Section VI: Investigating/Inspecting Ethanol Processing Facilities

Ethanol processing facilities contain specialized processes that can produce catastrophic consequences such as fire, explosion, engulfment, or asphyxiation (III) if the proper preventive measures (IV) are not implemented. Consequently, Compliance Safety and Health Officers (CSHOs) must be properly trained and equipped to recognize hazards and appropriate safety measures at these facilities.

A. Pre-inspection or Investigation Planning

Proper planning and preparation is needed to conduct an inspection or investigation at an ethanol processing facility.

1. OSHA Directives Review

The following is a list of resources that can be consulted when conducting inspections/investigations (additional resources are listed in Appendix B):

- Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119) www.osha.gov/SLTC/processsafetymanagement/index.html.
- CPL 02-02-045 Process Safety Management of Highly Hazardous Chemicals – Compliance Guidelines and Enforcement Procedures www.osha.gov/pls/oshaweb/owadisp.show_document?p_id=1558&p_table=directives.
- PSM Covered Chemical Facilities National Emphasis Program (CPL 03-00-014 PSM).
- Grain Handling (29 CFR 1910.272).
- Permit-Required Confined Spaces (29 CFR 1910.146).
- Application of the Permit-Required Confined Spaces Standard (CPL-02-00-100).
- The Control of Hazardous Energy (Lockout/Tagout) (29 CFR 1910.147; IV,U).
- Hazard Communication Standard (29 CFR 1910.1200).
- Respiratory Protection (29 CFR 1910.134).
- Although 29 CFR 1910.272 takes precedence inside grain handling facilities, it is not intended to address all the hazards that can be found in workplaces handling grains. Additional standards (as relevant) within 29 CFR 1910 for General Industry and 29 CFR 1917 for Marine Terminals will apply to the grain handling portion of these facilities. For example, bin entry requirements will be found in 29 CFR 1910.272(g) & (h), and permit- required confined space requirements will be found in 29 CFR 1910.146. Requirements for the control of hazardous energy will be found in 29 CFR 1910.272(e) & (m) and 29 CFR1910.147 as applicable.
- Some construction requirements are included in Appendix B.

2. Research the Facility

Most states have a state agency with a website that provides information on local ethanol production facilities. Information such as a description of the milling process (dry or wet), the feedstock (corn, other), production capacity, and number of permanent workers may be available for each operational facility at these websites. Additional information about the facility can be obtained on the OSHA website, if it has an OSHA Establishment History (www.osha.gov/pls/imis/establishment.html). A search for the facility's history can be conducted by using the Standard Industrial Classification (SIC) for ethanol processing facilities, 2869, industrial organic chemicals not elsewhere classified and the North American Industry Classification System (NAICS) 325193, ethanol, non-potable manufacturing.

Each Regional Office library should have ethanol industry reference documents accessible to CSHOs. Area Office jurisdictions that conduct a large number of Process Safety Management (PSM) inspections should have relevant reference documents in their libraries. CSHOs may also access documents available online through OSHA's Technical Data Center. Similarly, jurisdictions that cover a large number of ethanol processing facilities should have libraries with relevant resources covering appropriate subjects,

such as: pressure vessel inspection, rating, repair and alteration, ANSI piping inspection code, guidelines for the integrity of mechanical systems and engineering design of the process, etc.

Relevant American Petroleum Institute (API) publications (e.g., standards (STD), recommended practices (RP), and technical reports (TR)) include:

- API 510, Pressure Vessel Inspection Code: In-Service Inspection, Rating, Repair, and Alteration - Tenth Edition, 2014.
- API RP 520 part (PT) I, Sizing, Selection, and Installation of Pressure-relieving Devices in Refineries Part I - Sizing and Selection – Eight Edition, 2008.
- API RP 520 PT II, Sizing, Selection, and Installation of Pressure-Relieving Devices in Refineries Part II—Installation - Fifth Edition, 2003.
- API STD 521, Pressure-relieving and Depressuring Systems - Sixth Edition, 2014.
- API 570, Piping Inspection Code: In-service Inspection, Rating, Repair, and Alteration of Piping Systems - Third Edition, 2009.
- API RP 574, Inspection Practices for Piping System Components - Third Edition, 2009.
- API STD 653, Tank Inspection, Repair, Alteration, and Reconstruction - Fourth Edition, 2009; Incorporating Addendum 1: August 2010, Addendum 2: January 2012, Addendum 3: November 2013.
- API RP 752, Management of Hazards Associated with Location of Process Plant Permanent Buildings - Third Edition, 2009.
- API RP 753, Management of Hazards Associated with Location of Process Plant Portable Buildings - First Edition, 2007, reaffirmed 2012.
- API TR 939-D, Stress Corrosion Cracking of Carbon Steel in Fuel-Grade Ethanol: Review, Experience Survey, Field Monitoring, and Laboratory Testing - SECOND EDITION, ADDENDUM 1: OCTOBER 2013.
- API Bull 939-E, Identification, Repair, and Mitigation of Cracking of Steel Equipment in Fuel Ethanol Service - SECOND EDITION, 2013.

Another source of information is the Right to Know Network (www.rtknet.org); it provides access to various databases (e.g., Hazardous Waste, Toxic Releases), including the Environmental Protection Agency's (EPA) Risk Management Plan (RMP) database, which collects information on large amounts of highly hazardous substances used at facilities An example is the use of sulfur dioxide, gasoline and ammonia at a facility in Cedar Rapids, IA.

3. Select Equipment

- Prior to the initial walkaround inspections (if feasible), CSHOs should review the employer's procedures for PPE selection and allowable electronic equipment in the selected unit(s) and/or areas of the facility that will be inspected. The right type of PPE must be made available to the CSHO at all times, regardless of the urgency of the inspection/investigation circumstances.

- Equipment rated for the hazardous classified location must be used (if applicable). Process areas with the possibility of flammable vapors require Class 1 electrical equipment, while process areas with the possibility of combustible dusts require Class 2 electrical equipment.

- Required equipment includes cameras/or video cameras. CSHOs may use non-intrinsically safe cameras equipped with a telephoto lens from outside classified areas (OSHA 2011g; OSHA 2008b) and/or still cameras without batteries or a flash (OSHA 2011g). If the employer allows the use of non-intrinsically safe cameras in hazardous (classified) locations, CSHOs may use this type of equipment when: (1) the employer issues a hot work permit for the use of the camera; and

(2) continuous combustible gas metering, which has been calibrated prior to use, is provided in the areas where the camera will be used (OSHA 2011g).

- Properly calibrated four-gas meters and/or other appropriate detection equipment is recommended to determine the condition of the atmosphere.

- Flame-retardant coveralls for protection from flash fires must be available if needed. Clothing made of hazardous synthetic fabrics must not be worn underneath flame-retardant coveralls. CSHOs must wear natural fiber non-spark producing clothing and underwear (such as 100% cotton) for protection from ignitable combustible dusts and/or flammable vapors (OSHA 2011g; OSHA 2008b). Avoid jackets or other clothing with nylon liners.

- NIOSH-approved emergency escape respirators must be carried (the CSHO must be trained and certified to use them) in case an atmosphere that is Immediately Dangerous to Life and Health (IDLH; 29 CFR 1910.134(d)(2)) is encountered.

- Other necessary PPE may include: steel-toed shoes, hard hats, safety glasses, rubber/nitrile gloves, leather gloves, hearing protection, etc.

B. On-site Investigations or Inspections

On-site investigations/inspections follow a similar pattern. The CSHO must present official identification as soon as he/she arrives at the site and request to speak with the appropriate employer management representative. The CSHO conducts a preliminary opening conference, followed by a walkthrough of the facility. If there is union representation at the facility, a union representative should be at the opening conference and participate in the walk through or workplace evaluation.

The CSHO will walk through the facility to conduct a physical assessment and interview workers. This requires an examination of the processes involved (VI,B,1; OSHA 2000; OSHA 2011g), floor plans or drawings, maintenance procedures, written confined space program, and other appropriate safety and health information (II).

The inspection ends with the closing conference, during which the CSHO will discuss the findings of the walkaround evaluation. The CSHO will conduct the closing conference with the employer's management representative and the workers union representative (if applicable). The purpose is to discuss the standards violated based on the hazards observed, corrective actions to implement, and possible citations that would be recommended to the OSHA Area Director (Employer Rights and Responsibilities Following a Federal OSHA Inspection, 2011 [Publication OSHA-3000]; OSHA Field Operations Manual (FOM), 2011 [CPL-02-00-150]).

Prior to starting the walk-through evaluation, the CSHO should:

- Establish the applicability of the PSM standard (I) at the opening conference; for example, by reviewing the inventory of chemicals on site and their respective maximum intended quantities, including the amount of ethanol and any other flammable liquids, and determining if there are exemptions that apply as specified in the PSM NEP, OSHA 2011g. Due to its flashpoint of 55 degrees Fahrenheit, ethanol is a flammable liquid. In accordance with 29 CFR 1910.119(a)(1)(ii), the on-site threshold quantity for the implementation of PSM is 10,000 pounds or more of a flammable liquid. Exemptions may apply (I).

- Establish if an *inspection* for combustible dust hazards is warranted. During the opening conference and after a preliminary walkthrough of the facility, if the CSHO determines that the employer's operation does not have combustible dust explosion, deflagration, or other fire hazards, then the CSHO may terminate the combustible dust hazards inspection, or contact the Area Office on whether to continue. Additionally, if the CSHO determines that the facility has undergone an OSHA consultation visit in the past three years and verifies through a basic walkthrough and evaluation of any changes made by the employer that the combustible dust explosion hazards have sufficiently been addressed by the employer, then the CSHO shall normally terminate the combustible dusts hazard inspection (OSHA 2008b).

- Obtain a facility site map for PSM covered facilities (29 CFR 1910.119(e)(3)(v)). Facility means the buildings, containers or equipment that comprise a process (29 CFR 1910.119(b); API RP 752, Management of Hazards Associated with Location of Process Plant Permanent Buildings - Third Edition, 2009; API RP 753, Management of Hazards Associated with Location of Process Plant Portable Buildings - First Edition, 2007, reaffirmed 2012).

    - API RP 752 (2009), which discusses recommended practices for siting *permanent* buildings in process plants, is based on the following guiding principles:
        - Locate personnel away from process areas consistent with safe and effective operations.
        - Minimize the use of buildings intended for occupancy in close proximity to process areas.
        - Manage the occupancy of buildings in close proximity to process areas.
        - Design, construct, install, modify, and maintain buildings intended for occupancy to protect occupants against explosion, fire, and toxic material releases.
        - Manage the use of buildings intended for occupancy as an integral part of the design, construction, maintenance, and operation of a facility.

    - API 753 (2007 R 2012) which provides guidance for reducing the risk to personnel located in *portable* buildings from potential explosion, fire, and toxic release hazards is based on the following guiding principles:
        - Locate personnel away from covered process areas consistent with safe and effective operations.
        - Minimize the use of occupied portable buildings in close proximity to covered process areas.
        - Manage the occupancy of portable buildings, especially during periods of increased risk, including unit start-up or planned shut-down operations.
        - Design, construct, install, and maintain occupied portable buildings to protect occupants against potential hazards.
        - Manage the use of portable buildings as an integral part of the design, construction, maintenance, and operation of a facility.

- Information on the equipment used in the process must include the following:
    - relief system design and design basis;
    - piping and instrument diagrams (including piping components such as valves);
    - ventilation system design;
    - materials of construction;
    - design codes and standards employed;
    - materials and energy balances for processes built after May 26, 1992; and,

- safety systems (e.g., interlocks, detection/monitoring devices, sensors, alarms, or suppression systems).

- Determine the amount and type of grain on site. Obtain a process flow diagram during the opening conference. Refer to Production Steps in Corn Dry-Milling (Table II.1) or Production Steps in Corn Wet-Milling (Table II.2) as a guide for reviewing the specific process used. The tables summarize each of the production steps used, the primary inputs and outputs, and the main operations performed in each step. While common processing steps are documented, every facility differs, so some facilities may not employ every step whileother facilities may use different terminology for a step in the process than those used in the tables.

- Obtain information on what parts of the process flow are operating at the time of the on-site inspection. This may include all steps in the process, or segments of the process may be operational if it is a batch facility.

- The employer's emergency planning and response should be reviewed (V). Evaluate the evacuation route(s), assembly area(s), available emergency services and contact information. Observe if trucks or railcars block emergency access to a unit. Assess any emergency response facilities, fire pumps, emergency isolation valves, etc. Since ethanol processing facilities are often found in rural, remote locations, it would be prudent to evaluate the facility's contingencies for the provision of medical services and first aid (29 CFR 1910.151), permit-required confined space rescue (29 CFR 1910.146), and response to incidents or emergencies involving Hazardous Waste Operations (HAZWOPER) (29 CFR 1910.120).

- Review the employer's records (OSHA 2000):
  - Employee training documentation (e.g., PSM, HCS, confined space, PPE).
  - Safety procedures for contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process.
  - Injury and illness records including OSHA-300 and OSHA-300A.
  - Review the employers PSM records (if applicable) in accordance with 29 CFR 1910.119.
  - Request other safety documentation, such as hot work permits and procedures (e.g., shutdown of ducts and conveyor systems during welding), confined space entry permits, and procedures and contractor information.

1. Walkaround Evaluation

It is highly recommended that inspections of these industrial sites follow the process flow described in sections 1 and 2 (Figure VI. 1; Figure VI. 2). Some of the hazards that may be encountered in certain areas of the facility are summarized in this section. Refer to sections III and IV for a more detailed discussion of the hazards and safety measures respectively. Be prepared to draw and write an accurate description of the hazards that cannot be photographed and identify their locations.

Observe workers' use of the appropriate PPE. Interview workers to determine if they understand job hazards, safeguards, control measures, PPE, and other safety-related issues that the employer is required to ensure they fully understand. A noise exposure evaluation may be conducted (e.g., in grain receiving and processing areas; III.E; IV.J, IV.K, IV.L). Atmospheric testing may also be conducted to establish concentration levels for any hazardous chemicals used in the workplace (OTM Section III, Chapter 3, Ventilation Investigation, OSHA 1999).

Figure VI. 1 Example of a Process Building Map (IAFC, 2008)

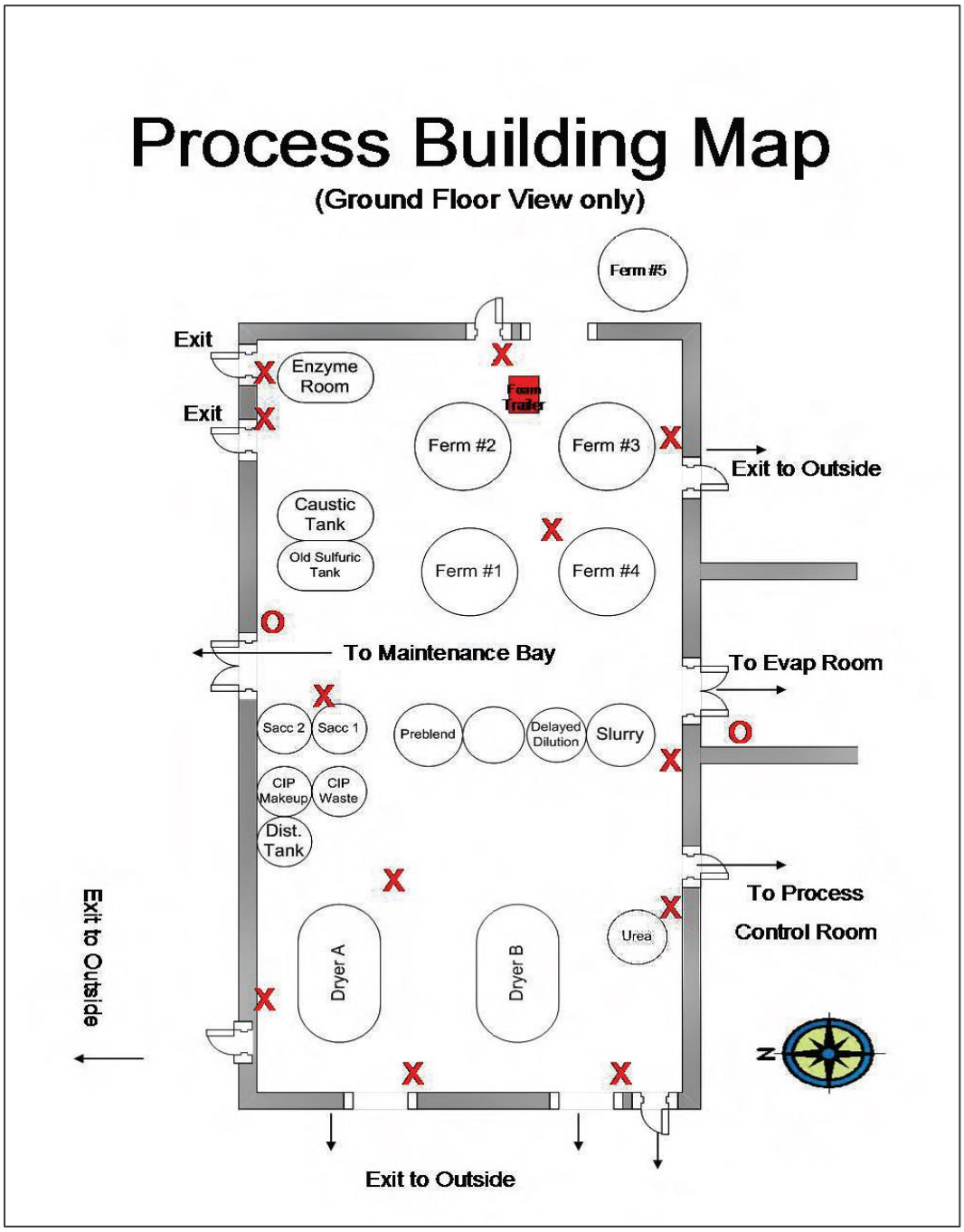

Figure VI. 2 Common Components of a Typical Ethanol Production Facility (IAFC, 2008)

Legend	
X	Approximate location of fire hydrants
O	Approximate location of fire department sprinkler connections
1	Administrative building
2	Cooling towers
3	Anhydrous ammonia tank
4	Maintenance building
5	Process area
6	Grain storage
7	Ethanol rail loadout
8	Tank farm

i. Grain receiving areas

Grain is received by truck or rail (II.B.2.i) and dumped into receiving pits. Observe the various activities in this area carefully: pedestrian/vehicular safety (IV.S), idling vehicles (which are sources of ignition), trucks or railcars that may be blocking emergency access to a unit/building, etc. Inspect bonding and grounding equipment. For example, check to see if they are properly connected and in optimal working

condition to properly dissipate electrostatic charges. Electrical equipment and wiring should be rated for a Class II hazardous environment (where there is a potential for dusts to be suspended in the air).

Grain elevators may be used to transport grains to trucks. They are made up of buckets attached to a continuous rotating belt driven by a motor with the entire system enclosed. Dust clouds may form if equipment is in poor condition (e.g., leakage from bucket elevators or if the dust collector is not functioning properly), if poor housekeeping is practiced, etc.

Other safety considerations in this area include confined spaces (III.G; IV.P; IV.Q), combustible dust hazards (III.C; IV.E; IV.F), and engulfment hazards (III.D; IV.G; IV.H; IV.I).

Prohibited practices in grain storage bins or areas include: standing in flowing grain in silos, or on bridged grain in silos, standing next to a grain mass in a storage pile, or standing next to large piles of grain (III.D). Review lockout/tagout procedures (IV.U) for sources of hazardous energy (III.I).

ii. Load-out/cooling areas for grains

In these areas (Figure II.16; Figure II.19), dried co-products are transferred to interim storage areas and eventually to railcars or trucks for distribution into commerce. Transfer and loading of dry products may lead to dust formation. Safety considerations would generally be the same as for grain receiving areas discussed above (VI.B.1.i; III.C; IV.E). Electrical equipment must be rated for class II hazardous location (29 CFR 1910.307(c)(2)(i); NFPA 70).

iii. Ethanol loading areas

Hazards in these areas include**:** overfilling; leaking equipment; and, presence of ignition sources (III.A; IV.A) such as smoking, lightning, idling vehicles (III.H; IV.S), and open flame operations (e.g., welding). Check for controls (e.g., bonding and grounding mechanism) and safeguards (e.g., fire suppression systems and vapor recovery systems). Inspect tanks, piping and other equipment for cracks and other signs of wear and tear (III.B). Electrical equipment and wiring must be rated for a Class I (Division I or II, as appropriate) hazardous environment where there is a potential for flammable gases and vapors (29 CFR 1910.307(c)(2)(i); NFPA 70).

iv. Distillation

The distillation process area (II.B.1.vii; Figure II.13) is typically where ethanol first becomes highly concentrated by heating the process stream. This part of the facility, therefore, has significant flammable vapor hazards (III.A; IV.A; IV.B) due to the presence of highly-concentrated ethanol vapors and heat. Overpressure or mechanical damage in the distillation columns can cause ethanol vapors to leak and this may present a fire and/or explosion hazard and may expose workers to concentrations above OSHA's permissible exposure limit (PEL) for ethanol (1,000ppm for an 8-hour time-weighted average, 29 CFR 1910.1000 Table Z1). This hazard also exists for other equipment (e.g., piping, molecular sieve) typically found in the distillation process area. Process controls must be adequate to maintain the required temperatures and pressures in the distillation columns.

Process equipment must be designed to handle process upsets (29 CFR 1910.119; 29 CFR 1910.106), for example, incorporating safety relief valves that avoid equipment failure by venting excess ethanol streams directly to safe areas; designing drains to quickly move spilled chemicals from surfaces into enclosed tanks; and, overfill protection devices that minimize spills from tanks and other vessels. Other safety measures include ethanol vapor detectors and automatic fire detection and suppression systems.

Sources of ignition must be eliminated in distillation areas, for example, by prohibiting smoking, implementing bonding and grounding mechanisms, utilizing electrical equipment and wiring that is classified for the hazardous location, and implementing a hot work program.

v. Fuel storage tank area

Hazards include: pipe and equipment ruptures (III.B; IV.C; IV.D), lightning strikes, potential for electrostatic discharge, leaks, improper storage, etc. Some fuel storage tank hazards are also discussed in III.A. Safety measures include: flame arrestors; bonding and grounding mechanisms; ethanol vapor monitoring devices; inerting headspaces; availability of drains designed to quickly remove spills from surfaces into tanks; vapor recovery systems; overfill protection devices; Class I electrical equipment, wiring and fixtures; installing a Lightning Early Warning System; posted signs; fences/barriers to keep unauthorized workers out of fuel storage areas; and, prohibiting the use of open flames and smoking in the area.

Evaluate the flammable liquids dispensing system, the design and capacity of containers, and the design and construction of any inside storage rooms, such as having fire protective walls (where required) and an appropriate ventilation system (OSHA Technical Manual [OTM], Section III, Chapter 3, Ventilation Investigation, OSHA 1999).

vi. Cleaning areas

In these areas (II.B.1.ii) screeners and scalpers (Figure II.10) are designed to remove oversized objects and finer material (e.g., dusts) from shelled corn. Corn kernels may also be passed through a destoner. Older and malfunctioning devices can release a significant amount of dust that can create a dust cloud which could cause fires or explosions when disturbed and confined in the presence of an ignition source. Dust collectors must be maintained in optimal working condition to function effectively in removing any generated dust (III.C). The operating limits for the dust collector may be obtained by reviewing a standard operating procedure for the equipment or its manual to determine if it is functioning as designed.

vii. Bulk storage areas for grains

These include silos and other bulk storage areas (Figure II.9; Figure II.15). Dust clouds can be generated if equipment is not in good working order. Highly efficient dust collection and aspiration systems are needed (III.C; IV.E; IV.F), Class II electrical equipment and wiring must be installed, a hot work program must be implemented, smoking must be prohibited, and proper bonding and grounding for processing equipment must be utilized, if applicable. Safety precautions to protect workers from engulfment hazards (III.D; IV.G; IV.H; IV.I) and confined space hazards (III.G; IV.P; IV.Q; IV.R) must be implemented in these areas (as applicable).

viii. Transfer points

Transfer points, such as enclosed belt conveyors (Figure III.3) and bucket elevators move large quantities of solid materials and dusts (III.C; IV.E; IV.F). Safety measures that can be implemented to prevent fires/explosions at transfer points include installing temperature sensors to monitor equipment temperature; maintaining a proper belt alignment on the bearing to help increase efficiency and reduce heat caused by friction; and equipping conveyor belts that are completely enclosed with a dust collection system (Imperial Sugar Company Dust Explosion and Fire (2/7/08), U.S. CSB Investigation). Electrical wiring and equipment (e.g., chutes, bucket elevators, and conveyor belts) must be designed for Hazard Class II locations (dust ignition proof) to prevent an explosion and/or ignition (29 CFR 1910.307(c); Hazardous (Classified) Locations, Construction Safety and Health Outreach Program webpage, OSHA, 1996a).

ix. Dryers

Safety measures include automatic suppression systems that detect pressure rises in the equipment (Figure II.18) and inject inert materials to suppress an explosion; explosion relief venting that detects a rise in pressure and opens to vent heated gases outside (NFPA 69); dust tight equipment design; automatic system to detect sparks and smoldering materials, for example, in the ductwork on the outlet of unit operations suspected of causing sparks or smoldering; and, a control system for maintaining the dryer's temperature within prescribed limits.

x. Grinding/milling area

Grinding/milling (II.B.1.iii) reduces feedstock materials into smaller particle sizes of corn flour, therefore there is a potential to generate large amounts of dust. The key to avoiding fires and explosions is to prevent ignition sources from entering the equipment (Figure II.11), such as tramp metal that might be inadvertently conveyed inside the mill along with the feedstock. Implement the same precautions as for dryers in VI.B.1.ix above.

xi. Liquefaction

Toxic enzyme, alpha-amylase is used in this phase (II.B.1.iv) to convert corn starch into dextrins. Exposure to alpha-amylase is associated with increased risk for respiratory effects, such as occupational asthma, in exposed workers. Also reported are exposure-related symptoms in the eyes (e.g., itchiness) and nose (e.g., blockage, sneezing), as well as allergic reactions in those who are more sensitized to its effects. At this time, OSHA has no permissible exposure limit (PEL) for alpha-amylase.

xii. Saccharification

There are various hazardous chemicals (III.F; IV.M; IV.N; IV.O) used in this phase (II.B.1.v) including sulfuric acid. Proper procedures should be in place to protect workers from exposure to hazardous chemicals (VI.B.1.xv, below).

xiii. Fermentation

Carbon dioxide (CO_2) may be released into the atmosphere during an overpressure event in the fermentation phase (II.B.1.vi). This can be prevented by properly venting the equipment (Figure II.12) and piping network. However, facilities will generally include scrubbers and other devices to ensure that any gaseous ethanol in the CO_2 exhaust system is captured and returned to the process. Failure to control potentially dangerous chemical reactions may lead to the rupture of equipment and pipes; cause explosions and fires; and, expose workers to hazardous chemicals. Equipment may rupture (III.B; IV.C; IV.D) due to age deterioration, if it is not properly designed or maintained in good condition. Smoking must be prohibited in work areas where flammability and/or explosion hazards exist. It is also critical that there is an effective permit issuing process in areas where flammability and/or explosion hazards exist to ensure that safety procedures are implemented before starting any hot work, for example, welding operations (IV.B). Other engineering controls include: controlling the rate and sequence of chemical addition; providing robust cooling; segregating incompatible materials to prevent inadvertent mixing; and using detailed operating procedures to keep the process within safe limits. The appropriate PPE must also be provided to workers when needed.

xiv. Denaturing of ethanol

At facilities that manufacture ethanol for fuels, the ethanol is denatured with conventional gasoline before storing it in tanks. Workers should be cautious of flammable headspace vapors in tanks (III.A; IV.A).

xv. Hazardous chemicals

Biofuels and the chemicals used (Table III.1) in the manufacturing process present potential exposure hazards (III.F; IV.M; IV.N; IV.O) that must be eliminated or carefully controlled to safe levels to protect workers' safety and healthSDSs/MSDSs must be consulted to determine the hazards of exposure to feedstocks, products, and other hazardous chemicals used in biofuel processes, including, but not limited to, methanol, sulfuric acid, and ethanol, as well as hydrocarbons used for blending and alcohol denaturing, e.g., gasoline. Workers must also be protected from exposure to benzene, an important hazardous constituent of gasoline (29 CFR 1910.1028; 29 CFR 1926.1128).

xvi. Temporary Structures and Permanent Buildings

Temporary employee-occupied structures include trailers that by virtue of their location expose workers to potential hazards (e.g., fires, explosions, overpressures, toxic or corrosive materials) or that risk being damaged by process equipment from other locations (e.g., toppling of equipment onto occupied structures). Both temporary and permanent structures within the facility must be evaluated for compliance with proper facility layout/siting. PSM covered facilities must implement process hazard analysis that includes facility siting information, such as a blast study (VI.B).

xvii. Dehydration

There are significant hazards associated with operating the molecular sieve beds, especially in regenerating them, which is generally done using hot nitrogen or another inert gas. It is easy to have fires or explosions in these vessels unless their operation is precisely sequenced. It is necessary to review appropriate documentation (e.g., operating manuals, equipment manuals, operating procedures, incident reports, and maintenance records) to determine if the equipment is being properly operated and maintained in good working condition by trained workers.