Gasoline Spill Scenario

Barge Spill in the Columbia River near Hood River

Setting

A single-hull oil barge carrying 25,000 barrels of gasoline is proceeding upriver 12 miles past Bonneville Dam. Another vessel traveling down river has steering difficulties and crosses the navigation channel where it tears a gash through two center tanks on the side of the oil barge. Tanks in the bow section are protected by the location of the oil barge in the tow with a cargo barge out front. The hull rupture in the oil barge is just below the waterline and product immediately starts flowing out. It is assumed that there is no immediate source of ignition for the gasoline but every precaution is taken to guard against an explosion.

The accident occurs in the reservoir behind the dam. Surface water flow is westerly at about 0.6 knots (1 ft per second or less). Winds are 20 to 30 knots across the river from the south, and wave action is a 1 to 2 foot chop.

The width of the river between the spill site and the dam ranges from 2,500 to 5,000 feet with depths greater than 50 feet in the main channel.

Impact Issues

This area of the river is used extensively for recreational boating, fishing and wind surfing. A fish ladder at the dam allows salmon and other fish to migrate upstream. There are two fish hatcheries on the north shore of the river downstream of the spill site (according to Scenario 13 as described in OPL's Application).

Key variables affecting the eventual (residual) impact of the spill are the dynamics of flow in the river (flow and mixing energy), time of year in relation to recreational use and salmon migration, and downstream habitat.

Spill Characteristics and Behavior

The spill occurs rapidly, with the barge losing 5,525 bbls (236,250) of gasoline from the two damaged tanks within 8 hours. This volume represents 22.5% of the total capacity of the barge. Most of this volume being discharged near-shore where the barge is secured immediately following the collision. As explained below, for safety reasons, no physical intervention takes place to slow the leak or retrieve the product remaining in the damaged tanks.

The product starts to evaporate immediately and gasoline remaining on the surface spreads downstream at close to the same rate as the surface flow. At the same time, the oil is quickly spread laterally with wind and wave action. Gasoline spilled initially in the center of the channel drifts towards the north shore at between 0.5 and 1 knot. As it spreads under current and wind forces, the gasoline breaks into silvery strips (windrows) on the surface.

As the gasoline continues to evaporate rapidly, the vapors are borne away by the strong winds. At the same time, a significant proportion of the surface slick disperses into the upper water column through wave mixing. Volatile components (the most toxic) are lost very quickly to the atmosphere such that almost no residual slick is left on the water surface within an hour or less down river of the site.

Most of the gasoline remaining after initial evaporation is held in suspension in the river as fine droplets. Dispersion is greatly aided by the wave action and low viscosity of the product. A much smaller proportion of the spill (in the order of one percent or less) is dissolved into the water. Measurements of dissolved hydrocarbons beneath oil slicks are relatively rare and examples in the literate are for slicks at sea. Values are typically in the order of 0.1 part per million (ppm).

Within two hours of the spill, sheens (very thin films in the order 4 millionths of an inch thick) are visible within one mile downstream of the spill site and along the north shore of the river. Note: sheens over large areas represent extremely small volumes; for example 25 gallons of gasoline appearing as a sheen would cover a square area over half a mile on a side.

The soluble fraction (generally less than 1% of the overall spill volume) has mixed to within the upper ten feet of the river, but dissolved hydrocarbon concentrations fall rapidly away from the barge as the surface slick is removed to the atmosphere through evaporation. As the spill proceeds, evaporation, dispersion and spreading continue such that gasoline is barely visible as patches of sheen on the surface and long the shoreline beyond two miles downstream.

Immediate Response Actions

Immediately following the collision and once the safety of all crew members is confirmed, the tug pushes across the river (keeping a following or cross wind to maintain vapors clear of the tug). and securely grounds the damaged barge in shallow water near shore. At no time, is the barge at any risk of sinking or overturning even with two tanks flooded on one side.

Calls go out within fifteen minutes to all of the required agencies, dam operators, fish hatchery operators and other commercial concerns along the river, as well as Tidewater's own response organization. Spill and safety response is coordinated between the agencies, unified through the Incident Command System (ICS).

Once the barge is secure, all machinery is shut down and the crew is evacuated to minimize any further risk of fire and explosion as well as human respiratory effects. Response teams arrive within two hours after the spill with small boats and sorbents for shoreline surveys and cleaning. The nearest locations of pre-staged response equipment are Tidewater's maintenance facility in Vancouver, WA, Sundial Marine Shipyard in Troutdale, OR, and the Port of Hood River maintenance yard.

Sensitive areas downstream are identified through existing contingency plans and geographic response plans. Diversion booms or protective booms are deployed to keep gasoline away from critical areas such as wildlife habitat, hatcheries and fish ladders.

No attempt is made to contain the gasoline on the water through booming, or to effect tank to tank transfers on the barge due to unacceptable hazards of explosive risk and exposure to hazardous vapors. The spill is allowed to evaporate and disperse naturally, aided by wind and wave action.

Post Emergency

Once the barge is safely salvaged and the spill is finished, crews assess damage and search for any evidence any weathered gasoline sheens which may naturally collect at certain points along shore. Sorbents are used from small boats to pick up any floating residual oil in protected areas near-shore. Minor accumulations are barely visible as sheens and rainbow colors in some backwaters and eddies over a distance of two miles. Within ten hours after the accident (two hours after the end of the spill) crews are unable to locate any product in concentrations sufficient to enable effective recovery. No further clean-up is possible. Protective booming is maintained around sensitive areas until there is no further risk of contamination.

Expected Consequences

The exact consequences of any oil spill depend on a wide variety of factors including the success of mechanical recovery operations, degree of natural cleaning, type of oiled habitats and wildlife presence and life cycle at the time of the spill. General comments based on observed effects from previous oil spills around the world were extracted from Baker et al. (1990) are provided in the diesel spill scenario.

Gasoline is a far less persistent product than diesel fuel. Evaporation rates, especially in moderate to strong winds, can be so high as to essentially remove the most toxic components and almost all visual signs of the oil's presence within a matter of minutes or hours. Remaining sheens and films, while potentially covering large areas for a short period of time, quickly break down and disperse.

Consequences in this scenario will depend largely on the timing of the fish migration. If the spill occurred at the most sensitive time, there could be short-term effects for a brief period (less than 24 hours) when measurable hydrocarbon concentrations could be present in the river upstream of the dam. At other times of the year, there may be no identifiable effects.