point
- Critical Point
- Platform arrival
- Bottom Hole
- Reservoir

- Freezing
- Melting
- Condensing
- Subliming
- Boiling
- Injection
- Heating
- Recharged gas field or aquifer
- Depleted gas field

Offshore CO2 Storage Workshop - May 2018
Reference

ACT Acorn Programme

- St Fergus CO₂ hub design
- Twin storage site selection
- Expansion scenarios
- Full chain business case
- Novel geomech & shallow seismic supporting integrity assessment
- Storage development plan
- Lifecycle assessment including “Just Transition”

Significant coastal emissions point
Existing transport infrastructure options
Well qualified choice of storage sites
Reference

Infrastructure

Source: Statoil, 2010

Source: Subseaworldnews