APPROVED, LISTED, AND FIELD EVALUATED - REQUIREMENTS FOR LOW VOLTAGE ELECTRICAL EQUIPMENT USED FOR POWER DISTRIBUTION AND MOTOR CONTROL

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Abstract - The purpose of this paper is to examine the various laws, regulations, and codes that are applicable to the approval of low-voltage electrical power distribution and motor control equipment. Electrical equipment needs to be approved to help ensure that is safe for its intended function. If equipment is not approved, it would result in delays in the execution of a project. This paper is primarily focused on requirements within the United States of America, with the expectation that users in other countries will then be able to identify the requirements in other countries. The paper helps to answer frequent questions such as: What does it mean for equipment to be approved? Does all electrical equipment need to be approved? Who can give approval for equipment? Is a Listing the same as approval? What to do if equipment is not approved? If a change is made in the field to equipment that is listed or labeled, does that equipment require field evaluation in order to be approved? If so, who can provide that evaluation? What are the consequences of using custom "homemade" equipment that is not listed?

At the conclusion of the paper, the user should be able to answer each of those questions and be better aware of the approval requirements for low-voltage electrical equipment.

Index Terms – Electrical equipment, approval, listed, labeled, OSHA, NEC®, FEB

I. INTRODUCTION

Many factors impact the requirements for the installation and use of electrical equipment and wiring. Government requirements exist at the Federal, State, and local levels. In addition, individual entities may have their own internal requirements based on their own procedures plus those of their insurance underwriters.

A key distinction in requirements is whether or not the equipment is being installed in a residential or workplace setting. The basic installation requirements are likely to be the same for both situations. However, in residential applications, the local authority having jurisdiction (AHJ) is the sole authority to approve an electrical installation. Whereas, when the electrical equipment is installed in a workplace setting, it is subject to the not only the requirements of the local AHJ, but also to the requirements of the Occupational Safety and Health Administration (OSHA). Of course, the argument could be made that if electrical equipment or an installation will need to be serviced, it becomes a workplace and will be subject to OSHA requirements.

This paper will focus on the requirements for approval of electrical conductors and equipment used in workplace settings within the United States of America. Other countries will likely have similar requirements, but they are not within the scope of this paper.

Most electrical equipment users are familiar with the requirements in the NFPA 70, National Electrical Code (NEC®). The NEC is a model electrical code that is adopted by various levels of government, from the State level down to the local municipality level. In California, there is a State of California Electrical Code, then there are requirements by the County of Los Angeles, and finally there are requirements from the City of Los Angeles. It is important to understand the requirements of all of these various authorities to help ensure that a safe and successful installation will be made. The NEC may be adopted in whole, or in part, or it may have modifications made to its rules by local jurisdictions. Throughout the United States, there are actually various versions of the NEC in force. As of March 1, 2022, 16 states had adopted the NFPA 70-2020; several states are using older versions, with two states, Kansas and Indiana, still using the 2008 NEC. [1]

When the location of an electrical equipment installation is a workplace, there are Federal Government rules and requirements in effect that will be enforced by the Occupational Safety and Health Administration (OSHA). OSHA's primary mandate is the protection of workers by helping to "*ensure safe and healthful working conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance.*" [2]

II. NATIONAL ELECTRICAL CODE

A. Overview

The National Fire Protection Association (NFPA) produces and publishes NFPA 70, the National Electrical Code (NEC). The NEC is a model code that provides requirements to help ensure the safe installation of electrical wiring and equipment. It has various requirements (divided into various "Articles") which deal with the conductors and equipment used for

electrical installations, as well as the methods used in their installation.

The NEC can be adopted by various jurisdictions at the state or local level to use as their electrical code. Most often, it will be adopted as it is written, however, these jurisdictions may use versions of the NEC other than the latest version, create their own rules which may supplement the NEC, or create rules that might even replace certain provisions found in the NEC.

In the United States, there is a great likelihood that the applicable electrical code will either be the NEC or the NEC with some modifications. In this paper, we will use "NEC" as representative of the applicable electrical code(s) which will be enforced at the state or local level.

Article 90.2 of the NEC discusses which installations are included within its scope of coverage, as well as installations that are not within its scope of coverage. Article 90.2(B) indicates installations that are excluded from the scope of the NEC. These excluded installations will have regulations provided by other jurisdictional bodies. For example, installations in underground mines are excluded from the scope of the NEC. There are Federal regulations related to underground mines (including electrical requriements) which can be found in Title 30 of the Code of Federal Regulations (30 CFR) and are administered by the Mine Safety and Health Administration [3]. State and local governing bodies may also have their own regulations related to electrical installations for underground mining.

The enforcement of the requirements of the NEC and the approval of the installation, wiring, and equipment is the responsibility of the Authority Having Jurisdiction (AHJ).

B. Definitions

Article 100 of the NEC contains definitions for some of the more important words and concepts that will be helpful when interpreting the rules in the code.

The NEC defines the "Authority Having Jurisdiction" as "An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure." [4]. The accompanying informational note goes on to say that the AHJ could take the form of a broad array of agencies and individuals. Authorities having jurisdiction might include representatives of a government agency, the property owner (i.e., workplace employer), or even an insurance company representative.

When it comes to the approval for electrical equipment, there are several other definitions found in Article 100 that are important to know and will be used in this paper: "Approved", "Listed", "Labeled", "Field Evaluation Body" and "Field Labeled."

"Approved" – "Acceptable to the authority having jurisdiction." [4]

"Listed" - "Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose." [4] An informational note is also provided, which states that, "The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. Use of the system employed by the listing organization allows the authority having jurisdiction to identify a listed product." [4] Equipment that is listed will not necessarily include labeling which indicates that it is listed. Listed equipment that is unlabeled can be verified as being listed by reviewing the list maintained by the organization which provided the listing. Some provisions of the NEC require equipment to be both listed and labeled.

"Labeled" - "Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner." [4] This is essentially Listed equipment which has also been labeled to identify it as being compliant with the appropriate testing standards.

"Field Evaluation Body (FEB)" – "An organization or part of an organization that performs field evaluations of electrical or other equipment." [4] It should be noted that the NEC leaves the suitability and acceptance of an FEB to the AHJ. There is no requirement that the FEB evaluating a piece of equipment has to be an organization that provides labeling or listing services for that type of equipment at its point of manufacture.

"Field Labeled" – "(as applied to evaluated products). Equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB indicating the equipment or materials were evaluated and found to comply with requirements as described in an accompanying field evaluation report." [4]

C. Requirements for Equipment

Article 90.7 "Examination of Equipment for Safety" says "For specific items of equipment and materials referred to in this Code, examinations for safety made under standard conditions provide a basis for approval where the record is made generally available through promulgation by organizations properly equipped and qualified for experimental testing, inspections of the run of goods at factories, and service-value determination through field inspections…. It is the intent of this Code that factory-installed internal wiring or the construction of equipment need not be inspected at the time of installation of the equipment, except to detect alterations or damage, if the equipment has been listed by a qualified electrical testing laboratory that is recognized as having the facilities described in the preceding paragraph and that requires suitability for installation in accordance with this Code. Suitability shall be determined by application of requirements that are compatible with this Code" [4]

This is one of the first clues that using listed equipment may ease the burden on the AHJ who needs to approve an electrical installation and associated equipment.

Article 110 is a foundational article and gives "… general requirements for the examination and approval, installation and use, access to and spaces about electrical conductors and

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equipment; enclosures intended for personnel entry; and tunnel installations." [4]

Article 110.2 says "The conductors and equipment required or permitted by this Code shall be acceptable only if approved." [4] As we learned in the definition of "approved", this means that the equipment or installation is acceptable to the authority having jurisdiction.

Article 110.3 discusses the requirements to ensure that electrical equipment is suitable for use.

Article 110.3(A) lists the required items to be thoroughly reviewed by the AHJ in order them to grant their approval. These include the following:

(1) Suitability for installation and use in conformity with this Code
(2) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided
(3) Wire-bending and connection space
(4) Electrical insulation
(5) Heating effects under normal conditions of use and also under abnormal conditions likely to arise in service
(6) Arcing effects
(7) Classification by type, size, voltage, current capacity, and specific use
(8) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment [4]

Article 110.3(B) states that equipment that has been listed or labeled, or both, must be installed and used in accordance with any instructions included in such listing or labeling. Using listed equipment in a manner inconsistent with its listing could be the basis for rejection by an AHJ. For example, listed equipment with a Type 1 general purpose enclosure designation used in an outdoor area should be rejected by the AHJ, as this type of exposure requires a suitable enclosure, such as one with a Type 3R rating.

Article 110.3(C) says that product testing, evaluation, and listing is required to be performed by a recognized testing laboratory. OSHA maintains a list of Nationally Recognized Testing Laboratories (NRTLs) along with a list of the electrical conductor and equipment standards for which they have been authorized to test, evaluate, and list. [5]

Specific requirements for when electrical equipment is required to be listed or labeled are found in the various articles within the NEC. For example, NEC Article 242.8 explicitly says that all surge protective devices shall be listed devices. Almost all wiring methods (conductors, raceways, etc.) delineated in Chapter 3 carry a listing requirement.

Some equipment may not have a specific, overall listing requirement, but listing may still be required for parts of the equipment. For example, low voltage motor control centers (MCCs) (discussed in NEC Article 430, Part VIII) are typically modular assemblies and, if listed, have separate listings for the MCC sections and the MCC units. Refer to Fig. 1.

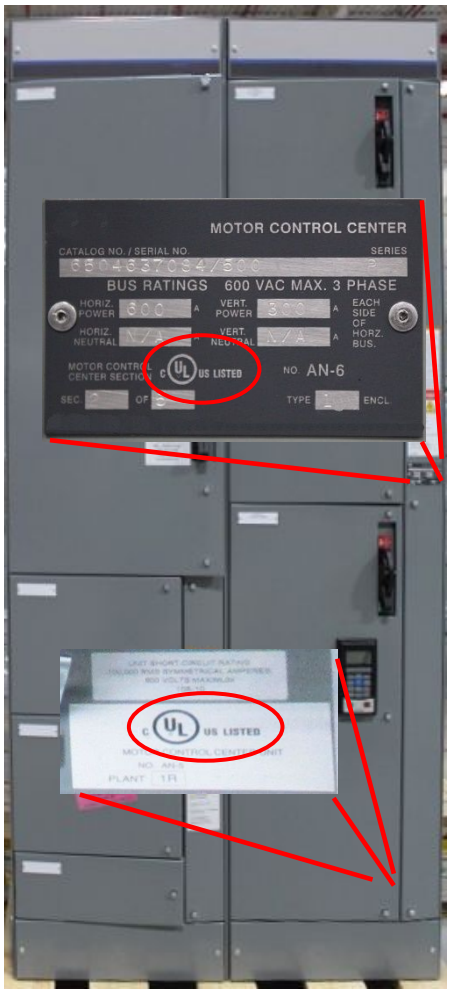

Fig. 1 MCC with Certification Labels

It should be noted that there is not an explicit NEC requirement for MCC sections or units to be listed. However, Article 430.98 [4] requires the MCC to have proper markings, including the "common power bus rating and motor control center short circuit current rating," as well as all of the required items in Article 110.21, which include "the manufacturer's name…, voltage, current, wattage, or other ratings as specified elsewhere in this code."

It is important to note that there might be other requirements in the rest of the NEC that impose a listing requirement. Following are three examples of these requirements:

The disconnecting means used in a motor control center unit is required to be listed per 430.109. Refer to Fig. 2 for an example of a switch. The disconnecting means mentioned in 430.109 can be any one of the seven devices, ranging from a disconnect switch to a self-protected combination controller – all of which require the item to be listed. However, the overall motor control center unit is not necessarily required to be listed.

Fig. 2 Disconnect Switch with Certification Label

Sometimes a motor control center contains an overcurrent protective device (OCPD) intended for operation at 100% of its rating. There are several NEC articles, 210.20(A), 215.2(A)(1)(a), 215(3), 230.42(A)(1), which will require that the OCPD is listed for 100% operation. There is an additional requirement that the entire assembly (in this case, MCC unit) containing that OCPD will also need to be listed.

If the motor control center is serving as service equipment, then, according to Article 230.66(A), the service equipment portion of the motor control center needs to be listed or field labeled.

NEC Article 408, which covers switchboards, switchgear, and panelboards, also does not include an overall listing requirement. Construction specifications are mentioned in Part IV of the article, but again, no overall listing requirements are mentioned. However, as with the MCC, there may be other requirements in the NEC which will require some or all of the equipment in Article 408 to be listed.

D. Modified or Unlisted/Unlabeled Equipment

The listing and labeling of electrical equipment only applies to the equipment in the state that it was when it was produced in a manufacturing location under the surveillance of the NRTL that provides the listing or labelling. If equipment is modified beyond that which may be allowed in its installation instructions, then the compliance with the underlying listing/labeling standard may be suspect.

Field modifications that go beyond those permitted in the equipment instructions are outside the control of the listing agency. They would say that the listing should no longer be considered to be valid. They have no way to know if the modified product meets the requirements of the applicable standard. This is usually when the AHJ and an FEB get involved, particularly if the equipment is required to be listed per the NEC.

From the manufacturer's perspective, the biggest concerns are if the modification affects the safety or performance of the equipment. If equipment will be modified, these modifications should be discussed with the manufacturer and gain their approval and perhaps obtain advice about precautions to take while making the modification. If the manufacturer does not agree with the modification, they can provide more information about why the modification should not be made and alternative solutions. The manufacturer can also inform the user if the modification would affect the manufacturer's warranty.

Many AHJs will simply refuse to go through the process required to evaluate unlisted/unlabeled electrical equipment by themselves and will simply require that all electrical equipment to have listing/labeling from a NRTL whether or not the NEC specifically requires listing or labeling.

If the equipment does not have a listing or label showing compliance with the applicable equipment standard, the AHJ will often require that the user engage the services of a field evaluation body (FEB) to review the equipment and, if it is found to be compliant with the applicable standard, the FEB will apply the label from their organization indicating that a field evaluation has found the equipment to be compliant. If the equipment is not found to be compliant, the installation will be rejected and the installation will be delayed until suitable equipment can be procured and installed.

III. OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

A. Overview

The Occupation Safety and Health Administration (OSHA) came into being after the passage of the Occupational Safety and Health Act in 1970. OSHA's mandate is to "to ensure safe and healthful working conditions for workers by setting and enforcing standards and by providing training, outreach, education and assistance." [2]

The requirements that OSHA enforces are found in Title 29 of the Code of Federal Regulations (29 CFR); more specifically, 29 CFR Part 1910 "OCCUPATIONAL SAFETY AND HEALTH STANDARDS". Electrical related regulations are found in 29 CFR Subpart S (Electrical, 1910.301 – 1910.399) which

"*addresses electrical safety requirements that are necessary for the practical safeguarding of employees in their workplaces*" [6] The scope of coverage of Subpart S is found in 29 CFR 1910.302. Similar to Article 90.2(B) of the NEC, one of the excluded installations is in underground mines.

The sections with regulations in regard to electrical equipment and installations are currently found in 29 CFR 1910.302 through 1910.308 and the definitions found in 1910.399.

The rule of most interest for this paper is 29 CFR 1910.303(a) "*Approval. The conductors and equipment required or permitted by this subpart shall be acceptable only if approved, as defined in § 1910.399*"

There are three options for approving conductors and equipment given in 29 CFR 1910.399:

§ 1910.399 Definitions applicable to this subpart.

Acceptable. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this subpart S:

(1) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory recognized pursuant to § 1910.7; or

(2) With respect to an installation or equipment of a kind that no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code, and found in compliance with the provisions of the National Electrical Code as applied in this subpart; or

(3) With respect to custom-made equipment or related installations that are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives. [7]

This means that in addition to the approval of the AHJ from an electrical code perspective, the installation and equipment also needs to be acceptable to the Assistant Secretary or Labor. Hereafter, we will refer to this acceptance as being "approved by OSHA" since the Assistant Secretary of Labor acts through OSHA as their representatives.

B. NRTL Approved Equipment

OSHA maintains a list of nationally recognized testing laboratories (NRTLs) [5] and the standards for which they are specifically approved to certify. Using equipment that has been certified, listed, and/or labeled by a NRTL is the most straightforward way of knowing that the conductors or equipment is approved and therefore acceptable to the OSHA.

If it is not possible to use equipment that is already included in an equipment manufacturer's existing range of certified, listed, and/or label products, it may be worth the extra cost and lead-time that may result from working with the manufacturer to add the new equipment to their range of listed/labeled products.

If the equipment is found by OSHA to not be approved, the resultant cost and project delay could far exceed the cost and lead-time of having the manufacturer extend their product line.

C. Equipment not covered by a standard

In regard, to 29 CFR 1910.399(2), it is likely to be a rare occurrence to have an installation of distribution or motor control equipment that is not covered by a standard within the scope of certification of one or more NRTLs. In the event that this situation occurs, it is imperative that the employer work with the appropriate AHJ(s) and OSHA representatives to ensure that the equipment is able to be accepted. The earlier that these discussions take place, the less impact there will be to a project's schedule. OSHA maintains a list of recognized "Appropriate Test Standards" that can be used by a NRTL to certify, list, and/or label equipment. This list can be found on OSHA's website. [8]

Equipment which originates outside the United States may have been designed, tested, and rated in accordance with a standard that is not found in OSHA's list of "Appropriate Test Standards" [8]. Even if it was designed, tested, and rated in accordance with the appropriate standard, if the evaluation was not performed by an OSHA approved NRTL, then the equipment would still not be acceptable to OSHA and would not be able to be used in the United States without some additional evaluation (perhaps by an FEB who is a NRTL for the appropriate standard).

An example would be equipment designed, tested, and rated in accordance with IEC 61439-2, the standard for "Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies". The equipment might also be marked with a "CE" label, but that simply indicates the equipment is declared by the manufacturer to be in compliance with the appropriate European Union (EU) Directives, including EN 61439-2 (the EU version of IEC 61439-2). Equipment which is designed to meet the requirements in IEC 61439-2 must also meet the applicable requirements of IEC 61439-1 ""Low-voltage switchgear and controlgear assemblies – Part 1: General Rules".

In the United States, the equipment that would fall under the same classification as IEC 61439-2 equipment could actually be one of three types of equipment which each have different OSHA recognized test standards:

- low-voltage motor control centers
  (Test Standard is UL 845),
- low-voltage switchboards
  (Test Standard is UL 891),
- low-voltage switchgear
  (Test Standards are UL 1558, IEEE C370.13, IEEE C37.20.1, NEMA C37.50, and NEMA C37.51) [8]

Therefore, this IEC 61439-2 equipment would be required to be evaluated in accordance with the applicable OSHA recognized test standard(s) for the type of equipment it represents. In addition, the evaluation would need to be performed by an OSHA recognized NRTL. However, if the equipment was only designed to meet the requirements for IEC 61439-2, then it may not be able to be approved for use in the United States of America. One significant difference in the standards is found in the IEC 61439-1 "General Rules" which permits much smaller through-air and over-surface spacing distances between live parts, and between live parts and the equipment enclosure, than the applicable OSHA recognized test standards. These distances in the IEC standard are based

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on the manufacturer declared impulse voltage. For example, for an impulse voltage rating of 8 kV (according to IEC 61439-1, Annex G, Table G.1, 8 kV would be used for service entrance applications on systems with AC voltages up to 600 V [9]), the through-air spacing, according to Table 1 of IEC 61439-1 [9] is only required to be 8 mm. Depending on the specific construction, the over-surface spacing (according to Table 2 of IEC 61439-1 [9] may also be 8 mm. The similar spacing requirements according to Table 19 in ANSI/UL 845 "Standard for Low Voltage Motor Control Centers", for through-air spacing is 25.4 mm and for over-surface spacing is 50.8 mm. It should be quite obvious that equipment that was designed to meet the spacing distances of IEC 61439-1 will not comply with the requirements for ANSI/UL 845. The temperature rise testing method and limits are also different, such that the equipment might have temperature rises that exceed the permissible limits in the requirements of the appropriate OSHA recognized test standards.

If equipment which originates outside the United States is intended for use in the United States, it is imperative the design, rating, testing, and certification of this equipment needs to be closely examined to verify that it meets the requirements to be approved by OSHA.

D. *Custom Equipment*

Whether or not equipment can be considered to be "*custom equipment…for use by a particular customer*" per 29 CFR 1910.399(3) may be subject to interpretation by an OSHA representative. If deemed valid, this option for approval requires that the manufacturer conduct appropriate tests and determine that the equipment is safe for its intended use and must provide a test report to the user (employer) which would include a declaration that the equipment is safe for its intended use. The employer will need to keep this report on file to be able to present to an OSHA inspector to prove the equipment has been determined to be safe for its intended use. If there is an appropriate OSHA recognized test standard for this type of equipment, it would need to be used by the manufacturer for this equipment evaluation. Note that if the NEC requires this equipment to be listed or labeled, the manufacturer's report may satisfy OSHA, but there would need to be a separate approval by the AHJ, who will need to evaluate the manufacturer's report.

An example of custom equipment is if the manufacturer is the employer and made some electrical equipment "in house." Perhaps the employer has had their employees fabricate some custom industrial control panels. These would normally fall under the OSHA recognized test standard UL 508A. Since this would be custom equipment, intended for a particular user, then the employer, as the manufacturer, could create a test data report that details how they determined the panel to be safe for its intended use and use that as the basis for approval and acceptance by OSHA. A separate approval would still be needed from the AHJ.

OSHA maintains a library of "Standard Interpretations" which are intended to help clarify requirements in the various regulations. [10] One of the most recent standard interpretations is in regard to custom equipment and emphasizes that 29 CFR 1910.399(3) provides a means to have the custom equipment be acceptable to OSHA. [11]

IV. FIELD EVALUATION

Various Field Evaluation Bodies exist which may be able to validate and apply a field label to equipment which is not listed or labeled or was orignally listed or labeled but has had some field modifications made which go beyond those permitted by the equipment's installation instructions.

As mentioned previously, the NEC defines a Field Evaluation Body (FEB) as "*an organization or part of an organization that performs field evaluations of electrical or other equipment.*" and Field Labeled as "*equipment or materials to which has been attached a label, symbol, or other identifying mark of an FEB indicating the equipment or materials were evaluated and found to comply with requirements as described in an accompanying field evaluation report.*" [4]

It is important to understand that the FEB needs to be acceptable to the AHJ. However, as mentioned previously, in a workplace, the equipment not only needs to be approved by the AHJ, but it also needs to be acceptable to OSHA and be approved as defined in 29 CFR 1910.399. Discussions need to take place between the user, the FEB, the AHJ, and appropriate OSHA representatives to ensure that the evaluation process goes smoothly.

It should be noted that while the local AHJ may approve of the FEB to be used for the evaluation and provide compliance with the NEC, if the FEB is not also an OSHA approved NRTL with coverage for the applicable OSHA recognized test standard, the field labeling may not be acceptable to OSHA; thus, the importance of including an OSHA representative in discussions for the field evaluation of the equipment in question.

V. CONCLUSION

There are various authorities which define the requirements for the approval of electrical equipment. Most common are Federal, State, and local regulations, however it is also possible that the end user or their insurance underwriter may have additional requirements in order to approve electrical equipment and its installation. It is important to understand all of these requirements.

Electrical equipment used in a workplace has to not only be approved by the AHJ as complying with the appropriate electrical code requirements at the location where the equipment will be installed, but it also needs to comply with OSHA requirements to be acceptable and approved by OSHA.

When electrical equipment is not listed or labeled by an NRTL approved by OSHA, it is possible that the equipment can still be found acceptable to and be approved by OSHA. If the equipment is customized for the specific end user, the equipment manufacturer can determine, based on test data, that it is safe for its intended use, but it is then incumbent on the employer (end user) to obtain this test data and make them available for inspection by OSHA.

If the listed or labeled equipment has been modified after it has been manufactured or if it is custom made equipment, it is possible that a field evaluation can be performed which may result in the equipment being approved by both the AHJ and OSHA. It is imperative that if a field evaluation is going to be used as the basis of approval, that discussions take place between the manufacturer, the user, the FEB, the AHJ, and

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appropriate representative of OSHA to ensure that the FEB is acceptable and that those authorities will accept the field labeling provided by the FEB.

The use of equipment which is factory listed or labeled by an OSHA approved NRTL, streamlines the approval process since 29 CFR 1910.399(1) tells us that the equipment is automatically acceptable and approved by the Assistant Secretary of Labor (i.e. OSHA); in addition, the AHJ can use that listing or labeling as the basis for their approval without further evaluation of that equipment and can focus on inspecting and approving the installation and field wiring made to the equipment.

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VII. VITAE

Todd R. Sauve, P.E. (trsauve@ra.rockwell.com) received his BS degree in Electrical Engineering from the Milwaukee School of Engineering. He has been an engineer in various roles with Rockwell Automation's Low-voltage Motor Control Center Business and is currently a Principal Engineer on the LV MCC Development Engineering Team. Combined with his time in industry, he has over 32 years of low-voltage motor control center expertise. He is a member of several IEEE standards working groups and is a US Expert to the IEC, participating in MT2 of SC121B and several other IEC project teams. He is a registered professional engineer in the state of Wisconsin.

Kenneth Sellars (ken.sellars@e-hazard.com) is a partner at e-Hazard, LLC, based in Louisville, KY. He holds an unrestricted electrical license in Georgia and is a Certified Electrical Safety Compliance Professional. He also holds a bachelor's degree in Business Management from the University of Phoenix. He teaches electrical safety, including NFPA 70E®, OSHA 1910.331-335, OSHA 1910.269, OSHA 1926 Subpart V, the National Electrical Code, and Telecommunication Electrical Safety (based on 1910.268). Mr. Sellars performs electrical safety training, investigations, and audits in the USA and in over fourteen countries abroad and has developed electrical safety procedures for a host of international companies. Mr. Sellars served as a firefighter and medical first responder for 18 years and is an instrument-rated private pilot. He uses principles from his experiences in fire and emergency medical response, as well as aviation safety principles, in his approach to electrical safety. He has taught safety classes since 1994, including Firefighter I and II, Confined Space, Hazmat Tech, Rope Rescue, Electrical Safety for Emergency Personnel, and electrical compliance. He brings his passion for safety, as well as his experience from injury and fatality response, into the classroom.

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