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Benefits of a Baseline Hazardous Area Classification Assessment for a Facility with Limited Personnel Resources

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Abstract

The purpose of this workshop is to show the benefits of having a baseline Hazardous Area Classification assessment and compliance assessment for a facility processing flammable hydrocarbons having limited personnel resources. The intent of the workshop is to demonstrate how OSHA's requirements for documenting process safety information and process safety studies link to this baseline Hazardous Area Classification assessment and compliance assessment. A common sense approach for completing a baseline Hazardous Area Classification assessment and why it is a key to reducing resources required to maintain it will be discussed.

The workshop attendee will be exposed to the following:

- Process Safety Management as defined per OSHA 1910.119 and its 14 basic elements
- Common sense approach to performing baseline hazardous area classification assessment and compliance assessment
- Matrix showing information links to process safety information and process safety studies
- Personnel resource interface map showing ties to process safety information and process safety studies

Background

In February of 1992 Occupational Safety and Health Administration (OSHA) 29 CFR 1910.119 Process Safety Management of Highly Hazardous Chemicals became law in the United States and confusion reigned supreme. Over the next several years industry professionals began the process of sorting through the responsibilities, regulations and impending deadlines that had been placed squarely in their laps. Acronyms such as PSM (Process Safety Management), PSI (Process Safety Information), RAGAGEP (Recognized and Generally Accepted Good Engineering Practices), MOC (Management of Change), and PHA (Process Hazards Analysis) became commonplace in the vocabulary of process safety professionals nationwide.

Employers now were required to meet stringent deadlines regarding the creation and management of a plethora of process information associated with equipment in manufacturing processes covered by this law, i.e. any covered process. This information would be used to support the exhaustive efforts needed to create a baseline process hazards analysis (PHA) for each covered process by May of 1997. In addition OSHA required all PHA's be placed on a five year life cycle requiring their review and revalidation. Along with the revalidation of PHA's came the task of also revalidating all process safety information on the same five (5) year cycle.

As a result, every willing and able bodied employee was thrust into the quagmire of supporting, participating in, facilitating, or conducting PHA's. The required information (i.e. process safety information or PSI) used to support PHA's included the materials of construction, Piping and Instrument Diagrams (P&ID's), relief system design and design basis, ventilation system design, material and energy balances, safety shutdown systems, and electrical classification (electrical area classification). Individual departments and specific disciplines were assigned the responsibility of owning and maintaining specific PSI. Electrical engineers automatically became the custodians of electrical area classification primarily due to the name assigned by OSHA to this very important PSI.

Introduction

Twenty five years have passed since implementation of OSHA 1910.119 began and certain aspects are still a challenge for those individuals charged with enforcing and managing its requirements. Electrical engineers specifically have not been entirely successful in shifting the ownership of electrical area classification to other disciplines. Once the purpose of electrical area classification is understood and its role in the overall management of process safety is explained, however, a transfer of ownership is not only reasonable but logical. This transfer of ownership should be a priority, especially in facilities with limited technical and operational resources.

This paper describes a logical path forward to move electrical area classification or hazardous area classification away from ownership by a single discipline. The steps to achieve this goal are presented as follows:

1. Understand Process Safety Management as defined per OSHA 1910.119 and its 14 basic elements.
2. Eliminate the confusion with the term "electrical area classification".
3. Establish a process to conduct a baseline hazardous area classification assessment and baseline hazardous area classification compliance assessment.
4. Educate personnel on how updated hazardous area classification information links to other process safety information and process safety studies

Process Safety Management per OSHA

The topic of Process Safety Management (PSM) primarily involves the understanding of OSHA 1910.119 and its 14 basic elements. These elements cover typical activities which routinely occur in support of a production process or facility as well as new requirements to increase the safety of employees, contractors, and the community. This regulation focuses on

establishing a baseline for process safety information and its subsequent documentation, communication, and utilization by those individuals assigned to work in a covered process. These elements are represented in Figure 1 below:

Figure 1. 14 Elements of OSHA's PSM

Note the center of the wheel states an overall goal for PSM as protection of employees. This does not mean contractors and the community are not important. It merely represents a philosophy where an employee is the first line of defense in any PSM activity. Ownership of process safety follows once the expectation of responsibility for the safety of all who work or do work in the area is set. The wheel in Figure 1 also facilitates an understanding of the 14 elements not as separate requirements but interrelated actions with inputs from one as outputs of another.

"Electrical" Area Classification Is a Misnomer

The terminology in the industry is moving away from "electrical area classification" to the preferred term "hazardous area classification". Why the word "electrical" in the first place? The NFPA 70 National Electrical Code® (NEC) covers the requirements for electrical installations in locations classified as hazardous due to the materials handled, processed, or stored in those locations. In order to identify the correct requirements for electrical equipment and electrical systems, the classification of the area must be known. This could be how the term "Electrical Area Classification" came to be.

Hazardous area classification (HAC) is a probability analysis and risk assessment evaluation of a manufacturing or process area possessing a potentially abnormal flammable atmosphere that focuses exclusively on the minimization or elimination of electrical energy as a potential or

probable source of ignition. The intent of HAC is to minimize electrical energy as a potential source of ignition due to a non-catastrophic release of flammable or combustible materials in a classified area. Results of a HAC assessment (area classification, material group, and Temperature Class (T Code)) are used in the design, selection, construction, and operation of electrical equipment and electrical systems to ensure this aspect of process safety is addressed.

Properties of materials handled in process equipment or an area under study set its classification per NEC Article 500 "Hazardous (Classified) Locations, Classes I, II and III, Divisions 1 and 2", 500.5(A) Classification of Locations. Materials can be gas, liquid-produced vapor, liquid, or solid and the classes are defined as follows:

- Class I (gases and vapors)
- Class II (dusts)
- Class III (fibers/flyings)

This paper focuses on Class I and Class II materials only due to their prevalence in industry and excludes Class III materials.

This explanation of what HAC is should eliminate the confusion associated with the terms electrical classification, electrical area classification, area classification, and puts the focus on using the correct term hazardous area classification.

A Baseline HAC Process

The overall process steps in assigning a baseline hazardous area classification (HAC) and determining compliance to it vary slightly but can be generally be defined as follows:

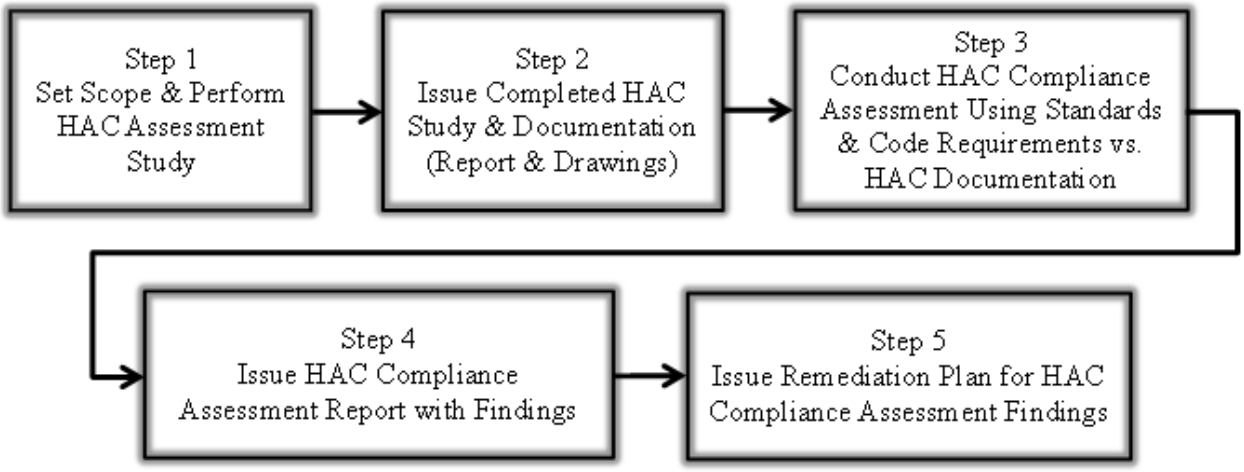

Figure 2. The HAC Process

The steps shown in Figure 2 present a process as first assigning HAC to a location and concluding with a remediation plan to address any findings identified in the HAC compliance assessment. Activities for each step are outlined below to assist in setting the inputs and outputs as groundwork for later discussion:

Step 1: Set Scope & Perform HAC Assessment Study

The scope of a HAC assessment study determines the location, quantity and type of equipment, and methodology of how an assessment will be performed. Steps for completing a HAC assessment are prescriptive and should be based on requirements given in both company standards and applicable recognized and generally accepted good engineering practices (RAGAGEP). Two common RAGEGEP for Class I materials is National Fire Protection Association (NFPA) 497 "Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas" and API RP 500 "Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Division 1 and Division 2". A common RAGAGEP for Class II materials is NFPA 499 "Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas".

Properties of the material must be known to properly complete Step 1 for both gases and vapors and combustible dusts. For a gas and vapor, its composition, pressure, and temperature determine its classification as well as its material grouping and temperature class (T Code) designation. For a combustible dust, its composition and material grouping along with other factors determine its classification. By definition then, a methodology to perform a HAC assessment study is all about the material being processed ("the process") and whether it is flammable or combustible if a non-catastrophic release occurs. All proper HAC methodologies must take into account properties of the material in the location under study. This requires careful study for both Class I and Class II materials. Most process streams in refineries and petrochemical facilities are complex mixtures requiring analysis of multiple components. Many manufacturing processes have a combination of gas, liquid-produced vapor, liquid, or solid materials requiring application of several RAGEGEP to complete the HAC assessment.

Step 2: Issue Completed HAC Study & Documentation (Report & Drawings)

Results of a HAC assessment study are typically issued within a report and a set of drawings. This documentation at a minimum should include the following:

- The basis for determining the HAC assessment results.
- Drawings referenced to the unit or area plot plan.
- Drawings showing both the plan and elevation views.
- The area classification and material grouping.
- The Temperature Class designation (Class I material) or ignition temperature (Class II material).

The report contains a description of the methodology used in the study and references sources for process-related information used. This report covers how and why the area classification was determined and gives an overall temperature class (T Code) designation for Class I materials or ignition temperature for Class II materials for the location. A report should provide the classification and hazard radius as well as material grouping for each point source within the scope in order to link study results to information displayed on the drawings. A drawing set typically includes location plans, elevations, details, tables, notes, and legends to properly

document the hazardous area classification study. Drawings present assigned Class, Division, material grouping, and hazard radius (if applicable) for each point source of emission.

Step 3: Conduct HAC Compliance Assessment Using Standards & Code Requirements vs. HAC Documentation

A HAC compliance assessment for a unit or area focuses on visible process electrical equipment and electrical installation practices. It is a gap analysis between both code requirements and other recommended practices or guidelines versus the latest version of HAC documentation. In other words this activity compares what's there to what's supposed to be there. The scope is set for the HAC compliance assessment by first determining what will be included and what will be excluded and then listing specific parameters or assessment bases for the assessment team. For example, a building containing online process analyzers for flammable or combustible materials should be included. Transitions from below to above grade for conduit systems containing grounding and cathodic protection conductors could be excluded if there are no associated electrical arc producing devices. Personal safety guidelines are also noted such as allowing access only to structures having dedicated stairs and handrails. A format for the communication of any findings such as photographs or a checklist in electronic format is also established so the assessment team is prepared. A physical walkthrough of the area allows the assessment team to visually confirm compliance and note as findings those instances of noncompliance.

Step 4: Issue HAC Compliance Assessment Report with Findings

Results of the HAC compliance assessment are placed in a report which documents the scope and presents the findings in the format as set in Step 3. Findings can be categorized as "specific" with a unique number for each piece of electrical equipment or electrical installation practice as well as "general" or "systemic" which is applied to the overall area assessed. Clear wording is important to communicate the exact case of noncompliance found. The same piece of electrical equipment may have several findings which stem from a unique noncompliance to code and each should be noted individually within the results.

Step 5: Issue Remediation Plan for HAC Compliance Assessment Findings

A remediation plan for the HAC compliance assessment findings provides an opportunity for the assessment team to make its final recommendations. Many findings may have simple solutions to bring the installed electrical equipment or associated electrical installation practices into compliance. Some findings, due to electrical equipment accessibility or label illegibility, require further investigation in order to determine whether a noncompliance situation actually exists. Still other findings have complex solutions which may require detailed engineering design to remediate. A remediation plan can include recommendations for findings which encompass all or some of these categories. In each case, however, a detailed review of the remediation plan by those individuals responsible for the design, operation, and maintenance of the electrical equipment assessed is highly recommended. Each finding and its associated remediation recommendation now moves into the project or work order process so the resolution can be tracked for closure.

This description of a process to complete a baseline HAC assessment and associated baseline HAC compliance assessment contains not only the tasks which should be done but also shows key documentation deliverables. The following section discusses the importance of communicating HAC assessment documentation (report and drawings) especially in facilities with limited technical and operational resources.

HAC Documentation and Communication

The NEC states "all areas designated as hazardous (classified) locations shall be properly documented. This documentation shall be available to those authorized to design, install, inspect, maintain, or operate electrical equipment at the location". *(1)* This formally sets in place the team membership (Team) which should routinely use HAC information to safely implement electrical equipment and electrical system changes in a production unit. This team membership could include personnel with responsibilities for Process Engineering, Project Engineering, Maintenance, Mechanical Integrity, and Construction who are charged with a common goal of sharing and using the latest HAC information available. Issuing the latest HAC information as formal record documents is critical but a key to the team's success is utilizing it effectively.

With HAC information available and the Team in place why do questions and confusion frequently arise regarding compliance with the assigned classification? Several factors can contribute to this but they center on the HAC documentation itself. The major issues associated with using hazardous area classification documentation can often be broken into three problem areas:

1. Lack of understanding
2. Lack of knowledge
3. Lack of utilization

These problem areas can be exhibited by some individuals but more often by the team as a whole. Even though these problem areas exist they can be addressed by taking a more focused team approach as the following discussion shows.

Lack of Understanding

The first area is a lack of understanding regarding what should be included in hazardous area classification documentation. Although information was presented in Step 2 "Issue Completed HAC Study & Documentation (Report & Drawings)"in the HAC Process above, further discussion is required. A HAC assessment report covers the technical aspects of how the classification was determined and should be available if background information is required. A report, however, is not normally used in the field for obtaining details of the assigned classification. Drawings are important since they should be considered as "at the point of use" or quick reference documents and should be a priority for record documents associated with hazardous area classification.

There are two main reasons drawings should be the focus of HAC documentation. First, the NEC states "one type of documentation consists of area classification drawings. Once the hazardous area has been classified and the hazardous area documentation has been developed the materials and installation methods of the *NEC* are used to construct the electrical system in the classified area. This approach provides the necessary information for installers, service personnel, and AHJs (authority having jurisdiction) to ensure that electrical equipment installed

in classified areas is of the proper type." *(1)* The NEC calls out responsible parties as not only those individuals who install the electrical systems but also the service personnel and those with the authority having jurisdiction (AHJ) for the classified location. Although a legal term, one definition for AHJ is "a person who has the delegated authority to determine, mandate, and enforce code requirements established by jurisdictional governing bodies". *(2)* The intent of the NEC as stated should be viewed as a shared mission by those individuals having these roles and responsibilities to ensure HAC compliance is maintained.

The second reason drawings should be the focus of HAC documentation is they are a recognizable medium for individuals in a plant or facility. Technical drawings are used during all phases of project development and are central to communicating many types of process safety information. The format of the HAC drawings should allow all Team members, from an electrician assigned to install new equipment in the field to a project engineer assigned to design an upgrade to an existing electrical system, to obtain all HAC information efficiently. The key is to have all required information clearly shown and the document readily available when needed.

The purpose of HAC drawings, then, is to provide the Team with information to ensure electrical equipment and electrical system changes are done in compliance with the assigned classification, material grouping, and Temperature Class designation. The lack of understanding problem area has been addressed if all your Team members can correctly interpret hazardous area classification drawings and readily obtain the required information.

Lack of Knowledge

The second problem area is a lack of knowledge regarding how and when to revise hazardous area classification documentation. Since OSHA considers hazardous area classification as required PSI for all covered processes, specific documentation steps must be followed:

- The documented results must be based on the process technology and materials used in the unit.
- The Area classification documentation must be kept "evergreen".
- This "Evergreen" state of documentation is to be maintained using the management of change process, process hazards analysis process, and company specific document control standards and procedures.

The Team involved in the use of the HAC documentation will usually be involved in supplying process information needed for the assessment study as described above in HAC Process Step 1 "Set Scope & Perform HAC Assessment Study" or may even perform the HAC assessment itself. Maintaining "evergreen" HAC reports and drawings are critical for the Team to manage this aspect of process electrical safety. Other benefits include understanding as well as communicating upcoming changes for a process unit which could impact material grouping and Temperature Class designations. You have properly addressed the problem area of how and when to revise HAC documentation if your document control methodology includes these basic components.

Lack of Utilization

The third problem area is the lack of utilization of hazardous area classification information both in updating PSI and in the Process Safety risk assessment process. Typical activities which routinely use HAC information in a production facility are shown as follows:

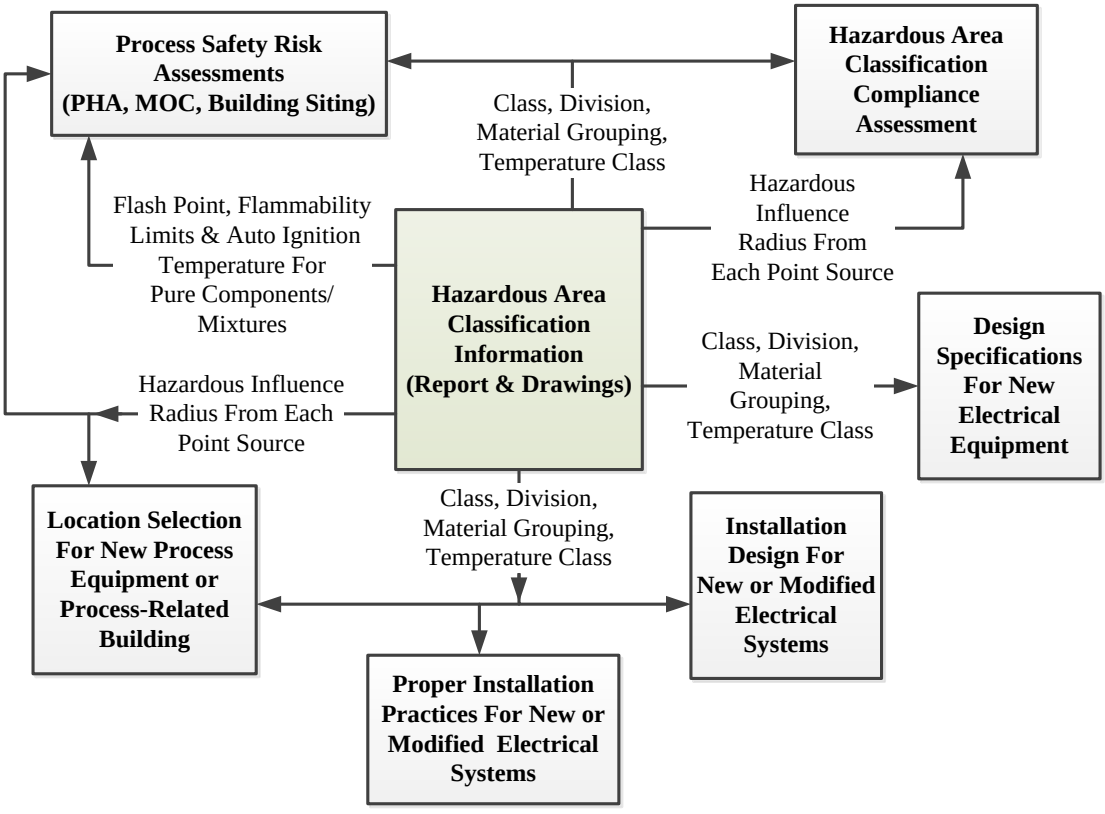

Figure 3. Example of HAC Information Utilization Process

The information flow shown in Figure 3 above reinforces the need for communication between those individual Team members in applying HAC information. Reports and drawings which document the HAC assessment basis and the assessment results can provide key information as follows:

- The process technology and materials documented for the production process are also used for the hazardous area classification assessment study.
- The hazardous area classification documentation should be used to support Process Safety risk assessments such as Process Hazard Analysis (PHA) studies, Management of Change (MOC) evaluations, and building siting studies.
- Hazardous area classification drawings show the potential for a non-catastrophic release of flammable materials and provide the classification (Class & Division), material grouping, and temperature class (T Code) designation for the location.

- Hazardous area classification information sets the design criteria for electrical equipment and electrical equipment installation requirements.

A major barrier to communicating HAC assessment results is removed once Team members understand how this PSI is linked between their individual tasks and areas of responsibility. This encourages Team ownership of the HAC information flow rather than one specific discipline or department and the problem area associated with lack of utilization of HAC information is addressed.

Conclusion

Every day changes are made in production facilities worldwide. Physical equipment changes can impact the equipment layout of a production unit requiring communication to ensure those individuals impacted are made aware. Changes in operating procedures and training, updates to PM schedules, and updates to other PSI documentation are but a few of the documents typically affected by such changes. Moving hazardous area classification away from ownership by a single discipline can occur through the understanding of PSM, using the term hazardous area classification, creating a baseline HAC and utilizing HAC documentation effectively, and communicating and incorporating updated PSI to individuals with single and overlapping responsibilities. This is especially important in facilities with limited technical and operational resources.

References

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2. Authority having jurisdiction (AHJ). Definition. In *Dictionary of Construction.com*. Retrieved May 23, 2017, from http://www.dictionaryofconstruction.com/definition/authority-having-jurisdiction-ahj.html