Depressurization and Draining Philosophy

CO_2 Capture Facility

Kårstø, Norway

Rev.	Date	Reason for Revision	By	Check	App	App	App
0	12 NOV 08	Issued for Comment	MJC				

Bechtel Overseas Corporation

Job No. 25474

Document No.	Rev.
25474 – 000 – 30R – M01G - 00002	0

GASSNOVA

Project No. – Originator – Disc Code – Doc Type – Serial No.

10112936 – PB – P – TDO – 0013

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1.0 INTRODUCTION

This document describes the depressurizing and draining considerations made in the design of the CCC Plant. In particular attention was paid to ensure recovery and re-use of all water effluents and to ensure that MEA drained from the plant is recovered.

2.0 DISCUSSION

2.1 DEPRESSURIZATION

The CCC Plant contains carbon dioxide at supercritical conditions. In the event of leakage or equipment failure, the released carbon dioxide will reach extremely low temperatures causing a hazard to surrounding equipment and personnel. Additionally the concentrations of carbon dioxide may reach dangerous levels.

The bulk of the supercritical CO2 is stored in the CO2 Surge Drum and the plant is provided with a valve to depressure the CO2 Surge Drum and associated equipment. While depressuring the compressor shall be shut down in order to limit the depressuring volume to the CO2 supercritical part only

During depressurization low temperatures are envisaged and the metallurgy of the system specified to protect against low temperature embrittlement. The rate of depressurization will be designed to ensure the temperature in the CO2 Surge Drum is maintained above -50'C to avoid solid carbon dioxide ('dry ice') formation. The vessel will not be depressured below 10 atm to avoid the risk of sublimation at 5.1atm and below.

The venting carbon dioxide is to be routed to the absorber stacks to mix with the exiting flue gases to ensure buoyancy necessary to disperse the carbon dioxide. Assuming a supercritical carbon dioxide volume of 15m3 depressured over 15 minutes results in a carbon dioxide vent flow of 13 kg/s or <2% of the flue gas flow, so the flue gas exit temperature should not be significantly reduced.

2.2 DRAINING

The plant has a number of drainage systems. This document describes the draining from process equipment.

2.2.1 Continuous water draining sources

Water is continually drained from;

Compressor KO drums: The compressor condensate is a clean water stream and is recovered to the Wash Water Surge Tank which supplies water to the Flue Gas Fogger System and the CO2 Absorber water wash section.

The process design philosophy is to maintain an overall water balance with only net input to the process. In the event that the CCC Plant produces a surplus of water, compressor condensate can be discharged to the waste water holding tank for later sample testing and disposal to the seawater return pit.

Stripper Reflux Drum: The excess stripper reflux flow has a low MEA content and is recovered to the Wash Water Surge Tank which supplies water to the Flue Gas Fogger System and the CO2 Absorber water wash section. In the event that the CCC has a surplus of water, this stream can be discharged to the waste water holding tank for later sample testing and disposal to the seawater return pit.

Wash Water Circulation Bleed: The circulation bleed has a high MEA content and is routed to the circulating amine solution as make-up water. This ensures that the MEA is recovered into the process.

2.2.2 MEA Draining

MEA solvent and water containing MEA will need to be drained from the plant at shutdown or from individual equipments for maintenance activities.

For plant shutdown, MEA circulation continues without flue gas flow to ensure the MEA solution is lean throughout all the equipment. The equipment will be pumped out to minimum level directly, or through other vessels, to the Lean Amine Solvent Storage Tanks. The remaining MEA solution will be drained by gravity through the amine sewer to the Amine Sump Tank and then pumped to the Lean Amine Solvent Storage Tank. For these purposes the Lean Amine Solvent Storage Tank has been sized to accommodate the MEA solution from all equipment and piping at the CCC Plant amounting to 1650m3.

For individual equipment, the equipment will be pumped out to minimum level directly to the Lean Amine Solvent Storage Tanks. The remaining MEA solution will be drained by gravity through the amine sewer to the Amine Sump Tank.

The Amine Sump Tank provides an opportunity to test the drained amine and ensure it is of acceptable quality before pumping to Lean Amine Solvent Storage Tank. For this reason the sump has been sized to accommodate the entire contents of the largest vessel (One CO2 Absorber including wash water contents) amounting to 500m3. In the event that the drained MEA solution is not acceptable it can be pumped from the Amine Sump Tank to road tankers for off-site disposal.

2.2.3 Other draining

The non process draining are described in the Discharge and Emissions Data Forms, Document 10112936 - PB - S - HSE - 0004.

3.0 CONCLUSION

Depressuring facilities are installed after the final stage of the compressor to ensure the plant can be depressured to mitigate the impact of loss of containment. The depressuring rate, valve and piping is designed to ensure excessively low temperatures and 'dry ice' formation are avoided.

The process design ensures that process water is retained and reused within the CCC plant to eliminate routine draining and minimise make-up requirements.

Facilities are provided to drain and store amine from the plant during operation and shutdown. These facilities enable the CCC Plant to be completely emptied of MEA solution at a shutdown and MEA solution to be drained from individual equipment and tested before pumping to the lean amine storage tank.