CDC-NIOSH-OMSHR REPORT

Quality Assurance of Nationally Recognized Test Laboratories using

ANSI/ISA Standards for Certification of Intrinsically Safe Equipment

Introduction

The information contained herein is in response to the "Statement of Work for Professional Services" and is organized in a similar manner to that request. The information has been gleaned from a variety of documents, others involved with the issues, and the experience of the writer. A bibliography of sources is attached.

It is the opinion of the writer that the current standards for the intrinsic safety explosion protection technique are quite conservative and reduce the probability of ignition to levels likely well below that of other explosion protection techniques. All the techniques in use today have proven over a long period of time that they provide more than adequate explosion protection when properly designed, properly installed, and properly maintained. In reviewing the causes of explosions where electrical equipment having some form of explosion protection was present, it has not been determined that the ignition was caused by such equipment. In just about all of these explosions that do occur, the root cause has usually been human error. Further, the American National Standards Institute provides a creditable service in recognizing standards writing bodies and monitoring the processes used to develop such standards using well documented procedures for protecting the interests of all parties and to providing oversight of the process.

It is also the opinion of the writer that the Occupational Safety and Health Administration (OSHA) in developing and administering its Nationally Recognized Testing Laboratory (NRTL) program also has performed a creditable service in establishing criteria for such recognition, evaluating testing laboratories that apply for such recognition, and providing oversight via a comprehensive audit process performed at the recognized laboratory facilities on an ongoing basis.

I. OSHA and the NRTL Program

A. NRTL Program History – The concept of nationally recognized testing laboratories was introduced when the initial OSHA standards were promulgated in 1971. CFR 1910 Subpart S stated that electrical equipment would be acceptable to the Assistant Secretary of Labor if they were listed or approved by, but not limited to, Underwriters Laboratories, Inc. or Factory Mutual Research Corporation. At this time there were no established criteria to gain NRTL status or

any oversight of those that were or might be acceptable otherwise. One of the unnamed test laboratories took umbrage with the statement regarding the test laboratories and filed a lawsuit to remove all references to the two named test laboratories. The law suit was won by the offended laboratory in 1983 forcing OSHA to remove all references to Underwriters Laboratories, Inc. and Factory Mutual Research Corporation from the regulations.

In the meantime, OSHA had taken action proposing a set of criteria and procedures that OSHA intended to use to accredit independent testing laboratories which would test and certify equipment required to be "accepted" or "approved" under OSHA standards. This appeared as 29 CFR Part 1907 on September 11, 1973, and proposed for revocation on June 3, 1974. This procedure was never implemented.

Presumably, after the adverse court decision in 1983, OSHA began work on developing a new set of criteria and procedures for evaluating test laboratories who desired recognition as an NRTL. The proposal was published on March 6, 1984 as 29 CFR Part 1936, and proposed a new Part 1935 to Title 29, covering test methods and procedures. The development process took several years, but in 1988, OSHA revised its regulations removing all lab-specific references and established the NRTL program. The final documents were published as Part 1910.7 (Definition and Requirements for a Nationally Recognized Testing Laboratory) of the Code of Federal Regulations, Part 1910 (Occupational Safety and Health Standards), Subpart A (General) as well as Part 1910.7 A, an appendix addressing the detailed procedures for gaining NRTL status. The first laboratory recognized under this program occurred in 1989. At that time, Underwriters Laboratories, Inc. and Factory Mutual Research Corporation were both grandfathered in as NRTL's without being processed through the application procedures due to their long standing as product certification organizations. This recognition was granted for 5 years after which both organizations would have to apply for a renewal using the new procedures. Further experience of OSHA working with the testing laboratories led to a major program addition on March 9, 1995. This is the Satellite Notification and Acceptance Program (SNAP) which allows NRTL's to apply for and gain acceptance of using facilities outside of the already "recognized" facilities without having these sites formally "recognized" by OSHA. These facilities would be allowed to perform designated test, evaluation, equipment maintenance and similar under the control of the NRTL.

B. Basis for NRTL program requirements -- The basis for the NRTL program requirements essentially came from what well established laboratories were

doing at that time. Both Underwriters Laboratories (UL) and Factory Mutual Research Corporation (FMRC) were well established testing laboratories with a long history of well-developed standards, processes and procedures. Because of their histories, both of these laboratories were grandfathered in as NRTL's and were given a five year window before they had to come into full compliance with the new procedures. Since the criteria and procedures were modeled somewhat after the activities of these two organizations, this action by OSHA was justified especially since there would have been no NRTL's at the onset of the new program.

There are four fundamental sets of criteria that must be satisfied for a testing laboratory to become "Recognized" by OSHA.

First, the laboratory must demonstrate that it has the capability to provide the testing services it has requested in its application for recognition. This includes the testing facilities, testing equipment and its calibration control, testing evaluation and processing procedures including which consensus standards are used for each category of equipment to be tested, the presence of a documented and active quality assurance program, records maintenance including a standards library, and that there are capable personnel to carry out the various aspects of the test and evaluation program.

Second, the testing laboratory must have control programs in place that address how the specific certification mark is controlled and protected from misuse, a document must be generated providing a list of all the products certified by the testing laboratory, there must be an active program to follow up the test and evaluation process with a site visit at the product manufacturing facilities to assure that the certified product is controlled and meets the criteria as evaluated, and there must be routine follow up audits (usually on a quarterly basis) performed, documented , and with appropriate corrective action to assure continued compliance with certification requirements.

Third, the testing laboratory must demonstrate that it is sufficiently independent both organizationally and financially from any of the manufacturers or users of the products they are certifying. Minor relationships are allowed but are very limited. Also, individuals holding a substantial position within the testing organization cannot have any significant interest in either manufacturers or users of certified products and must be governed by signed conflict of interest statements.

Fourth, the testing laboratory must have an adequate system of issuing reports of their findings for their product test and evaluation program and have adequate procedures in place to address complaints associated with the process including documented resolution and corrective action procedures.

These four sets of criteria along with performing comprehensive audits to assure that these criteria are being adequately fulfilled form the basis for the NRTL program.

C. **The NRTL's Program for Evaluating CB's** – The OSHA program for evaluating Certifying Bodies is addressed in a standard and its appendix. OSHA defines a Certification Body in document CPL 01-00-003, NRTL Program Policies, Procedures, and Guidelines, Appendix B published 12/02/1999. This definition states: "Within the context of the NRTL Program, the part of the NRTL's organization that conducts the product certification, as opposed to testing laboratory, activities, i.e., listing and labeling and inspection of manufacturer's facilities." A translation of this would be the organization that has been recognized by OSHA as an NRTL which authorizes the CB to perform the evaluations, tests, and issuing the certification. In this respect, the CB is wholly responsible for the process and performs its function independent of OSHA except for the oversight performed by OSHA in the processing of the request for becoming an NRTL and the follow-up audits performed on each NRTL. In most cases, the entire process would be carried out by the NRTL. The base document for evaluating a potential CB is 29 CFR, Part 1910, Subpart A, Standard 1910.7, "Definitions and Requirements for a Nationally Recognized Testing Laboratory". This document refers to Standard 1910.7 App A, "OSHA Recognition Process for Nationally Recognized Test Laboratories", for the detailed criteria and procedures for becoming an NRTL. The program is open to anyone who wishes to apply.

The responsibility lies fully with the applicant to demonstrate that their testing and control protocols meet the intent of the OSHA evaluation criteria. This is accomplished by filing an application to become an NRTL and supporting the request with full documentation that describes the test and evaluation activities they perform and designating for what products they wish to be an NRTL. This includes providing all written procedures that describe what testing the applicant performs, how this is controlled and administered, which standards are used as the basis for their evaluation and test program, how the test facility performs oversight once they have certified a product as having met their test and evaluation procedures, how the certification mark is protected and controlled,

how the results of product test and evaluations are reported, and how complaints are handled should a manufacturer object to any part of the process.

OSHA has also prepared supplemental guidelines to assist testing laboratories in the preparation of applications for recognition, additions or renewals. Directive Number CPL 01-00-003, NRTL Program Policies, Procedures, and Guidelines, 12/02/1999 provides a considerable amount of guidance on the entire process while the document, “Application Guidelines”, provides detailed instructions for preparing an application for any of the NRTL related OSHA services.
OSHA thoroughly reviews all submitted material and can accept the documentation as submitted, can request additional information or clarifications if deemed necessary, can reject portions as not meeting the OSHA criteria and request additional evidence to provide the applicant the opportunity to bring their program into compliance, or reject the application totally because the submitted material does cannot possibly meet the OSHA criteria.

Once OSHA is satisfied that the applicant has sufficiently satisfied the program requirements based on the documentation submitted, then applicant site visits are planned. These visits are intended to physically demonstrate that the program described in the documentation is in fact what the applicant actually does. This part of the evaluation gives the OSHA staff an opportunity to access the personnel involved, that they follow the written procedures, that they interact with their customers in a reasonable and professional manner providing ample opportunity for their customers to correct any deficiencies, that the process and results are well documented and maintained, that test equipment and related facilities are adequate and properly maintained, that ultimately certified products are sufficiently labeled to show exactly their certification status (model, type of certification, standardized safety markings, warnings, special instructions, as required), that the manufacturing of such certified products is monitored through field audits of the manufacturers’ facilities, and that certified products are periodically reviewed to assure they meet current criteria (this is especially important if the standards have changed). These OSHA evaluation visits are performed at all primary sites where the product certification evaluation and testing programs are performed.

Once OSHA has established that all of their criteria have been met, a notice is posted in the Federal Register of their intent to recognize the laboratory giving a 30 day window for any comments. Once this process has been completed, the applicant is officially notified that they are now recognized as an NRTL. This

notification is also published in the Federal Register. Such recognition is valid for a period of five years.

There is an adjunct to the regular recognition process described above called the Satellite Notification and Acceptance Program (SNAP). This program allows the use of specific facilities outside of the OSHA recognized laboratories for specific functions within the product evaluation and test process. This is particularly useful for those larger testing laboratories that have diverse satellite facilities perhaps even around the world. It would be prohibitive and found to be unnecessary for OSHA to evaluate all such sites in this situation. OSHA has prepared a document, Satellite Notification and Acceptance Program (SNAP) Application Guidelines, to assist applicants in preparing appropriate documentation and detailing requirements of the complete process.

The SNAP procedure identifies 8 different supplemental programs available to NRTL's in their product certification process. In all cases the NRTL shall maintain the control of and be responsible for all aspects of the product certification process. NRTL's may request acceptance of a SNAP facility by filling out appropriate forms that identify the products/services to be provided from that site, and documentation to support the fact that the site is fully capable to perform the desired functions. The latter is established, administered and controlled by the NRTL in each case. The process is just as rigorous as that used to establish the NRTL in the first place. Oversight is also provided by the NRTL to assure that the outside service maintains its facilities and operations in accordance with the criteria used to establish its SNAP status. OSHA will also perform periodic audits on some SNAP sites to provide assurance that the NRTL is indeed performing the required functions to preserve the integrity of the safety approval process. Of course, it is in the best interests of the NRTL's to treat these relationships carefully since their reputation and credibility are on the line as well.

D. The NRTL's Program for Monitoring CB's – The OSHA monitoring program begins during the application evaluation process. The initial site inspection is performed based on the scope of recognition as defined in the application of the potential NRTL. The process and procedures for conducting this initial site evaluation are the same as will be used after NRTL recognition is granted. Depending on the size and scope of the site to be visited, OSHA may use a single auditor or send a team with a lead auditor to review the facility. The process includes preparing an audit plan before the visit to set an agenda for the audit that would include consideration of the scope of the recognition, type of

personnel needed to perform the audit, the planned duration of the audit, travel arrangements, and consideration of any third party involvement as defined by the applicant/NRTL.

There are three elements to an audit, the opening conference with the facility's staff, the audit per the review plan, and the closing conference with the facility's staff.

The purpose of the opening conference is to make personnel introductions, discuss the scope and objectives of the review, answer any questions that may arise, and to adjust the agenda as necessary based on the discussions.

The objective of the assessment/audit process is to verify that the policies, procedures, or other information provided for each category defined by the applicant is addressed or as is already included in an NRTL's recognition.

At the closing conference, the applicant's staff is presented with a summary of the findings, and if possible, a Preliminary Report on Findings. Any questions the applicant has regarding the findings are addressed as well as discussions on how any issues can be remedied.

Post audit activities include telephone follow-up for additional information if such is required after further review the audit results, and to establish a deadline for the applicant or NRTL to submit a written response for any findings or request for additional information or to make additional comments. The OSHA auditor then finalizes the report on findings and submits it to the applicant/NRTL with a cover letter requesting the written response and citing the agreed on or other appropriate date. If for an audit, this letter would provide notice of revocation if the audit findings were serious enough to warrant such action. Once this stage is completed, then the assessor/auditor will begin the final audit report.

If the NRTL fails to provide a written response by the established deadline, the director will send a notice to the NRTL advising that written responses must be received within 30 days or the revocation of recognition process will begin.

Based on firsthand experience, the audit process is quite detailed and thorough. The lead auditor went beyond the written criteria and defended his position as valid. Although the issues required additional actions for the testing laboratory, the auditor action was not appealed to OSHA nor was a complaint filed. This item was added to demonstrate that the audit process is quite comprehensive.

E. Confidence Levels – This issue is to establish that OSHA's monitoring is effective in determining that NRTL's are performing in accordance with the OSHA regulations. Both my experience and the existing record suggest that OSHA has been reasonably diligent in both by finding significant issues and then following up on them resulting in an appropriate action. Since the inception of the program there have been 27 organizations recognized as NRTL's. There are currently 15 recognized testing laboratories and 12 no longer have such recognition.

1. **CB's that have been removed from the OSHA program** – Of the 11 organizations that have been withdrawn, 3 have been revoked by OSHA, 7 withdrew voluntarily, and 1 allowed their recognition to expire without applying for a renewal. Of the 3 that were withdrawn for reason, none provided certification service for hazardous locations. Two of the organizations were withdrawn because there were deficiencies in their testing and certification process which were neither corrected nor appealed. Thus, the withdrawals were executed per the applicable OSHA procedures. The third testing laboratory was purchased by a company that used products in their own operations that were required to be certified by OSHA thus violating the "independence" criteria resulting in the withdrawal. The other 8 withdrawals were initiated by the NRTLs for a variety of reasons, but not due to any OSHA initiated action.

    a. **Restrictions on Recognition** – The only restrictions on recognition are those imposed by the testing laboratory themselves. When a testing laboratory applies to OSHA for recognition, they must state which product categories of the 37 identified by OSHA for which they wish to be recognized. Although several of the testing laboratories have been recognized for several product categories, no testing laboratory has been recognized for all categories. The recognition will be only for those product categories named in the applications for recognition. In addition, the testing laboratories also may apply for OSHA to accept portions of the recognition activities carried on outside of their organization as allowed in the SNAP program which have specific limits as stated in each individual case. For a current list of recognized NRTL's and the extent and limitations of the recognition for each, see www.osha.gov/dts/otpca/nrtl/. Of the 15 existing recognitions, 7 of these are recognized for evaluating and testing products for intrinsic safety.

2. **IS Evaluations** – IS evaluations are left strictly to the NRTL's qualified or recognized to perform these activities. There are no known resources within OSHA that would be conversant in the detailed requirements, their interpretation, or what factors influenced each particular requirement given in the standards for IS rated equipment. Since the original consensus standards for IS were developed prior to the formation of OSHA, going back to the 1950's and 60's, and OSHA has not been a factor in the several developments of later IS standards, it is clear that OSHA has trusted the ANSI accreditation process and the bodies of expertise that do this type of work do so with the intent of providing both a safe working environment for employees in their work place as well as providing a significant measure of protection for high valued capital equipment in and around hazardous (classified) locations. Certainly the ANSI process and endorsement are important to OSHA, but they recognize other criteria for standards that may be used by NRTLs. As it turns out in practice, all NRTLs who certify products as IS use ANSI ANS's as their standard.

   Early on, OSHA recognized that certain laboratories were well known and respected for their work in certifying products as intrinsically safe and, so much so, that they were exempted from having to meet the criteria established to evaluate potential NRTLs for 5 years. The requirements that OSHA ultimately published for CBs to become an NRTL are based on performing an extremely comprehensive set of criteria to establish that a candidate CB has the wherewithal to perform their service as well as the originally recognized laboratories. This was essential since OSHA did not have the resources to address most of the issues directly. Therefore, OSHA had to place significant trust in the NRTLs that they would perform their function in a manner that would enhance the safety of the worker in the workplace. This trust is at least partially blind since OSHA does not have personnel well steeped in the intrinsic safety concept. It is likely that the criteria they developed to evaluate candidate CBs and the rigorous audit program were developed to assure that laboratories were competent and consciously working to improve safety in manufacturing facilities.

   Once a product is certified as intrinsically safe, the design is essentially frozen. However, change is inevitable whether it be due to a change in the standard that requires re-evaluation of the product, or the manufacturer initiates changes to solve any given problem they may have such as adding features, other design improvements, or ease of manufacturing issues. All NRTLs have a process by which a manufacturer can apply for re-evaluation and testing by the NRTL when

changes to the product are proposed. The changes must be approved by the NRTL before the manufacturer can begin producing and shipping revised products. If there have been no changes in either the products or the standards used in the original evaluation, NRTLs have a policy to do a review of the product after 5 years to revalidate the certification. For example, FM has such a program but they have not always been diligent in this aspect of their operations usually due to their workload and manpower requirements. Of course, the checks and balances are the periodic audits (up to 4 per year) performed by the CB's on the manufacturers' products to assure that products currently being manufactured are the same products that were tested and approved for IS service. This is accomplished by examining production units and reviewing documents on record at the CB with those being used by the manufacturer to produce the products.

There is nothing in any of the consensus standards or the OSHA regulations that address processing of changes to the standards or the products. It is part of the protocol of each CB. It is certain that OSHA evaluates and audits re-certifications involving changes to products to establish that such protocols exist and are satisfactorily performed. Using UL and FM as examples, both require that "substantive" changes be submitted with a revision form for evaluation and acceptance or rejection of the change(s). In this context, acceptance means it is a simple change not requiring any retesting and the change is approved and entered in the records for the product. A rejection means that further evaluation and testing is required meaning a project needs to be opened with billable charges which will ultimately lead to acceptance. The manufacturers have the responsibility for notifying CB's of product changes. A "substantial" change would be one that would affect the parts of the product that generate the intrinsic safety rating usually meaning changes in the electronics, printed wiring boards, and such. If a screw is being changed from a pan head to a round head, then no CB is interested in evaluating that type of change.

When the consensus standard changes, manufacturers are notified and given a reasonable amount of time to make whatever changes are required to meet the changes in the standard and require that the products be re-certified by a certain date.

Educating practitioners and evaluators has always been an issue. Except for a few short courses that provide some fundamentals about designing and using electrical equipment in hazardous locations, there are no

educational resources that teach the total background and knowledge required to fully understand ignition theory, what it takes to cause ignition, what it takes to prevent ignition, and how that translates to writing a standard by which a product can be evaluated and tested to assure that it will not be a source of ignition when installed in a hazardous location. Unfortunately, not too many people that are involved with the standards writing process have that depth of background or knowledge, but there have been enough to make the standards development credible. The pioneers in the field that did the original work, thankfully, had that type of knowledge studying the works of Lewis and von Elbe who wrote a notable book on ignition of gases and vapors, and Widginton of the UK Safety in Mines Research Establishment who did fundamental ignition work in the 1950's and 60's resulting in the ignition curves for various materials still in use today in the IS standards. Because of this lack of understanding of the fundamentals behind the basic criteria for IS, the tendency is to err on the conservative side with the result that we now have a set of criteria that is far more conservative than it needs to be relative to the probability of an ignition occurring. This has both positive and negative effects. The positive effect is that the probability of ignition is even lower. For the standards that existed 40 years ago, Hickes and Brown wrote a paper presented in London around 1970 in which they had calculated the probability of ignition caused by intrinsically safe equipment as being somewhere around 10 to the -7. This was several orders of magnitude lower than explosion proof equipment which had a probability of about 10 to the -5 calculated using a similar approach. Today, the probability is a few orders of magnitude lower for intrinsically safe equipment due to the contributions of those who do not fully understand. The negative effect is that a lot of equipment that was approved and been in use for 40 or 50 years as intrinsically safe with perfect safety records can no longer be approved as intrinsically safe because they do not meet the requirements of the latest standards. The change in requirements did not have much to do with safety, but certainly has had a devastating effect on the sale of products that cannot meet the latest requirements.

However, the safety record for IS equipment, and electrical equipment in general using any of the standardized protection techniques for hazardous locations over the life of such equipment, strongly suggests that the standards writers, testing laboratories, and manufacturers of such equipment have done a creditable job.

It should be noted that the standards criteria for intrinsic safety have a perquisite to satisfy “ordinary” safety criteria which specifically targets worker safety (electrical shock hazards and mechanical hazards) such as found in the International Society for Automation (ISA) standards S 82 Series.

a. **Restrictions on IS interpretations (infallible circuits)** – There are no “infallible circuits” per se. There are infallible components, construction, spacing, and assembly of parts. The latter could be considered a circuit, but in the only case I know, it is a collection of parts that make up part of a circuit. This would be the widely used zener barrier device. For specifics on infallibility, standard ANSI/ISA 60079-11 defines infallibility in the definitions section 3.11. Section 8 of this standard provides specific information on infallible components, construction, etc.

   There are no known restrictions on any aspect of IS expressed by OSHA. If a recognized testing laboratory has been determined to be capable of performing testing and evaluations in this category of equipment and certifies that a product meets the IS criteria, it is accepted as being so. The testing laboratories have no incentive to be less conservative than the standards suggest and follow the criteria strictly. Manufacturers are quite sensitive to anything a testing laboratory might do to give their competition an edge and are more critical reviewers of what the testing laboratories do than any auditor. As a result, the testing laboratories take extraordinary measures to assure that they are treating everybody equally in evaluating and testing equipment. They have to perform an “honest” service and cannot and will not make decisions that result in treating their clients differently with respect to any of the IS standards requirements.

Testing laboratories also must be sensitive to their own reputation as well. They cannot afford to approve electrical equipment not meeting the requirements of the standard being use as it would destroy their credibility for performing that type of activity should an unfortunate event occur in a user’s plant that was traced back to shoddy work by the testing laboratory in applying the standards requirements.

Today, all NRTL’s who certify equipment as IS apply the same set of requirements for the test and evaluation. The only thing that can differ is the interpretation of specific details and how competing laboratories will treat that detail. One such example of this has to do with flex

circuits that is printed wiring applied to flexible insulating material as opposed to stiff printed wiring boards. One testing laboratory believes that flexible circuits meet the intent of the IS standard while another testing laboratory has decided that flexible circuits do not meet the intent and will not accept their use where IS circuits are involved. Who's correct? The current body of evidence suggests accepting such a structure is reasonable, but this demonstrates how some differences do occur. In this case, OSHA probably does not know that this situation even exists, but it is real.

b. Restrictions on IS testing and certification – Only testing laboratories who have included this category (IS) in their application and successfully completes the application process through OSHA can test and certify such equipment. Once this is established, there are no restrictions other than what the NRTL's impose in the process of performing such testing and certification. This situation would only change with OSHA if ongoing OSHA audits of a given NRTL uncovered cause for the NRTL to lose its accreditation for this category of equipment.

The testing laboratories can make decisions when testing may or may not be required for a given set of circumstances when evaluating a product. For example, if the circuits in a piece of equipment have been determined to have maximum voltage and current levels much lower than allowed by the ignition curves for given circuit conditions, the testing laboratories can waive ignition tests as unnecessary. This is allowed by the standard.

Testing laboratories do have peer review to assure that the test and evaluation have been properly executed. In addition, individuals in the organization authorized to sign acceptance of a report by a test and evaluation engineer also review the work performed for correctness.

F. OSHA participation on standards panels – OSHA does allow its personnel to participate in consensus standards writing organizations either as a representative of OSHA or the Department of Labor or representing themselves. This is covered in OSHA Instruction (Policy) PER 00-00-002, OSHA Personnel Participation in Non-governmental Organizations, July 31 2003. If an individual joins a committee representing OSHA/DOL, he/she cannot be a voting member to avoid any conflict should issues be at odds with OSHA public policy. An

OSHA employee who joins such a committee representing him/herself can be a voting member as long as he/she complies with the OSHA policy.

In investigating specific OSHA participation in standards writing organization/committees dealing with hazardous locations, only one such instance can be found where there is an OSHA representative serving on Underwriters Laboratories' Standards Technical Panel 60079, Electrical Equipment for Use in Class I, Zone 0, 1, And 2 Hazardous (Classified) Locations as a non-voting member. It appears that the OSHA representative has never attended a meeting, and probably is on the committee roster just to receive the documentation generated by the committee. In looking at committee rosters and querying others who are involved, there is no other evidence of OSHA participation.

There is a Memorandum of Understanding (MOU) between OSHA and the American Standards Institute (ANSI) that was consummated on January 19, 2001 pledging cooperation in the standards making process. ANSI pledged to provide assistance to OSHA in its standards making processes, to provide copies of all relevant drafts national and international of consensus standards relevant to OSHA activities, and to establish a joint Working Group to implement the provisions of the MOU. No evidence can be found that such Working Group was ever formed. OSHA pledged to support ANSI to the extent possible to achieve their mission, to provide comments on all draft consensus standards received from ANSI as appropriate, and to help strengthen the US position in the international consensus standards development arena. No evidence can be found that OSHA has provided any involvement in the standards development for hazardous location operations other than the one representative furnished to the UL Standards Technical Panel cited above.

G. OSHA Effect on Small Businesses – Small business is undoubtedly more vulnerable to the effects of OSHA regulations than larger businesses. OSHA has demonstrated a concern for this by involving the Small Business Administration and equivalent external organizations to gain a measure of how the rule making process will affect small business when implemented. When the effect may be relatively significant, OSHA will allow relaxed implementation such as a longer period to come into compliance for small business. However, small business is not exempt from compliance.

In order to satisfy OSHA criteria for any given business, there is a real and significant cost to do so. When talking about obtaining NRTL approvals of

equipment for hazardous locations, the cost starts at $10's of thousands and goes up depending on the complexity of the product and can be much greater than a $100,000. OSHA argues that the cost of the certification process represents a fraction of the cost of the product development and therefore, should not be a real burden for the manufacturer. This is certainly true for larger companies, but not so sure this holds for real small businesses that are usually not blessed with lots of available capital for such activities.

As a part of a proposed rule to charge testing laboratories fees to process applications for NRTL status and for the ongoing (audit) programs, OSHA did a cost analysis to determine the effects on the bottom line of small (<$5 million) testing laboratories and determined it would affect the bottom line on an average of almost 4.5%. This would undoubtedly be passed on to the manufacturers that were having their products tested by the NRTL's. This of course raises the much larger cost for small business owners of obtaining the required equipment approvals in order to successfully market their products. I have not been able to find a numeric value for what the cost of obtaining and maintaining product approvals at an NRTL does to small business bottom lines. You can certainly argue that it is a necessary cost of doing business, and that these costs are passed on to their customers.

Some organizations have tried to address lowering costs for manufacturers with NRTL approval of products. One, Measurement, Control, and Automation Association (MCAA) has proposed to OSHA that the requirement for quarterly audits for manufacturers making equipment intended for use in hazardous (classified) locations is excessive especially for those manufacturers who make one or two such products and they never change. MCAA argues that annual audits are more than sufficient to assure compliance with the maintenance of approval criteria. Having been an auditor for an NRTL, I can fully relate to this as some of the very small operations I audited every three months were extremely simple and never changed. It was difficult to spend more than an hour going through their entire process, inspecting their documentation and the approved product.

Another organization representing lighting fixture manufacturers is attacking UL and OSHA via a lawsuit with the objective of breaking up the "monopoly" and lowering the cost of gaining approval of lighting fixtures. There is no equivalent activity related to hazardous location products, but it does demonstrate that there is a concern for the cost of the current process for small business operations.

II. The ANSI Standards Process – This section will focus on how the ANSI standards managing process maintains the integrity of the standards development process and the how the ANSI quality control process helps to assure that standards development and maintenance activities satisfy ANSI procedures.

A. Introduction – ANSI facilitates the development of American National Standards (ANS) by accrediting the procedures of standards developing organizations (SDOs). These groups work cooperatively to develop voluntary national consensus standards. The bible, so to speak, for SDOs is the ANSI document: "ANSI Essential Requirements: Due process requirements for American National Standards". Each organization that is accredited by ANSI as an SDO must develop and operate to a set of procedures that meet all the criteria given in the "bible". Once an SDO has successfully completed the ANSI evaluation process, it becomes an ANSI-Accredited Standards Developer (ASD). In order for a standard to be submitted for consideration as an American National Standard (ANS), it must be prepared by an ASD or the ASD can take the lead for a standard developed by a non-ASD SDO by managing the standards development process and assure that the development process met all the criteria of the ANSI Essential Requirements.

There are five pillars embodied in the essential requirements: (1) Consensus on a proposed standard by a group or "consensus body" that includes representatives from materially affected and interested parties; (2) Broad-Based public review and comment on draft standards; (3) Consideration of and response to comments submitted by voting members of the relevant consensus body and by public review commenters; and (4) Incorporation of approved changes into a draft standard; and (5) Right to appeal by any participant that believes that due process principles were not sufficiently respected during the standards development in accordance with the ANSI-accredited procedures of the standards developer.

ANSI does not develop standards within its organization and limits its activities to coordinating and managing the overall development of standards in the USA as well as coordinating international activities such as with the ISO and IEC standards developing organizations.

B. Developing & Updating Standards – When an ASD decides to develop a new standard the process developed by ANSI has an immediate effect. The first thing that has to happen is the preparation of a purpose and scope for the new standard which is submitted to the ANSI Board of Standards Review (BSR). The ASD then prepares a public notice to advise all who would be materially affected by such a standard of their intent and to provide the opportunity to participate in

the development process. ANSI publishes the same in their publication, Standards Action. The ANSI procedures demand that the author committee shall be made up of not only the materially affected population, but also be balanced by having no group over-represented (no more than 1/3 of the committee membership) and have the membership mix include those who represent "users", those who represent "producers", and those who represent "general interest". In the development of the standard, ANSI has already established that the ASD's procedures satisfy the abovementioned five pillars of the ANSI Essential Requirements. It is initially assumed by ANSI that the ASD will, in fact, operate to the procedures which have been accredited. This is all tested when the initial standard is completed by a newly accredited ASD as ANSI performs its first audit to assure that due process was followed.

When an ASD revises or updates a standard, the same process is used and usually performed by the same committee that wrote the original. In normal circumstances, each ANS must be reviewed within 5 years of its issue and either reaffirmed 'as is' or process appropriate revisions. There are variations of the procedures for maintaining and issuing ANSs based on the maturity of the organization and how many ANSs have been successfully promulgated. Whatever process is used, it must have prior approval by ANSI, and the fundamental process laid out by ANSI still must be followed. If the audit results are satisfactory, then the ADS may continue. If there are issues, the ADS has an appropriate period to resolve any issues. If the issues cannot be satisfactorily resolved, then the ADS will lose its accreditation status.

Having been involved with both the application of an organization to become an ADS as well as the audit process, I can assure that the accreditation and audit processes are very thorough and complete. ANSI rightfully takes this responsibility quite seriously as do the ASDs as the credibility of both is at risk if either of the two parties is not diligent in following procedures.

C. Accrediting Standards Development Organizations (SDOs) – The ANSI accreditation process is fairly straight forward. First, the SDO must become acquainted with ANSI's Essential Requirements document and assure that their written procedures are compliant with the criteria in the ANSI document. Once this is established, the SDO fills out the comprehensive ANSI Application for Accreditation form and submits it along with a copy of their procedures and a check for $4000. ANSI has a multistep procedure to process such applications. These activities as well as the audit program are managed by the ANSI Executive Standards Council (ExSC). Once the ANSI review staff is satisfied that the SDO has at least procedurally satisfied all of the Essential Requirements, they send a recommendation to the ExSC to accredit the SDO as

an ANSI ASD. The DSO is notified of the same and the action is published in the ANSI Standards Action to notify the public. The final act is the comprehensive audit that occurs when the ASD submits its first standard to be accepted as an ANS by ANSI. This will attest that the ASD in fact followed the procedures that led to their accreditation.

D. ANSI Panels and Appeals Procedure – ANSI currently has nine panels organized to address a variety of topics. They take form as three types of entities – panels, collaboratives, and one network. Appeals procedures provide for at least four avenues for an individual or organization to take depending on the issue and circumstances.

1. **ANSI PANELS** – The falling demonstrates some ways in which ANSI coordinates standards activities in many fields.
   - **a.** There are presently five panels organized to address Theft Prevention and Identity Management Standards, ANSI Nanotechnology Standards, Electric Vehicle Standards, ANSI Biofuels Standards Coordination, and Healthcare Information Technology Standards. None of these are particularly germane to standards management issues pertaining to intrinsic safety or mining applications.
   - **b.** There are three collaboratives addressing ANSI Energy Efficiency Standardization Coordination, ANSI Homeland Defense and Security Standardization, and Nuclear Energy Standards Coordination. Again, none of these activities pertain to the issues related to the mining industry or intrinsic safety.
   - **c.** There is one network, the ANSI-NAM Network on Chemical Regulation established to provide an issue-driven forum to enable U.S. manufacturers and other stakeholders to speak with one voice when addressing chemical regulations at all levels from local to global.
2. **Appeals Procedure** – As mentioned above there are at least four avenues for appeals to be made from offended parties. The first level would be with an ASD who must have appeals procedures as part of its operating regimen in order to be an ASD. Beyond ASD's the appeals process then goes to ANSI where there are three avenues available, BSR, ExSC, and ANSI Appeals Board (AB). The four levels are provided in more detail below as this is one of the cornerstones in assuring that standards are prepared according to the agreed upon rules in a fair and open manner in order to be recognized as ANSs.
   - **a. Appeals to ASDs** – Every ASD must have written procedures that contain an identifiable, realistic, and readily available appeals mechanism for the impartial handling of substantive and procedural complaints regarding any

action or inaction. Such appeals must be processed and resolved before a standard can become an ANS. If an appeal cannot be resolved at the ASD level to the satisfaction of the appealing party, there is a path to bring the issue to either the BSR or the ExSC for consideration, depending on the nature of the issue.

b. **Appeal to the BSR** – Once an appeal has been processed at the standards developer level, the standards developer may proceed to submit the standard and appropriate supporting documentation to the BSR for processing as an ANS. The BSR will review the support documentation which includes evidence of consensus such as the final voting tally, information related to unresolved public review comments, information relative to unresolved negative votes, and the identification of those who appealed at the developer level. The BSR will determine if the ASD followed all appropriate procedures including diligence in trying to resolve all issues and will either accept or reject the standard as an ANS. If the BSR approves the standard, then those on record as having filed an appeal at the developer level are notified of this action and that they have the right to file a procedural appeal to the BSR. The BSR rightfully will not accept appeals based on technical content of a standard since they do not have any particular technical expertise to make such decisions. How such issues are addressed by the developer is certainly part of the BSR review process. The recipient(s) of the BSR appeals notice has/have 15 days to make such appeal. If an appeal is filed at this point, an appeals panel made up of members of the BSR is organized and meets live (face to face) to hear the appeal. After the meeting process, the Appeals Panel meets in executive session to make their decision. The decision is in written form and not announced at the hearing. Whatever the decision, this ruling may be appealed to the ANSI Appeals Board which is the final level of appeal.

c. **Appeal to the ExSC** – Appeals to the ExSC relate to the accreditation of SDOs. When the ExSC approves a new accreditation for an SDO, there is a 15 day period for which this action can be appealed by anyone. Once this time period clears, the new ASDs may still be subject for an appeal to the ExSC related to removing their accreditation for violating the procedures in the development of standards. It would have to be a serious breach of the procedures to get this far since there are both the ASD appeals process and the BSR appeals process to possibly correct the situation. An appeal to the ExSC is before a live panel made up of ExSC members. The result of the appeal can still be appealed further to the ANSI Appeals Board where a final decision would be made.

d. ANSI APPEALS BOARD – The AB has a two phase process. If a decision from either the BSR or the ExSC is appealed to the AB, first, the board is given an opportunity to review the material and vote via letter ballot whether or not to schedule a hearing. If they vote to move it forward, then a hearing is scheduled and operates per this board's procedures. The decision from the AB is final as there are no further appeals processes available other than, perhaps, legal adjudication.

E. Standards Process Concerning ANSI/ISA 60079-11 –

1. European Influence – The European influence has been strong in shaping the intrinsic safety standards now in effect in North America. There are two basic reasons why this is true. First, when the fundamental technical requirements were debated, there were several differences between European and North American practices. The Europeans were much more conservative in developing their requirements in many areas of the standard. This occurred because these standards were developed almost exclusively by personnel from the European testing laboratories who had no stake in the outcome except to have a common set of criteria for all laboratories to use. There was no "balance" in this approach as has been required for standards writing organizations in the US where all interests (stake holders) must be represented. The user and the manufacturing communities were not part of the process. Even in the early days of the development of intrinsic safety standards in the US and Canada, users, manufacturers and testing laboratories were all involved in the process. The North Americans believed they had used a superior approach in developing its requirements and satisfied the basic criteria of assuring safety for humans and preserving valuable capital equipment. Despite presenting good technical arguments in support of the North American positions, the vote was taken and the 'United States of Europe' each with a vote far outnumbered the two North American votes.

Second, the US had signed an agreement along with many other countries within the IEC to adopt IEC standards once they were approved internationally. Since the IS standard gained this status, the US kept true to their agreement and adopted as much of it as they could with the exceptions being where there was conflict with existing regulations which could not be easily changed. This agreement was entered into as there was a strong desire to have a common standard so manufacturers who marketed their products globally did not have to have a different design for each set of IS criteria throughout the world. This hasn't been fully achieved, but it is close.

2. **US Committees** -- The process for this standard actually began back in 1970 when it was drafted, internationally debated and ultimately approved. The IEC intrinsic safety standard has gone through several revision cycles with significant participation by US interests in each edition. The current edition is the basis for intrinsic safety requirements around the world. It and the CENELEC standard of Europe are in lock step. The US had to massage it to bring it in compliance with other regulations in this country, to wit, the National Electrical Code. However, it should be noted that these changes did not alter any of the technical requirements related to intrinsic safety but were necessary due to the differences between area classification systems between Europe and North America and differences in equipment marking requirements between the two. At the beginning of ANSI/ISA 60079-11, there is a section that describes US national differences that were required to satisfy regulations in this country. The NEC has been revised often in recent cycles to broaden its scope to allow use of IEC area classification designations which opens the door for a broader use of the IEC apparatus standards such as the intrinsic safety one.

   The process by which this standard was developed and adjusted followed the ISA standards development procedures which have been recognized by ANSI as meeting the criteria of their 'Essential Requirements' and the recognition of ISA by ANSI as an ASD. The responsible ISA committee is balanced having several interests represented with no dominating interest. The process was public and any interested party had the opportunity to comment on any aspect of the technical requirements and the process by which it was promulgated. This effort did not result in any technical changes to the intrinsic safety requirements as these were debated and voted on internationally when this edition of the IEC standard was adopted at the IEC level. The ISA effort was limited to making those adjustments required to make it compliant with the US NEC while maintaining the technical integrity. This was apparently accomplished as the standard was approved and has become an ANS.

   In processing the standard, there were negative comments on the technical content because there were significant changes between the IEC standard and the IS standards in effect in the US when the IEC standard was adopted. The IEC standard is considerably more conservative especially in the area of safety factors where US practice was to apply a 1.5 safety factor on energy while the IEC safety factor was 1.5 on voltage or current which effectively makes the safety factor the square of 1.5 on energy. The major effect on product designs is that the amount of free capacitance allowed in a circuit design is drastically reduced based on the IS ignition curves making many

products that have been intrinsically safe for many years no longer able to meet the standard. In this case, safety was a moot point as that had already been well demonstrated, but adopting the IEC standard was an action simply to have a “common” global standard. But then that didn’t really happen since exceptions had to be made to accommodate the NEC.

F. Summary – The above describes the multifaceted processes available to promulgate a standard with all the controls in place to at least make the process consistent, fair, and open. Of course, it does not guarantee a technically correct standard as all of the quality control functions are strictly related to process, not content. The content is usually controlled by the SDO, but in the case of the standard of interest (ANSI/ISA 60079-11); the content was really controlled by the IEC committees responsible for its development. It was adopted in this country in support of the pledge of the US standards community to ‘harmonize’ our standards with those of the IEC. Also addressed is the processing in particular of the IEC IS standard in making it an ANS.

III. NTTAA and OMB A119 – The Circular OMB A119 predates the NTTAA by several years. OMB A119 was a statement of policy that federal agencies would use consensus standards wherever possible instead of writing new federal standards. The NTTAA was enacted by congress in 1996 to codify the essence of OMB A119. NIST was assigned the responsibility to promote the elements of the law and the circular within all government agencies and to prepare an annual report to congress on the implementation of the law and how the various government operations respond to the requirements.

A. OSHA Policies and Compliance with OMB A119 – When OSHA was formed in 1971, under Section 6(a) of the OSH Act, OSHA was given the authority for a period of 2 years to adopt both national consensus standards and established Federal standards as OSHA standards without following notice and comment rulemaking procedures. Congress provided this authority so that OSHA would have a mechanism to begin immediately protecting the Nation's workers through mandatory standards. Using Section 6(a), the Agency adopted over 200 consensus and Federal standards as OSHA standards. OSHA adopted some of these standards through "incorporation by reference."

OMB A119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities has been in existence for many years. It was issued as a policy by the Office of Management and Budget within the executive branch of the government having several objectives. Three significant ones were to effect cost cutting by making use of

existing consensus standards rather than write new ones, harmonizing standards nationwide, and taking advantage of industry expertise that went into the consensus standards. There are exceptions allowed for proprietary government standards to be promulgated when conditions warrant such action, but such action is discouraged. Therefore, OSHA was already in step with OMB A119 before it was even written.

Since this original adoption of consensus and Federal standards occurred over 40 years ago, most of them have been revised probably several times or even become obsolete and replaced by a new standard. Consequently, OSHA has conducted several exercises to review the adopted consensus standards and to update the regulations accordingly to make them current with existing voluntary consensus and Federal standards. It is difficult to determine how many government proprietary standards are used by OSHA, but it is safe to say that the number used for equipment intended for use in hazardous locations is essentially zero. This can be said because approval of products for use in hazardous areas is the responsibility of NRTLs who exclusively use standards which may be proprietary to their organization but fully embody the requirements given in the voluntary consensus standards for such equipment.

B. OSHA Policies and Compliance with NTTAA – The NTTAA was enacted in 1996 which codified the essence of the circular OMB A119. It embellished the policies established in OMB A119 which was revised in 1998 to adjust to these changes.

As stated above, OSHA has been fully into using Federal and voluntary consensus standards since its inception. For the purposes of interest to MSHA, it can be concluded that OSHA is meeting the requirements of NTTAA; certainly in spirit, if not in fact, even if not intended!

C. ANSI and National Archives and Records Administration (NARA) – The ANSI/ISA standards are included in the Code of Federal Regulations via notices posted in the Register by OSHA. The latest such notice was published on 25 November 2013 in Volume 78: 70349-70352 which specifically lists all of the ISA versions in the IEC 60079 series of standards as well as those of UL. These of course were processed through ANSI and became ANS's. This particular publication is a proposal to make changes in the manner of how OSHA processes NRTL related activities to speed up the process as well as to accept the list of standards as being appropriate for use by NRTL's. OSHA has reviewed these standards and has issued a preliminary opinion that they are

appropriate. Now the public has the opportunity to comment on the proposed actions by 26 December 2013. It is expected that this proposal will be finalized essentially as written.

A search of the NARA web site produced no results in trying to find archival information on the ANSI/ISA standards. There are only two entries for ANSI standards found, but for unrelated material. The specific CFR publication cited above could not be found in NARA as well. It would appear that either the search required different parameters, or this type of information is not part of NARA's archives.

IV. Hazardous Location (HazLoc) Classifications and General Information – The National Fire Protection Association (NFPA) publishes The National Electrical Code (NEC). The NEC offers three approaches to area classification given in NEC Articles 500, 505, and 506. Article 500 of the NEC fully defines the classification system for hazardous locations used by NRTLs, product manufacturers, inspectors, and just about anyone else dealing with hazardous locations in the USA. In recent years the NEC has been revised adding Article 505 allowing the use of the IEC Zone system of classification for hazardous gas locations and Article 506 allowing the use of the IEC Zone system of classification for hazardous dust locations. In addition, the NEC specifies what methods of protection and types of equipment are permitted in each classified hazardous location.

A. NEC Hazardous Location and Equipment Classifications

1. **Article 500 Classifications** -- The fundamental classification system used in North America consists of Class, Division, and Group designations. Class defines the nature of the hazard where Class I includes flammable gases and vapors, Class II combustible dusts, and Class III fibers and flyings. Division defines the probability of the presence of the hazard where Division 1 means flammable materials are in the atmosphere under normal operating conditions and Division 2 means that the flammable materials would be in the atmosphere under abnormal conditions such as a failure of process containment. Group defines specific materials based on common characteristics within each Group ranging from A to F.

   Groups A through D are for flammable gases and vapors with Group A requiring the least amount of energy to cause ignition and group D the most amount of energy to cause ignition. Gases and vapors have been classified based on the maximum experimental safe gap (MESG) for explosionproof enclosures or by minimum ignition energy (MIE) based on ignition by electric

arcing. As it turns out, either method gives the same result when it comes to grouping a variety of gas and vapor materials. Also, classification can be done by comparing characteristics of known gases and vapors to unknown and if they are similar, they can be placed in the same group which has been verified to be true by test. Group A materials include acetylene and anything similar, Group B is represented by hydrogen and similar materials, Group C is represented by ethylene and similar and Group D is represented by propane and similar materials. Methane is a Group D gas.

Groups E, F and G are for combustible dusts where Group E are conductive such as metal dusts, Group F are carbonaceous having more than 8% volatile content such as coal dusts and Group G are all dusts not included in Groups E and F such as grain dusts.

There are no Group designations for Class III materials.

Considerably more information on area classification and the classification of materials can be found in NFPA 497: Classification of Flammable Liquids, Gases, or Vapors and of Classified (Hazardous) Locations for Electrical Installations in Chemical Process Areas.

2. **Article 505 Classifications** – Article 505 of the NEC introduced the IEC Zone classification for gases and vapors as an alternative to the USA Division classification approach. This article defines Zones 0, 1, and 2. The major difference in the Zone and Division classification system is that Zones 0 and 1 are both included in Division 1 locations while Zone 2 is equivalent to Division 2. Zone 0 includes locations where flammable materials are normally present for long periods of time while Zone 1 locations have flammable materials normally present but for shorter durations. The transition point for going from a Zone 1 to a Zone 0 has been left undefined on purpose. There are differences in opinion as to where the break should occur where one school would consider flammable materials present for more than 100 hours per year as Zone 0 while others would set Zone 0 when flammable materials are present more than 1000 hours per year.

   The use of Zones also leads to different choices for the types of protection and equipment allowed to be used. For Zone 0, the IEC standards allow two fault intrinsic safety (ia), enhanced encapsulation (ma), and special protection techniques (undefined) that are individually evaluated for suitability. Zone 1

would allow one fault intrinsic safety (ib), explosionproof enclosures (d), and a variety of other protection techniques as given in the IEC standards.

3. **Article 506 Classifications** – Article 506 introduced the IEC Zone classification for dusts as an alternative to the USA Division approach covered in the NEC Articles 500, 502, and 503. This article defines Zones 20, 21, and 22. Zone 20 is a location where combustible dusts or ignitable fibers/flyings are present continuously or for long periods of time. Zone 21 is a location where combustible dust or ignitable fibers/flyings are present occasionally in normal operation. Zone 22 is a location where combustible dust or ignitable fibers/flyings are not likely to occur under normal operation. Equipment having dust-ignitionproof enclosures, or intrinsically safe (ia or iD) equipment or encapsulated equipment (mD) would be allowed for all three Zones. Pressurized (pD) would be allowed for Zones 21 and 22, and equipment with dusttight enclosures would be allowed in Zone 22 locations. Other lesser used techniques are available as well.

B. ANSI/ISA 60079-11 & ANSI/ISA 60079-0 Classifications – These two documents are in the IEC 60079 series that addresses protection technique requirements applied to the design of equipment that is intended to be used in hazardous locations. The ANSI/ISA 60079-0 document contains the general requirements that apply to several different types of equipment. Of particular note is that all references to Group I equipment (below grade locations such as mines) have been struck from the document as approved in the by ISA and ANSI. It does have a section on cells and batteries and addresses marking requirements as well.

The ANSI/ISA 60079-11 document contains the construction requirements for the intrinsic safety technique. It covers all aspects of all types of equipment intended to meet the intrinsic safety requirements including portable/handheld equipment**.** In addition, it has a section on product marking that first states that the marking requirements given in ANSI/ISA 60079-0 apply as well as providing additional marking requirements specific to intrinsic safety to be used as applicable. This is the document NRTL's will use when testing and evaluating equipment intended to satisfy the intrinsic safety requirements. For example, the FM Global standard for intrinsic safety, FM 3610, gives some FM Global boiler plate but then defers to the ANSI/ISA 60079-11 for the detailed intrinsic safety requirements.

V. IS Markings that Meet the "ia" mining Equipment Classifications – The "ia" mining equipment would be defined as equipment that meets the intrinsic safety two

fault criteria, is suitable for methane atmospheres (Group D North American) and carbonaceous dusts (Class 2, Division 1, Group F North American or Zone 20, Group IIIB International). In addition, if the equipment is marked as "Group I", by definition it is approved for mining applications with methane gas and carbonaceous dusts present. This designation will not appear in the NEC because its scope states that the NEC is not applicable to mining applications.

As can be seen below, the marking system is quite complicated and a bit cumbersome especially for products having limited surface area to contain all the required marking.

A. United States Marking System -- For the United States, the NEC offers three approaches to area classification which leads to three sets of marking alternatives in NEC Articles 500, 505, and 506. NEC, Art. 500 provides the traditional Class, Division, Group classification system and appropriate marking information. NEC Art. 505 provides the Americanized version of the International Electrotechnical Commission (IEC) Class, Zone, Group classification system and appropriate marking information. NEC Art. 506 provides the IEC hazardous dust Zone classification system and appropriate marking information. Since all NRTL's are recognized to test and/or evaluate equipment per US consensus standards only, the standards used by NRTLs for hazardous location equipment provide marking information in accordance with the NEC criteria. The specific marking criteria for a given product is based on the details of the equipment manufacturer's request of the NRTL (Type of approval requested).

1. **NEC Art. 500 Marking Specifications** – An example of a "traditional marking" on a portable device might be as follows.

   Intrinsically Safe for Cl I, II, III Div 1, 2 Gp B,C,D,E,F,G T4

   The important data for a mining application would be the "Cl I, II" indicating that gas and dust environments are included and the "Gp D and F" designations that would include methane (D) and carbonaceous dusts (F). The "T4" designation would tell you that the maximum surface temperature at 40C does not exceed 135C which allows you to determine if the temperature is below the autoignition or dust layer temperature limit for the materials present.

2. **NEC Art. 505 Marking Specifications** –An example of IEC Zone marking from this article of the NEC might be as follows.

   Cl I Zone 0 AEx ia IIB T4

In this case the “Cl I” indicates gases, “Zone 0” means an essentially constant hazard, “AEx” means North American explosion protected, “ia” means two fault intrinsic safety, “IIB” is for above ground service for the ethylene and propane groups of gases (includes methane), and “T4” is the same as the previous example.

The 2011 edition of the NEC does not address installations in mines (see NEC Article 90.2 Scope) so marking for IEC Group I equipment that is specifically for mines is not covered in Article 505. If mines were included in NEC Art. 505, a typical marking might be as follows.

Cl I, II Zone 0 AEx ia I T4

In this case the “Cl I, II” would cover gas and dust environments, and the “I” after “ia” signifies Group I for mines that by definition is for methane gas and carbonaceous dusts.

Earlier, it was learned that the ISA SP12 committee had decided to include mining applications with regard to the 60799-x series of standards produced by ISA. It has been further learned that national differences in these standards have not been addressed with regard to Group I (mining) requirements. Also, there are no known proposals in process to change the NEC to remove the exclusion of mines from its scope.

3. **NEC Art. 506 Marking Specifications** – An example of the IEC Zone 2x where x is 0, 1, or 2 marking from this article of the NEC might look as follows.

20 AEx iaD lllB T135CTa=70C

The “20” indicates that the hazardous dust is present normally and for long periods of time (like Zone 0), “AEx” means North American explosion protected, the “iaD” indicates that the product is two fault intrinsically safe for dusts, “IIIB” indicates that the dusts are non-conductive, and the “T135CTa=70C” indicates that the maximum surface temperature is 135C at an ambient temperature of 70C.

B. Canadian Marking System – The Canadian marking system is similar to that in the USA and is given in the Canadian Electrical Code (CEC) in a similar manner. In fact, the “traditional” marking given in Item **A.1.** above is identical to that in Canada. Further, the marking given in item **A.2.** above is also identical with one minor exception. The US designation “AEx” becomes just “Ex” in Canada

emulating the IEC system exactly. Finally, the CEC has not recognized the Zone 20, 21, and 22 area classification system as of yet and product marking for Class II (dusts) and Class III (flyings and fibers) are the only designations in use for such hazards in Canada.

C. **Equipment data bases** -- I expect that all NRTL's have catalogues or lists of the products that have certified for the various classes of service. Both FM and UL for sure have such lists. FM produces a document called the FM Approval Guide and is a complete listing of all products they have certified. The list is available on a CD or can be accessed on the FM web site at http://www.approvalguide.com/CC_host/pages/custom/templates/fm/index.cfm?line=1 . This will bring you to a sign-in page where you can register and gain access for free. UL has produced several volumes of equipment lists by category. I expect these are also available on CD, but can be accessed on line at http://database.ul.com/cgi-bin/XYV/template/LISEXT/1FRAME/index.html . This will bring you to a page where you can search for a specific product or gain access to other data related to the products that have been certified by UL.

CDC-NIOSH-OMSHR REPORT

Quality Assurance of Nationally Recognized Test Laboratories using

ANSI/ISA Standards for Certification of Intrinsically Safe Equipment

BIBLIOGRAPHY

The following is a list of documents used as a basis for the contents of the subject report. Most of the information was gleaned from the internet, but information was also provided via both telephone conversations and email correspondence with several organizations including ANSI, ISA, FM, and OSHA.

I. Information to support (a) OSHA and the NRTL Program History

A. General Overview

1. Proposed Rules of 1973 which were withdrawn – https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=12424
2. Common Sense Regulation – History -- https://www.osha.gov/archive/html/regulation.html
3. Introduction to the Nationally Recognized Testing Laboratory (NRTL) Program – Power Point presentation by Kevin Robinson, OSHA Electrical Engineer and Lead Auditor -- History -- http://www.nist.gov/director/sco/upload/2_1_Robinson.pdf
4. Scope of what the Occupational Safety and Health Systems (1910.302) from Subpart S covers – specifically mentions exclusion of installations in underground mines – history -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9879

B. Information to support (b) Basis for NRTL Program Requirements, (c) NRTL evaluation program, and (d) NRTL monitoring program

1. Part 1910, Subpart S, 1910.399, definitions applicable to this subpart -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9976
2. Specific references to OSHA Standards Requiring NRTL Approval -- https://www.osha.gov/dts/otpca/nrtl/1910refs.html and https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=24041 and MOU with ANSI --

https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=MOU&p_id=239

3. Type of Product Requiring NRTL Approval -- https://www.osha.gov/dts/otpca/nrtl/prodcatg.html
4. Part 1910.7, Definitions and Requirements for a Nationally Recognized Testing Laboratory -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9703
5. Part 1910.7 App A, OSHA Recognition for Nationally Recognized Testing Laboratories -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9704
6. NRTL Application Guidelines for testing laboratories wishing to become an NRTL -- https://www.osha.gov/dts/otpca/nrtl/applguid.pdf
7. OSHA INSTRUCTION detailing OSHA NRTL program policies, procedures, and guidelines and providing interpretations and clarifications https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2004
8. Information on Submitting an Application (to become an NRTL) -- https://www.osha.gov/dts/otpca/nrtl/appinfo.html
9. Federal Register/Vol. 60, No. 46/3March1995/Notices, Satellite Notification and Acceptance Program (SNAP) -- http://www.gpo.gov/fdsys/pkg/FR-1995-03-09/pdf/95-5780.pdf
10. Deleting standards from an NRTL's scope of activities, page 52568 of FR/Vol. 78 N0.164/Friday, Aug. 23, 2013/ Notices -- http://www.gpo.gov/fdsys/pkg/FR-2013-08-23/pdf/FR-2013-08-23.pdf

C. Information to support OSHA participation on Standards Panels – Email information received from William Lawrence, FM, who is involved with all of the pertinent committees. He reported only one OSHA representative on the UL 913 panel.

D. Information on (g) Cost effects on small business -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=PREAMBLES&p_id=1017 and http://docs.house.gov/meetings/HM/HM07/20130717/101140/HHRG-113-HM07-Wstate-FalconerD-20130717.pdf and http://161.58.174.41/thirdpartycert.html and http://161.58.174.41/thirdpartycert.html and http://161.58.174.41/thirdpartycert.html

II. Information on The ANSI Standards process – About ANSI, an overview --

http://www.ansi.org/about_ansi/overview/overview.aspx?menuid=1 and http://www.ansi.org/about_ansi/introduction/introduction.aspx?menuid=1

A. (a) Developing and updating standards overview overview http://www.ansi.org/standards_activities/domestic_programs/overview.aspx?menuid=3 and ANSI Essential Requirements http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2014_ANSI_Essential_Requirements.pdf
B. (b) Accrediting SDO's -- http://www.ansi.org/standards_activities/domestic_programs/accreditation_as_developer/acc_sum.aspx?menuid=3 and Application for Accreditation as a Standards Developer by the ANSI plus ANSI audit Procedures -- http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2013_ANSI_Audit_ASD.pdf and http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/2013_ANSI_Audit_ASD.pdf And http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/Procedures,%20Guides,%20and%20Forms/aud_docuchklist_2012.pdf
C. (c) ANSI Panels and appeals procedure -- http://www.ansi.org/standards_activities/domestic_programs/appeals/appeals.aspx?menuid=3 and http://publicaa.ansi.org/sites/apdl/Documents/Standards%20Activities/American%20National%20Standards/ANSI%20Accredited%20Standards%20Developers/ANS%20Guidance%20Documents/Appeals%20process%20summary%2004082010.pdf
D. Standards and Process concerning ANSI/ISA 60079-11 – Email exchanges with ISA

III. NTTAA and OMB A119 -- http://www.whitehouse.gov/omb/fedreg_a119rev and http://gsi.nist.gov/global/index.cfm/L1-3/L2-6/A-166 and http://www.whitehouse.gov/omb/circulars_a119 and http://www.archives.gov/research/guide-fed-records/groups/100.html

IV. Hazardous location (hazloc) classifications and general information -- https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=9884&p_table=standards

V. IS Markings that meet the “ia” mining equipment classification -- http://www.documentation.emersonprocess.com/groups/public/documents/bulletins/d103222x012.pdf and http://www.automation.com/library/articles-white-papers/machine-process-safe-guarding/methods-of-protection-in-hazardous-explosion-risk-locations and http://www.schischek.com/explosion-proof/classification-labelling-explosion-proof-ATEX-equipment.html and http://www.bartec.de/homepage/eng/downloads/produkte/exschutz/poster.pdf and http://www.extronics.com/extronics/documents/ExtronicsWallchart_160708.pdf and FM and UL info on equipment data bases – Both of these sites require log ins, but the information I obtained is in the accompanying package of printed material.

CDC-NIOSH-OMSHR REPORT

Appendix A

Quality Assurance of Nationally Recognized Test Laboratories using

ANSI/ISA Standards for Certification of Intrinsically Safe Equipment

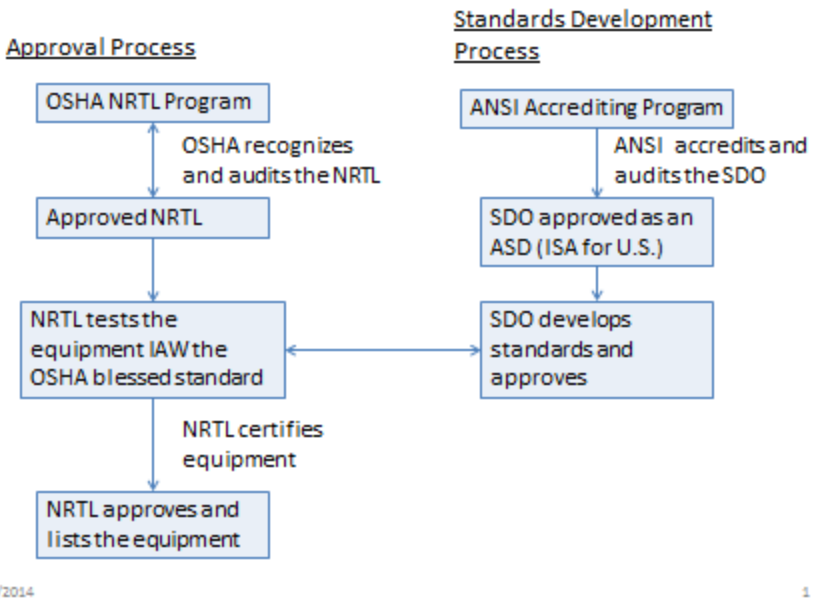
One of the common questions regarding the operational aspects of OSHA is how they accept standards and their subsequent revisions as used by NRTL's to evaluate and test intrinsically safe electric equipment. The following discussion addresses this issue specifically to help clarify the situation.

One of the not well understood facets of OSHA is by what authority they accept standards and subsequent revisions thereto that are used as the basis to evaluate and test electrical equipment as intrinsically safe by NRTLs. When congress enacted the "Occupational Safety and Health Act of 1970", CFR 29 USC 655, congress saw the need to expedite the process to establish suitable standards due to the high incidences of injury and death in the workplace. Accordingly, Section 6 of the law, Occupational Safety and Health Standards, started with the statement:

> "(a) Without regard to chapter 5 of title 5, United States Code, or to the other subsections of this section, the Secretary shall, as soon as practicable during the period beginning with the effective date of this Act and ending two years after such date, by rule promulgate as an occupational safety or health standard any national consensus standard, and any established Federal standard, unless he determines that the promulgation of such a standard would not result in improved safety or health for specifically designated employees. In the event of conflict among any such standards, the Secretary shall promulgate the standard which assures the greatest protection of the safety or health of the affected employees."

This gave OSHA carte blanche to adopt any standard dealing with the safety of workers in the workplace. Among those standards adopted included the intrinsic safety standards in use at that time. Further, the act did not provide direction on how standards would be adopted after the two year period except that the process of giving due notice inviting comments, hearings or whatever else is required when establishing regulations (in this case standards). OSHA was given the authority to adopt what they wanted to adopt and to manage the same based on criteria they established within the general guidelines provided in the law. There are several paragraphs of guidelines, but these are primarily procedural making sure the public has an opportunity to question or comment on any standard adopted by OSHA. Since they got off the ground by using public consensus standards, they have continued to do that in the field where equipment test and certification is involved.

The process diagram below showing the product approval steps and the standards development steps is a simple but accurate representation. It is a rather complex process, however, and it does work. A related question on how OSHA controls the standards that NRTL's use is an interesting one. When I worked on writing these standards, they eventually became ANSI ANS's, the testing laboratories committed to use such standards, the standards changed from time to time and life went on rather smoothly. In my view, OSHA's stance and performance in all of this should be a model for the rest of "regulatory" government. Although many had serious heartburn when OSHA was enacted, over time, OSHA has demonstrated that working with all of the organizations involved in a non-confrontational



manner and allowing more degrees of freedom than one might expect has been both refreshing and, I believe, quite effective. I firmly believe that OSHA, ANSI, NRTL'S and the ASD's have functioned responsibly and developed a system of standards generation and application by the NRTL's that achieved OSHA's goal of maintaining a high level of safety in the work place. OSHA may well have been forced to act this way as they have not been staffed or funded to operate much differently in this part of their operation, but they have made good use of the resources available to them and made it work.

First, let's look at the standards that may be used. OSHA has identified several options available to an NRTL in FR Part 1910.7, Definition and requirements for a nationally recognized testing laboratory. Item 1910.7(c) addresses testing standards and defines an 'appropriate or adequate test standard' as a document which specifies the safety requirements for specific equipment or class of equipment and is:

(1) Recognized in the United States as a safety standard providing an adequate level of safety, and (2) Compatible with and maintained current with periodic revisions of applicable national codes and installation standards, and (3) Developed by a standards developing organization under a method providing for input and consideration of views of industry groups, experts, users, consumers, governmental authorities, and others having broad experience in the safety field involved, or (4) In lieu of items (1), (2), and (3), the standard is currently designated as an American National Standards Institute (ANSI) safety-designated product standard or an American Society for Testing and Materials (ASTM) test standard used for evaluation of products or materials. A possible alternative to all of this is the use of a standard not meeting the criteria above that the Assistant Secretary of Labor has evaluated and determined that it provides an adequate level of safety.

Of course this raises further questions such as in item (1), recognized by whom. But the point is, if a standard exists that was developed essentially in the mold of an ANS, but has not been recognized by ANSI, it still can be used. Further, if it is an ANS as recognized by ANSI or an ASTM standard, it is automatically acceptable. In this case, OSHA has endorsed the standards development process of both these organizations as meeting the criteria they believe to be important [as stated in (1), (2), and (3) above]. Or it can be any other standard such as a proprietary standard of the testing laboratory if the Assistant Secretary of Labor finds it equivalent to the other acceptable approaches.

As you can see, OSHA has taken a pretty liberal view of what standard may be used as long as it meets the fundamental requirement of adequacy as defined by the Assistant Secretary of Labor. This discussion muddies up the flow chart a bit, but as far as I know, all testing laboratories use ANS's as the basis for their testing. I make that statement based on the OSHA list of recognized NRTL's and the standards they have declared that they use in performing their tests and evaluations.

A closely related issue is the subject of how OSHA and NRTL's handle changes to standards. FR 1910.7 App. A, Item II.A addresses test standard changes. It states: A recognized NRTL may change a testing standard or elements incorporated in the standard such as testing methods or pass-fail criteria by notifying the Assistant Secretary of the change, certifying that the revised standard will be at least as effective as the prior standard, and providing the supporting data upon which its conclusions are based. The NRTL need not inform the Assistant Secretary of minor deviations from a test standard such as the use of new instrumentation that is more accurate or sensitive than originally called for in the standard. The NRTL also need not inform the Assistant Secretary of its adoption of revisions to third-party testing standards such as those accepted by ANSI or ASTM standards, if such revisions have been developed by the standards developing organization, or of its adoption of revisions to other third-party test standards which the developing organization has submitted to OSHA. If, upon review, the Assistant Secretary or his designee determines that the proposed revised standard is not "substantially equivalent" to the previous version with regard to the level of safety obtained, OSHA will not accept the proposed testing standard by the recognized NRTL, and will initiate discontinuance of that aspect of OSHA-recognized activity by the NRTL by modification of the official letter of recognition. OSHA will publicly announce this action and the NRTL will be required to communicate this OSHA decision directly to affected manufacturers. To my knowledge, no change to any IS standard has been deemed to lower the safety level of the standard.

It is clear that the Assistant Secretary of Labor has the authority and the responsibility to assure that the standards used by testing laboratories are 'adequate'. It is also clear that the standards developing process and the NRTL program are in lockstep where IS is concerned and that everyone is working on the same page.