

FATALITY ASSESSMENT AND CONTROL EVALUATION**Snowmaker Killed after Sliding off an Icy Trail and Striking a Tree
Case Report 12NY001****CASE SUMMARY**

In January 2012, a 41 year-old male snowmaker (victim) at a ski resort suffered fatal injuries after slipping off a ski trail and striking a tree. On the day of the incident, the victim was assigned to work on an expert-rated ski run with a partner to connect the snow guns with water and compressed air. Both workers wore hard hats without chin straps, ear muffs and boots with microspikes. Neither of them carried a radio. At approximately 9 AM, the victim hooked up the last snow gun on the run and started walking down a lower trail (also expert rated) to get to a lift station. The lower trail was icy and not groomed. The partner took the lead traversing to the skiers left side that was less steep and then started descending. He was approximately 30 feet down the trail when he heard the victim calling for help. He turned around and saw the victim sliding down the middle of the trail in a seated position. The victim was trying to stop with his hands and feet but could not. As he was gaining speed, he slid past the partner towards the steeper side (at skiers-right) of the trail and into a wooded area (see Photo 1 for the section of the trail where the victim slid off). The partner quickly descended to reach the victim who was unconscious next to the base of a clump of trees. The partner then immediately walked down the trail to the lift station to use a phone to call the ski patrol. The ski patrol rescue team descended from the summit lodge and arrived on scene about 5 minutes after receiving the call. The rescuers extricated the victim and performed CPR while transporting him in a toboggan to the base area first aid station where the victim was pronounced dead by a coroner.

CONTRIBUTING FACTORS

- Victim worked on a steep slippery trail covered by ice and snow;
- Victim was unable to stop the uncontrolled descent;
- The hard hat fell off victim's head during the fall since it did not have a chin strap.

KEY RECOMMENDATIONS

New York State Fatality Assessment and Control Evaluation (NY FACE) investigators concluded that to help prevent similar incidents from occurring, employers of ski resorts and areas should:

- 1) *Conduct a job hazard analysis and implement a comprehensive fall prevention program;*
- 2) *Explore and implement feasible measures to reduce the frequency of maintenance for snowmaking equipment through upgrading, modifying, retrofitting or replacing the old equipment and system;*
- 3) *Groom steep and icy trails before allowing snowmaking staff on them;*
- 4) *Identify high risk areas for slips and falls and design and construct alternate routes for workers to travel;*
- 5) *Consult with manufacturers and their retail representatives to ensure the right selection of traction footwear for snowmakers and to understand the limitations of such footwear;*

- 6) *Provide snowmakers with ANSI Type II Class G hard hats with chin straps for head protection;*
- 7) *Provide snowmakers with training on fall prevention; and*
- 8) *Provide all snowmakers with radios and require them to carry the radios whenever they are working on the mountains.*
- 9) *Develop an emergency response plan to ensure a timely delivery of emergency medical service in case of worker injury.*



Photo 1. A section of the ski trail where the victim slid off and crashed into the trees on the left side of the trail.

INTRODUCTION

In January 2012, a 41 year-old snowmaker (victim) of a ski resort suffered fatal injuries after he slid off a ski trail and struck a tree. New York State Fatality Assessment and Control Evaluation (NY FACE) staff learned of the incident from newspaper articles. A NY FACE investigator conducted an on-site investigation in March 2012. During the site visit, the NY FACE investigator met with the mountain operations manager and observed the incident site. The case was reviewed and discussed with the Occupational Safety and Health Administration (OSHA) compliance officer who investigated the incident. The OSHA investigation report, New York State Police report and the death certificate were reviewed.

The ski resort first opened in 1960. During the 2011-2012 ski season, approximately 500 full and part-time workers were employed in lift operations and maintenance, trail grooming, snowmaking, ski patrol, ski school and the cafeteria. The snowmaking department employed approximately 45 workers who were snowmakers, equipment operators and mechanics. All workers in the snowmaking department received a full day orientation training at the beginning of the season. The first half of the training was a classroom session that covered company safety policies, job safety hazards and employee responsibilities. During the second half of the training, workers went up the mountain to observe the trails, stationary snow guns, air and water hydrants and pump houses. New hires were paired with the returning snowmakers who showed them how to hook up the hoses and start the guns. Safety talks were conducted on a weekly basis throughout the season and additional safety reminders were provided whenever there were hazardous conditions such as ice.

The victim was hired in November 2011, three months prior to the fatal incident. He did not have any prior snowmaking experience and had not previously worked at a ski resort. He received both classroom and field training.

This was the ski resort's second work related fatality. A mechanic was killed after being pulled into a snow thrower in 2007.

INVESTIGATION

The ski resort has 58 trails on 240 acres of skiable areas with a vertical drop of 1,600 ft. The snowmaking operation for the season started in November of 2011. Workers worked in two 12-hour shifts making snow around the clock. They set up snow guns and connected the guns to water and compressed air. Once the guns were operating, they monitored water and air output and cleared blockages in the system. Workers traveled around the mountain on snowy and icy trails by foot. Slips and falls were known by the facility to be major causes of worker injuries.

In the beginning of the 2011-2012 ski season, the resort provided all employees who are exposed to fall hazards, including parking lot attendants, lift maintenance and operating staff as well as snowmakers with microspikes with the intention of preventing and reducing slips and falls. The manufacturer described the product as a pocket-sized ice traction system that can be used for conditions that do not warrant a full crampon. According to the website advertisement, the microspikes can be used for traveling across ice, scree, snow-covered driveways and wet rocks and for activities such as snow shoveling, winter hiking and trail running. The microspikes have a flexible rubber top to fit over boots and metal chains with 3/8 inch spikes (photos 2 and 3). The workers in the snowmaking

department selected their microspikes based on their boot sizes and learned how to put them on over their boots. Employees could choose to wear the microspikes when they felt that they needed them.



Photo 2. Microspikes with rubber top fitting to fit over boots and metal chains with 3/8 inch metal spikes to provide traction on snowy/icy surfaces.



Photo 3. Microspikes fitted over a boot.

Workers used shovels to dig out buried hydrants or hoses. The mountain operations manager encouraged workers to carry shovels for support and stabilization while traveling across the mountain. Some workers preferred sliding down the mountain in a seated position. This was discouraged by management due to the concern that the sliding might get out of control. It was emphasized that no one should ride the shovels to descend the mountain. The recommended clothing for snowmakers was a water repellent suit such as a Carhart or ski jacket. Rain gear was not allowed due to being too slippery. Workers were provided with hardhats that did not have chin straps and ear muffs for hearing protection (snow guns can generate noise levels up to 100 dBA). Although radios were available for workers to use, the snowmaking department did not require all workers to carry radios. It was reported that the radios did not work in some areas of the mountain.

Snowmakers worked in pairs on assigned trails; new hires or those with less experience were teamed up with more experienced snowmakers. The western side of the mountain was steeper and icier. More experienced and skilled snowmakers were assigned to work on the west side. A few of the most experienced and skilled snowmakers were trained in using crampons and ice axes. Since crampons can cause serious injuries for untrained users, the snowmaking department did not allow untrained workers to use crampons. The victim always worked on the less steep and icy eastern side along with a more experienced partner.

On the day of the incident, the victim reported to work at 7 AM. He was assigned to work on an expert-rated ski run on the east side with a partner. They were to hook the snow guns to the air and water hoses. The two workers took the lift to the summit. Both workers wore hard hats, ear muffs and boots with microspikes. Neither of them carried a radio, nor did they carry a shovel.

At approximately 9 AM, the victim hooked up the last gun on the run and started descending a lower trail (also expert rated) to get to a lift station. There had been a prolonged period of warm rainy weather followed by a cold front with temperatures dropping to single digits in consecutive days prior to the incident. The lower trail, that was approximately 100 ft wide, was icy and not groomed. The trail began with a steep section, followed by a flattened stretch and then another steep section. The skiers left side of the trail was less steep. The skiers right side of the trail was slightly elevated and then dipped into a wooded area. There were no skiers on the trail since the lifts were not yet open. The workers decided to descend from the skiers left side since it was less steep.

The partner took the lead traversing to the skiers left side of the trail and then started descending. He later stated that the microspikes provided adequate traction as he traversed and descended. The partner was approximately 30 feet down the trail when he heard the victim calling for help. He turned around and saw the victim sliding down the middle of the trail in a seated position. He did not see how the slide initiated: whether the victim slipped and fell or intentionally began descending in the seated position. The victim was trying to stop with his hands and feet but could not. He was gaining speed as he slid past the partner towards the skiers right side of the trail and into the wooded area. The partner quickly reached the victim who was unconscious next to the base of a clump of trees. The partner tried to get the victim up, but his body was limp. The partner then immediately walked down the trail to the lift station to call the ski patrol. According to the partner, it took approximately five minutes for him to reach the lift station. The ski patrol rescue team descended from the summit lodge and arrived on scene about 5 minutes after receiving the call. The rescuers extricated the victim and performed CPR while transporting him on a toboggan to the base area first aid station where the victim was pronounced dead at 9:26 AM by a coroner. The immediate cause of death on the death certificate was cardiopulmonary arrest due to skull fracture and subarachnoid hemorrhage.

RECOMMENDATIONS

Recommendation #1: *Ski resorts and areas should conduct a job hazard analysis and implement a comprehensive fall prevention program.*

Discussion: Incidents associated with serious injuries and deaths can occur when snowmaking staff traverse mountains and descend icy trails, ride snowmobiles, ATVs and trucks, and inadvertently collide with trees, snowmaking equipment, skiers or boarders. NY FACE analyzed injury data from approximately 40 ski areas in New York State between 1999 and 2009 and found that approximately 40% of all injuries were caused by slips and falls.

Mild winters that offer less snow and more rain may become the norm based on the current weather trends. Ski resorts especially in the northeast have come to rely more on manmade snow to sustain and survive the ski seasons. The increased manpower, time duration, and intensity of snowmaking subjects workers to even higher risks for serious injuries. Employers should conduct a job hazard analysis to identify specific risk factors. A comprehensive and synergistic approach should be taken to manage, control and reduce the risks. A fall injury prevention program should include the following components:

- Engineering and administrative controls:
 - Replace and renovate the snow guns so that they need less frequent maintenance
 - Groom icy trails before allowing snowmakers onto them
 - Provide lift services for snowmakers
 - Construct alternate safer travel routes for snowmakers
- Proper personal protective equipment including head protection and safe clothing and footwear
- Adequate employee training on hazard recognition and safe work practices to prevent and reduce slips and falls.

Recommendation #2: *Ski resorts and areas should explore and implement feasible measures to reduce the frequency of maintenance of snowmaking equipment through upgrading, modifying, retrofitting or replacing the old equipment and system.*

Discussion: Old air-water guns that work the best in high winds and cold temperatures demand high maintenance compared with the new automated snow guns. Ski resorts and areas should work with the equipment manufacturers to explore and implement feasible measures for automation and maintenance reduction through upgrading, modifying, retrofitting or replacing old snowmaking equipment and systems. More efficient and automated snowmaking equipment and systems can improve working conditions and reduce energy and other operation costs as well.

Recommendation #3: *Ski resorts and areas should groom steep and icy trails before allowing snowmaking staff onto them.*

Discussion: Under icy conditions, employers should coordinate snowmaking with the trail grooming operation. The employers should ensure that steep and icy trails are groomed before sending snowmaking crews to these trails. Groomed trails have more secure footing and can reduce the risk for worker fall injuries.

Recommendation #4: *Ski resorts should identify high risk areas for slips and falls and design and construct alternate routes for workers to travel.*

Discussion: Ski resorts should survey the snowmaking routes and identify high risk areas. Employers may consider modifying the routes and the area to make it less steep, adding barriers to prevent sliding and falling, or constructing alternate or additional “service” or “access” routes for snowmaking crews to travel safely.

Recommendation #5: *Ski resorts and areas should consult with manufacturers and their retail representatives to ensure the right selection of traction footwear for snowmakers and learn the limitations of such footwear.*

Discussion: Snowmakers are exposed to a variety of surface conditions including powder, frozen granular, hard packed, and hard glazed surfaces created by freezing rain or old surface snow melting and quickly refreezing, or by ground water seeping up into the snow and freezing. Some expert trails are as steep as 40 degrees at this particular ski resort. Footwear that provides adequate traction for parking attendants or lift operators, may not prevent slips and falls for snowmakers.

There is a wide range of snow/ice footwear currently available on the market offering varied traction mechanisms and fitting types. The traction mechanisms range from studs, chains, spikes and beads to conventional crampons. Many designs offer both flexible and fixed top fittings. Each type of footwear works best for the weather and ground conditions that it is specifically designed for. It is very important for ski areas to consult with the manufacturers and their sales representatives to choose the appropriate footwear for workers before committing to purchasing a particular type of footwear. Each type of traction footwear has its limitations. It is important to know those limitations so that users can be trained in proper precautions under a variety of conditions.

Recommendation #6: *Ski resorts and areas should provide snowmakers with ANSI Type II Class G hard hats with chin straps for head protection.*

Discussion: Snowmakers are exposed to overhead hazards including broken tree branches and ice falling from the snow guns and towers. Side (lateral) impact protection is also needed if a worker falls or strikes (or is struck by) an object such as trees, rocks, mobile equipment, or skiers. Snow guns can generate noise levels exceeding 100 dBA (OSHA allowed time weighted average exposure is 90 dBA) and many snowmakers have to wear hearing protection. Ear muffs rather than ear plugs are generally preferred by ski workers since they are easier to handle with gloved hands. Considering all of these conditions, ideal head protection for snowmakers should provide penetration and impact protection against both vertical falling objects and lateral strikes, stay on the worker’s head during a fall or collision, and have the ability to be worn with ear muffs.

The American National Standards Institute (ANSI) establishes both performance and testing standards for industrial helmets in “*Standard for Industrial Head Protection*” (ANSI Z89.1-2009). As required by OSHA, all head protection must meet the ANSI standard. ANSI classifies industrial hard hats by types (Type I and Type II) and classes (E, G and C) based on the types of penetration and impact protection and electrical insulation ratings. A Class E (electrical) helmet is tested to withstand 20,000 volts; Class G (general) can withstand up to 2,200 volts while Class C (conductive) provides no electrical protection.

A Type I hard hat offers top or crown protection against objects falling from overhead. It is designed to protect workers from head trauma on the crown of the head and prevent the force of the impact from transmitting down the spine. A Type II hard hat offers both crown and lateral impact protection. It has a foam liner made of expanded polystyrene that protects the top, front, back and sides of the head against impact force. The Type II hard hats are also tested for chin strap retention based on the ANSI testing standard (Type I hats are not tested for chin strap retention). Therefore Type II Class G hard hats with chin straps are the best available choice for snowmakers. These hard hats can be worn with attached muffs.

The victim in this case was wearing a Type I hard hat without a chinstrap. The hard hat fell off the victim during the fall and the victim suffered fatal crushing injuries to the head.

Recommendation #7: Ski resorts and areas should provide snowmakers with training on fall prevention.

Discussion: An effective employee training program is key to the success of fall injury prevention. Ski resorts and areas should develop a comprehensive employee training program to include the following components:

- 1) **Risk factors for falls:** Snowmakers are at high risk for slips and falls while descending icy trails, riding snow mobiles, ATVs or trucks, and inadvertently colliding with trees, snowmaking equipment, skiers or boarders. Recognition of these risk factors can help snowmakers take precautions to avoid hazardous conditions.
- 2) **Measures to prevent falls:** Workers should learn the measures for fall prevention that include traversing instead of descending straight down an icy trail, taking alternate routes that are less icy and steep and have better footing, and operating equipment only if trained and permitted to operate it.
- 3) **Personal protective equipment usage and their limitations:** Workers should receive training on the use of personal protective equipment (PPE) including proper head protection, foot wear and protective clothing. It is important for workers to learn the limitations of the PPE so that they can take precautions in hazardous conditions to prevent serious injuries.

Recommendation #8: Ski resorts and areas should provide all snowmakers with radios and require them to carry the radios whenever they are working on the mountains.

Discussion: The employer in this case provided radios to the snowmaking crew, but did not require them to carry the radios. The victim's partner had to descend on foot to the lift station to use the phone to summon the ski patrol causing a delay in rescue. Ski resorts should provide radios to snowmaking staff and require them to carry the radios whenever they work on the mountains.

According to the mountain management, radios did not work on some areas of the mountain. Radio signals are transmitted by line of sight. Trees and mountains can block the radio signals. It is a common problem that the ski areas have to deal with. Resorts should survey the ski areas, identify the "dead zones" and work with radio companies to construct additional radio towers to ensure radio signal coverage.

Recommendation #9: *Ski resorts and areas should develop an emergency response plan to ensure a timely delivery of emergency medical service in case of worker injury.*

Discussion: Many ski resorts in the northeast make snow around the clock during ski seasons. Because of the snowmakers' harsh working environment, rescue can be challenging. Without coordination, preparation and training, rescue may be delayed. Employers should develop a medical emergency plan to ensure that the medical emergency/rescue service is readily available during all working hours.

During the normal business hours when the resorts are open, ski patrols can respond to worker emergencies. Resorts will need to decide how to cover the time when ski patrols are off duty. One solution is to have ski patrols on duty whenever snowmaking is conducted. If a resort decides to use the community medical emergency services instead, it needs to coordinate with local fire department and ambulance services so that the EMT staff know the routes to get to the mountain and have appropriate gear to respond to on-mountain situations. Resorts should make sure that during each shift there are trained staff who can coordinate and assist the rescue.

Keywords: *snowmaker, fall, icy surface, ski trail*

REFERENCES

1. *American National Standard for Industrial Head Protection.* ANSI/ISEA Z89.1-2009. Virginia: International Safety Equipment Association, 2009.

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