BLASTING

Rules and Regulations

Martin Marietta
Raleigh, North Carolina

Revised 2017

Safety in the Use of Explosives

These rules and regulations were developed to ensure the safety of our employees, on-site contractors, and the general public and must be adhered to strictly. They represent the composite standards of our employees, explosives manufacturers and regulatory agencies, and are intended to be used in both surface and underground operations.

Safety shall always be the first consideration in the use of explosives, whether blasting is done by Martin Marietta personnel or by independent contractors. If a problem or question arises, contact your supervisory personnel, Martin Marietta Explosives Engineering and/or the Safety Department. Remember to never compromise safety for convenience of the moment and to always use common sense.

In those cases where independent contractors do blasting, Martin Marietta shall retain the right to be present while such services are performed. Although the contractor is legally responsible for these services, Martin Marietta personnel must stay involved in monitoring all phases of blasting operations to insure that our rules and regulations are being followed.

Explosives Engineering
Martin Marietta
Raleigh, North Carolina

Revised October 2017

Your Name: _____

Date Trained: _____

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The Guardian Angel Creed

I am now and always will be empowered to stop any actions or processes that will endanger any other person or myself, and will do so with no fear of retribution from anyone at **Martin Marietta**. I will do so because I am totally committed to working in a safe environment that my family and I know will allow me to come home safe and healthy.

6000. Definitions

1. Blast Area. The area around a blast within the influence of flying debris, gases and concussion from an explosion that may cause injury to persons or damage to property. The Blaster-in-Charge is responsible for defining the Blast Area for each shot.

2. Blast Site. The area where explosive material is handled during loading, including a 50-foot perimeter around loaded blast holes. In underground mines, 15 feet of solid rib, pillar or broken rock can be substituted for the 50-foot distance. A distance of 30 feet may replace the 50-foot limit if the perimeter of loaded holes is marked with a barrier such as orange traffic cones. The 50-foot and 30-foot limits apply in all directions, including the full depth of the loaded borehole column.

3. Blaster-in-Charge (BIC). The qualified person in charge of, and responsible for, the loading and firing of a blast.

4. Delay Period/Delay Time. The time interval, in milliseconds, between any two successively designed detonations within a blast.

5. Detonator or "Cap". A device containing an explosive charge used to initiate a blast or individual blast hole. These devices include safety fuses and electric, non-electric and electronic blasting caps.

6. Detonating Cord. A flexible cord containing a solid core of high explosives which may be used to initiate other explosives.

7. Dynamite. A detonator-sensitive cartridge explosive containing nitroglycerin (NG). **NOTE: The use of dynamite and other NG-based products is not permitted on Martin Marietta property.**

8. Explosive Material. Includes explosives (dynamites and other high explosives), water gels, emulsions, blasting agents, ANFO and detonators (caps).

9. Flyrock. Rock or materials displaced out of the designated and defined Blast Area, quarry pit, or off of quarry property as a result of blasting.

10. Misfire. The complete or partial failure of explosive material to detonate after an attempt at initiation. The term also is used to describe the product itself, or the blast, or a part of the blast that failed to fire. **Any blast, or product, that fails to perform as designed should be treated as a misfire.**

11. Primer. A unit, package or container of explosives that contains a detonator (blasting cap) and is used to initiate other explosive materials.

12. Pull Wire Igniter. A device used to initiate a cap and safety fuse assembly.

13. Safety Fuse. A flexible cord containing an internal burning medium by which fire is conveyed at a continuous and uniform rate for the purpose of firing blasting caps.

14. Shot. The term used to describe either the actual blast itself, or the specific site where explosives are loaded or are to be loaded, or the muckpile produced by the blast.

15. Temperature Inversion. A meteorological condition in which warm air creates a "cap" over cooler surface air. The elevation at which these two layers meet creates a barrier that will tend to reflect air overpressure (sound waves), increasing blast perception at nearby dwellings.

6100. Magazine Storage

1. No smoking, flame or flame-producing devices (e.g., matches, lighters, welding units or cutting torches) shall be permitted within 50 feet of any explosive materials, or any magazine or storage

facility (trailer) containing any type of explosive material. **NEVER FIGHT AN EXPLOSIVES FIRE.** In the event of an explosives fire, evacuate to a safe distance and secure the area.

2. Magazines containing explosive materials must be visually inspected each working day. **Any theft of explosives or signs of forcible entry must be reported immediately to the Plant Manager, Production Manager, Explosives Engineering, local law enforcement, and the U.S Bureau of Alcohol, Tobacco, Firearms, and Explosives (BATFE) at 1-800-461-8841.** Failure to do so is deemed a felony by the Safe Explosives Act, Title XI, Subpart C of Public Law 107-296. In operations not located in the United States, such reporting shall be to the respective government agencies as required, and to Corporate Explosives Engineering.

3. All explosive materials (high explosives, water gels, emulsions, blasting agents, ANFO and detonators) must be stored in magazines constructed and located in accordance with the respective foreign government and BATFE/MSHA standards and permitting requirements. All metal magazines shall be properly grounded.

4. No welding shall be done on any magazine unless explosive materials are removed to a distance of at least 50 feet. Locks shall not be removed with cutting torches.

5. The area around the magazine must be cleared of all vegetation, leaves, debris, or any flammable materials and small saplings less than 10 feet in height, for a distance of 25 feet.

6. The magazines shall be kept clean, dry, ventilated, and in a good state of repair.

7. Before making interior repairs or moving a magazine, all explosive materials stored inside shall be removed. Prior to exterior repair, all explosive materials stored within the facility shall be removed if the work to be performed creates a risk of spark or flame. Removed materials shall be located at a minimum of 50 feet from the magazine, and properly secured.

8. The magazine doors shall be padlocked with two BATFE-approved 5-tumbler locks with case-hardened 3/8-inch shackles in separate hasps and eyes. Each lock shall be keyed differently, and protected with steel hoods opening to the bottom, and not less than 1/4-inch thick so as to prevent forcible entry. Blasting agent trailers need only be secured on each door with a single 5-tumbler, case-hardened 3/8-inch shackle lock.

9. The magazines shall be locked at all times except when explosives are being placed in, or being removed from, the magazine.

10. Proper discipline, control and security of magazine keys must be exercised at all times. At a minimum, a list should be maintained that specifies the number of each type of magazine key in circulation, and to whom those keys have been assigned. Unassigned keys should be kept in a secure location with limited access.

11. Detonators shall not be stored in the same magazine with other explosive materials.

12. When ANFO and other explosives materials are stored in the same magazine, they shall be separated to prevent co-mingling.

13. No materials other than explosives, with the exception of non-sparking cleaning tools and aluminum conveyors, shall be stored in the magazines.

14. Explosives shall be stacked so that the oldest stock can always be accessed and used first. This is known as First-In-First-Out (FIFO) inventory control.

15. The location of any magazine or storage facility shall be identified by the placement of warnings signs stating “DANGER – EXPLOSIVES” and “NO SMOKING” approximately 50 feet from each

corner of the magazine, and so located that, in the event they are fired upon, the projectile would not have a direct strike on the magazine.

16. No signs shall be placed on the exterior of the magazine unless required by respective regulatory agencies.

17. When explosive materials have deteriorated and do not resemble the original manufactured appearance, or they leak liquid (other than ANFO weeping), Explosives Engineering shall be notified. **This product shall not be used.**

18. Firearms shall not be allowed on sites where explosive materials are stored or used. Law enforcement or security personnel are exempt.

19. Explosives inventories and permits shall be maintained at each quarry mine office, as well as accurate inventories at each magazine. Inventories at the magazine must be updated as product is added or removed, and likewise updated at the mine office within 24 hours of any change. Bulk inventories must be monitored. Empty the bin or silo with some frequency to balance (zero-out) the inventory and adjust as necessary.

20. A perpetual inventory must be verified by physical count weekly, and must be verified on a quarterly basis at a minimum, independently by a third party (i.e., the plant manager or office staff).

21. Only explosive materials purchased by Martin Marietta shall be stored in Martin Marietta magazines.

22. Facilities, such as trailers and bins, used to store blasting agents shall be posted with the appropriate placards or other appropriate warning signs that indicate the contents. All signs must be visible from each approach. Any trailer storing ANFO or other blasting agents must have a kingpin-locking device on the fifth wheel, as well as one steel padlock for each door (which need not be protected by a steel hood). The lock must have at least 5 tumblers, and a case-hardened shackle of at least 3/8-inch diameter. Bins storing blasting agents must have locks on the feed device, hatches, discharge and ladders.

23. Areas containing day boxes shall be posted with the appropriate 50-foot warning signs. This type of storage must also be emptied at the end of each day and never left unattended.

24. Any magazine, powder house, cap house, storage facility or blasting agent trailer relocation shall be reported to Explosives Engineering, BATFE, and any required state or local agency. Remember that all storage facility locations and magazine types are recorded on the federal explosives permit, and on file with BATFE or the respective state, foreign and government agencies.

6200. Transporting Explosives to the Shot

1. Explosive materials shall be transported on company-controlled property in company-approved vehicles, or trucks provided by the explosive supplier. No loaders or dozers shall be used for transporting explosives.

2. The vehicle used must be in safe operating condition, equipped with two 10-pound multipurpose dry-chemical fire extinguishers and have “EXPLOSIVES – DANGER” and “NO SMOKING” signs displayed on the front, rear and both sides.

3. Explosives shall be transported in the rear storage compartment or cargo space of the vehicle. The cargo space shall be free of all spark-producing tools, or other extraneous items, and lined with a non-sparking material.

4. The top height of the load (boxes or bags) shall not be higher than the sideboards or tailgate of the vehicle being used.

5. Explosive materials shall not be transported on public roads in company-owned vehicles.

6. Detonators may be transported in the same vehicle with other explosives, provided that they are separated in a separate compartment from the other explosive material by 4 inches of hardwood attached to the vehicle, or in a properly designed IME box.

7. A vehicle transporting explosives shall be attended at all times, and secured while parked by having the parking brakes set and the rear wheels chocked.

8. A vehicle transporting explosives shall take the most direct low-traffic route between the magazine and the Blast Site, and make no stops at other facilities, such as shops or employee buildings.

9. Smoking, or the use of electronic cigarettes ("vaping"), is not permitted within 50 feet of a vehicle loaded with explosives.

6201. Drilling

1.The driller shall inspect the shot area and blast face, prior to drilling, for the following hazards:

a. Unstable bench areas that will not support the weight of a drill;

b. Rock overhangs that present a danger of collapse; and

c. Electric lines that could pose a hazard through contact with drill boom, frame or carriage.

2. Drilling is not allowed within 50 feet (30 feet if barricaded) of a loaded or partially loaded blast hole, or any explosive material.

3. When drilling a boulder that is in the muckpile, ensure that the rock is in a stable position.

4. Drills shall not be positioned in unstable face areas where rockslides from the bench could cause injury to personnel or damage to equipment.

5. It is sound practice to leave, at minimum, a 20-foot catch bench underneath any dead (permanent) wall. This establishes an apron or buffer zone that decreases the chance of rock falling on personnel and/or equipment working on a lower bench.

6. Drill holes must be checked the day before scheduled blast hole loading so that re-drilling or re-opening may be conducted.

7. Angle or inclined drilling is not permitted unless approved by Explosives Engineering and the production manager. Angle holes must be profiled and bore tracked prior to loading.

8. Be alert to ground conditions. Personnel and equipment shall not work underneath loosely appearing mud, dirt, rock or large boulders where there is no buffer or safety zone to protect personnel from a hazardous slide.

9. Drillers shall maintain accurate drill logs indicating hole depth, rock changes, voids, anomalies and hole positions, and shall provide copies of the drill logs to the Blaster-in-Charge before blast hole loading commences. Drill logs shall be retained on file with their respective blast reports, and should be periodically reviewed by site management.

10. Drillers shall use safety lines and belts when drilling face holes, and/or within 10 feet of stable crest area, while working outside of the drill cab.

11. The practice of drilling face holes at night is not recommended.

12. Drillers shall move all drill equipment out of the immediate Blast Area prior to blasting, to ensure against flyrock damage.

13. Any unusable or partially drilled hole that cannot be loaded must be properly stemmed with stone as if it were a loaded hole, and noted on the drill log.

6202. Underground Blasting

1. Surface procedures for storing, transporting and using explosive materials and reporting misfires apply to underground blasting as well, unless indicated otherwise. Use appropriate district forms and/or CORE for reporting underground misfires to Explosives Engineering.

2. Short, modified blast reports may be used for documenting the type and quantity of explosives used, and the location of every underground face event. However, underground floor/bench blasts shall be recorded on the standard Martin Marietta Blasting Report.

3. All blasting operations shall be discontinued at the first approach of a thunderstorm and shall remain suspended until safe conditions are restored, as determined by visual observation, internet review or other suitable method. Personnel and equipment shall be evacuated from the Blast Area, and that area barricaded against unauthorized entry. A designated person on the surface shall be responsible for notification of all underground personnel of the storm conditions.

4. The Blast Area underground may be defined as that area influenced by gases, moving rock or debris resulting from a blast that could result in personal injury or equipment damage.

5. Pneumatic hoses for loading ANFO shall be static resistant (semi-conductive), as indicated by a distinct stripe along the length of the hose.

6. Never tamp directly on an explosive primer assembly.

7. Electric pumps and welding machines shall not be used within 100 feet of an underground Blast Site containing electric caps. Welding and cutting is prohibited within 50 feet of any Blast Site.

8. All electric and electronic cap circuits shall be checked for continuity and resistance upon completion of loading face rounds. When loading floor/bench shots, all electric and electronic caps must be checked before stemming is introduced. All non-electric floor/bench shot surface connections must be taped to verify connection and to guard against misfire.

9. Special care shall be taken to keep detonators and explosives separate while loading from the powder truck basket.

10. In underground storage, the same standard for housekeeping, security and record-keeping is required as in surface magazines.

11. During shift changes, the responsibility for all explosive materials in the charge of the shift-ending Blaster shall be turned over to the beginning-shift Blaster by physical acceptance with appropriate entry into the explosive record form. Otherwise, the explosive materials should be returned to the magazines with due entry.

6300. Explosives on the Blast Site

1. When explosive materials or initiation systems are brought to the Blast Site, the area shall be barricaded and posted or flagged against unauthorized entry.

2. Explosives on the Blast Site shall be attended to at all times.

3. Detonators shall be brought to the Blast Site in their original containers or in company-provided wooden boxes with the lids closed. **No other material shall be carried in a container with detonators or blasting caps.**

4. Detonators shall be kept separate from other explosives until loading begins. The detonators may be distributed at each hole to ensure proper delay sequence, but shall be kept at least 18 inches apart, and/or on opposite sides of the borehole from any explosives material when placed at the hole.

5. Packaged blasting agents, water gels and emulsions may be stacked at the boreholes during loading.

6. Primers shall not be placed by the blast hole, but loaded into the hole immediately after being assembled. (Remember that a primer is an assembly of a detonator and a unit of explosive.)

7. No explosive material, including small cast primers or detonators (blasting caps) shall be carried in personal clothing or pockets.

8. Cell phones should be kept a minimum of 150 feet from the Blast Site.

9. When electric detonators are utilized within a blast, the use of two-way radios is prohibited within 150 feet of the Blast Site.

6301. Bulk Explosives Loading

1. Bulk explosive materials shall only be discharged into blast holes or non-sparking containers such as cardboard boxes or plastic pails, and not on any terrain surfaces, or waters, on quarry property.

2. Fuel or chemicals shall not be allowed to spill from the bulk truck.

3. Washing of non-company-owned bulk explosive trucks is prohibited on company property. Washing of mud and clay from truck wheels is permitted and encouraged.

4. All bulk explosive material delivery systems, such as bulk trucks, shall have properly-functioning metering devices that can indicate fuel blend, volumes and explosive loading weights.

5. The Blaster-in-Charge should pre-determine the amount of explosives to be loaded in each hole prior to loading any blast holes.

6. The bulk truck operator or Blaster-in-Charge shall keep a record of the amount of materials used in the shot, and at a minimum, document the typical hole loads used within the shot.

7. The Blaster-in-Charge, or designated assistant, shall continually tape each hole while auguring or pumping explosive product to monitor column rise.

8. If using a gassed emulsion product, multiple sampling is required to ensure proper product performance. Copies of density samples should be included with shot report documentation.

9. When using a pumped product, placing the product hose to the bottom of the hole is the recommended method for loading either a wet or dry hole.

10. All contractor-supplied bulk trucks shall be weighed upon entry into the quarry before blast loading begins, and after loading has been completed, to ensure accurate weights. Extra trips to the scales may be necessary if different product densities at varying costs are used such that weights cannot be verified by metering devices.

11. Bulk delivery trucks shall be maintained in good operating condition, and meet all Martin Marietta, state and federal mine safety standards.

12. Safety relief valves on bulk truck pump systems shall be in proper operating condition and of the correct pressure rating. Continually rupturing relief valves or hoses indicates serious mechanical

problems and potential safety hazards. Expedient repairs by Martin Marietta employees are not authorized.

13. No personnel are allowed to work underneath bulk truck discharge booms.

14. Shot-loading personnel shall not work in the space between the bulk truck boom loading the first row of holes and the free face, since a falling or swinging boom could cause someone to fall off the high wall.

15. Bulk trucks shall not pass over any holes loaded with explosive materials, and no part of the vehicle shall be allowed to come in contact with any explosive materials or initiation systems on the Blast Site, or around any loaded or partially loaded blast hole.

6302. Loading the Shot

1. The Blaster-in-Charge shall conduct an inspection to ensure safe working conditions before explosive loading begins, and shall certify on the shot report that the Blast Site was inspected and determined safe.

2. Refer to the drill log on each hole as to depth, soft seams, cracks, loose rocks and any problems encountered.

3. Access to the Blast Site shall be barricaded or otherwise controlled in a manner that prevents unauthorized entry. Entrance points into the Blast Site should be posted with warning signs such as "Danger," "Explosives" or "Keep Out."

4. All work during loading shall be supervised at all times by a qualified Blaster-in-Charge. When a Blaster-in-Charge provided by the explosive supplier is loading a shot, a Martin Marietta employee knowledgeable of all company rules and regulations relative to explosives shall be in the Blast Area at all times, and will periodically check in with the Blaster-in-Charge. The plant manager may authorize an individual to work within the Blast Area based on the employee's knowledge of *Martin Marietta Blasting Rules and Regulations* and his/her explosives experience and training.

5. Explosives shall not be handled during the approach or progress of an electrical storm, and all persons in the Blast Area shall move immediately to a safe location. Under no circumstances shall anyone remain in the Blast Area after thunder or lightning is observed.

6. Only persons knowledgeable of *Martin Marietta Blasting Rules and Regulations*, and authorized by the plant manager, shall be allowed on the Blast Site.

7. Whenever possible, shot loading should commence from the front of the shot at the free face, proceeding to the rear. Loading in this manner allows for shot loading to be terminated, if needed, and the shot fired.

8. Personnel or equipment shall not work in an area where a blast is being loaded closer than 50 feet (30 feet when marked by a barrier) unless such activity is directly related to blast loading.

9. When explosive materials have been loaded into blast holes on a bench, the same 50-foot and 30-foot rule shall apply with respect to muckpile digging. No loader, shovel or excavator operation shall occur within these Blast Site perimeters in front of the face wall being loaded.

10. All blast holes shall be checked to determine the need for clearing of obstructions or re-drilling before loading commences. No drill is allowed on the Blast Site once loading begins.

11. Primers shall be assembled only at the hole where they are to be used and immediately loaded into the hole.

12. A blast hole with an electric or electronic detonator shall be checked with the proper instruments prior to stemming or decking. The completed series is checked one final time with the proper equipment, before leaving the Blast Site and wiring the series back to the blasting house.

13. An approved Blaster's Galvanometer or Blaster's Multimeter shall be used to test electric detonators. A STANDARD ELECTRICIAN'S MULTIMETER CAN DETONATE AN ELECTRIC CAP, AND IS FORBIDDEN. If using electronic detonators, testing must only be completed with the respective manufacturer's test equipment and procedures.

14. All non-electric surface connections must be taped to verify connection and to guard against misfires.

15. Priming ANFO shall not be attempted with a blasting cap only.

16. Blasting agents shall be primed strictly in accordance with the manufacturer's recommendations. The use of a 1/3-pound cast booster should not be used for priming, unless dictated by hole size.

17. Tamping and dislodging of bridged or hung explosive material shall be done only with non-sparking or wooden loading poles.

18. Primers shall not be tamped or forced past any obstruction in a hole. Stemming material shall also not be tamped.

19. Only non-sparking material such as brass, lead or aluminum shall be put into a charged blast hole. Only cloth or plastic tapes with lead or brass plumb weights shall be used to measure blast holes after explosive materials have been introduced.

20. Unused explosives shall be returned to magazines as soon as practical after loading and before firing the blast.

21. Records shall be kept of the amount of materials used in each shot and, at a minimum, documentation shall be made of the typical hole loads used within each shot.

22. When pouring, pumping or auguring explosive materials, column rise shall be checked continuously. Loading shall be discontinued if there is little or no buildup of explosives in the borehole, and corrective action taken, such as decking through the no-rise area. **Remember that such a condition can produce wildly violent flyrock if special techniques to ensure blast control are not used.**

23. Only persons authorized by the plant manager shall be allowed on the Blast Site.

24. Blast Sites where loaded holes await firing shall be guarded or barricaded against unauthorized entry, in accordance with all state and federal regulations. **Do not leave the Blast Site unattended.**

25. Upon completion of loading and connecting of circuits, firing of blasts shall occur without undue delay.

26. Any blast holes into which explosive material has been loaded shall not be dewatered.

27. Passing of trucks, loaders or other equipment over loaded holes shall not be permitted. In no case shall any part of equipment (wheels, track or body) come in contact with, or put pressure on, any explosive material, detonator leg wire, shock tube or any part of a charged blast hole.

28. Packaged explosives or blasting agents exceeding 4 inches in diameter shall not be dropped on the primer assembly except where covered by water to a height equal in length to the dropped stick.

29. Blast holes shall be double-capped when exceeding 30 feet in depth, unless approved by Explosives Engineering and the production manager.

30. Areas in which loading is suspended, or shots await initiation, shall be attended and barricaded against unauthorized entry.

31. If a stemming vehicle is used on the Blast Site, the operator shall be assisted by a spotter to direct vehicle movement to avoid running over any blast holes, cap wires, cap tubing or explosive materials.

32. Never shoot a series of toe holes with a production shot. A misfire could occur and in the event an Air Overpressure (dB) or Vibration PPV (in/s) level is exceeded, segregation of blast events allows for a quicker investigation. They should be shot as two separate events with appropriate shot and seismic reports. If questions arise, contact Explosives Engineering.

33. The FAA has ruled (14 CFR, Part 107) that a small unmanned aircraft (i.e., a drone) shall not operate over any persons not directly involved in the flight operation. Due to the evolving nature of UAV (unmanned aerial vehicle) technology and oversight, drones operating within Martin Marietta shall not be operated directly over a blast that is loaded or a Blast Site where loading is under way or explosive materials are present. Additionally, a drone shall not be operated within 150 feet of a loaded shot until after the Blast Area is clear and the warning signal has been given.

6303. Firing the Shot

1. Warnings shall be posted at highly visible entry points to the Blast Area and/or quarry, fully describing the blasting signals. While the use of standard Martin Marietta signals is recommended, specific warnings or signals may be required by local practice or regulation.

Recommended Signals:

a. Blast Warning Signal: A series of short siren blasts lasting a total of one to two minutes. The blast shall be initiated two minutes after the end of the warning signal.

b. All Clear Signal: One long siren indicating that the blasting activity has been completed, and that it is safe to return to the pit or former Blast Area.

c. Cancelation Signal: A rapid series of short bursts of a siren signaling the shooter not to fire. Radio communication with the shot-firer can also be used to cancel the shot.

2. The Blast Warning Signal shall be sounded only after ample time has been allowed to accomplish the following security measures in the Blast Area:

a. All equipment has been moved to a safe location.

b. All personnel have been warned of the planned blast, and cleared from the Blast Area.

c. All access routes leading into the Blast Area have been guarded or barricaded to prevent entry of persons or vehicles.

d. A clear and unobstructed exit route has been provided for the shot-firer.

e. An approved blasting shelter has been properly positioned, or a safe remote firing location has been determined.

3. After the Blast Area has been cleared, the Blaster-in-Charge and/or shot-firer must be able to communicate by radio with the individuals designated to clear and guard the Blast Area in order to maintain the security and control of the Blast Area. Only rely upon positive confirmation as an acceptable means of verifying security of the Blast Area.

4. The initiating device shall not be connected to the blasting circuit until the warning signal has been sounded and a final check of blasting circuits is complete.

5. The Blaster-in-Charge and/or shot-firer shall ensure that the Blast Area continues to be secured, being sure to maintain communication with blockers up until immediately before initiating the blast.

6. The shot may be fired two minutes after the warning signal is completed if the Blast Area is secure, the blasting and initiation systems properly checked, and the cancellation signal has not been sounded.

7. The all-clear signal shall be sounded only after the shot-firer has inspected the blast site to ensure that the blast was initiated as planned, smoke and dust have subsided, and no hazards such as potential rock fall exists in the work area.

8. All surface shot firing shall be conducted from an approved blasting house. If utilizing a remote firing system from an appropriate and safe location, adequate distance can be substituted for physical shelter.

a. Explosives Engineering shall approve blasting house design and construction.

b. The blasting house shall be located at least 200 feet generally in the opposite direction of intended shot movement, behind the blast and never to the front.

c. The blasting house shall never be located in view of the free face of the Blast Site, or at a point from a direction in which flyrock from the free face could travel.

d. The blasting house shall not be located near a face or high wall where a slide, or injury from falling or bouncing rocks may occur.

e. The blasting house shall not be located within 200 feet of an overhead electric transmission line, underground gas pipeline or fall zone of a large pole or tower.

9.If a blast must be allowed to sleep overnight:

a. The Blast Site shall be secured with barricades such as traffic cones.

b. The production manager and Explosives Engineering shall be informed.

c. A guard shall be positioned in view of the Blast Area to protect continuously against unauthorized entry. The guard shall be familiar with *Martin Marietta Blasting Rules and Regulations* concerning the safety and use of explosives.

d. MSHA must be notified if the blast is delayed more than 72 hours.

10. No surface blast shall be fired after dark, or at any time where there is not sufficient visibility to view the entire Blast Area. This includes instances of dense fog, heavy rain, snow or smoke, among other conditions.

11. Blasting, either surface or underground, shall not be conducted on weekends. A variance may be requested through the production manager and Explosives Engineering.

6304. Misfires

1. Only experienced persons approved by Explosives Engineering and/or the production manager shall handle misfires. Faces and muckpiles shall be examined for misfires after each blast. When a misfire is suspected, all personnel shall stay out of the Blast Area for:

a. 30 minutes when cap-and-fuse is used;

b. 15 minutes when utilizing non-electrics or electrics; or

c. In the case of electronic detonators, follow the manufacturer’s recommended wait time, with a

minimum of 15 minutes.

2. Procedures for clearing a misfire are as follows:

a. If **small amounts of explosive materials** are found:

i. Alert your immediate supervisor and Explosives Engineering.

ii. Retrieve un-detonated products and return to the magazine or supplier.

iii. Communicate to loader/shovel operator and primary crusher operator, and instruct them to watch for explosives in the process stream.

iv. Inform the explosives supplier.

b. If **large amounts of explosive material** and/or live charges are found in an otherwise normal-appearing muckpile, the following actions shall be taken:

i. Access to the misfire location shall be restricted by barricade at least 50 feet around the suspected misfire, and only the minimum number of personnel that can safely handle the situation shall be allowed to enter the area.

ii. The shovel or loader shall be stopped immediately from digging in the shot in which such a misfire appears to have occurred.

iii. The plant manager, production manager and Explosives Engineering shall be immediately notified.

iv. Digging shall not be resumed until the following steps have taken place, and the production manager and/or Explosives Engineering gives approval.

1. A safety glass (i.e., ½-inch Lexan) and screen shall be attached to the windshield of the loading unit.

2. An explosives technician, or person designated by the production manager and/or Explosives Engineering, shall be present at all times while digging into the shot.

3. The loader operator and other recovery personnel shall have an established two-way communication protocol.

v. All employees not required to work on the misfire shall be prohibited from the area.

vi. The loader shall not dig directly into the front of a misfired hole, but from the sides.

vii. The drivers of the trucks to be loaded shall back their trucks into the muck pile, and park in such a way that the rear of the truck protects the driver from the shot. The driver of the truck shall remain in the cab, and shall not lean from the cab to watch the operation.

viii. If any explosive material is observed mixed with shot rock in the bucket or truck bed, that material shall be retrieved or carefully dumped and sorted near the Blast Site, and unexploded products removed for safe disposal.

ix. Un-detonated explosive products shall not be left unguarded.

x. Explosive materials recovered from a misfired shot shall not be re-used as primary products, but should be picked up by the supplier or disposed of as directed by Explosives Engineering.

xi. Primary crusher operators and plant personnel shall be instructed to keep a close watch for explosives. If any explosives are seen in the feeder, crusher or on the screens or conveyors, the equipment must be stopped immediately and the plant manager and Blaster-in-Charge notified to undertake proper retrieval and disposal.

c. If a **major misfire occurs** (i.e., all or part of a blast did not detonate), the following actions shall be taken:

i. The all-clear signal shall not be sounded.

ii. All personnel must stay out of the Blast Area for the amount of time prescribed in 6304.1.

iii. Access to the Blast Area shall be guarded and barricaded.

iv. The plant manager, production manager, Explosives Engineering and explosives supplier shall be notified.

v. All electric or electronic detonators and circuits that are intact shall be checked with the appropriate testing devices. If a non-electric initiation system was used, a visual check shall be made of all surface detonators and lines.

vi. If a sequential timer was used, the entire sequential system should be checked both visually and with the appropriate test equipment.

vii. Careful consideration must be given to determine if any holes are unburdened, or under-burdened, such that they could produce flyrock if re-fired. If part of the wall of the blast is not intact, a possibility exists for hazardous rock throw. Explosives Engineering shall advise management whether or not the shot can be safely re-fired.

viii. The misfired Blast Site shall not be re-drilled without authorization by the production manager and Explosives Engineering.

ix. If re-firing is not acceptable and neutralizing or retrieving of explosives is not possible, then digging the muckpile may be the next course of action.

x. If digging is authorized, steps outlined in paragraph 6304.2.b shall be followed.

6305. Prevention of Misfires

1. To avoid misfires with all initiating systems, know the rules, follow the rules, use good blasting practices and be aware of the causes of misfires. The following are the most frequent causes of misfires, and the related practices to avoid their occurrence:

a. Defective Wiring System. Thoroughly check, both visually and with test equipment, the blasting machine, firing cable, terminal board, electronic loggers, electronic blasting machines and all connections. Strictly follow initiation equipment manufacturer's recommendations.

b. Slumping Holes Breaking Detonator Leg Wires or Shock Tube. Test each detonator and measure each hole for this condition before stemming is introduced. Sometimes an extra primer may be required. If stemming has been completed, and a cut-off is evident, it shall be necessary to remove the stemming to re-prime.

c. Detonators Not Connected to the Circuit. Visually check electrics and electronics by walkthrough, and counting of all connected blasting circuits by the Blaster-in-Charge. For non-electrics, follow the procedure for taping all surface connections.

d. Bare Wire in Water. Keep all bare wire connections out of water and off damp ground. Make certain that the firing cable, terminal boards, wiring harness and electronic clip connections are in good condition, and that moisture cannot enter the internal wiring circuit. If any damage is apparent to the board or cable, return to the manufacturer for repair or replacement.

e. Poor Wire Connections or Broken Cap Wire. Visually inspect all tie-ups and test each circuit

with proper test equipment. Know how to calculate circuit resistance of each circuit. **Double-cap all holes exceeding 30 feet in depth.**

f. Inadequate Power Source. Know the energy capacity of your electric blasting machine and stay 20 percent below rated capacity. When using an REO sequential blasting system, if charge-up time takes longer than 25 seconds, do not attempt to fire before replacing batteries. If there is any question on hook-up or expected performance, or equipment appears damaged, do not attempt to fire. Strictly follow the manufacturer's operating procedures. **Take no shortcuts**!

g. Non-Electric Surface Cut-Offs. Follow manufacturer's instructions explicitly. Take precautions when stemming so that the shovel blades do not strike any part of the non-electric trunk line. Remember that the only method of checking this system is visual, so carefully inspect your hookup and tape all surface connections. Always use redundant surface connections between rows. Follow manufacturer recommendations for the maximum number of shock tubes that are permitted in each surface connection block.

h. Current Leakage. Abraded wires in wet conditions usually cause this. Handle all detonator wires carefully. Use a Blaster's Galvanometer or Blaster's Multimeter to check for leaks in electric systems, and limit the number of detonators per circuit if current leakage exists. For electronic systems, test with the required manufacturer's equipment for leakage. Do not tamp stemming, as this will cause wire scrapes and breaks. Review the Blaster's Multimeter instructions on how to check for current leakage.

i. Explosive Product Failure. Do not use any explosive product if it appears defective or substandard. Remember that detonators that are deformed, over-aged, have bare wire or show signs of nicked/cut shock tube may misfire. Ammonium Nitrate without a minimum of 6-percent diesel fuel, emulsions that are crystallized and hard, and water gels used at low temperatures may not detonate as designed. All emulsions and water gels rarely have a shelf life exceeding one year and become less sensitive to detonation with age.

j. Poor Timing/Delay Practices. In sequential electric blasting, if all circuits are not energized, the possibility exists for rock motion to cut off an un-energized circuit, thus causing a "shut-down" or misfire. Only F.A.S.T. (Fully Activated Sequential Timing), not P.A.S.T. (Partially Activated Sequential Timing) shall be used. It is strictly required at Martin Marietta for all sequential blast circuits to be fully energized before the first charge detonates. **Care shall be taken to ensure that the correct settings are selected on the sequential blasting machine.** In non-electric blasting, care should be taken in designing the timing sequence of the shot in order to minimize the likelihood of a cut-off due to material movement. The use of longer in-hole delay periods, which have a greater amount of cap scatter, is not recommended. The use of dual control rows in a blast design is not recommended.

6306. Blasting in a Primary Crusher

1.The use of explosives to clear "blocked" impact crushers should be avoided. However, if no other reasonable solution is available, the use of explosives will be allowed if the following procedures are followed:

a. A cap-sensitive high explosive that is capable of performing below zero degrees Fahrenheit must be used in small quantities (¼ to ½ pound).

b. A full-strength non-electric detonator, no less than 60 feet in length, must be used in conjunction

with a hand-held non-electric starter.

c. All explosives must be kept in an approved magazine as defined by MSHA and BATFE standards. A day box meeting BATFE construction standards may be used to temporarily store the small amounts used during the day or to be transported to the crusher. All unused products must be returned to the magazine at the end of the work shift, and inventories properly adjusted.

d. All plant and loading operations within the Blast Area must cease, and all non-essential personnel must be cleared beyond the designated Blast Area prior to initiation.

e. A blasting house or equivalent protection must be provided to the Blaster-in-Charge. Any personnel in the Blast Area must take protected cover to protect against flyrock.

f. Blast warning signals and all-clear signals must be sounded as is done for production blasts.

g. A blast report showing plant location, date, time and quantity of explosive materials used must be filled out after each blast.

6307. Blasting During Approach of Electrical Storms

1.All explosive materials, including all types of initiation systems, are susceptible to premature initiation by lightning. The following practices shall be observed while blasting upon approach of an impending storm:

a. Ensure someone is responsible for monitoring local weather conditions. Notify all site personnel that blasting operations are in progress, and ask that they report thunder/lightning to the foreman or other person that will notify the blasting crew. This is particularly important in underground mines or deep pits where surface weather conditions are not easily apparent.

b. Because thunderstorms tend to occur in the afternoon, schedule blasting to be completed in the mornings, if possible. Be aware of potential temperature inversions.

c. When it is determined that a storm is imminent (i.e., a threatening cloud seen, thunder heard or lightning observed), evacuate all personnel from the Blast Area to a position of safety immediately, regardless of the type of initiating system being used. Move the explosives truck off the Blast Site and to a safe location if time permits with the approaching storm. If possible, park the truck at the nearest explosive magazine. If there is no magazine at the quarry, make sure the truck is away from the office, shop, plant and all personnel. Keep access to the Blast Area and storage area secure until the storm passes.

d. Regardless of initiation system type, the Blaster-In-Charge should not begin tying-in until the shot is completely loaded. However, if a storm is imminent and the tying-in of the shot has begun, if time allows, open closed wire loops in the blasting circuit and re-shunt individual electric or electronic detonators, being careful to keep all bare wire off the ground. In the case of non-electric initiation, disconnect any surface connections if time permits. The control row connections should have priority for disconnection when time is critical.

e. After the storm has passed, resume standard wiring or hook-up procedures.

f. Underground blasting shall be suspended, and all persons withdrawn from the Blast Area to a safe location during the approach and progress of an electrical storm.

6308. Flyrock

1. Flyrock resulting from uncontrolled blasts is the number one cause of blasting-related death, injury and property damage. A variety of factors such as shot design, geology and explosive loading practices at the Blast Site determine whether or not flyrock will occur. Flyrock may result from any one, or a combination of, the following conditions.

a. Overloading of Holes. This issue is especially dangerous and cannot be tolerated. Normal powder factors shall be maintained at all times. The use of a measuring tape in every hole to measure column rise is essential. Be particularly careful during bulk loading operations, because rapid column buildup is characteristic of auger and pumping operations.

b. Insufficient or Inadequate Stemming. Too little and/or poor quality stemming can lead to flyrock. Make certain that each hole is properly stemmed with appropriately sized clean crushed stone. When determining proper stemming height, a recommended **rule of thumb** is to use 25 times the borehole diameter (i.e., 25 x 4 inches = 100 inches or approximately 8 feet). Another **rule of thumb** is no less than 70 percent of the burden. Unused boreholes within a shot should be filled with stemming material to prevent explosive gas venting. Particular attention must be given to all stemming heights on all free face holes (front row holes).

c. Lack of Burden. If the distance from a borehole to the free face is insufficient, excessive flyrock from the face may occur. Front row minimum burden distances should be carefully monitored. Use setback marks, measure front row burdens and decrease the explosive load in thin burden areas of the wall. Normal powder factors shall be maintained within the hole at all times. A **rule of thumb** for determining a minimum burden is 2 times borehole diameter (express the borehole diameter as feet -- for example, 2 x 4 inches = 8 feet)

d. Excessive Burden. Too much burden can create excessive upward displacement of rock being blasted. Rather than the rock collapsing in sequence upon itself, it will follow the path of least resistance upward or to the back of the shot. This is also referred to as “cratering.” Setback marks, measurement of burdens and spacings, and proper hole locations are essential.

e. Improper Delay Patterns. Improper hole delaying can render any shot dangerous and unpredictable. Proper delay sequences are essential for desired fragmentation and rock movement. Pay close attention to the delay design. A reasonable **rule of thumb** when using electric or non-electric detonators is not to allow less than 8 milliseconds between any two adjacent fully-loaded holes, or less than 42 milliseconds between rows. Never allow a higher delayed hole to detonate in front of a lower delayed hole, unless specifically intended for shot design purposes.

f. Weak Geological Rock Structures. Weak areas such as cavities, cracks, joint planes and clay seams can produce violent and uncontrolled rock throw. **The Blaster-in-Charge must begin every blasting operation by reviewing the provided drill log concerning the depth, condition and position of each hole, and carefully inspecting the face for signs of incompetent rock or seams.** Decking can be used to reduce powder factor and as a method to control rock throw.

g. Inadequate Communication. Documented and verbal communication throughout the drill & blast process is critical to flyrock risk management. The communication of any changes in the process or design is especially important for ensuring that desired results are safely achieved.

h. Filming of shots is required, and can be used as a tool to recognize and prevent a future flyrock situation.

6309. Electric Blasting

1. Never mix detonators of different manufacturers in a blast.

2. Do not operate a welding machine or any other electric motor within 100 feet of an electric detonator. Do not use electric caps within 100 feet of power lines, electric dragline cables or electric motors without authorization from Explosives Engineering.

3. Portable radio equipment, such as two-way radios or cellular phones, shall not be operated within 150 feet of the Blast Site.

4. When blasting within 1,500 feet of radio transmission towers, contact Explosives Engineering.

5. When blasting within 500 feet of high power electrical transmission lines or gas pipelines, contact Explosives Engineering.

6. Keep all detonator leg wires shunted until ready to check the detonators with a **Blaster's Galvanometer** or **Blaster's Multimeter**. After checking the detonator, twist the bare ends together until ready to be connected to a circuit.

7. When wiring the blast, keep all connections, splices, and bare wires off the ground and out of water.

8. Keep all cap wires and connecting wires, whether insulated or not, from contact with any metal objects, such as drills, vehicles, and air or water lines. Do not allow spliced connections to come in contact with one another or to allow one series connection to cross over another when running the series to the circuit board.

9. No one, except the Blaster-in-Charge or persons designated by the Blaster-in-Charge, shall be allowed to walk over the Blast Site after an electric shot has been wired. **Hookup is not to begin until hole loading and stemming is completed and the Blast Site is cleared of vehicles, equipment and nonessential personnel.**

10. Blasting machines shall be tested in accordance with the manufacturer's recommendations before loading begins at a safe distance from any explosive products or the Blast Site.

11. Always use an approved Blaster's Multimeter or Blaster's Galvanometer to check the resistance of electric detonators and electrical blasting circuits. **Never us an electrician's Multimeter on electric detonators.**

12. All electric detonators must be checked with a Blaster's Multimeter or Blaster's Galvanometer before stemming the blast holes.

13. When potential conditions exist for stray electric currents, check the future Blast Site with a Blaster's Multimeter. If stray current is present, find and eliminate the source or use a non-electric initiation system.

14. Immediately before wiring the circuit to the blasting machine, and after hookup has been completed, the Blaster-in-Charge shall "walk the shot" to inspect and double-check all connections, and conduct a count to ensure all detonators are connected.

15. The blasting machine must be stored in a secure area separate from all explosive materials and blasting caps, and shall not be brought to the firing point until immediately before time of use.

6400. Sequential Blasting

1. The sequential timer and associated equipment must be checked before shot loading begins.

2. The sequential timer should be checked at least annually for energy output and circuit timing accuracy with a BTU 300-10 tester.

3. New batteries shall be installed in the sequential blasting machine when the charging time exceeds 25 seconds. **Do not** attempt to fire a sequential timer if the charge time exceeds 25 seconds. A misfire may occur.

4. When using a sequential timer to initiate a blast, the timing shall be such that the first hole in the shot does not initiate until all the circuits (series) are energized. This follows the principle of F.A.S.T. (Fully Activated Sequential Timing).

5. Sequential blasting cables shall be carefully inspected before use, and taken out of service if found defective. The use of short blasting cables (2 to 10 feet) with appropriate length 20-gauge connecting wire connecting to the terminal board is recommended.

6. Damaged circuit boards shall be discarded or returned to manufacturer, or an approved service facility, for repair.

7. When designing a blast, do not exceed 80 percent of the resistance capacity of the sequential timer in any series or circuit. For example, in an REO BM-125, one should not exceed 100 ohms. When using an REO BM-175, one should not exceed 140 ohms in any single circuit.

8. A spare circuit board and short cable shall be kept at each quarry for backup use, in the event of damage to the board and/or cable.

6500. Non-Electric Blasting

1. Non-electric detonators shall be used strictly in accordance with the manufacturer's recommendation. Never mix detonators of different manufacturers in a blast.

2. It is generally required to use non-electric systems if electrical equipment such as pumps, compressors, power lines or transformer stations exist within 100 feet of the Blast Site (see section 6309).

3. The non-electric starter and shot shell primers shall be stored in a secured area separate from all explosive materials and detonators, and not removed until immediately before use. Ensure the starter is always maintained in a clean condition.

4. Connection of non-electric systems shall not begin until blast hole loading is complete and the Blast Site is cleared of vehicles, equipment and non-essential personnel.

5. Special attention shall be paid to non-electric systems with the delay caps on the surface ends of dual-delay detonators. These surface delays are exposed during loading and must be carefully avoided by vehicles, equipment and tools.

6. All surface connections between rows shall be twin-path (redundant) to guard against initiation failures.

7. After the blast has been tied in, all surface connections must be taped and counted to visually verify each connection.

6501. Electronic Blasting

1. Electronic initiation systems require a specially-coded digital signal to initiate the detonator, thus providing a level of increased safety over conventional electric or non-electric detonators. This digital code is provided by a specially-designed blasting machine. Do not attempt to mix detonators, or use

a tester or blasting machine from different manufacturers.

2. Electronic detonators provide a level of micro-second accuracy to the initiation sequence which will consequently, with proper site-specific design procedures, result in significant benefits to blast performance, vibration reduction and air over-pressure control. The accuracy of the electronic detonator is based upon a computer chip, so care must be taken, as with all detonators, not to expose it to any abuse. Due to the evolving nature of programmable electronic technology, any performance issues should be reported to the manufacturer and Explosives Engineering. "Pre-compression" failures of electronic detonators have been recognized, and occur due to extremely high borehole pressures from adjacent holes. Be sure to follow all manufacturers' guidelines on care and use.

3. If a blast must be aborted due to a non-communicating detonator, or the identification of an unscanned unit, follow the manufacturer's prescribed wait time before attempting to re-enter the area and correct the problem. Every reasonable attempt must be made to correct a non-communicating detonator before shooting.

4. If a misfire does occur with an electronic initiation system, personnel must be kept out of the blast area for the manufacturer-recommended amount of time, or a minimum of 15 minutes (whichever is greater).

5. As with all initiation systems, do not make any connections to the Blasting Machine until the Blast Area is clear. Some blasting service providers utilize a "Remote Firing System." This is a unique system that allows the shot-firer to view the entire Blast Area, but care is still required to ensure the Blast Area is clear and all individuals are protected.

6600. Drilling Inclined Holes

1. Due to the potential for flyrock accidents associated with inclined holes, the practice of drilling angled blast holes requires that a plan for proper execution and borehole tracking of angled holes has been approved by the plant manager, production manager, and Explosives Engineering (or designee).

2. If angle holes are required, at a minimum, all face holes will be bore-tracked and profiled for safety and accuracy before loading commences.

6700. Basic Blaster's Rules

1. No smoking or open flame is permitted on the Blast Site, or within 50 feet of any explosive material, whether in storage or in transportation.

2. In the event of an explosive fire, do not fight the fire. Evacuate to a safe distance and secure the area.

3. Only approved Blaster's Galvanometers and Blaster's Multimeters shall be used to test electric blasting circuits.

4. Be alert for conditions that might cause flyrock.

5. Observe the drill pattern prior to loading. Study the wall for clay seams, weak burdens, slips, joint sets and cracks.

6. A pre-blast design is required before the shot is laid out or drilled, including hole depth, pattern, designed powder factor, etc., and a copy is to be left onsite and provided to the driller for attachment of the required drill log.

7. Always calculate powder factors prior to loading, and measure burden, spacing and hole depth.

Check the drill log. Talk to the driller about any additional noted abnormalities (e.g., dust escaping to the face area, loss of air return, mud seams or change in cuttings or penetration).

8. Allow yourself ample time to load and fire the shots. Rushing will cause misfires.

9. Check blasting machines and associated equipment prior to loading the shot.

10. Make sure you understand the signal to fire the shot. If in doubt, delay firing.

11. Always have a blasting house at a blasting point at least 200 feet in the opposite direction of the intended movement of the shot, and behind the blast, **NEVER** in front.

12. Complete the shot report before leaving the quarry.

13. Always clear the Blast Site of bags, wire, boxes, hole plugs and extraneous debris prior to connecting up and firing the shot.

14. Keep the number of people to a minimum when loading and connecting the shot. Idle people on a shot can be dangerous.

15. Assign duties to specific people during loading. The Blaster-in-Charge is ultimately responsible for the safety and performance of the shot, and must do the final "walk-through" to confirm proper initiation sequence and hook-up.

16. Be certain stemming is adequate. Avoid using wet or muddy stemming material. Clean crushed stone is recommended.

17. Be aware of weather conditions and be ready to evacuate at the first sign of a thunderstorm.

18. Use common sense. Stay focused on safe blasting. Always have safety as a first priority.

19. Know your limitations. Do not hesitate to ask questions or request assistance.

20. Refer to the drill log on each hole as to depth, soft seams, cracks, loose rocks and any problems encountered.

21. The Blaster-in-Charge shall keep a record of the shot as to depth, type and amount of explosives, water depths and stemming heights.

22. Do not allow any explosive containers to leave the quarry premises unless by the supplier truck.

23. Check all boxes and bags to make certain they contain no explosives before burning.

24. The empty explosive containers may be piled behind the Blast Site and burned after the blast if local burning regulations allow.

25. No explosive material shall be destroyed, except under the supervision or direction of Explosives Engineering.

26. The use of dynamites (NG) is not permitted.

27. "Always and Nevers" should be read by all blasters. Copies of "Always and Nevers" (Do's and Don'ts) can be found in every box of detonator-sensitive explosive products.

28. Do not blast after dark at surface operations, or on weekends unless approved by district management and Explosives Engineering.

29. In bulk truck operations, do not allow fuel oil or explosive material to be discharged onto the ground.

30. Conduct a complete inventory of all explosives products used before the supply truck leaves and an inventory balance is achieved.

31. If explosives products are purchased and stored in Martin Marietta magazines, ensure an accurate "Explosives Inventory Transaction Record" is completed.

32. Maintain compliance with all MSHA regulations, and Martin Marietta internal policies with particular attention paid to fall protection requirements near high wall crests.

33. It is recommended that the Blaster-in-Charge designate a member of the loading crew to don fall protection prior to loading any holes.

34. A fall hazard zone within 10 feet of stable crest should be demarcated by paint or other suitable means (cones, chain, ribbon, caution tape, etc.). Any personnel working within this zone are required to use appropriate fall protection/arrest equipment.

6710. Specialized Blasting

1. Specialized blasting such as pre-splitting, ditch-line shooting, boulder shooting, stream relocation, beaver dam blasting, close proximity blasting or any activity not related to ordinary bench blasting **SHALL NOT** be planned or conducted without the authorization and involvement of the production manager and Explosives Engineering.

6800. Vibration/Air Over-Pressure and Seismograph Use

1. The Blaster-in-Charge shall always be aware that pounds per delay and stemming are major factors in blast design influencing ground vibration and air over-pressure, and are frequent contributors to blasting complaints. In order to protect Martin Marietta from possible legal action resulting from vibration damage claims, the use of a seismograph to monitor blasts is required.

2. Seismic monitoring shall be done at the closest occupied, non-company-owned structure (with property owner's permission).

3. Seismographs shall be calibrated annually.

4. All blast complaints shall be reported on the company provided **Blast Complaint Form** to the production manager and Explosives Engineering.

5. Seismographs are electronic instruments and must be handled with care.

6. Peak particle velocities (PPVs) that exceed 0.50 inches per second, and air over-pressure levels exceeding 127 decibels (dB) must be reported to the production manager and Explosives Engineering.

6801. Blast Complaints

1. Due to public attitudes toward blasting, complaint handling has become a frequent and difficult task in our industry. Since any complaint has the potential to become a lawsuit, it is essential that supervisory personnel (including blasters) be trained to handle complaints. The manner in which a complaint is first dealt with often paves the way to successful or unsuccessful resolution. Explosive supplier representatives and blasting-related consultants are not authorized to make public statements or speak to the public concerning Martin Marietta blasting issues, unless specifically authorized by division or corporate management.

2.In handling blast complaints, the following guidelines shall be followed:

a. Initial Telephone Contact

i. DO:

1. Record on complaint form all details requested.
2. Be a good listener.
3. Be courteous.
4. Encourage complainant to discuss circumstances.
5. Keep an open mind.
6. Suggest a return call or visit by manager.
7. Promptly forward complaint to Explosives Engineering and local management.

ii. DO NOT

1. Argue or become angry.
2. Demand an inspection.
3. Volunteer information.
4. Discuss damage.
5. Take abuse – politely break off the conversation if this occurs.

b. Follow-up Visit/Call Conducted by Explosives Engineering or Local Management

i. DO

1. Review complaint form.
2. Review blast and seismograph records.
3. Review past complaints from this individual.
4. Be prompt for the visit.
5. Be a good listener.
6. Be courteous.
7. Get the facts.
8. Observe all alleged damage.
9. Observe general conditions.
10. Take notes and photographs, and document visit on **Blast Complaint Form.**
11. Suggest seismograph placement on site.
12. Accept their opinions as valid concerns, not facts.

ii. DO NOT

1. Argue or become angry.
2. Volunteer information.
3. Dispute claims of complaint.
4. Accept responsibility for causing alleged damage.
5. Agree to repairs.
6. Tell them “no.”
7. Hesitate to seek additional support from a third-party seismic consultant or Explosives Engineering.
8. Take abuse – politely leave.
9. Visit complainant alone.

6900. Required Reports: When and Where to Send

Type of Report	When Required	Where/Copies to
Blast Report and Seismograph Report	Immediately	As directed by local management
Blast Complaint	Immediately	Plant Manager District Manager Explosives Engineering
Explosives Loss or Theft	Immediately	Plant Manager Production Manager Explosives Engineering
	Within 24 hrs of discovery	BATFE Form 5400.5 1-800-461-8841 1-800-800-3855 *(after hours)*
Flyrock	Immediately by phone	Plant Manager Production Manager Explosives Engineering
Misfire	Immediately by phone	Plant Manager Production Manager Explosives Engineering
Excessive Vibration (>.5 in/s PPV, or >127 dB)	Immediately by phone or email	Production Manager Explosives Engineering
Blast Delay Over Night (sleeping a shot)	Immediately by phone or email	Production Manager Explosives Engineering

Addendum: Short Bench Blasting Guidelines

Overview

The blasting of **short benches** is unique and difficult in nature, due to the short drill hole depths and associated blast dynamics. Short benches are benches that range in height from 3 to 15 feet. This guidance is intended to aid in the safe execution of the blasting process. At any point in the drilling and blasting process, everyone involved is to report concerns to site management and/or the Martin Marietta Explosives Engineering Team for clarification and guidance. **Each site is unique and requires individual consideration to the desired outcome.**

Stemming

1. Stem 0.7 x Burden (min. recommended is 0.35 x Burden).
2. In small hole diameters, 3 inches or less, 2 inches of appropriate stemming will make a difference in the management of cap rock oversize.
3. **Rule of Thumb:** Minimum Hole Depth for a 3 ½-inch Ø Hole = 6 feet.
4. Use video at an appropriate orientation to determine and assess stemming ejection.
5. Use clean, appropriately sized stemming material that will "lock" in the blast hole.

Blast Design

1. Ensure that the blaster-in-charge has an accurate drill log.
2. Design the shot to move "outward;" not "upward." The exception is if the shot was designed to be a "sinking cut."

Stiffness Ratio (SR) = Face Height/Burden
SR < 1.0 = Cratering Effect
SR 1.0 – 3.0 = Semi-Cratering Effect
SR > 3.0 = "True" Bench Blasting

Rule of Thumb for Stiffness Ratio: The Greater the Better. Blasting with a low SR leads to a "need" for high powder factors (explosive lbs/cu-yd) and the risk of tight digging at the toe. **Do not have both the burden and spacing greater than the hole depth.**

Risk of Flyrock

If blasting exhibits little forward movement, then an **equilateral pattern** usually will provide the best results. An equilateral pattern is a staggered pattern where the spacing to burden ratio is 1.15:1.00. Evaluate the use of 3 – 3½-inch diameter holes on short benches, which will safely enable the powder column to come up higher relative to the face height, aiding in cap rock breakage.

Blast Preparation

It is important to muck out the face/toe prior to shooting. Impeded movement will result in blast hole cratering, possible flyrock and/or tight digging. Ensure that the bench is prepared properly, without loose or undesirable materials on the bench. Loose material will fly, often times great distances, when shot. Ensure that ALL blast holes are checked prior to loading. Lost/blocked/short holes will increase the possibility of blast hole cratering.

General

• Pay attention to detail.
• Never rush or act in a hurried manner.
• Review the blast timing sequence to ensure that the initiation sequence is appropriate.
• Ensure that the blast area is appropriately sized, cleared, guarded and secure when the blast is initiated.
• Maximize the size of the cleared blast area.
• Ensure that the blast signals are appropriately communicated to ALL involved.
• Discuss with the blaster-in-charge any changes in pattern, orientation, design parameters, desired results or shot initiation sequencing.
• Ensure that the shot firer has appropriate shelter, or that a remote firing system is being utilized from a safe location.
• Following the blast, ensure the blaster-in-charge inspects the blast to confirm that no misfires occurred, and to assess the muck pile for any unusual or unexpected shot profile characteristics prior to communicating the "All Clear."

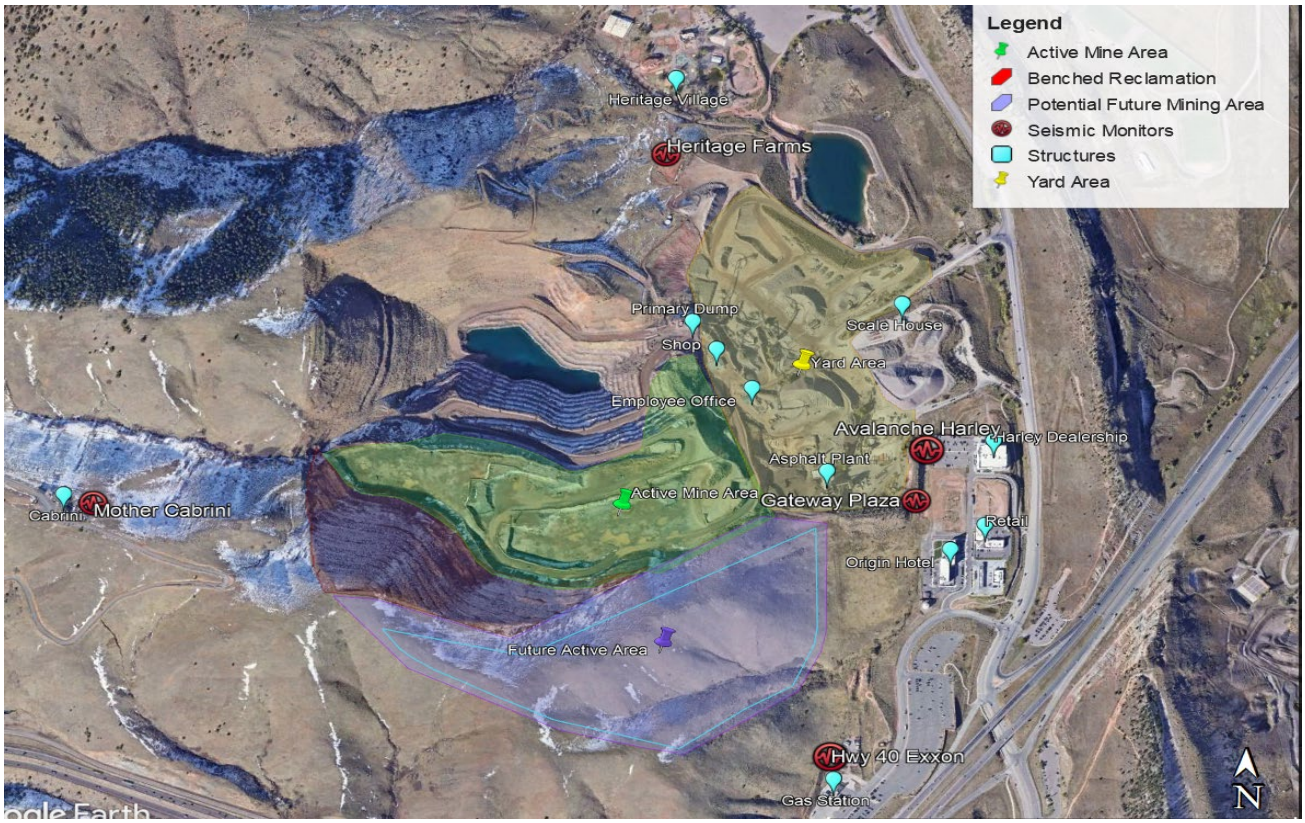
Flyrock Causes

• Inadequate stemming amounts;
• Over-confinement of blast holes;
• Loose material on top of a bench, or in the stemming area;
• Insufficient delay time between rows;
• Heavy burdens;
• Soft seams in the geology;
• Caves/voids/cavities/crevices;
• Broken material;
• Mud seams;
• Insufficient burdens on the front row;
• Overloaded holes;
• Poor quality stemming;
• Lack of relief; and
• Spacing and Burden exceeding the depth of the blast hole.

Blast Area Safety and Security Plan

Specification Aggregates (Spec Agg)

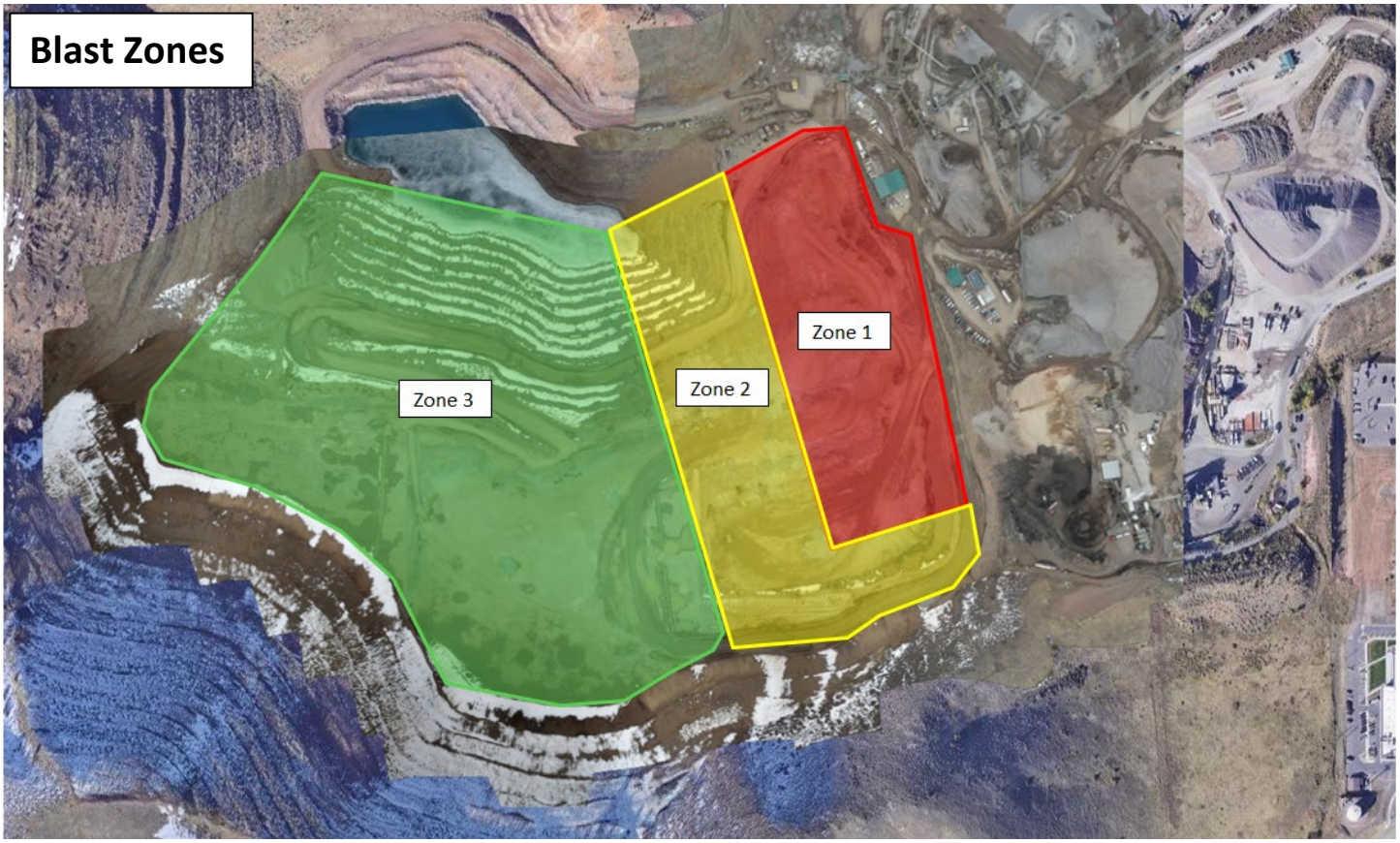
Reviewed 03-14-2022



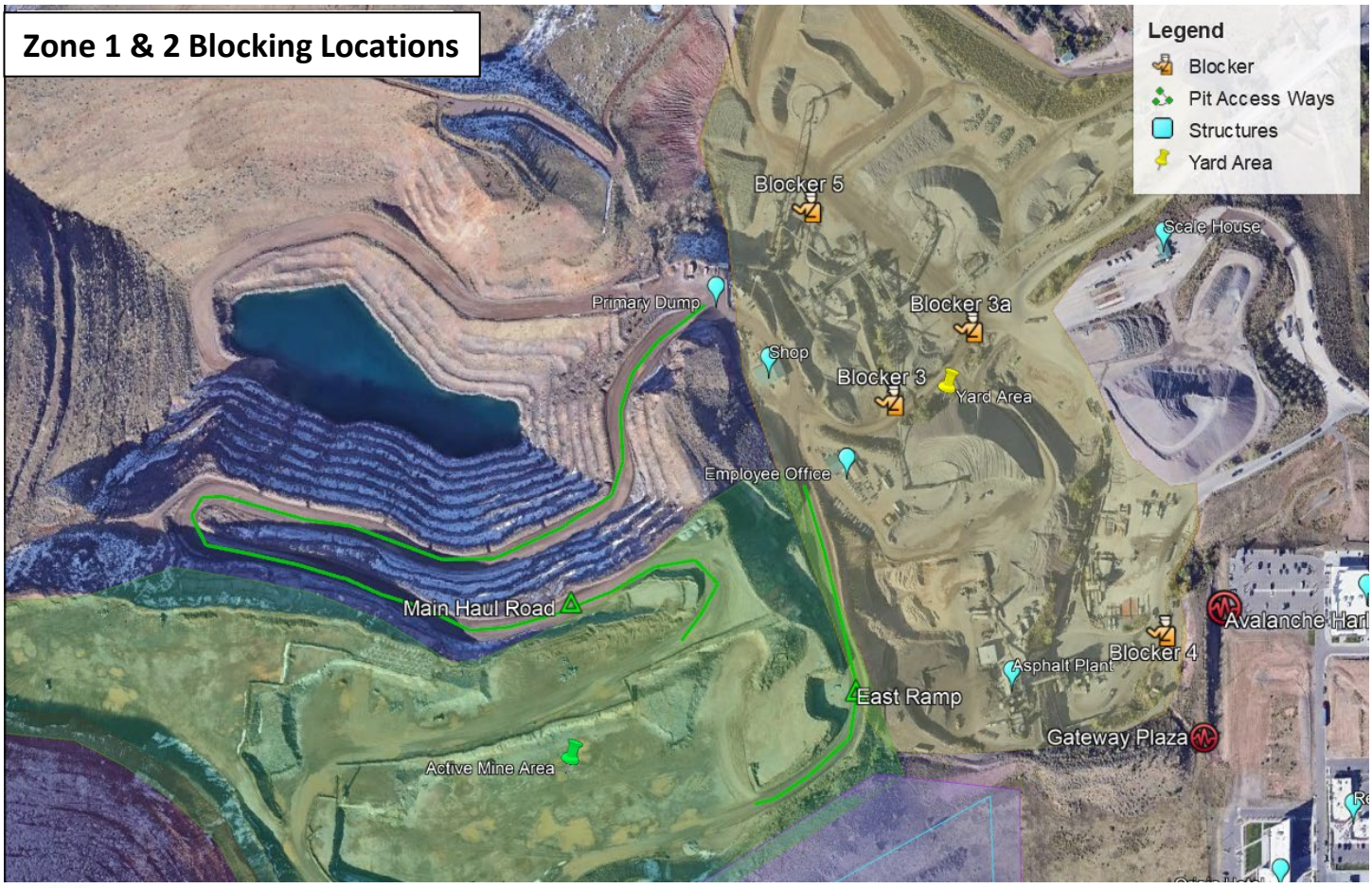
1. **Working Areas were blasting occurs**
    a. Active Mining Area (**Green**)
        - Benched pit layout, highwalls of 40 ft or less.
    b. Potential Future Mining Area (**Purple**)
        - Planned Benched pit layout similar to current Active Mining Area.
        - Review and update Blast Plan if/when that area becomes active.

2. **Blasting Restrictions/Limits**
    a. Seismic output (vibration, airblast) of all blasts is monitored at locations marked on map
        - Locations on map are permanent seismographs, but may be relocated as needed to ensure monitoring of the nearest non-company dwelling. Seismic output is managed/monitored by a 3rd party.
    b. Blast-induced vibration shall not exceed 0.5 inches per second at any dwelling (home or business).
    c. Blast-induced vibration shall not exceed 2.0 inches per second at any other non-company structure.
    d. Blast-induced air overpressure shall not exceed 127 decibels at any dwelling.
    e. Blasting shall be planned to occur in hours of daylight, during normal business hours.
    f. District management authorization shall be required for blasting outside of the standard time window, as well as notification to the Golden Fire Department and Police Department, and Golden Planning Department.
    g. Under no circumstances shall blasting occur between local sunset and sunrise times (darkness).
    h. The use of ANFO in blasting is limited to 24 tons per single day, or 1,400 tons per calendar year (as per Air Permit)

Blast Zones



Zone 1 & 2 Blocking Locations



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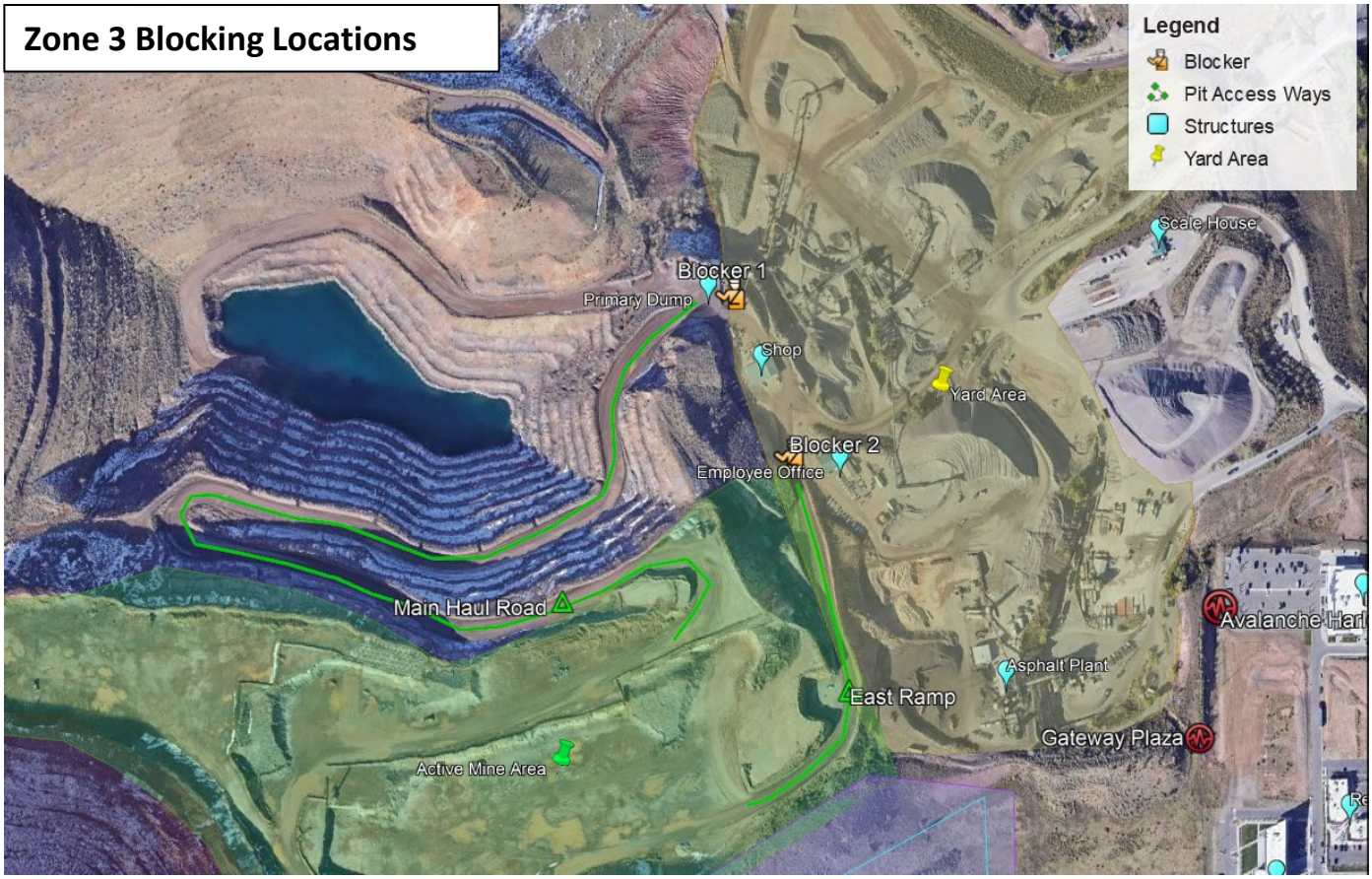


3. **Pre-Blast Process**
    1. The blasting contractor will identify in what zone the blast is located after design of the pattern.
    2. The blasting contractor will inspect the Blast Site and related work area before loading any explosives.
    3. Review weather forecast, drill logs, and blast face for any potential concerns.
    4. Blaster-in-Charge will review blast clearing/blocking locations to ensure safe distances will be achievedfor all personnel, equipment, and structures.
    5. Any observed or expected problems or concerns will be immediately reported to Plant Management.
    6. If any serious issues are apparent, or arise during loading, the Plant Manager, Production Manager, and the Explosives Engineering team will work together to determine a plan for safe resolution.

4. **Blocking Locations and Blast Zones (Marked on map)**
    1. Zone 1 & Zone 2 Blocking Locations
        i. Blocker 3 / Blocker 3a – North of fines stockpile, blocking pit access via plant yard ramp. If Blocker 5 is being used this location moves to Blocker 3a at the base yard access to pit.
        ii. Blocker 4 – East asphalt plant entrance, blocking asphalt plant access via east ramp.
        iii. Blocker 5 – Secondary surge pile location, blocking pit assess via crushing plant.

    2. Zone 3 Blocking Locations
        i. Blocker 1 – Primary Dump location, blocking pit access via main haul road.
        ii. Blocker 2 – West of Employee Office, blocking pit access via East Ramp.

    3. The above blocking locations may be moved, or other locations will be added as warranted by blast/pitcircumstances.

5. **Areas to be cleared of personnel and equipment/vehicles**
    1. Zone 1
        i. All personnel, equipment, and vehicles will be cleared from the employee parking lot, office/shop area, fuel island and primary crusher area.
    2. Zone 2
        i. All personnel will be cleared from the employee parking lot and shop/office area.
        ii. In addition, if there is a blast in Zone 2 with a free east face that could directly impact the employee parking lot and shop/office area, all vehicles and equipment must be removed.
    3. Zone 3
        i. When blasting occurs in Zone 3, no standard clearance of nearby buildings or structures are needed due to current distances from active mine areas, but, if necessary, will be done as determined by Blaster-in-Charge and Plant Management.
    4. No blast will be initiated if there is suspected risk to any non-quarry structures, dwellings, or travel ways.

6. **Equipment to be cleared in blast area, safe distances determined by Blaster-in-Charge and MM Management**
    1. Loaders and haul trucks cleared to safe distance from in front of blast faces.
    2. Drills and other equipment will be cleared a safe distance from blast.
    3. If for any reason, any equipment cannot be cleared to a safe distance, the Blaster-in-Charge and Plant Manager will determine the best course of action.
    4. No blast will be initiated if there is suspected risk to non-quarry vehicles or equipment.

7. **Precautions to Protect Equipment in the Blast Area**
    1. All equipment should be cleared and removed from blast area, to include pumps.
    2. Additional consideration will be taken on specialty blasts closer to plant equipment.

8. **Blast Area clearing route**
    1. Zone 1 & Zone 2
        i. Driller will clear the pit
        ii. Start at top of pit
        iii. Work way through each level
        iv. Clear plant area and set Blocker 5
        v. Clear plant yard ramp and set Blocker 3/3a
        vi. Clear employee parking lot and office/shop area of personnel
            - Clear equipment and vehicles in Zone 1 or when required in Zone 2.
        vii. Clear Asphalt Plant and set Blocker 4
        viii. Drive back through pit area
        ix. Continue down main haul road, ending at Primary Crusher
        x. Confirm Blockers are set and ready
        xi. Sound Warning Siren
        xii. Drive down to Blocker 3
        xiii. Radio to Blaster-in-Charge that blast area is secure

8. Blast Area clearing route (continued)

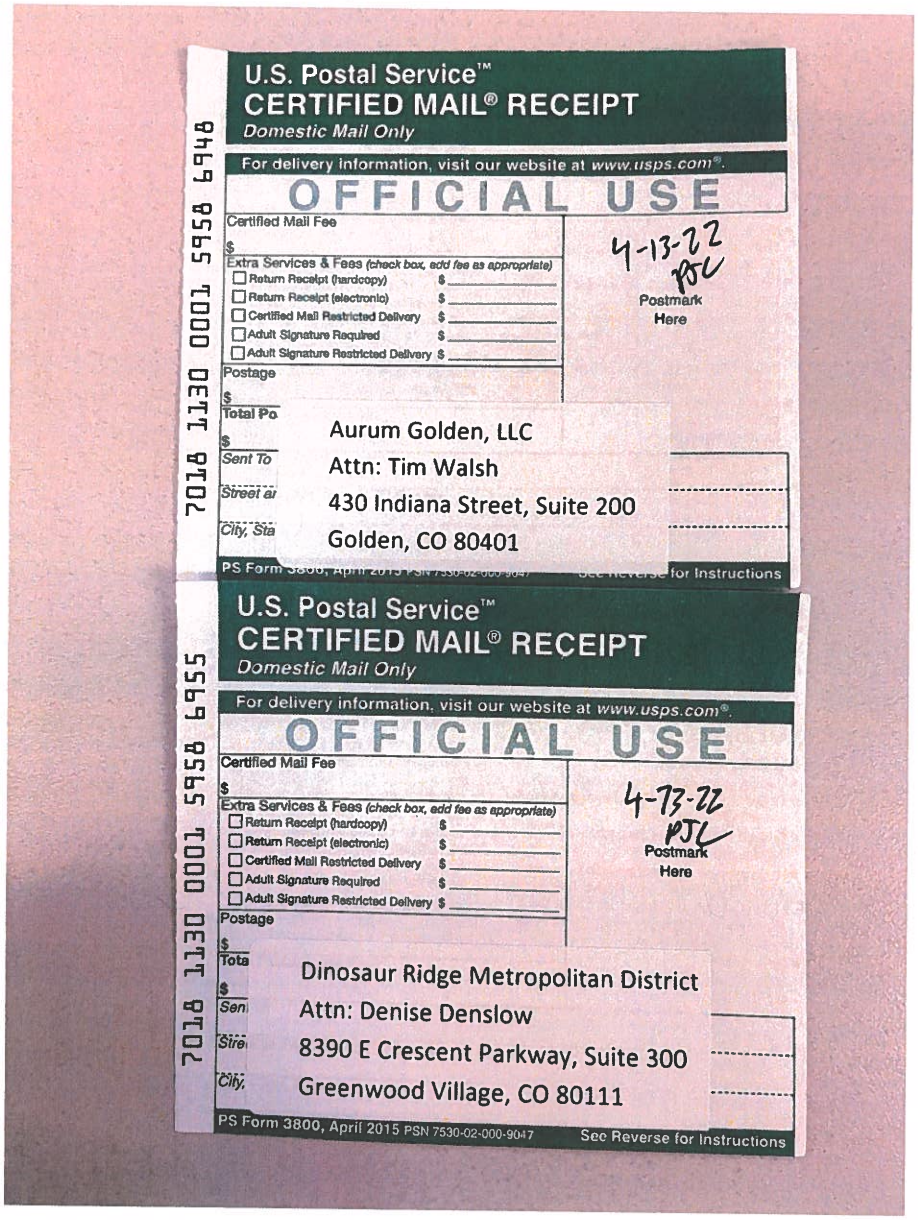
2. Zone 3
    i. Driller will clear the pit
    ii. Start at top of pit
    iii. Work way through each level
    iv. Set blocker at East Ramp (Blocker 2)
    v. Drive back through pit area
    vi. Continue down main haul road, ending at Primary Crusher
    vii. Maintain blocking point at this location (Blocker 1)
    viii. Sound Warning Siren
    ix. Radio to Blaster-in-Charge that blast area is secure

9. Communication Plan and Initiation Process

1. All Spec Agg employees, contractors, and visitors will be notified of an intended blast, and a blast sirennotification sign is in place where visitors can see it.
2. Radio silence is announced and required for all personnel not involved in the blast clearing/blocking process
3. Mine radios are the primary communication.
    i. Blast clearing process is announced Martin Marietta Lead.
    ii. Blockers and Lead are to then use active mine channel (onsite radio).
4. Lead to confirm Blaster and blasting contractor representatives are in place and secure.
5. Clear blast area via designated clearing route (Martin Marietta Lead or other MM Rep).
6. Confirm all blocking locations are still secure via radio.
7. The blast warning siren protocols are as follows:
    i. 5-second siren
    ii. 15 seconds of silence
    iii. 5-second siren
    iv. 15 seconds of silence
    v. 10-second siren
    vi. 10-second countdown to initiation
    vii. Blast is fired
8. All blockers are to maintain blast area security until the All Clear signal is given by the Blaster-in-Charge.

10. Blast Shelter

1. A steel blasting shelter is available onsite to serve as extra protection for the Blaster-in-Charge duringblast initiation if it is to be conducted within the Blast Area.
2. When using remote initiation methods, and located from a safe distance (as determined by the Blaster-in-Charge), a blasting shelter may not be required.



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