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NUCLEAR REGULATORY COMMISSION

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10 CFR Part 50

[Docket No. PRM-50-56]

Richard P. Grill; Denial of Petition for Rulemaking

AGENCY: Nuclear Regulatory Commission.

ACTION: Denial of petition for rulemaking.

SUMMARY: The Nuclear Regulatory Commission (NRC) is denying a petition for rulemaking (PRM 50-56) submitted by Richard P. Grill on August 16, 1991. The petitioner requested that the NRC amend 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," and issue new regulations, as necessary, to add lightning induced and other electrical transients to the required list of phenomena licensed nuclear power plants and other nuclear facilities must be designed to safely withstand. The petition is being denied because the design and construction of existing nuclear power plants adequately protect plant electrical systems from the effect of electrical transients, and there is no evidence at this time that electrical systems and components were not designed to withstand the effects of electrical transients in such a manner as to require additional generic regulatory action.

ADDRESSES: Copies of the petition for rulemaking, the public comments received, the NRC internal report "Report on the Sources and Effects of Electrical Transients on the Electrical Systems of Commercial Nuclear Power Plants," and the NRC's letter to the petitioner are available for public

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inspection or copying in the NRC Public Document Room, 2120 L Street NW.
(Lower Level), Washington, DC, 20037.

FOR FURTHER INFORMATION CONTACT: Chris Rourk, Office of Nuclear Regulatory
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SUPPLEMENTARY INFORMATION:

- I. The Petition
- II. Basis for the Petitioner's Request
- III. Public Comments on the Petition
- IV. Reasons for Denial

I. The Petition

In a letter dated August 16, 1991, Mr. Richard Grill filed a petition
for rulemaking with the NRC. The petition requested that the NRC take the
following actions:

(1) Amend the regulations or issue new regulations as necessary to add
lightning-induced and other electrical transients to the required list of
phenomena licensed nuclear power plants and other nuclear facilities must be
designed to safely withstand,

(2) Perform a comprehensive study to determine the current state of
knowledge of electrical transients,

(3) Perform a study to identify and quantify potential consequences on licensed nuclear facilities from electrical transients,

(4) Require each licensed facility to be analyzed and modified as necessary to prevent the compromise of safety-related electrical systems by electrical transients,

(5) Develop regulatory guidance for the protection of safety-related control systems from electrical transients, and

(6) Determine why this issue was not addressed and resolved in the past.

II. Basis for the Petitioner's Request

The petitioner asserts that (1) because of the complexity of the electrical systems in nuclear facilities, there is a need for explicit requirements for protection of electrical systems from electrical transients in the provisions of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, (2) inadequacies exist in the analysis of the electrical system of each licensed facility regarding the effects of electrical transients, and (3) a large number of alternative paths for the entry of electrical transients into the safety-related electrical systems exist that can only be discovered by performing a thorough and rigorous analysis of the entire electrical system. In support of his position, the petitioner states that the Defense Nuclear Agency (DNA) and the Defense Communications Agency (DCA) have developed computer programs that can be used to analyze the effects of nuclear electromagnetic pulse (EMP) on electrical systems. The petition states that these programs can be used to determine the effect of electrical transients on safety-related electrical systems in NRC-

licensed facilities.

The petition also refers to a draft regulatory guide that was issued for public comment in 1979. This draft guide concerned the protection of nuclear power plants from lightning. The petition requests information on the reasons the regulatory guide was never issued, even though a draft of it had been issued for public comment.

The petition also refers to potential improprieties in the manner that the petitioner was treated by the NRC and its predecessor, the Atomic Energy Commission in the 1970s. These references are separable from the safety questions raised by the petition.

III. Public Comments on the Petition

A notice of receipt of the petition for rulemaking was published in the Federal Register on December 23, 1991 (56 FR 66377). Interested persons were invited to submit written comments or suggestions concerning the petition by February 21, 1992. The NRC received four comments in response to the notice: two from private citizens, one from a citizens group, and one from a public utility. Three of the commenters supported the petition. The main reasons cited by the commenters who supported the petition were:

One commenter feels that the changes in world conditions increase the likelihood of a nuclear device detonation and that nuclear power plants must be hardened against EMP from nuclear explosions.

One commenter believes that efforts by the national defense agencies to harden equipment from the effects of nuclear EMP indicate that similar efforts are required of civilian nuclear power plants.

One commenter, a citizen group, believes that electrical transients in nuclear power plants present a safety hazard, based upon NRC generic communications regarding operational events caused by radio frequency interference (RFI), lightning, geomagnetically induced currents (GIC), and battery failure. In addition, they believe that the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities program should have included a review of the potential effects of lightning for all licensees, not just those licensees who have experienced adverse plant effects from lightning besides loss of offsite power.

Two of the above three commenters support the petition because of the perceived delicate nature of solid-state electronic devices, and the belief that these devices will not be adequately protected in the absence of regulation by the NRC.

One commenter, a public utility, was opposed to the petition because research has not yet proven the need for any rulemaking, or the extent of rulemaking if a need is shown. If the order of proposed actions in the petition were accepted, licensees would be required to take actions prior to the issuance of any guidance.

IV. Reasons for Denial

The NRC has considered the petition, the public comments received, and other information and has concluded that the issues raised in the petition, though valid concerns, do not warrant new staff regulatory positions for existing plants. The following discussions address the issues raised in the petition.

Upon receipt of the petition from Richard Grill, the NRC staff reviewed all the General Design Criteria of Appendix A to 10 CFR Part 50 to determine whether any of them, not just those cited in the petition (Criteria 2, 13, 14, 17, 18, 19, 21, 22, 23, 24, 29, 63, and 64), should be modified as requested. Design Criterion 2 states that "Structures, systems and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornados, hurricanes,without loss of capability to perform their safety functions." Although lightning is not specifically identified, it is implicitly included in the natural phenomena for which protection must be provided. Criterion 4 states that "Structures, systems and components important to safety shall be designed to accommodate the effects of and be compatible with the environmental conditions associated with normal operation, maintenance, testing.... These structures systems and components shall be appropriately protected against dynamic effects.... and from events and conditions outside the nuclear power unit." The environmental conditions cited implicitly include electrical transients and their sources. Also, qualification of safety-related systems and components for the applicable environmental conditions is required for conformance with this criterion. Design Criteria 2 and 4 apply to all safety-related instrumentation, control, and power systems. Therefore, the staff finds that there is no need to modify any of the General Design Criteria in order to assure that the effects of electrical transients are considered in the design of these systems.

The NRC licensing review of operating plants for conformance to General Design Criteria 2 and 4 in regard to protection against lightning, switching surges, and other electrical transient phenomena was based on the knowledge that: (1) established industry design standards and practices were being

applied in the design of the electrical control and instrumentation systems; (2) the great majority of electrical systems and components in nuclear power plants were qualified for operability in the electromagnetic environment of these plants on the basis of prior operational experience in similar industry applications; and (3) the equipment and systems deemed to be particularly vulnerable, such as those utilizing solid state components and circuitry, were required to be qualified for operability in the electromagnetic environment by appropriate type testing before being approved for nuclear power plants.

The NRC next thoroughly reviewed the technical literature regarding sources of electrical transients. This review and other bases for the staff's conclusions are documented in an internal NRC report entitled "Report on the Sources and Effects of Electrical Transients on the Electrical Systems of Commercial Nuclear Power Plant," which is available for public inspection or copying in the NRC Public Document Room. It was determined that potentially dangerous electrical transients are not generally transmitted to electrical systems or components in the power generation plant from the power transmission system. There are only four physical mechanisms by which an electrical transient can be transmitted to an electrical system or component, all of which are well documented in the technical literature and are generally considered in the design of nuclear safety-related electrical systems. First, the transient may enter via a transmission line that carries power or data to or from the system or component. Second, the transient can enter via capacitive (electric field) coupling of the system or component to the source of the transient. Third, the transient can enter via inductive (magnetic field) coupling of the system or component to the source of the transient. Finally, the transient can be caused by ionized particles impinging on the

system or component. The NRC finds that the present consideration of these effects is sufficient to assure safe operation of nuclear power plants with analyses conducted on a system- or component-specific basis. There is no need to perform a comprehensive analysis of the entire electrical system of a nuclear power plant.

Based on a review of the technical literature, it appears that analyses of components and systems have been conducted and have effectively prevented electrical transients from significantly affecting the operation of nuclear power plants for the electromechanical controls-based systems typically employed at licensed U.S. nuclear power plants. In addition, the NRC has required licensees to perform additional testing of solid-state controls components and systems which specifically targeted the potential for problems to be caused by electrical transients. These considerations provide a sufficient basis for the NRC to conclude that electrical transients have been adequately considered in the licensing of existing nuclear power plants.

The NRC then reviewed 177 operating events that were attributed to lightning from 1980 to 1991, a period representing approximately 967 operating years, to determine whether any of these events might indicate that nuclear safety-related electrical systems and components have not been adequately protected from power line transients, capacitively coupled transients, and magnetically coupled transients. This review is also contained in the previously referenced internal report. Ten of these events were also analyzed in NUREG/CR-3591, "Precursors to Potential Severe Core Damage Accidents," vol. 1, July 1984, and NUREG/CR-4674, "Precursors to Potential Severe Core Damage Accidents," vol. 2, December 1986; vol. 6, May 1988; vol. 8, July 1989; vol. 12, August 1990. None of these incidents resulted in a significant risk of

core damage. Based on this review, it was determined that the existing level of protection against electrical transients is sufficient to protect against failure of nuclear safety related electrical systems. It should be noted that the electrical transients created by lightning can be more severe than any other source of electrical transient except nuclear EMP.

The effect of nuclear EMP on nuclear safety-related electrical systems has been studied by the NRC. This investigation is documented in NUREG/CR-3069, "Interaction of Electromagnetic Pulse with Commercial Nuclear Power Plant Systems," February 1983. It was determined that a high-altitude nuclear explosion would not prevent the safe shutdown of a nuclear power plant. Therefore, it is not necessary to analyze nuclear safety-related electrical systems with the programs developed by the DNA and DCA. In addition, these programs were written to determine the effects of ionizing radiation on electrical systems and components, an effect known as system generated EMP (SGEMP). A civilian nuclear power plant would only be exposed to SGEMP in the event of a near or direct strike with a nuclear weapon. Nuclear power plants are not required to be designed to survive the effects of a near or direct nuclear weapon strike.

Some of the petitioner's concerns will be further addressed in the individual plant IPEEE reviews. Because the NRC has previously determined that additional regulation of lightning protection is not cost-justified, lightning is not required to be specifically considered in the IPEEE program unless there have been plant-specific effects. For those licensees where, based on operating experience, lightning strikes are likely to cause more than just loss of offsite power, further examination of lightning effects is expected, including a determination of whether any plant modifications are

required. Licensees have been notified of this position by Supplement 4 to Generic Letter 88-20, which includes NUREG-1407, "Procedural and Submittal Guidance for the Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities," June 1991, as guidance. However, operating events which have been studied to date have not revealed any significant concerns. Therefore, there is no need to extend the IPEEE review to consider other potential effects besides loss of offsite power to plants which have had no operating experience with such effects, as requested by one commenter.

The on-going staff reviews of advanced light water designs are more focused in regard to the application of General Design Criteria 2 and 4 in the review of these designs for protection against electrical transient phenomena. The NRC staff is reviewing the advanced designs against the Electric Power Research Institute's (EPRI) requirements that address lightning protection, grounding, surge withstand capability, electromagnetic interference (EMI) and electrostatic discharge. EPRI's requirements are based upon good engineering practices and established industry standards. The NRC staff is also evaluating the above criteria for inclusion in the "Inspection, Tests, Analyses, and Acceptance Criteria/Design Acceptance Criteria (ITAAC/DAC)" verification programs that will be implemented on advanced designs. More information on this subject is provided in SECY-92-53, "Use of the Design Acceptance Criteria during 10 CFR Part 52 Design Acceptance Reviews," which is also available in the NRC Public Document Room.

Copies of NUREG-1407, NUREG/CR-3591, NUREG/CR-4674, and NUREG/CR-3069 may be purchased from the Superintendent of Documents, U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20013-7082. Copies are also available from the National Technical Information Service, 5285 Port Royal

Road, Springfield, VA 22161. A copy is also available for inspection and copying for a fee in the NRC Public Document Room, 2120 L Street, NW. (Lower Level), Washington, DC.

The petitioner also requested the reason that the Draft Regulatory Guide RS 705-4, "Lightning Protection for Nuclear Power Plants," was never issued in final form. The Advisory Committee for Reactor Safeguards (ACRS) requested on February 3, 1981, that a risk assessment be performed to determine whether the draft regulatory guide would be cost effective. This risk analysis indicated that implementation of the guide would not be cost effective. In addition, measurements of surge arrester current magnitude which are reported in the technical literature indicate that there is no apparent basis for the position adopted in the guide that a 120,000-ampere surge arrester is required to protect nuclear safety-related electrical systems and components from power line transients. For example, one study (Gaibrois, G. L., "Lightning Current Magnitude Through Distribution Arresters," IEEE Transactions on Power Apparatus and Systems, Vol. PAS-100, No. 3 March 1981) indicates that 0.07% of measured surge arrester currents exceeded 100,000 amperes for a sample size of 2488 distribution surge arresters. These currents would be higher than transmission line surge arrester currents because distribution lines do not typically have shield wires. Implementation of the draft regulatory guide would have imposed an economic burden on licensees, and the staff did not find sufficient safety benefit to justify such a burden on them or their ratepayers.

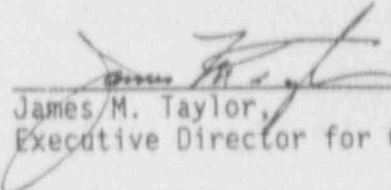
On the matter of the potential improprieties in the treatment of the petitioner or his concerns by the NRC or its predecessor, the questions raised have been referred to the Office of the Inspector General for appropriate

consideration and disposition.

For the reasons cited above, the NRC denies the petition.

Dated at Rockville, Maryland this 8th day of January, 1992.

For the Nuclear Regulatory Commission.



James M. Taylor,
Executive Director for Operations.