ENSERVA™

PO Box 1950 Stn M
Calgary, AB T2P 2M2

403.264.4195
enserva.ca

ENSERVA GUIDANCE DOCUMENT ON EXPLOSIVES STAGING FOR PERFORATING ACTIVITIES

MAY 2024

TABLE OF CONTENTS

DEFINITIONS

Blast Area	An area extending at least 15 m (50 ft) in every direction from a place where: (a) explosives are stored outside of a magazine or are placed or primed, or (b) a misfire is known or believed to exist This is an active working area. In-use day boxes will be staged within this area for current use. This area is under the direct supervision of the Blaster of Record.
Blaster of Record	The person who is the holder of a valid blaster's certificate issued by the Board or acceptable to the Board. The Blaster of Record is designated to be in charge of a blasting operation.
Competent Person	A person who is adequately qualified, suitably trained and with sufficient knowledge and experience to safely perform work without supervision or with only a minimal degree of supervision.
Conventional Detonators	Detonators used on conventional (non-pumpdown) operations. These detonators have at least 50 ohms of resistance to limit the risk of RF interference and unintentional detonation, but do not have the RF resistance or other protections included in RF Resistant/Secure Detonators.
Conventional Perforating Systems	Conventional perforation is typically conducted on vertical or slightly deviated wells where perforating is accomplished using gravity feed of the guns and explosive service tools to achieve depth of detonation. These wells will then allow production or injection of fluids. Conventional well perforating operations will see a limited number of perforating guns ranging from 0.5-6 meters in length being shot within the vertical sections. *Intervals are usually only in the tens of meters or less.* Conventional perforating systems are typically installed with single detonators or select fire devices utilizing Group 1 or Group 2 detonators. Arming of the devices (installation of the Initiator/Detonator) must not be made until immediately prior to running the explosives systems into the wellbore. "Last practical opportunity"
Day Box	A portable, outdoor, heavy-duty magazine for safely holding perforating explosive substances during staging operations while at a wellsite. Day boxes can be used for bulk, temporary staging on location, within 150 meters to 15 meters from the wellhead. Each explosive within a day box will be classified according to hazard, determined on the basis of manufacturing operations, the quantity of explosive and how the explosive is packaged as per Transport Canada TDG regulations.

Day Box (Ctd.)	Day boxes must always be: (a) Labelled “EXPLOSIVES/EXPLOSIFS” (b) Protected against undue impact (c) Equipped with a locking mechanism and maintained under 24-hour care and supervision of a competent person (d) Kept clean, organized, free of grit, combustible or abrasive material, any fire-producing, spark-producing or flame-producing device and any substance that might ignite spontaneously (e) Constructed, covered or lined to prevent the exposure of any ferrous metals or gritty materials (f) Weatherproof and protected against moisture (g) Protected from and kept at a distance from any article or substance that is likely to cause a fire or explosion (h) Stored in the blast area which allows for line of site and monitoring by personnel. *Explosives at a worksite must be guarded or stored in a locked and secured day box until used or returned to a magazine to prevent unauthorized access or removal. A day box will always be under the direct supervision of an authorized, competent individual.*
Division 1 Factory License	A license that is issued under paragraph 7(1)(a) of the Explosives Act and authorizes the manufacture of explosives at a factory.
Group 1, 2 & 3 Detonators	As defined in the most current version API RP67
Multi-Stage Perforating Systems	These systems are designed to have multiple perforating guns in one string that are selectively fired in stages as they are pulled back out of a well. There can be anywhere from 5-30 individual perforating guns being run in one “multi-stage” select fire system with dozens of these stages per lateral section. To allow the selective firing of several perforating guns in the system the tools are installed with Group 2 initiation devices with electronic control systems (detonators as defined in RP67) which are electronically shunted by default. The control chips within the string allow communication with a smart firing system at the surface, that allows controlled detonation of the individual perforating guns from the lowest perforating gun in the string, to the top perforating gun as the system is being recovered from the depth they are pumped to. Multi-stage perforating systems include control fire detonators that must not be set to armed state (i.e. They are electronically un-shunted) before being deployed into the wellbore. Some multi-stage gun systems have ballistic interrupts to prevent explosive transfer from the detonator to the detonating cord before being deployed into the wellbore. The Blaster of Record must maintain the ballistic interrupts in place until immediately before running the perforating systems into the wellbore.

Potential Effect (PE) Classification	The required minimum distance in the QD Standard is based on the Potential Effects (PE) classification of the explosives in question and the maximum quantity of explosives stored.
Pump-Down Perforating	A wireline method of perforating used on horizontal wells. Fluid is pumped from the surface using high volume/rate pumping units which conveys multi-stage gun systems to position a plug and perforating guns to a desired depth for subsequent fracturing operations. This allows the plug to be set below the proposed fracture interval where the guns are then fired establishing tunnels through the casing and cement and into the formation for the fracturing treatment. This process is done multiple times per wellbore within the lateral sections of horizontal wellbores.
Quantity Distances (QD) Standard	The Quantity Distances (QD) Standard is used to determine the minimum separation distances between potential explosion sites (process units and magazines) and exposed sites (such as public roads, inhabited buildings, power lines, fuel storage, etc.)
RF Resistant/Secure Detonators	Detonator systems that are designed to be used in areas with Radiofrequency Radiation. These systems are commonly used in unconventional perforating jobs but may also be used on any wellsite where RF Radiation is a concern. These explosive detonating devices require the use of addressable technology and must meet the requirements of API RP67e3 Group 2 and 3 detonators. These devices have a resistance to radio frequencies to allow the limited use of radio communication on location which must be calculated and controlled by the Blaster of Record for the operations. Tables of allowable distances are provided by the manufacturer and must align to *IME SLP 20 – Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the use of Commercial Electric Detonators.*
Staging Area	This is considered a restricted area. Most of the day boxes will be located within the staging area for future use. It is possible for an overlap to take place between the staging area and the blast area depending on the size of the lease.
Staging of Explosives	A provisional part of the overall coordinated project as the explosives are positioned, on a wellsite, for future use on the location on which they are staged. They will typically be staged for use during the planned completion operations of a well or pad of multiple wells at the wellsite.
Storage of Explosives	The storage of explosives must be done within a federally licensed facility under permanent securement. In order to meet these storage requirements a permit holder requires a *Division 1 Factory License* issued by Natural Resources Canada through their Explosives Regulatory Division (NR-Can-ERD). In addition, any federally licensed storage facilities must comply with federal regulations and cannot be situated within 150 meters of any drilling, production or processing operations. Spacing from wellsites are typically classified as D7 as per *CAN/BNQ 2910-510/2015 – Explosives – Quantity Distances.*

Unconventional Perforating Systems	Unconventional perforating includes both horizontal and steam injected heavy oil wells. The perforating of these wells require that the perforating guns are gravity fed down to a "point of refusal" (where deviation no longer permits the guns to drop on their own) wherein high-volume pumps are used to push the perforating guns down the lateral section. Alternately, they can be pushed in with pipe, typically via coil tubing operations. Multiple unconventional wells are typically drilled from one surface pad, as a result they tend to have dozens or even hundreds of approximately 0.3-meter (1-2 foot) perforating guns spread out across the lateral section of the wells to complete the wells for production. This type of perforating operation typically accompanies fracturing operations, where, during the operations, activities alternate between perforating and fracturing treatments. An isolation plug, run in conjunction with the perforating guns, is set below each stage to provide a barrier for the next fracture treatment to enter into the newest perforations and to prevent the previously shot and fractured intervals below from taking the fracture treatment.

INTRODUCTION

The primary section of the regulations requiring a demonstration of risk mitigation is within the Oil and Gas Activities Act, Drilling and Production Regulation, B.C. Reg 266/2022, last amended January 1, 2023, Fire Prevention 47, section g: *explosives of every kind and description are stored only in properly constructed magazines, situated not less than 150 m from any place where any drilling, production or processing operation is being undertaken.*

As per **CAN/BNQ 2910-500/2015(r2022) Standard for Explosives – Magazines for Industrial Use,** the storage of explosives must be done within a federally licensed facility under permanent securement. In order to meet these storage requirements a permit holder requires a **Division 1 Factory License** issued by Natural Resources Canada through their Explosives Regulatory Division (NR-Can-ERD). In addition, any federally licensed storage facilities must comply with federal regulations and cannot be situated within 150 meters of any drilling, production or processing operations, typically a "D7" distance as per **CAN/BNQ 2910-510/2015 Standard for Explosives – Quantity Distances**. As a result, perforating explosives that are maintained at a wellsite, and are for the specific use on that wellsite, are not considered storage, rather they are temporarily housed on site as part of staging for perforating operations.

As regulated permit holders, Enserva members shall demonstrate regulatory compliance in accordance with the legislation pertaining to the staging of explosives. The staging process for prepared perforating guns and/or explosives perforating materials is considered a provisional part of the overall project as explosives are positioned, on a wellsite, for future use, on the location, during a planned duration of operation.

TRANSPORTATION RISK MITIGATION

The transportation of explosives on roads and highways presents the risk of exposure to the public through the possibility of unsecured explosives falling from transport vehicles, motor vehicle collisions, explosive packages being driven over, possible initiation by impact, friction fire or shock, and the increased chance of incident through theft.

The impact of an uncontrolled transportation incident involving explosives may include:

- Blast injuries
- Hit by projectiles
- Impact injuries caused by interaction with a hard surface caused by a blast wave
- Hearing damage
- Lung damage
- Burns
- Entrapment
- Exposure to toxic materials
- Smoke plumes and water run off may contain concentrations of chemicals
- Debris dispersal into the environment

The above-mentioned effects are further exacerbated by the uncontrollable nature of explosives in the event of a transportation incident. The location, proximity and training of emergency response personnel, weather conditions, number of people impacted, neighboring areas and traffic are all factors that remain uncontrollable, and unknown should a public incident take place involving explosives on the roadways.

To lower the amount of exposure to the public, oil well perforating activities must seek to reduce the amount of time explosives are present on the road. Through proper planning of an oilwell perforating job a company can limit the probability of a transportation incident by coordinating the specified amount of explosives required for the operation and ensuring a limited amount of roadway interaction through one wellsite trip versus multiple.

The advantages of a singular transportation of oilwell perforating explosives to site also aims to prevent misruns and misfires downhole as explosive orders are mass-produced by a manufacturer and shipped together. This style of quantitative mass production ensures consistent quality control measures are in place for a batch of explosives.

**Any person or company transporting explosives must ensure that they comply with Part 9 of the Regulations, as well as the Transportation of Dangerous Goods (TDG) Regulations.*

CONVENTIONAL PERFORATING RISK MITIGATION

Potential hazards and implications associated with conventional perforating procedures include, but are not limited to:

- Injury or fatality resulting from a surface detonation
- Impact, crushing, amputation or line of fire injury when handling perforating guns or running guns in/out of the hole
- Falling objects when moving perforating guns and tools in/out of the hole

Common mitigating risk controls used within the industry include:

- Designating and clearly marking out a “Blast Area”
- Labeling all opened boxes of detonator with the factory license number
- Being mindful of pinch-points when removing detonators from the magazine
- Using only certified blasters galvanometers and never using unapproved blasting meters for testing explosive devices
- Ensuring that ≥50 Ohm resistant or RF safe or resistant detonators are being used
- Ensuring the cable head is not connected with the perforating guns unless a secure detention system is being used
- Ensuring the supervisor on site is maintaining a constant line of sight to the cable head to verify no connection to the guns occurs
- Ensuring personnel remain outside of the line of fire
- Using a safety tube for detonators and ensuring it is armed electrically before ballistic (EBBA)
- Ensuring the E-line switch is in safe mode and the key is removed from the logging truck until the tool is a minimum of 60 meters (or more as per company policy) below the surface. *All surface firing panels must have lockout keys and best practices dictate that the key remains in the possession of the worker handling the explosives until they are a minimum of 60m (200ft) below surface.*
- Using hand signals and maintaining line of site with the crane operator as discussed in the pre-job safety meeting
- Creating and reviewing an overhead lift plan; including line of sight, communication methods and a dropped object red zone
- Utilizing tag lines when lifting or tailing perforation guns or settling tools.
- Guiding the lubricator when stabbing perforating guns/settling tools or lubricator during rig-up while ensuring hands are never under the lubricator
- Never lifting equipment with a forklift/crane over a wireline
- Using a tool cart to laydown tools with a tagline
- Prior to un-securing any explosive devices, all units must be positioned, and any risks and/or hazards identified during the site inspections must be controlled or eliminated

PUMP-DOWN PERFORATING RISK MITIGATION

Potential hazards and implications associated with pump-down perforating procedures include, but are not limited to:

- Injury or fatality resulting from a surface detonation
- Impact, crushing, amputation or line of fire injury when handling perforating guns or running guns in/out of the hole
- Falling objects when moving perforating guns and tools in/out of the hole

Common mitigating risk controls used within the industry include:

- Designating and clearly marking out a “Blast Area”
- Labeling all opened boxes of detonator with the factory license number
- Being mindful of pinch-points when removing detonators from the magazine

- Using only certified blasters galvanometers and never using unapproved blasting meters for testing explosive devices
- Ensuring that RF resistant detonators are being used
- Ensuring the RF safe calculator is completed as per IME SLP 20
- Ensuring the cable head is not connected with the perforating guns unless a secure detention system is being used
- Ensuring the supervisor on site is maintaining a constant line of sight to the cable head to verify no connection to the guns occurs
- Ensuring personnel remain outside of the line of fire
- Using a safety tube for detonators and ensuring it is armed electrically before ballistic (EBBA)
- Ensuring the E-line switch is in safe mode and the key is removed from the logging truck until the tool is a minimum of 60 meters (or more as per company policy) below the surface. *All surface firing panels must have lockout keys and best practices dictate that the key remains in the possession of the worker handling the explosives until they are a minimum of 60m (200ft) below surface.*
- Using hand signals and maintaining line of site with the crane operator as discussed in the pre-job safety meeting.
- Creating and reviewing an overhead lift plan; including line of sight, communication methods, dropped object red zone
- Utilizing tag lines when lifting or tailing perforation guns or settling tools.
- Guiding the lubricator when stabbing perforating guns/settling tools or lubricator during rig-up while ensuring hands are never under the lubricator
- Never lifting equipment with a forklift/crane over a wireline
- Using a tool cart to laydown tools with a tagline
- Prior to un-securing any explosive devices, all units must be positioned, and any risks and/or hazards identified during the site inspections must be controlled or eliminated

PERFORATING IMMEDIATE USE RISK MITIGATION

In addition to staging explosives, there is also an operational requirement to have what is referred to as *limited perforating systems ready for deployment into the wellbore*. During this stage, a limited number of perforating systems, ready for deployment, may be maintained within the 15-metre radius of a wellhead. To ensure that the activities being undertaken are in a manner that protects the safety of personnel, and the surrounding environment, only the necessary requirements of the guns will be assumed under the multi-stage and conventional perforating states as required.

When using explosives for perforating, the time between installing detonators and deployment shall be minimized to:

(a) The last practical moment in conventional perforating, or;
(b) A maximum of 1 shift before deployment for pump-down multi-stage perforating due to the unpredictability of simultaneous operations (Fracturing).
***These systems must be equipped with Group 2 or 3 detonators*

When the specific purpose for which explosives were removed from a day box has been carried out or is no longer required, any remaining explosives must be returned to the day box as soon as practicable. Boxes must be resealed and clearly marked with the revised contents

being updated on the location inventory or Transportation of Dangerous Goods (TDG) manifests. Empty boxes must be flattened, and all explosive markings must be removed or defaced before disposal.

STAGING OF EXPLOSIVES RISK MITIGATION

As regulated permit holders Enserva members will continue to ensure that hazards have been identified and controlled for wherever explosives are being staged, while on site, to facilitate the lowest level of risk for personnel and equipment whilst adhering to provincial and federal requirements.

Such controls include but are not limited to:

a) The creation and/or review of a site hazard assessment, by the Perforating Service Blaster of Record, to determine if additional distances are required based on site-specific potential hazards that may be present. A site hazard assessment should include but not limited to: Placement of the blast area, staging area, perforating guns and day boxes.
b) Explosives will be staged, within the blast area, a minimum of 15m (50') from the well head away from:
    i. Open ignition sources (grinding, welding, matches, lighters, open heating units)
    ii. Smoking
    iii. Exposure to excessive heat
c) Explosives will be staged in a manner so that they will be protected from undue impact.
d) Staged explosives in day boxes, a perforating gun, or other Transport Canada approved over-pack containers, will be monitored and secured 24/7 on site. *Unattended staging is not permitted as per NR-Can-ERD regulatory requirements.*
e) While staging explosives at a wellsite the Transport Canada packaging requirements shall be adhered to as per ***CAN/CGSB-43.151-2019*** or relevant ***Equivalency Certificates*** (eg. SH 11778 (Ren.5) or SH 13869 (Ren. 1)) specific to the gun systems being used.
f) Reducing the potential exposure to explosives by reducing and restricting personnel to the minimum number required to operate safely, for the minimum amount of time, with the minimum amount of explosives. Only persons with jobs essential to a particular hazardous operation should be permitted access to the explosives areas.
g) Ensuring that explosive staging inspections are only carried out by authorized regulatory inspectors or jurisdictional RCMP/local police officers who must always be accompanied by an authorized representative of the perforating service company. *The identity of the persons requesting to perform these inspections shall be confirmed before allowing access to the designated explosives areas.*
h) Labeling all opened boxes of detonator with the factory license number.
i) When using explosives for perforating, the time between installing detonators and deployment shall be minimized to:
    i. The last practical moment in conventional perforating, or;
    ii. A maximum of 1 shift before deployment for pump-down multi-stage perforating due to the unpredictability of simultaneous operations (Fracturing). *These systems must be equipped with Group 2 or 3 detonators*

**At no time can the staging of explosives contravene the NR-Can ERD security requirements for explosive materials, this includes maintaining direct control of the explosive materials by the Blaster of Record on location.*

***Unpackaged explosives, unless authorized as such, may not have the same hazard classification as packaged. Explosives should always be maintained in its authorized packaging to ensure that the PE applied is appropriate.*

CONCLUSION

Wellsites where perforating activities are planned and are actively taking place do not meet the requirements of a Division 1 federally licensed storage facility as per Natural Resources Canada, through their Explosives Regulatory Division. Consequently, perforating explosives are on site as part of staging operations only and therefore do not fall within the category of stored explosives as per B.C. Reg 266/2022. As regulated permit holders, Enserva members will demonstrate regulatory compliance in accordance with the legislation pertaining to the staging of explosives.

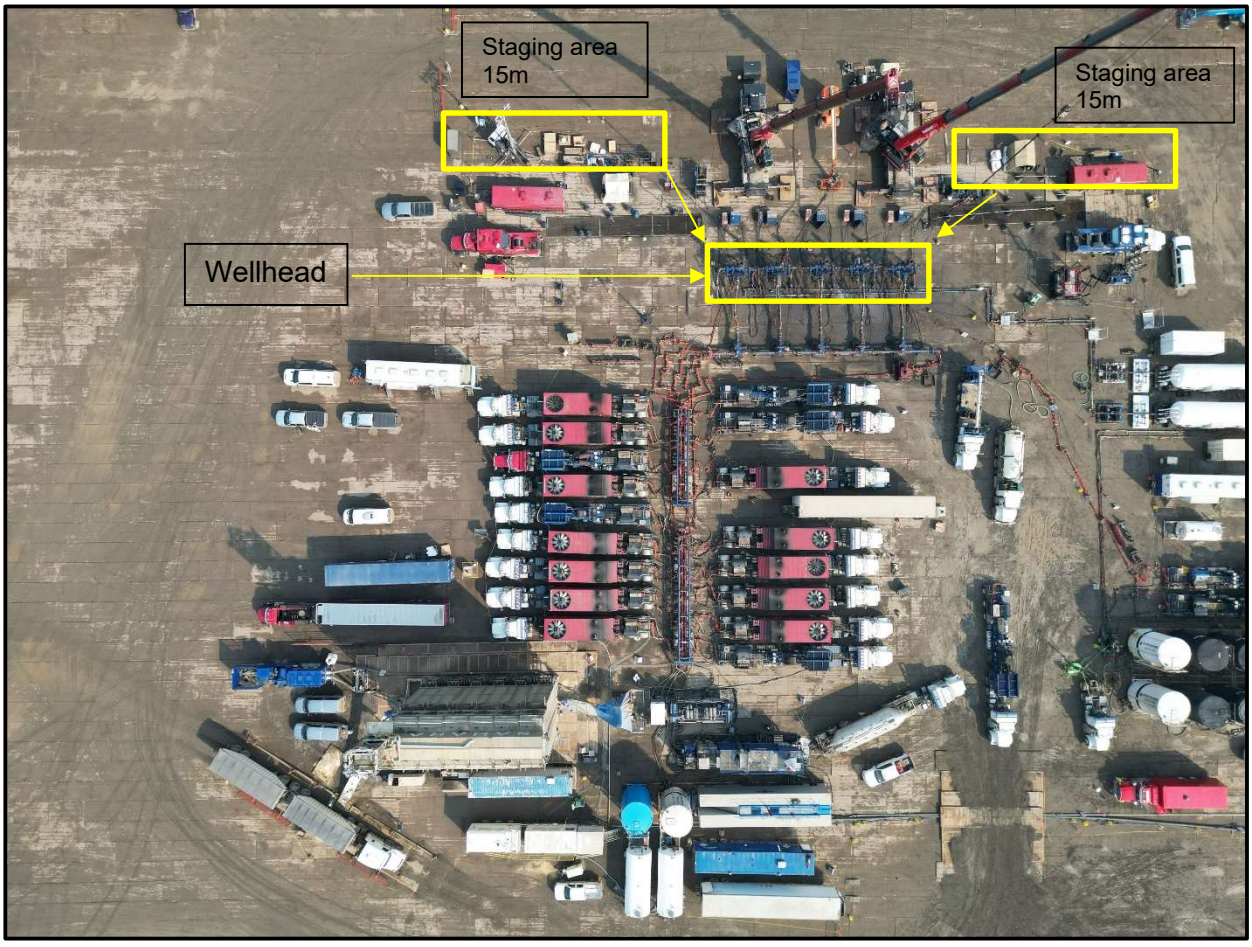
The precautions and hazard controls within this document are to be maintained in conjunction with company, site-specific hazard assessments for staging during oilwell perforating operations. Enserva members are dedicated to ensuring that their formal practices and day-to-day operations strive to safeguard personnel, the public and the environment while maintaining regulatory compliance.

APPENDIX I – DIAGRAMS & PHOTOGRAPHS

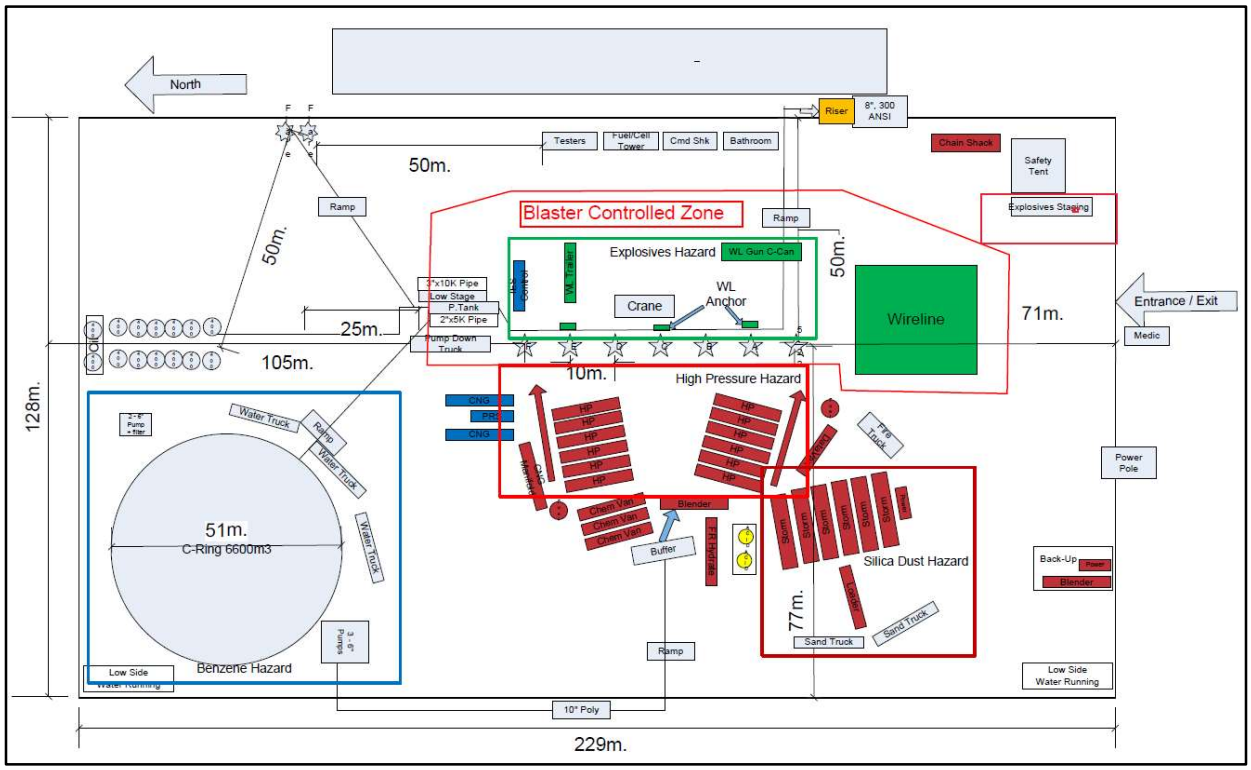
Standard Staging Day Box for Oilwell Perforating Operations

Typical Well Spacing Layout

Ideal Layout of Pumpdown Operations



Ideal Layout of Pumpdown Operations



APPENDIX II – REFERENCE DOCUMENTS

API RP67 - *Recommended Practice for Oilfield Explosives Safety*
CAN/BNQ 2910-500/2015 Explosives – *Magazines for Industrial Explosives*
CAN/CGSB-43.151-2019 – *Packaging, Handling, Offering for Transport and Transport of Explosives (Class 1)*
CAN/BNQ 2910-510/2015 Explosives – *Quantity Distances*
Explosives Regulations, 2013, SOR/2013-211
IME SLP 20 - *Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use of Commercial Electric Detonators (Blasting Caps)*
NR-Can-ERD – *Explosives Guidelines and Standards*
Transportation of Dangerous Goods Act, 1992, S.C. 1992, c. 34