1. Introduction

Although oxycombustion produces flue gases that are much richer in CO₂ than air-fired systems, a purification step is still required to produce CO₂ which is optimal for transport, storage and potential EOR usage. When transport by pipeline is envisaged, the purified CO₂ must be typically compressed to above the supercritical pressure of ~74bara. If transport by ship is chosen, it must be liquefied.

Pilot testing of the CO₂ Compression and Purification Unit (CPU) is one of the key steps in the development of commercial scale oxycombustion technology for carbon capture and storage.

The Callide Oxyfuel Project situated in Queensland, Australia is the largest operating oxycombustion power plant worldwide. Air Liquide has provided its Cryocap™ system for the CPU unit which is sized to operate on a flue gas slip stream producing 75tpd purified CO₂. It was designed based on initial concept studies in 2007 as a downscale of Air Liquide’s vision of commercial size CO₂ CPUs.

Since November 2012, Air Liquide has been commissioning the CPU at Callide. It is planned to run until November 2014. Several months of detailed R&D tests are planned for 2013 starting in April.

The presentation will describe the technologies used in the CPU and discuss key results from the tests planned for 2013. An outline of the material to be presented may be found in the following section.

2. Callide CPU technologies and results to be presented

The Callide CPU pilot contains all the key technologies required for a large-scale plant. The main equipments are visible in the pictures below.
2.1. **Flue gas quench and scrubber**

In order to protect downstream equipment from corrosion by species such as sulphuric and fluoric acid, the CPU is fitted with a high performance scrubber. It consists of a quench followed by one washing tower. A sodium-based reagent is injected into both these elements and re-circulated. The performances of this system will be discussed during the presentation.

2.2. **High performance dust filtration**

A high performance dust filtration system is installed. It uses regenerative pleated cartridges to achieve \(<100\mu g/Nm^3\) dust loading downstream. Feed-back concerning its operation will be given during the presentation.

2.3. **Integrally-geared centrifugal compression**

Large-scale CPUs will require integrally-geared centrifugal compressors in order to treat the large flow rates involved with the required efficiency. However, due to the acidic nature of the gases and potential presence of dust it is important to test this technology at pilot scale.

Feed-back regarding the operation of the compressor in the corrosive conditions of the flue gas will be given during the presentation.

2.4. **Dryers**

Following flue gas compression, a Temperature Swing Adsorption (TSA) unit is required to dry the gas to ppm levels of water content. The objective is to remove sufficient water to avoid freezing in the cryogenic systems downstream.

2.5. **Cold Box**

The cold box uses distillation for producing highly pure CO₂. The objective is to reach >99.9% CO₂ purity with cryogenic NOₓ and O₂ removal.
The process is also designed to demonstrate the concept of auto-refrigeration whereby an external refrigeration cycle is avoided by producing cold through the vaporisation of liquid CO$_2$ produced in the cold box. A brazed aluminium heat exchanger is used in order to ensure efficient, compact multi-fluid heat exchange.

A further objective of the cold box is to test operation close to the CO$_2$ triple point. This is important for reaching high CO$_2$ recovery factors.

The presentation will give details of the CO$_2$ recovery rates and purity levels achieved.

2.6. Mobile laboratory

Air Liquide research teams will operate a mobile laboratory featuring analyzers for all major gaseous components in addition to SO$_x$, NO$_x$ and Hg speciation apparatus.

Feed-back regarding impurities measurement techniques and results in the challenging oxycombustion environment will be given during the presentation.