APPENDIX F. BIOFUELS QUICK RESPONSE GUIDE

F.1 Overview of Spill Characteristics, Properties, Behaviors, and Hazards

Table F-1, Table F-2, and Table F-3 provide a high-level overview of biofuels spill characteristics, properties, behaviors, and hazards.

Table F-1. Biofuels spill characteristics (Kass et al., 2021).

Fuel Type	Behavior when Spilled	Dissipation or Degradation Rate	Ecological Impacts	Flammable / Explosion Risk	Toxicity	Air Displacement and Suffocation Risk to Crew	Spill Cleanup
Biodiesel	Will form a slick on the water surface	Moderate: Can take up to a week or more	Aquatic life may become coated	Low	Low	None	Boom containment is most optimal
HVO	Will behave as a diesel spill and rapidly spread out as a clear oily film	Moderate: Can take up to a week or more	No long term impacts are expected. Aquatic life may become coated	Low	Low	None	Boom containment is most optimal

Table F-2. Summary of key biodiesel (FAME and HVO) properties and behaviors (ITOPF, 2024b).

	FAME	HVO	Behavior
Boiling Point	182 - 338 °C	150 - 315 °C	At ambient conditions, biodiesels are liquid.
Specific Gravity (@ 15 °C)	≈0.89	0.78 - 0.79	Biodiesels are less dense than water; therefore, they will float if spilled on water.
Viscosity (@ 40 °C)	≈4.5 mm^2/sec	2.5 - 3.5 mm^2/sec	Biodiesels have a low viscosity at ambient temperatures.
Pour Point	-4 to 16 °C	-35 to -15 °C	Biodiesels, below these temperatures, will no longer be free flowing.
Solubility	Insoluble	Insoluble	Biodiesels will not dissolve in water (run-offs) or seawater.
Flash Point	>101 °C	>70 °C	Below these temperatures, biodiesels will not produce flammable vapors.

Table F-3. High-level overview of hazards associated with biofuels (ITOPF, 2024g).

State		Longevity in the Environment	Toxicity to Humans	Health & Safety: Main Concerns	Protracted Response to Recover Pollutant
Under Ambient Conditions	During Transport				
Liquid	Liquid	Weeks to months	Toxic (direct contact)	Low risk from initial exposure, toxicity poses a risk if exposed for extended periods	Likely

F.2 Responder Safety Considerations

Biofuels, specifically biodiesels such as FAME (Fatty Acid Methyl Esters) and HVO (Hydrotreated Vegetable Oil), present a different risk profile compared to cryogenic or highly flammable fuels. While they are less hazardous in many respects, they still pose important operational risks during spill incidents.

Principal hazards include:

- Flammability: Both FAME and HVO are combustible. HVO has a lower flash point, similar to conventional diesel, while FAME may have slightly higher flash points but can still ignite under the right conditions.
- Toxicity: Generally low compared to traditional petroleum fuels, but prolonged skin contact should still be avoided.
- Degradation risks: FAME in particular can degrade to produce acids and peroxides, which may complicate cleanup and increase health risks over time.

Personal Protective Equipment (PPE) will be necessary if vapors accumulate in confined spaces, especially during operations involving degraded biofuels:

- Self-contained breathing apparatus (SCBA).
- Chemical-resistant gloves and eye protection.

Decontamination procedures should be established for personnel who come into contact with spilled product. Responders must exercise caution on contaminated surfaces to prevent slips and falls.

F.3 Detection and Monitoring

Table F-4 shows how effective existing detection methodologies are for identifying biofuels.

Table F-4. Summary of detection methodologies for biofuels (Kass et al., 2021).

Fuel Type	Visible	Radar	Infrared	Fluorescence	Chemical Analysis
Biodiesel	Potentially yes	Yes	Potentially yes	Unknown	Yes
HVO	Possible if sheen is formed	No	Potentially yes	Unknown	Yes, but limited to spill zone

Detection and monitoring during a biodiesel spill are focused on identifying flammable atmospheres and assessing environmental impact. Combustible Gas Indicators (CGIs) may detect vapors if concentrations are sufficient, though biodiesel vapors are less volatile than lighter hydrocarbons.

Thermal imaging and infrared cameras are generally not required unless monitoring heated tanks or systems. Portable volatile organic compound (VOC) detectors can assist in enclosed spaces where vapor buildup could create hazardous atmospheres.

Visual inspections are essential to identify surface slicks and assess the extent of spread. Surface sampling and water quality testing may be necessary if the spill enters the marine environment, especially for detecting FAME emulsification.

Continuous air monitoring is less critical than for cryogenic fuels but should still be conducted if there is any suspicion of vapor accumulation, particularly in confined or low-ventilation spaces. The concern is lower in open-water environments.

F.4 Fire Fighting

Use same approach to fires involving biodiesel spills as conventional marine fuel fires.

Concerns/considerations:

- FAME fires:
  - Alcohol-Resistant Aqueous Film Forming Foam (AR-AFFF) is preferred due to its polar nature.
  - Can also be extinguished using standard firefighting techniques.
- HVO fires:
  - Can generally be suppressed with regular AFFF, dry chemical extinguishers, or standard firefighting techniques.
  - Water spray may be used to cool adjacent structures and suppress vapors.

F.5 Spill Response

Responders can primarily use mechanical recovery technique and strategies for biodiesel fuel spills. Absorbents, booms, and skimmers designed for oil spills are likely to be effective at containing and recovering both FAME and HVO from the water surface.

HVO behaves more predictably like a distillate fuel, floating cleanly and being more amenable to mechanical recovery using traditional oil spill response equipment. Since FAME can emulsify in water, spill responders should anticipate more challenging recovery operations compared to HVO or conventional diesel. Emulsified slicks may require skimmer modifications to improve recovery efficiency with more viscous fluids.

Exclusion zones are generally based on the extent of surface contamination rather than vapor hazard, except in confined areas where vapor monitoring should inform safe working distances.

F.6 Environmental Impacts

FAME is readily biodegradable, which can be beneficial but also cause rapid oxygen depletion in water bodies, leading to fish kills or other ecosystem impacts. Emulsification increases the surface area exposed to microbial degradation, accelerating these effects.

HVO behaves more like conventional diesel, floating on the water surface and remaining recoverable for longer periods. Its biodegradation is slower than FAME, reducing the risk of immediate oxygen depletion but increasing persistence if not promptly removed.

Both fuels have lower aquatic toxicity compared to conventional diesel. However, secondary effects from nutrient enrichment or oxygen depletion must be considered, especially in confined or low-energy environments.

Environmental monitoring following a biodiesel spill should include dissolved oxygen levels, chemical oxygen demand (COD) measurements, and tracking of visible surface contamination. Remediation is typically less intensive than for heavy oil spills but should be based on site-specific ecological sensitivity.