

UNITED STATES
 NUCLEAR REGULATORY COMMISSION
 WASHINGTON, D. C. 20555



June 4, 1976

MEMORANDUM FOR: Ben Huberman
 FROM: Jim Beckerley
 SUBJECT: LIGHTNING PROTECTION: TECHNICAL CONSIDERATIONS

Al, Ted and I have discussed the subject and the following represents a consensus on the technical aspects.

The possible effect of lightning on nuclear power reactor safety should be considered in the NRC safety evaluation. General Design Criterion 2 of 10 CFR Part 50, Appendix A, requires the power plant designer to consider the effects of "natural phenomena" on "structures, systems, and components important to safety." Although lightning is not listed in Criterion 2 following the "such as", it is considered to be a natural phenomenon. In Regulatory Guide 1.70, Section 2.3.1.1 ("Regional Climatology"), the applicant is requested to furnish "seasonal and annual frequencies of severe weather phenomena, including ... thunderstorms, lightning..." at the site. This explicit reference shows that lightning has been considered by the site safety staff to be a potentially significant natural phenomenon.

From a preliminary scanning of Standard Review Plans (SRP), we can find no specific reference to review of lightning hazards to nuclear power plants. Chapter 8 ("Electric Power") of the Standard Review Plan notes in the introduction (by reference to Table 8-1) that General Design Criterion 2 (GDC 2) is "currently applied by the staff to safety-related electric power systems." However, in SRP 8.2 ("Offsite Power System") where GDC 2 is specifically considered (Sec. III, item 6), lightning or thunderstorms are not mentioned. This is somewhat anomalous since Regulatory Guide 1.70, Sec. 8.2.1, specifically asks the applicant to consider the effects of "Unusual features...e.g., ... high thunderstorm rate" on transmission lines supplying power for safety loads. In SRP 8.3.1 ("A-C Power Systems (Onsite)"), General Design Criterion 2 is noted only in connection with seismic considerations (Sec. III, item 2c). The general applicability of Table 8-1 is noted, however. The same comments hold for SRP 8.3.2 ("D-C Power Systems (Onsite)").

Chapter 7 ("Instrumentation and Controls") of the Standard Review Plan includes a Table 7-1 that is referred to in SRP 7.1 as listing "the criteria currently applicable to safety-related instrumentation and control

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systems." The table includes General Design Criterion 2 and indicates its applicability to all Chapter 7 review plans. Each SRP of Chapter 7 refers to Table 7-1 but does not include any specific references to GDC 2, although there are references to seismic qualification. In SRP 7.3 ("Engineered Safety Feature Systems"), the reviewer is referred to many of the SAR chapters but not the chapter (i.e., Chapter 2) which is relevant to GDC 2. In Appendix 7-B ("General Agenda, Station Site Visits"), there are several references to "potential for damage due fire, flooding, missiles, etc."; it is not apparent that the "etc." includes lightning.

Throughout the Standard Review Plan and in Regulatory Guide 1.70, there are references to the need to satisfy the requirements of IEEE Std. 279-1971 (ANSI N42.7-1972), "Criteria for Protection Systems for Nuclear Power Generating Stations." We do not have a copy at hand to check whether lightning protection is covered by the IEEE-279 criteria. However, it is quite possible that, in this or some other standard cited in the SRP, there may be a lightning protection criterion. Certainly, the need for lightning protection is well known. In Chapter 10, "Installation of Instrumentation Systems", of "Nuclear Power Reactor Instrumentation Systems Handbook, Vol. 1 (USAEC, 1973)", the subject is discussed in connection with grounding design.

As far as information on lightning is concerned, it is not true that "little information" is available in the open literature. Although certain USAF work (e.g., at the Air Force Cambridge Research Center) is classified, much of it has been published, particularly information of general value to the electric power industry. I have among my older books, one which reports on a USAF Conference ("Thunderstorm Electricity", H.R. Byers, Ed., Univ. Chicago Press, 1950, 344 pages). This has an excellent brief summary of power-line protection information as known at that time. Other chapters in the book describe results of many research efforts sponsored by USAF and the electric power industry.

In summary, we believe NRC regulations require consideration of lightning protection of structures, systems, and components important to safety. Because applicants are required to provide information on thunderstorms and lightning at the site, it appears to us that applicants are also required to consider the potential effects of lightning on plant safety. The Standard Review Plan implies, but does not explicitly state, that the NRC staff review of the applicant's proposed plant design includes an evaluation of the plant's safety in withstanding the effects of lightning.

We can not determine, from the Standard Review Plan, whether the staff does, in fact, consider lightning hazards in reviewing proposed nuclear power plants. For this reason, the staff should consider whether the Standard Review Plan and the Standard RFR Format (Regulatory Guide 1.70) should be revised to explicitly require consideration of the potential effects of lightning on nuclear power plant safety, i.e., to explicitly include lightning as a natural phenomena covered by General Design Criterion 2 of 10 CFR Part 50, Appendix A. If the staff decides such revisions are unnecessary, then the decision and the supporting reasons should be documented.

cc: Al Kenneke
Ted Quay