

## Executive Summary:

This Guide provides tactical guidance and information for the On-Scene Incident Commander responsible for the management of bulk flammable liquid emergencies involving High Hazard Flammable Trains (HHFT), with a focus upon petroleum crude oil and ethanol. The application and use of a risk-based response (RBR) methodology for both planning and response purposes are critical success factors in the successful management of a HHFT incident.

In order to safely and effectively employ risk-based processes at HHFT incidents, emergency responders must initially be qualified at the First Responder – Operations and On-Scene Incident Commander levels, and have an understanding of the following:

- The physical properties (i.e., how it will behave) and chemical properties (i.e., how it will harm) of the materials involved.
- Tank car design and construction of the DOT-111 / CPC-1232 and DOT-117 specification tank cars, and their potential behavior in an emergency scenario.
- Knowledge of the strategic and tactical considerations to be evaluated at a hazardous materials incident.
- Selection, application and use of large-flow water and firefighting foam streams at train derailments involving Class B fuels.

Among the key factors that Incident Commanders operating at HHFT incidents must know are the following:

- HHFT incidents are large, complex and lengthy response scenarios that will generate numerous response issues beyond those normally seen by most local-level response agencies. Although emergency response operations may be limited to less than 24 hours, post-response clean-up and recovery operations may continue for weeks.
- Unified command will be critical for the successful management of the incident.
- The initial container stress / breach / release behaviors are directly influenced by the speed of the train, the kinetic energy associated with the derailment, and the properties of the commodities being transported. After the initial mechanical stress caused by the derailment forces, subsequent container stress / breach / release behaviors will be thermal or fire focused.
- Incident growth will generally follow a process of (a) thermal stress from the initial fire upon the tank cars (level of thermal stress will be influenced by the presence and integrity of thermal blanket protection); (b) subsequent activation of tank car pressure relief devices; (c) continued thermal stress on adjoining tank cars from a combination of both pool fires and pressure-fed fires from PRD's; (d) increasing probability of container failures through heat induced tears; and (e) subsequent fire and radiant heat exposures on surrounding exposures when explosive release events occur.
- Heat induced tears (HIT) have been observed on tank cars containing both crude oil and ethanol. Tank car failures can occur at any time. Heat induced tearing has occurred within 20 minutes of the derailment and as long as 10+ hours following the initial derailment.
- Based upon an analysis of approximately 25 HHFT incidents, there is a very limited window of opportunity in the early stages of an incident for implementing offensive fire control strategies. There is a higher probability that response options will be limited to defensive strategies (e.g., exposure protection) to minimize the spread of the problem or non-intervention strategies (i.e., no actions) until equilibrium is achieved. Using a risk-based response process will be critical for this re-assessment process.
- Fires will continue to burn off the available flammable liquid fuel until such time that the incident achieves a level of "equilibrium" and is no longer growing in size or scope. An analysis of historical incidents shows that equilibrium at a major incident may not occur for approximately 8-12 hours. There is a lower probability of additional heat induced tears or tank car breaches once equilibrium is achieved
- Once the equilibrium phase is achieved, responders may choose to switch to an offensive fire control strategy.