UNIFIED LIGHTNING DETECTION, ALERT, AND WARNING SYSTEM

Darryl Randerson
National Oceanic and Atmospheric Administration (NOAA)
Air Resources Laboratory (ARL)
Special Operations and Research Division (SORD)
Las Vegas, NV

Introduction

Creating and maintaining a safe working environment is essential to the United States Department of Energy (DOE) Integrated Safety Management concept. An important facet of Integrated Safety Management is guarding the safety of personnel against injuries due to lightning. This goal has been achieved on the Nevada Test Site (NTS) by unifying weather prognostication, lightning detection, and communication. The fundamental concept is to provide timely advanced warning of an increasing threat of lightning to personnel, equipment, and facilities on the NTS. Warning is followed by actions to cease dangerous project operations, to place equipment in safe configurations, and to shelter personnel safely until the lightning threat has ended.

The NTS encloses an area of approximately 3600 sq. km. The climate is arid with thunderstorm activity occurring mainly in May through October. Terrain is complex, ranging in elevation from 850 m to 2300 m above mean sea level. To detect cloud-to-ground lightning on the NTS, a high-resolution lightning detection system was installed and a lightning alert procedure implemented. Modifications to the system and procedure have been made based on 10 yrs of operating wisdom. Experience in working with this system is presented in this paper.

The design basis for an effective site-specific lightning warning system involves the following considerations:

1. Time required to cease work, or to make operations safe
2. Time to shelter personnel
3. Time to communicate information
4. Speed of movement of thunderstorms
5. Distance between successive cloud-to-ground flashes
6. Accuracy of lightning detection system.
7. Application of the “30-30 Rule”

Melding all this information into a comprehensive lightning detection, alert, and warning system will not assure complete safety from a lightning accident. As the American Meteorological Society (2003) has noted, “…..complete safety from lightning cannot be achieved…..”. However, when prudent and knowledgeable steps are taken, a robust and reliable lightning warning system can be constructed.

After due consideration to the above issues; a three-tiered lightning alert and warning system was implemented at the NTS. This system includes prognostication, detection, and communication.

Prognostication (Phase 1)

Upon reporting for duty, the SORD Duty Forecaster analyzes present meteorological conditions, using site-specific weather data, GOES satellite imagery, NOAA weather radar, and NOAA weather forecast models. If meteorological conditions are conducive to the development of thunderstorms, a Thunderstorm Forecast is issued for the NTS (Phase 1). This forecast is faxed electronically to a predetermined list of customers, facility managers, and safety officers. This action advises responsible safety managers of the potential for lightning activity on the NTS. In addition, SORD field personnel are alerted to monitor sky conditions and to notify the Duty Forecaster of any observed significant weather developments over the NTS. Monitoring activity continues until lightning or thunderstorms are detected or until the threat of lightning ceases.

Detection/Alert (Phase 2)

The ARL/SORD lightning detection network operates continually. Every morning, at approximately 7 a.m. local time, the Duty Forecaster verifies the status of the network by transmitting a test flash. Moreover, SORD personnel have developed an automatic lightning status check system that monitors the communications lines from the direction finders (DFs) to the Position Analyzer (PA). This system verifies that the DF self-test messages were active. If they were not, the automatic lightning status check system generates an audio alarm message that, when displayed, provides an explanation of the potential communication problem. Corrective actions are taken promptly.

Once cloud-to-ground (CG) lightning is detected, the position of the flash is immediately plotted on the lightning display consol in the SORD Weather Forecast and Assessment Center. If the CG flash occurs within 20 mi (32 km) of the boundaries of the NTS (see Figure 1.); lightning surveillance enters Phase 2; an NTS Lightning Alert is issued to a wide variety of customers on the NTS.

Communication (Phase 3)

A schematic of the flow of NTS lightning data is shown in Figure 2. This figure portrays the NTS Automatic Lightning Detection and Data Distribution System.

The Lightning Alert is announced by the SORD forecaster via an "all nets" radio broadcast on and around the NTS (see Figure 1). In addition, the forecaster notifies other key facilities by telephone as well as through the SORD Meteorological Alert Distribution System (MADS). Once the alert has been issued, the Duty Forecaster tracks lightning activity, issuing updates as needed to guard the safety of personnel and to help protect facilities and equipment

Through an Internet connection, CG lightning displays, with zoom capability, are available to project managers so that they can monitor the lightning threat and consult with the Duty Forecaster. When the threat of CG lightning has ceased; project managers are notified.

Summary

An effected, three-tiered lightning detection, alert, and warning system was described. Operational experience has demonstrated the functionality of the system.

Acknowledgement

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References

American Meteorological Society, 2003: AMS Statement: Lightning Safety Awareness, Bull. Amer. Meteor. Soc., 84, 260-266.

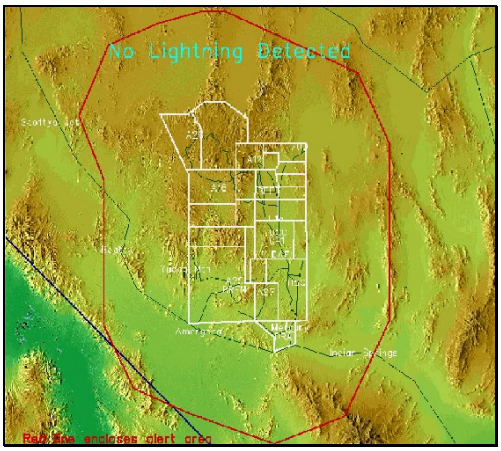

Figure 1. Red "circle" surrounding the Nevada Test Site encloses the Lightning Alert Area.

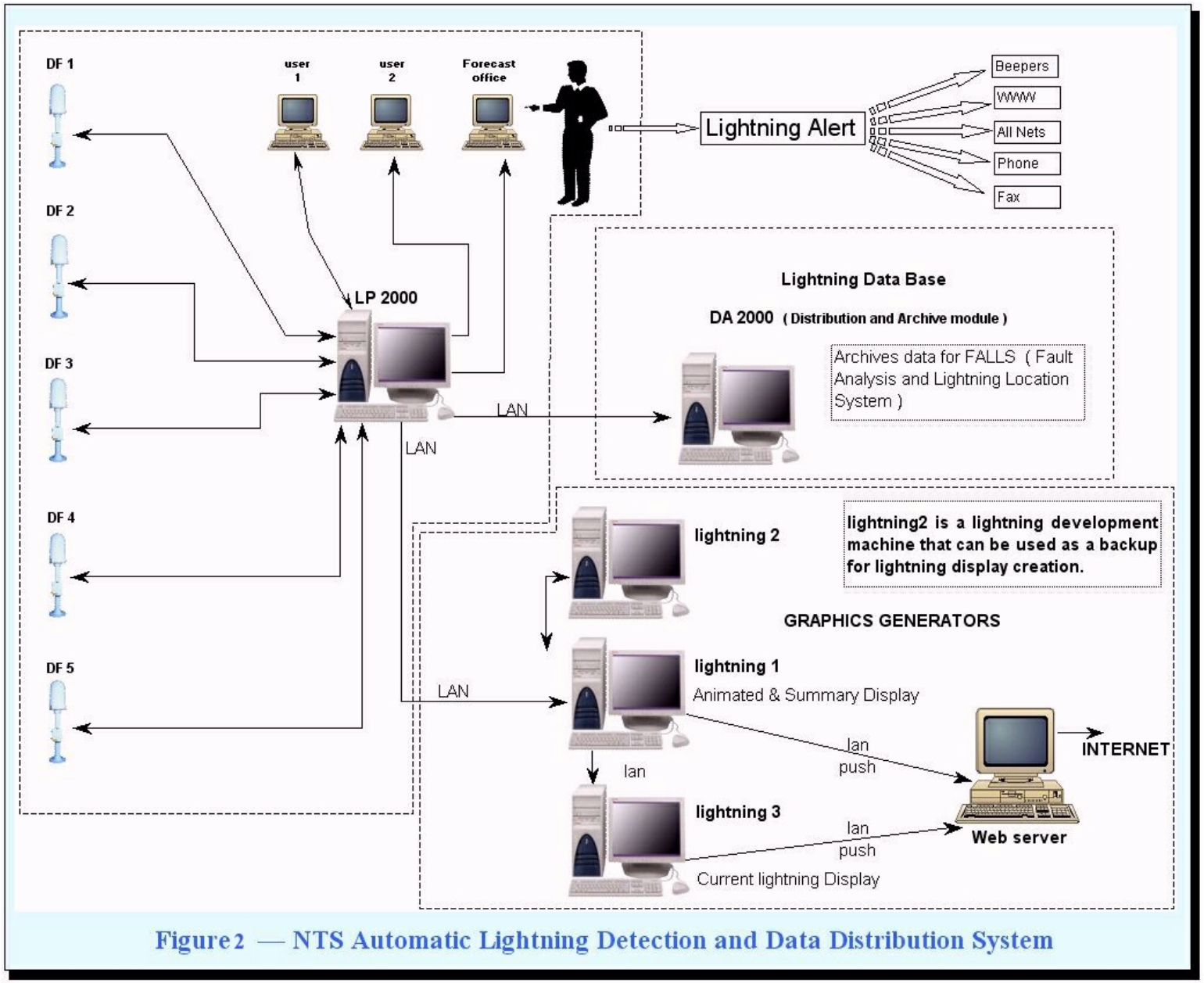

Figure 2 — NTS Automatic Lightning Detection and Data Distribution System