State of California
Department of Industrial Relations
Division of Occupational Safety and Health

Memorandum

Date: July 19, 2019

To: Christina Shupe, Executive Officer
Occupational Safety and Health Standards Board
2520 Venture Oaks Way, Suite 350
Sacramento, CA 95833

From: Eric Berg, Deputy Chief *Eric Berg*
Division of Occupational Safety and Health

Subject: Evaluation of Petition No. 575 to amend title 8 section 5357

1.0 INTRODUCTION

On April 23, 2019 the Division of Occupational Safety and Health (Cal/OSHA) received a petition from Nathan Heit and Charles Megivern (petitioners) representing Mammoth Mountain Ski Area (MMSA). The petitioners propose to amend title 8 section 5357 Snow Avalanche Control Blasting to allow for the use of Remote Avalanche Control Systems (RACS) to mitigate avalanches.

Labor Code Section 142.2 permits interested persons to propose new or revised standards concerning occupational safety and health, and requires the Occupational Safety and Health Standards Board (Standards Board) to consider such proposals and render a decision no later than six months following receipt.

California Labor Code section 147 requires the Standards Board to refer to Cal/OSHA for evaluation any proposed occupational safety and health standard. Cal/OSHA is required to submit a report on the proposal within 60 days of receipt.

2.0 PETITIONER'S REQUEST AND BASIS TO AMEND TITLE 8 REGULATIONS

The petitioner proposes to change subsections 5357(a)(4) and 5357(a)(4)(E). According to the petitioner, the amendment is necessary to allow for the use of RACS to mitigate destructive avalanches.

2.1 Proposed Amendment to Section 5357

The changes proposed by the petitioners are shown below in underline-strikeout format.

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Subchapter 7. General Industry Safety Orders
Group 18. Explosives and Pyrotechnics
Article 121. Snow Avalanche Blasting
§5357. Snow Avalanche Control Blasting.
(a) General Requirements.
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(4) Charges shall be placed, dropped, tethered, thrown or propelled to the desired location from a safe position by one of the following methods:

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(E) Deployed from such remote control devices accepted by the Division as providing equivalent safety.~~to the remote control devices allowed under subsection (e).~~

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2.2 Background and Petitioner's Basis for Amendment

Snow avalanche blasting utilizes explosives to trigger small avalanches to prevent the buildup of large quantities of snow that can result in destructive avalanche events. Over the last 10 years, avalanches have caused an average of 27 deaths per year[1] during winter across the United States.

Currently, MMSA use two methods of snow avalanche blasting. One method employs a 105 mm Howitzer artillery to launch a projectile at potential avalanche areas. The projectiles explode upon impact to initiate a controlled avalanche. The second method employs a ski patrol team who deploy dynamite charges by hand.

The petitioner asserts that RACS are more effective in avalanche mitigation than other methods and RACS provide a substantial improvement to worker safety than using hand deployed explosives. The petitioner also contends that RACS removes employees from key hazardous points in avalanche blasting. Since employees are remote from the deployment and initiation of blast charges, they are protected from the hazards of explosives and resultant avalanches. RACS, the petitioner adds, are a costly expenditure and thus MMSA petitioned for title 8 regulations to ensure the Division's acceptance of the devices prior to making financial commitments to their use.

3.0 Applicable Title 8 Regulations

Remote avalanche blasting is currently regulated by section 5357(a)(4)(E), which in turn references subsection 5153(e) Avalauncher/Launcher requirements. Avalaunchers/launchers are canons that use compressed gas to propel explosive projectiles up to 2 kilometers away to control snow packs from a distance.

Subchapter 7. General Industry Safety Orders
Group 18. Explosives and Pyrotechnics
Article 121. Snow Avalanche Blasting

§5357. Snow Avalanche Control Blasting.
(a) General Requirements.

* * * * *

(4) Charges shall be placed, thrown or propelled to the desired location from a safe position by one of the following methods:

[1] Colorado Avalanche Information Center – https://avalanche.state.co.us/accidents/statistics-and-reporting/

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(E) Deployed from such remote control devices accepted by the Division as providing equivalent safety to the remote control devices allowed under subsection (e).

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(e) Avalauncher/Launcher requirements.
(1) The operation of an avalauncher/launcher shall be under the direct supervision of an authorized, licensed avalanche blaster certified for propelled operation.
(2) Only trained and authorized personnel shall be permitted to operate an avalauncher/launcher.
(3) During loading and firing of explosive rounds, the firing crew shall consist of the blaster in charge, one trained operator, and/or one blaster in training. All other personnel shall be removed to a minimum of 100 feet from the avalauncher/launcher before firing can commence.
(4) All equipment shall be in good working condition, and shall be assembled, maintained, and operated in accordance with the manufacturer's instructions at the launch site.
(5) The components of projectile assemblies shall not be interchanged, and shall be assembled at the launch site and used in accordance with the manufacturer's instructions.
(6) The projectiles shall be inspected before transport to the avalauncher site to ensure proper working condition, and shall be free from damage, obstructions, dirt and debris.
(7) Defective projectiles shall not be used and shall be properly disposed of or returned to the manufacturer.
(8) The projectile's safety devices or components shall not be removed, unless recommended by the manufacturer, and then only immediately prior to inserting the projectile into the barrel.
(9) The operator, and at least one other member of the firing crew shall check the vertical, horizontal (altitude & azimuth), and pressure settings of the avalauncher before each shot is fired.
(10) Operators shall attempt to determine and record whether or not each round which is fired actually explodes on contact.
(11) The approximate location of all known or suspected misfires shall be recorded.
(12) Firing of explosive avalauncher/launcher rounds shall only be conducted when personnel are not in the target area.
(13) The avalauncher/launcher apparatus shall be stored in a nonfunctional condition when not in use, or shall be locked securely to prevent unauthorized use.

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4.0 Federal OSHA regulations.

Code of Federal Regulations, title 29, section 1910.109 includes requirements for explosives used in the general industry, but does not specifically regulate snow avalanche blasting. The federal regulations do not contain requirements similar to title 8 section 5357.

5.0 ACCIDENTS USING EXPLOSIVES IN SNOW AVALANCHE CONTROL

Cal/OSHA reviewed accidents related to snow avalanche blasting. The following list of fatal accidents were related to hand deployed explosives. The victims were either directly killed by the explosive blast or

indirectly killed when an explosion triggered an avalanche. Non-fatal accidents resulting in serious injury are not listed.

- During the winter of 1973/74 two workers were killed and one injured at MMSA in two separate incidents. The cause of both accidents were defective pull-wire igniters that prematurely ignited a time delay fuse and detonated explosives while the workers were handling them.

- March 3, 2009, a ski patroller in Olympic Valley, CA died from an avalanche initiated by a hand deployed explosive. The worker was positioned too close to the blast area and was caught by snow released from the explosion.

- January 6, 2010, a ski patroller in Teton Village, WY died from asphyxiation after being buried by snow. He was setting explosive charges for snow avalanche control.

- November 22, 2010, a ski patroller in Pagosa Springs, CO was caught in an avalanche and died of asphyxiation. He was performing snow avalanche control.

- December 24, 2012, a ski patroller in Tahoe City, CA died from an avalanche initiated by hand deployed explosives. The worker was positioned too close to the blast area and was engulfed by snow released from the explosion.

- January 24, 2017, a ski patroller in Olympic Valley, CA died while detonating explosives for snow avalanche control.

6.0 REMOTE AVALANCHE CONTROL SYSTEMS (RACS)

RACS consist of a broad range of avalanche control devices that are designed to be triggered from a safe location. Similar to other types of active avalanche control methods, RACS create small controlled avalanches to prevent excessive snow buildup that may lead to large destructive avalanches. RACS use cast explosives or flammable gas ignition to create explosions and resultant avalanches. RACS can be mounted on stationary structures or mobile devices.

Explosive-based RACS deploy cast explosives. The explosives are usually loaded into the RACS prior to winter and then fired via remote control weeks or months later after significant snow fall.

Gas-based RACS contain oxygen and a flammable gas in separate pressure vessels. When avalanche control is needed, the gases are mixed in a combustion chamber and ignited via remote control to create an explosion and avalanche.

Stationary RACS consist of a fixed tower or similar structure located on a mountain near locations where dangerous snow buildup can occur. The RACS can be loaded prior to winter and activated remotely later during winter or spring when necessary to prevent excessive snow buildup. Stationary RACS can be explosive-based or gas-based.

Mobile RACS use gas-based devices. The mobile RACS are suspended from a helicopter and flown to the location of a snow buildup. The helicopter hovers directly above the snow buildup where the flammable gases are mixed and ignited in the RACS to create an avalanche.

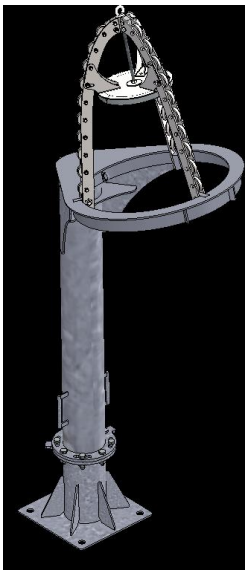
The following are some examples of RACS currently being used worldwide. These RACS devices are not currently regulated in title 8.

6.1 Seilbahnen-Avalanche Guard

The Seilbahnen-Avalanche Guard is a stationary RACS. Twenty shots of explosives can be preloaded on the unit. Time delay, fused explosives are launched at avalanche targets using remote control.

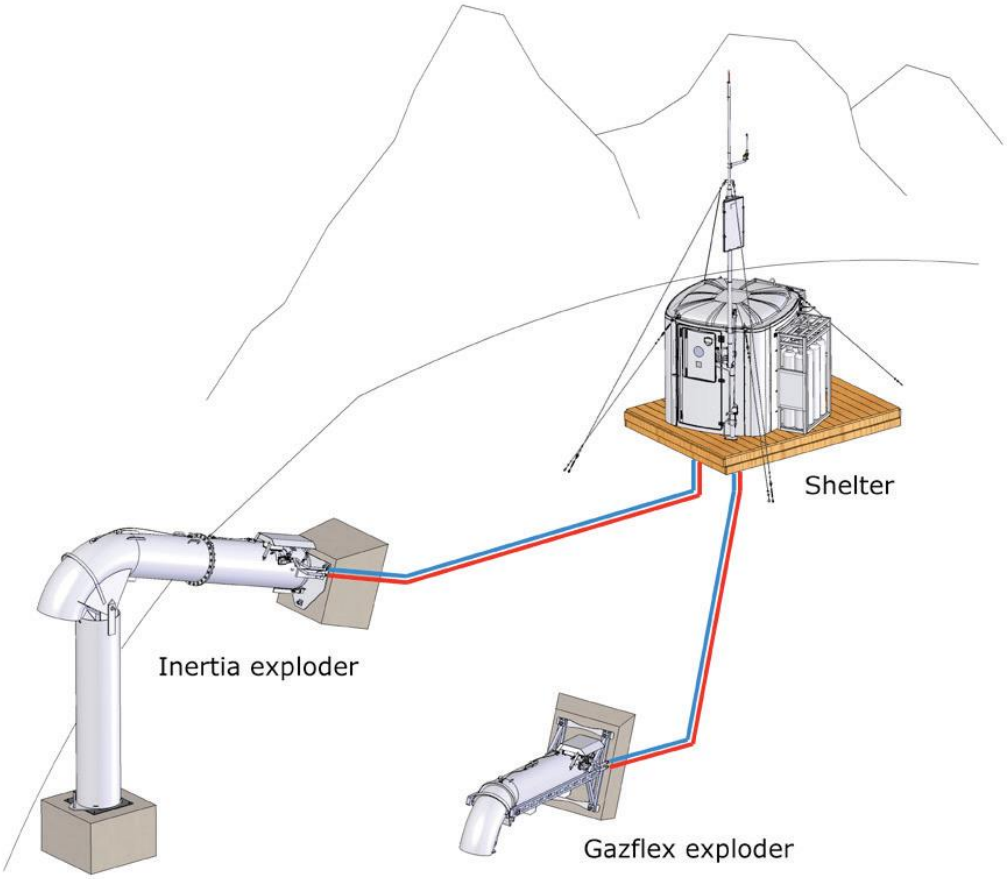
6.2 TAS-ObellX

The TAS-ObellX unit is a stationary RACS that is transported by helicopter and placed on permanent brackets on a mountain where avalanches are targeted. The system detonates a mixture of oxygen and hydrogen to initiate an avalanche.



6.3 TAS-Gazex

The TAS-Gazex is a stationary RACS installed on a mountain that uses oxygen and propane to blast locations of reoccurring avalanche formations.



6.4 TAS-Daisybell

The TAS-Daisybell is a mobile RACS transported to the avalanche site by helicopter. While the helicopter hovers, the unit directs an explosion onto a target using a hydrogen and oxygen mixture. The unit can fire up to 70 times using remote control.

6.5 Montax – Catex

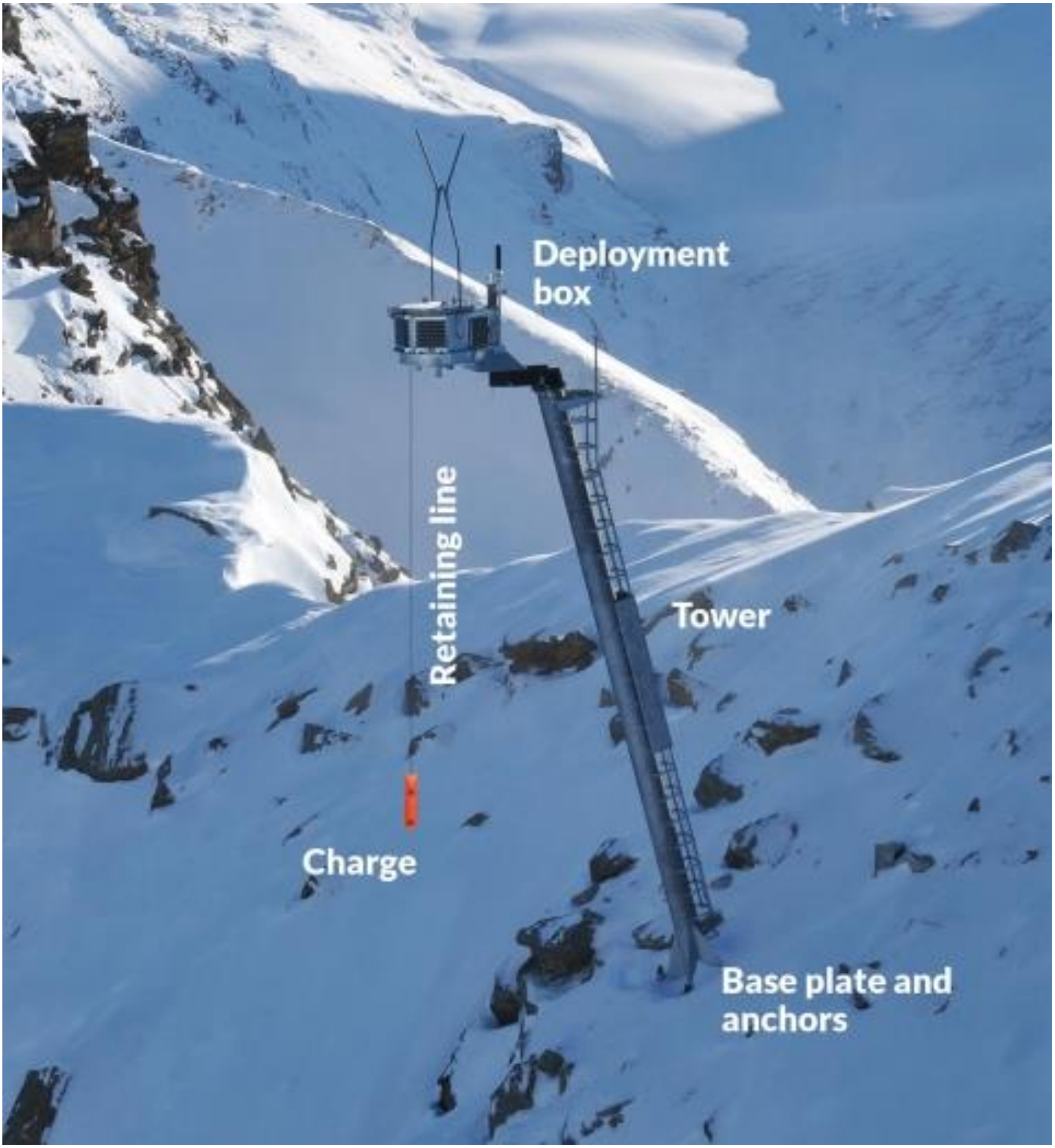
The Montax – Catex unit is a stationary RACS that uses aerial ropes connected between towers. This model requires employees working on the platform shown in the photograph below to manually transport explosives on the rope to position explosives over the suspected avalanche area where they released and detonated.

6.6 Doppelmayr

The Doppelmayr-aerial rope blastway is a stationary RACS that uses aerial ropes connected between towers. The movement of explosives is accomplished using a rack attached to the rope from which they are released, and the detonated remotely.

6.7 Wyssen Avalanche Tower

The Wyssen Avalanche Tower is stationary RACS consisting of a permanent tower unit that uses aerial ropes to lower explosives before detonation. The reloading of this system involves lifting the entire deployment box from the tower by helicopter.



7.0 PROFESSIONAL DOCUMENTS AND INDUSTRY EXPERTS

Information from "*The Avalanche Handbook*"[2] published by the United States Department of Agriculture (USDA) Forest Service was utilized in this evaluation. In addition, Dr. Karl Birkeland, the director of the USDA Forest Service Avalanche Center was contacted by Cal/OSHA staff for insight regarding the use of RACS. Dr. Birkeland was a former ski patrolman and dedicated a career to snow avalanche safety. Dr. Birkeland stated he has no reservations in the use of RACS. He commented that they are widely used in Europe and are coming into common use in the United States. He added RACS are inherently safer because they place the user farther away from the blast.

Geraldine Link, Director of Public Policy for the National Ski Areas Association (NSAA) was also contacted by Cal/OSHA staff regarding her opinion of RACS. The NSAA is a trade organization representing 315 ski area owners, operators, and manufacturers of products for the industry. Based on conversations with Ms. Link, the NSAA supports the needs of its members including RACS manufacturers and has no objections to the use of RACS.

8.0 DIVISION ANALYSIS

8.1 RACS can provide improved safety

When used properly, RACS can provide equal or superior safety for deploying and detonating explosives to other methods of avalanche mitigation currently permitted by title 8 regulations. Proper use of RACS removes the worker from the zone of danger of explosions and avalanches.

Hand deployment of explosives often puts employees in close proximity of the zone of danger, which can result in serious injuries and fatalities as shown in the accidents described in part 3.0 of this evaluation.

8.2 The petitioner's proposal does not provide adequate regulatory language

The petitioner's proposed language in subsection 5357(a)(4)(E) is "*Deployed from such remote control devices accepted by the Division as providing equivalent safety*." The petitioner fails to state what the safety should be equivalent to. Also, the proposed language is excessively vague as it provides no direction whatsoever to employers on what Cal/OSHA would find acceptable. The language is so imprecise that it would likely be considered unenforceable by the Occupational Safety and Health Appeals Board.

The regulatory language should address the specific hazards involved with RACS such as: handling of heavy loads; transporting, handling, and loading explosives into RACS; handling of misfires and unexploded charges; handling of flammable gases; using helicopters, and accessing remote stationary RACS.

9.0 CONCLUSION

Cal/OSHA has reviewed the petitioner's request to amend subsection 5357(e). This review included information provided by the petitioner, research of the various types of RACS and accident data of employees deploying explosive avalanche blasting charges. Additionally, professional documentation

[2] USDA Forest Service Avalanche Handbook is available at https://www.n-sda.org/files/education/handbooks/Avalanche.pdf

regarding avalanche blasting was reviewed and experts in the field from the USDA and NSSA were consulted.

The use of RACS is inherently safer than hand-deploying explosives as the worker is positioned away from the proximity of an explosive blast and the path of the resultant avalanche. However, Cal/OSHA recommends rejecting the regulatory language from the petitioner because the language is vague. Cal/OSHA recommends the petition be granted to the extent that an advisory committee be convened to consider appropriate and specific regulations to ensure employee safety for the various types of RACS.

cc: Yancy Yap
Jason Denning