An Overview of Lightning Detection Equipment

By Richard Kithil, President & CEO, NLSI

Lightning hazards can be mitigated by advanced planning. One part of this safety program should include an early detection and warning alarm package. Lightning detectors can give notice to shut down dangerous operations before the arrival of lightning. They also may signal "all clear" conditions after the lightning threat has passed. Some type of detection package may help you with Duty-To-Warn issues.

Lightning detectors vary in complexity and cost from large dedicated equipment packages costing in excess of $150,000 to inexpensive $20-$30 Radio Shack portable weather radios. The Flash-to-Bang (F-B) Method requires no dedicated detector: only counting the time in seconds from seeing lightning's flash, to hearing the associated thunder or bang. For each five seconds, lightning is one mile away. Thus, a F-B of 10 = 2 miles; 15 = 3 miles; 20 = 4 miles; etc.

The distances from lightning Strike A to Strike B to Strike C easily can exceed more than five miles. How much time is needed to get to shelter? Three to four minutes is suggested. Suspension of activities is very site-specific. For general situations, we recommend activating your lightning defense at a F-B of 30 (lightning is six miles away). We also recommend waiting to resume activities 30 minutes after the last observed lightning or thunder. This protocol may seem excessively conservative in many situations ("we'll never get anything done under such strict guidelines…"). It is a case-by-case risk management decision. And yes, safety and productivity sometimes are incompatible. Safety, however, always should be the prevailing directive.

Available technologies of the present day lightning detectors include:

1. **Radio Frequency (RF) Detectors**. These measure energy discharges from lightning. They can determine the approximate distance and direction of the threat.
2. **Inferometers**. These are multi-station devices, much more costly than RF detectors. They measure lightning strike data more precisely. Usually they require a skilled operator. See www.vaisala.com.
3. **Network Systems**. The *National Lightning Detection Network* and the *USPLN* systems cover all the U.S. and report lightning strikes to a central station. Local storm data is available by subscription. Past strike information is archived and accessible upon request. See www.lightningstorm.com and www.uspln.com.
4. **Electric Field Mills**. These pre-lightning equipments measure the potential gradient (voltage) changes of the earth's electric field and report changes as thresholds build to lightning breakdown values. For more on EFMs, see www.missioninstruments.com and www.campbellsci.com.
5. **Optical Monitors**. These can provide earlier warning as they detect cloud-to-cloud lightning that typically precedes cloud-to-ground lightning.

6. **Hybrid Designs**. These monitors use a combination of the other single-technology designs. Two or more sources of information (for example, C-C, C-G, optical recognition, EFMs) may be better than just one.
7. **Subscription Services**. NLSI recommendation: Rent a meteorologist. Here hired professionals make the critical decisions and advise you. This method may blunt claims of negligence if something goes wrong. And some of these companies can provide data sets on wind speed, rain, hail, tornado, and others. Off-site lightning detection by subscription is available from several vendors, including Meteorlogix.com ("Weather Sentry"), Weatherdata.com ("Sky Guard"), and Skyview-wx.com.

Lightning Detection Options - Accuracy vs. Cost vs. Complexity

Source of Information	**Accuracy**	**Cost**	**Complexity Level**
Hearing thunder	Danger is near	None	Simple
TV weather channel	General info.	None	Simple
Weather radios	General info.	Up to $40	Simple
Handheld detectors	50-60% accurate	Up to $500	Somewhat
Boltek system	70-80% accurate	Up to $1,500	Somewhat
WXLine system	90-95% accurate	Up to $7,000	Somewhat
Subscription service	95%+ accurate	Monthly fee	Simple

Beware of a false sense of confidence from detectors; none of them will detect all of the lightning all of the time. None of them will provide "first strike/bolt out of the blue" information or forecast in advance the positions of lightning strikes on earth. Various detector detection receiver algorithms operate at different frequencies and wavelengths: Boltek Stormtracker in the low frequency range 100-700 KHZ; Vaisala GAI NLDN at 100-400 KHZ; NMT Lightning Array at VHF 60-78 MHZ; NASA LIS and OTD optical at 777.4 m; Vaisala SAFIR VHF 109-119 MHZ; Vaisala GAI LDAR II at 50-120 MHZ; GAI VLF at 20-50 KHZ; the U.K. Meteorological Office RDI at 9.8 KHZ; etc. An excellent summary of families of lightning detectors and future research is at: http://thunder.msfc.nasa.gov/validation/instruments.html

Detectors can display early warning of lightning conditions to hazardous operations. Some detectors can start/stop standby power generators. A signaling or alarm notification method is essential to alert field personnel of developing dangerous circumstances. Two-way radios, remote activation siren packages, strobe lights, and other methods are available.

Essential companions to any type of lightning detector include: 1) a written lightning safety policy; 2) designation of primary safety person; 3) determination of when to suspend activities; 4) determination of safe/not safe shelters; 5) notification to persons at risk; 6) education — at a minimum consider posting information about lightning and your organization's safety program; and 7) determination of when to resume activities.

For many situations, if you hear thunder, your (brain) detector is working fine. Since lightning and thunder always occur paired, the lightning associated with the thunder you just heard is within your hearing distance – some 7 to 9 miles. Immediately go to safe shelter. No place outside is safe!

Select the detector and/or signaling device that is site-specific to your requirements, easiest to use, and offers the most favorable cost/benefit to your operation's budget. No detector is 100% perfect.

Summary: Detectors give advanced notice of the lightning hazard. Now consider other defenses to mitigate the hazard. Where is safe refuge? How long will it take to get there? How long should you stay there? What about computers and servers and telecommunications? Are facility bonding and grounding and surge protection OK? Are lightning rods required? For assistance in answering these questions, contact NLSI.