Duquesne Light
435 Sixth Avenue
Pittsburgh, Pennsylvania
15219

(412) 456-6000

DOCKET NUMBER PROPOSED RULE PR - Misc Notice Reg Guide

October 3, 1979

Secretary of Commission
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
Attention: Docketing Service Branch

DOCKETED USNRC OCT 19 1979 Office of the Secretary Docketing & Service Branch

U.S. Nuclear Regulatory Commission
Draft Regulatory Guide and
Value/Impact Statement
August 1979, Division 1
Task RS 705-4

Dear Sirs:

The proposed Regulatory Guide on Lightning Protection for Nuclear Power Plants can have a significant impact upon the design of nuclear power facilities. In view of this we feel obligated to comment upon this Regulatory Guide, and thus have prepared a series of comments which are attached to this letter.

Even though there may be many instances of failures of equipment being reported due to lightning, it has been our experience that such reports are an easy answer to a problem and may not be directly related to a failure due to a lightning surge. The failures which may occur may result from subsequent switching operations which were taken to isolate the lightning event; or as pointed out in our attachment, even with the application of the best lightning surge protection to the high voltage system, failures can occur to secondary equipment since such protection is not capable of providing the level of protection necessary for this equipment.

Very truly yours,

E. J. Woolever

E. J. Woolever
Vice President

1742 215

Acknowledged by card... 10/22

8001140 143

Comments on Draft Regulatory Guide
and Value/Impact Statement
August 1979, Division 1
Task RS 705-4
Lightning Protection for Nuclear Power Plants

(1) Page 3, Paragraph 2

A statement is made that the "Available data suggest a significant frequency of lightning surges with currents on the order of 200,000 amperes". It is this figure which the document uses as the design based condition for application of surge protection to nuclear power plants. The word "significant" is one which needs reasonable clarification. Many successful and currently designed substation and power station installations are designed for design base lightning surge currents of a considerably lower magnitude. Although documentation may be available which shows that stroke currents of 200,000 amps do occur, the frequency of such occurrence that is considered significant is open to question.

(2) Page 3, Paragraph 5

A theme of this paragraph would tend to suggest that lightning surges external to a nuclear power plant facility are the result of failures of sensitive electronic equipment utilized within the power plant. Little recognition is made of two facts well known to those who apply surge protection, (a) surges which originate on the primary side of a transformer and induced on the secondary side of a transformer are greatly induced by the surge impedance of the transformer and (b) That the arrester protection provided for the transformer is intended to protect the transformer's insulation system, and in no way is designed nor can be designed to reduce surges to such a magnitude that would prevent failure of sensitive electronic equipment. Thus protection of sen itive electronic equipment has litle or no relationship to the magnitude of the stroke current that may be impressed upon the power system external to a nuclear facility.

(3) Page 4, Paragraph 2

A statement is made that an arrester voltage must be higher than the maximum expected rms line-to-ground voltage under normal or faulted condition. This statement does not recognize nor permit the use of modern arresters which are capable of operating at temporary overvoltages during fault conditions, and yet reseal after the fault is properly isolated.

(4) Page 5, Section C.1 - DESIGN BASIS SURGE

The Design Basis Surge as stated provides no leeway for use of a Design Basis Surge current that may be less than the 200,000 amps stated figure. Provisions are provided only if the local conditions indicate a higher frequency of larger surge current. There are certain sections of the United States that have practically no exposure to lightning. Thus the probability of 200,000 amps stroke may be insignificant.

(5) Page 5, Item C.2 - SURGE ARRESTERS FOR TERMINAL EQUIPMENT PROTECTION

Items 2.1 through 2.4 appear to be completely unnecessary inasmuch as adequate information is provided in ANSI C62.2-1975 to provide guidance in application of surge arresters as their operation relates to the effectiveness of the grounding of the power system.

(6) Page 6, Item C.2 - SURGE ARRESTERS FOR TERMINAL EQUIPMENT PROTECTION - Paragraphs 2.5, 2.6, 2.7

The requirement that surge arresters have a current discharge capability of 200,000 amps fails to recognize the effectiveness of shielding of transmission lines associated with the nuclear power station facility or shielding of switchyard facilities and the extremely low probability of such strokes being impressed upon the surge arresters.

Attention is called to a recent study which was presented at the CIGRE SC33 Colloquium in London in June 1977. The report is titled Current Through Surge Arresters Due to Lightning With Main Reference to Distribution Systems by A. Schei and J. Huse. A quote from the Introduction of this article states the following: "The highest lightning current through surge arresters will occur on distribution lines with system voltages equal to 24kV or below. Arrester failures due to lightning occurs very seldom on 123kV and above." This particular article provides a comparison of the lightning surge current experienced by arresters on 24kV versus that of arresters connected to 123kV, 420kV, and 7.65kV systems.

Figure 23 of this article is of particular importance since it provides a probability distribution of arrester current in a 24kV open air station and shows the effect of various type insulating systems upon the stroke current to which a surge arr:ster is subjected. The worse condition shown is that for an insulated crossarm (wood pole line), a grounding impedance of 60 ohms, and a BIL to ground of 4000kV. At 65,000 amps the probability of this surge being impressed upon a surge arrester is less than .05%.

It is further stated in the article "An increase of the BIL above 4000kV has only a minor influence on the arrester current distribution curve.

Based on this and other previously published information, it is difficult to understand the justification of a 200,000 amperes current discharge capability for station type surge arresters.

(7) Page 6, Item C.2 - SURGE ARRESTERS FOR TERMINAL EQUIPMENT PROTECTION - Paragraph 2.7

An assumption is made here that if arresters of lower rating than 200,000 ampere current discharge capability are parallel, that they would have the capacity of a 200,000 ampere arrester. Such an assumption does recognize a well known industry fact that surge arresters when parallel do not share the surge current equally nor does the effective protective levels of the arresters become reduced in magnitude by 1/N x the arrester characteristic.

(8) Page 7, Section C.2 - SURGE ARRESTERS FOR TERMINAL EQUIPMENT PROTECTION - Paragraph 2.10

The requirement that redundant systems important to safety electrically connected to unit auxiliary and startup transformers be protected by arresters based on a discharge current of 200,000 amps reaching the systems appears to be most unrealistic. It does not take into consideration or evaluation the design of the shielding which is employed in modern transmission switchyards nor the shielding provided in power plant facilities. It also fails to recognize any effect of the transformer connections upon the reduction of the surge current which could be impressed upon a surge arrester that is protecting the redundant equipment connected to the auxiliary and start up transformer. This equipment is located deep within the nuclear power facility in well shielded enclosures. The secondaries of the unit auxiliary and startup transformer in most designs are not exposed to lightning surges, since they are provided by shielded cable or are shielded by the structural enclosures of the power plant itself. To obtain a 200,000 stroke, if it did exist, would require a failure of the high-to-low insulation system of the transformer concurrent with a loss of a ground source on the secondary of the unit auxiliary or startup transformer, since most transformers supplying station auxiliaries have their secondaries grounded either solidly or through a low resistance.

(9) C.2 - SURGE ARRESTERS FOR TERMINAL EQUIPMENT PROTECTION - Paragraph 2.11 Periodic Testing With Surge Arresters

To test an arrester in accordance with the Performance Test Requirements of Section 5 of ANSI C62.1-1975 does not seem practical. To conduct these tests it would be necessary to destroy the arrester, and thus its characteristics may be changed as a result of this action. For example, action 5 of ANSI C62.1-1975 under paragraph 5.6, Duty Cycle Test, refers to Section 7.6, Duty Cycle Test. To conduct a Duty Cycle Test the following is required. It shall be made on two voltage ratings on complete arresters or on a pro-rated section. It would be impossible to comply with the statement it shall be made on two voltage ratings. Thus even if one could successfully remove the arrester from service and take it to a testing lab, it would not be possible to meet the requirements set forth in paragraph 2.11.17 of the proposed guide. We believe the guide should provide opportunity for the operator of the nuclear power facility to develop a test procedure which is demonstrative of the characteristic of the arrester rather than attempt to use our basically designed base test as a means of determining the viability of a surge arrester in an operating facility.

(10) Page 8, Item 3 - GROUND WIRES FOR TRANSMISSION LINE SHIELDING, Paragraph 3.2

The suggestion that a 30° shield angle is sufficient to protect transmission lines reflects an over-simplification of a complex technology. Attention is called to IEEE Transactions on Industry and Application, Volume IA-14, No. 6, November/December 1978 on an article titled "Protection Zone for Buildings Against Lightning Strokes Using Transmission Line Protection Practices".

Table 2 of this article and Figure 1 provide an extensive discussion of the effects of tower height and shield angles on failures for 100 miles per year This data is based on BILs of 1400kV. A statement is made "higher BILs would operate as well with flatter protection angles."