ISB

In-Situ Burning:

A Valuable Tool for Oil Spill Response

Alaska Clean Seas

Alaska Department of Environmental Conservation

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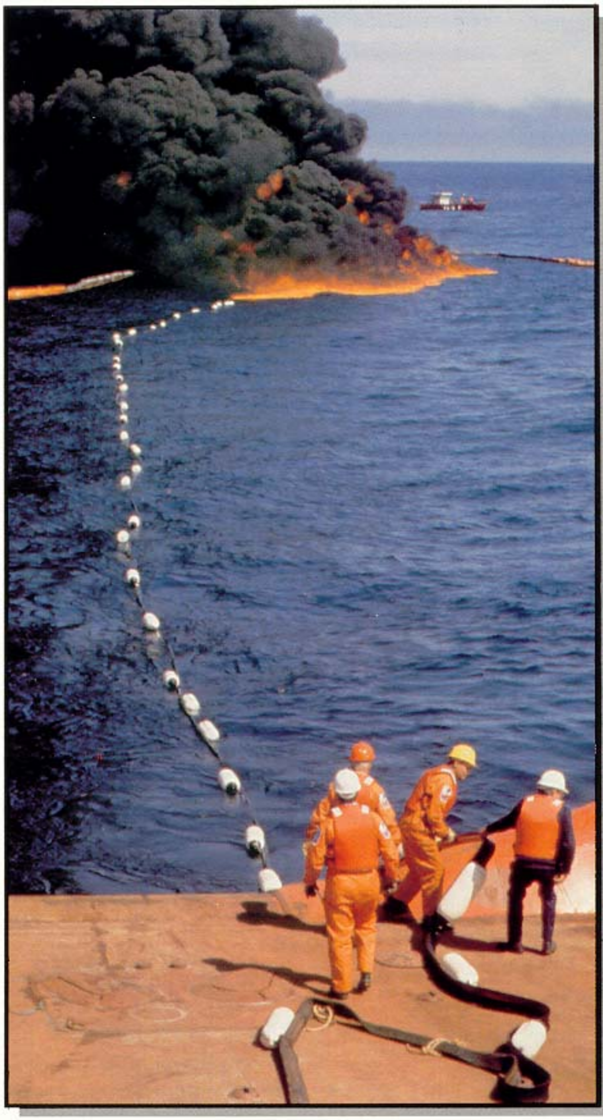
Introduction

In order to respond to spills in a variety of environmental conditions, a number of techniques are available, each with its own advantages and limitations. In recent years, interest in burning oil spills has increased as industry and government search for effective ways to clean up oil spills. Results from controlled tests in the United States, Canada, and Europe indicate that *in-situ burning* — the burning of spilled oil in place — can be an effective spill response tool in a variety of environments, particularly for oil spilled on water.

In Alaska, the equipment needed for a successful in-situ burn is maintained by Alaska Clean Seas (ACS), Cook Inlet Spill Prevention and Response, Inc. (CISPRI), and Ship Escort/Response Vessel System (SERVS) — the oil industry spill response cooperatives for Alaska's North Slope, Cook Inlet, and Prince William Sound, respectively. Additionally, Alyeska maintains equipment along the Trans-Alaska Pipeline. The equipment these groups have includes fire-resistant containment boom, helicopter-mounted ignition systems, and hand-held igniters.

The Alaska Regional Response Team (ARRT), which is made up of state and federal agencies, including the Alaska Department of Environmental Conservation (ADEC), wants to ensure that in-situ burning is used safely and in an environmentally sound manner. Thus, the ARRT has issued in-situ burning guidelines for Alaska.

The purpose of this booklet is to explain what in-situ burning is and why it is such a valuable spill response tool in most situations. In addition, we hope to answer some of the more common questions asked about it.



Q What is in-situ burning?

A *In-situ burning*, or ISB, involves controlled burning of oil that has been spilled. The word *in-situ* is Latin for *in place*. In-situ burning of oil spills is the controlled burning of oil at or near the spill site.

Q Why would you want to conduct in-situ burning?

A In-situ burning is an effective technique for removal of oil, which is harmful to the environment. An oil spill can have adverse effects on a variety of natural resources: fisheries, terrestrial and marine mammals, shellfish beds, recreational beaches, and birds. This, in turn, can have significant impacts on the people who rely on these natural resources for their economic, cultural, and recreational well-being.

In-situ burning offers a practical method to remove large quantities of oil from the environment very quickly, thereby minimizing the environmental exposure to oil's long-term effects.

Q How effective is ISB?

A Under the right conditions, burning can remove 95% to 98% of the contained oil. However, a number of factors related to the physical environment and oil properties can affect burn efficiency. In addition, the correct types and amounts of equipment must be in place.

Q Under what circumstances will ISB work?

A A number of physical limitations restrict the feasibility of ISB. These include wind speed, wave height, thickness of the oil, oil type, how weathered the oil is, and how emulsified it is. The more oil weathers and emulsifies, the harder it is to ignite.

Weathering is a process that occurs as oil is exposed to the elements and loses its more volatile components. The major process of weathering is evaporation. *Emulsification* is a process whereby water gets incorporated into the oil. Emulsion formation results in large increases in the spill's volume. Weathering and emulsification can occur at the same time.

Optimal Environmental Conditions

- Winds less than 20 kt (23 mph or 37 km/hr).
- Waves less than 2-3 feet (62 to 92 cm).
- Currents less than 3/4 knot (0.9 mph or 1.4 km/hr) relative velocity between the boom and the water.

Required Oil Conditions

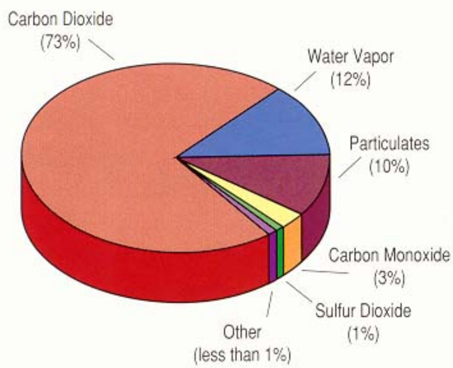
- Minimum thickness:
  - 0.08 to 0.12 inches (2 to 3 mm) for fresh crude oil.
  - 0.12 to 0.2 inches (3 to 5 mm) for diesel and weathered crude.
  - 0.2 to 0.4 inches (5 to 10 mm) for emulsions and Bunker C.
- For most crude oils, less than 30% evaporative loss.
- Most oils readily burn if water content is less than 25%. For oil-in-water emulsions with water contents greater than 25%, an emulsion breaker may be needed to obtain ignition.

What are the emissions from an oil fire?

A The primary constituents of an oil fire are gases and particulates. The most abundant combustion products of crude oil are gases: carbon dioxide, water vapor, carbon monoxide, and sulfur dioxide. The particulate portion of the smoke is mostly carbon.

Major Products of Crude Oil Combustion

Carbon dioxide and water form approximately 85% of the mass of combustion products of burning crude oil.



What are the potential impacts to human health from a burn?

A A number of the combustion products from a burn are potentially harmful to humans. The primary concern is the particulate matter in the smoke plume. Of specific concern are the very small particles 10 microns or less in diameter (a micron equals one-millionth of a meter, or 0.0004"). These particles are commonly referred to as "PM10" and are small enough to lodge in your lungs. It is generally long-term exposure over months or years to PM10 that affects health. However, short-term exposure to high concentrations can aggravate symptoms in sensitive individuals with existing heart or lung ailments.

To adequately protect human health, the federal and state governments are refining guidelines for the use of in-situ burning. A key objective is to ensure that concentrations of PM10 do not exceed permissible exposure levels for people. Currently, federal regulations say that levels should not exceed 150 micrograms of PM10 per cubic meter of air averaged over a 24-hour period. Typically, the PM10 concentrations will fall below this concentration within one to six miles downwind of a burn. The exact distance varies with atmospheric conditions: wind speed and direction, temperature, and atmospheric stability.

Burning oil in fire resistant containment boom.

Close-up of burning oil in fire resistant containment boom.

Burn residue inside fire resistant containment boom.

Steps for Burning Oil

Step 1 - Obtain Regulatory Approval

Obtain approval from the regulatory agencies to conduct the burn by submitting a detailed application form to the Federal and State On-Scene Coordinators.

Step 2 - Collect and Concentrate the Oil

This is typically done in a fire resistant boom that can withstand the high temperatures (2,000° to 2,500°F, or 1,093° to 1,371°C) of an oil fire. To stay lit, oil must be at least 0.08 to 0.12 inches (2 to 3 mm) thick.

Step 3 - Ignite the Oil

There are several ways to do this. A special device called a "Helitorch" is carried by a helicopter and discharges gelled gasoline or diesel onto the oil. Additionally, ignitors that can be thrown by hand into a pool of oil are available.

Step 4 - Monitor the Burn

Maintain a constant watch of the fire and smoke plume, condition of the boom, and the speed and positions of towing vessels. Maintain constant vigil for potential safety hazards such as unwanted fires.

Step 5 - Recover and Dispose of Residue

The type and amount of burn residue will depend on the starting oil type, environmental conditions and how the burn is conducted. Most burns result in taffy-like, buoyant layers of oil that can generally be recovered manually for disposal. In some cases, residues may sink. This usually happens when the oil picks up sediments suspended in the water or when a highly efficient burn leaves only the heaviest parts of the oil.

Q Who makes the decision to conduct a burn?

A The use of ISB to respond to an oil discharge is regulated by both federal and state law. In Alaska, the Alaska Regional Response Team (ARRT), which is made up of federal and state agencies, has developed guidelines that provide a common decision-making process to evaluate the appropriateness of using ISB during a spill response. The Federal On-Scene Coordinator (OSC), in consultation with the State OSC, has the authority to approve ISB. The decision-making process is outlined below and on the next page.

Step 1: Evaluation

- Location?
- Nature, size, and type of spill?
- Weather and sea conditions?
- Is mechanical containment/recovery adequate?

Step 2: Feasibility

- Are weather and sea conditions appropriate?
- Is oil burnable?
- Are sufficient personnel/equipment available?
- Is there a burn plan?

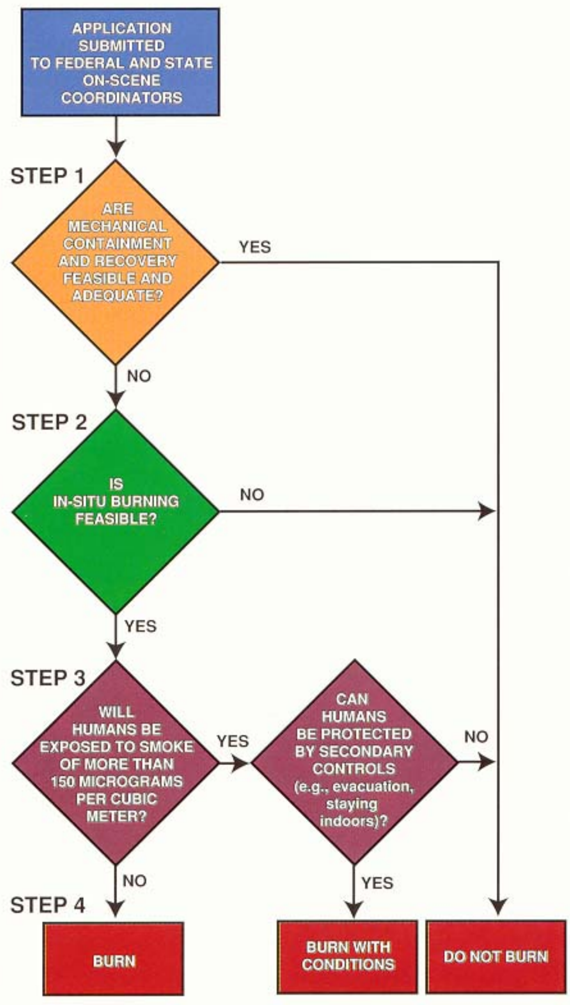
Step 3: Acceptability

- Location of burn in reference to human population?
- Distance between burn and human population?
- Forecast plume direction in reference to human population?
- Atmospheric conditions

Step 4: Authorization and Conditions

- Forecast weather conditions?
- Conduct trial burn to evaluate smoke plume drift and dispersion.
- Burn extinguishment measures are available.
- Public notification.

ISB Decision-Making Process



Q Does ISB preclude other spill response measures?

A The main techniques used to respond to an oil spill are mechanical containment and recovery, dispersant application, shoreline cleanup, and ISB. Whether or not burning would interfere with other spill response measures will depend on the spill circumstances. In a major spill it may be possible for all response techniques to be used simultaneously. The objective should be to find the right mix of equipment, personnel, and techniques that will minimize the environmental, socioeconomic, and cultural impacts.

Q Is ISB the answer to all spill response?

A ISB is a useful spill response tool in certain circumstances. There are situations where burning may be the only means of eliminating large quantities of oil quickly and safely. There are also situations in which burning cannot be used. No two spills are the same. Burning should only be used where it can be done safely, with no risk of secondary fires and minimal risks to human health.

Q How quickly can ISB remove oil from water?

A For thick layers of oil (greater than 0.5 inches) the oil removal rate is approximately 4.2 gallons of oil per hour for every square foot of oil on fire. For example, a fire covering 50 x 50 feet (2,500 square feet) would consume about 10,500 gallons per hour under optimal conditions.

Q Isn't burning just trading water pollution for air pollution?

A The overriding goal is to protect the environment to the maximum degree possible while ensuring that air pollution does not jeopardize human health. Air pollution from an in-situ burn is usually short-lived and consists mainly of smoke particulates. In certain concentrations, these particulates may be harmful to some persons. However, unburned oil is also a source of air pollution, mainly from evaporating hydrocarbon compounds that also present health hazards. These compounds also contribute to the formation of smog.

Uncollected oil can harm wildlife, fish, recreational beaches, and the rest of the marine environment. It can be taken by the currents to a wide geographic area, potentially covering hundreds of miles. A smoke plume from burning oil will usually be confined to a narrow band that may stretch several miles.

Q How do you control an ISB and avoid spreading of the fire?

A The fire is usually contained in a fire resistant boom. The goal is to avoid accidentally igniting oil outside the boomed area or the spill source (for example, a leaking tanker). Oil can be burned in an area physically remote from other sources of oil, or a boom can be used to isolate it for burning. If the potential for igniting the spill source or other valuable resources cannot be minimized, burning operations will not be allowed.

ISB Versus Other Response Methods

Mechanical skimming of oil is considered the response method least harmful to the environment. However, it requires large quantities of equipment and personnel. It is a multistage process that can be time-consuming and has several potential bottlenecks in which the system can break down. First, you need to contain the oil; then you recover it, store it temporarily, treat it, and dispose of it. In each stage you handle the oil; equipment and personnel are needed. The operation will be hampered if any stage in the system breaks down.

Chemical dispersants are used to break oil into small droplets in the upper part of the water column. This speeds up natural dispersion, degradation, and evaporation. To be effective, dispersants must be applied soon after a spill, since weathered oils are hard to disperse. Dispersants should be used in deep water, where the oil can mix into the water column. In addition, mixing energy from wind and waves is needed.

Shoreline cleanup involves the physical removal of oil from beaches. This is the most labor- and equipment-intensive response method, and techniques must be chosen carefully. Removal of oiled sediments can sometimes create environmental problems such as beach erosion. Running heavy equipment on shorelines can sometimes do more damage than the oil. A variety of shoreline cleanup methods are available. The one used depends on the beach type, its location, the type of oil, and the equipment and labor available.

In-situ burning creates a temporary air pollution problem that may pose a risk to people exposed to the smoke. Unwanted fires can also happen. As with all response methods, burning works only under certain weather and oil conditions. Equipment and trained personnel are also needed.

Top left: mechanical containment and recovery; top right: dispersant application; bottom left: shoreline cleanup; bottom right: in-situ burning.

Because they can seriously affect people, wildlife, and the environment, significant oil spills are emergency situations. The response must be appropriate to the size of the spill and its potential impacts. Due to the toxicity of oil, there will always be impacts, but often choices must be made among response options that will require trade-offs among those impacts. Also, as in any emergency, the human safety risks must be considered. In some cases, the safest and most environmentally sound response may be to let nature take its course with the oil.

When ISB is considered, the impacts of water and shoreline pollution must be weighed against the impacts of air pollutants. Effects on the environment, wildlife, economy, and human health must be evaluated. Certain trade-offs will be necessary. ISB offers important advantages over other response methods in specific cases and may not be advisable in others.

Want More Information?

Additional information on in-situ burning can be obtained from:

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