Lusail Real Estate Development Company

Health, Safety, Security, Environment, Logistics & Quality Department

Lusail Construction Safety Management Procedure – Ventilation

Document No	LUS-HSE-WG3-446-037.01			Rev	1
Uncontrolled Copy		Controlled Copy	x	Date	01-Apr-2015

Amendment Record

This document is reviewed to ensure its continuing relevance to the systems and process that it describes. A record of contextual additions or omissions is given below:

Rev .No	Description / Comments	Prepared By	Checked By	Approved By	Issue Date
1	(Pg. 1) Company Propriety Information – Not controlled if printed has been added.	HSE Working Group	Michael Ford	Uwe Krueger	1st April 2015
1	(Pg. 2) Revised Amendment Table	HSE Working Group	Michael Ford Michael Ford	Uwe Krueger	1st April 2015

CONTENTS

1. Introduction

This element of the LCSMP provides Contractors and personnel with guidelines for establishing and implementing ventilation systems intended to control airborne contaminants in the work area and provide healthy indoor air quality to employees.

This Procedure applies to all Lusail personnel, Contractors, Developers, Consultants and subcontractors working on the Lusail project.

2. Definitions

Term	Description
Acceptable Indoor Air Quality	Air in which there are no known contaminants at harmful concentrations as determined by cognizant authorities and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.
Job Hazard Analysis (JHA)	A process used to identify the hazards or potential hazards associated with each step of a job or work plan to uncover hazards and then eliminate, control, or remove them before the work is started.
Baffle	An obstruction used to achieve a more uniform distribution of velocities or to divert flow of air through a ventilation system.
Capture Velocity	Air velocity at any point in front of the hood or at the hood opening necessary to overcome opposing air currents and to capture the contaminated air at that point by causing it to flow into the hood.
Dewpoint	Temperature at which moisture condenses from humid vapors into a liquid state.
Dilution Ventilation	Dilution of contaminated air with uncontaminated air for the purpose of controlling potential airborne health hazards, fire and explosive conditions, odors, and nuisance-type contaminants.
Exhaust Ventilation System	A system for removing contaminated air from a space, comprising two or more of the following elements: (a) enclosure or hood, (b) duct work, (c) dust collecting equipment, (d) exhauster, and (e) discharge stack.
Face Velocity	Measurement of the air velocity at the face of the hood in an HVAC system.
Flange	A protruding rim, edge, rib, or collar around the face of a local exhaust hood.
Fume	Tiny solid particles, condensed from a vapor, normally in the presence of intense heat such as welding, cutting, soldering, or brazing.
Hood	A shaped inlet designed to capture contaminated air and conduct it into the exhaust duct system.
Lower Explosive Limit (LEL)	The lower limit of flammability or explosibility of a gas or vapor at ordinary ambient temperatures expressed in percent of the gas or vapor in air by volume.
Workplace Exposure Limits (WEL)	Regulatory limits on the amount or concentration of a substance to which a person may be safely exposed without adverse health effects. They may also contain a skin designation. WELs are enforceable and usually based on an 8-hour time-weighted average (TWA) exposure.

Radioactive Alpha or Beta Emitters	A radioactive isotope that decays by emitting an alpha or beta particle.
Relative Humidity (RH)	The amount of water vapor present in the atmosphere expressed as a percentage of the maximum that could be present at the same temperature.
Spray-Finishing Operations	Spray-finishing operations employ methods wherein organic or inorganic materials are used in dispersed form for deposit onto surfaces to be coated, treated, or cleaned. Such methods of deposit may involve automatic, manual, or electrostatic deposition. Methods do not include metal spraying or metallizing, dipping, flow coating, roller coating, tumbling, centrifuging, or spray washing and degreasing, as conducted in self-contained washing and degreasing machines or systems.
Static Pressure	Pressure of a fluid whether in motion or at rest.
Vapor	The gaseous phase of matter that normally exists in a liquid (or solid) state at room temperature.

3. Responsibilities

The Contractor is fully responsible for the pre-planning, development of Method Statements, Joh Hazard Analysis, overall safe work planning and implementation. Project Management is responsible for the assurance that all work is planned and conducted according to the pre-planning documents; Contractor and Lusail Health Safety & Environment (HSE) procedures and the Qatar Construction Specifications 2010. Should a conflict occur between procedures/standards or requirements the more stringent shall apply.

4. Ventilation General Requirements

Ventilation systems are designed, installed, operated, and maintained to prevent or control dispersion into the air, or drawing through the work area, of dusts, fumes, mists, vapors, and gases in concentrations greater than Workplace Exposure Limits (WEL), in accordance with **LUS-HSE-WG3-446-009**, Exposure Identification & Controls.

General ventilation, dilution ventilation, or local exhaust ventilation is used as necessary in at least the following project site areas:

- Site offices
- Tunnels and confined spaces
- Toilet facilities
- Chemical storage areas
- Welding, cutting, or brazing operations
- When fuel-powered tools are used indoors
- Underground construction and/or excavations
- Lead abatement
- Paint booths or rooms

Before the equipment is acquired or installed, the Project Manager approves the design of proposed ventilation engineering controls. Design data and drawings will accompany the request for system(s) approval. Ventilation systems are designed, constructed, installed, inspected, and maintained in accordance with manufacturer's specifications and design criteria for the intended purpose.

Make-up air must be clean and respirable. Do not use pure oxygen for ventilation purposes, comfort cooling, blowing dust from clothing, or for cleaning of the work area. Do not use air that has passed through underground oil or fuel-storage areas, or that contains internal combustion engine exhaust to ventilate work areas, as there exists potential for contaminants to be present.

Capture velocity of the system must be adequate to successfully convey and/or capture contaminants present in the work area, considering factors such as:

- Room/space air currents
- Distance to hoods or outdoor air
- Vapor pressure and density
- Chemical hazard characteristics (flammable, toxic, reactive)
- Size of the space
- Manner in which contaminants are being used/generated
- Sources of ignition
- Worker presence and location

Operate ventilation systems continuously during work activities and keep them operating for a time after the work process or equipment has ceased to ensure the removal of any contaminants remaining in suspension or volatilizing into the air.

Ventilation engineering control systems shall be included in periodic maintenance programs to ensure the efficiency and effectiveness of the system(s). Personnel involved in ventilation system maintenance or adjustment shall be qualified on the type of system in use.

Where contaminated air is exhausted from spaces to outdoor areas, the Contractor must ensure that release locations are away from sources of clean air intake, sources of ignition, and offices or other occupied structures.

As necessary, the Contractor shall pass contaminated air through filters or scrubbers capable of removing contaminant concentrations to safe levels before being exhausted. Particulate matter collectors (traps) should be set up for collection of non-hazardous large diameter particulates to prevent distribution to other working areas.

Contractors are required to comply with all Qatar Ministry of Environment permitting and monitoring requirements/regulations pertaining to the release of airborne contaminants.

The Contractor is required to have HSE programs in place to manage potential worker exposure to chemical and biological hazards associated with tasks requiring cleaning or disposal of ventilation system components.

5. Indoor Air Quality

Ventilation systems shall be capable of maintaining an acceptable quality of air inside occupied buildings. Systems shall be capable of temperature control.

Air intake locations for indoor air shall be properly located and adequately safeguarded to eliminate the potential for contaminant introduction into the building, as follows:

- Locate designated smoking areas away from air intakes and building entrances/exits.
- Install guards to prevent water and debris intrusion.
- Use bird screens to prevent bird nesting.
- Avoid locating air intakes near standing water, waste storage areas, parking areas and roads, and chemical use and storage areas.

Ventilation exchange rates are based on space type/application, occupancy level, and floor area. Optimum temperature depends on activity, air movement, structure insulation, and relative humidity.

Outdoor air, which has been judged to be unacceptable or contaminated by a qualified person, shall not be used for indoor air quality ventilation.

To prevent microbial growth inside ventilation system components, and accommodate the human comfort zone, maintain relative humidity between 30% and 60%, relative to dewpoint temperatures.

Maintain carbon dioxide (CO_2) levels at less than 700 ppm above outdoor concentrations to prevent unpleasant accumulations of human bioeffluents (body odor).

6. Hazardous Materials Storage Areas

Ventilation must be provided to control hazardous vapor accumulations inside chemical storage areas, in accordance with **LUS-HSE-WG3-446-017**, Hazardous Material Handling, Transportation, and Storage.

- Ventilation must prevent the accumulation of flammable or combustible vapors to concentrations greater than 10% of the Lower Explosive Limit.
- Ventilation must maintain toxic vapor/gas concentrations at or below the safe exposure levels of the specific substance/material.

7. Confined Spaces and Underground Operations

Ventilation systems (dilution) in confined spaces and underground work areas need supply fresh breathing air in sufficient quantities to maintain concentrations of hazardous fumes, vapors, gases, or particulates below applicable WEL, and to ensure 10% of the LEL of combustible or flammable materials is not exceeded.

The Contractor shall provide effective mechanical dilution ventilation systems in these areas, except where it can be numerically demonstrated that natural ventilation from outdoor air sources provides sufficient air quality, volume, and airflow to maintain the workers breathing zones free of hazardous contaminants or combustibility.

When 5% or more of the LEL for methane or other flammable gas is detected, the Contractor need take steps to increase ventilation air volume, or otherwise control the gas concentration, unless operations are conducted in accordance with the potentially gassy or gassy operations requirements specified in LCSMP 30-00, Underground Construction.

The supply of fresh outside air cannot be less than 200 cfm (94.4 liters per second [L/s]) for each employee working underground; plus the supply necessary to operate the equipment.

The linear velocity of air flow in all underground work areas must be at least 30 ft/min (0.15 m/s) where blasting or rock drilling is conducted; or where other conditions are likely to produce dusts, fumes, vapors, or gases in harmful concentrations.

The direction of mechanical airflow in underground blasting areas must be reversible. After blasting, ventilation systems must be capable of exhausting the smoke and fumes from the underground work areas before work is resumed. Gassy operations must be conducted with controls to reverse the airflow of ventilation systems located above ground.

Ventilation doors to underground work areas must be designed and installed so that they remain closed when in use, regardless of the direction of airflow.

8. Special Operations

8.1 Abrasive Blasting

Blast-cleaning (sand blasting) enclosures must be exhaust ventilated in such a way that a continuous inward (return) flow of air is maintained at all openings in the enclosure during the blasting operation:

- All air inlets and access openings must be baffled or arranged so that, by the combination of inward air flow and baffling (negative pressure), the escape of abrasive or dust particles into an adjacent work area is minimized and visible spurts of dust are not observed.
- The rate of exhaust must be sufficient to provide prompt clearance of the dust-laden air within the enclosure after blasting stops.
- Before the enclosure is opened, the blast must be turned off with the exhaust system remaining operational for a sufficient period to remove the dusty air within the enclosure.
- When leaks are noted, repairs must be made as soon as possible. Substantial leaks in the enclosure require cessation of blasting.
- The static pressure drop at the exhaust ducts leading from the equipment must be checked when the installation is completed and periodically thereafter to ensure continued satisfactory operation. When an appreciable pressure drop indicates a partial blockage, blasting must be halted until the system is cleaned and can be returned to normal operating condition.

- In installations where the abrasive is recirculated, the exhaust ventilation system for the blasting enclosure cannot be relied upon to remove fines from the spent abrasive; an abrasive separator must be provided for that purpose.

8.2 Grinding, Polishing, and Buffing Operations

Where dry grinding, dry polishing, or buffing is performed, and air monitoring indicates that employee exposure exceeds applicable WEL without a ventilation system, a local exhaust ventilation (LEV) system shall be implemented to remove the particulates from reaching to workers breathing zone. Where this is infeasible, the Contractor shall implement a proper respiratory protection program, in accordance with **LUS-HSE-WG3-446-008**.

Local exhaust hoods must be designed, and positioned so that the dust or dirt particles generated by the activity are adequately collected by the LEV. Workers shall be trained to avoid operating grinding wheels, discs, straps, or belts in such a manner and in such a direction as to cause the particulates to not be captured by the LEV.

Local exhaust ventilation systems must maintain minimum exhaust air volumes specific to the equipment in accordance with manufacturer's specifications.

8.3 Welding, Cutting, and Brazing

In accordance with **LUS-HSE-WG3-446-028**, Welding, Cutting, and Brazing, Contractors shall conduct general hot work in open/outdoor areas provided with natural air currents, when possible.

To maintain contaminant concentrations below applicable WEL, Contractors are advised to utilize LEV when performing welding, cutting, or brazing inside enclosed space. Where use of LEV is infeasible, Contractors shall implement a comprehensive respiratory protection program.

The Contractor shall implement regulatory driven contaminant-specific HSE programs when hot work performed inside enclosed spaces involves any of the following hazardous substances:

- Beryllium-containing base or filler metals
- Cadmium-bearing filler materials
- Chromium bearing metals or metals coated with chromium-bearing metals
- Metals coated with mercury-bearing metals
- Zinc-bearing base or filler materials or metals coated with zinc-bearing materials

Airborne contaminants generated by portable power tools (e.g., drills, saws, and grinders) in concentrations exceeding safe exposure levels must be effectively controlled at the source.

When drilling rock or concrete, appropriate dust control measures must be taken to eliminate airborne dust which may contain harmful concentrations of silica and/or chromium IV. Where dust control is ineffective, respiratory protection is required.

9. Training

The Contractor shall provide training to all workers on ventilation systems in use, the function of such systems, and system limitations. Personnel assigned LEV's shall be competent in the proper use and positioning of system hoods.

The Contractor shall ensure that personnel performing maintenance and servicing of ventilation systems are properly trained and qualified for the specific systems in use.

10. Documentation

Contractors must document all maintenance activities performed on ventilation systems. Calibration, maintenance, and testing records shall be retained at the site for the duration of the project and archived a minimum of 10 years from creation date.

11. References

Qatar Construction Specifications 2010 Section 11 Part 2.3.2 "COSHH (Control of Substances Hazardous To