Instructor Manual
Module

7

General Health and Safety Considerations

Module Objective

Upon the completion of this module, participants should be able to determine the potential spill control methods, proper personal protective equipment (PPE), and detection and monitoring devices for responding to ethanol and ethanol-blended fuel incidents.

Enabling Objectives

1. Discuss the possible combinations of fuel/ ethanol-blended fuel spills.
2. Determine the tools/ personnel/ steps necessary to clean up spills of various fuels.
3. Identify devices for responding to ethanol and ethanol-blended fuel incidents.

Instructor Note:

Module Time: 30 minutes/ 55 minutes

Materials:

- Activity 7.1
  - Worksheet 7.1
- Emergency Response Considerations *video – (Show the video segment from 15:42 to 17:50)*

Instructor Note:

Show the video Emergency Response Considerations *(15:42 to 17:50).*

Instructor Note:

The video previously mentioned that dilution with water was not an effective tactic for ethanol and ethanol-fuel blend fires. Why is this true?

- ***Answer**: Ethanol diluted up to 500% (5:1 ratio) with water will still burn.*

Introduction

Understanding the properties and characteristics of both gasoline and ethanol will help emergency responders mitigate incidents involving ethanol-blended fuels. Gasoline blended with up to 10% ethanol will retain hydrocarbon fuel chemical characteristics. In an incident of this type absorbents and booms that are designed to pick up oil-type substance are effective. Blends with greater than 10% ethanol will start to take on polar solvent characteristics. If available absorbents and booms that are designed to pick up polar solvents should be used.

When water is introduced to a gasoline ethanol blend, phase separation may start to take place. Phase separation occurs after the fuel blend reaches the water saturation point. The water will then attract the ethanol and form a water/ethanol solution in the bottom of the tank. In this situation, an oil-type boom or absorbent will pick up the remaining gasoline on top leaving the water/ethanol solution.

https://www.youtube.com/watch?v=-o5D-nic9WM is a video of hydrocarbon and ethanol fuels burning.

Fuel Spill Control

It is important to recognize the various types of spill control measures that may be needed in an emergency response. Different tactics will be needed for land spills versus water spills. It is also important to recognize what type of spill containment products will be needed.

It is important to notify the appropriate local, state and/or Federal authorities having jurisdiction in an incident the event of a spill.

Best practices would be to establish good working relationships with these organizations who have statutory responsibilities and/or functional capabilities well in advance of an incident.

This ensures a more pro-active incident response instead of a reactive incident response which will place first responders and the community at a potentially greater risk.

Special Considerations

The water/ethanol solution can be picked up with water absorbing boom or absorbent. Keep in mind that depending on the water-to-ethanol ratio, the solution may still be flammable.

Also remember that if an AR foam blanket is used to contain the ethanol-blended fuel vapor, a portion of the foam solution will absorb into the ethanol-blended fuel, forming a solution that sinks below the gasoline level. This solution again will have water/ethanol properties, which will require a water-type boom or absorbent.

Initial Response Distances

The Initial response distances are established by the first emergency response unit arriving on the incident to protect the civilian population immediately. The Initial Isolation Distance (IID) is established, which is the radius of the initial isolation zone surrounding the spill in all directions. Then the Protective Action Distances (PAD) are used to establish downwind protection as soon as possible for the at-risk population.

Initial response distance and control zones are initially established using the U.S. DOT Emergency Response Guidebook.

Ethanol Scene Evaluation

Proper scene evaluation will assist in making the right choices for successful incident management and mitigation. Benchmarks that need to be considered are:

- Initial size-up
    - Life safety
    - Incident stabilization
    - Property environmental conservation
- Establish Unified Command
- Protect exposures
- Deny entry
- Assemble resources for tactical response to include
    - Foam
    - Water
    - Personnel

Keep in mind that AR foams are effective on both alcohol fires and hydrocarbon fires. Regardless of the type of incident, scope or magnitude, emergency responders adhere to the universal professional benchmarks of Life Safety, Incident Stabilization and Property Environmental Conservation (LIP) which ultimately lead to recovery activities.

At every incident, some type of management process must be initiated to “organize the chaos.” This incident command system (ICS) becomes even more important when the nature of these incidents increases in complexity, geography and as mentioned before scope, magnitude and involving multiple response organizations with statutory responsibility and/ or functional capabilities.

Within the concept of the incident management system, standardized benchmarks need to be addressed at every single ethanol and ethanol-blended fuel incident. This will ensure the health, safety and welfare of the emergency responders and impacted community. Additionally, the

benchmarks noted above ensures that the incident management process is initiated and that objectives are developed.

Strategies or solutions to achieve the objectives are identified, and resources (human and equipment) with the appropriate knowledge, skills and abilities are assigned to perform the work necessary to achieve the specific incident objectives and universal benchmarks previously discussed.

Finally, the intent of this information is to assist emergency responders following the ICS management process to arrive at an educated conclusion on whether their specific incident is going to become offensive or defensive in nature.

*Please note that offensive operations involving the use AR-AFFF or AR-SFFF foam, specialized foam fire firefighting equipment and personnel may not always be the best strategy or solutions for every ethanol and ethanol-blended fuel incident.

Control Zones

Control zones are the areas established by the hazardous materials team and incident command around a hazardous materials incident. They indicate the safety level and degree of hazard in that specific zone. There are three control zones that must be established: hot, warm, and cold.

- The hot zone is located immediately around the release of a material. This area encompasses materials that are hazards. It is the area of greatest danger and contamination. It is commonly referred to as the zone immediately dangerous to life and health or IDLH.
- The warm zone is located immediately outside of the hot zone and is the area where decontamination takes place.
- The cold zone begins where the warm zone ends. The command post, as well as other support functions, in the cold zone. Personal protective clothing in this area may be limited to safety equipment and normal working clothes.

After the control zones are established, detection and monitoring are used continuously to refine and/or modify the perimeter of the control zones as the incident changes.

Detection and Monitoring

Detection and identification of hazardous materials using monitoring equipment is normally performed by responders at the technician/specialist level. Monitoring equipment is a crucial resource for responders to use during an ethanol and ethanol-blended fuel incident for assessment and mitigation.

Monitoring equipment will help responders determine the vapor concentration levels of hazardous materials and make response decisions based on these readings. Utilizing a multi gas meter can detect LEL, CO, H2S and O2. Monitor readings will help responders determine how best to protect themselves and others from the effects of the material and how far the public should be removed from the contaminated area.

At a minimum the use of two (2) multi-gas detectors allows the responders to focus on each individual aspect of the ethanol and ethanol-blended fuel incident. One responder focuses on hydrocarbon identification while the second responder focuses on ethanol identification.

Since current multi-gas detectors are not "smart" and therefore cannot identify the gas or vapor being analyzed; the use of two detectors helps minimizes confusion as to which vapor or gas has been detected and what conversion factor must be applied.

Personal Protective Equipment (PPE)

Instructor Note:

Ask participants if they can list the health hazards of ethanol. Put them on a paper chart or white board. Typical hazards include:

- *Irritation to the eyes and skin*
- *When inhaled or absorbed:*
    - *Produces central nervous system depression*
    - *Headaches*
    - *Nausea*
    - *Dizziness*
    - *Loss or balance or coordination*
    - *Stupor*

Typical hazards include:

- *Inhalation:*
    - *Central nervous system depression*
    - *Irritation*
    - *Nausea*
    - *Vomiting*
- *Long-term exposure:*
    - *Liver damage*
    - *Kidney damage*

Ask participants what they consider the most important type of PPE when responding to ethanol emergencies including spills, releases, and fires.

Remind participants that we often think of the dangers of materials when they are involved in a fire, however, it is just as important to consider PPE and in particular respiratory protection for materials involved in spills and releases.

Remind participants that this is an awareness course on ethanol and ethanol-fuel blends. However, it is always critical to stress the importance of proper PPE. This course is not designed to provide instruction in the use or selection of PPE, but this section is presented as a reminder of its importance.

Ethanol and ethanol-blended fuel burns similarly to gasoline fires; therefore, it is critical that all responders wear appropriate firefighter PPE. Protective clothing is designed to protect the wearer from head to toe and has proven to reduce the severity of injuries as well as save the lives of many firefighters. The following components constitute a general set of firefighter PPE:

- Helmet with either a face shield or eye protection
- Protective hood
- Turnout coat
- Turnout pants

- Gloves
- Boots
- Respiratory protection

Respiratory protection is especially critical since the respiratory system is the primary route of exposure into the body for hazardous chemicals. There are three types of respiratory protection:

- Air-Purifying Respirators (APR) and Powered Air-Purifying Respirators (PAPR);
- Supplied Air Respirators (SAR); and
- Self-Contained Breathing Apparatus (SCBA)

Remember that all personnel responding to a spill or fire must wear and be trained in the use of the specific PPE required for a given emergency (see Figure 7.1 in the Participant Guide).

Figure 7.1: Firefighter Wearing Full Set of Protective Clothing

Decontamination Recommendations

Post response decontamination is required to prevent contamination outside the incident zones (secondary contamination). Decontamination should include surfactant and water based cleaner. All decontamination runoff should be contained, tested and disposed of properly.

Summary

In this module we learned that regardless of whether you are confronted with a spill or a fire, there are certain procedures that must be followed to ensure safe incident management.

Knowing the type of fuel that has spilled or is burning is essential to the success of your operation. In addition, you should take steps to contain the incident.

If offensive foam operations are going to be initiated, then appropriate quantities of AR-AFFF or AR-SFFF foam concentrate and the necessary foam application equipment must be obtained and staged at the incident scene. Personnel must have been trained IN ADVANCE on how to utilize the specialized foam firefighting equipment.

It is very critical that all emergency responders wear the appropriate PPE when responding to emergencies involving ethanol and ethanol-blended fuels.

Activity 7.1: Incident Procedures

Purpose

To become familiar with the correct order of steps in the following procedures and the rationales behind them.

Instructor Note:

Time: *15 minutes*

Materials: *Worksheet 7.1*

Instructor Directions:

1. Have participants attempt to properly order the steps in the following procedures.
2. Participants can work individually or in groups.
3. Use Worksheet 7.1.
4. After the participants have put the procedures in order, go over the correct order and then discuss the rationales behind each.

Participant Directions

1. Use Worksheet 7.1 to properly order the steps in the procedures.
2. You can work individually or in groups.
3. Be prepared to discuss the correct order and the rationales behind each step.

Worksheet 7.1: Non-Fire Spill and Leak Procedures

A. Establish a safety zone using conventional detection devices. Normal gas detection meters will still detect the lower explosive limit (LEL) of the gasoline component since the gasoline has a lower LEL than ethanol. Since both the gasoline component and the ethanol component are heavier than air, predict the vapor travel to be down and to lower levels of elevation.

B. Determine which approach to use:

- If the ethanol-blended fuel is spilled on dry surface, "oil only" absorbents, pads, and booms will contain the gasoline component of the product. Plugging containers or over-packing may also be considerations.
- If the ethanol-blended fuel is spilled into a waterway, the ethanol will precipitate out of the fuel mixture and blend with the water. Depending on water to ethanol quantities, the water/ethanol solution will become non-flammable at high water ratios. The ethanol will become essentially inseparable from the water in field conditions. The remaining gasoline components will remain on the surface of the water and can be contained with normal "oil only" booms or underflow dam systems.
- If vapors present a problem at the spill location, covering the spill with foam should be a consideration. Foam, however, can make remediation and cleanup more difficult.

C. Cleanup and remediation can be accomplished with standard booms, absorbents, and pads keeping in mind that if water or foam is present, it will take a two-step process.

D. Attempt to identify the product by placards, labels, shipping documents, and other identifying factors, staying upwind and uphill and using appropriate PPE. Physical properties will also aid in identification. High concentrations of ethanol will give the fuel a lighter color and a "sweeter" odor.

Instructor Note:

D

A

B

C