



## Worker falls from ladder when gutter hits high-voltage line

Three workers were installing new roof gutters on a three-storey apartment building. Two of the workers were on the roof, and the third was on an extension ladder. The three workers were lifting a 56-foot section of gutter onto the roof. Because of the gutter's length, the top end protruded above the edge of the roof, while the lower end came to rest on the edge of the roof. As the worker on the ladder lifted the lower end of the gutter, the top end contacted the inboard conductor of a high-voltage circuit. On electrical contact, the worker on the ladder fell 22 feet onto a concrete patio. The worker later died of his injuries.



### Purpose of this report

The purpose of this online incident investigation report is to identify the causes and contributing factors of this incident to help prevent similar incidents and to support preventive actions by industry and WorkSafeBC. This online version is not the official WorkSafeBC report. It has been edited to remove personal identifying information and to focus on the main causes and underlying factors contributing to this incident.

### Notice of Incident information

Number: 2006114550142

Outcome: Fatal

Core activity: Gutter installation

Region: Lower Mainland

Date of incident: May 2006

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# 1 Factual Information

## 1.1 Work site

KR Gutter Systems Ltd. (the employer) had been hired to install new gutters on a three-storey apartment building. The building had a flat roof, and the new gutters were to be installed around the perimeter of the roof (see Figures 1 and 2).



*Figure 1: South side (front) of building.*

The ground sloped away slightly from the building on the south side, which meant that the distance from the ground to the roof was greater on the south side than on the north side. The entrance to the underground parking garage was located on the building's south side.

### 1.1.1 Low-voltage power lines

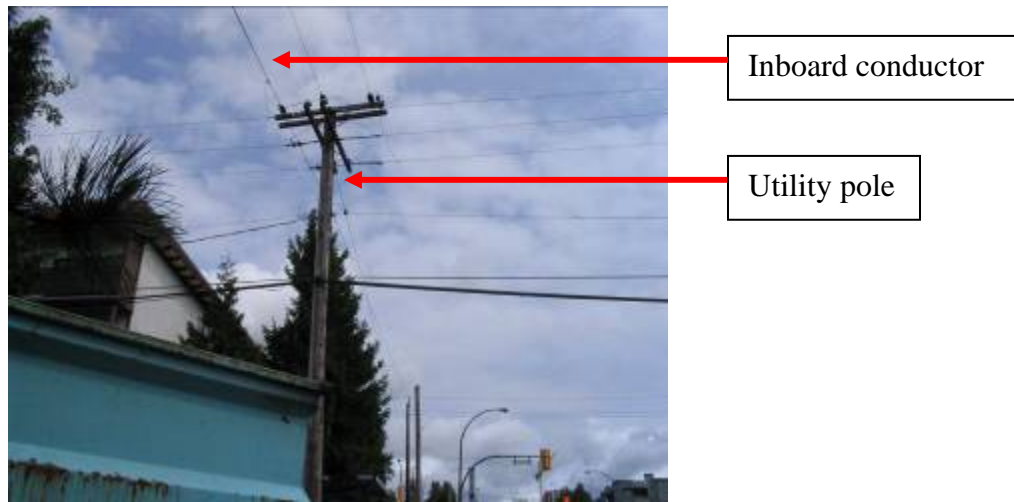
Low-voltage power lines entered the building at the north end, or rear, of the building. These wires were yellow and highly visible.



*Figure 2: North side (rear) of apartment building and truck location.*

### 1.1.2 High-voltage power lines

A utility pole carrying high-voltage power lines was located northeast of the building. A 12-kilovolt (kV) circuit supplying electricity to the area consisted of three energized conductors and one neutral line. An inboard conductor (7.2 kV) that was part of the high-voltage circuit was located about 20 feet away from the edge of the building's roof (see Figure 3).



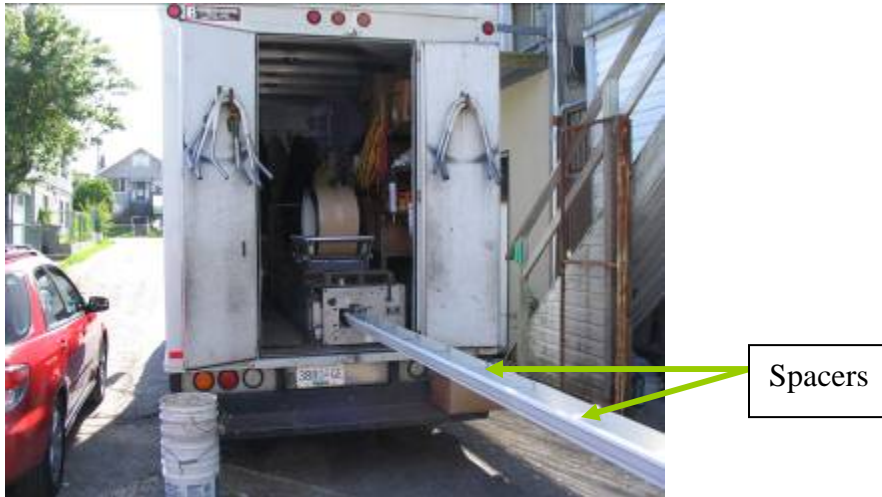
*Figure 3: High-voltage power lines located northeast of the building.*

## 1.2 Gutter installation

Repairing gutters, installing new gutters, and cutting gutters to length require hand and power tools. Workers should be physically fit and able to climb a 36-foot ladder. Typically, some workers work on the roof, where they measure the required lengths of gutter and call these lengths down to another worker in the truck. The worker in the truck cuts the appropriate lengths of gutter, then carries the gutters to the building and lifts them up to the workers on the roof. Sometimes the workers on the roof come down to help carry up gutters, particularly when they are long and unwieldy.

### 1.2.1 Equipment

Gutters are usually cut to measure on the job site. A gutter-forming machine is transported in a truck. A spool of aluminum is fed into the machine, which shapes the aluminum into gutters. The gutters are then cut to the desired length. Spacers are inserted to maintain the gutter profile (see Figure 4).



**Figure 4:** Gutter fabrication machine in rear of the employer's truck.

### **1.2.2 Hazards of gutter installation**

Typical hazards of gutter installation arise from the use of ladders and scaffolding, working from heights, and overhead electrical conductors. A company representative visited the work site before the job to identify any safety hazards. He then met with the crew and discussed the job requirements, the hazards, and the safety precautions they should take.

### **1.2.3 Safety training / supervision**

Typically at the job site, a crew supervisor will set up for the day's work, assigning tasks and reviewing any job site hazards. The supervisor will train and observe new workers to ensure the safe performance of their duties. As the job progresses, the supervisor also monitors the crew's activities and any foreseeable safety hazards.

## **1.3 Crew responsibilities**

The crew for the gutter installation job consisted of Worker 1, Worker 2, and Worker 3. The crew divided the work as follows:

- Worker 1 worked on the roof, assisting Worker 2 in measuring lengths of gutter and attaching gutters and downspouts.
- Worker 2 was the crew supervisor. He worked on the roof, measuring the required lengths of gutter and deciding where to place downspouts.
- Worker 3 stayed on the ground, manufacturing lengths of gutter in the truck. He sometimes assisted in installing gutter lengths if they were long or in awkward areas.

## **1.4 Pre-job planning**

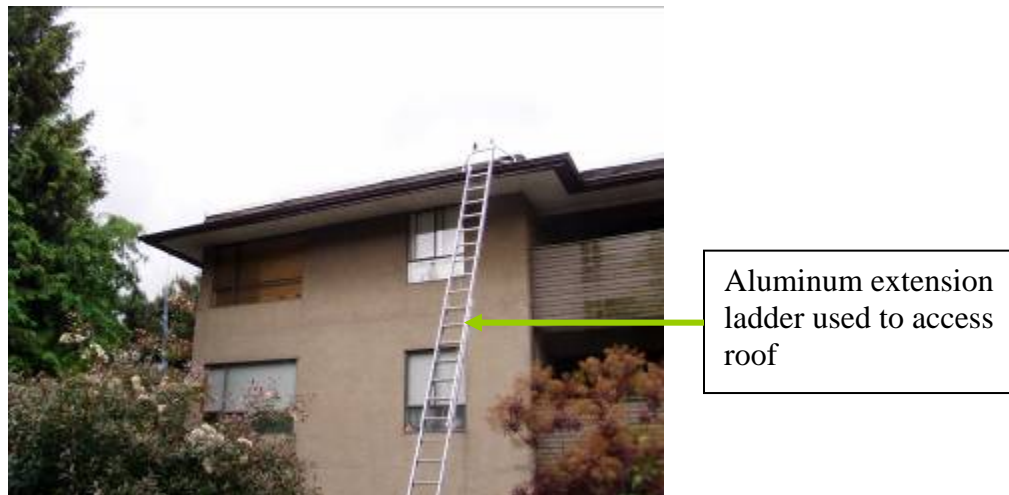
The employer developed a work plan for the project and performed a hazard analysis of the site. This plan was discussed in the shop with the crew before installation. It was decided to locate the truck in the alley, place the aluminum extension ladder at the northeast part of the building due to the location of the incoming low-voltage wires, and use the available roof anchors to secure ropes for fall protection. The

employer did not identify the high-voltage lines as a hazard and therefore did not discuss them with the crew.

## 1.5 Incident

Workers 1, 2, and 3 arrived at the apartment building to install a new gutter around the roof's perimeter. The weather conditions were dry and partially overcast.

The crew parked the gutter truck in the lane behind (on the north side of) the building and set up an aluminum extension ladder on the northeast end of the building (see Figure 5). Worker 1 and Worker 2 climbed up onto the roof. They measured the required lengths of gutter and called the lengths down to Worker 3, who made the gutters to length in the truck on the ground. Worker 3 passed the finished gutter sections up the extension ladder to Worker 1 and Worker 2 on the roof, who then installed the gutters.



**Figure 5:** Ladder on north side of building. The low-voltage lines are not visible in this photograph but are located 25 feet to the right of the ladder.

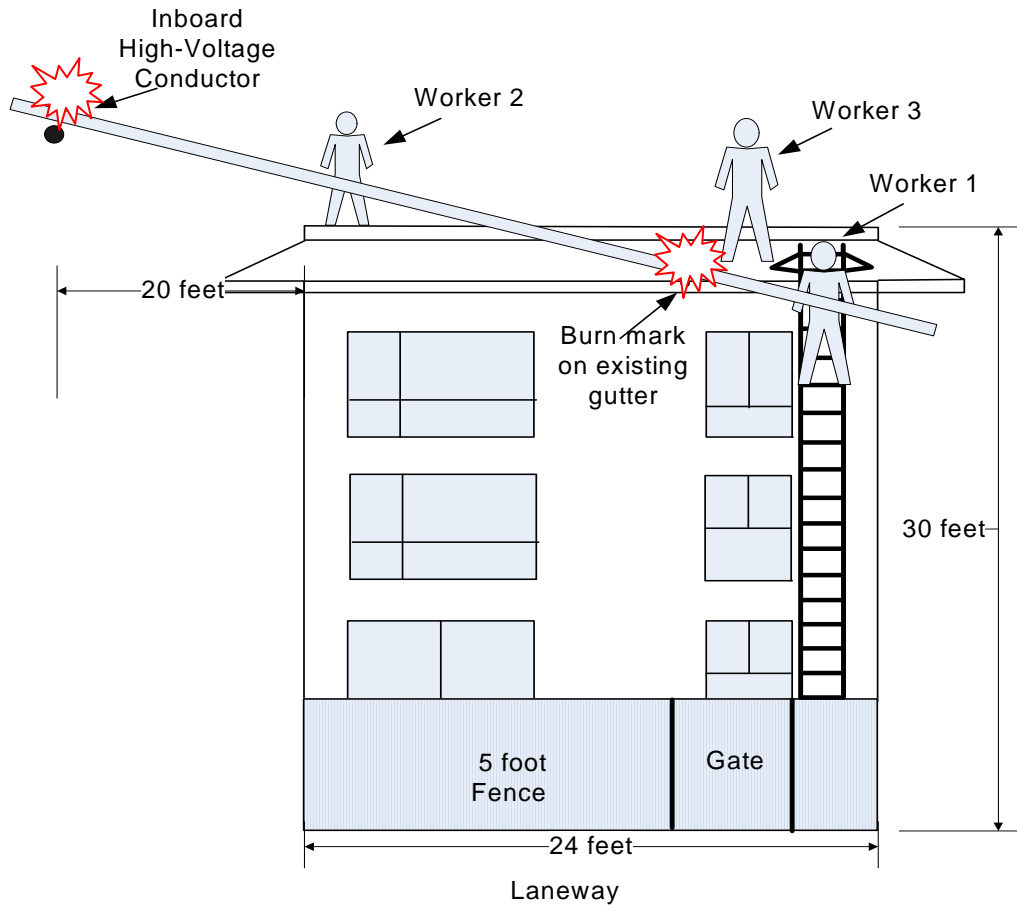
The crew started installing the gutters midway on the north side of the building, then worked their way around the east side to the south side. A gutter length of 56 feet was required for a mid-section span on the south side. Workers 1 and 2 both came down the extension ladder to help carry up the long gutter. Worker 1 set up a small stepladder in the lane near the extension ladder and climbed up on it to support the lower end of the gutter. Worker 2 climbed up the extension ladder, carrying the top end of the gutter.

Worker 3 climbed up the extension ladder behind Worker 2 to support the gutter in the middle. After climbing up the extension ladder with the top end of the gutter, Worker 2 climbed onto the roof, walked over to the east end, and began sliding the top end of the gutter over the northeast edge of the roof as Worker 3 climbed higher on the extension ladder.

Worker 1 got down from the stepladder and started climbing the extension ladder, carrying the lower end of the gutter. Worker 3 climbed onto the roof and waited for Worker 1 to pass up the lower end of the gutter. Worker 2 continued to slide the gutter over the edge of the roof, while Worker 1 climbed higher up the ladder. The lower end came to rest on a section of gutter that had already been installed on



the north side of the roof. The top end of the gutter now protruded 20 feet beyond the edge of the roof and rose above the high-voltage power lines. As Worker 1 lifted the lower end of the gutter, the top end began to come down and contacted the inboard conductor, which was attached to the utility pole located near the building (see Figure 6).



**Figure 6:** Positions of workers, gutter, and high-voltage power lines.

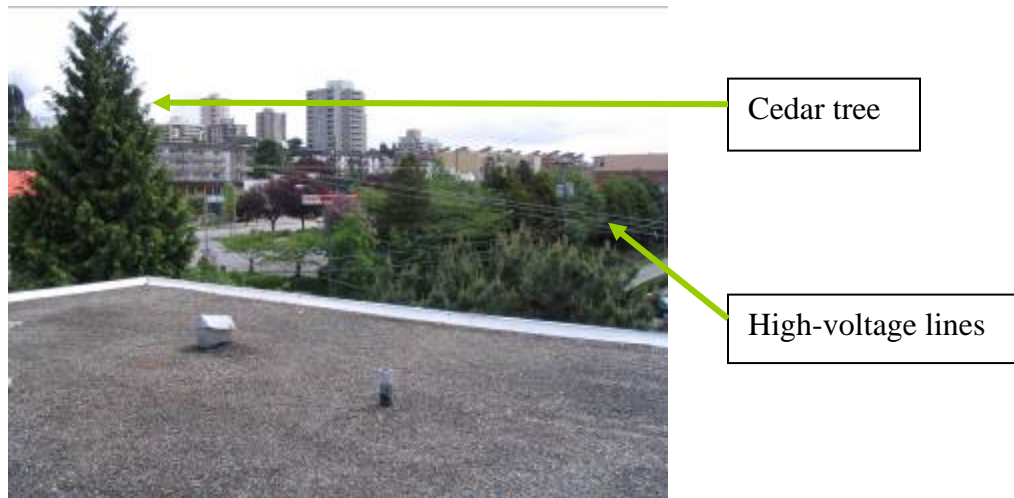
When the gutter contacted the power line, Worker 2, who was standing on the flat roof and positioned closest to the high-voltage line, was still holding the gutter. He felt nothing but heard a loud bang and saw a flash of light beside Worker 1. Worker 3 heard a bang and also saw a flash of light where the lower end of the gutter contacted the existing gutter. Almost instantly Worker 1 let go of the lower end of the gutter and fell backwards off the ladder 22 feet onto the concrete patio.

Worker 2 pulled the gutter up and over the edge of the roof before climbing down the extension ladder, followed by Worker 3. Both attended to Worker 1. A tenant who had heard the loud bang and lost her electricity came to help the workers and called 9-1-1. Worker 1 was taken to the hospital but later died from his injuries from the fall.

## 1.6 Visibility of high-voltage power lines

From the point of view of someone standing on the roof and looking northeast, a large cedar tree obscures the utility pole (see Figure 7). The grey high-voltage lines run parallel to the roof of the

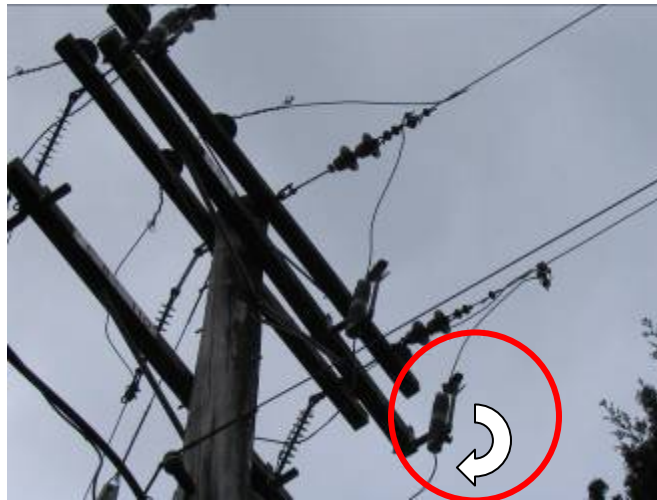
building and blend into the background. This would especially be true on an overcast day like the day of the incident.



*Figure 7: View of power lines from the roof of the building, looking northeast.*

## 1.7 Electrical damage

When the gutter contacted the conductor, a 100-amp fuse tripped, resulting in a loud bang. The fuse arm (see red circle in Figure 8) released and swung down, causing a power outage in the area.



*Figure 8: 100-amp fuse.*

After the incident, a burn mark was found near the upper end of the gutter, where contact was made with the inboard conductor. Another burn mark was found near the bottom end of the gutter, where it had been resting on the section of gutter that had been installed earlier.

## 1.8 Coroner's findings

The coroner found no evidence of electrical burns on Worker 1 when he was admitted to the hospital. Worker 1's fatal injuries were caused by the fall.



## **1.9 Employer and worker experience**

The employer had been installing and repairing gutters for over 25 years.

Worker 1 had been working in construction as a labourer for less than five years and had been with this employer for less than six months. Worker 1 was being trained by and was under the direct supervision of Worker 2. Worker 2 had more than 15 years of experience installing gutters. He was the supervisor of the crew and was directly involved in training Worker 1. Worker 3 had more than 15 years of experience in the gutter installation industry and worked mainly to make the lengths of gutter from the truck.

## **2 Analysis**

This analysis looks at why the job was carried out the way it was, why certain safety hazards went unrecognized, and why Worker 1 fell to his death.

### **2.1 Why did the workers position the ladder where they did?**

The workers positioned the 36-foot aluminum extension ladder at the rear (north) of the building for several reasons:

- The front (south) side of the building was 11 feet higher than the north side, due to the slope of the land. The extension ladder was not long enough to reach all areas of the roof.
- The volume of traffic entering and exiting the underground parking on the south side presented a hazard to the workers. The north side was the most convenient place to park the truck (away from traffic, out of sight of the street, and with enough room). Also the workers needed to keep the ladder near the truck, where the gutter sections were made.
- Low-voltage power lines were located on the north side of the building. The workers recognized these lines as a hazard because of their proximity to the building, their size, and their bright yellow colour, which symbolized “caution.” Accordingly, the workers developed a work plan to avoid contact with the low-voltage power lines and decided to put the ladder near the northeast corner of the building, away from the lines.

### **2.2 Why was a 56-foot-long gutter manufactured?**

Gutter lengths are generally made in one piece to eliminate seams and potential leaking points. In this case, 56 feet was the required length to span the front edge of the roof in one piece. The maximum length the crew would install in one piece was 60 feet. These long lengths are very flimsy and need support so that they will not buckle. The 56-foot-long gutter was not heavy, but it was awkward to manage.

### **2.3 Why did the crew slide the gutter section past the edge of the building?**

The crew decided to slide the gutter along the roof and extend it over the east side of the building in order to keep the lower end away from the low-voltage lines attached to the building.

## **2.4 Why didn't the workers recognize the high-voltage lines as a hazard?**

In the pre-job planning the employer did not mention the high-voltage lines. Also, the installation crew did not realize that the high-voltage lines were close to the building. Without incident earlier in the day the crew installed gutter along the building's entire east side, which ran parallel to the high-voltage lines.

### **2.4.1 Power lines in peripheral vision**

The investigation looked into the limitations of human vision to see how this might have affected the workers' perception of the high-voltage power lines. Objects in our peripheral vision are not as clear as they are in our main area of focus. As Workers 2 and 3 would have been looking towards Worker 1, the high-voltage lines would have been in their peripheral vision at the time of the incident. Depth perception of objects in peripheral vision is not as accurate, and the workers would not likely have had a strong sense of distance.

### **2.4.2 Utility pole was not visible**

One expects high-voltage lines to be connected to a utility pole, yet the closest utility pole for the high-voltage lines was concealed by a large tree (see Figure 7). A solid object, such as a utility pole, is easier to see than a thin object, such as an electric wire. Without the visual connection of the lines to the pole, the lines appeared out of their expected context. This would decrease the likelihood of the workers noticing the lines.

### **2.4.3 Limited contrast of the power lines against background**

Contrast—which is the difference in brightness, colour, or texture between an object and its background—affects the visibility of objects. The grey high-voltage lines, viewed against the grey sky, produced limited contrast, making them difficult to see. Grey high-voltage lines do not emphasize their importance and hazardous nature.

## **2.5 Why did Worker 1 fall?**

Worker 1 probably received an electrical shock, which knocked him backwards and caused him to fall from the ladder onto the concrete patio. The exact amount of voltage that Worker 1 received cannot be determined. Many variables could have affected the actual voltage he received: whether or not he was holding on to, or resting against, the aluminum extension ladder; the length of the gutter; the thickness of the gutter material; the humidity in the air; and the gutter's contact with the existing gutter. However, the coroner reported that there was no evidence of electrical burns found on Worker 1 when he was admitted to the hospital and that his fatal injuries were caused by the fall.

## **2.6 Why did Worker 2 not get an electric shock?**

It is likely that Worker 2, who was closest to the inboard conductor, did not feel any electricity because he was well insulated by good footwear and was protected by standing on the building's roof.

## 3 Conclusions

### 3.1 Findings as to causes

Worker 1 received fatal injuries when he fell from the ladder after the section of aluminum gutter he was holding came into contact with an electrical conductor located near the building he was working on.

### 3.2 Findings as to underlying factors

- The high-voltage lines in the area were not discussed at the pre-job meeting as the employer had not identified them as a hazard. The crew developed a plan to avoid the low-voltage lines entering the building but did not recognize the high-voltage lines as an electrical hazard.
- The length of the gutter made it necessary to extend it above the roof of the building to manoeuvre it onto the roof. This position of the gutter created a safety hazard.

## 4 Orders Issued after the Investigation

WorkSafeBC issued an order after the investigation. An order requires an employer to take steps to comply with the *Workers Compensation Act* or Occupational Health and Safety Regulation, to take measures to protect worker health and safety, or to fix a hazardous condition. An order is not intended to identify fault on the part of the employer but to ensure that unsafe conditions are identified and corrected and that the employer complies with the Act and the Regulation. An employer may ask the Review Division to review an order; the Review Division may confirm, vary, or cancel an order.

In addition to issuing orders, WorkSafeBC may recommend proceeding with an administrative penalty against an employer. Penalties are fines for health and safety violations of the *Workers Compensation Act* and/or the Occupational Health and Safety Regulation. For information on when penalties are considered and how the amount of the penalty is calculated, see the [penalty FAQs](#) on WorkSafeBC.com. [Companies that have been penalized](#) are also listed on the web site.

### 4.1 Order to KR Gutter Systems Ltd.

This section summarizes an order to the employer. The investigation found that this employer was in contravention of the *Workers Compensation Act*, [section 115\(2\)\(b\)\(i\)](#), which states that an employer must ensure that the employer's workers are made aware of all known or reasonably foreseeable health or safety hazards to which they are likely to be exposed by their work.

The employer did not discuss the high-voltage power lines at the pre-job meeting because the lines had not been identified as a hazard. As a result, the workers allowed the gutter to come within the limits of approach. The gutters should have been kept a minimum distance of 3 metres (10 feet) from the power lines, according to [section 19.24](#) of the Occupational Health and Safety Regulation.

## 5 Health and Safety Action Taken

In addition to the specific actions below, employers, workers, or others in industry may have taken measures to prevent this type of incident. Employers are expected to comply with any orders issued. At WorkSafeBC, the Lessons Learned committee examines recommendations from incident investigations to see what can be done to prevent similar incidents.

### 5.1 The employer

- The employer has limited the gutter lengths to be manufactured on-site to 45 feet.
- All jobs will have a Work Site Safety Inspection Sheet. It will contain a layout of the job, showing any problem areas and will be discussed with the installation crew in the pre-job meeting.
- The supervisor will do a walk-through on all jobs to verify any problem areas before work begins.

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