



Lusail Real Estate Development Company

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

Lusail Construction Safety Management Procedure – Blasting

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- 1. Description**

This element of the LCSMP details Lusail’s guidelines for safe practices in all explosives handling and blasting operations. This element applies to all Lusail personnel, Contractors, Developers, Consultants and subcontractors working on the Lusail projects.

This element does not address transportation and storage of explosives, which are covered in [LUS-HSE-WG3-446-017](#), Hazardous Material Handling, Transportation and Storage.

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.
Barricaded	The effective screening of a building containing explosives from a magazine, building, railway, or highway, either by a natural or an artificial barricade of such height that a straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine, or building, or to a point 12 feet above the center of a railway or highway, will pass through the intervening natural or artificial barricade.
Blast Area	The area of a blast, including the area immediately adjacent, within the influence of flying rock missiles.
Blast Hole	A hole drilled in a medium, usually rock, to accept an explosive charge.
Blasting Accessories	Non-explosive devices and materials used in blasting, such as, but not limited to, cap crimpers, tamping bags, blasting machines, blasting galvanometers, and cartridge punches.
Blasting Agent	Any material or mixture, consisting of fuel and oxidizer, intended for blasting and not otherwise defined as an explosive provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a No. 8 Test Blasting Cap when unconfined.
Blasting Cap	A metallic capsule containing an initiating explosive and base charge, open at the upper end to accept a section of safety fuse and used for initiating the primer or main charge. Also referred to as fuse cap or regular or ordinary blasting cap.
Blasting Galvanometer	An electrical resistance measuring device designed specifically and approved for testing of electric blasting cap circuits.
Blasting Machine	An electrical or electromechanical device that provides electrical energy for the purpose of energizing electric blasting caps.
Blasting Machine Rheostat	A graduated electrical resistance device used to simulate electric blasting cap resistance in the testing of blasting machines.
Blasting Mat	A mat of woven steel wire, rope, scrap tires, or other suitable material or construction to cover blast holes to prevent flying rock missiles.
Blasting Vibrations	The waste energy from a blast that manifests itself in air-, water-, or earth-borne vibrations.
Booster	An explosive charge, usually of high strength and high detonation velocity, used to increase the efficiency of the initiation system of the main charge.

Term	Description
Burden	That dimension of a medium to be blasted measured from the borehole hole to the face at right angles to the spacing. It also refers to the total amount material to be blasted by a given hole, usually measured in cubic yards or in tons.
Collar	The mouth or opening of a borehole.
Detonator	Any device containing a detonating charge that is used for initiating detonation in an explosive; the term includes (but is not limited to) electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses and detonating-cord delay connectors, and nonelectric instantaneous and delay blasting caps.
Dynamite	A high explosive used for blasting, consisting essentially of a mixture of (but not limited to) nitroglycerin, nitrostarch, ammonium nitrate, sodium nitrate, and carbonaceous materials.
Electric Blasting Cap	A blasting cap designed for, and capable of, initiation by means of an electric current.
Explosive	<p>Any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, i.e., with substantially instantaneous release of gas and heat, unless that compound, mixture, or device is otherwise specifically classified as such using the following:</p> <p>Class A: Possessing a detonating or otherwise maximum hazard, such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.</p> <p>Class B: Possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.</p> <p>Class C: Includes certain types of manufactured articles that contain Class A or Class B explosives, or both, as components in restricted quantities.</p>
Explosive-actuated power device	Any tool or special mechanized device that is actuated by explosives, but not including propellant-actuated power devices. Examples of explosive-actuated power devices are jet tappers and jet perforators.
Fire Current	An electric current of recommended magnitude to sufficiently energize an electric blasting cap or a circuit of electric blasting caps.
Fire Extinguisher Rating	A rating set forth in the National Fire Code that may be identified on an extinguisher by a number (5, 20, 70, etc.) indicating the extinguisher's relative effectiveness followed by a letter (A, B, etc.) indicating the class of classes of fires for which the extinguisher has been found to be effective.
Firing Line	The wire(s) connecting the electrical power source with the electric blasting cap circuit.
Flash Point	The lowest temperature at which vapors above a volatile combustible substance ignite in air when exposed to flame.
Fuel	A substance that may react with the oxygen in the air or the oxygen or other oxidizing substance yielded by an oxidizer to produce combustion.
Fumes	Toxic gases produced by the detonation of an explosive.

Term	Description
Hangfire	The detonation of an explosive charge at an undetermined time after its normally designed firing time. This can be a dangerous phenomenon.
Lead Lines or Wires	The wire(s) leading from a source of electric power to an electric blasting cap circuit.
Leg Wires	The two single wires or one duplex wire extending out from an electric blasting cap.
Magazines	Any building or structure, other than an explosives manufacturing building, designed and/or approved for the storage of explosive materials.
Misfire	An explosive material charge that fails to detonate after an attempt at initiation.
Natural Barricade	Natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.
Oxidizing materials	Substances that yield oxygen readily to stimulate the combustion of organic matter.
Permissible Explosive	An explosive that is permitted for use in gassy and dusty atmospheres and that must be approved by the Qatar Enforcing Authority
Primer	An assembly consisting of a cartridge or container of explosives into which a detonator or detonating cord which is inserted or attached at the point and time of use. It is used to initiate the main explosive charge.
Propellant	An explosive that normally functions by deflagration and is used for propulsion. It may be a Class A or a Class B explosive, depending on its susceptibility to detonation.
Propellant-Actuated Power Device	Any tool or special mechanized device or gas generator system that is actuated by a propellant or that releases and directs work through a propellant charge.
Railway	Any stem, electrical, diesel electric or other railroad or railway that carries passengers for hire.
Small Arms Ammunition	Any shotgun, rifle, pistol, or revolver cartridge, and cartridges for propellant-actuated power devices and industrial guns. Military-type ammunition containing explosive-bursting charges or incendiary, tracer, spotting, or pyrotechnic projectiles is excluded from this definition.
Tamping	To compact an explosive charge or the stemming in a blast hole. Frequently synonymous with "stemming."

3. Responsibilities

The Contractor is fully responsible for the pre-planning, development of Method Statements and Job Hazard Analyses, and 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. Project Blasting Plan

The HSE Representative is responsible for the development and implementation of a project-specific blasting plan (Plan) in accordance with Qatar Labor Laws, and this Procedure. The project-specific blasting plan is included in the site-specific health and safety plan.

During the design phase, the Project Manager conducts a search for drawings of all areas that require blasting. All pertinent drawings are included in the blasting plan.

The Project Manager holds a constructability meeting with the client's representative and Lusail HSE Department as early as possible in the design stage.

The Project Manager reviews and approves the Plan. If required, the Contractor project engineer approves the Plan as well.

The Project Manager facilitates implementation of, and compliance with the Plan. The Project Manager designates a blasting supervisor to direct and supervise loading and firing. Blasting Permits shall be managed by the Blasting Contractor, being recognized as the qualified entity. Lusail will defer to the Blasting Contractor (or designated qualified person) for completion and authorization of the Blasting Permit.

Copies of completed and authorized Blasting Permits shall be provided to the Supervising Consultant and Lusail HSE prior to initiating any blasting activity.

Before explosive materials are brought on the jobsite, the blasting supervisor completes and submits a blasting agent material safety data sheet (MSDS) to the Supervising Consultant for approval. Periodic replenishment of approved supplies does not require written approval.

The HSE Representative audits the activities of Blasting Contractor employees and subcontractors to ensure compliance.

The Plan must include site-specific provisions for the following:

- Blasting Permit
- Risk Assessment
- Job Hazard Analysis (JHA)
- List of names, qualifications, and responsibilities of blasting supervisor, blasters, and any other people associated with handling of explosives
- Procedures for handling and disposal of explosives, blasting agents, and associated material
- Employee training
- Blasting schedule
- Applicable state licenses
- Certificate of liability insurance
- Firing method
- Loading procedures
- Methods for publicizing and posing warning system on the job
- Methods for vibration and damage control
- Post-blast ventilation, inspection, and misfire procedures
- Removing personnel and equipment
- Designating of safe areas nearby
- Appropriate signs to identify blasting area:
 - 1,000 feet away on adjacent highways with turn-off radio signs
 - 50-foot perimeter signs for equipment

- Warning signs for personnel
- Maintaining a blasting log
- Monitoring methods and acceptable criteria

5. General Precautions

- Job Hazard Analysis (JHA) will identify the specific hazards of working with explosives for a particular job.
- Employees must use PPE in accordance with [LUS-HSE-WG3-446-006](#), Personal Protective Equipment.
- Blasters must be in good physical condition and must be able to understand and give written and verbal orders. The HSE Representative ensures that blasters receive a medical evaluation in accordance with [LUS-HSE-WG3-446-001](#), Employee Health Assessment & Historic Health Exposure Questionnaire.
- Blasting operations near overhead power lines, communications lines, utility services, or other structures cannot be conducted until the operators and/or owners have been notified and measures for safe control have been taken.
- Smoking, welding, and/or possession of matches, open lights or other fire is forbidden near explosives storage handling and use areas.
- Before blasts, workers must be removed from the blast area to designated locations.
- Blast warning signals must be used; signs, flags, and flagmen are used as needed:
 - Warning Signal: A series of five (5) long horns five (5) minutes before the blast signal
 - Blast Signal: A series of five (5) short horns blasts one (1) minute before the shot
 - All Clear Signal: One (1) long horn after charges are fired and the area is checked
- Before a shot is fired, a competent flag person is posted at all access points to danger areas.
- For safety, shots are separated by about thirty (30) minutes.

6. Drilling

- Do not drill in an area already blasted until the blasting supervisor conducts a thorough examination to ascertain that no unexploded charges remain.
- Control dust by wet drilling.
- Do not conduct drilling and loading operations simultaneously in the same area.

7. Loading

- Keep the loading area free of equipment, persons, and operations not essential to loading.
- Use the oldest stock of explosives first. Open or repack the containers at least 50 feet from any magazine.
- Use approved wood rods or plastic tamping poles without exposed metal parts for tamping.
- Do not tamp primers.
- Insert maps into dynamite only in holes for that purpose and punched with a nonmetallic punch.
- Stem loaded holes to the collar with noncombustible material.
- When charges are checked and covered with blasting mats, take care to protect electric blasting circuits.
- Handle detonating cord trunk lines and branch lines with care and ensure that they are free of loops, kinks, or angles toward the line of detonation.
- Tape or otherwise secure connections to a blasting cap along the side or end of the detonating cord.

8. Firing

- All blasts must be fired electrically using an electric blasting machine or using a method approved by the Project Manager.

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- Blasting machines must be secured and accessible only to the blasting supervisor and blaster. They will have the key to the switches in their possession and are solely responsible for connecting the lead wire to the machine just before the shot is fired.
 - Blasting power circuits cannot exceed 550 V, and wiring and control circuits must conform to the following requirements:
 - Blasting Switch: The blasting switch must be an ungrounded, UL-listed, enclosed, externally operated double-pole, double-throw switch which, when locked in the open position, will shunt the firing lines.
 - Underground Operations: A grounded safety switch must be installed between the blasting switch and the power circuit at a distance of at least 1.5 meters (5') from the blasting switch. Also, a "lighting" gap of at least 1.5 meters (5') between the two switches will be connected by cable plug and receptacle. This gap is bridged by the jumper cord just before firing.
 - Static Protection: Refer to Section 9 below.
 - Do not remove the manufacturer's shunt from the cap leg wires until the cap is connected to the lead lines.
 - The blaster fires the shot and then immediately disconnects the leading wires from the power source and shunts them. Additional requirements are listed below:
 - All caps in a blast must be of the same manufacturer.
 - The number of electric blasting caps in a circuit cannot exceed the capacity of the blasting machine or power source.
 - Before connecting the circuit to the firing line, use an approved galvanometer to test the circuit (including all caps).
 - Do not connect a lead wire to the circuit until the circuit has been grounded to dissipate static charges.
 - Before connecting the firing line to the blasting machine or other power source, use an approved galvanometer to check the firing line at the terminals.
 - Do not connect a firing line to a blasting machine or other power source until the shot is to be fired.
 - Do not ground a power circuit used for firing electric blasting caps.

9. Static Electricity

- Depending on conditions, place static electricity detectors 800 to 6,000 feet away from the blast area.
- Monitor the static electricity detectors when conducting blasting operations.
- The blasting supervisor is responsible to halt operations if static electricity is detected within five to ten (5-10) miles of the blasting area, depending on conditions. Ground the circuits and open switches to prevent accidental discharge if the above conditions occur.
- The explosives safety officer gives alert when an electrical storm approaches within twenty-five (25) miles of the blasting area. Halt operations and move personnel to a pre-designated safe area during the approach or progress of the storm. Consider the history of storms in the area, the nature of the terrain, and the speed of thunderstorms across the area.

10. Inspection After Blasting

- Immediately after the blast has been fired, disconnect the firing line from the blasting machine or power source lock open the power switches power switches.
- The blasting supervisor inspects the area to determine that all charges have exploded.
- No one is to enter the area of the blast until the blasting supervisor gives an "all clear" signal.
- Before work proceeds, scale all rock and debris that is subject to falling.

11. Misfires

- The blaster handles the misfires. No drilling, digging, or picking is permitted until the blaster signals that detonation is complete.
- If broken wires, faulty connections, or short circuits are the cause of a misfire, make the proper repairs, reconnect, and test the firing line and fire the charge.
- Misfired holes may be cleaned out by water, a new primer attached, and the charge detonated. If the hole is underwater, blow it out with air.

12. Underground Blasting

- Do not keep explosives and detonators in tunnels, shafts, or caissons.
- Hoist, lower, or convey explosives and blasting agents in a powder car.
- Do not transport personnel or other materials in the powder car at the same time as the explosives.
- Separate the powder car from the locomotive by at least two (2) car lengths.
- Load and unload the car only when the conveyance is stationary.
- Only the amount of explosives needed for the shot is permitted in the loading area.
- Take detonators and explosives separately into pressure working chambers. The blasting supervisor is responsible for the receipt, unloading, storage, and transportation of explosives and detonators.
- Only the personnel needed for blasting tasks are permitted in an airlock with explosives.
- Ensure that all metal pipes, rails, steel liners, and air locks are bonded together at no less than 1,000-foot intervals.
- Use light charges and light burden to excavate in mixed face. Advanced drilling will be performed to determine the general nature of the rock cover and soft ground.
- After blasting, wait at least fifteen (15) minutes to allow toxic gases, dusts, mists, and fumes to be exhausted by reverse flow of the ventilating system.
- In accordance with [LUS-HSE-WG3-446-009](#), Exposure Identification & Controls, use monitoring instruments to determine the presence of carbon monoxide, nitrogen dioxide, methane and hydrogen sulphide, as well as the oxygen content. Document the results of monitoring in the blasting log. Ensure that respiratory protection and rescue equipment are available in accordance with [LUS-HSE-WG3-446-008](#), Respiratory Protection Program; and [LUS-HSE-WG3-446-015](#), Confined Space Entry.
- Do not start drilling until the blasting supervisor has determined that no undetonated charges remain.
- Explosives suitable for use in wet holes must be water resistant and Fume Class 1.

13. Underwater Blasting

- Do not use loading tubes and casings of dissimilar metals because of possible electric transient currents due to the galvanic action of the metals and water.
- Use water-resistant blasting caps and detonating cords for all marine blasting. If a tube necessary, load through a non-sparking loading tube.
- Display blasting flags. When more than one charge is placed underwater, attach a float device to each charge so that it will be released by firing.
- Do not fire a blast while any vessel under way is closer than 1,500 feet to the blasting area. Notify persons on board vessels moored within 1,500 ft before the blast is fired.
- Do not fire a blast while swimming or diving operations are in progress near the area. If such operations are in progress, signals and arrangements will be agreed upon in the project blasting plan to ensure that no shot is fired while any person is in the water.
- Before firing, move the drill boat or vessel to a safe distance from the blasting area. The drill boat signals by horn or whistle the usual navigation warning signals and display blasting flags. When a drill boat is moved

from the setting, fire all loaded water holes. If any holes will be loaded, those engaged in drilling operations on another vessel will be signaled to leave the drill frame for cover.

14. Destruction of Explosives

- Destroy excess explosives, boosters, primers, in accordance with state or local requirements. Burn quantities of up to 100 pounds in piles 7.6 meters (25') apart.
- Do not burn material in cartons or deep piles. Remove and slit the cartridges and spread them on the ground over paper or excelsior.
- Explode the detonator by dynamite. Limit this to ½ pound of dynamite, 100 caps placed in at least a one (1') foot deep hole and covered with paper and then dry sand or dirt.
- Do not place explosives for destruction as successive shots on sites unless the shot is cool to the touch.

15. Periodic Inspection

- ◆ The blaster must test blasting machines before use and periodically as recommended by the manufacturer.
- ◆ Before any person may enter the blasted area, the blasting supervisor inspects the blasted areas to determine that all charges have exploded.

16. Training

Contractors shall train employees in the project-specific blasting plan, including signals.

The HSE Representative arranges employee training at the time of their 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.

The blaster and blasting supervisor must have proven experience and ability in blasting operations in accordance with the manufacturer's requirements and international standards.

17. Documentation

Before explosive materials are brought on the jobsite, the blasting supervisor submits a blasting agent MSDS to the Supervising Consultant for approval. Periodic replenishment of approved supplies does not require written approval.

The blaster initiates and maintains a blasting log. The blasting log may include of the project-specific blasting plan, updated throughout the blasting. The log must contain following information:

- A copy of the approved permit and blasting plan
- The location of the blasting operation
- The date and time of each blasting occurrence
- The name of the blaster and possessor of explosives
- Whether blasting mats and earthen cover were used
- Inspection reports
- The type of explosive, pounds of explosive per delay, drill hole layout, depths and diameters of drill holes, timing and delay pattern, anticipated peak particle velocities, and scaled distance
- Any and all known damage or injury that occurred as a result of the blast. If no known damage or injury occurred, the log will so state.

The HSE Representative documents and files all training and re-training records, and maintains project records at the site for the duration of the project and archived a minimum retention time of 10 year from creation date.

18. References

Qatar Construction Specifications 2010 Section 11 Part 1.5.9 “Other Hazardous Activities”

Qatar Construction Specifications 2010 Section 2 Part 1.5 “Use of Explosives”

The Guide for Civil Users of Explosives in Qatar prepared by the former Ministry of Industry and Public Works.