

A high-angle, wide shot of a snowy mountain landscape. In the foreground, a steep, snow-covered slope descends from the left, with several large, dark brown rocks protruding from the snow. A ski lift tower and cable are visible on the far left. In the middle ground, a ski resort is nestled in a valley, featuring various buildings, ski runs, and a small pond. The background consists of rolling mountain ranges under a clear sky, with patches of snow and dense evergreen forests.

# Remote Avalanche Control Systems (RACS) that use a Safety Fuse



# Background

- April 2019, Mammoth Mountain Ski Area submitted Petition 575 to amend existing regulations to allow the use of RACS. RACS use a broad range of avalanche control devices designed to trigger avalanches from a safe location for workers. The Occupational Safety and Health Standards Board (OSHSB) Granted Petition 575 for rulemaking.
- In May 2019, Mammoth Mountain Ski Area applied for Permanent Variance (19-V-167) to allow the use of RACS utilizing explosives deployed by aerial ropeways and a unit to drop explosives to the ground. The disposition of Permanent Variance 19-V-167 is ongoing and unsettled.

# RACS Type: Fuel Gas and Oxygen

- **DAISYBELL**

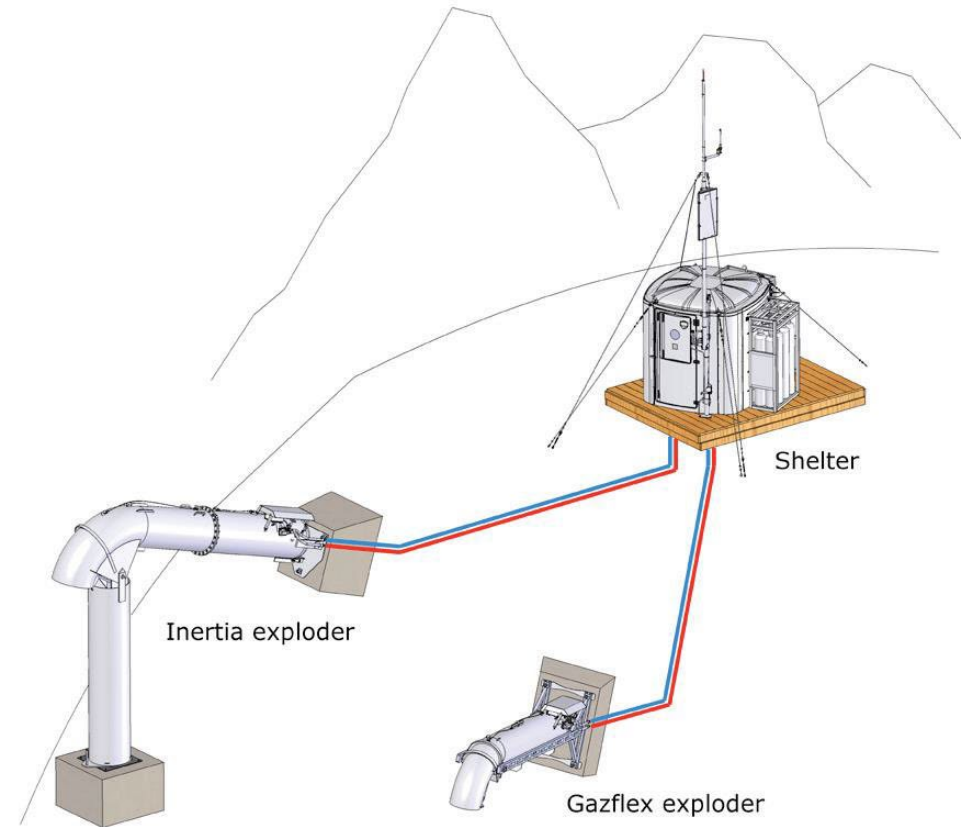
- Oxygen and Hydrogen exothermic reaction explosion to blast snow.
- §5237 “Explosives.” Any chemical compound, mixture or device, the primary or common purpose of which is to function by explosion.
- No Safety Fuse required.
- Helicopter transported to avalanche trigger locations.
- Hovers over snowpack then remotely triggered blast.
- Caltrans testing usage in 2025.



# RACS Type: Fuel Gas and Oxygen

- **GAZEX**

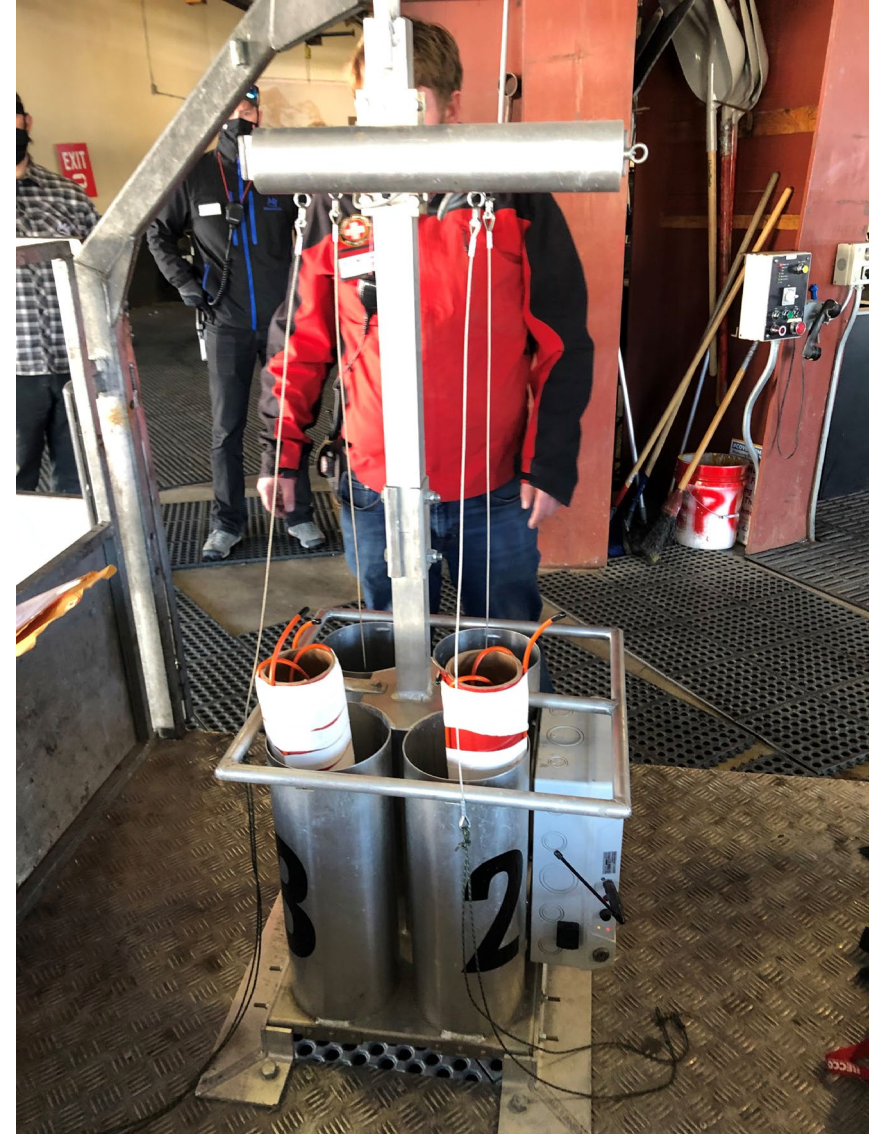
- Oxygen and Propane combustion to blast snow.
- No Safety Fuse required.
- Permanently installed at key mountain top locations where snow accumulates that form avalanches.
- Caltrans use Gazex along state route 50 and state route 88.
- Palisades Tahoe (Squaw Valley) California installed and have used 13 Gazex units since 2017.





# RACS Type: Solid Explosive Charge

- **DOPPELMYAR**  
**INAUEN-SCHATTI**
- Cast explosive charge dropped into the snowpack.
- Safety Fuse, Blasting Cap, and Igniter necessary.
- Existing ropeways used to transport explosives.
- Remotely triggered.
- Mammoth Mountain ready to use, pending variance outcome.



# Mammoth Mountain Permanent Variance 19-V-167

- During field evaluation of RACS system, Cal-OSHA identified a plausible hazard with potential for Serious Injury or Death.
- Photo depicts workers handling armed explosives while loading onto the RACS deployment unit.





# Mammoth Mountain Permanent Variance 19-V-167

“Armed” is loosely defined in title 8 regulations section 5355(a)(1) as the condition when an explosive charge is combined with its detonator. Photos show an “armed” charge where the fuse and blasting cap have been combined.



## Mammoth Mountain Permanent Variance 19-V-167



The following link in the PDF directs you to a video on the safety fuse. <https://youtu.be/GcEHef9O9RI>

## Hazard #1 identified by Cal-OSHA

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- Safety Fuse “ignition spit” and the burning fuse is **not** easy to see, hear, and smell while the fuse is burning.
- Mountain top inclement weather conditions make detecting a burning fuse difficult if not impossible.
- Fuse video provided by Ski California association.



## Mammoth Mountain Permanent Variance 19-V-167

### Hazard #2 identified by Cal-OSHA

- Difficult to distinguish a safety fuse before and after burning.
- Photo depicts two safety fuses, one burned, and one not burned.
- Workers need an obvious visual indicator to determine if a fuse has already burned, to preclude re-lighting.



## Hazard Exposure Duration

- Hazard begins when igniters are mated to the fuses and ends when explosives are conveyed on ropeways to a safe distance.
- Hazard exposure time 15 minutes.
  - 2 minutes to attach igniters to four fuses
  - 3 minutes to attach lanyards to the igniter loops
  - 10 minutes to use ropeways to convey explosives to a safe distance



## Mammoth Mountain Permanent Variance 19-V-167

2 minutes to  
attach four  
igniters to  
fuses.

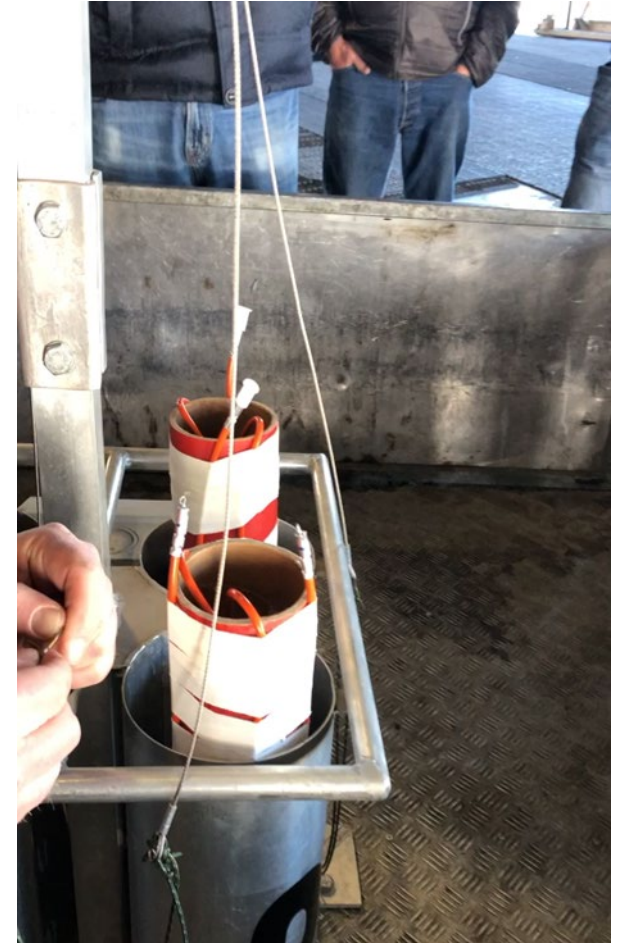


The following link in the PDF  
directs you to a video on  
attaching igniters to fuses.

<https://youtu.be/LLaaZTZMCKw>

3 minutes to  
attach four  
lanyards to  
igniters.

Hazard:  
Entanglement  
and potential  
for accidental  
initiation of  
fuses.



The following link in the PDF  
directs you to a video on  
attaching lanyards to igniters.

<https://youtube.com/shorts/fM PppfHWx5Q>

*Blaster's Handbook, Dupont, 16th edition (1980), pg. 122*

“Persons who fail to recognize the ignition spit, or who are misled by the burning of the cover, have been killed or injured by trying to relight fuse which has been ignited.”



## *Occupational Safety and Health Standards Board Rule Making File Snow Avalanche Blasting 2-15-2007*

- On December 27, 1973 a member of MMSA's ski patrol was fatally injured (and her partner seriously injured) when she attached the fuse igniter well prior to deployment and it ignited the fuse spontaneously, causing the charge to prematurely detonate. Static electricity was also one of the suspected causes of the explosion. Pg 267 of 994.
- On January 11, 1974 another member of MMSA was seriously injured when he attached the fuse igniter well prior to deployment. As with the December 27 accident, the fuse was spontaneously ignited and the explosive charge detonated in the employee's hands, causing the amputation of two fingers, fractures to both legs, a lung collapse, and severe damage to his hands. As a result of this second catastrophic accident, ski facilities no longer placed the pull-wire igniters on the fuse end until the blasting team was ready to deploy the charge. Pg 267 of 994.

# *Occupational Safety and Health Standards Board Rule Making File Snow Avalanche Blasting 2-15-2007*

- On December 25, 1996 a member of the Big Sky ski patrol in Montana was killed and her partner seriously injured when she attempted to relight a fuse she thought had not ignited. The explosive charge detonated on her lap. Pg 267 of 994
- According to C. Duane Niesen, Consultant for California Ski Industry Association, Former Cal-OSHA Mining & Tunneling for 30 years, retired in 2003. Pg 438 of 994

*“The problem is when the blaster lights the fuse and cannot tell for sure, by smoke and smell, whether it is lit, then he or she must decide very quickly what to do next. It is hoped that he or she will not stand around and fiddle with it, which is probably what happened in the (1996) Montana accident.” Pg 442 of 994*



# *Cal-OSHA Investigation Case # 1205433*

- On January 24, 2017 a member of the ski patrol at Palisades Tahoe (formerly Squaw Valley) ski resort in California was killed while performing snow avalanche control using hand deployed explosives.
- The accident occurred on a mountain ridge elevation 8,743 feet with the conditions being 10 degrees Fahrenheit with **strong winds blowing 25-35 miles per hour** and **limited visibility due to fog**.
- Based on the coroner's report of injuries, it appears the decedent was holding the explosive charge when it detonated. All the trauma and injury were to the head, torso, and upper extremities. No apparent injury or damage to the back, buttocks, or back of legs.

# *Cal-OSHA Investigation*

## *Case # 1205433*

### *continued.*

- According to the Cal-OSHA case investigator **Joe Crocker**, it is plausible the victim did not see the safety fuse burning down.
- **Nicholas Frey**, former ski patrol avalanche blaster (2004-2008) at Palisades Tahoe (Squaw Valley),  
*“On a super windy day, it would be difficult to hear or see a burning safety fuse if held in the air.”*



01/25/2017 13:05



# Observations

- The commonality with the four past accidents/fatalities is:
    1. Workers handling armed explosives using a safety fuse.
    2. Explosives detonated in full view of the workers.
    3. No definitive cause to the accidents.
    4. Victims did not use time delay to get rid of the charge while the fuse was initiated and burning fuse.
  - *§5357(a)(6) Avalanche blasting shall not be conducted during conditions where the blaster cannot determine whether the fuse is lit, or clearly identify the location of the target area for the detonation of the charge.*
- This existing regulation is dependent on a recognizable fuse when it is burning.

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## *Cal-OSHA's Proposed New Regulation.*

- Add new regulation in *Section 5353(d) Safety Fuse*.
- Employees exposed to a blast from armed explosives shall use a safety fuse with an ignition spit, and when burning, that is visible from 25 feet at fuse initiation conditions. After ignition and burning, the fuse shall be of dissimilar physical characteristics.
- Requirement for new safety fuse regulation when :
  1. RACS using a Safety Fuse
  2. Hand deployed charges using a Safety Fuse.



# Feasibility

- **Chemring Energetics UK:**
- Polyethylene cover for waterproofness.
- Polyethylene tubing can be manufactured transparent for visibility.
- Burn speed similar to existing fuses in avalanche industry.
- Elements such as Strontium, used in pyrotechnics, can be blended with fuse black powder for higher visibility and contrast.

## SAFETY FUZE

**Chemring**  
Energetics UK



Safety Fuze is used in demolition work where a delay is required to give personnel time to retire to a place of safety before the charge detonates.

### Application

Safety Fuze is often used in conjunction with an L1A2 Non-Electric Detonator crimped onto one end of the Safety Fuze which in turn is placed into the main charge. The other end is initiated via Match Fuzee or a Grip Switch fitted with a Flash Initiator.

### Description

Safety Fuze consists of a train of gunpowder enclosed in a yarn wrapped in waterproof black outer polyethylene covering with a nominal diameter of 5.1mm.

Supplied in 8 meter lengths coiled and fitted with a reusable rubber seal on each end, sealed in a bag. 10 off coils are packaged in an H83 container.

Safety Fuze burns at 131 +/- 13 seconds per metre (or 7.5mm per second) allowing the user to accurately calculate the length of Safety Fuze required to provide the desired delay.

### Specification

Burning Speed	131 +/- 13 seconds per metre
Explosive Type	Black Powder
Explosive Quantity	5.6 grams per metre
Storage Life	5 years

### References

Product Code	Safety Fuse
NATO Stock Number	1375-99-248-4203
Hazard Class	1.4S
UN Number	0105
Proper Shipping Name	FUSE, SAFETY

### Shipping

Outer Pack	H83 Steel Box
Qty per H83	80metres
NEQ	0.488kg
Gross Weight	5.0kg
Dimensions	300 x 160 x 190mm





The End – Questions