Occupational Health Area Charts

CO_2 Capture Facility

Kårstø, Norway

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Rev.	Date	Reason for Revision	By	Check	App	App	Client
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Contents

1.0 INTRODUCTION

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 in Kårstø, Norway.

The CCC Plant will recover at least 85% of the CO2 contained in the flue gas from the CCPP and deliver liquefied CO2 to the battery limit of the facility. This is a new, process plant to be located within an existing facility.

During the design cycle, construction, commissioning and operation of the CCC Plant, working environments are identified to address occupational health design requirements as input to engineering activities, with the goal of a "zero harm" philosophy.

To optimize the project design, it is necessary to consider technological solutions to prevent unacceptable working environment risks for planned tasks that are foreseeable and reasonable.

NORSOK Standard S-002 "Working Environment" provides a framework for preparation of Working Environment Area Charts (WEACs), and establishes baseline requirements in the design of each working environment. WEACs are updated through the project development cycle to further evaluate and document the design during detailed engineering and then to validate the design during construction, commissioning and operation.

Reference should be made to Fichtner-Gassnova document number 10112936-PB-S-HSE-0008 "Concept Working Environment Impact Assessment" for the CCC Plant.

Attachment 1 below includes twenty-nine (29) WEACs for the CCC Plant, as foreseeable at the FEED stage of engineering. It is anticipated that further refinement of the WEACs will occur during detailed engineering as part of Working Environment Design Review work mandated in NORSOK S-002.

As permitted in note 'i' of each WEAC, the cover for this document package serves as "signatures on a common sheet".

It is assumed that the design requirements for all WEACs will meet the Working Environment Area Limits (WEALs), as a minimum. Preliminary Predictions for noise are documented in the WEACs below where available from the Coarse Noise Evaluation Report.

For each WEAC in Attachment 1, the lower portion of the chart includes a column entitled "Description of identified hazards/nonconformities/comments". For this iteration of WEACs, this column is used to identify general comments applicable to the working environment being documented.

However, each WEAC includes detailed comments in a "Notes" section at the foot of each chart. These notes are subtitled to align with the subsections in the lower portion of the chart (e.g. "Arrangements"). Each notes subsection further qualifies hazards specific to the working environment and engineered or administrative barriers to reduce risk.

2.0 DEFINITIONS AND ASSUMPTIONS

There are requirements dependent on occupancy or "manning". Thus manning levels are required to be defined on the WEACs. Three levels of manning are defined in NORSOK S-002:

Permanently Manned:	Areas manned at least 8 hours per day at least 50% of the time
Intermittently Manned:	Work areas where inspection, maintenance and other tasks are planned to last at least 2 hours a day at least 50% of the days.
Normally Unmanned:	All other work areas.

NORSOK S-002 Annex A Table A-1 manning levels are used for the FEED issue of WEACs, since they are normative.

Design reviews and risk analyses that are to occur during detailed engineering (and later) may establish such manning levels as inconsistent. Manning levels can be revised based on discussion. In general, the NORSOK manning levels are based on experience and should be followed.

The HVAC discipline will primarily design ventilation systems to meet the temperature limits imposed on a working environment and provide adequate cooling and air changes for equipment located in a room. NORSOK S-002 makes reference to Norwegian Directorate of Labour Inspections standard number DLI 444 and all HVAC designs should comply with its guidance.

Attachment 1

Working Environment Area Charts (WEACs)

WORKING ENVIRONMENT AREA CHART	Doc. no. 10112936-PB-S-0007 sheet 1 of 29	Rev. 1	Date: 11.11.2008	Page 1 of 3
Installation: CO2 Kårstø	Room/area name: Main Process Plant – Tank Bund	Module/level: Main Process Plant North	Area no.: NA	Manning:[a] I

WORKING ENVIRONMENT AREA LIMITS					
Factor	Limit/level[b]	Preliminary prediction [c]	Predicted at issue for construction [c]	As built [d]	Status[e]/Notes[f]
Noise: Total HVAC	85 dB(A)				
Vibration	Category 3				
Illumination[j]	200 +Task	200			
Temperature	Outdoor	Ambient			
Air changes per hour	Natural				
Types of hazardous substances[g]:	See Notes Below				

GENERAL				
Factor	Document Id. No. [h]	Description of identified hazards/nonconformities/ comments	Decision	Status [e] /Notes [f]
Arrangements	WEIA -- 10112936-PB-S-0008	NORSOK S-002 Annex B and C; Tankage Signs for EC labeling requirements; All vertical tanks require internal ladder		See note 1) below for additional detail
Ergonomics	WEIA -- 10112936-PB-S-0008	Shall comply with all codes; local lifting devices may be required with access for items >25 kg and/or > 200 kg		See note 1) below for additional detail
Human factors	WEIA -- 10112936-PB-S-0008	Shall comply with all codes		See note 2) below for additional detail
Technical appliances	WEIA -- 10112936-PB-S-0008	Lock-out/Tag-out/rundown and blanking philosophy and JHA required specific to work areas under repair or maintenance conditions		See note 2) below for additional detail
Chemical substances	WEIA -- 10112936-PB-S-0008	Flushing and Purging Required prior to entry (confined space exposure may exist)		See note 3) below for additional detail
Permanent protective equipment	WEIA -- 10112936-PB-S-0008	Manways must be provided, fall arrest harness and lifting hardware to be provided Outside toxic/combustible gas detection provided		See note 4) below for additional detail
Outdoor operations	WEIA -- 10112936-PB-S-0008	Cold weather operations potential; Flare Radiant Heat from Gassco area to south		See note 5) below for additional detail
Radiation	NA	No radioactive sources		
Notes f: ***SEE DETAILED NOTES BELOW***				

PREPARED BY [i]:	CHECKED BY [i]:	APPROVED BY [i]:

Notes:
a Level of manning, see Annex A: Permanently Manned (M); Intermittently Manned (I); Normally Unmanned (U).
b To be established according to 4.3
c Preliminary prediction at issue for construction shall be made for noise, see 4.4.7. The needs of two separate predictions shall be evaluated for other factors.
d Measure values during commissioning.
e Status: OK; Action Required (AR); Non-conformity, Action Pending (NCP); Non-conformity, Approved (NCA); Not Identified (NI); Not Applicable (NA).
f State references to underlying documentation, i.e. non-conformity reports.
g List all identified chemicals, that are planned for use and that may represent a health hazard, see 4.4.6.
h State document identification number for performed working environment analysis and design reviews.
i May be replaced by signatures on a common sheet.

NOTES:

1) Arrangements/Ergonomics:

These locations will be classified as "Intermittently Manned" under normal shutdown conditions and otherwise unmanned as sealed equipment items under operational conditions.

Internal tank maintenance activities (confined space) should be subject to full JHA. Temporary task lighting will be required to provide adequate internal illumination during maintenance or repair activities. Full flushing procedures to minimize vapor residues will be required as a procedural layer of protection for workers (see Chemical Hazards below).

Consistent with the requirements of NORSOK S-002, for parts over 25 kg in mass, additional material handling equipment may be necessary.

Regular inspection activities may require using external tank ladders or platforms to access instrumentation or vent areas. Proper ladder arrangements to ISO/NORSOK requirements and fall arrest hardware and training should be addressed.

2) Human Factors/Technical Appliances: Full Lock-Out/Tag-Out program, and blinding philosophy will be required for the general plant areas for worker safety when working on equipment.

Use of instrumentation field output to be reviewed during EPC phase to determine instrument accessibility for inspection, calibration and field readouts.

Equipment and motor arrangements to follow the requirements of NORSOK S-002 clause 5.3.

A full Lock-out/Tag-out program must be observed in this area and blanking and blinding philosophy to take equipment out of service safely before equipment opening and/or entry.

3) Chemical Hazards: Bulk Lean and Concentrated MEA storage subject to Chemical Hazard Risk Assessment during detailed engineering. All chemical storage in the bunded area is subject to EC labeling requirements.

Due to chemical inventories present, proper flushing and shutdown/isolation procedures will be required for system maintenance and repairs under scheduled and unscheduled conditions.

Chemical additives for water treatment tanks in the bunded area to be determined and validated during detailed engineering. MSDS review to confirm compatibility of agents stored in a common area.

4) Permanent Protective Equipment: Escape considerations will be addressed through the use of audible and visual alarms (strobes and horns) to minimize worker exposure under leakage conditions or a plant-wide/site-wide evacuation alarm due to elevated noise exposures in this area.

Two means of egress from the bunded area required.

Tank will have an external ladder. During any ladder or access to the top of the tank, proper fall arrest is required (with PPE). A JHA for this work is required.

Additional hearing protection may be required under normal testing operations to minimize worker exposure to the 85 dB(A) limits in general plant HSE requirements.

5) Outdoor Operations: Scheduled maintenance and repairs should be arranged to occur when outdoor ambient temperature is well above freezing (i.e. 5 warmest months of the year).

Shift inspections of the bunded area in cold weather shall observe limitations on time outside based on NORSOK S-002, clause 5.8.

If an unscheduled outage occurs that mandates work in conditions below freezing, working duration limitations may apply depending on outdoor temperature and wind velocity (Wind Chill Index) consistent with NORSOK S-002 clause 5.8. A full Job Hazards Analysis procedure should be developed during the Construction and Commissioning phase of project by EPC contractor with owner.

The bunded tank area is located at the north battery limit of the CO2 Capture and Compression unit. Under a site wide power failure condition, radiant heat from Gassco flares FC111, FC211 and FC510 could expose workers in the area to greater than the 4.73 kW/m² limit. Under site wide power failure conditions with flaring, worker must evacuate this area to the main administration building by prescribed routes.

WORKING ENVIRONMENT AREA CHART	Doc. no. 10112936-PB-S-0007 sheet 2 of 29	Rev. 1	Date: 11.11.2008	Page 1 of 3
Installation: CO2 Kårstø	Room/area name: Main Process Plant – Amine Reclaimer Pumpout	Module/level: Main Process Plant South	Area no.: NA	Manning:[a] U

WORKING ENVIRONMENT AREA LIMITS					
Factor	Limit/level[b]	Preliminary prediction [c]	Predicted at issue for construction [c]	As built [d]	Status[e]/Notes[f]
Noise: Total HVAC	85 dB(A)				
Vibration	Category 3				
Illumination[j]	Min. 300 +Task	300			
Temperature	Outdoor	Ambient			
Air changes per hour	Natural	Ambient			
Types of hazardous substances[g]:	See Notes Below				

GENERAL				
Factor	Document Id. No. [h]	Description of identified hazards/nonconformities/ comments	Decision	Status [e] /Notes [f]
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Human factors	WEIA -- 10112936-PB-S-0008	Shall comply with all codes		See note 2) below for additional detail
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Notes:
a Level of manning, see Annex A: Permanently Manned (M); Intermittently Manned (I); Normally Unmanned (U).
b To be established according to 4.3
c Preliminary prediction at issue for construction shall be made for noise, see 4.4.7. The needs of two separate predictions shall be evaluated for other factors.
d Measure values during commissioning.
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g List all identified chemicals, that are planned for use and that may represent a health hazard, see 4.4.6.
h State document identification number for performed working environment analysis and design reviews.
i May be replaced by signatures on a common sheet.

NOTES:

1) Arrangements/Ergonomics:
Supplemental task lighting may be required to provide adequate illumination during activities around the reclaimer or reclaimer waste storage tank.

All requirements of Exhibit E2 "General CCC Plant Requirements" clause 2.6.5 shall apply for the arrangement of the off-loading station for contractor use. Full JHA will be required during detailed engineering phase by EPC Contractor.

2) Human Factors/Technical Appliances: Gassnova HSE Requirements mandate the use of a dedicated coupling type unique to the pumpout of the Amine Reclaimer Waste.

Pumping operations must be a manual start setup under the control of the attending contractor who must have received proper training. Once pumping, upset on pumping conditions may be stopped automatically by control system (e.g. overfilling potential, over-pressure) or via local manual or remote manual stop from Main Control Room.

Proper bonding and grounding requirements (as established during detailed engineering) must be provided as a guard against ignition source, if static discharge is deemed a credible risk of ignition of concentrated reclaimer sludge.

3) Chemical Hazards: Degraded Amine Sludge is considered a Hazardous Waste that must be pumped out to tanker truck and removed from the Kårstø site for safe disposal by contractor.

As requested in client document 10112936-FI-B-CON-0140, rev. 05, section 4.2.5, this degraded amine waste solids product should be labeled as follows:

C: Corrosive
Xn: Harmful (Sensitizing)
Xi: Irritant

R-Phrases: R34 – R22-R36/37/38-R43
S-Phrases: S9-S16-S22-S23-S26-S36/37/39-S45-S61

Due to chemical inventories present, proper flushing and shutdown/isolation procedures will be required for system maintenance and repairs under scheduled and unscheduled conditions.

4) Permanent Protective Equipment: Escape considerations will be addressed through the use of audible and visual alarms (strobes and horns) to minimize worker exposure under