

# OVERVIEW OF LIGHTNING DETECTION EQUIPMENT

by National Lightning Safety Institute (NLSI). Rev. 7/16

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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 may give notice to shut down sensitive/dangerous operations before the arrival of lightning. Detectors also may signal "all clear" conditions after the lightning threat has passed. Lightning detection may assist you with Duty-To-Warn/Liability/Negligence issues.

Lightning detectors vary in complexity and cost from hardware ranging from large NASA-type equipment packages costing in excess of \$100,000 to inexpensive \$20-\$30 portable FM weather radios. "Apps" for cell phones are recent source of reliable information. Network systems consisting of off-site information services are available in many places. A very good detector already exists in all our brains: hearing thunder indicates the accompanying lightning is within our hearing range. (Thunder and lightning always happen together – acoustic and electrical signatures.) You may see lightning but don't hear thunder. That indicates lightning was beyond your hearing range.

The distances from lightning Strike A to Strike B to Strike C easily can be greater than 6-8 miles. Hear thunder? How much time is needed to get to shelter? Three to four minutes max. is suggested. Suspension of activities is very site-specific. For general situations, we recommend activating your lightning defense when thunder is first heard. Immediately find shelter! 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. People Safety, however, always should be the primary consideration.

A three stage warning criteria is recommended by *NFPA-780, Annex M*:

*Range 20-40 miles Yellow Alert – threat is possible;*

*Range 10-20 miles Orange Alert – threat is probable;*

*Range 10 mile Red Alert – Danger, No One Allowed Outside.*

Reducing these radii by +/-50% may be appropriate for highly-populated or high altitude or high lightning density or for capital-intensive operations. Safety is the Prevailing Directive.

Available technologies of the present day lightning detectors families include:

- a. Radio Frequency (RF) Detectors. These measure past energy discharges from lightning. They can determine the approximate distance and direction of the threat. For many such devices, accuracy is inversely proportional to distance. False alarms from spurious RF (ex. welding) are possible. Also, within this category are Cloud-to-Ground (C-G) and Cloud-to Cloud (C-C) and dual C-G

and C-C antennas. Is one better than the other? Or are both data sets useful? Why?

- b. Inferometers. These are multi-station devices, much more costly than RF detectors. These measure lightning strike data more precisely. Usually they require a skilled operator and most often are employed for research purposes.
- c. Network Systems. These ground-based integrated sensors cover entire countries. They report lightning strikes to central stations and to end users. For one example, examine the *National Lightning Detection Network* (See: Google – “NLDN”) for details.) Near real-time data is available by subscription and archive (historical) lightning is available.
- d. Electric Field Mills (EFM). This pre-lightning equipment measure the potential gradient (voltage) changes of the earth's electric field (cloud voltages) and reports changes as thresholds build to lightning breakdown values, in the range of 15KV. Expect narrow reporting range for many EFMs. False alarms from dust storms are possible.
- e. Optical Monitors. These can provide earlier warning as they detect cloud-to-cloud lightning that typically precedes cloud-to-ground lightning.
- f. Hybrid Designs. These monitors use a combination of the above single-signal technology designs, such as RF, or light or magnetic coincidental recognition. Two or more sources of information may be more accurate than just one source.
- g. Meteorological Subscription Services. Rent a Meteorologist. Off site professionals make the critical decisions and advise you. This method may deflect claims of Negligence if something goes wrong. Some of these skilled providers collect windspeed, rain, hail, t tornados and other data sets. A reliable incoming communications system is vital. Do-it-yourself smart phone “apps” include: Weatherbug’s “Spark”; “LightningFinder”; NOAA’s “Hi-Def Radar”; and others. These are sourced from Network System described above.

A caveat about all detectors --- investigate Detection Efficiency (DE) and Detection Ranging (DR) as indexes of overall accuracy. Investigate older technologies and their upgrades. Investigate after-sales support. Beware excessive claims of perfection.

#### Lightning Detection Options - Accuracy vs Cost vs Complexity

| <u>Source of Info.</u> | <u>Accuracy</u> | <u>Cost</u>  | <u>Complexity</u> |
|------------------------|-----------------|--------------|-------------------|
| Hearing Thunder        | Very good       | No Cost      | Simple            |
| Lightning APPs         | Accurate        | Low Cost     | Simple            |
| Weather Radios         | General Info.   | Up to \$40?  | Simple            |
| Handheld Detectors     | 50%+ Accurate   | \$100-\$800? | Somewhat          |
| Professional Grade     | 85-95% Accurate | \$10,000\$+  | Somewhat          |
| Subscription Service   | 90-95% 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" timely information or will forecast in advance the positions of lightning strikes on earth. Beware especially of handheld detectors reliability and their calibration requirements. Vendors who claim to "predict" lightning in advance (impossible and just guess-work) should be rejected.

Detectors can display early warning of lightning conditions to hazardous operations. Some detectors can be relayed to 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, other meteorological subsets (rain, temp., humidity, wind, etc.) and other options are available.

Essential companions to any type 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; 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 6-8 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 which offers the most favorable cost/benefit to your operation's budget. No detector is 100% perfect. Avoid the obsolete "Flash-to-Bang" method. It is not reliable.

There are no industry wide required lightning protection guidelines. At storm arrival typically the "Red Alert" or "suspend activities" decision is made. A "resume activities" decision then is made based upon time or distance or both. These are the two critical thresholds demanding attention: Suspension and Resumption. They are not aided by lightning's erratic, stochastic and unpredictable behavior. To add to the puzzle, various detectors and their varying technologies will report inconsistent information when placed alongside one another.

Summary: This is a Risk Management and a Time Management subject. Detectors give advanced notice of the lightning hazard. Solve related issues such as: Where is safe refuge? ; How long to get there? ; How long to stay there? ; Comfort factor inside shelters? ; What about protection of computers and servers and telecommunications? ; Are facility bonding and grounding and surge protection OK? ; Are defenses for process control operations installed? ; Is overall electric power continuity assured? ; Are our outdoor workers educated and trained adequately? Is there a company Policy and procedural documents?

Contact NLSI for professional assistance.