EXPRO National Manual for Projects Management

Volume 11

Project Blasting and Explosive Procedure

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Table of Contents

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1.0 PURPOSE

The purpose of this Procedure is to provide the requirements applicable to all explosive blasting and ordnance handling operations conducted in connection with all types of Project work.

2.0 SCOPE

The scope of this procedure applies to all works performed under all Government Construction Contracts executed throughout the Kingdom of Saudi Arabia.

3.0 DEFINITIONS

Definitions	Description
Blasting Agent	Any material or mixture, consisting of a fuel and oxidizer, intended for blasting, not otherwise classified as an explosive and in which none of the ingredients are classified as an explosive, provided that the finished product, as mixed and packaged for use or shipment, cannot be detonated by means of a No. 8 test blasting cap when unconfined.
Explosive-Actuated Power Devices	Any tool or special mechanized device which is actuated by explosives, but not including propellant-actuated power devices. Examples of explosive-actuated power devices are jet tappers and jet perforators.
Explosive	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 such compound, mixture, or device is otherwise specifically classified by the U.S. Department of Transportation (see 49 CFR chapter I) or another regulatory agency. The term "explosives" shall include all material which is classified as Class A, Class B, and Class C explosives and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse, fuse lighters, fuse igniters, squibs, cordeau detonator fuse, instantaneous fuse, igniter cord, igniters, small arms ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives that are intended for use in commercial or industrial operations.
Class A Explosives	Possessing, detonating, or otherwise maximum hazard; such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.
Class B Explosives	Possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.
Class C Explosives	Includes certain types of manufactured articles which contain Class A or Class B explosives, or both, as components but in restricted quantities.
CSM	Construction Site Manager
EOD	Explosive Ordnance Disposal The detection, identification, field evaluation, rendering-safe, recovery, and final removal of unexploded ordnance.
Forbidden or Not Acceptable Explosives	Explosives which are forbidden or not acceptable for transportation by common carriers by rail freight, rail express, highway, or water in accordance with applicable local, and/or federal regulations.
Highway	Any public street, public alley, or public road.
HSSE	Health, Safety, Security and Environment
JHA	Job Hazard Analysis
Magazine	Any building or structure, other than an explosives manufacturing building, used for the storage of explosives.
Motor Vehicle	Any self-propelled vehicle, truck, tractor, semi-trailer, or truck-full trailers used for the transportation of freight over public highways.
OEW	Ordnance and Explosive Waste

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Definitions	Description
OSHA	Occupational Health and Safety Administration.
Ordnance	A term applicable to anything related to munitions designed to cause damage to personnel or material through explosive force, incendiary action, or toxic effect. Examples are bombs, guided and ballistic missiles; artillery, mortar and rocket ammunition; small arm ammunition; anti-personnel and anti-tank mines, demolition charges; pyrotechnics; grenades, torpedoes and depth charges; containerized and un-containerized high explosives and propellants; depleted uranium projectiles; toxic military chemical agents; and all similar or related items or components designed to cause damage to personnel or material. Soil with explosive constituents is considered ordnance explosive waste (OEW) if the concentration is sufficient to present a safety hazard to personnel and/or property.
Powder-Actuated Power Devices	Any tool or special mechanized device or gas generator system which is actuated by a smokeless propellant or which releases and directs work through a smokeless propellant charge. Also, referred to as “propellant-actuated device.”
Pyrotechnics	Any combustible or explosive compositions or manufactured articles designed and prepared for the purpose of producing audible or visible effects that are commonly referred to as fireworks.
Semi Conductive Hose	A hose with an electrical resistance high enough to limit flow of stray electric currents to safe levels, yet not so high as to prevent drainage of static electric charges to ground (earth); hose of not more than 2 megohms resistance over its entire length and of not less than 5,000 ohms per foot meets the requirement.
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, incendiary, tracer, and spotting or pyrotechnic projectiles is excluded from this definition.
Small Arms Ammunition Primers	Small percussion-sensitive explosive charges, encased in a cup, used to ignite propellant powder.
Smokeless Propellants	Solid propellants, commonly called smokeless powders in the trade, used in small arms ammunition, cannon, rockets, propellant-actuated power devices, etc.
Special Industrial Explosives Devices	Explosive-actuated power devices and propellant-actuated power devices.
Special Industrial Explosives Materials	Shaped materials and sheet forms and various other extrusions, pellets, and packages of high explosives, which include dynamite, trinitrotoluene (TNT), pentaerythritol tetranitrate (PETN), hexahydro-1,3,5-trinitro-s-triazine (RDX), and other similar compounds used for high-energy-rate forming, expanding, and shaping in metal fabrication, and for dismemberment and quick reduction of scrap metal.
STARRT	Safety Task Analysis and Risk Reduction Talk
UXO	Unexploded Ordnance: An item of explosive ordnance which has failed to function as designed or has been abandoned, discarded, or improperly disposed of but is still capable of functioning, causing damage to personnel or material.
Water Gels or Slurry Explosives	These comprise a wide variety of materials used for blasting. They all contain substantial proportions of water and high proportions of ammonium nitrate, some of which is in solution in the water. Two broad classes of water gels are (i) those which are sensitized by a material classed as an explosive, such as TNT or smokeless powder, (ii) those which contain no ingredient classified as an explosive; these are sensitized with metals such as aluminum or with other fuels. Water gels may be premixed at an explosives plant or mixed at the site immediately before delivery into the borehole.
WMS	Work Method Statement
HSSE	Health, Safety, Security and Environment

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4.0 REFERENCES

- OSHA 29CFR 1910.109 Explosives and Blasting Agents
- OSHA 29CFR 1926 Subpart U Blasting and the use of Explosives
- U.S. Department of Transportation 49 CFR Chapter 1 Parts 177 - 180
- EPM-KSS-PR-000001 Project General Safe Working Requirements Procedure
- EPM-KSS-PR-000006 Project Barricades and Signs Procedure
- EPM-KSS-PR-000021 Project Electrical Safety Procedure

5.0 RESPONSIBILITIES

No person shall store, handle, or transport explosives or blasting agents when such storage, handling, and transportation of explosives or blasting agents constitutes a hazard to life.

All Blasting tasks must have the approval of the Ministry of Interior Permits and / or other required permits under Kingdom of Saudi Arabia Law. Managers, Supervisors, Blasters, and any other involved persons, shall have an understanding of these requirements.

5.1 Project Manager

The Project Manager is responsible for ensuring the resources and arrangements are available for the implementation and management of this procedure.

5.2 Construction Site Manager (CSM)

The CSM shall ensure that this procedure is implemented. If an onsite Health, Safety, Security and Environment (HSSE) representative has not been designated, the responsible CSM shall coordinate with the designated HSSE Manager to determine requirements.

5.3 HSSE Manager

In conjunction with the CSM, the HSSE Manager is responsible for implementing and administering this Procedure.

5.4 Supervisors

Superintendents, foremen, and other responsible supervisors are responsible for:

- Ensuring that work areas and tasks under their responsibility have been assessed for explosives or blasting agents.
- Ensuring that engineering and administrative controls have been assessed for their work locations/tasks and ensuring the implementation of such controls.
- Identifying and alerting HSSE of employees who are or will be potentially affected by the requirements of this Procedure.
- Ensuring that employees who may be working with or exposed to explosives or blasting agents have been trained in accordance with the project's training requirements.
- Enforcing the requirements of this Procedure.

5.5 Employees

Employees are responsible for:

- Adhering to the requirements of this Procedure.
- Not carry out any work with explosives or blasting agents unless they are suitably trained and authorized.

6.0 RISK ASSESSMENT

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An integral aspect of the work planning process is the performance of a proper risk assessment. Risk Assessments must be conducted at the Planning Stage to identify the hazard risks and determine control measures. Any work activity that involves the storage, handling, or transportation of explosives or blasting agents must be fully risk assessed before any such work is undertaken.

The Risk Assessments that shall be conducted at the Planning Stage are as follows:

- Project Risk Assessment.
- Work Method Statements (WMS)
- Job Hazard Analysis (JHA).
- Safety Task Analysis and Risk Reduction Talk (STARRT).

It is imperative that prior to beginning any work activity, a STARRT briefing occurs to discuss the contents of the WMS/JHA which includes mitigations for any other hazards noted by the crew at the jobsite. The discussion shall also include job steps, expected hazards associated with the activity, and the mitigation and protection methods that shall be implemented to prevent incidents.

If circumstances change by way of the environment, other work crews are in the area, additional hazards are now present, change of methodology of the task etc..... another STARRT briefing shall occur.

The Hierarchy of control shall be used to reduce the likelihood of an incident occurring.

- ***Elimination*** (Remove the Hazard)
- ***Substitution/Isolation*** (Replacing material, process or hazard with a lower risk one/ separate people from the hazard (such as suitable guarding, distance, etc.)
- ***Engineering Controls*** (Redesign or replacement of plant and equipment)
- ***Administration Controls*** (Procedures, training, signage)
- **PERSONAL PROTECTIVE EQUIPMENT (PPE)**

No work is to commence until the above has been implemented and signed by the relevant Supervisor in charge.

7.0 GENERAL REQUIREMENTS

7.1 Planning

Before any blasting can commence, the Blasting Contractor's personnel involved in the task must have an understanding of this procedure, and have had the correct training in handling explosives. (Refer to Sect 7.13 of this procedure) Furthermore, a detailed Blasting Plan shall be implemented and approved by the relevant authorities.

Refer to Section 7.4 of this procedure, for detailed information relating to the Issue of a Blasting License.

The Blasting Plan must contain at a minimum the following information:

- Copy of all Blasters ID, Blasting License/Certificates, and Qualifications.
- Approved drawings with blast location.
- Permits.
- Vibration Calculation Sheet.
- Details of type of explosives to be used and quantities.
- Exclusion Zone boundary defined on drawings.
- Access and egress points defined on drawings.
- Where temporary explosives are stored and how controlled.
- Duration of the blasting, and the timings.
- What PPE requirements are needed.
- Person in charge of blasting and contact information.
- Communication Plan.
- Detail on how contractor controls the area. (Security Check Points)

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7.2 Storage of Explosives

- All Class A, Class B, Class C explosives, and special industrial explosives, and any newly developed and unclassified explosives, shall be kept in magazines that meet the requirements of this procedure.
- Blasting caps, electric blasting caps, detonating primers, and primed cartridges shall not be stored in the same magazine with other explosives.
- Ground around magazines shall slope away for drainage. The land surrounding magazines shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 7.6 meters.
- Magazines as required by this paragraph shall be of two classes; namely, Class I magazines, and Class II magazines.
- Class I magazines shall be required where the quantity of explosives stored is more than 22.5 kilograms. Class II magazines may be used where the quantity of explosives stored is 22.5 kilograms or less.
- Class I magazines shall be located away from other magazines in accordance with the Table shown as Attachment 1.
- Class II magazines shall be located in accordance with Attachment 1, but may be permitted in warehouses when located on a floor which has an entrance at outside grade level and the magazine is located not more than 3 meters from such an entrance. Two class II magazines may be in the same building when one is used only for blasting caps in quantities not in excess of 5,000 caps and a distance of 3 meters is maintained between magazines.
- When used for temporary storage at a site for blasting operations, Class II magazines shall be located away from other magazines. A distance of at least 45.7 meters shall be maintained between Class II magazines and the work in progress when the quantity of explosives kept therein is more than 11.3 kilograms, and at least 15.2 meters when the quantity of explosives is 11.3 kilograms, or less.
- The requirements specified above do not apply to the following:
    - Stocks of small arms ammunition, propellant-actuated power cartridges, small arms ammunition primers in quantities of less than 750,000, or of smokeless propellants in quantities less than 340 kilograms.
    - Explosive-actuated power devices when in quantities less than 22.7 kilograms' net weight of explosives.
    - Fuse lighters and fuse igniters.
    - Safety fuses other than Cordeaux Detonator fuses.

7.3 Site Procedures

Before work begins at an UXO/OEW-contaminated area, site-specific training addressing UXO/OEW is presented to Responsible Contractor and subcontractor employees. Where UXO/OEW are suspected of being present, special precautions are taken during routine work activities. The work plan addresses the potential for encountering UXO/OEW and the actions required upon discovery of suspected UXO/OEW. Site workers must be observant and call to the attention of the HSSE representative any object suspected to be UXO/OEW. UXO/OEW hazards are routinely covered in Pre-start safety meetings.

Environmental sampling is not performed in UXO/OEW-contaminated areas. The following general safety measures are strictly adhered to:

- No one enters an area that has not been cleared and obviously marked by the Explosive Ordnance Disposal subcontractor. At no time, will anyone veer outside the cleared area unless accompanied by the EOD subcontractor.
- Entry into a work area is by clearly marked paths.
- Before any object is driven into the ground (i.e., stakes, fence posts, marker posts), a magnetometer assessment of that point is performed.
- Before soil-sampling activities begin, the EOD subcontractor scans the area. If a positive reading occurs, the sample point is relocated.
- No mechanical boring occurs in an area where UXO/OEW may be present. The EOD subcontractor determines whether the subcontractor or Responsible Contractor will do the sampling.
- All environmental samples are screened to ensure that UXO/OEW debris has been removed (i.e., spent cartridges, powder residue, projectiles).

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- The EOD subcontractor maintains an UXO/OEW Log that includes the type of UXO/OEW encountered, time, location, action taken, and final disposition of the UXO/OEW.

7.3.1 Equipment Controls (when determined necessary by site conditions)

Special consideration may be required when operating mechanical equipment where UXO/OEW are present. Working with the UXO/OEW subcontractor, the site superintendent determines the type(s) of special controls that may be required; namely:

- Equipment such as backhoes and track hoes may be equipped with shields capable of redirecting explosive forces to protect the operator from shrapnel should an explosion occur.
- Where soil is being excavated, a mechanical screen may be employed that will sift the debris from the soil. Typically, the screen size should be 6 cm by 6 cm.

At sites where rotary kilns are in service for soil treatment, special consideration should be given to communicating the hazard associated with live rounds entering the kiln. The potential for UXO/OEW damaging the rotary kiln must be addressed prior to soil treatment.

7.3.2 EOD Role

Only qualified EOD or UXO personnel work with UXO/OEW found on a Responsible Contractor site. The role of the EOD/UXO team is to ensure through safety rules and approved techniques that no undue risk is involved while UXO/OEW is being excavated, handled, transported, or disposed of. The procedures and safety precautions required for handling and rendering ordnance safe are determined solely by the onsite EOD/UXO personnel. Only personnel essential to the detection and removal of UXO/OEW are allowed in the restricted exclusion zone.

Prior to beginning EOD operations, the military construction contact (or local government, as applicable) and Responsible Contractor meet to discuss the procedures for rendering the site safe and the time required to achieve this objective. The site operations do not proceed until the military (or government, as applicable) can ensure that work can proceed safely.

Work starts/restarts upon clearance of the area by the EOD personnel. Responsible Contractor works through their military construction contact (or local government, as applicable) to monitor progress of the UXO/OEW survey. The military construction contact/local government representative schedules a briefing with the EOD Officer in Charge (or local equivalent) and Responsible Contractor to discuss the survey results.

7.3.3 UXO Subcontractor Role

The EOD/UXO subcontractor role consists of:

- Providing historical research on sites or areas suspected of being contaminated with UXO/OEW.
- Addressing UXO/OEW potential/precautions in safety meetings.
- Overseeing of personnel activities to limit potential encounters with UXO/OEW.
- Providing guidance on procedures required to protect employees where UXO/OEW may be encountered.
- Providing clearance of areas where UXO/OEW may be encountered.
- Providing interface with military, civilian, or Corps of Engineers EOD teams.
- Drilling, digging, or excavating, as required, for sampling of soils for non-EOD/UXO remediation activities.

7.3.4 Procedure if EOD is Discovered

The following steps are to be followed if EOD is discovered:

- The object suspected to be UXO/OEW must not be touched, moved, or disturbed in any manner.

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- All work activities in the immediate area must stop immediately upon discovery of any object suspected to be UXO/OEW.
- The use of all equipment that may generate electromagnetic waves must be terminated (i.e., cellular phones, radios, LASERS, generators, and alternators) within a distance of 275 meters.
- Employees must evacuate the area and move to a pre-determined assembly point in the support zone.
- The individual observing the suspected UXO/OEW must contact his supervisor and the HSSER. Responsible Contractor and subcontractor personnel must not handle any ordnance item. **Only trained explosive ordnance disposal personnel will handle UXO/OEW.**
- On military bases, the detection, identification, field evaluation, rendering-safe, recovery, and final disposition of UXO/OEWW is the responsibility of EOD teams. Each site must have current emergency numbers for EOD teams in their HSSE Execution Plan.
- Appropriate contacts will be established.
- The incident call log must be completed and the information forwarded to appropriate contacts.

7.3.5 Exclusion Zone

Where suspected UXO/OEW is encountered, the Responsible Contractor HSSER, working with the EOD/UXO team, establishes an exclusion zone for Responsible Contractor and subcontractor personnel. The EOD/UXO team will determine the distance from the ordnance to barricades. Typically, the type of ordnance discovered will dictate the safe distance. The non-fragmenting explosive materials evacuation zone should be a minimum of 381 meters. The evacuation distance for fragmenting explosive materials should be a minimum of 762 meters. For bombs and projectiles with calibers greater than 12.7 cm, the minimum evacuation distance is 1219 meters.

7.3.6 Communication and Notification

- The HSSER contacts the appropriate Responsible Contractor HSSE Manager and the military engineering representative (if applicable) at the earliest possible time.
- If the Project Superintendent is not onsite, the HSSER immediately forwards the appropriate information to the Project Manager.
- If the military engineering representative is not onsite, the appropriate information is forwarded to base security (where applicable).
- On civilian sites, the local law enforcement authorities must be contacted immediately.
- The Project Superintendent or a designee is responsible for informing the Responsible Contractor Project Manager.
- The military engineering representative (where applicable) contacts base security to initiate EOD contact.
- Notification of key personnel must occur immediately upon discovery of UXO/OEW. The use of project-specific notification checklists and/or call logs ensure proper notification of appropriate personnel and provide a written record of actions taken.

7.3.7 Recordkeeping Requirements

An incident pertaining to UXO/OEW is an encounter with suspected or actual UXO/OEW other than spent small arms cartridges. A verbal report of the incident must be given within 12 hours, and a written report must be filed within 48 hours of encountering UXO/OEW. The incident report must include a completed Ordnance Incident Call Log (see attachment 4). The report must also include pictures and a statement regarding the condition of the material found. The incident report must also include corrective actions taken and a schedule of completion of all action items.

7.3.8 Pre-Work Review

Before work begins on a Responsible Contractor site, a review of historical data, drawings, and permits shall be completed to determine past history and previous use of the work area.

A remedial investigation/feasibility study is typically performed to assess site conditions and to evaluate alternatives to the extent necessary to select a remedy. These two actions should be sufficient to develop an understanding of UXO/OEW hazards at the work site. Typically, the historical research is the

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responsibility of the local military and/or, upon request, the Responsible Contractor EOD subcontractor. Research criteria are listed in Ordnance Research Documentation (see Attachment 2). Upon completion of the RI/FS and historical research, all conclusions and recommendations are reviewed at a Responsible Contractor Readiness Review Meeting for the project. The results of the reviews are used to establish site-specific work plans to address UXO/OEW risks possible during Responsible Contractor work activities.

7.3.8.1 Background Search

Before work commences on a site where past ordnance activities are known or suspect, the following information shall be obtained:

- Historical search of work site with an emphasis on ordnance use or disposal.
- Historical search pertaining to past battle sites.
- Previous use of site (rifle range, bombing range, etc.).
- Evidence of UXO/OEW having previously been found on the site.
- Architectural drawings and plots.
- Surface and subsurface piping diagrams.
- Previous excavation or subsurface work activities undertaken.
- Interviews with knowledgeable current and former site personnel.

The possibility of encountering UXO/OEW must be anticipated in all site-specific HSSE Execution Plans. At sites where the potential is high for encountering UXO/OEW, a plan shall be developed by the EOD contractor for safe operations. Adequate budgeting shall be provided to address EOD contracting and requirements pertaining to encountering UXO/OEW.

Before starting work, contingency planning to address UXO/OEW must be in place. The work plan must identify areas where UXO/OEW may be encountered and the type of UOX/OEW (known and suspected).

7.3.8.2 Readiness Review Meeting

The following information shall be discussed during the Readiness Review Meeting before the initiation of field work:

- Past and present use of the area(s) where work is planned.
- Building layout and piping/utility diagrams for the site (recent and historical).
- Historical use of the site, with particular attention to possible use as a firing range, bombing range, and battle site.
- Previous work activities involving the discovery of ordnance (if applicable).
- UXO/OEW disposal in the area and ordnance-related activities on the site.
- UXO/OEW procedures in the work plan and site-specific HSSE Execution Plan.
- EOD survey of the work site.
- Training of site personnel.

For non-military sites, the following must be considered:

- What was the previous use of the work site?
- Is the location a past battle site?
- Is the location a former military installation?
- Does the work plan and the HSSE Execution Plan address the potential of discovering UXO/OEW?

7.4 Requirements for Issue (Blasting License)

As per the requirements of the Ministry of Interior Blasting Police the following shall apply:

- Letter from the Project's owner to blasting police regarding contract awarding (Name of contactor plus estimated quantity of rocks to be blasted).
- Consultant Report from the consultant of the project to blasting police regarding rock condition, estimated quantity of rocks to be blasted, surrounding properties, working site boundaries, drilling and blasting methodology, safety recommendations, suggested required explosives quantities.

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- Report to be prepared as per blasting police requirements.
- Rock quantities to be blasted mentioned on the consultant report should be the same as mentioned on owner letter, otherwise, the blasting police will consider the least quantity.

- Copy of the contract between the owner and main contractor/sub-contractor.
  - If the blasting expert is an employee of the main contractor, then a copy of the employment contract shall be submitted.
  - If the main contractor is not a registered company at the blasting police for executing blasting activity, then, the blasting license will be issued under the name of the blasting subcontractor.

- Copy of Municipality work permit.
- Site plan (sketch, lay-out).
  - Drawing only, Arial photograph (e.g. Google Earth) is not acceptable. The plan should clearly show:
    - Working site borders.
    - Drilling and blasting activity location.
    - Utilities and properties location (either within the working site limits or outside the borders).
    - Distances between the drilling and blasting activities
    - Location to the nearest utility or property.

- Letter from the main contractor to blasting police requesting issue a blasting license for the Project.

This request should state the company name under which the blasting license will be issued. If the main contractor is a registered company at the blasting police, then, his name will be mentioned on the letter, otherwise, the name of the specialized Drilling and Blasting sub-contractor should be mentioned, plus any other future regulation that might appear while executing the Project.

- Commitment letter from the main contractor to blasting police.
  - This letter shall clearly state the contractor's willingness to follow all safety regulation on site, drilling and blasting plan, and follow all safety work instructions within the report.
  - Contractor has full responsibility for any damages to personnel, citizens, utilities and property as a result of any damage from Drilling or Blasting activity.
  - This letter must be legalized from the Chamber of Commerce.

- Copy of a Grade 1 or 2 valid blasting license.
- Copy of blaster Identification
- Copy of the valid Commercial registration and Chamber of Commerce.

7.4.1 Other Important Notes

- Contractor should start applying for blasting license as early as possible. It will take about (6) weeks to be issued.
- All correspondences should be addressed to the: Public Security, Weapons and Explosives Deactivating Police.
- The license will be issued from the Public Security, Riyadh.
- All correspondences should be on Arabic Language.
- All above mentioned papers and documents should be compiled and indexed in a green hanging file.
- The contractor should assign one Saudi employee as his official representative to blasting police (he will be responsible for sending and receiving any documents).
- Once the file delivered to police and accepted, minutes from a site visit will be prepared by blasting police, indicating site conditions, safety requirements, explosives types and quantities, and comments on drilling and blasting plan. These minutes will be part of the file.

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- The whole file will be sent by Blasting Police to Public Security, Riyadh to obtain the license. Once the license issued, the Blasting Police will inform the contractor.

The blasting police have special formats for explosives usage and reporting for a daily and monthly reports. Copy of these formats will be supplied by blasting police to the contractor.

7.5 Construction of Magazines

Magazines shall be constructed in accordance with the following general requirements:

- Magazines for the storage of explosives, other than black powder, Class B and Class C explosives shall be bullet resistant, weather resistant, fire resistant, and ventilated sufficiently to protect the explosive in the specific locality.
- Magazines used only for storage of black powder, Class B and Class C explosives shall be weather resistant, fire-resistant, and have ventilation.
- Magazines for storage of blasting and electric blasting caps shall be weather resistant, fire-resistant, and ventilated.
- Property upon which Class I magazines are located and property where Class II magazines are located outside of buildings shall be posted with signs reading "Explosives-Keep Off" (in English and the national language, where applicable).
- Magazines requiring heat shall be heated by either hot-water radiant heating within the magazine building; or air directed into the magazine building over either hot water or low-pressure steam (15 psig) coils located outside the magazine building. The magazine heating systems shall meet the following requirements:

    - The radiant heating coils within the building shall be installed in such a manner that the explosives or explosives containers cannot contact the coils and air is free to circulate between the coils and the explosives or explosives containers.
    - The heating ducts shall be installed in such a manner that the hot-air discharge from the duct is not directed against the explosives or explosives containers.
    - The heating device used in connection with a magazine shall have controls that prevent the ambient building temperature from exceeding 54.5ºC.
    - The electric fan or pump used in the heating system for a magazine shall be mounted outside and separate from the wall of the magazine and shall be grounded (earthed).
    - Electric fan motor and the controls for electrical heating devices used in heating water or steam shall have overloads and disconnects. All electrical switchgear shall be located a minimum distance of 7.6 meters from the magazine.
    - The heating source for water or steam shall be separated from the magazine by a distance of not less than 7.6 meters when electrical and 15.2 meters when fuel fired. The area between the heating unit and the magazine shall be cleared of all combustible materials.
    - The storage of explosives and explosives containers in the magazine shall allow uniform air circulation so product temperature uniformity can be maintained.

- When lights are necessary inside the magazine, electric safety flashlight, or electric safety lanterns shall be used.

7.5.1 Construction of Class I Magazines

- Class I magazines shall be of masonry construction or of wood or of metal construction, or a combination of these types.
- Thickness of masonry units shall not be less than 20 cm. Hollow masonry units used in construction required to be bullet resistant shall have all hollow spaces filled with weak cement or well-tamped sand.
- Wood constructed walls, required to be bullet resistant, shall have at least a 15.2 cm space between interior and exterior sheathing and the space between sheathing shall be filled with well-tamped sand.
- Metal wall construction, when required to be bullet resistant, shall be lined with brick at least 10.2 cm in thickness or shall have at least a 15.2 cm sand fill between interior and exterior walls.

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- Floors and roofs of masonry magazines may be of wood construction. Wood floors shall be tongue and grooved lumber having a nominal thickness of 2.5 cm.
- Roofs required to be bullet resistant shall be protected by a sand tray located at the line of eaves and covering the entire area except that necessary for ventilation. Sand in the sand tray shall be maintained at a depth of not less than 10.2 cm.
- All wood at the exterior of magazines, including eaves, shall be protected by being covered with black or galvanized steel or aluminum metal of thickness of not less than No. 26 gage. All nails exposed to the interior of magazines shall be well countersunk.
- Foundations for magazines shall be of substantial construction and arranged to provide good cross ventilation.
- Magazines shall be ventilated sufficiently to prevent dampness and heating of stored explosives. Ventilating openings shall be screened to prevent the entrance of sparks.
- Openings to magazines shall be restricted to that necessary for the placement and removal of stocks of explosives. Doors for openings in magazines for Class A explosives shall be bullet resistant. Doors for magazines not required to be bullet resistant shall be designed to prevent unauthorized entrance to the magazine.
- Provisions shall be made to prevent the piling of stocks of explosives directly against masonry walls, brick-lined or sand-filled metal walls and single-thickness metal walls; such protection, however, shall not interfere with proper ventilation at the interior of side and end walls.

7.5.2 Construction of Class II Magazines

- Class II magazines shall be of wood or metal construction, or a combination thereof.
- Wood magazines of this class shall have sides, bottom, and cover constructed of 5 cm hardwood boards well braced at corners and protected by being entirely covered with sheet metal of not less than No. 20 gage.
- All nails exposed to the interior of the magazine shall be well countersunk.
- All metal magazines of this class shall have sides, bottom, and cover constructed of sheet metal, and shall be lined with 9 mm plywood or equivalent.
- Edges of metal covers shall overlap sides at least 2.5 cm.
- Covers for both wood- and metal-constructed magazines of this class shall be provided with substantial strap hinges and shall be provided with substantial means for locking.
- Magazines of this class shall be painted red and shall bear lettering in white, on all sides and top, at least 7.6 cm high: "Explosives - Keep Fire Away."
- Where necessary due to climatic conditions, Class II magazines shall be ventilated.

7.6 Storage Within Magazines

- Packages of explosives shall be laid flat with the top side up.
- Black powder, when stored in magazines with other explosives, shall be stored separately. Black powder stored in kegs shall be stored on ends, bungs down, or on side, seams down.
- Corresponding grades and brands shall be stored together in such a manner that brands and grade marks show.
- All stocks shall be stored so as to be easily counted and checked.
- Packages of explosives shall be piled in a stable manner.
- When any kind of explosive is removed from a magazine for use, the oldest explosive of that particular kind shall always be taken first.
- Packages of explosives shall not be unpacked or repacked in a magazine or within 15.2 meters of a magazine or in close proximity to other explosives.
- Tools used for opening packages of explosives shall be constructed of non-sparking materials, except that metal slitters may be used for opening fiberboard boxes.
- A wood wedge and a fiber, rubber, or wood mallet shall be used for opening or closing wood packages of explosives.
- Opened packages of explosives shall be securely closed before being returned to a magazine.
- Magazines shall not be used for the storage of any metal tools nor any commodity except explosives, but this restriction shall not apply to the storage of blasting agents and blasting supplies.
- Magazine floors shall be regularly swept, kept clean, dry, and free of grit, paper, empty used packages, and rubbish.
- Brooms and other cleaning utensils shall not have any spark-producing metal parts.

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- Sweepings from floors of magazines shall be properly disposed of.
- Magazine floors stained with nitroglycerin shall be cleaned according to manufacturer instructions.
- When any explosive has deteriorated to an extent that it is in an unstable or dangerous condition, or if nitroglycerin leaks from any explosives, then the person in possession of such explosive shall immediately proceed to destroy such explosive in accordance with the instructions of the manufacturer. Only experienced persons shall be allowed to do the work of destroying explosives.
- When magazines need inside repairs, all explosives shall be removed and the floors cleaned.
- When making outside repairs, and there is a possibility of causing sparks or fire, the explosives shall be removed from the magazine.
- Explosives removed from a magazine under repair shall either be placed in another magazine or placed a safe distance from the magazine where they shall be properly guarded and protected until repairs have been completed, and they can be safely returned to the magazine.
- Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 15.2 meters of magazines.
- The land surrounding a magazine shall be kept clear of all combustible materials for a distance of at least 7.6 meters.
- Combustible materials shall not be stored within 15.2 meters of magazines.
- Magazines shall be in the charge of a competent person at all times who shall be responsible for the enforcement of all safety precautions.
- Explosives recovered from blasting misfires shall be placed in a separate magazine until competent personnel have determined from the manufacturer the method of disposal.
- Caps recovered from blasting misfires shall not be reused. Such explosives and caps shall then be disposed of in the manner recommended by the manufacturer.

7.7 Transportation of Explosives

- No employee shall be allowed to smoke, carry matches or any other flame-producing device, or carry any firearms or loaded cartridges while in or near a motor vehicle transporting explosives; or drive, load, or unload such vehicle in a careless/reckless manner.
- Explosives shall not be transferred from one vehicle to another within the confines of any jurisdiction without informing the fire and police departments thereof.
- In the event of breakdown or collision, the local fire and police departments shall be promptly notified to help safeguard such emergencies.
- Explosives shall be transferred from the disabled vehicle to another only when proper and qualified supervision is provided.
- Blasting caps or electric blasting caps shall not be transported over the highways on the same vehicles with other explosives, unless packaged, segregated, and transported in accordance with applicable regulatory requirements.

7.7.1 Transportation Vehicles

- Vehicles used for transporting explosives shall be strong enough to carry the load without difficulty and be in good mechanical condition.
- If vehicles do not have a closed body, the body shall be covered with a flameproof and moisture-proof tarpaulin or other effective protection against moisture and sparks.
- All vehicles used for the transportation of explosives shall have tight floors and any exposed spark-producing metal on the inside of the body shall be covered with wood or other non-sparking materials to prevent contact with packages of explosives.
- Packages of explosives shall not be loaded above the sides of an open-body vehicle.
- Every vehicle used for transporting explosives and oxidizing materials shall be marked in accordance with applicable national and/or local regulations.
- Such markings or placards shall be displayed at the front, rear, and on each side of the motor vehicle or trailer, or other cargo carrying body while it contains explosives or other dangerous articles of such type and in such quantity as specified in Table 1 below. The front marking or placard may be displayed on the front of either the truck, truck body, truck tractor or the trailer.
- Any motor vehicle, trailer, or other cargo-carrying body containing more than one kind of explosive as well as an oxidizing material requiring a placard under the provisions of Table 1 below, the aggregate gross weight of which totals 454 kg or more, shall be marked or placarded "Dangerous"

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as well as "Explosive A" or "Explosive B" as appropriate. If explosives Class A and explosives Class B are loaded on the same vehicle, the "Explosives B" marking need not be displayed.

- In any combination of two or more vehicles containing explosives or other dangerous articles, each vehicle shall be marked or placarded as to its contents and in accordance with the requirements of this section.
- Each motor vehicle used for transporting explosives shall be equipped with a minimum of two extinguishers, each having a rating of at least 10-BC. Only extinguishers listed or approved by a nationally recognized testing laboratory shall be deemed suitable for use on explosives-carrying vehicles.
- Extinguishers shall be filled and ready for immediate use and located near the driver's seat.
- A competent person shall examine extinguishers periodically.
- A motor vehicle used for transporting explosives shall be given the following inspection to ensure that it is in proper condition for safe transportation of explosives:

    - Fire extinguishers shall be filled and in working order.
    - All electrical wiring shall be completely protected and securely fastened to prevent short-circuiting.
    - Chassis, motor, pan, and underside of body shall be reasonably clean and free of excess oil and grease.
    - Fuel tank and feed line shall be secure and have no leaks.
    - Brakes, lights, horn, windshield wipers, and steering apparatus shall function properly.
    - Tires shall be checked for proper inflation and defects.
    - The vehicle shall be in proper condition in every other respect and acceptable for handling explosives.

Commodity	Type of Marking or Placard
Explosives, Class A, any quantity; or a combination of Class A and Class B explosives.	Explosives A (Red letters on white background).
Explosives, Class B, and quantity.	Explosives B (Red letters on white background).
Oxidizing material (blasting agents, ammonium nitrate, etc.), 454 kg or more gross weight.	Oxidizers (Yellow letters on black background).

Table 1 - Placards

7.7.2 Operation of Transportation Vehicles

- Vehicles transporting explosives shall only be driven by and be in the charge of a driver who is familiar with the traffic regulations, local laws, and the provisions of this procedure.
- Except under emergency conditions, no vehicle transporting explosives shall be parked before reaching its destination, even though attended, on any public street adjacent to or in proximity to any place where people work.
- Every motor vehicle transporting any quantity of Class A or Class B explosives shall be attended by a driver or other attendant of the motor carrier at all times. This attendant shall have been made aware of the class of the explosive material in the vehicle and of its inherent dangers, and shall have been instructed in the measures and procedures to be followed in order to protect the public from those dangers. The attendant shall have been made familiar with the vehicle he/she is assigned, and shall be trained, supplied with the necessary means, and authorized to move the vehicle when required.
- A motor vehicle shall be deemed "attended" only when the driver or other attendant is physically on or in the vehicle, or has the vehicle within his/her field of vision and can reach it quickly and without any kind of interference.
- Attended also means that the driver or attendant is awake, alert, and not engaged in other duties or activities which may divert his/her attention from the vehicle, except for necessary communication with public officers, or representatives of the carrier shipper, or consignee, or except for necessary absence from the vehicle to obtain food or to provide for his/her physical comfort.

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EXCEPTION: An explosive-laden vehicle may be left unattended if parked within a securely fenced or walled area with all gates or entrances locked where parking of such vehicle is otherwise permissible, or at a magazine site established solely for the purpose of storing explosives.

- No spark-producing metal, spark-producing metal tools, oils, matches, firearms, electric storage batteries, flammable substances, acids, oxidizing materials, or corrosive compounds shall be carried in the body of any motor truck and/or vehicle transporting explosives, unless the loading of such dangerous articles and the explosives comply with applicable regulations.
- Vehicles transporting explosives shall avoid congested areas and heavy traffic. Where local authorities have designated routes through congested areas such routes shall be followed.
- Delivery shall only be made to authorized persons and into authorized magazines or authorized temporary storage or handling areas.

7.8 Use of Explosives and Blasting Agents

The following general provisions apply to the use of explosives and blasting agents:

- While explosives are being handled, or used, smoking shall not be permitted and no one near the explosives shall possess matches, open light or other fire or flame.
- No person shall be allowed to handle explosives while under the influence of intoxicating liquors, narcotics, or other dangerous drugs.
- Original containers or Class II magazines shall be used for taking detonators and other explosives from storage magazines to the blasting area.
- When blasting is done in congested areas or in close proximity to a structure, or any other installation that may be damaged, the blast shall be covered before firing with a mat constructed so that it is capable of preventing fragments from being thrown.
- Persons authorized to prepare explosive charges or conduct blasting operations shall use every reasonable precaution, including but not limited to warning signals, flags, barricades, or woven wire mats to ensure the safety of the public and other workers.
- Blasting operations shall be conducted during daylight hours.
- Whenever blasting is being conducted in the vicinity of gas, electric, water, fire alarm, telephone, telegraph, and steam utilities, the blaster shall notify the appropriate representatives of such utilities at least 24 hours in advance of blasting, specifying the location and intended time of such blasting. Verbal notice shall be confirmed with written notice.
- Due precautions shall be taken to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, lightning, adjacent power lines, dust storms, or other sources of extraneous electricity. These precautions shall include:

    - The suspension of all blasting operations and removal of persons from the blasting area during the approach and progress of an electric storm.
    - The posting of signs warning against the use of mobile radio transmitters on all roads within 107 meters of the blasting operations.
    - The use of cellular phones or other radio-frequency energy producing devices (such as two-way radios, pagers, etc.) shall be prohibited when handling or using explosive ordnance of any type.

7.9 Storage at Use Sites

- Empty containers and paper and fiber packing materials that have previously contained explosive materials shall be disposed of in a safe manner, or reused in accordance with applicable regulatory requirements (e.g., in the U.S., the Department of Transportation's Hazardous Materials Regulations 49CFR Parts 177-180).
- Containers of explosives shall not be opened in any magazine or within 15.2 meters of any magazine. In opening kegs or wooden cases, no sparking metal tools shall be used; wooden wedges and either wood, fiber or rubber mallets shall be used. Non-sparking metallic slitters may be used for opening fiberboard cases.
- Explosives or blasting equipment that are obviously deteriorated or damaged shall not be used.
- No explosives shall be abandoned.

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7.9.1 Loading of Explosives in Blast Holes

- All drill holes shall be sufficiently large to admit freely the insertion of the cartridges of explosives.
- Tamping shall be done only with wood rods without exposed metal parts, but non-sparking metal connectors may be used for jointed poles. Violent tamping shall be avoided. Primed cartridges shall not be tamped.
- When loading blasting agents pneumatically over electric blasting caps, semi-conductive delivery hose shall be used and the equipment shall be bonded and grounded (earthed).
- No holes shall be loaded except those to be fired in the next round of blasting. After loading, all remaining explosives shall be immediately returned to an authorized magazine.
- Drilling shall not be started until all remaining butts of old holes are examined with a wooden stick for unexploded charges, and if any are found, they shall be re-fired before work proceeds.
- No person shall be allowed to deepen drill holes that have contained explosives.
- After loading for a blast is completed, all excess blasting caps or electric blasting caps and other explosives shall immediately be returned to their separate storage magazines.

7.9.2 Initiation of Explosive Charges

- When fuse is used, the blasting cap shall be securely attached to the safety fuse with a standard-ring type cap crimper. All primers shall be assembled at least 15.2 meters from any magazine.
- Primers shall be made up only as required for each round of blasting.
- No blasting cap shall be inserted in the explosives without first making a hole in the cartridge for the cap with a wooden punch of proper size or standard cap crimper.
- Explosives shall not be extracted from a hole that has once been charged or has misfired unless it is impossible to detonate the unexploded charge by insertion of a fresh additional primer.
- If there are any misfires while using cap and fuse, all persons shall be required to remain away from the charge for at least 1 hour. If electric blasting caps are used and a misfire occurs, this waiting period may be reduced to 30 minutes. Misfires shall be handled under the direction of the person in charge of the blasting and all wires shall be carefully traced and search made for unexploded charges.
- Blasters, when testing circuits to charged holes, shall use only blasting galvanometers designed for this purpose.
- Only the employee making leading wire connections in electrical firing shall be allowed to fire the shot. Leading wires shall remain shorted and not be connected to the blasting machine or other source of current until the charge is to be fired.
- Before a blast is fired, the employer shall require that a loud WARNING SIGNAL be given by the person in charge, who has made certain that all surplus explosives are in a safe place, all persons and vehicles are at a safe distance or under sufficient cover, and that an adequate warning has been given.

7.10 Fixed Location Mixing

Buildings used for the mixing of blasting agents shall conform to the following requirements:

- Buildings shall be of noncombustible construction or sheet metal on wood studs.
- Floors in a mixing plant shall be of concrete or of other nonabsorbent materials.
- All fuel oil storage facilities shall be separated from the mixing plant and located in such a manner that in case of tank rupture, the oil will drain away from the mixing plant building.
- The building shall be well ventilated.
- Heating units which do not depend on combustion processes, when properly designed and located, may be used in the building. All direct sources of heat shall be provided exclusively from units located outside the mixing building.
- All internal-combustion engines used for electric power generation shall be located outside the mixing plant building, or shall be properly ventilated and isolated by a firewall. The exhaust systems on all such engines shall be located so any spark emission cannot be a hazard to any materials in or adjacent to the plant.
- Equipment used for mixing blasting agents shall conform to the requirements of this section.

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- The design of the mixer shall minimize the possibility of frictional heating, compaction, and especially confinement. All bearings and drive assemblies shall be mounted outside the mixer and protected against the accumulation of dust. All surfaces shall be accessible for cleaning.
- Mixing and packaging equipment shall be constructed of materials compatible with the fuel-ammonium nitrate composition.
- Suitable means shall be provided to prevent the flow of fuel oil to the mixer in case of fire. In gravity flow systems, an automatic spring-loaded shutoff valve with fusible link shall be installed.
- The provisions of this section shall be considered when determining blasting agent compositions.
- The sensitivity of the blasting agent shall be determined by means of a No. 8-test blasting cap at regular intervals and after every change in formulation.
- Oxidizers of small particle size, such as crushed ammonium nitrate prills or fines, may be more sensitive than coarser products and shall, therefore, be handled with greater care.
- No hydrocarbon liquid fuel with flashpoint lower than that of No. 2 diesel fuel oil (51.6ºC) minimum shall be used.
- Crude oil and crankcase oil shall not be used.
- Metal powders, such as aluminum, shall be kept dry and shall be stored in containers or bins which are moisture-resistant or weather tight. Solid fuels shall be used in such manner as to minimize dust explosion hazards.
- Peroxides and chlorates shall not be used.

1. All electrical switches, controls, motors, and lights located in the mixing room shall conform to the requirements in EPM-KSS-PR-000021 Project Electrical Safety Procedure for Class II, Division 2 locations; otherwise they shall be located outside the mixing room. The frame of the mixer and all other equipment that may be used shall be electrically bonded and be provided with a continuous path to the ground/earth.

- Safety precautions at mixing plants shall include the requirements of this section.
- Floors shall be constructed so as to eliminate floor drains and piping into which molten materials could flow and be confined in case of fire.
- The floors and equipment of the mixing and packaging room shall be cleaned regularly and thoroughly to prevent accumulation of oxidizers or fuels and other sensitizers.
- The entire mixing and packaging plant shall be cleaned regularly and thoroughly to prevent excessive accumulation of dust.
- Smoking, matches, open flames, spark-producing devices, and firearms (except firearms carried by guards) shall not be permitted inside of or within 15.2 meters of any building or facility used for the mixing of blasting agents.
- The land surrounding the mixing plant shall be kept clear of brush, dried grass, leaves, and other materials for a distance of at least 7.6 meters.
- Empty ammonium nitrate bags shall be disposed of daily in a safe manner.
- No welding shall be permitted or open flames used in or around the mixing or storage area of the plant unless the equipment or area has been completely washed down and all oxidizer material removed.
- Before welding or repairs to hollow shafts, all oxidizer material shall be removed from the outside and inside of the shaft and the shaft vented with a minimum 1.3 cm diameter opening.
- Explosives shall not be permitted inside of or within 15.2 meters of any building or facility used for the mixing of blasting agents.

7.11 Bulk Delivery and Mixing Vehicles

The provisions of this section shall apply to off-highway private operations and all public highway movements.

- The body of the vehicle shall be constructed of noncombustible materials.
- Vehicles used to transport bulk premixed blasting agents on public highways shall have closed bodies.
- All moving parts of the mixing system shall be designed as to prevent a heat buildup. Shafts or axles that contact the product shall have outboard bearings with 25 mm minimum clearance between the bearings and the outside of the product container. Particular attention shall be given to the clearances on all moving parts.
- A bulk delivery vehicle shall be strong enough to carry the load without difficulty and be in good mechanical condition.

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- Operation of bulk delivery vehicles shall conform to the requirements of this subdivision. These include the placard requirements as specified by applicable regulatory requirements.
- The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. The operator shall be familiar with the commodities being delivered and the general procedure for handling emergency situations.
- The hauling of either blasting caps or other explosives, but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives.
- No person shall smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing transfer or down-the-hole loading of blasting agents at or near the blasting site.
- Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials.
- Responsible Contractor shall assure that the driver, in moving the vehicle, has assistance of a second person to guide movements.
- No in-transit mixing of materials shall be performed.
- Pneumatic loading from bulk delivery vehicles into blast holes primed with electric blasting caps or other static-sensitive systems shall conform to the requirements of this procedure.
- A positive grounding/earthing device shall be used to prevent the accumulation of static electricity.
- A discharge hose shall be used that has a resistance range that will prevent conducting stray currents, but that is conductive enough to bleed off static buildup.
- A qualified person shall evaluate all systems to determine if they will adequately dissipate static under potential field conditions.
- Repairs to bulk delivery vehicles shall conform to the requirements of this section.
- No welding or open flames shall be used on or around any part of the delivery equipment unless it has been completely washed down and all oxidizer material removed.
- Before welding or making repairs to hollow shafts, the shaft shall be thoroughly cleaned inside and out and vented with a minimum 38 mm diameter opening.

7.12 Unexploded Ordnance and Explosive Waste

This Section establishes the minimum requirements for work at sites potentially contaminated with unexploded ordnance/ordnance and explosive waste (UXO/OEW) and the actions required if such ordnance is encountered.

All personnel working where there is a potential for exposure to UXO/OEW are to be trained in the associated hazards of UXO/OEW.

UXO/OEW can cause injury, disability, and death. The hazards associated with ordnance require that Responsible Contractor employees be prohibited from handling or disposing of UXO/OEW.

The requirements of this Section are applicable to ordnance such as grenades, artillery projectiles, bombs, mines, and rockets, as well as historical ordnance such as cannon balls and mortar and artillery projectiles.

7.12.1 History – Background

Military installations in most countries routinely disposed of ordnance and explosive waste by land burial. This method of disposal was used frequently until the mid-1970s. Abandoned ranges typically were given cursory sweeps before use for new activities. For this reason, UXO/OEW will be considered to be present and planned for on all formerly used defense/military sites. Firing ranges were also used for weapons other than those for which they were designed.

Many military installations in countries may be considered historical sites. In the U.S., Civil War-era and earlier munitions, including canisters and the more familiar cannon ball, may be encountered. Similar items may be found on historical battlefields in Europe, Asia, Africa, and the Middle East. Historical projectiles are to be treated as any other UXO, especially projectiles with uncut Bormann time fuses or percussion fuses, particularly brass. These have generally provided a watertight seal, even if they have been in the ground over 100 years. No projectile should be exposed to excessive heat (e.g., the ignition point of black powder, used in a bursting charge in all Civil War projectiles, is 7°C. Black powder that has been wet and then dried possesses a shock hazard due to the instability of the powder charge. Wet powder is relatively

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inert. Historical sites require a work plan that addresses actions to be taken in the event of finding older UXO.

Modern ordnance (World War I to present) is designed to withstand long periods of storage under unfavorable conditions and may be in usable condition when discovered. Some older pieces of ordnance should be considered more sensitive to handling due to destabilization of the fusing mechanism or the explosive filler.

7.13 Policy

Before any visit to or work at a potential UXO/OEW site, personnel must be trained to recognize the markings, terminology, and correct safety procedures to use during their visit or work. Individuals performing work on a UXO/OEW site must receive UXO/OEW recognition and safe response training. The training requirements are identified in Section 7.14.

Responsible Contractor policy is to provide a working environment that is free of hazards associated with UXO/OEW. No person will be instructed to work in surroundings or under conditions that are unsafe or dangerous to their health. Responsible Contractor will stop all work in the immediate area if UXO/OEW is encountered. The HSSE Department and Site Manager will be contacted immediately and the responsibilities for site operations will revert to the designated authority (e.g., local military detachment, police bomb squad, etc.) until the work area is declared safe by the designated authority.

7.14 Training Requirements

Training shall be provided by an EOD subcontractor (or Responsible Contractor personnel) who has successfully completed an EOD course appropriate for the level of training required. Each individual visiting or working in an area that may contain UXO/OEW must attend either an Awareness Training or Recognition and Response Training session.

Minimum training elements of Awareness Training shall include:

- Historical background of the work site.
- Types of UXO/OEW that may be discovered in the work area.
- Actions to take upon encountering UXO/OEW.

The minimum training for site personnel shall be Recognition and Safe Response Training. In addition to the above material, the following information is required:

- Pertinent contacts (military, where applicable, and Responsible Contractor) and telephone numbers.
- Special precautions pertaining to heavy equipment operation and additional shielding, when required.
- Methods used to detect metal objects.
- Limitations of detection equipment in use by UXO/OEW teams.
- Techniques used to ensure thorough coverage of the work site.
- Effects on equipment such as thermal treatment units.
- PPE Requirements when handling explosives, and devices.

See Attachment 3 for examples of depths of detection in regard to modern types of ordnance.

8.0 ATTACHMENTS

1. Separation Distances for Explosive/Ordnance Storage Magazines
2. Ordnance Research Documentation
3. Depths of Detection Using Ferex Detector (Ferrous Material)
4. EPM-KSS-TP-000037 - Ordnance Incident Call Log Form Template
5. Process Flow Chart Sample

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Attachment 1 - Separation Distances for Explosive/Ordnance Storage Magazines

EXPLOSIVES				Separation of Magazines (distance in feet/meters when storage is barricaded)
Pounds Over	Kilograms Over	Pounds not Over	Kilograms not Over	
2	0.9	5	2.3	6 feet/1.8 m
5	2.3	10	4.5	8 feet/2.4 m
10	4.5	20	9.1	10 feet/3.0 m
20	9.1	30	13.6	11 feet/3.35 m
30	13.6	40	18.1	12 feet/3.65 m
40	18.1	50	22.7	14 feet/4.27 m
50	22.7	75	34.0	15 feet/4.57 m
75	34.0	100	45.3	16 feet/4.88 m
100	45.3	125	56.7	18 feet/5.48 m
125	56.7	150	68.0	19 feet/5.79 m
150	68.0	200	90.7	21 feet/6.40
200	90.7	250	113.4	23 feet/7.01 m
250	113.4	300	136.0	24 feet/7.31 m
300	136.0	400	181.4	27 feet/8.23 m
400	181.4	500	226.8	29 feet/8.84 m
500	226.8	600	272.1	31 feet/9.45 m
600	272.1	700	317.5	32 feet/9.75 m
700	317.5	800	362.9	33 feet/10.06 m
800	362.9	900	408.2	35 feet/10.67 m
900	408.2	1000	453.6	36 feet/11.0 m
1000	453.6	1200	544.3	39 feet/11.8 m
1200	544.3	1400	635.0	41 feet/12.5 m
1400	635.0	1600	725.7	43 feet/13.1 m
1600	725.7	1800	816.5	44 feet/13.4 m
1800	816.5	2000	907.2	45 feet/13.7 m
2000	907.2	2500	1134.0	49 feet/15.0 m
2500	1134.0	3000	1361.0	52 feet/15.85 m
3000	1361.0	4000	1814.4	58 feet/17.6 m
4000	1814.4	5000	2268.0	61 feet/18.6 m
5000	2268.0	6000	2721.5	65 feet/19.8 m
6000	2721.5	7000	3175.0	68 feet/20.7 m
7000	3175.0	8000	3629.0	72 feet/22.0 m
8000	3629.0	9000	4082.3	75 feet/22.9 m
9000	4082.3	10000	4536.0	78 feet/23.7 m
10000	4536.0	12000	5443.0	82 feet/25.0 m
12000	5443.0	14000	6350.1	87 feet/26.5 m
14000	6350.1	16000	7257.5	90 feet/27.4 m
16000	7257.5	18000	8164.6	94 feet/28.6 m
18000	8164.6	20000	9071.8	98 feet/29.8 m
20000	9071.8	25000	11339.8	105 feet/32.0 m
25000	11339.8	30000	13607.7	112 feet/34.1 m
30000	13607.7	35000	15875.7	119 feet/36.2 m
35000	15875.7	40000	20411.6	124 feet/37.8 m
45000	20411.6	50000	22679.6	135 feet/41.1 m
50000	22679.6	55000	24947.6	140 feet/42.6 m

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EXPLOSIVES				Separation of Magazines (distance in feet when storage is barricaded)
Pounds Over	Kilograms Over	Pounds not Over	Kilograms not Over	
50000	22679.6	55000	24947.6	140 feet/42.6 m
55000	24947.6	60000	27215.5	145 feet/44.2 m
60000	27215.5	65000	29483.5	150 feet/45.72 m
65000	29483.5	70000	31751.5	155 feet/47.2 m
70000	31751.5	75000	34019.4	160 feet/48.8 m
75000	34019.4	80000	36287.4	165 feet/50.3 m
80000	36287.4	85000	38555.3	170 feet/51.8 m
85000	38555.3	90000	40823.3	175 feet/53.3 m
90000	40823.3	95000	43091.3	180 feet/54.9 m
95000	43091.3	100000	45359.2	185 feet/56.4 m
100000	45359.2	110000	49895.2	195 feet/59.5 m
110000	49895.2	120000	54431.1	205 feet/62.5 m
120000	54431.1	130000	58967.0	215 feet/65.5 m
130000	58967.0	140000	63503.0	225 feet/68.6 m
140000	63503.0	150000	68039.9	235 feet/71.7 m
150000	68039.9	160000	72574.8	245 feet/74.7 m
160000	72574.8	170000	77110.7	255 feet/77.7 m
170000	77110.7	180000	81646.3	265 feet/80.7 m
180000	81646.3	190000	86182.5	275 feet/83.8 m
190000	86182.5	200000	90718.5	285 feet/86.9 m
200000	90718.5	210000	95254.4	295 feet/90.0 m
210000	95254.4	230000	104326.2	315 feet/96.0 m
230000	104326.2	250000	113398.1	335 feet/102.1 m
250000	113398.1	275000	124738.0	360 feet/109.7
275000	124738.0	300000	136077.7	385 feet/117.3 m

Notes:

1. "Natural barricade" means 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.

2. "Artificial barricade" means an artificial mound or revetted wall of earth of a minimum thickness of three feet.

3. "Barricaded" means that a building containing explosives is effectually screened from a magazine, building, railway, or highway, either by a natural barricade, or by 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 such intervening natural or artificial barricade.

4. When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and in addition, they should be separated from each other by not less than the distances shown for "Separation of Magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "Separation of Magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum of distances specified from other magazines, inhabited buildings, railways, and highways.

5. This table applies only to the permanent storage of commercial explosives. It is not applicable to transportation of explosives, or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

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Attachment 2 - Ordnance Research Documentation

In the United States, the overriding regulation for OEW cleanup is the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In the absence of similar legislation at projects outside the USA, these requirements shall apply. When similar legislation exists, the most stringent requirements shall apply. There is nothing in this procedure that is intended to override or pre-empt any applicable laws. Check with local environmental regulatory bodies in the case of conflict or confusion.

The format for CERCLA response is given in the National Contingency Plan. A risk assessment is required of all formerly used sites that have the potential for ordnance contamination. Technical Bulletin TB5-890-2, "Ordnance and Explosive Waste Risk Assessment," January 1993, addresses procedures for characterizing risks at OEW sites.

The preliminary assessment culminates in preparation of an inventory project report (InPR). The InPR reports the findings and determination of eligibility for funding under the Formerly Used Defense Sites (FUDS) and includes the Site Summary Sheet and the Project Summary Sheet.

The Site Summary Sheet will include:

- A detailed description of the site.
- Description of former site use.
- Current site uses, ownership, and deed restrictions (results of real estate records review).
- A detailed description of the area inspected (site map should be a minimum).
- The date of site visit and the hazard category.
- Available studies and reports.

The Project Summary Sheet will include:

- Project description.
- Project eligibility.
- Policy consideration.
- Risk assessment code.
- Proposal activities.
- Point of contact.
- RAC worksheet for each suspected ordnance site with narrative justification.

The InPR for any site with potential OEW is submitted to USAEDH and Headquarters, U.S. Army Corps of Engineers (HQUSACE) simultaneously for a critical review. CEHND-ED-SY reviews all ordnance InPRs. If there is reason to believe that OEW may be on a site, a site inspection is recommended by CEHND. An archive search will be performed by CEHND to supplement the onsite field evaluation. If a former facility dealt with ordnance, it is assumed that OEW is present, even if the initial inspection does not reveal UXO/OEW.

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Attachment 3 - Depths of Detection Using Ferex Detector (Ferrous Material)

Modern Ordnance Type	Approximate Detection Depth
13 millimeter shell	1 ft. / 0.3 m
Mills bomb (grenade)	2 ft. / 0.6 m
Anti-personnel mine	4 ft. / 1.22 m
Flat anti-tank mine	5 ft. / 1.5 m
8.8 centimeter projectile	10 ft. / 3.0 m
500 pound bomb (227 kilograms)	14 ft. / 4.3 m
1,100 pound bomb (500 kilograms)	20 ft. / 6.1 m

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Attachment 4 - EPM-KSS-TP-000037 - Ordnance Incident Call Log Form Template

Date and Time of Call to Military (if applicable):_____
Name of Person Making Contact:_____
Organization or Company Name:_____
Date and Time of Call GBU HSSE Manager:_____
Person(s) Contacted in GBU:_____
Time Operations were Shut Down:_____
Time Military Officials Arrived Onsite (if applicable):_____

INFORMATION ON OEW OR UXO

SAMPLE

The following information must be obtained from a safe distance and must be stated as estimates of actual.

Location of item(s):_____
Description of item(s):_____
How was/were the item(s) discovered?_____
Was the item(s) dropped or jarred?_____
Was the item wet or dry?_____

COLOR/MARKINGS:

Length:	*Width:*	*Diameter:*
Shape:	Fins:	
Possible fuses noted:	Nose:	Tail:

General condition of the OEW or UXO:_____
Description of area and type of work activities:_____
_____

Was there an explosion or fire involved?_____
Has the area been secured by military authorities?_____

Sketch of work site and location of incident:

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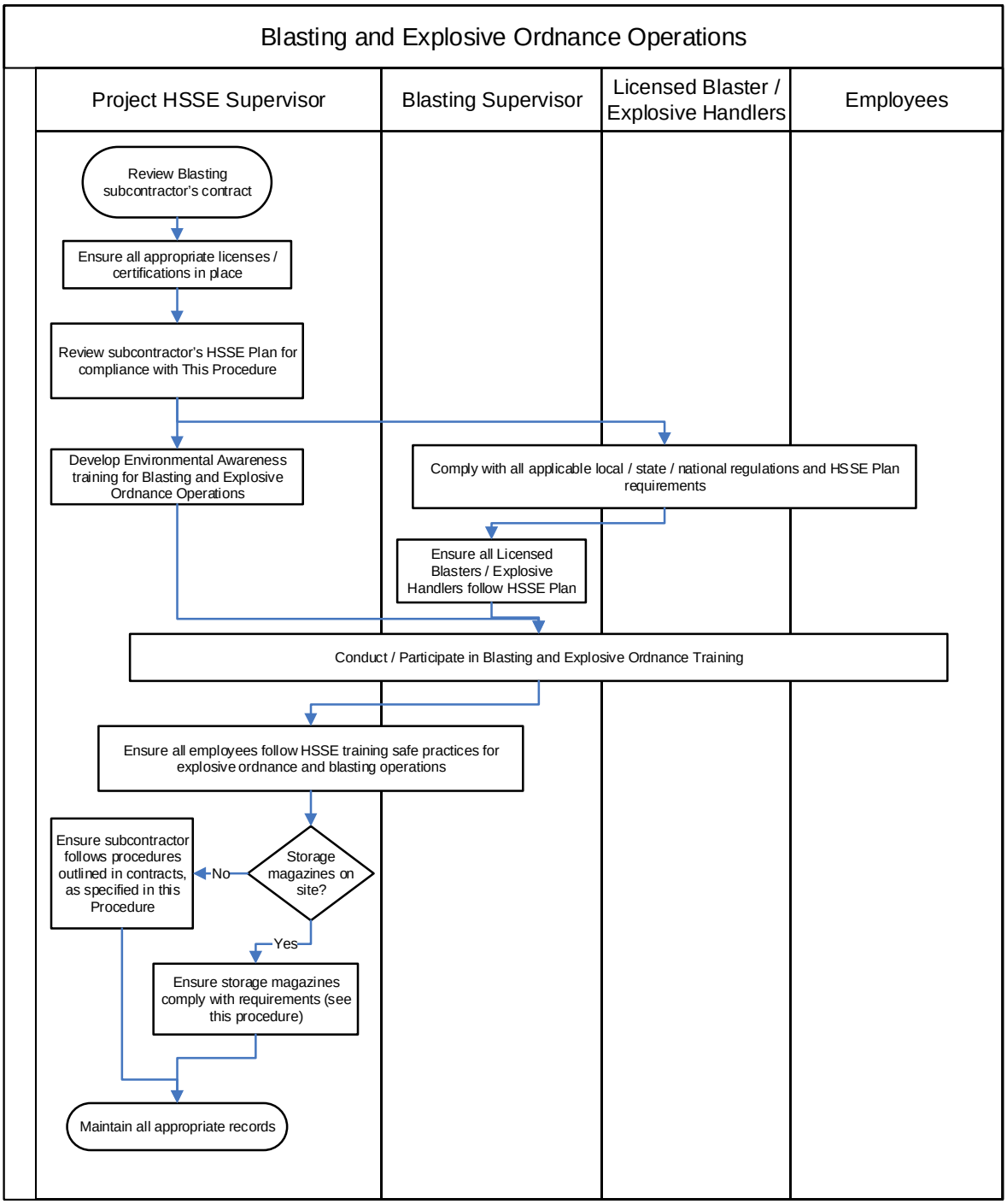
Attachment 5 - Process Flow Chart Sample



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