

Escape, Evacuation and Rescue Strategy

CO₂ Capture Facility

Kårstø, Norway

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1.0 SUMMARY

The Escape, Evacuation and Rescue (EER) strategy describes the Escape, Evacuation and Rescue provisions to be provided for the Carbon Dioxide Capture and Compression (CCC) Plant forming the Kårstø CO₂ Capture Project.

The Kårstø CO₂ Capture facility will be onshore and will not have any credible fire, toxic gas or explosion hazards present that can result in escalation to the muster area under a single failure event (e.g. localized spill or leak).

Therefore, evacuation provisions for the complete facility personnel will not need to be included. Once the facility personnel have mustered in the designated safe haven (TR) they will be able to escape to the designated Kårstø site wide muster areas under the direction of the site wide Central Control Room staff and/or emergency services personnel.

Emergency services coordination will need to be in place in the event of personnel injury to remove them to a site wide muster point or medical facilities.

2.0 INTRODUCTION

2.1 GENERAL

The success of EER from the CCC Plant depends upon number of factors:

- Hazard prevention, control and mitigation;
- CCC Plant physical design (e.g. escape routes, temporary refuge (TR), muster areas);
- The performance of equipment in an emergency (e.g. alarm systems, fire fighting equipment, escape routes, etc);
- The actions of personnel concerned (e.g. emergency response and management teams).

2.2 OBJECTIVE

The EER strategy describes the provisions to be put in place for the escape and mustering of personnel.

An EER Assessment will be performed during detailed engineering to demonstrate that for all credible hazardous events the escape and muster provisions are adequate and meet all relevant codes and standards.

3.0 ABBREVIATIONS

CCC	CO ₂ Capture and Compression
CCPP	Combined Cycle Power Plant
CO ₂	Carbon Dioxide
CR	Control Room

FEED	Front End Engineering Design
EER	Escape, Evacuation and Rescue
PA	Public Address
RAL	Deutsches Institut für Gutesicherung und Kennzeichnung
TR	Temporary Refuge

4.0 DEFINITIONS

The terms escape, evacuation and rescue are defined as follows:

Escape	refers to the process of moving from a point on the plant to the muster area.
Evacuation	refers to the process of leaving the facility.
Rescue	refers to the process of being rescued after evacuation from the facility.
TR	refers to the place provided where personnel can take refuge for a pre-determined period whilst investigations, emergency response and evacuation pre-planning are undertaken.

Although the term rescue in EER refers to rescue after evacuation, in the event of an injury to a person during an incident, adequate provisions will be required to allow rescue and escape to the muster point.

5.0 PROJECT OVERVIEW

It is the intention of the Norwegian Government to develop a carbon dioxide capture and compression (CCC) project in association with an existing 420 MW gas-fired combined cycle power plant (CCPP), which is located at the Gassco facility in Kårstø, Norway.

The CCC Plant has a CO₂ capture target of at least 85% of the CO₂ contained in the flue gas from the CCPP. The CCC Plant will deliver liquefied CO₂ to the battery limit of the CCC Plant.

The CCC Plant consists of the following systems:

- Flue gas diversion – where the flue gas is extracted from the existing CCPP stack to the CCC Plant;
- Flue gas cooling – the flue gas must be cooled to be processed efficiently in the amine system. Cooling is to be to saturation temperature before entering the absorber towers;

- CO₂ Absorption – two absorbers remove the CO₂ from the flue gas using an amine solution;
- Heat Integration – this system recovers heat from internal streams to enhance the energy efficiency of the facility;
- CO₂ Stripping – the amine is regenerated for reuse by liberating the CO₂ from the amine solution;
- Amine Reclamation – this system removes heat stable salts from the amine solution, generating a waste stream;
- Amine Storage – concentrated amine and lean (35% wt) amine are stored and injected in to the absorption system to maintain the amine solution concentration;
- CO₂ Compression and drying – the CO₂ is dried and liquefied to meet the CO₂ specifications.

Construction operations will occur in a sequence that will involve flue gas duct tie in preparation during normal operations of the CCPP plant.

6.0 ESCAPE STRATEGY

The escape strategy for CCC Plant is based on NORSOK S-001 and ISO-13702 standards.

6.1 ROLE

The purpose of the escape routes is to ensure that personnel may leave areas in case of a hazardous incident by at least one safe route and to enable personnel to reach the designated mustering area from any part of the CCC Plant.

6.2 INTERFACES

The escape routes interface the following safety systems/functions:

- Equipment layout
- PA, alarm and emergency communication
- Emergency power and lighting
- Passive fire protections
- Structural integrity

6.3 REQUIRED UTILITIES

The performance of the escape routes is dependant upon emergency power and lighting to ensure lighting for escape if main power supply fails. Emergency lighting requirements shall be provided along all preferred escape routes.

6.4 FUNCTIONAL REQUIREMENTS

6.4.1 EER Strategy

The EER strategy shall be based on the EER assessment, which considers a wide range of events, which may arise and contain a viable approach for all these events. The FES, gas dispersion and HAZID studies shall be used for identification of hazardous events.

The EER strategy shall also address issues such as organization, procedures, information, training and emergency response, which are necessary to achieve successful EER process.

A command structure shall be established that will, as far as reasonable practicable, remain effective throughout all stages of the emergency.

A place shall be provided where personnel can muster while investigations and emergency response are undertaken. This place shall be the Main Stores Area “Temporary Muster Point” and designated as TR. This point shall be reflected on the applicable Escape Route Drawings. Designation of any secondary or alternate muster points shall only be undertaken following full evaluation of the Kårstø site wide EERS.

Communication systems shall be provided to allow personnel to effectively execute their emergency duties.

6.4.2 Escape Routes

Escape routes, leading to muster area, shall be provided to enable all personnel to leave an area in case of a hazardous incident.

Escape routes shall be part of the daily used passageways. Escape routes should preferably be provided on the outside along the periphery of the plant.

Escape routes shall be well marked, including signs. Marking shall show the preferred direction of escape.

There shall be at least two exits to escape routes from permanently or intermittently manned area outside buildings, leading in different escape directions.

The escape route network shall lead to safe area (i.e. TR).

Required width of escape routes shall emphasize easy transport of injured personnel on stretcher.

The dimension of escape routes shall be minimum 1 meter width (0.9 meters for doors) and 2.3 meters in height (2050 mm for doors). Escape routes intended for use by more than 50 persons shall be extended to 1.5 m (1.2 m for doors) in width.

Escape routes on elevated structures shall be provided with a non-skid, slip resistant coating in yellow (RAL 1023). On deck grating, two parallel 100 mm wide yellow lines shall be painted indicating the width of the escape route.

Escape routes leading to higher or lower level should be provided with stairways. Ladders can be used in areas where the work is of such a nature that only a few persons (maximum three) are in the area on a short time basis.

6.4.3 Escape Exits

There shall be no dead end corridors exceeding 5 m in length.

Internal building arrangements should be evaluated for possible blocking of exits following an accident as well as external blockage. Any building where more than 15 persons may assemble shall have at least two exits.

All doors shall be constructed so that one person can easily open them from either side. They shall open in the direction of escape, without blocking the outside escape route.

Rescue of injured parties, stretcher access, safety showers, first aid etc shall be included where necessary.

A preliminary assessment of escape routes is carried out during FEED. Full Assessment of all escape routes will be performed during the next phase to demonstrate that the design meets the Norwegian and ISO standards.

Escape Route Drawings showing the primary escape route(s) shall be prepared. For FEED, these drawings are preliminary in detail and subject to further evaluation during detailed engineering.

6.4.4 Gas Detection

Toxic gas detection shall be provided to detect potentially toxic gas leaks in all process buildings and throughout the outdoor portions of the CCC Plant. Alarming and annunciation shall be arranged to provide visual and audible signals to prevent workers from entering an area where leakage has been detected and to signal an escape to the temporary muster point (CCC Plant Stores area).

Concentrations for the low alarm detection thresholds shall be determined by tabulated values in DLI 361 for occupational limits and DLI 361 concentration formulas for high alarm concentration. No executive action will be taken beyond the annunciation of area alarms and at the CCC Plant Control Room.

F&G detection philosophy, detector location and alarm levels shall comply with provisions described in Fichtner-Gassnova document number 10112936-FI-B-CON-0140-05 "Exhibit E8.1- HSE Requirements."

The F&G system shall comply with the requirements of Fichtner-Gassnova document number 10112936-FI-B-CON-0094-01 "Exhibit E4.4 - General Technical Requirements, Fire and Gas Monitoring and Alarm System."

7.0 EVACUATION STRATEGY

The Kårstø CO₂ Capture facility will be onshore and will not have any credible fire, toxic gas or explosion hazards present that can result in escalation to the muster area under a single failure event (e.g. localized spill or leak). Therefore evacuation provisions for the complete facility personnel will not need to be included. Once the facility personnel have mustered in the designated safe haven (TR) they will be able to escape to the designated Kårstø site wide muster areas under the direction of the site wide Central Control Room staff and/or emergency services personnel.

8.0 RESCUE STRATEGY

The Kårstø CO₂ Capture facility will be onshore and will not have any credible fire, toxic gas or explosion hazards present that can result in escalation to the muster area under a single failure event (e.g. localized spill or leak). Therefore rescue provisions for the facility personnel will not need to be included. Once the facility personnel have mustered in the safe haven (TR) they will be able to escape to the designated Kårstø site wide muster areas under the direction of the site wide Central Control Room staff and/or emergency services personnel.

Rescue means will need to be in place in the event of personnel injury. This includes safety showers, safety cabinets and first aid kits. During detailed engineering, detailed emergency extrication planning from confined spaces and elevated spaces shall be prepared to ensure that personnel can be safely removed for examination, first aid and transport to medical facilities.

8.1 SAFETY SHOWERS/EYE WASH

Strategic location should be identified through a separate evaluation considering the spillages that may occur or risk from burns or personal exposure to hot fluids or chemicals.

8.2 SAFETY STATION CABINETS

An adequate number of safety cabinets shall be provided. The cabinets shall be painted green (RAL 6002). They shall contain:

- Four vacuum wrapped blankets
- One scoop type stretcher
- One basket type stretcher
- One first aid kit

8.3 FIRST AID KITS

An adequate number of first aid kits shall be provided at suitable locations. Examples of locations where first aid kits should be considered are workshops, electrical building and other areas where cuts injuries are likely to occur.