Lusail Real Estate Development Company

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

Lusail Construction Safety Management Procedure – Welding, Cutting, and Brazing

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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

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1. Description

This element of the LCSMP details Lusail requirements intended to ensure safe conduct of welding, cutting, and brazing operations, commonly referred to as Hot Work. This element applies to all Lusail personnel, Contractors, Developers, Consultants and subcontractors working on the Lusail project.

2. Definitions

Term	Description
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.
Hazardous Areas	Areas in which flammable or combustible materials, liquids, gases, vapors, or dusts are present of could be present.
Hot Work	Any work activity, process, or tool which generates or uses an open flame, or is high heat and spark producing. Examples include; electric arc welding, gas welding, torch cutting, brazing, sawing operations which generate sparks, metal grinding, use of heat guns, and any other activity which contains high potential for serving as a source of ignition.

3. Responsibilities

The Contractor is fully responsible for the pre-planning, development of Method Statements (MS), Job Hazard Analysis (JHA), 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. Hot Work Authorization

The Contractor shall apply for and acquire an authorized Lusail Hot Work Permit (Attachment **LUS-HSE-FM4-446-063**) prior to starting any hot work activity, of any scope, in any location. Hot work permits shall be issued by the Contractor's Supervising Consultant only. The Contractor must submit a JHA and MS for the proposed hot work activity to the Consultant for review. Following documents review, consultation with the Contractors qualified person(s), and a walk-down of the hot work area, the Consultant will issue the Contractor the hot work permit.

Hot work permits are valid for one (1) ten hour shift, unless approved for extended durations by the Supervising Consultant and Lusail HSE Department. The Contractor is required to provide the Consultant with adequate written justification for requests for hot work permits authorized to exceed one (1) shift. A new permit will be required should the work activity not be completed prior to the end of the shift or permit period.

The original copy of the hot work permit shall be retained at the specific hot work area for the duration of the hot work activity. Permits shall be readily available for Lusail Representative review upon request.

The Supervising Consultant shall terminate the hot work permit:

- At the conclusion of the work activity
- When the permit period has expired, or
- When previously unknown/ unplanned for hazards have been identified or arisen.

5. General Precautions

Welding and cutting shall be performed only by experienced and properly trained persons.

During the 2-week look-ahead, supervisors and foremen notify the Project Manager and HSE Representative of any hot work to be conducted. The Project Manager adds the work to the schedule and initiates preparation of an JHA. The Contractor shall ensure that a MS specific to the activity is prepared and reviewed by all persons involved in the hot work activity.

The JHA need describe the safe work practices required for fire prevention, PPE, and equipment to be used, in accordance with **LUS-HSE-WG3-446-006**, Personal Protective Equipment.

All tools and equipment must be inspected prior to their use in accordance with to **LUS-HSE-WG3-446-029**, Tools. Worn or damaged hoses, welding leads, and other equipment with defects that affect safe operation cannot be used and must be taken out of service until properly repaired or replaced.

The Construction Manager ensures that a record of all welding and cutting equipment on site is maintained and periodic maintenance is performed to ensure the equipment's continued safe operation.

If unusual service conditions exist, machines are specially designed to safely meet requirements of the following exposure conditions:

- Abnormal vibration or shock
- Adverse weather
- Excessive dust
- Excessive oil vapor
- Flammable gases
- Steam or excessive humidity
- Unusual corrosive fumes

Welders and their helpers are not allowed to carry matches when engaged in welding or cutting operations.

Welders must place welding cable, hoses, and other equipment so that it is clear of passageways, ladders, and stairways.

After welding or cutting operations are completed, the welder marks the hot metal or provides other means of warning other workers.

Before welding, cutting, grinding or heating any material covered by a coating whose combustibility is unknown, the qualified person conducts a test to determine its combustibility.

When metal coatings are highly flammable, the assigned worker (welder or fitter) removes them from the area to be heated in order to prevent ignition. The assigned worker strips all coated surfaces of the coating for a distance of at least 4 inches on each side of the cut, weld, or grind and takes the following precautions when metal coatings are determined to be toxic:

- Hazardous Areas: In dusty or gaseous spaces where flammable or combustible materials, liquids, gases, vapors, or dusts create the possibility of an explosion, welding or cutting equipment cannot be used until the space is adequately ventilated.
- Enclosed Spaces: Welding and cutting in enclosed spaces must conform to requirements of **LUS-HSE-WG3-446-015**, Confined Space Entry.
- Open Air: Employees in open air must be protected by either an air line respirator, an appropriate respirator meeting the respiratory protection requirements, or use of adequate ventilation.

6. Gas Welding and Cutting

- Use only approved gas welding or cutting equipment.
- Handle and store compressed gas cylinders in accordance with **LUS-HSE-WG3-446-017**, Hazardous Materials Handling, Transportation, and Storage.
- Use approved backflow check valves on gas welding rigs in both gas and oxygen lines.
- Do not repair welding hose with tape.

- Do not use matches to light a torch; use a friction lighter or other approved device.
- Do not take oxygen or fuel gas cylinders into confined spaces.
- Use flashback safety valves (flash arrestors) on all gas lines. Preferably, arrestors should be located between cylinder valves and gas lines. Torches must have flashback protection built into the torch body.
- Guard against mixtures of combustible gases and air; they can be very explosive.
- Never support welding or cutting work on compressed gas cylinders or other containers. Do not weld, cut, or grind on drums, containers, or hollow structures that have contained toxic or flammable substances until they have been thoroughly cleaned or purged and tested with a gas meter.
- Do not perform inert gas metal arc welding within 60 meters (200') of an area in which any chlorinated solvent is being used.

7. Electric Welding

- Use only approved electric welding equipment. Follow the rules and instructions supplied by the manufacturer instructions or on labels affixed to the machine.
- Properly ground the electric welding machine before use.
- Do not strike an arc with an electrode if persons nearby might be affected by the arc.
- Welders shall use approved arc flash screens at all times possible when personnel nearby are affected by arc flash.
- When electrode holders are left unattended, remove the electrodes and place or protect the holders so that they cannot make electrical contacts with employees or conducting objects.
- If you must leave work or stop work for more than thirty (30) minutes, or if the welding machine is to be moved, open the power supply switch to the equipment.
- Do not stand in water when using an arc-welder. To avoid the risk of electric shock, stand on a dry platform made of wood or another nonconductive material.
- Do not dip electrode holders in water to cool them.
- Keep your body insulated from the work and the electrode holder during welding operations.
- Do not weld in the rain.

8. Grounding

- Ground the frame or case of the welding machine under the conditions and according to the methods prescribed in NFPA 70 (NEC), by the manufacturer, and in accordance with **LUS-HSE-WG3-446-024**, Electrical.
- Ensure that the work or metal upon which the operator welds is grounded to a satisfactory electrical ground. Locate the work on a grounded metal floor or by connections to a grounded building frame or other satisfactory ground. Do not use pipelines carrying gases or flammable liquids and contents carrying electrical conductors for grounding.
- Preferably, welding current is returned to the welding machine by a single cable from the work to the welding machine.
- Do not use conduit containing electrical conductors to complete a work lead circuit.
- Check all chains, wire ropes, cranes, hoists, and elevators to determine that they are mechanically strong and electrically adequate for the required current.

9. Fire Prevention

When possible, perform hot work in areas designed for such work (i.e., a maintenance shop or a detached outside location of non-combustible or fire-resistant construction) and free of combustible and flammable materials.

If this is not possible, remove all combustible and flammable materials within 11 meters (35') of the hot work, or protect materials from contact with fire, sparks, and/or slag. The Contractor should be equipped with fire blankets for this purpose.

When welding inside/near buildings or combustible materials, take the following precautions:

- Ensure that no flammable liquids are in the vicinity of the work area.
- Have all combustible/ flammable materials within area of proposed hot work moved to a safe distance at least 11 meters (35') away. If the material cannot be moved protect it with a fire-resistant shield or fire blanket.
- Ensure that no chlorinated solvents are within work area.
- Make the area fire safe by wetting down the area or stretching canvas or other non-combustible material over the area where the work is to be performed.

Before hot work is started, inspect the area for potential fire hazards and secure the area as follows:

- Install non-combustible barriers below welding or burning operations in or over a shaft, raise, or grating.
- When welding or cutting in elevated positions, take precautions to prevent sparks or hot metal slag from falling onto people or combustible material below by use of fire blankets or shields.
- Where floors have been wetted down, protect personnel operating arc welding or cutting equipment from possible shock.
- All welders must have a container for the disposal of used welding rods.
- Ensure that machinery, tanks, equipment, shafts, or pipes that could contain explosive or highly flammable materials are thoroughly cleaned and decontaminated before applying heat.
- Shut down or blank off any ducts and conveyor systems that might carry sparks to distant combustibles.
- At passageways, keep welding leads, extension cords, and gas hoses suspended above the working surface. Hang them from adequate support with rope or insulated wire. Hoses and welding leads will not be hung through doorways unless the doors are braced open, and hoses and leads are protected from damage.
- Ensure that all welding machines and/or portable generators are properly grounded in accordance with manufacturer's directions.

Suitable fire extinguishing equipment in accordance with the requirements of **LUS-HSE-WG3-446-012**, Fire Protection, must be immediately available at all locations where hot work is being performed.

A portable fire extinguisher(s), appropriate for the type of possible fire (20-lb ABC) must be located at the work area. Maintain the fire extinguisher in a "ready to use" condition at all times. Where hose lines are available and required, they must be connected and ready for service.

Fire watch personnel shall be assigned to all hot work operation(s). A fire watch must be on duty during the duration of the hot work operation(s) and for a sufficient period (minimum 30 minutes) following the completion of the work to ensure that no possibility of fire exists. After the thirty (3) minute period, a final inspection of the area will be made by the fire watch before leaving the area.

Fire watch personnel must be provided with the necessary fire protection equipment and PPE, and communication equipment must be readily available. Fire watch personnel will be properly trained by the Contractor to perform the fire watch duties prior to being assigned fire watch duties.

The fire watch must be familiar with procedures for sounding an alarm in the event of fire. In addition, fire watchers have the following responsibilities:

- Watch for fires in all exposed areas and extinguish them if possible with the equipment available or otherwise sound the alarm immediately.
- Maintain fire watch for at least thirty (3) minutes after completion of hot work operations to detect and extinguish smoldering fires.
- After completion of a job, check to ensure that the immediate area is free from evidence of fire.

10. Ventilation

Welding may produce flammable and toxic by-products, including cadmium, fluorides, mercury, chlorinated hydrocarbons (volatile organic compounds [VOCs]), stainless steel, zinc or galvanized materials, beryllium, lead, or other materials or compounds determined to be toxic or flammable by the manufacturer.

Employees who weld, cut, heat, or braze, or who use fluxes, coatings, and filler materials must be protected from exposure to potentially toxic or flammable welding metals and byproducts. Refer to the project hazard communication plan for specific requirements pertaining to the above-listed hazardous materials.

Ventilation must be provided to remove hazardous fumes, gases or vapors from the breathing zone of the workers involved in the hot work activity, in accordance with **LUS-HSE-WG3-446-037**, Ventilation:

- General Dilution Ventilation: When possible, hot work shall be performed in open outdoor areas with natural air currents to provide general ventilation. General dilution ventilation is typically inadequate to control hot work activities performed indoors and in enclosed/confined areas.
- Local Exhaust Ventilation: Welding in enclosed areas with poor air movement is performed with the aid of local exhaust ventilation. Local exhaust ventilation involves the use of hoods and fans/blowers to exhaust or carry the fume, gas or vapor away from the workers breathing zone.

Ensure that contaminated air exhausted from a working space is discharged into the outdoor air or otherwise clear of the source of HVAC system intake air.

Proper ventilation is a prerequisite for work in confined spaces to keep the concentrations of hazardous or toxic fumes, gases, vapors or dusts below Workplace Exposure Limits (WELs), in accordance with **LUS-HSE-WG3-446-009**, Exposure Identification & Controls; and **LUS-HSE-WG3-446-015**, Confined Space Entry.

11. Protective Clothing

Welding and gas cutting requires specialized protective clothing and equipment. The thickness of the electrode used and the type of welding work performed determine the shade number of the welding hood lens. Welders, torch users, and helpers must wear eye protection as specified in (Attachment **LUS-HSE-FM4-446-013**) Filter Lenses for Welding. Secondary eye protection must be worn to guard against flying particles when the helmet or goggles are raised.

Employees must be protected from the effects of hot work activities. Welders must wear long sleeves and/or leather chaps, and welding gloves when burning or welding. Sleeves must be buttoned, and cuffs and top pockets must be avoided. Bystanders in the hot work area must be protected from exposure to welding arc flash, sparks, molten metal, and slag.

- Welder's helpers must wear safety glasses with side shields as a minimum protection under the face shield. Shaded glasses are preferred.
- Where the work permits, the welder is enclosed in an individual booth or is enclosed with non-combustible screens.
- Workers or other persons adjacent to the welding areas must be protected from ultraviolet light by use of welding shields, or are required to wear appropriate eye and face protection.
- Other employees must not observe welding operations unless they use approved eye protection.

Where ventilation systems are inadequate at maintaining worker exposures to contaminant concentrations below relevant workplace exposure limits, the Contractor shall implement additional engineering controls and/ or a respiratory protection program, in accordance with **LUS-HSE-WG3-446-008**, Respiratory Protection Program.

An approved cartridge-type air purifying or supplied air respirator must be used to protect against metal fumes when welding, cutting or grinding the following materials:

- Zinc metal
- Metal coated with lead or lead base paint
- Metal containing mercury or cadmium
- Hard facing with manganese
- Beryllium or exotic metals
- Welding or cutting of stainless steels

The HSE Representative determines additional PPE requirements, which may include the following clothing:

- Aprons for protection against radiated sparks

- A cape, shoulder covers, skullcaps, and/or ear protection for overhead welding
- Fire-resistant leggings and high boots for heavy work
- Fire-retardant clothing, such as Indura Proban, is highly recommended for welders. Dupont Nomex is recommended for pipe fitters and helpers who are exposed to welding slag and grinding sparks.

In accordance with **LUS-HSE-WG3-446-022**, Fall Protection, 100% fall protection is required on all platforms, ladders, scaffolds, or runways over 1.8 meters (6') above lower levels:

- A full-body harness with shock-absorbing lanyards is required to be worn by all workers and tied off to an attachment point that is capable of supporting 5,000 lbs per worker.
- Lifelines must be used if a welder must enter a confined space through a vertical manhole or other small opening. Lifelines must be used in a manner that does not present an entanglement hazard. Lifeline rescue procedures must be listed on the Hot Work Permit (Attachment **LUS-HSE-FM4-446-063**).

12. Confined Space

JHAs will outline the use of proper PPE, signs, guards, and barricades in these areas.

Welding, burning, cutting, and grinding in a confined space require strict adherence to **LUS-HSE-WG3-446-015**, Confined Space Entry. Safe work practices include training, air quality monitoring, ventilation, and confined space and hot work permits.

- The space attendant and the fire watch cannot be the same person unless fire watching can be done from outside the confined space.
- Leave gas cylinders and welding machines outside the confined space and secure them at all times.
- Avoid accidental contact of the electrode in the holder by removing the electrode when work is suspended and the machine is disconnected from the power source.
- Thoroughly clean used drums, barrels, tanks, or other containers to be welded to remove combustible/ flammable materials and substances such as greases, tars, acids, or other materials, which, when subjected to heat, might produce flammable or toxic vapors. Disconnect or blank any pipelines or connections to the drum or vessel.
- To eliminate the possibility of gas escaping through leaks or improperly closed valves when gas welding or cutting, close the torch valves and shut off the gas supply to the torch at some point outside the confined area if the torch is not to be used for a substantial period. Whenever practicable, remove the torch and hose from the confined space.
- Welding, cutting, or heating in any enclosed space must be performed with effective local exhaust ventilation, or employees must be protected with airline respirators, in accordance with **LUS-HSE-WG3-446-008**, Respiratory Protection Program where ventilation is not adequate at removing contaminants to concentrations below relevant workplace exposure limits.
- In any enclosed space, all surfaces covered with toxic preservative coatings must be stripped a distance of at least 4 inches from the area of heat application.

13. Periodic Inspection

Employees must visually inspect welding equipment before use on each work shift. Remove from service any defective or damaged equipment until it is repaired and tested.

To ensure that all hazards in the work area have been addressed, the HSE Representative and Supervising Consultant walk the area down prior to issuing the hot work permit. The HSE Representative checks the work area periodically to ensure the conditions of the hot work permit are maintained.

14. Training

Contractors shall train affected personnel in the hot work procedures to be used on the worksite. Welding and cutting are performed only by experienced and properly trained persons.

The HSE Representative arranges employee training at the time of initial assignment. Supervisors are responsible for identifying additional employee training needs during risk mitigation planning (2-week look-ahead). Training can be organized and presented to groups or on a work area by work area basis, depending on the operation.

Re-training is provided for all hot workers when there is a change in job assignment, or a change in machines, equipment, or processes that present a new hazard.

Additional re-training is conducted when there are deviations from, or inadequacies in, the employee's knowledge or use of proper procedures. The re-training re-establishes employee proficiency and introduces new or revised control methods and procedures, as necessary.

15. Documentation

The HSE Representative maintains a record of all training or instruction given to employees. Records verifying completion of training are kept in the individual employee's training files.

All records of periodic maintenance on equipment are archived for a minimum retention time of 10 years from creation date.

16. References

Qatar Construction Specifications 2010 Section 1 Part 10.3.11 "Hot work and Welding" & 10.3.12 "Compressed Gas Cylinders"

Qatar Construction Specifications 2010 Section 11 Part 2.3.11 "Permit to Work Systems"

Qatar Construction Specifications 2010 Section 11 Part 1.2 "Occupational Health and Hygiene"

17. Attachment

LUS-HSE-FM4-446-063 Hot Work Permit