

## **Do I Need A Rocket Scientist?**

**By Michael Cloutman**

**“Do I need to hire a rocket scientist?” I thought to myself while running correlations between lift faults and sunstorm activity.\***

**The level of technology, and with it increased safety categories, has been impressive over the last few years. However, it seems with every increase in technology comes increased fragility. PLCs and PCs are very particular about their environment. Combining CPUs with lift systems is like hooking your computer to a giant antenna.**

**Thanks to all these electronics, lift problems are becoming more complex. While ten lifts may function perfectly, though, there are occasionally installations that will experience problems due to their environment.**

**Angel Fire ski area in New Mexico has one such lift. It encountered numerous shutdowns and electrical issues, and we couldn't seem to eliminate them. We basically had to start over from the ground up when investigating the sources of our problems.**

**The problems we were having with this lift came to a head in 2000-2001 ski season. We discovered this also coincided with one of the worst years in recent history for sunspots and solar storms. We discovered that two aspects of this lift were contributing to the electronic nightmare: with its length, nearly two miles long, and its orientation, along a perfect east-west axis, the lift was acting as a giant catch net for any solar winds that pushed geomagnetic storms down from magnetic north.**

**Then we looked at other environmental factors that might effect the lift. There were induced voltages on the haul rope from a power line that ran parallel to the lift. The towers themselves were acting as antennae, picking up radio communications from 100 miles away. The power quality we were getting was not the cleanest.**

**In the summer, lightning was taking a large number of proximity switches along with I/O blocks and fuses in the filter bank, and it was damaging our computer operating system, which became corrupted due to the constant noise and power fluctuations.\* There is a radio station transmitting tower on one side of the drive, and the diesel APU would seek the radio frequency instead of the magnetic pickup frequency, causing the lift to surge and droop.**

**Discovering the sources of these problems—and their solutions—required much research. We consulted with people from diverse fields: power quality experts, grounding experts, surge protection people, consultants who worked with NASA, lift specialists with years of experience and radio communications professionals.\***

**Ultimately, though, it was the Angel Fire Lift Maintenance and electrical department that had to sort through all the data and come up with solutions. And these proved to be as complex as the problems.**

### **Exorcising the Demons**

**Starting from the ground up, we looked at grounding and bonding. We installed a ground loop around the top and bottom terminals and bonded together through all the towers. This eliminated any potential differences and gave all the noise we were picking up a place to go. This also helped with the lightning in the summer.**

**Surge protectors and filters were put on all incoming power, including the power to the battery chargers for the control circuits. We also put protection at the end of our power rails on the towers. The power line was buried, and the top one third diverted away from the lift. We went through all**

bonding and tried to equalize all potential differences. A new operating system was installed that did not require top to bottom I/O links.\* We also installed Franklin rods on all the towers to divert lightning away from the proximity switches.

We discovered that the haul rope needed to be grounded at all times, especially in the summer when trying to unload the lift with severe weather approaching. This was achieved by putting grounding studs in the bullwheel at the return and grounding brushes at the drive.

The fix was not perfect, but lift downtime was dramatically reduced in both summer and winter. We no longer lost proximity switches and other components due to lightning. We were also able to reduce the weather window. Before we completed our fix, lightning 40 miles out would fault the lift. Last summer a tower took a direct hit and the lift stopped—but reset immediately, with no lost components. Our equipment was also protected when the local Power Company decided to drop the power to both our quads this past winter, without notification. The same occurrence two years before took out blower motors and other 480 VAC equipment. The faults on the operating system were reduced to nuisance faults and did not cripple the lift.

### Lessons of Experience

Our experience shows just how much lift maintenance has changed. Lift maintenance personnel are now required to be acquainted with more than just mechanical systems. They must also know electrical, electronics components, computer operating systems, PLC programs and troubleshooting, power quality, grounding, bonding, and the effects of environmental factors on lift systems. These environmental effects can be local, such as poor harmonics due to unfiltered DC drives, or global, such as sunstorm activity.

And so the answer to the question posed back in the beginning is yes, for at least one resort we know of. Taos Ski Valley in New Mexico has an electrician so well versed in multiple disciplines that they did, in fact, hire a rocket scientist to apprentice with him. The resort management reasoned that only a rocket scientist would be able to replace head electrician Dan Craybill when he eventually decides to retire. Simply hiring another electrician—even a very good one—would not cut the mustard.

The answers to modern lift problems are not cut and dried. They require eliminating as many detrimental factors as possible and taking a broad overview of the problem. Lift maintenance personnel can not let themselves get tunnel vision.

Ultimately we cannot put ski lifts into a Faraday cage isolating them from their environment. The lift industry needs to begin to look at lift-specific environmental technologies. This will be a hard task, since most lift technology comes off the shelf from technologies that fit a wide range of applications. But we must find ways to adapt them for our purposes, and our extraordinary environment.

1. Space Environment Center-<http://sec.noaa.gov> for real time space weather, alerts and forecasts.
2. MTI surge protection, PowerQC power quality and grounding, Decker communications radio and other telecommunications. Leitner-Poma Mikel Carhart extensive lift professional.
3. Leitner-Poma operating system courtesy Mikel Carhart
4. Conversation with Dan Craybill Rocky Mountain Lift conference 2002