Potential Effectiveness of ISB

Although in situ burning is a relatively simple technique, its effectiveness can be limited by spill circumstances. Whether and how oil burns is the result of the interplay among a number of physical factors related to the oil itself and the extent to which the oil has been exposed to the environment. Critical factors—such as oil thickness, degree of weathering, and extent of emulsification—generally change with the passage of time, and the changes that occur make it more difficult to burn the oil. As a consequence, in situ burning is most easily and effectively implemented during the early stages of a spill.

The efficiency of in situ burning is highly dependent on a number of physical factors. Test burns and actual spill situations suggest it can be very effective in removing large quantities of oil from the water. Burn efficiencies of 50 to 90 percent can be expected making this response method more efficient than others methods. In comparison, mechanical removal (such as skimming) typically has an efficiency of 10-20 percent.

In situ burning has most often been considered and tested with crude oil spills. However, its feasibility with other types of refined oil products (e.g., diesel and Bunker C fuel oil) has been demonstrated. Difficulties with establishing and maintaining necessary slick thicknesses (in the case of lighter oils) and ignition (for heavier oils) make in situ burning a slightly less viable alternative for those materials than for crude oils.

ISB Relationship to Other Countermeasures and Potential Environmental Tradeoffs

Relationship to Mechanical and Other Response Methods

Spill prevention is the first line of defense in spill response planning, however, acceptance of the probability that a spill can and will occur is essential to successful preparedness. Burning will be considered as a possible response option only when mechanical containment and recovery response methods are incapable of controlling the spill alone.

While physical containment and mechanical removal of spilled oil is the primary objective of any response, prudent planning dictates the consideration of alternative countermeasures.

Summary of Potential Tradeoffs Relevant to ISB

As is the case with all response methods, the environmental tradeoffs associated with in situ burning are situation dependent and cannot be considered independently from operational tradeoffs. In situ burning can offer important advantages over other response methods in specific cases, and may not be advisable in others depending on the overall mix of circumstances.

Advantages

- In certain areas where other techniques may not be possible or advisable due to the physical environment (e.g., ice conditions or wetlands) or the remoteness of the region, burning may represent one of the few viable response choices besides no action.
- In situ burning may prevent or significantly reduce the extent of shoreline impacts, including exposure of sensitive biological resources, wildlife habitats, and the oiling of high value recreational or commercial beaches.
- The magnitude of a spill may overwhelm the containment and storage equipment deployed or available for a region, necessitating the consideration of other methods in an overall response strategy.
- Burning can rapidly remove a large volume of oil from the surface of the water, reducing the magnitude of subsequent environmental impacts of stranded oil.

Disadvantages

- Large quantities of highly visible black smoke is generated that may adversely affect human and other exposed populations downwind.
- There may be the potential for mortalities and other adverse biological impacts from localized temperature elevations at the water surface. Although this would be expected to occur in a relatively small area, in specific bodies of water at specific times of the year, affected populations may be large enough or important enough to represent reasons for not considering burning as a cleanup technique. Adverse impacts from temperature elevation should be considered relative to the toxic effects of the spill if burning is not employed.
- The longer-term effects of burn residues on exposed biological populations has not been investigated. It is not known whether these materials represent a significant source of toxicity.
- In situ burning must be carefully controlled in order to maintain worker safety and to prevent unintended environmental impacts.
- There is a relatively short window of opportunity to use burning after a spill occurs prior to the oil weathering and losing its flammable characteristics.

Proposed Guidelines for ISB in Marshes

Based on the available data on effectiveness and effects of burning on oiled marshes, the following guidelines are proposed:

- Make sure that it is possible to contain and control the fire; it is not as easy to put out a fire in vegetation as it is with oil contained in a fireproof boom.
- Impacts to below ground vegetation are likely to be lower if there is a water layer between the oil and the substrate.
- A standing water layer of just a few inches may get hot enough to kill shallow roots anyway, however, little information is available regarding this effect.
- Burning of oiled woody wetland vegetation (compared to grasses and sedges) should not be considered.
- Not enough is known about seasonal effects on the ability of burned, oiled vegetation to recover, yet burning in late fall to early spring, when the vegetation is dormant and before production of new growth seems to be the best time.
- If it can be done with minimal impacts, heavy accumulations of oil should be removed using other methods, to reduce the amount of burn residues which may cause long-term impacts to both vegetation and animals returning to the habitat.
- Light fuels oils and crudes burn more efficiently and generate less residues, which should reduce the potential for long-term impacts.
- Burning of oil trapped in ice appears to have the least environmental impacts because the burn area is contained, the plants are dormant, and the above-ground vegetation is dead.
- There is some concern that burning of muddy substrates could alter their physical properties (i.e., make them hard) thus degrading their biological productivity.
- Every wetland is different in terms of the type of wetland, the species growing there, the condition (optimal or marginal for species use), and the known or estimated tolerances of that type of system to physical and chemical disturbances. Biologists or botanists should be consulted prior to the use of burning as a cleanup technique in a wetland.
- Mechanical or manual alternatives to in situ burning may compact oil into sediments, where it persists longer. Therefore, the relative damages from different response options should be weighed carefully.

ISB in Wetland Habitats

There are few studies on the relative effects of burning oiled wetlands compared to other techniques or natural recovery and most of the experience is derived from estuarine habitats. However, in situ burning in wetlands can be effective since it can remove a large quantity of oil with a minimum of physical disturbance. The type of wetland vegetation and the season of the year along with many other factors will dictate whether burning is feasible in a particular wetland.

Refuge managers have historically conducted prescribed burns of wetlands to rejuvenate wetlands that have accumulated high litter loads, generate green vegetation or open spaces to attract wildlife, release nutrients for re-cycling, and to restore habitats in areas that were historically subject to frequent wildfires to their natural conditions. The presence of oil in a wetland may have two important effects: the high BTU of the oil may increase the temperature and heat penetration of the burn, and there is often an oil residue which can cause toxicity. However, the experiences of fire ecologists and practitioners can greatly contribute to the development of guidelines for burning wetlands as a spill-response strategy.

Proposed Guidelines for ISB in Marshes

(Continued)

Guidance is being developed for specific types of wetlands such as:

- Wooded swamps
- Fresh-to-brackish impoundment marshes
- Great Lakes coastal marshes
- Upper Mississippi River marshes (lock and dam pools)
- Riparian wetlands
- Inland freshwater marshes
- Potholes

For now, based on discussions with refuge staff with fire management duties, the following general considerations for use were developed:

Pros

- Where access is limited or mechanical/manual removal has the potential to cause more damage by equipment and trampling, burning can rapidly remove oil from sensitive areas.
- It provides a response option when no others are acceptable, or where likely oil residues will be unacceptably high with other options, including natural recovery.
- It rapidly removes oil from the habitat when there is a time-critical element, such as a short-term change in the physical conditions which will likely cause loss of containment and further spreading, or a seasonal increase in wildlife use, such as arrival of large numbers of migratory waterfowl.

Cons

- Burning can cause substantial initial plant damage because the above-ground vegetation is removed.
- Burning can cause long-term impacts to vegetation, especially if the fire is so hot that the below-ground plant parts are killed.
- There is a potential for burning to increase oil penetration into the substrate, when there is no standing water.
- Any animals present and unable to escape (such as gastropods on clean vegetation above the oiled area) will be killed.