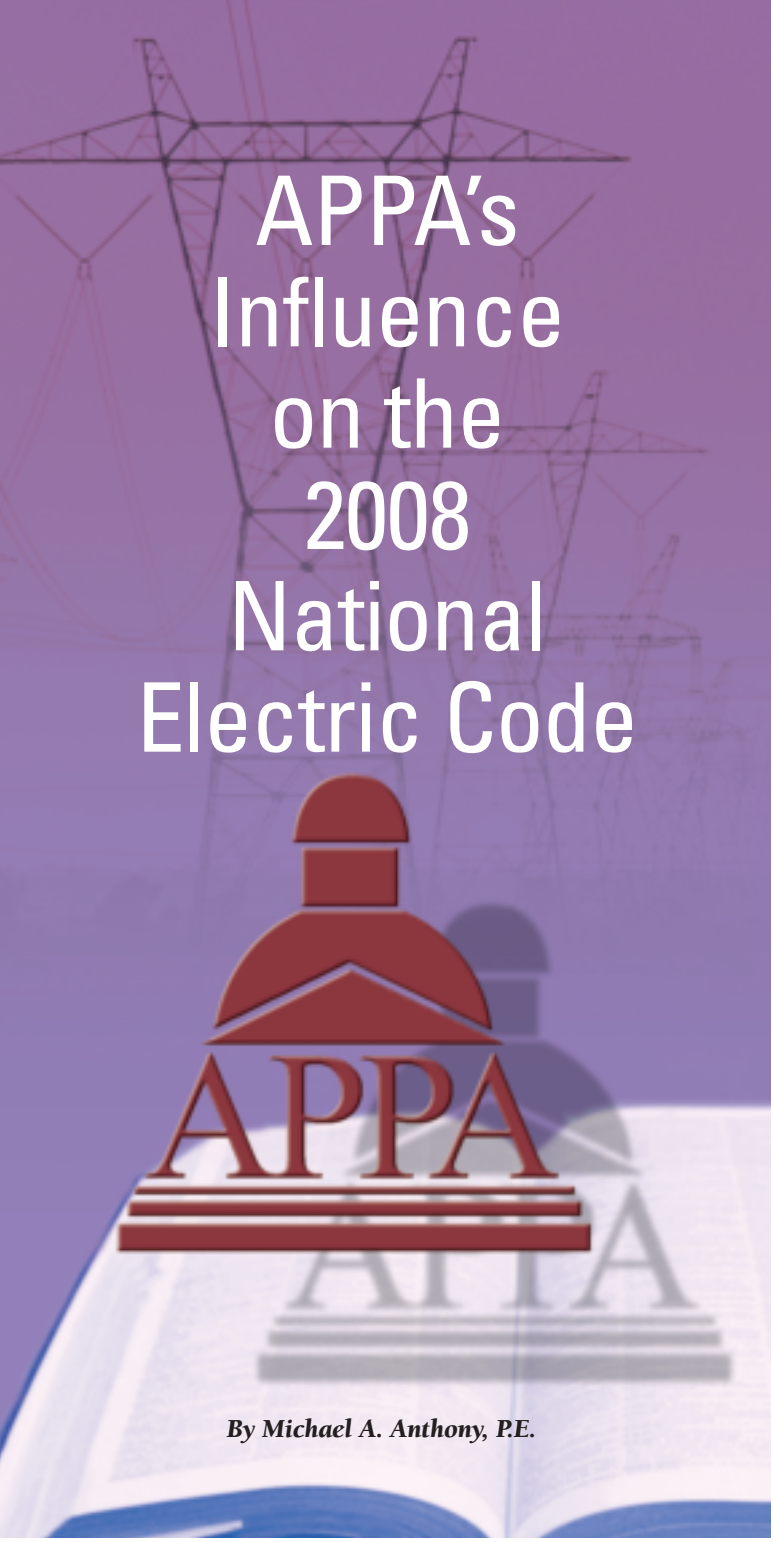
APPA's Influence on the 2008 National Electric Code



By Michael A. Anthony, P.E.

APPA's "wait and see" approach on a controversial electrical safety issue has forestalled at least $250 million in regulatory conformity costs; but at what price? Here's how it happened.

Since 1999, the year APPA obtained voting privileges on the content of the National Electric Code, the awareness of flash hazard has had a positive, transformative effect upon the electrical power industry. This effect resembles the market-moving transformation that took place when facility managers funded projects to eliminate the hazards associated with PCB transformers and hazards associated with circuit overloads caused by harmonics generated by personal computers.

While flash hazard has existed since the Big Bang it was not until we continued concentrating ever larger amounts of electrical energy in the built environment—and then expected electricians to keep the power on while maintaining the equipment—that the flash hazard issue began its ascent on the list of hazards. Safe work practices were not rigorously codified until 1976 when the first edition of *NFPA 70E–Standard for Electrical Safety in the Workplace* was published. This code, with its numerical similarity to NFPA 70 (otherwise known as the National Electric Code) was written to assist OSHA (the Occupational Safety and Health Administration) in preparing electrical safety standards that would serve OSHA's need to reference a more dynamic standard than the U.S. government could produce.

The worlds of the few federal OSHA inspectors and the many local electrical inspectors remained fairly separate until the 1999 NEC code cycle, when the first IEEE research on flash hazard was made available to the safety community. It took until the 2002 code cycle for the first proposals, based on this research, to appear before the panel at which APPA has its vote. The electrical safety community submitted a proposal to translate the flash hazard sections of NFPA 70E into NFPA 70—a bit of a stretch because NFPA 70E is a safety standard, and NFPA 70 is a code for premises wiring in buildings.

In the proposal stage of the 2002 code cycle I voted with the majority to include the incident energy number with the following Comment on the Affirmative: *"Acceptance of this proposal is a bold stroke on behalf of electrician safety. It could be a very costly addition to the NEC, however, if it raises engineering costs for building owners… I hope for lively and engaging debate on this subject in the ROC stage of the 2002 NEC."*

Lively and engaging debate, indeed. The following questions were—and still remain—typical.

- What do I do now? Allocate more money for training, for repairs, or for scheduled outages?
- Who is responsible for assuring that any incident energy number etched on a label remains accurate?
- Will the process of gathering cable, fuse, and transformer data that is required to compute short circuit current, cause more injuries?

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Even though the committee changed the original proposal in the comment stage by removing the incident energy requirement, I was not convinced that the world was ready for this kind of legislation. My Explanation of Abstention read: *"Even with the modifications to the original proposal, this change to the NEC may have unintended consequences for manufacturers, for building owners and for persons in the risk management community. While our support for electrician safety is unconditional, the practical details and the practical effects of this proposal needs more study."*

Many engineers embraced the incident energy labeling proposal because it held out hope for more funding for engineering. We saw flash hazard regulations as a way to get funding to fix stuff. Sensing the market, the IEEE updated its

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standard 1584, *Guide for Performing Arc Flash Hazard Calculations*. Among the 5,870,000 Google hits on the term "flash hazard," are websites that will produce flash hazard labels for you *online* as low as $50 *per item* of switchgear—as long as you key in the necessary circuit data along with a valid credit card number.

In the proposal stage of the 2005 NEC essentially the same proposal came before the committee and it was plain that the three years had changed some minds. (See sidebar on page 55.) The committee discussed the pro's and con's of incident energy labeling for days—early in the morning, late into the night and on weekends. Ultimately a compromise was struck with an "Agreement in Principal" crafted by a respected voice representing the electrician's union. As the record shows however, APPA's vote neither supported nor rejected the compromise. APPA's vote was entered as an abstention in both the proposal and comment stage of the 2005 NEC. APPA's 2005 abstention was a pivotal vote and presaged formation of a new majority.

How could the writers of this part of the NEC have come so close to placing an economic burden of this magnitude on its users? A partial answer is that code writers know the American National Standards Institute (to which the National Fire Protection Association conforms) provides a workaround. Even if the APPA abstention had failed to pre-

What is the cost of putting incident energy numbers on the labels of every piece of accessible electrical equipment in every building at every college and university in the US?

According to the National Center for Educational Statistics, there are 30 million students and 15 million faculty and staff in U.S. higher education. We can estimate how much power they consume by using a number available from the *Statistical Abstract of the United States.* With total U.S. power consumption at 3.13 Terawatts and a population at 300 million, we can estimate that each would person consumes about 1 kilowatt per person. This number resembles average power consumption on many APPA member campuses and is a good number for a facility manager to have for other reasons.

To estimate how many items of equipment that would require an incident energy number assume that an "average" 480V piece of equipment requiring service while energized is 200 amperes and comprises 25% of a typical building power system. Similarly, assume that the average piece of 208V equipment is 100 amperes and equipment operating at this voltage comprises 70% of a building power system.

Finally, assume that another 5% of the equipment to carry incident energy labeling operates at 5kV to 15 kV farther upstream and from time to time it must be serviced while energized. Applying these percentage factors, and ampere conversions familiar to electrical engineers, results in an estimate of 940,000 items of electrical power equipment that would be affected by NEC Section 110.16. Round up to 1 million items of equipment in the buildings for those 45 million students, faculty, and staff.

Assume that the cost to investigate cable sizes, fuse/breaker ratings, record, calculate and label each item is on the order of $500 per item. (This figure will cover about 2 hours of engineering time, and 2 hours of field work by technicians and 1 hour of circuit detailing, compiling, organizing and archiving—*per item.*) This leads to $500 million—and we haven't even included the other accessible enclosures for equipment that operates between 50V and 120V. Even if we cut this number in half, we are left with $250 million items of equipment requiring an incident energy number. (Other methods employing square footage estimates for the 1,300+ APPA member institutions leads to higher estimates.) To treat the issue with an abundance of prudence let us settle on the $250 million averted cost knowing, however, that the cost to put incident energy numbers on equipment may easily be one or two orders of magnitude larger.

vent the incident energy number from being written into the 2005 NEC code anyone—and the NFPA holds the door open to anyone—would still have an opportunity to file an appeal to the NFPA Standards Council. Many costly and controversial issues in the past have been resolved in this way.

Just as likely, however, APPA member institutions could have simply stricken it from text they adopt from the NEC. Simply making a part of the NEC inapplicable to your jurisdiction is allowed. Writers of the NEC do not like to see this happen though and neither does the NFPA. They want to write clear, enforceable code in step with the technological times without increased hazards.

The rejection of the incident energy proposal for the moment is nothing over which to rejoice, despite the likely "savings" to our industry. First of all, the rather dramatic reversal in support for incident energy labeling has yet to be confirmed in the comment stage of the 2008 NEC. Second, even if incident energy proposals are rejected again, educational facilities managers may have to answer questions from safety advocates within their own organization. Our $250 million guess at averted regulatory expense has to be weighed against the cost of one human life. In other words, the APPA abstentions grant us a hollow victory.

Finally, to paraphrase the preface to the new *NFPA 70E Handbook on Electrical Safety,* it is hard to count something that does not happen. When electricians get together to talk shop they speak of "near misses." Data on near misses is hard to come by but, intuitively, we all know that the increased safety training and hazard awareness must be doing some good.

Here are a few proposals for facility managers to "spend" the savings.

- Have your electrical professionals design changes to electrical systems so that equipment does not have to be worked hot. Condition building occupants for outages. A great deal can be learned just by preparing for an outage.
- Work cooperatively with the IBEW, OSHA, and your Authority Having Jurisdiction on the local implementation of the various codes that apply to your organization. As it now stands in many jurisdictions, on Day One all you are required to do is conform to an installation code (NFPA 70). On Day Two, however, you are required to conform to a workplace safety code (OSHA's 29 CFR 1910.332). Get some clarity.
- At every flash hazard training session ask electricians to add to a list of hazardous electrical equipment. Putting together such a list is a delicate undertaking because it can result in the identification of units that have not had sufficient funding to keep their electrical infrastructure safe. The low voltage backbone a building's infrastructure—upstream from the power outlets funded by individual research projects but downstream from the service switchgear—is usually an area of neglect. Use this list to rank priorities no matter how far away a funding possibility may be.
- Assemble a circuit diagram maintenance team anyway. The safety community that brought the incident energy proposals to the NEC is ingenious and well meaning. It is likely that this issue will emerge in another form, possibly in another code, in the future. Having a good start on keeping circuit diagrams up to date shows due diligence to OSHA which has adopted NFPA 70E by reference. It is neither practical, nor affordable, nor even expected of any organization to do this work instantly.

Facility managers probably do not need to be reminded that electrical systems are extremely complex. Arguably, electrical systems are more complex than the architectural and mechanical systems in campus buildings because; beyond the basics of power outlets, lighting fixtures, fire alarm systems and telecommunications; campus buildings are richly interconnected and have many "nerve endings" of an electrical nature (such as the controls for doors and windows, thermal and plumbing systems). The electrical power trades bring a concentrated form of energy closer to human beings than any other discipline involved in the built environment.

In summary, even though the NEC does not now require incident energy labels it still requires labels that warn that equipment likely to be service while energized must be labeled as a flash hazard. OSHA requires that you protect your electrical professionals with personal protective equipment but will probably not come knocking to look for incident energy labels required by NFPA 70E unless there is an accident. After the first accident, all bets are off. It is for this reason that many large manufacturers are implementing

Table showing the progress of NEC committee voting on mandatory incident energy numbers. The votes are stated as (AFFIRMATIVE)-(NEGATIVE)-(ABSTAIN). A 2/3 majority vote is required to change the NEC. Note the decline in support for incident energy labeling over three code cycles.

NEC EDITION	PROPOSAL VOTE	COMMENT VOTE
2002	11-1-0 New Section 110.16, *including an incident energy number,* is proposed for the first time. APPA voted with the majority to include the incident energy number.	12-0-1 In a procedural move, the committee removes the incident energy number and settles for a warning sign only. After polling electrical professionals, APPA enters an abstention vote, citing the need for more study of the legal ramifications of an incident energy number.
2005	7-4-1 Now four panel members cast votes against the *addition of the incident energy requirement to the labeling* approved in 2002. APPA was the abstention that kept the incident energy number from becoming code. Since a 2/3 majority vote is required to change the NEC the proposal did not pass the Proposal vote.	7-4-1 The voting in the comment stage affirmed the voting in the proposal stage. In its abstention, APPA suggests that many industries do not yet grasp the cost implications and suggests one more code cycle for the industry. This is as close as the voting ever got to mandating an incident energy number.
2008	1-9-2 Now nine panel members cast votes against the incident energy requirement in 110.16. The straw vote taken at the proposal meeting is a dramatic reversal in sentiment since 2002.	Comments on the voting that occurred in the proposal stage will be available to the general public in July 2006. Voting on the public reaction to the incident energy proposals will occur in December 2006.

large flash hazard conformity programs. Much remains jurisdiction dependent.

Many APPA institutions already have their electrical people putting labels on enclosed electrical equipment—at least on new electrical construction. Others are already attempting to conform to the workplace safety requirements where NFPA 70E is enforced. Others have assembled pilot programs with temporary workgroups to get a feel for the cost and the challenges if incident energy labeling becomes mandatory sometime in the future. These are all steps in the right direction. For a deeper understanding of the NEC code writing process and of the subtleties in the flash hazard debate, see the expanded link from this article on APPA's website.

Forward

The next challenge for writers of the National Electric Code seems to be reconciling the competing requirements of overall electrical safety with the accelerating costs of copper, aluminum, and PVC. For facility managers who have a growing need to operate and maintain newly acquired off-site (or campus perimeter) commercial buildings, challenges may lie in adapting the generally lower standards of commercial construction to the higher standards of electrical construction to which campus electrical professionals are accustomed.