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COLORADO HIGH ALTITUDE LIGHTNING PROTECTION: A CASE STUDY AT 10TH MOUNTAIN HUT ASSOCIATION

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1. Abstract. The 10th Mountain Division Hut Association is an icon for Colorado recreation. With some 28 remote high altitude huts members, guests and the general public can enjoy winter and summer recreation in an unspoiled setting. Lightning delivers as many as 90-100 Td/Yr in the wilderness triangle from Vail-to Aspen-to-Leadville. Lightning evidence to trees is commonly observed. A 2009 winter fire destroyed Fowler-Hillyard hut. Cost to rebuild was $750,000. Lightning was the suspected proximate cause. A system wide risk survey for lightning vulnerability was conducted. Three huts were identified for installation of defenses. This paper describes the methodology and actions taken.

2. Background of 10th Mountain Division Hut Association (Huts). As the crow flies, most huts are about 2-4 hours straight line distance from Denver. Hut system access via trails for skiers and hikers takes can be much longer, whether for day or overnight visits. Begun after WW II, the legacy of the huts is derived from Colorado training of US Army ski troops who served in Europe. Evolution of the hut installations over time came from individuals and member subscriptions.

3. Lightning Safety for People. It is general knowledge among Colorado outdoor persons that lightning represents a significant danger. Still, there are 4-8 Colorado lightning fatalities annually. No place outside is safe, with only degrees of more of less safety according to location and personal action. Education and awareness are the keys to individual response. The Huts organization has provided lightning safety resources for many years, including published materials at each hut.

4. Challenges.
    a. Investigation into lightning frequency in the Aspen-Vail-Leadville triangle have not disclose published results of annual lightnings within the area. However, timber cruising did show incontrovertible and significant past tree damage evidence.
    b. An on-the-ground study of relative lightning risk to all huts was conducted with huts ranked according to 1-2-3: most vulnerable to less vulnerable locations. Factors in the evaluation included: 1) Elevation; 2) Exposure to SW storm direction; 3) Local site geology and topography; 4) Nearby sacrificial (taller) trees; 5) Past tree strikes; 5) Anecdotal remarks from experienced Huts personnel, and 6) Consensus decision-

making among persons from US Forest Service, the Huts Board of Directors and staff members.

c. Four Huts were identified for attention to lightning fire hazard mitigation. Aesthetics became a major consideration for implementing defensive lightning protection designs. Of course the methodology also required compliance with NFPA-780, Standard for Installation of Lightning Protection Systems (780) for insurance purposes and by government agencies. Alternative design choices were:
    i. Franklin Rods. This 780 option could present issues with snow loading, falling ice from roofs, and excessive maintenance. Appearance of a pin-cushion like roofline was another consideration.
    ii. Free-standing sacrificial metal masts. Winds in the areas have exceeded 100 mph. Could masts per 780 withstand the weather? Would installation be possible in such remote areas?
    iii. Masts with connected overhead static wires. Cost and appearance of a powerline-like design would seem to have ruled out this option.
    iv. Do Nothing. Perhaps surprisingly, this is always an option since the probabilities of lightning strikes with resulting fires are very low. Yet the consequences, as demonstrated in 2009 were considerable ---$750,000 and loss of a popular hut for a year.

5. Results.
    a. Fowler-Hillyard Hut. A Franklin Rod system was selected following assurances by installation contractor that icing would not damage the installed air terminals and downconductors. Rocky soils in excess of 5000 ohms required special low resistance trenched backfills be provided to achieve a low impedance lightning destination. This overall design was judged to be the least obtrusive of alternatives.
    b. Jackal Hut. A free-standing 50ft. metal mast was installed uphill from the hut in accord with principles from 780 and as confirmed by proprietary computer-generated software. The mast was engineered to withstand 125 mpg winds.
    c. Skinner Hut. During the 2012 summer season, a single mast will be installed.
    d. Benedict Huts. Since these two huts are at lower elevation, on flat ground and are surrounded by many tall(er) trees, Doing Nothing seems a reasonable decision.

6. Conclusion. Decision-making for lightning hazard mitigation has followed scientific methods with the addition of empirical factors. Hut management and the Board of Directors have demonstrated to membership and to US Forest Service landlords a rational risk reduction process to raise the level of lightning safety.

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