

Ethanol Manufacturing Facility Response Overview



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I. Purpose

The purpose of this document is to provide useful planning and response information to the Region 5 United States Environmental Protection Agency (U.S. EPA) regarding ethanol manufacturing facilities. The growing demand for alternative fuels has led to the rapid development of biofuels manufacturing facilities in the U.S.; many of which are located or will be sited in Region 5. Therefore, U.S. EPA has identified a need to advise responders on the implications regarding potential material and chemical storage and implications of a release from an ethanol manufacturing facility. This document contains information specific to ethanol manufacturing facilities and is meant to provide an overall understanding of the ethanol manufacturing process including the potential chemicals involved, response measures for the chemicals involved, and Federal regulations applicable to these facilities.

II. Description of Ethanol Fuel and the Ethanol Production Process

Ethanol, which contains hydrogen, carbon, and oxygen in its chemical structure, is also known as ethyl alcohol or grain alcohol. Ethanol can be used as a fuel for spark-ignited internal combustion engines. When burned in engines without active catalytic converters on the engine exhaust, the presence of oxygen allows ethanol to burn with lower carbon monoxide emissions than gasoline, although aldehyde emissions tend to be higher. Ethanol plants can produce significant air emissions including volatile organic compounds (VOCs), hydrogen sulfide, sulfur dioxide, nitrogen oxides, hazardous air pollutants and particulate matter.

In the U.S., ethanol is primarily produced from corn. The ethanol production process takes place through two methods: dry milling and wet milling. The dry milling method is more common and accounts for about 80 percent (%) of U.S. ethanol production.

In the dry milling method, the entire corn kernel is ground into flour, which is referred to in the industry as "meal." The meal, which is processed without separating out the various parts of the kernel, is then mixed with water to form a "mash." Enzymes are added to the mash to convert the starch to dextrose, a simple sugar. The mash is then processed in a high-temperature cooker to reduce bacteria levels ahead of fermentation. The mash is cooled and transferred to fermenters where yeast is added and the conversion of sugar to ethanol and carbon dioxide begins. Ammonia or sodium hydroxide is also added for pH control and as a nutrient to the yeast.

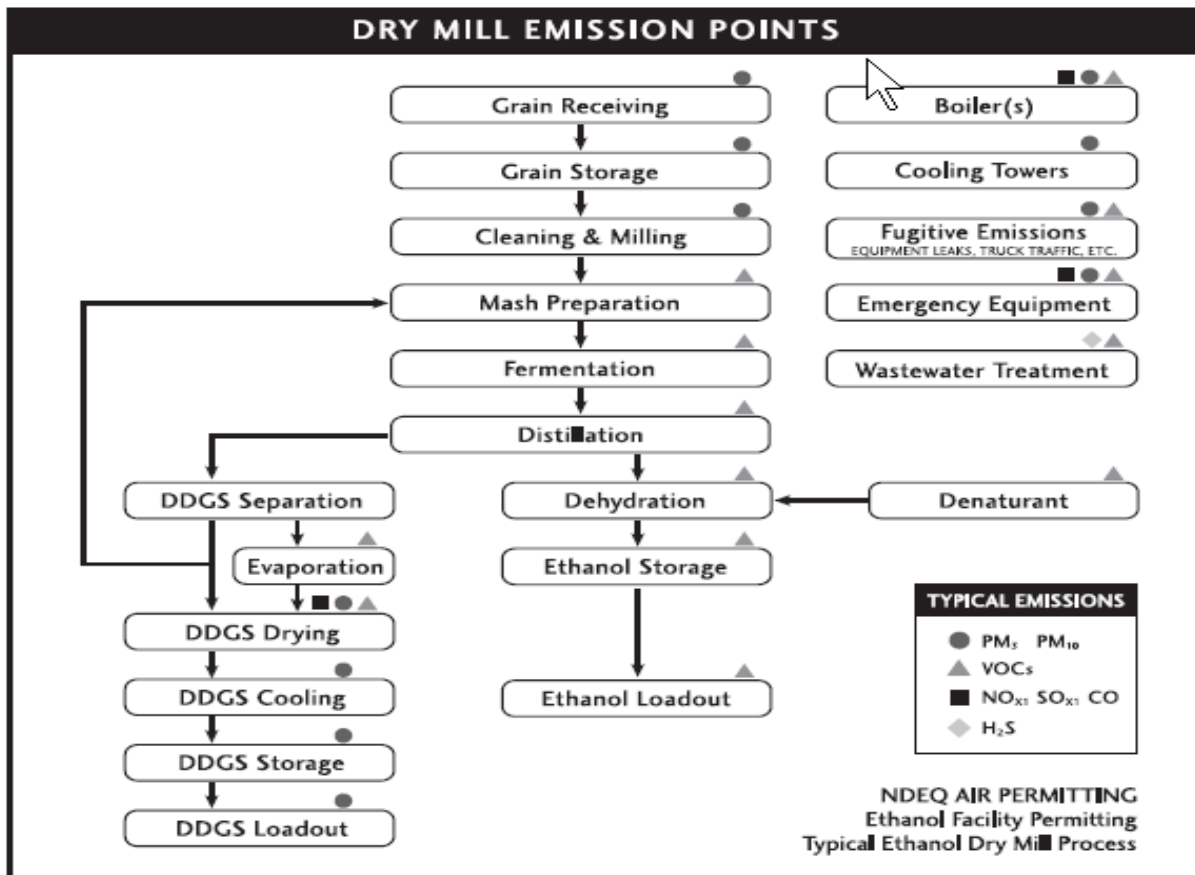
The fermentation process generally takes about 40 to 50 hours. During this part of the process, the mash is agitated and kept cool to facilitate the activity of the yeast. After fermentation, the resulting material is transferred to distillation columns where the ethanol is separated from the remaining "stillage." The ethanol is concentrated to 190 proof using conventional distillation, and then is dehydrated to approximately 200 proof in a molecular sieve system.

The liquid fraction ("stillage") remaining after ethanol production is centrifuged to remove and separate solids. The solid is referred to as wet distillers grains (WDG). The remaining liquid fraction ("thin stillage" containing 5-10% solids) is partially re-used as process water and/or evaporated and concentrated into a "syrup". The solids portion may be processed and sold for livestock feed as follows:

- Wet as WDG;
- Dried and sold as dried distillers grains (DGS);
- Combined with the syrup and sold as WDG with solubles (WDGS); or
- Combined with the syrup, dried and sold as DGS with solubles (DDGS).

The thin stillage and syrup may also be sold directly as livestock feed.

The principal steps in the dry milling process are summarized in Figure 1.



Source: Nebraska Department of Environmental Quality
 CO – carbon monoxide
 DDGS - Dried Distillers Grains with Solubles
 H₂S – hydrogen sulfide
 NO_x – oxides of nitrogen

PM₅ – particulate matter less than five micrometers
 PM₁₀ – particulate matter less than ten micrometers
 SO_x – oxides of sulfur
 VOCs – volatile organic compounds

Figure 1. Major Steps in the Dry Milling Process and Associated Air Emissions

In the wet milling method, the grain is soaked or "steeped" in water and dilute sulfurous acid for 24 to 48 hours. This steeping process (along with the use of centrifugal, screen, and hydroclonic separators) separate the grain into its many component parts of starch, germ, fiber, and protein. The starch resulting from these two processes is then turned into ethanol through a fermentation process that is very similar to the dry mill process described above.

The anhydrous ethanol produced by either process is then blended with about 5% denaturant (such as natural gasoline) to render it undrinkable and thus not subject to the excise tax on beverage alcohol. The fuel ethanol is then ready for shipment to gasoline terminals or retailers. The presence of 2-15% gasoline in the fuel ethanol is significant from a fire hazard point of view because the volatility of the ethanol-gasoline mixture is significantly greater than that of ethanol alone, leading to ignition hazard characteristics that are more like gasoline than ethanol.

Another consideration in reviewing ethanol plant operations derives from the fact that, particularly for the wet-milling process, it is not too difficult to arrange the plant to produce corn syrup as a sweetener for commercial food products. In fact, some plants vary the relative amounts of ethanol production and corn syrup production according to the prevailing economics. The significance of this situation is that some additional materials and process streams may be present.

A list of industrial-scale ethanol fuel producers currently operating in Region 5 is provided in **Attachment A**.

III. Chemicals Involved in Ethanol Production

Table 1 summarizes the major components, byproducts, and products of the ethanol manufacturing process. Quantities produced, stored, or used vary by facility. An ethanol plant that produces 40 million gallons per year might have (as an order of magnitude example):

- A 100,000-gallon gasoline storage tank (for the denaturant)
- An 18,000-gallon anhydrous ammonia tank
- A 14,000-gallon tank containing 50% sodium hydroxide solution by weight
- A 7,000-gallon sulfuric acid tank
- Many 30,000-gallon rail cars of ethanol

Note that the materials listed in Table 1 are those used in normal, stable production. However, other material streams may be present as well, often as waste streams. For example, raw materials or products may be rejected because they are contaminated or do not meet specifications. In some cases these materials cannot be recycled and will need to be discarded. For example, periodically tanks and other vessels may need to be taken out of service and cleaned. Depending on the size and configuration of the vessel, this might involve washing down the sides with a high-pressure hose perhaps with some detergent, then pumping out the resulting liquid as waste. So the resulting waste stream may include not only the normal tank contents, but also detergent or just “sludge” that has built up over time. Another situation could occur if bacterial contamination is present and tanks or pipes are treated or cleaned to control the bacteria. A number of agents from antibiotics to sulfuric acid are used for this purpose. Given that some process tanks may be 50,000 gallons or more, the amount of rinse liquid could be significant.

TABLE 1: MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Used Product, Product, byproduct, or emission and purpose	Flammability (National Fire Protection Association)	LEL	UEL	I.P.	S.G.	V.P.	F.P.	pH	Solubility in Water	Color	Odor	IDLH	Comments
Corn	Used Product – base material used for producing ethanol	NA	NA	NA	NA	NA	NA	NA	NA	NA	Yellow	NA	NA	May form explosive mixture in air. Incompatibilities may include (for corn starch): oxidizers, acids, iodine, and alkalis.
Sodium Hydroxide	Used Product – pH control during the fermentation process.	0	NA	NA	NA	2.13	0 mmHg	NA	13-14	Miscible	Colorless to white	Odorless solid	10 mg/m ³	Non-combustible solid but when in contact with water may generate sufficient heat to ignite combustible materials. Incompatibilities: acids, organics, some metals (i.e. aluminum).
Ammonia	Used Product – pH control and yeast nutrient during the fermentation process.	1	15%	28%	10.18 e.V.	NA	8.5 atm	NA - gas	A 1 % solution in water has a pH of >13	At least 34%	None	Pungent	300 ppm	Incompatibilities: strong oxidizers, acids, halogens, salts of silver and zinc. Should be treated as a flammable gas.
Sulfuric Acid	Used Product – used along with water, to separate the corn into starch, germ, fiber, and protein.	0	NA	NA	NA	1.84	0.001 mmHg	NA	<1	Miscible	Clear to cloudy liquid	None	15 mg/m ³	Incompatibilities: organic materials, chlorates, carbides, fulminates, water (reacts violently), powdered metals. Contact with reactive metals (aluminum) may result in the generation of flammable hydrogen gas.

TABLE 1 (CONTINUED): MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Used Product, Product, byproduct, or emission and purpose	Flammability (National Fire Protection Association)	LEL	UEL	I.P.	S.G.	V.P.	F.P.	pH	Solubility in Water	Color	Odor	IDLH	Comments
Fuel for process heat	Used Product – heat source	2	Varies	Varies	Varies	Varies	Varies	Varies	NA	Slight	Colorless	Foul skunk-like odor (Natural gas) Diesel-like odor (Fuel oil)	Varies	Keep away from high heat, strong oxidizing agents and sources of ignition.
Yeast	Used Product – used in fermentation process	1 (for yeast extract)	NA	NA	NA	NA	NA	NA	NA	Soluble	Yellow-white	NA	NA	May form explosive mixture in air. May be a genetically engineered variety that is not approved for food-related use. Incompatibilities: strong oxidizers.
Enzymes (amylase)	Used product – used for conversion of starch to dextrose	NA	NA	NA	NA	NA	NA	NA	NA	Soluble	Light brown or off-white powder	NA	NA	Enzymes may induce sensitization and allergic reactions in sensitized individuals. Enzymes may not be approved for use outside an industrial setting, so release into the general environment could be problematic.
Antibiotic such as penicillin	Used product – used for bacteria prevention in fermentation process	NA	NA	NA	NA	NA	NA	NA	NA	Soluble	White or off-white powder	NA	NA	A release could result in human exposure or be problematic in the environment by upsetting microbial balances. Incompatible with strong oxidizers

TABLE 1 (CONTINUED): MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Used Product, Product, byproduct, or emission and purpose	Flammability (National Fire Protection Association)	LEL	UEL	I.P.	S.G.	V.P.	F.P.	pH	Solubility in Water	Color	Odor	IDLH	Comments
Carbon Dioxide	Byproduct – captured and sold for use in carbonated beverages or in the production of dry ice.	0	NA	NA	13.77 e.V.	NA	56.5 atm	NA	NA	High, 0.145 grams per milliliter at 77 °F	None	None	40,000 ppm	Incompatibilities: dusts of various metals. Forms carbonic acid in water.
Hydrogen Sulfide	Emission	4	4.0%	44.0%	10.46 e.V.	NA	17.6 atm	NA - gas	NA	Soluble	None	Similar to rotten eggs	100 ppm	Incompatibilities: strong oxidizers, strong nitric acid, metals.
Sulfur dioxide	Emission	0	NA	NA	12.3 e.V.	NA	3.2 atm	NA	NA	Soluble	None	Highly irritating pungent odor	100 ppm	Incompatibilities: powdered alkali metals, water, ammonia. Reacts with water to form sulfurous acid.

TABLE 1 (CONTINUED): MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Used Product, Product, byproduct, or emission and purpose	Flammability (National Fire Protection Association)	LEL	UEL	I.P.	S.G.	V.P.	F.P.	pH	Solubility in Water	Color	Odor	IDLH	Comments
Nitric oxide	Emission	0	NA	NA	9.27 e.V.	NA	34.2 atm	NA	N/A	7.4%	None	Irritating odor	100 ppm	Nitric Oxide is extremely toxic by inhalation, and symptoms of overexposure may not become apparent for up to 72 hours. Exposure to the rapidly expanding gas can cause frostbite. The gas is an oxidizer and will support and enhance combustion. The gas can react with oxygen (in air) to generate nitrogen dioxide. Incompatibilities: fluorine, combustible materials, ozone, chlorinated hydrocarbons, metals. Reacts with water to form acid.
VOCs	Emission	Varies	Varies	Varies	Varies	Varies	Varies	Varies	Varies	Varies	None	Varies	Varies	Includes, but is not limited to, acetaldehyde, acrolein, ethanol, formaldehyde, 2-furaldehyde, methanol, acetic acid, and lactic acid.

TABLE 1 (CONTINUED): MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Used Product, Product, byproduct, or emission and purpose	Flammability (National Fire Protection Association)	LEL	UEL	I.P.	S.G.	V.P.	F.P.	pH	Solubility in Water	Color	Odor	IDLH	Comments
Thin Stillage or "Syrup"	Co-products/ Recyclable as Feedstock	NA	NA	NA	NA	NA	NA	NA	<5	Soluble	Yellow or golden brown	Sweet	NA	
Ethanol	Final Product	3	3.3%	19%	10.47 e.V.	0.79	44 mmHg	55 °F	NA	Miscible	None	Mild, similar to wine	3,300 ppm	Incompatibilities: strong oxidizers, potassium dioxide, bromine pentafluoride, acetyl bromide, acetyl chloride, platinum, sodium.
Gasoline	Final Product Additive – used for denaturing	3	1.4%	7.6%	9.24 e.V.- benzene	0.72	38-300 mmHg	-45 °F	NA	Insoluble but some component products will go into dissolved phase	Clear/ orange	Hydro-carbon odor	500 ppm - benzene	Incompatibilities: strong oxidizers.
Denatured Ethanol – if gasoline used	Final Product - blended	3	1.4%	19%	9.24 e.V. - benzene	0.70-0.77	43-776 mmHg	-45 °F	NA	Partially	Light golden brown	Hydro-carbon odor	500 ppm - benzene	Incompatibilities: strong oxidizers, potassium dioxide, bromine pentafluoride, acetyl bromide, acetyl chloride, platinum, sodium.

Atm - atmospheres
 °F – degrees Fahrenheit
 e.V. – electron volts
 F.P. – flash point

IDLH - Immediately Dangerous to Life and Health
 IP – ionization potential
 LEL – lower explosive limit
 mg/m3 – milligrams per cubic meter

mmHg – millimeters mercury
 NA – not applicable or information not available
 % - percent
 ppm – parts per million
 S.G. – specific gravity

UEL – upper explosive limit
 V.P. – vapor pressure
 < - less than
 > - greater than

The sources of process heat, and therefore the chemical properties will vary by facility. Facility-specific information must be obtained to determine source.

Note: Remember to account for correction factors for PID and LEL sensors when using the standard air monitoring device (Multi-RAE)

Note: The National Fire Protection Association ratings are on a 0 to 4 scale with 4 being the most flammable.

IV. Types of Potential Releases

Causes

Chemical releases may result from a variety of causes. Some examples of the causes are:

- **Containment failures.** Possible containment failures range from small, e.g. drips from a leaking fitting to large, e.g. loss of the contents of an entire tank or reactor. The size of containment units will vary by facility depending on the scale of production. For example, if the ethanol product at a facility is shipped in 30,000-gallon capacity rail cars, there must be tankage at the facility sufficient to fill one or more rail cars.
- **Process upsets.** Process upsets are often the result of operator error. If the process design is adequate, safety relief valves will prevent equipment failures and vent streams will be directed to safe locations. The ability of the equipment to function properly or shut down properly in the event of an evacuation or incident depends primarily on the control system i.e. how automated it is, whether or not it has fail safe design, and how much damage it may have sustained. If the control system is not functional then process operations and upsets will likely continue until they can be manually shut down. But if the system is well designed, equipment should be automatically shut down in an orderly manner.
- **Equipment malfunctions.** Equipment malfunctions include a wide variety of conditions from inoperable sensors, pumps that fail to pump, valves that fail to close or open, broken or jammed equipment, or clogged pipes.
- **Loss of utilities.** The most obvious utility loss is an electrical power failure, though for some plants, loss of cooling water supply may be a risk. The location of some ethanol processing plants in rural areas may make them more susceptible to loss of utilities.
- **Unexpected chemical reactions.** While the chemistry of ethanol production is relatively old and quite well known, there is always the possibility that an unexpected chemical reaction may occur. For processes like ethanol production that are well-understood, the most common causes of unexpected chemical reactions are mislabeling, mishandling of materials, or mistaken delivery of materials, or the use of contaminated materials.
- **Transportation Accidents.** Ethanol production facilities generally have very active traffic in tanker trucks and railcars; resulting in a potentially increased incidence for collisions, derailments, etc. and the consequences thereof should be examined carefully.
- **Pollution Control Equipment.** Ethanol production plants generally have high-temperature thermal oxidizers to control VOC emissions. Experience has shown that fires can occur in this equipment.
- **Illegal Activities.** Like any other chemical process, ethanol production results in waste streams. Like any competitive business, there will always be a temptation for operators to be less than diligent about waste disposal. Thus, materials used in production may be dumped illegally, resulting in a deliberate release or spill. In such cases it is likely that the material spilled will be off-spec, contaminated, a rinse liquid, or some other material with little or no economic value.

Consequences

Whatever the cause of a release at an ethanol facility, the seriousness of the release is dependent on the amount of inventory of material on site. This will vary with the scale of the process, and the amount of storage provided. Consequences of an ethanol facility release could range from relatively minor (small releases contained on site) to very significant (large quantities released affecting off site areas or an explosion or fire). The assessment of the amounts of various materials typically stored at ethanol production plants is an area where further facility-specific information gathering is needed. Several fire outbreaks have been documented at ethanol production plants.

Industrial-scale facilities are subject to many of the regulations summarized in Section VIII including hazardous substance storage and reporting requirements. Therefore, local first responders should have

industrial-scale facility information on file for those within their response jurisdiction if the proper reporting requirements are being followed. The facilities subject to reporting requirements must have product quantity and storage information on-site to be in compliance with applicable regulations.

V. Response to a Release

The response to releases depends on the size, location, and nature of the release. In general, identification of the material being released is often the first and most essential task. In this respect, labeled tanks or containers (at a minimum with NFPA hazard codes) would be most useful. It would also be useful to produce a color reference card that shows photos of various materials as typically shipped and also the typical appearance of the spilled material.

Sodium hydroxide releases a large amount of heat when reacted with water. Because of the amount of heat released, steam may be formed that can result in the dispersal of the hydroxide through spattering or forming a mist.

In the case of fire, the main issue is that accidental fires rarely have an adequate amount of oxygen delivered to the fuel to achieve complete combustion. Thus, in addition to the oxides of nitrogen formed by all types of combustion in air, the partial combustion results in the emissions of carbon monoxide, unburned fuel, partially burned fuel, and soot. The amount of such emissions varies widely depending on the geometry and circumstances of the fire. Data on the amounts of various air pollutants produced by accidental fires in process plants are sparse to non-existent, and in any case, the differences in circumstances are such that data from one incident will not have much applicability.

Table 2 provides general response procedures for releases of the primary products used, byproducts and final products generated at an ethanol manufacturing facility. When responding to an ethanol facility where ethanol or denatured ethanol has been released, the situation in general should be treated the same as a gasoline fuel spill with respect to the flammability and toxicity hazards and the need to mitigate/capture product, but the response needs are different. One primary factor to consider is that response equipment (such as absorbents and fire-fighting foams) must be alcohol-resistant. Traditional gasoline fire-fighting foams will not be effective on pure or denatured ethanol. The Ethanol Emergency Response Coalition has determined the most effective fire-fighting foam to be alcohol-resistant, aqueous film-forming foam (AR-AFFF). A video demonstrating an ethanol fire can be downloaded from the website: <http://www.dtnethanolcenter.com/index.cfm?show=10&mid=62>.

Although ethanol will rapidly biodegrade in water, the degradation process can lower the amount of dissolved oxygen (DO) in an aquatic system resulting in fish kills. Further, ethanol is toxic to fish and other aquatic and terrestrial organisms at high enough concentrations. Fuel ethanol is heavier than gasoline and miscible in water; further, the ethanol will separate from the gasoline in high enough concentrations of water. Therefore absorbents will not be as effective in capturing/recovering the product in the event of a release to surface water. Product recovery efforts from surface water must be done quickly to maximize the amount of product recovered. Prevention of the discharge of ethanol or denatured ethanol to surface water through rapid containment of the spill or excavation of contaminated soils, if there is potential for migration to groundwater or surface water, must be a high priority. Other concerns include the potential for ethanol to transport the components of gasoline (i.e. benzene) through groundwater and surface water and to spread the floating product or sheet over a larger area due to ethanol's solvency with gasoline components and water.

Ammonia is used as a nutrient in the ethanol production process. Ammonia is also quite toxic to fish. Therefore, spills of process liquids containing ammonia are apt to present an environmental hazard to fish if these materials enter a lake or stream.

A few response actions that could be taken in the event of a spill included the installation of earth dams to stop all liquid mitigation, aeration in a affected waterway while monitoring DO and chemical oxygen demand, slow release of treated surface water once in stream treatment is complete and removal of the waste by pumping for on or off site disposal or treatment.

While process emissions might not necessarily be considered chemicals of concern in the ethanol manufacturing process, it is important for responders to know that these gasses may be present at the facility especially in the event of pollution control equipment malfunction.

Denatured ethanol is regulated under the Oil Pollution Act of 1990 (OPA 90) depending on the denaturant. The Region 5 Oil and Hazardous Substances Integrated Contingency Plan (ICP) provides specific action that should be used when responding to an oil or hazardous materials incident. (<http://www.great-lakes.net/partners/epa/acp-rcp/>).

TABLE 2: APPROPRIATE MITIGATION MEASURES FOR RELEASES OF MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemical	Proper Air Monitoring Equipment	Proper Spill Containment
Sodium Hydroxide	Sodium hydroxide is non volatile; however flakes and particulates may become airborne and particulate monitoring is recommended.	Ventilate area. Pick up spilled contents and containerize the contents by using a method to minimize particulate generation. Spill residues can be diluted with water and neutralized with acetic acid, hydrochloric acid, or sulfuric acid, and then absorbed with inert materials. Waste generated from the clean-up may meet the corrosivity characteristic for hazardous waste.
Ammonia	Dräger tubes: (1) Ammonia 0.25/a (0.25 -3 parts per million [ppm]) (2) Ammonia 5/b (5-100 ppm)	Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Residues from spills can be diluted with water, neutralized with dilute acid such as acetic, hydrochloric or sulfuric (when diluted with water). Absorb neutralized caustic residue on clay, vermiculite or other inert substance and package in a suitable container for disposal. Prevent entry into waterways, sewers, basements or confined areas. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Isolate area until gas has dispersed. Waste generated from the clean-up may exhibit one or more characteristics of hazardous waste.
Sulfuric Acid	Dräger tubes : Sulfuric Acid 1/a (1-5 ppm)	Hazardous concentrations in the air may be found in the local spill area and immediately downwind. DO NOT PUT WATER DIRECTLY ON THIS PRODUCT , as heat evolution may occur that could cause a violent reaction. Stop the source of the leak if it is safe to do so and if proper safety equipment is available. Evacuate the immediate area of the spill and, if necessary, down-wind of the sulfuric acid release. Spills can be neutralized with alkaline materials (lime/soda ash). Do not use combustible materials to contain spill. For a release into a body of water: This material is heavier than water, and is soluble in water. Divert all water flow to a containment area for treatment. Notify other water users of possible contamination and proceed to clean up via vacuuming liquid or neutralizing, as necessary. For a release onto land: Contain by creating a trench or dike, made of soil, sand, or other compatible materials. Accumulated liquid may be recovered via use of a vacuum truck or by pumping into a compatible and approved storage container. Waste generated from the clean-up may meet the corrosivity characteristic for hazardous waste.
Fuel for process heat (Natural gas, propane, or fuel oil)	For fire-hazard assessment: a combustible gas indicator (CGI). Remember to account for correction factors when using air monitoring equipment	Ventilate the area of the leak or spill. Remove all sources of ignition. Contain and stop the source of the spill. Use sorbent spill material to clean up contents on surfaces or deploy booms for surface water releases.

TABLE 2 (CONTINUED): APPROPRIATE MITIGATION MEASURES FOR RELEASES OF MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemical	Proper Air Monitoring Equipment	Proper Spill Containment
Carbon Dioxide	Dräger tubes: Carbon Dioxide 100/a (100-3000 ppm)	Ventilate the area. Stop leak if you can do it without risk. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Do not direct water at spill or source of leak. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Allow substance to evaporate. CAUTION: When in contact with refrigerated/cryogenic liquids, many materials become brittle and are likely to break without warning.
Hydrogen Sulfide (emission)	MultiRAE Plus Five-Gas Air Monitoring Instrument with hydrogen sulfide sensor. Remember to account for correction factors when using air monitoring equipment	Eliminate all ignition sources (no smoking, flares, sparks or flames in immediate area). All equipment used when handling the product must be grounded. Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Stop leak if you can do it without risk. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Do not direct water at spill or source of leak. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Isolate area until gas has dispersed. Consider igniting spill or leak to eliminate toxic gas concerns.
Sulfur dioxide (emission)	Dräger tubes: Sulfur Dioxide 0.5/a (1-25 ppm: 3 min.) (0.5-5.0 ppm: 6 min.)	Responders should wear fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Do not touch or walk through spilled material. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Do not direct water at spill or source of leak. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Isolate area until gas has dispersed.
Nitric oxide (emission)	Dräger tubes: Nitrous Fumes 2/a (2-100 ppm) Note: This tube monitors simultaneously for nitric oxide and nitrogen dioxide OR Sensidyne tubes: Nitric Oxide (0.5-30 ppm). (Note: These tubes are only compatible with an AP-20S Kitagawa Pump.)	Fully encapsulating, vapor protective clothing should be worn for spills and leaks with no fire. Do not touch or walk through spilled material. Keep combustibles (wood, paper, oil, etc.) away from spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors or divert vapor cloud drift. Avoid allowing water runoff to contact spilled material. Do not direct water at spill or source of leak. If possible, turn leaking containers so that gas escapes rather than liquid. Prevent entry into waterways, sewers, basements or confined areas. Isolate area until gas has dispersed. Ventilate the area.

TABLE 2 (CONCLUDED): APPROPRIATE MITIGATION MEASURES FOR RELEASES OF MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemical	Proper Air Monitoring Equipment	Proper Spill Containment
VOCs (emission)	Flame ionizing detector (FID) such as a TVA 1000; and a CGI. Remember to account for correction factors when using air monitoring equipment	Properly ventilate and monitor area for toxic vapors and hazardous conditions. Response approach will depend on the VOCs emitted.
Thin Stillage or “Syrup”	Not Applicable	Use absorbent materials or mechanized product recovery to contain surface spills. Avoid entry into sewers and waterways due to potential aquatic toxicity and microbial upsets at wastewater treatment plants as a result of lowered dissolved oxygen (DO), elevated ammonia/nitrate concentrations, and low pH. Evaluate surface water removal and treatment and/or in-situ aeration as mitigation measures. Do not store recovered product or absorbent material near oxidizers.
Ethanol	CGI and FID or MultiRAE Plus Five-Gas Air Monitoring Instrument; photo ionizing detector (PID). DO Meter. Remember to account for correction factors when using air monitoring equipment	Ventilate area and eliminate ignition sources. Containment/response should follow typical containment procedures; use non-combustible oil-dry, absorbent socks, booms, etc that are alcohol-resistant; do not store soaked materials near combustibles. Avoid entry into sewers and waterways due to flammability hazards, potential aquatic toxicity, and potential microbial upsets at wastewater treatment plants. Waste generated from the clean-up may exhibit the flammability characteristic for hazardous waste. The DO Meter will monitor the DO levels in waterways.
Gasoline	MultiRAE Plus Five-Gas Air Monitoring Instrument (PID). Remember to account for correction factors when using air monitoring equipment	Ventilate area and eliminate ignition sources. Containment/response should follow typical oil containment procedures; use oil-dry, absorbent socks, booms, etc; do not store soaked materials near combustibles. Avoid entry into sewers and waterways. Waste generated from the clean-up may exhibit the flammability characteristic for hazardous waste.

Note: Always review instrument-specific response factors for chemicals of concern when using a PID to determine action levels

VI. Environmental Receptors and Concerns

Table 3 summarizes the expected fate of the primary ethanol manufacturing products and byproducts.

TABLE 3: EXPECTED FATE OF THE MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Release in Soil	Release in Water	Release in Air as result of spill/fire	Release to storm/sanitary sewers
Sodium Hydroxide	Separates into sodium cations and hydroxide anions when it comes into contact with moisture.	Separates in water to sodium cations and hydroxide anions, which ultimately decrease the acidity of the water. May give off heat with water contact.	Breaks down readily in the atmosphere by reacting with other chemicals. Dangerous gases may accumulate in confined spaces. Incompatible with combustible materials, acids, halo carbons, metals, halogens, oxidizing materials, peroxides, metal salts. Thermal decomposition products are oxides of sodium.	Separates in water to form sodium cations and hydroxide anions which can make the water highly basic and corrosive.
Ammonia	At normal environmental concentrations, ammonia does not have a very long residence time in soil. It is either rapidly taken up by plants, bioconverted by the microbial population, or volatilized to the atmosphere. Because of these processes, and because ammonia generally exists in soils as NH_4^+ (which binds to soils particles), ammonia does not leach readily through soil; thus, it is rarely found as a contaminant of groundwater. However, nitrate derived from ammonia may leach to groundwater.	Ammonia gas can be dissolved in water and increase pH. If released to surface water, ammonia can volatilize to the atmosphere or be taken up by aquatic plants.	In air, a dominant fate process for ammonia is the reaction with acid air pollutants. Hydrogen is released on heating above 850 °F. The decomposition temperature may be lowered to 575 °F by contact with certain metals such as nickel. At 1,290 °F or in the presence of an electric spark, ammonia decomposes into nitrogen and hydrogen gases, which may form a flammable mixture in the air. Ammonia has potentially explosive or violent reactions with interhalogens, strong oxidizers, Nitric Acid, Fluorine, and Nitrogen Oxide. Ammonia forms sensitive explosive mixtures with air and hydrocarbons, Ethanol and Silver Nitrate, and Chlorine; and explosive products are formed by the reaction of ammonia with Silver Chloride, Silver Oxide, Bromine, Iodine, Gold, Mercury, and Tellurium Halides. Ammonia is incompatible or has potentially hazardous reactions with Silver, Acetaldehyde, Acrolein, Boron, Halogens, Perchlorate, Chloric Acid, Chlorine Monoxide, Chlorites, Nitrogen Tetroxide, Tin, and Sulfur.	Ammonia gas can be dissolved in water and increase pH. Chlorination will produce chloramines.

**TABLE 3 (CONTINUED): EXPECTED FATE OF THE MAJOR COMPONENTS,
BYPRODUCTS, AND PRODUCTS THE ETHANOL MANUFACTURING PROCESS**

Chemicals	Release in Soil	Release in Water	Release in Air as result of spill/fire	Release to storm/sanitary sewers
Sulfuric Acid	In soil, the ions from sulfuric acid can adsorb to soil particles or leach into surface water and groundwater. Sulfates can be taken up by plants and be incorporated into the parenchyma of the plant.	Sulfuric acid in water separates to form hydrogen ions and sulfate. The ability of sulfuric acid to change the acidity (pH) of water is dependent on the amount of sulfuric acid and the ability of other substances in the water to neutralize the hydrogen ions (buffering capacity).	Sulfuric acid dissolves in the water in air and can remain suspended in air for varying periods of time, contributing to the formation of acid rain. Sulfates, including sulfuric acid, are removed from the air by both dry and wet deposition processes. Sulfur trioxide gas is a hazardous decomposition product. Concentrated sulfuric acid can ignite combustible materials on contact.	Concentrated sulfuric acid should be kept out of sewers as it can make the water highly acidic and corrosive.
Natural gas	No information found	Slightly soluble in water.	Dangerous fire and explosion hazard when exposed to heat, sparks or flame. Liquefied Natural Gas (LNG) releases flammable gas at well below ambient temperatures and readily forms a flammable mixture with air. Decomposition products include carbon monoxide, carbon dioxide and non-combusted hydrocarbons (smoke).	No information found
Propane	Releases are expected to cause only localized non-persistent environmental damage. The passage of odorized propane through soil because of an underground leak will also diminish or eliminate entirely the smell of odorized propane.	Slightly soluble in water.	Normal combustion produces carbon dioxide; incomplete combustion can produce carbon monoxide. Propane vapors will form explosive mixtures with air and will easily ignite by heat, sparks, flames, build-up of static electricity, and other sources of ignition. Note: Ethyl mercaptan might, under certain conditions (when oxygen, water, iron oxide or other oxidizers are present in containers and piping) react with oxidizers which diminish or eliminate entirely its distinct smell, thereby reducing or eliminating the ability of a person to detect a leak. Incompatible with strong alkalines and oxidizers such as chlorine (gas or liquid) and oxygen.	Waste mixtures containing these gases should not be allowed to enter drains or sewers where there is danger of vapors being ignited.

TABLE 3 (CONCLUDED): EXPECTED FATE OF THE MAJOR COMPONENTS, BYPRODUCTS, AND PRODUCTS OF THE ETHANOL MANUFACTURING PROCESS

Chemicals	Release in Soil	Release in Water	Release in Air as result of spill/fire	Release to storm/sanitary sewers
Gasoline	Small amounts of the chemicals present in gasoline evaporate into the air when gasoline is accidentally spilled onto surfaces and soils. Other chemicals in gasoline dissolve in water and leach into groundwater. A few will probably stick to soil.	Some chemicals in gasoline will evaporate when spilled onto surface water; others will dissolve. The chemicals that dissolve in water also break down quickly by natural processes.	Vapors may be ignited rapidly when exposed to heat, spark, open flame or other source of ignition. Flowing product may be ignited by self-generated static electricity. When mixed with air and exposed to an ignition source, flammable vapors can burn in the open or explode in confined spaces. Being heavier than air, vapors may travel long distances to an ignition source and flash back.	Runoff to sewers may cause fire or explosion hazard. Keep out of sewers and drainage ways.
Carbon Dioxide	No information found	No information found.	Carbon monoxide and oxygen are formed when heated above 3,092 °F. Carbonic acid is formed in the presence of moisture. Carbon dioxide is heavier than air and will accumulate in low areas.	No information found.
Thin Stillage or "Syrup"	No information found, but the product is expected to biodegrade rapidly in soil.	Soluble in water. Decreases in DO and/or pH can occur resulting in toxicity to aquatic life. Increases in ammonia and nitrate concentrations can occur to levels that are harmful to aquatic life. Expected to rapidly biodegrade.	No information found.	The potential decrease in DO and/or pH and addition of ammonia/nitrates as a result of a release can upset microbial functions at wastewater treatment plants.
Ethanol	Ethanol is rapidly biodegraded in soil.	Fuel ethanol will mix with water, but at high enough concentrations of water, the ethanol will separate from the gasoline. Ethanol is rapidly biodegraded in groundwater and surface water. However, some studies are focusing on the possibility of ethanol inducing the transport of other chemicals such as benzene.	Ethanol vapor, like gasoline vapor, is denser than air and tends to settle in low areas. However, ethanol vapor disperses rapidly.	Ethanol released to water will volatilize and rapidly biodegrade. The potential decrease in DO as a result of ethanol degradation can upset microbial functions at wastewater treatment plants. The potential flammability hazard must be addressed when ethanol is released to a sanitary or storm system.

VII. Overall Health Risks from a Release from an Ethanol Facility

This section addresses the immediate and long term human health and/or environment hazards associated with a release from an ethanol fuel facility.

Corn Condensed Distillers Solubles

- **Human Health Effects**

The inhalation of high airborne concentrations of this material, in its dry state, can result in congestion of the upper respiratory tract. There are no health hazards due to long term chronic exposure.

- **Ecological Effects**

No information available. However, secondary effects such as lowered DO when introduced to surface water can be toxic to aquatic life.

Sodium Hydroxide

- **Human Health Effects**

Sodium hydroxide is very corrosive and can cause severe burns in all tissues that come in contact with it. Inhalation of low levels of sodium hydroxide as dusts, mists or aerosols may cause irritation of the nose, throat, and respiratory airways. Inhalation of higher levels can produce swelling or spasms of the upper airway leading to obstruction and loss of measurable pulse; inflammation of the lungs and accumulation of fluid in the lungs may also occur. Ingestion of solid or liquid sodium hydroxide can cause spontaneous vomiting, chest and abdominal pain, and difficulty swallowing. Corrosive injury to the mouth, throat, esophagus, and stomach is very rapid and may result in perforation, hemorrhage, and narrowing of the gastrointestinal tract. Case reports indicate that death results from shock, infection of the corroded tissues, lung damage, or loss of measurable pulse.

Skin contact with sodium hydroxide can cause severe burns with deep ulcerations. Pain and irritation are evident within three minutes, but contact with dilute solutions may not cause symptoms for several hours. Contact with the eye may produce pain and irritation, and in severe cases, clouding of the eye and blindness.

Long-term exposure to sodium hydroxide in the air may lead to ulceration of the nasal passages and chronic skin irritation. Not classified for carcinogenicity or reproductive damage in humans. However, it is unknown if exposure to sodium hydroxide could affect reproduction in humans.

- **Ecological Effects**

Highly toxic to aquatic life. As a contaminant in surface water, the primary effect of sodium hydroxide would be to raise the pH. Not bioaccumulated.

Ammonia

- **Human Health Effects**

No health effects have been found in humans exposed to typical environmental concentrations of ammonia. Exposure to high levels of ammonia in air may be irritating to skin, eyes, throat, and lungs and cause coughing and burns. Lung damage and death may occur after exposure to very high concentrations of ammonia. Some people with asthma may be more sensitive to breathing ammonia than others.

Swallowing concentrated solutions of ammonia can cause burns in your mouth, throat, and stomach. Splashing ammonia into your eyes can cause burns and even blindness. Ammonia has not been classified for carcinogenicity.

- **Ecological Effects**

Ammonia is harmful to aquatic life in very low concentrations and may be hazardous if it enters water intakes. Waterfowl toxicity may occur at elevated concentrations. Ammonia does not concentrate in the food chain. The conversion of ammonia to nitrites/nitrates by bacteria in aquatic systems can reduce the concentration of DO (referred to as nitrogenous oxygen demand). Ammonia does not last very long in the environment. It is rapidly taken up by plants, bacteria, and animals. Ammonia does not build up in the food chain, but serves as a nutrient for plants and bacteria.

Sulfuric Acid

- **Human Health Effects**

Touching sulfuric acid will burn your skin, and breathing sulfuric acid can result in tooth erosion and respiratory tract irritation. Drinking sulfuric acid can burn your mouth, throat, and stomach; and can result in death. If you get sulfuric acid in your eyes, it will cause your eyes to water and will burn. People have been blinded by sulfuric acid when it was thrown in their faces.

People who have breathed large quantities of sulfuric acid at work have shown an increase in cancers of the larynx. However, most of the people were also smokers who were exposed to other chemicals and acids as well. The ability of sulfuric acid to cause cancer in laboratory animals has not been studied. The International Agency for Research on Cancer (IARC) has determined that occupational exposure to strong inorganic acid mists containing sulfuric acid is carcinogenic to humans. IARC has not classified pure sulfuric acid for its carcinogenic effects.

- **Ecological Effects**

Because sulfuric acid is a direct-acting toxicant, rather than a substance that causes toxic effects after being absorbed into the blood stream, bioavailability from different media is not an important issue for sulfur trioxide and sulfuric acid. Lethal doses for fish are 24.5 ppm/24 hour/bluegill/lethal/fresh water and 42.5 ppm/48 hour/prawn/lethal concentration 50% (LC50)/salt water. Sulfur is an important constituent of normal biomolecules. Food chain bioaccumulation is not an important issue for either sulfur trioxide or sulfuric acid. Once sulfuric acid enters the environment, the sulfur enters the natural sulfur cycle which is well defined.

Ethanol Fuel

- **Human Health Effects**

Exposure to fuel ethanol can occur by breathing its vapors (inhalation), getting it on the skin or in the eyes (skin absorption), or accidentally swallowing it (ingestion). The following symptoms of exposure to fuel ethanol may appear immediately: Dullness of memory and concentration; impaired motor coordination; and drowsiness, stupor, and finally coma. May cause skin irritation as a result of defatting. Carcinogenic compounds are not present in pure ethanol; however, because gasoline is used in the blend, E85 is considered to be potentially carcinogenic.

- **Ecological Effects**

Pure ethanol has demonstrated lethal concentrations for fish (rainbow trout) at 11,200 to 15,300 milligrams per liter (mg/L). Pure ethanol is expected to biodegrade rapidly and bioaccumulation or concentration in the food chain is not expected. However, the biodegradation may decrease the DO in surface water resulting in fish kills. Ethanol in water will create Chemical of Demand (COD) and Biological of Demand (BOD) which will lower DO levels.

Gasoline

- **Human Health Effects**

Many of the harmful effects seen after exposure to gasoline are due to the individual chemicals in the gasoline mixture, such as benzene. Inhaling or swallowing large amounts of gasoline can cause death. Inhaling high concentrations of gasoline is irritating to the lungs when breathed in and irritating to the lining of the stomach when swallowed. Gasoline is also a skin irritant. Breathing in high levels of gasoline for short periods or swallowing large amounts of gasoline may also cause harmful effects on the nervous system. Serious nervous system effects include coma and the inability to breathe, while less serious effects include dizziness and headaches.

There is not enough information available to determine if gasoline causes birth defects or affects reproduction. Automotive gasoline has not been classified for carcinogenicity. Some laboratory animals that breathed high concentrations of unleaded gasoline vapors continuously for 2 years developed liver and kidney tumors. However, there is no evidence that exposure to gasoline causes cancer in humans.

- **Ecological Effects**

Gasoline, as a mixture of hydrocarbons, does not bioaccumulate in the food chain per se. However, the individual components making up the mixture may bioaccumulate depending on their individual properties. In general, the alkenes (e.g., pentene, butene, hexene) will not tend to bioaccumulate; the aromatics have a moderate tendency to bioaccumulate; and the higher molecular weight alkanes will tend to bioaccumulate.

Carbon dioxide

- **Human Health Effects**

Carbon dioxide exposure can cause nausea and respiratory problems. High concentrations may cause vasodilatation leading to circulatory collapse. Carbon dioxide is the most powerful cerebral vasodilator known. Inhaling large concentrations causes rapid circulatory insufficiency leading to coma and death. Asphyxiation is likely to occur before the effects of carbon dioxide overexposure. Cold gas or liquid or solid carbon dioxide may cause severe frostbite. Chronic, harmful effects are not known from repeated inhalation of low concentrations. Low concentrations of carbon dioxide cause increased respiration and headache. Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals.

- **Ecological Effects**

This material is a normal atmospheric gas. Oxygen deficiency during pregnancy has produced developmental abnormalities in humans and experimental animals. Exposure of female rats to 60,000 ppm carbon dioxide for 24 hours has produced toxic effects to the embryo and fetus in pregnant rats. Toxic effects to the reproductive system have been observed in other mammalian species at similar concentrations.

VIII. Applicable Regulations

The following are Federal regulations that would apply to ethanol manufacturing facilities when they meet the thresholds for the requirements of the regulation. Note that state-specific regulations may also apply.

TABLE 4: SUMMARY OF APPLICABLE FEDERAL REGULATIONS

Act Establishing Regulation	Regulation	Overview of Regulation	Chemicals/Thresholds where Regulations Apply
Emergency Planning and Community Right Know ACT (EPCRA)	Sections 302 and 303	Facilities with regulated chemicals above threshold planning quantities to notify the state emergency response commission and the local emergency planning committee within 60 days after first receiving a shipment or production of the substance on site. The local emergency planning committees to prepare comprehensive emergency response plans.	Waste Ethanol, sodium hydroxide, anhydrous ammonia and sulfur dioxide and are considered hazardous chemicals.
Emergency Planning and Community Right Know ACT (EPCRA)	Sections 311-312 – Hazardous chemical reporting	Requires facilities storing hazard chemicals on site to report this to local emergency authorities - annual inventory (Tier II report) required for most facilities.	Waste Ethanol, sodium hydroxide, anhydrous ammonia, and sulfur dioxide are considered hazardous chemicals. The threshold planning quantity (TPQ) is for each chemical, not all chemicals combined.
Emergency Planning and Community Right Know ACT (EPCRA)	Section 304 – Emergency release notification	Facilities are required to report a release or discharge of a regulated chemical if it exceeds the chemical's reportable quantity (RQ) and crosses the facility property line.	- Extremely Hazardous Substances 40 Code of Federal Regulation (CFR); Part 355; Appendix A and B. - Comprehensive Environmental Response and Compensation Liability Act (CERCLA) hazardous substances 40 CFR Part 302; Table 302.4 (including Waste Ethanol, sodium hydroxide, anhydrous ammonia, and sulfur dioxide) -Oil.
Emergency Planning and Community Right Know ACT (EPCRA)	Section 313 – Toxic Release Inventory	An inventory is required of toxic chemical emissions from certain types of facilities. This inventory is called the Toxic Release Inventory (TRI) or Form R report.	Must report if: -More than 10 full time employees -Facility has specific standard industrial code (SIC) -Manufactures/processes or otherwise uses listed toxic chemicals in more than threshold quantities.
U.S. EPA Oil Pollution Prevention	Spill Prevention, Control and Countermeasures (SPCC) Plan - 40 CFR 112	Plan is required for facilities with above-ground aggregate storage capacity for oil or oil products of greater than 1,320 gallons.	You must consider total capacity of your tanks, containers, and system piping, not just the actual amount of oil stored. Containers less than 55 gallons in size are not included in this capacity.
Clean Water Act	National Pollution Discharge Elimination System (NPDES)	Those regulated must obtain a NPDES storm water permit and develop a storm water pollution prevention plan (SWPPP) that shows the steps taken to reduce or prevent storm water contamination.	Ethanol production plants fall under the major SIC industrial group 28 (2869). Discharges of process wastewater to storm water would require a permit.

TABLE 4 (CONTINUED): SUMMARY OF APPLICABLE FEDERAL REGULATIONS

Act Establishing Regulation	Regulation	Overview of Regulation	Chemicals/Thresholds where Regulations Apply
Clean Water Act - continued			
Resource Conservation and Recovery Act (RCRA)	RCRA Contingency Plan	Contingency Plan is required for Hazardous Waste Large Quantity Generators (LQGs)	LQGs must establish and maintain emergency procedures to mitigate fires, explosions, or other releases. Must provide plan to local and state emergency authorities and make arrangements to familiarize them with the facility. Waste generated during response to a release from an ethanol manufacturing facility may exhibit one or more characteristics of hazardous waste.
Oil Pollution Act of 1990 (OPA 90)	Liability for Releases of Oil to Surface Water	<p>On-shore facilities, deep water ports, and vessels from which oil is discharged or poses a threat of discharge are liable for damages/removal costs.</p> <p>Provides for spill contingency plans and mandates development of response plans for worst case discharge; and provides for requirements for spill removal equipment.</p> <p>States have the authority to impose OPA for navigable waters of the State.</p>	Applies to facilities that store or produce oil – including denatured ethanol, depending on the denaturant. Facilities with over a one million gallon storage capacity and/or are next to water must submit Facility Response Plans to U.S. EPA.
Clean Air Act (CAA)	<p>-The Clean Air Act Amendments of 1990</p> <p>- Section 112(r)(1) – Chemical Accident Provisions</p>	<p>-Major Source Title V Air Permit</p> <p>-Minor Source Air Permit</p> <p>General Duty Clause</p>	<p>An ethanol plant would need to obtain a Title V operating permit if the plant has the potential-to-emit quantities greater than 100 tons per year of any criteria or is a major source of hazardous air pollutants.</p> <p>The CAA general duty clause directs owners and operators of stationary sources to identify hazards that may result from accidental releases, to design and maintain a safe facility, and to minimize the consequences of releases when they occur</p>
DOT Hazardous Materials Regulations (HMR); as amended by Homeland Security Act of 2002	HM-232 – Transportation Security Plan	Facilities must develop and implement a security plan if they offer for transportation or transport regulated types or quantities of hazardous materials under the rule.	Applies to hazardous material in an amount that must be placarded in accordance with Subpart F of Part 172 of the HMR; a hazardous material in a bulk packaging having a capacity equal to or greater than 3,500 gallons for liquids or gases or more than 468 cubic feet for solids.

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ATTACHMENT A
INDUSTRIAL-SCALE ETHANOL FUEL PRODUCERS IN U.S. EPA REGION 5

Current Industrial-Scale Producers in U.S. EPA Region 5

Plant Name	City	State	Feedstock	Capacity *	Process	Start Date
Archer Daniels Midland	Peoria	Illinois	Corn	100	Dry	N/A
Illinois River Energy LLC	Rochelle	Illinois	Corn	50	Dry	Nov-06
Aventine Renewable Energy Inc.	Pekin	Illinois	Corn	160	Wet	1981
MGP Ingredients Inc.	Pekin	Illinois	Corn / Wheat Starch	78	Dry	Feb-80
Archer Daniels Midland	Decatur	Illinois	Corn	290	Wet	N/A
Lincolnland Agri-Energy LLC	Robinson	Illinois	Corn	45	Dry	Jul-04
Adkins Energy LLC	Lena	Illinois	Corn	43	Dry	Aug-02
Poet Biorefining-Portland	Portland	Indiana	Corn	60	Dry	N/A
Iroquois Bio-Energy Company LLC	Rensselaer	Indiana	Corn	40	Dry	Jan-07
New Energy Corp.	South Bend	Indiana	Corn	102	Dry	N/A
VeraSun Linden LLC	Linden	Indiana	Corn	100	Dry	Summer 2007
Grain Processing Corp.	Washington	Indiana	Corn	20	Wet	N/A
Central Indiana Ethanol LLC	Marion	Indiana	Corn	40	Dry	Mar-07
Andersons Clymers Ethanol LLC, The	Clymers	Indiana	Corn	110	Dry	N/A
Poet Biorefining-Caro	Caro	Michigan	Corn	50	Dry	2002
Andersons Albion Ethanol LLC, The	Albion	Michigan	Corn	55	Dry	2006
U.S. Bio Woodbury	Lake Odessa	Michigan	Corn	50	Dry	Sep-06
Midwest Grain Processors LLC	Riga	Michigan	Corn	57	Dry	Feb-07
Agri-Energy LLC	Luverne	Minnesota	Corn	21	Dry	Feb-99
Minnesota Energy	Buffalo Lake	Minnesota	Corn	18	Dry	N/A
Melrose Dairy Proteins LLC	Melrose	Minnesota	Cheese Whey	3	Wet	N/A
Poet Biorefining-Preston	Preston	Minnesota	Corn	46	Dry	1998
Poet Biorefining-Lake Crystal	Lake Crystal	Minnesota	Corn	56	Dry	May-05
Heron Lake BioEnergy LLC	Heron Lake	Minnesota	Corn	50	Dry	N/A
Central Minnesota Ethanol Co-op	Little Falls	Minnesota	Corn	20.5	Dry	Jan-99
Poet Biorefining-Glenville East	Albert Lea	Minnesota	Corn	45	Dry	1999
DENCO LLC	Morris	Minnesota	Corn	24	Dry	Sep-99
Granite Falls Energy LLC	Granite Falls	Minnesota	Corn	50	Dry	Nov-05
Bushmills Ethanol LLC	Atwater	Minnesota	Corn	49	Dry	Dec-05
Heartland Corn Products	Winthrop	Minnesota	Corn	95	Dry	N/A
Archer Daniels Midland	Marshall	Minnesota	Corn	40	Wet	N/A
AI-Corn Clean Fuel	Claremont	Minnesota	Corn	36	Dry	May-96
Chippewa Valley Ethanol Company LLL	Benson	Minnesota	Corn	45	Dry	1996
Corn Plus LLLP	Winnebago	Minnesota	Corn	44	Dry	Nov-94
Poet Biorefining-Bingham Lake	Bingham Lake	Minnesota	Corn	30	Dry	1997
United Ethanol LLC	Milton	Wisconsin	Corn	42	Dry	Jan-07
Badger State Ethanol LLC	Monroe	Wisconsin	Corn	55	Dry	2002
United Wisconsin Grain Producers LL	Friesland	Wisconsin	Corn	52	Dry	Apr-05
Ace Ethanol LLC	Stanley	Wisconsin	Corn	42	Dry	Jun-02
Utica Energy LLC	Utica	Wisconsin	Corn	52	Dry	Apr-03
Renew Energy LLC	Jefferson	Wisconsin	Corn	130	Dry	Jul-07
Western Wisconsin Energy LLC	Boyceville	Wisconsin	Corn	45	Dry	late fall 2006

Source: <http://www.ethanolproducer.com>

*Capacity is in Million gallons per year.

NA - not applicable