EXHIBIT B

Electrical
TECHNICAL ADVISORY COMMITTEE

WITH COMMENTS

Total Mods for this report: 8

TAC: Electrical **2** Total Mods for **Electrical in No Affirmative Recommendation with a Second**

Mod #	Proponent	Chapter	Section	Summary
6460	Bryan Holland	35	2703	This modification expands the requirements for the installation of lightning protection systems to certain commercial occupancies and provides exceptions to the new rule.

No Affirmative Recommendation with a Second

Linda

Comment

- [X] 1. Support comment. Comment sufficiently addresses the TAC's concern(s). — G4
- [ ] 2. Do Not Support comment. Comment does not address the TAC's concern(s).
- [ ] 3. No comment is needed.
- [X] 4. Straw Poll. — 7 Yes – 3 No **Fails w/o 70%**

Commission Action

- [X] AS [ ] AM [ ] !
- [ ] W [ ] NAR

2nd Flanagan
Flanagan/Swope for AS
20 yes – 4 no

SubCode: Existing Building

3-Provisions for All Compliance Methods

Mod #	Proponent	Chapter	Section	Summary
6529	Bryan Holland	3	302.6	This modification adds electrical safety requirements to existing swimming pools in response to the Commission's "Swimming Pool Electrical Safety Project" approved recommendations.

No Affirmative Recommendation with a Second

Comment

- [X] 1. Support comment. Comment sufficiently addresses the TAC's concern(s). — A1
- [ ] 2. Do Not Support comment. Comment does not address the TAC's concern(s).
- [ ] 3. No comment is needed.
- [X] 4. Straw Poll. — 8 yes – 1 no

Commission Action

- [ ] AS [X] AM [ ] !
- [ ] W [ ] NAR

2nd Batts
Batts – Calleja AM
24 yes – 0 no

Search Criteria

Modification #:	ALL	**Code Version:**	2017
Code Change Cycle:	ALL	**Sub Code:**	ALL
Chapter & Topic:	ALL	**Section:**	ALL
Date Submitted From:	ALL	**Date Submitted To:**	ALL
TAC:	E	**TAC Recommendation:**	ALL
Commission Action:	ALL	**Modification Status:**	ALL
Proponent Last Name:	ALL	**Proponent First Name:**	ALL
Text of Modification:	ALL	**Related Modifications:**	ALL
Affects HVHZ:	ALL	**Archived:**	No

EXHIBIT C

FIRST NIAGARA

April 24, 2015

Heary Bros Lightning Protection Co Inc
11291 Moore Rd
Springville, NY 14141

To Whom It May Concern:

During the many years we have done business with Heary Brothers Lightning Protection Co. Inc., we have found your commitment to developing quality products for your customers as paramount. Included in that commitment would be the successful line of the Early Streamer Lightning Protection Equipment.

Your dedication has allowed us to establish a comprehensive and cost-effective insurance program for your companies. Because of your dedication, we have been able to secure 11 million dollars of Liability limits. This includes coverage for damage from direct lightning strikes to the structure of any buildings. Please see enclosed America Certificate of Guarantee as additional evidence.

In addition, claims activity has been negligible and we, as your broker, the The Travelers Insurance Company, as your carrier, appreciate your attention to workplace safety and products liability quality control efforts. In today's highly competitive world, this is critical.

Without a doubt, your company was built around a commitment to give customers the products they need and confidence in our ability to meet or exceed expectations. We encourage your efforts and with you continued success.

Sincerely,

Timothy M. Wroblewski
Vice President

TW/lam

First Niagara Risk Management, Inc.
726 Exchange Street, Suite 900 • Buffalo, NY 14210
Phone: 716-819-5500 • Toll Free: 800-854-9121 • Fax: 716-819-5140

EXHIBIT D

Preface from NFPA 780

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See inside back cover for additional important notices and information.

EXHIBIT E

EXHIBIT E

EARLY STREAMER EMISSION AIR TERMINALS LIGHTNING PROTECTION SYSTEMS

LITERATURE REVIEW AND TECHNICAL ANALYSIS

Prepared by

Dr. Richard J. Van Brunt
Thomas L. Nelson
Samara L. Firebaugh

NATIONAL FIRE PROTECTION RESEARCH FOUNDATION

FIRE RESEARCH

NATIONAL FIRE PROTECTION RESEARCH FOUNDATION

BATTERYMARCH PARK
QUINCY, MASSACHUSETTS, U.S.A. 02269

development has been established from laboratory investigations [113], considerably less is known about the dynamics and interactions of these species in a discharge compared to what is known about ions. In particular, very little is known about how they contribute to lightning discharge initiation or propagation under relevant atmospheric conditions. As with negative ions, the metastable content of the air around a lightning terminal will be affected by relative humidity and general air contamination. The influence of metastable species should not extend significantly beyond the end of a lightning rod. Their role, if anything, will be to enhance initial development of a streamer at the rod tip.

In summary, it would appear that enhancement of upward streamer initiation from an ESE terminal (compared to a conventional terminal) has a plausible physical basis. However, it would also appear that a complete and universally accepted understanding of how all ESE devices work has not yet been achieved, and it can be argued that a better understanding is needed to make meaningful quantitative comparisons between the performances of ESE and conventional devices. To reach such an understanding it will undoubtedly be necessary to address numerous basic questions such as:

1. What are the predominant streamer initiation mechanisms under different conditions of polarity, atmospheric humidity, air contamination, and terminal geometry?

2. What are the relative roles of ions, electrons, and metastable species on the development and propagation of a streamer discharge from a terminal for different conditions?

3. What is the likelihood of corona formation around a terminal and how will the presence of corona affect the ability of the terminal to launch a streamer upon approach of a lightning stroke?

4. In the case of radioactive terminals, what is the dependence of the streamer initiation probability on the intensity and type of radiation source?

5. In the case of electrically triggered devices, how does the streamer initiation probability depend on the timing and magnitude of the electrically triggered spark?

6. Also for electrically triggered devices, how reliable is the field sensor that controls the triggering, and can its performance be affected by local space charge?

Attempts to find answers to questions like these are the focus of much ongoing experimental and theoretical research, not only on lightning, but on electrical discharge phenomena in general.

D. Validation of ESE System Performance

Three general methods have been used to evaluate and test the performance of lightning protection systems, namely: 1) small-scale laboratory or outdoor tests in which lightning, or the effects of lightning are simulated by applying high-voltage impulses lightning seldom hits a terminal regardless of whether or not it is equipped with an ESE device [182,183,215]. Although a few isolated strikes to the mountain were reported to have occurred within the supposed zones of protection of ESE terminals [183,215], it would appear that the overwelming majority of strikes to the mountain were at considerable distance from any terminal. In any case, the failure of air terminals to attract lightning on mountain tops at elevations of 3000 m (9843 feet) or more is obviously disturbing and raises questions about the interpretation of such observations. Before any serious conclusions are drawn about the performance of lightning attractors from tests performed on mountain tops, it may be necessary to consider the perturbing effect of the mountain itself on such parameters as the surface charge distribution and electric-field profile under a thundercloud, as well as the extent that lightning strokes at such high elevations differ from those that normally occur in lower, flatter locations. It would appear that the answers to some of these questions might already be found in the literature.

It is noted in some papers that lightning that occurs at high elevations generally differs on average from that which occurs at sea level, if in no other respect than that it has less distance to cover in going from the cloud to ground [36]. At an elevation of 3000 m, the ground can be quite close to or even engulfed by the base of a storm cloud. Certainly the results from high mountain tests cannot be dismissed, and such tests should continue, as should similar tests underway at other locations [107]. The problem is how to interpret the results of these tests and infer what they might imply about air terminal performance at lower elevations, and what they indicate about the influence of mountainous or rocky terrain on the effective zone of protection of an air terminal.

The unfavorable statistical odds associated with natural lightning can be partially overcome by using artificially triggered lightning. Tests have shown that lightning can be triggered with reasonably high probability by a rocket launched into a thundercloud [124,160,190,193]. A long trailing wire is usually attached to the rocket which provides a low resistance path to guide the initial discharge and define its direction of propagation [45,120,193]. Transportable facilities have been developed for rocket triggering of lightning that can be used for testing at nearly any location [231]. Although tests of air terminals are being made using triggered lightning, there are questions that can be raised about the meaning of such tests. There is evidence that triggered lightning is unlike natural lightning both in its intensity and propagation characteristics. In particular, it has been noted that triggered lightning is of lower current than natural lightning and exhibits characteristics more like those of return strokes observed in natural lightning [78,161]. It has also been argued that triggered lightning does not satisfactorily mimic the primary stroke and is therefore unsuited for investigation of the attachment to a grounded lightning conductors, i.e. its use in evaluating air terminals would appear to be questionable [78]. The extent to which rocket-triggered lightning behaves like natural lightning seems to depend on the length of the trailing wire and the distance of the bottom end of the wire above

3. Radiation hazards

In the case of ESE devices that employ radioactive materials, issues have been raised in the literature about the possible radiation hazards to humans that the use of these devices present [24,25,39,81,180,196,278]. As noted above, radioactive air terminals are banned in some countries, presumably because of perceived health hazards. It has been noted that ^{241}Am sources used in lightning protection devices are not any more hazardous than similar sources approved for use in smoke detectors or static eliminators [109,167,180]. Nevertheless, there are those who argue that the public may be placed at risk from a proliferation of radioactive materials in devices that can enter the environment without adequate controls [25,81,180]. An evaluation of the health and safety aspects of radioactive sources used in air terminals lies outside the scope of this report. However, we have identified this as a serious issue that the manufacturers and users of radioactive terminals must be prepared to address.

4. Damage and maintenance

Given that ESE devices likely have a structure and associated instrumentation that are more complex than conventional air terminals, questions can be raised about their susceptibility to damage during a lightning strike. The electric current and energy deposited by a lightning stroke can be sufficiently high to actually melt metallic structures and destroy electronic components. There are numerous reports of damage inflicted by the primary lightning stroke to metal parts on aircraft, etc. [70,79,138,209,237,269]. The possibility of damage means that a lightning protection device may require periodic inspection and/or maintenance that is generally not required for conventional terminals. Although this problem is pointed out [155], there seems to be very little discussion about it in the open literature.

IV. CONCLUSIONS

The possible conclusions that can be drawn from an examination of the literature included in the bibliography are discussed in this section. The main conclusions of this report are briefly summarized in Section VI.

Because of the sparsity of information that can be found in the peer-reviewed literature from tests of early streamer emission air terminals, either in the laboratory or in the natural environment, it is nearly impossible to make quantitatively meaningful statements or judgements about the performance of ESE devices in comparison to conventional Franklin rods. In fact, insufficient reliable quantitative data seem to exist about the performance of conventional rods, and there seems to be an ongoing debate about the best geometrical design for conventional terminals required to achieve optimum lightning attraction efficiency.

Nearly all of the information or data that could found on ESE device performance resulted either from tests performed by manufacturers of lightning protection systems or by those directly or indirectly employed by such manufacturers. Although abundant criticism is published by non-manufacturers about the performance of ESE devices, especially radioactive air terminals, it is seldom based on actual test data. Those on both sides of the issue invoke lack of evidence in making their case about the performance of ESE terminals. Proponents of these devices claim that a lack of credible statistical data on failure of ESE terminals proves their effectiveness; while critics of these terminals argue that a lack of evidence about the improved performance of ESE terminals over conventional terminals proves their ineffectiveness. In either case, one must beware of faulty logic, in as much as a lack of evidence never proves the lack of something.

There are reports of incidents where ESE devices failed to provide the protection specified by the manufacturer [156,158,165,215]. Statistics on the failure of conventional systems have also been documented [109]. When examining reports of "failures", one can always raise questions about their cause, e.g., whether they are primarily a consequence of exaggerated claims made by the manufacturer or a consequence of misuse (faulty installation) of the device. Reports of isolated failures raise legitimate concerns, but are seldom accompanied by enough supporting data about the event to enable a determination of why the failure occurred. Generally it is difficult to draw significant conclusions from single events that can be used to improve system design or evaluate system performance. There is no reason to believe that an air terminal is 100% efficient in attracting lightning, regardless of what kind of ESE device it uses, if any. Considering the wide range of possible atmospheric conditions and types of lightning behavior that have been recorded, it is not surprising that air terminals of all types will sometimes fail [37,201,271]. Tall structures are reported to be struck occasionally by lightning at points far below the top, i.e., outside of the "protection zone" [173,185,186]. Any claims of 100% efficiency in the performance of a lightning attractor should be viewed with skepticism. In any case, the meaning of the term "efficiency", when specified for an air terminal, should be clearly defined and understood.

A reasonable physical basis for the operation of an ESE device appears to exist in the sense that there is good evidence from laboratory investigations that the probability of initiating a streamer discharge from an electrode can be increased significantly by irradiation or electrical triggering. However, the precise amount by which this enhancement in streamer initiation improves the lightning attraction efficiency of an air terminal remains questionable. There is reason to doubt that it significantly extends the maximum range of protection. A lightning stroke that would not hit a conventional terminal because of the fact that it does not enhance the field at the terminal tip enough to allow streamer formation will also not likely hit a terminal equipped with an ESE device. (The exception would be an ESE device that significantly increases the terminal potential during the approach of a lightning stroke.) In our view, the possible advantage offered by an ESE device, if operated properly, is that it helps to insure that a streamer will be initiated if the field produced by the

EXHIBIT F

REPORT OF THE THIRD-PARTY INDEPENDENT EVALUATION PANEL ON THE EARLY STREAMER EMISSION LIGHTNING PROTECTION TECHNOLOGY

BY

John L. Bryan

Richard G. Biermann

Glenn A. Erickson

Submitted to the National Fire Protection Association Standards Council on
September 1, 1999

Rison (336) reported in 1991 on studies conducted at the Langmuir Laboratory from July 15 to August 23, 1991 to evaluate whether a radioactive ESE air terminal provided protection within a 100 meter radius as reported by the Manufacturer. The ESE device was installed on a twenty foot mast 4 meters below South Baldy Peak. Video cameras were used to record the occurrence of lightning strikes. There were two recorded lightning strikes within the 100 meter radius area during the approximate five week study, one 85 meters from the ESE device and one approximately 78 meters from the device. However, the following statement should be noted from the report:

> Near the end of the test period, it was noticed that the radioactive Preventor had been damaged --the weld had broken between the spherical ball on the Preventor and the nut to which it attached. It is not certain when or how this happened. There was no evidence of tampering or vandalism. Examination of the tip of the Preventor under a microscope showed evidence of melting, such as would occur if lightning were to have struck it. Most likely, the Preventor was struck by lightning at a time when the camcorders were not turned on (when the peak was in a cloud, or a storm occurred in the early morning hours), and the lightning broke the weld.[13]

Thus, it might appear that the ESE device was active in a lightning strike not recorded by the video cameras utilized during the study, since there were periods during the study when the cameras were inactive.

---

[13]Rison, William, A Study of Lightning Strikes in The Vicinity of a Radioactive Preventor, Langmuir Laboratory, New Mexico Tech., Socorro, NM, 11-8-91, p. 4.

Moore *et al.* (248) reported in 1998 a summary of all the field tests of the radioactive "Preventor" ESE device during the summers of 1990, 1991, 1993, 1994, 1995, 1996, and 1997. Moore's analysis is as follows:

> In the six summers during which the "preventor" was exposed to thunderstorms overhead, lightning struck six different sites within 100 meters of the device yet the "preventor" itself was never struck.
>
> Digitized measurements with quarter-microsecond time resolution, of the currents that flowed from the "Preventor" during two nearby lightning strikes in September 1997 showed no indication that the "Preventor" emitted any effective "early streamers". In fact, during one of these discharges, lightning struck a blunt rod located 20 meters distant yet no streamers were emitted from the "Preventor" to connect with this close strike.[14]

It should be noted these seven-year tests involved a single ESE device of a radioactive type. It should also be noted that Moore's (243) field studies under natural lightning conditions have questioned the validity of the effectiveness of the sharp-pointed Franklin air terminal as follows:

> The failure of radioactive-ionizing and of sharply pointed air terminals to participate in lightning discharges by being pre-eminent connectors of lightning to earth is no surprise to scientists studying thunderstorms and lightning. For the past 40 years, I have been measuring the electric currents flowing into the air from both radioactive electrodes and from sharply pointed ones under the influence of the strong electric fields beneath thunderstorms but not one of my well-exposed electrodes has ever been struck by lightning.[15]

[14]Moore, C. B., William Rison, and G. D. Aulich, An Assessment of The Radioactive "Preventor" as an Early Streamer Emitting Lightning Protector, New Mexico Tech., Langmuir Laboratory for Atmospheric Research, Socorro,NM, 12-29-98, pp. 24-25.

[15]243. Moore, Charles B., New Mexico Tech., "Personal Communication to Subcommittee of NFPA Board of Directors", 9-4-95, p. 1.

2. Consideration of System Performance

It would appear the ultimate evaluation of any complete lightning protection system would be the performance of the systems as installed on buildings. The submitted materials included one reference to the failure of a conventional system with Franklin rods (328) and there was one newspaper account of a Franklin rod system failure resulting in personnel injuries. (252) There were several studies of failures of ESE lightning protection systems. (146) (220).

The failure of the Franklin rod system resulting in the eleven personnel injuries occurred at the Robert F. Kennedy stadium in Washington, D.C. on June 13, 1998. (252) Richardson reported on the failure of a Franklin rod air terminal located approximately four feet from an externally mounted camera on the building which was damaged by a lightning strike. (328)

Makerras *et al.*, (220) have reported on four cases of lightning striking buildings in Singapore from the late 1960's until the 1980's. Hartono and Robiah (146) have reported on ten cases of failures on buildings protected with ESE lightning protection systems. This study utilized photographs of the building conditions both before and after the reported lightning strikes on the damaged areas of the buildings. It was found from this photographic study the damage appeared to be dependent on the number of strokes received, the strength of the lightning stroke and the shape of the structure at the point of the stroke. Although not specified in the study Hartono and Robiah have indicated lightning strike damage was found on buildings protected with Franklin air terminals as indicated in the following statement:

> Studies conducted on the buildings equipped with the standard lightning air terminals (Franklin rod type) also exhibited similar lightning damage locations on or near the rooftop. Based on this comparison, we conclude that no advantage can be obtained by using the ESE device in protecting the building against direct lightning strikes.[21]

It should be noted that all of the incidents of system failure submitted to the panel lacked the necessary detailed documentation to enable a valid analysis as to the effectiveness of the system. Even the most detailed photo study lacked the necessary documentation consisting of the following: The manufacture and model of the air terminal. The date the installation was completed, thus establishing the age of the system when the lightning strike occurred. The maintenance and condition of the system when the strike occurred, including the condition of the down conductors and the grounding system. It would appear that detailed documentation of lightning protection system operations or failures is a needed component for the evaluation of the effectiveness of lightning protection systems of all types on various buildings of differing heights and configurations.

[21] Hartono, Zainal Abidin and Ibrahim Robiah, A Long Term Study on The Performance of Early Streamer Emission Air Terminals in a highly Isokeraunic Region. 2-19-99, p. 2.

Van Brunt *et al.*, (369) has referenced this problem of adequate data on lightning protection system performance in the following manner:

> There are reports of incidents where ESE devices failed to provide the protection specified by the manufacturer [156,158,165,215]. Statistics on the failure of conventional systems have also been documented [109]. When examining reports of "failures", one can always raise questions about their cause, e.g., whether they are primarily a consequence of exaggerated claims made by the manufacturer or a consequence of misuse (faulty installation) of the device. Reports of isolated failures raise legitimate concerns, but are seldom accompanied by enough supporting data about the event to enable a determination of why the failure occurred. Generally it is difficult to draw significant conclusions from single events that can be used to improve system design or evaluate system performance.[22]

Thus, given the present situation of lightning protection system performance not being a priority of the proponents of the systems, the manufacturers, the insurance companies or public officials it would appear little valid information or data relative to a validation of the theoretical basis of the systems will be obtained.

III. RECOMMENDATIONS TO STANDARDS COUNCIL

Based on a thorough and complete evaluation of the 377 items submitted to the third-party independent panel the members of the panel have agreed in a complete consensus on the following recommendations to the National Fire Protection Association Standards Council. It should be

[22] Van Brunt, Richard J., Thomas L. Nelson, Samar L. Firebaugh, Early Streamer Emission Air Terminals Lightning Protection Systems: Literature Review and Technical Analysis, Quincy, MA, National Fire protection Research Foundation, 1-31-95, p. 25.

recognized the Standards Council is the official designated authority on any action to be taken relative to the NFPA lightning protection documents.

A. Scientific and Technical Basis of ESE

The initial question posed to the third-party independent evaluation panel was stated as: "whether the ESE lightning protection technology is scientifically and technically sound." The panel's review of the submitted materials resulted in the following determinations:

1. The ESE air terminals appear to be technically sound since they are generally equivalent to the conventional Franklin air terminal in laboratory experiments.

2. However, neither the ESE air terminals nor the conventional Franklin rod appear to be scientifically or technically sound when evaluated in field tests under natural lightning conditions.

3. The ESE lightning protection technology as currently developed in the installation of complete systems does not appear to be scientifically and technically sound in relation to the claimed areas of protection or the essentials of the grounding system.

B. Adequacy of Theoretical Basis and Lab Tests

The second specific question posed to the third-party independent review panel was stated as: "whether the ESE lightning protection technology is supported by adequate scientific-theoretical basis and laboratory testing." The panel's review of the submitted materials resulted in the following determinations:

1. There does appear to be an adequate theoretical basis for the early streamer emission lightning protection air terminal concept and design from a physical viewpoint.

2. There does not appear to be an adequate theoretical basis for the claimed enhanced areas of protection with limited down conductors and grounding system.

3. The high voltage laboratory tests of the ESE air terminals appear to be adequate in scope and quantity, but they are limited in that they are not equivalent to an evaluation of the complete ESE lightning protection system under natural thunderstorm conditions.

C. NFPA Lightning Protection Documents

The third-party independent evaluation panel was also directed in the Settlement Agreement as follows: "This panel, in issuing its report, shall address the following issues, and any other issues it deems relevant:" The panel considered the issues of the existing NFPA 780 document titled: Standard for The Installation of Lightning Protection Systems 1997 edition. (294) and the proposed NFPA 781 document titled: Standard for Lightning Protection Systems Using Early Streamer Emission Air Terminals. (277) The panel considered the need for each document and each committee's membership and balance in accordance with NFPA procedures. The panel's review of the submitted materials resulted in the following determinations:

1. The current NFPA 780 Committee should be discharged and the Committee should be completely restructured. The committee needs new and additional memberships in the membership categories of enforcer, consumer, user, insurance, labor, special expert and research/testing..

2. The Council should solicit memberships from prominent users such as: FAA, DOE, DOD, NASA, IBM, Reedy Creek Improvement District, phone, radio, television organizations and electric power utilities.

3. The NFPA 780 document should be reformulated as a Guide or Recommended Practice. It appears to the panel the NFPA 780 document does not meet the NFPA criteria for a standard since the recommended lightning protection system has never been scientifically or technically validated and the Franklin rod air terminals have not been validated in field tests under thunderstorm conditions. The NFPA criteria for a standard as stated in the NFPA 99 Directory (298) is as follows:

> Standard --A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix, footnote, or fineprintnote and are not to be consider as part of the requirements of a standard.[23]

[23] NFPA, National Fire Protection Association 1999 Directory, Quincy, MA, 11-98, p. 52.