


# Guarantees on Key Parameters

## CO<sub>2</sub> Capture Facility

Kårstø, Norway

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## Guarantees on Key Parameters

### 1.0 INTRODUCTION

The primary purpose of this document is to provide an overall summary level understanding of the key performance guarantees and procedure for substantiating and verifying the values.

### 1.1 LIMITS BY DESIGN

The following technical parameters have been provided for in the design. There are no implied guarantees on these values, which can be addressed once the EPCI contract terms and liquidated damage (LD) levels have been established.

- Design complies with the limit for a sea water discharge temperature of maximum 21°C.
- Far field noise for the CCC Plant only will be limited to 40 dBA at 700 meters to the nearest receptor. Near field equipment design limits have that been established to 85 dBA at 1 meter.

### 1.2 GUARANTEES – ANTICIPATED:

No performance guarantees are provided. The following parameters are anticipated to be required to be guaranteed. These can be addressed once the EPCI contract terms and liquidated damage (LD) levels have been established.

- Availability (currently by contract at min. 97%)
- CO<sub>2</sub> capture rate (currently by contract at min. 85%)
- CO<sub>2</sub> purity (currently by contract at min. 99.6%)
- Overall solvent loss
- Steam consumption
- Electric power consumption
- Sea water consumption
- Emissions to air (emission limit of 5 ppmvd amine from the absorbers)
- Emissions to sea water
- Hazardous waste level and quantity
- Liquid effluent discharges

No limit for NO<sub>x</sub>, SO<sub>x</sub>, CO, CO<sub>2</sub>, or any other exhaust gas emissions which are received from the Naturkraft CCPP are expected to be imposed on the CCC Plant.

## **2.0 CONDITIONS FOR PERFORMANCE TESTS**

The following aspects of the testing to substantiate and verify the guarantee values include:

- Conditions under which the performance testing will be executed
- Performance test objectives qualified (but not quantified at this stage)

This document is not intended to detail the final performance target for each objective that will be measured, rather it provides for the mutual understanding by the Owner and Contractor of the procedure and conditions under which the testing will take place. The defined performance target for each objective will be finalized in the EPCI Contract. Any data included in this document are for information only and may not predict data to be included in the detailed design documents.

Where available, all testing will be conducted utilizing installed instrumentation and on site laboratory facilities.

### **2.1 TEST PROGRAM APPROVAL**

The Contractor will develop and submit to Gassnova a Test Program that outlines each test objective and its corresponding target value that will be measured. The target values will be based upon the final design criteria contained in the FEED Study, and finally agreed and specified in the EPCI Contract.

### **2.2 TIMING OF PERFORMANCE TESTING**

The performance tests shall commence only after successful commissioning of the facility.

The Contractor will submit the Performance Guarantee Test Program to Gassnova at least 30 calendar days prior to commencement of the Performance Testing period to allow time for Gassnova to coordinate for its representative to be present.

### **2.3 TESTING CORRECTION CURVES**

If applicable the Contractor will provide the final test results to Gassnova with correction curves. Correction curves will be mutually determined between Contractor and Gassnova prior to final submission.

### **2.4 REPRESENTATION AT TESTING**

The Contractor and Gassnova shall have the right to have their representatives present during the performance tests. Absence of either party shall not prevent the Performance Test from occurring. Absence of all qualified Gassnova representation shall give cause for acceptance of the Performance Guarantee Test.

## 2.5 INPUTS REQUIRED FOR TESTING

Gassnova will be responsible to provide all energy and utility inputs, solvent, chemicals, gases, spare parts and all other items required to operate and maintain the facility. Gassnova will ensure these items are available and in adequate inventory for the operation of the facility during the course of the Testing Period.

## 2.6 TIME ALLOTTED FOR CORRECTIVE REMEDY

If the entire Performance Test or a single objective of the Performance Test cannot be met due to mechanical or electrical failure of the facility, sufficient time will be provided to remedy the failure and re-perform the test.

## 2.7 BOUNDARY CONDITIONS FOR TESTING

Testing shall be conducted under ambient conditions as given in Appendix E1.1. If ambient conditions are not adequate for testing within 30 days of commissioning of the facility, Gassnova will be responsible for all Contractor costs to conduct tests at a later date.

Testing shall be conducted utilizing flue gas composition provided in the Exhibit E0 Design Basis document.

Testing shall be conducted using the cooling water and steam conditions as provided for in Exhibit E9 Battery Limits.

Applicable corrections based on corrective curves for the above Boundary Conditions will be mutually agreed to between the Contractor and Gassnova.

## 2.8 TOLERANCE ON MEASURED OBJECTIVES

Allowable tolerance on each measured objective will be defined in the EPCI Contract.

## 2.9 OTHER CONDITIONS

In addition to the above, the contractual obligations of the EPCI Contract shall apply without any restrictions.

## 3.0 PERFORMANCE TEST OBJECTIVES

### 3.1 CO<sub>2</sub> CAPTURE RATE

The CO<sub>2</sub> capture rate will be determined by measuring the CO<sub>2</sub> content in the off-gas at the top of each absorber and the CO<sub>2</sub> content in the incoming flue gas at the HRSG transition to the ductwork. These will be presented as a percentage (%) of volume in both streams.

### 3.2 CO<sub>2</sub> PURITY

The CO<sub>2</sub> purity will be determined by suitable analytical equipment. Measurement of the CO<sub>2</sub> product will be after the compression operation.

### 3.3 OVERALL SOLVENT LOSS

The overall solvent loss will be determined within the Testing Period by taking the amount of solvent added to the system over an agreed period of time/frequency under the conditions listed below:

- a. The system is fully commissioned
- b. The correct concentration is determined and maintained during the agreed time/frequency specified
- c. The system is running in steady state
- d. A solvent use log records all solvent transactions into the system

Only solvent transaction events recorded in the report log will be utilized in the calculation of overall solvent loss.

### 3.4 SOLVENT AVAILABILITY

Solvent availability during the Testing Period is the responsibility of Gassnova.

### 3.5 UTILITY CONSUMPTION

Utility consumption will be measured using the facility integrated instrumentation. Temporary instrumentation will not be utilized.

#### 3.5.1 ELECTRICAL POWER

Electrical power used will be measured in kilowatts at the incoming feed from the Naturkraft CCPP to the CCC Plant, using permanent revenue class metering. The consumed power will not include non-process related consumers such as lighting, HVAC, heat tracing, etc.

#### 3.5.2 STEAM

Steam demand will be measured in the number of units of steam required to capture a single unit of CO<sub>2</sub> excluding operation of the reclaimers. The unit of measurement will be kilograms for both steam and the CO<sub>2</sub> product gas. CO<sub>2</sub> production will be determined by measurement taken at the CO<sub>2</sub> product gas piping immediately following the reflux knock-out tank. Steam consumption will be measured using an LP steam meter located immediately inside the CCC plant battery limit, using permanent revenue class metering.

#### 3.5.3 OVERALL COOLING DUTY

Overall cooling duty performance will be determined by measuring supply and return sea water temperature and flow at the sea water pump intake structure and at the CCC plant seal well, respectively.

#### 3.5.4 RAW WATER

Overall raw water consumption will be determined by measuring water received at the CCC Plant battery limit, using permanent revenue class metering.

### 3.6 OFF-GAS EMISSIONS TO AIR

Off-gas emissions to air will be measured using online Continuous Emissions Monitoring (CEMS) instrumentation located at the top of each absorber.

### 3.7 LIQUID EFFLUENT

There are no expected continuous liquid effluents from the CCC plant.

### 3.8 HAZARDOUS WASTE (TO BE DEFINED)

Hazardous waste (to be defined) will be measured in the condition that it leaves the battery limit of the facility and reported in the unit normal to its transport.