

Field Operations Guide for In-Situ Burning of Inland Oil Spills

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Contents

Purpose of this Field Operations Guide	vii
Priorities for Oil Spill Response	vii
Safety	vii
Intended Audience	vii
How to Use this Field Guide	viii
Introduction	1
Specific In-Situ Burning Considerations	2
ISB Decision-Making Components	4
ISB Field Operations Checklists	5
General Precautions and Preferred Conditions	5
Prerequisites	5
Logistical Considerations	6
Location Considerations	8
Monitoring, Notifications, and Documentation	10
ISB Plan Components of an Incident Action Plan	12
Habitat-Specific ISB Information	19
Upland Areas Including Forests, Fields, Prairies, and Savannas ...	19
Freshwater Wetlands	21
Open Water Lakes and Ponds, Without Currents	21
Open Waters, with Current	22
Cold Climate Considerations	23
Ice Conditions on Water	23
Tundra	24
Deserts	26
Appendix A Appropriateness of ISB	27
Appendix B Personnel Safety	31
Appendix C Weather and Smoke Management	33
Appendix D Fire Containment & Fire Safety	37
Appendix E Ignition of ISB	42
Appendix F Efficiency and Volume Estimation	47
Appendix G Air Quality Monitoring	50
Appendix H Unburned Oil and Burn Residue Recovery	54
Appendix I Incident Command for ISB	56
Glossary	60
References	66

Purpose of this Field Operations Guide

This is a field operations guide. It is not an educational or decision-making tool. This Guide contains a set of operational checklists, tools, and references to assist in the conduct of inland in-situ burning (ISB) of spilled oil.

Priorities for Oil Spill Response

- People—safety of response personnel and the public.
- Environment—prevention of environmental, human health, and welfare effects.
- Assets—minimizing damage to structures and equipment.

Safety

Responder safety and health must never be compromised for tactical considerations. Likewise ISB should be conducted to minimize smoke/particulate safety and health impacts to responders, the public, occupied areas, roadways, etc.

Intended Audience

This Guide is intended for experienced response operations personnel having basic knowledge or expertise in ISB. Although widely applicable, this Guide reflects research and experience in North America.

How to Use this Field Guide

A decision to use ISB with appropriate local, state, and/or federal approvals should already have occurred before field operations commence. The decision to pursue burn should be made early in an incident, taking into account its feasibility and appropriateness and with guidance from Incident Command/Unified Command to make best use of windows of opportunity.

Operations managers should then use this Guide to develop timely plans, brief personnel, and manage operations. Environmental staff should ensure that operational plans conform to any permission requirements or permit conditions.

- The included checklists provide guidance to develop operational arrangements to support ISB at inland locations.
- Verification of continued favorable burning conditions must occur throughout preparations and just prior to ignition. General and habitat-specific listings of such conditions are included.
- The scale of an ISB and its duration will significantly affect the potential hazards, permissions required, operational staffing, management structure, and intensity of any air quality monitoring. This Guide is intended to be incident scale-neutral.
- When encountering unfamiliar terms or acronyms, please refer to the Glossary.
- Appendices provide additional detail on specific operational considerations.

Field Operations Guide for In-Situ Burning of Inland Oil Spills

Introduction

This Guide is intended to assist oil spill responders who are considering or executing controlled in-situ burning of an inland spill. In-situ burning (ISB) is the combustion of hydrocarbon vapors from spilled oil which are converted predominantly to carbon dioxide and water and released to the atmosphere. *In situ* means “in place” in Latin.

The basic objectives of an ISB operation are to:

1. Safely and efficiently remove as much oil as possible from a surface to reduce any environmental impact;
2. Lessen any potential physical damage to habitats from exposure to oil while removing oil from sensitive environments or areas of economic or social importance.

This Guide is intended primarily as a field guide for experienced personnel, as opposed to an educational or decision-making tool. It is assumed that users have basic knowledge or expertise in ISB, so the Guide primarily functions as a set of checklists, tools, and references to assist in conduct of ISB.

- The inland environments in this Guide include terrestrial or upland areas such as grasslands, savannas, forests, deserts, and open agricultural fields, as well as lakes, ponds, rivers, streams, associated wetlands, and other freshwater environments. Near shore marine and estuarine environments are included in this Guide. All environments are considered with and without snow and ice.
- This Guide is intended for all sizes of an incident, since even small, localized incident responses should follow the same basic procedures as a large incident.

Specific In-Situ Burning Considerations

Tactical decisions as well as the nature and amount of resources needed to conduct a safe and effective burn depend upon the size of the expected burn(s); the volume and condition of the oil spilled; the type of release (i.e. batch vs. continuous spill); the proximity of intended burns to their source; and whether the spill source is already ignited, or could be ignited accidentally.

The safety of personnel will always be of paramount importance. Sometimes safety considerations will drive use of specific procedures for ignition and sustained combustion of highly volatile fluids.

Oil Types

It is assumed that the type of oil to be burned is crude oil, diesel, or other petroleum product, which can be burned safely. Lighter petroleum products such as gasoline are typically considered too volatile for a safe burn. The condition of the oil, its weathering state and ability to ignite and burn, is key.

Location Considerations

ISB should be conducted at locations sufficiently removed from an unignited spill source for fire control purposes, especially when oil is still being released. Many inland locations may be conducive to a safe and efficient ISB. In some situations, burning may be the only means of both quickly and safely removing large amounts of oil.

Requirements to Ignite and Sustain an ISB

ISB requires fuel, oxygen, and an ignition source. Fuel for a burn is provided by the vaporization of oil, which is increased by the heat from a fire. To sustain a burn, there needs to be adequate oil for continued vapor generation sufficient to yield steady-state (sustained) burning. The thicknesses required to ignite and sustain combustion depend upon the volatility of an oil, its emulsification (or water content), and wind and sea state conditions. Ignition of spilled oil is especially dependent upon these conditions because of the limited size and intensity of most ignition devices.

- Volatile fractions can quickly evaporate from spilled oil and render it too heavy for a sustained burn. An oil spill over approximately four or five days old may be impossible to ignite or a burn impossible to sustain without use of very hot and long burning ignition devices.
- Once ignited, spilled oil will tend to burn down to a thickness of about 1 mm on water. On soil, the oil soaks in to varying extents, and there is often combustible organic material (vegetation), which contributes fuel for a more complete burn.
- For a burn to be ignited and sustained on water, the spilled oil must be at least 1/10 in., or 2–3 mm, in thickness. For heavier and emulsified oils up to 10 mm in thickness may be necessary to generate burnable vapor concentrations.

Containment

Containment of some form is usually necessary to limit spreading of an oil slick and maintain necessary thickness for ignition and sustained burning. There can be sufficient sorption of oil on soils and vegetation that there may be little horizontal movement.

- On land, spilled oil can be contained by physical means (such as by dikes, snow berms, or ditches). Spilled oil will also collect in natural depressions or low-lying areas where it can be contained and ignited.
- Other types of physical containment (e.g. snow, ice, debris, shorelines) can provide barriers against spreading of oil to support ISB.
- On inland waters, spilled oil can be contained within a fire-resistant boom or naturally in ice, or it can be held by wind against a shore or dam.
- Ambient winds and chemical herders can also help drive oil slicks on water against natural or manmade barriers to thicken oil and support combustion.

ISB Decision-Making Components

ISB quickly and significantly reduces the amount of spilled oil on land or on water surfaces, thereby preventing longer environmental exposure times or spilled oil affecting additional, natural resources and/or habitats. ISB can also reduce ground level air emission concentrations, typically making the post-burn work environment safer for response crews.

The decision to pursue and conduct an on-water burn should take into account the feasibility and appropriateness of ISB. Checklists are provided in this Guide to help address issues involving:

- nature and distribution of spilled oil;
- size and condition of the spill source (a batch or continuous release);
- potential for accidental ignition of the source or other facilities nearby;
- environmental conditions which might preclude a successful ignition and sustained burning, etc.

Once it is determined that a safe and effective burn can be conducted, such information can be used by planners to secure appropriate approvals and resources to carry out the burn(s). Once approved, operations managers should share site-specific burn plans, mobilize resources, brief personnel, and coordinate all offshore, shoreline and air operations.

The focus of this Guide is on the operational plans and implementation of the ISB, not the decision-making process. The Guide should serve as a field reference and summary of key factors in executing safe and effective controlled burns in inland environments once the decision to burn has been made and approved.

ISB Field Operations Checklists

Including Confirming Planning Considerations

General Precautions and Preferred Conditions

- **Winds**—<12 mph (10.5 knots or 19 km/hr) for ignition for better fire control; sustained burning is possible with higher wind conditions.
- **Oil**—at least 2 to 3 mm thick to burn on water (thickness on soil may be less, as determined by a test burn).
- **Standing water**—at least 2 mm deep or well saturated soils with water to soil surface can protect plant roots from heat, particularly applicable for Marshes and Tundra.
- **Peat bogs**—if dry, may catch on fire, are very difficult to extinguish and burning may persist for a long time.
- **Deserts**—consider only burning in non-vegetated areas, between plant groupings and in dry streambeds.
- **Forests**—ISB is generally discouraged but may be acceptable in certain conditions.

Prerequisites

- ☐ On scene conditions continue to justify, and satisfy requirements for, ISB (Appendix A).
- ☐ Human populations are at a safe distance from anticipated fire and smoke (Appendix A).
- ☐ ISB can be conducted safely (Appendix B). A Site Safety Plan specific to a planned burn has been developed, approved, and communicated.
- ☐ Weather forecast indicates suitable conditions will persist over the estimated burn-time window (Appendix C).

- ☐ Oil on bare soil or on water is contained by natural barriers (plants, wind, and topography), or by booms; creating a minimum oil thickness of 2–3 mm for successful ignition.
- ☐ For on-water burns, current and sea state is low enough so that entrainment and loss of oil under containment is precluded.
- ☐ Oil is fresh enough and has enough volatile hydrocarbons to allow ignition and there is sufficient oil and vapors for sustained burning (Appendix E). A test ignition is suggested and may be required.
- ☐ Access (weight, width, turn radius) for fire control, rescue, and monitoring is adequate.
- ☐ Fuel load (vegetation and oil) has been evaluated (if possible by a wildland, prescribed burn specialist/qualified Burn Boss) for inland and upland areas including fields, prairies and savannas.
- ☐ Federal, state, and local approvals have been obtained; consultations have been made.
- ☐ All necessary permits have been obtained and are available onsite.
- ☐ The Responsible Party/Parties, property owner(s), and incident management have given written consent to conduct of a burn.

Logistical Considerations

Personnel

- ☐ Personnel have been identified and assigned for:
 - ☐ Command and Communications.
 - ☐ Safety.
 - ☐ Environmental Protection.
 - ☐ Ignition Operations.

- Fire Surveillance.
- Pollution Monitoring.
- Unburned Residue Recovery.
- Post-Burn Activities (including residue recovery, burn volume estimation, equipment decontamination, photographic and environmental documentation).
- Emergency Medical, Rescue, and Fire Suppression Teams have been established.
- ALL personnel are appropriately trained and/or experienced for their roles.
- Appropriate personal protective equipment (PPE) and safety gear is available, distributed and personnel are trained on its use.
- Hydration, toilets (and in cold conditions warming stations), and food supplies are available.
- Burn area maps and communications call lists have been prepared, verified, and distributed to ALL operations personnel.
- All operations personnel have been briefed on:
 - Safety (including health signs and symptoms of exposure and what to do about it).
 - Ignition and sustained burn plan.
 - Fire control and suppression.
 - Habitat, wildlife, and environmental protection.
 - Emergency response tactics.

Staging

- ☐ Staging areas are identified.
- ☐ If needed, field heliports, or helispots, are identified and marked for:
 - ☐ Medical evacuation/Air ambulance procedures.
 - ☐ Aerial ignition support base (if used).
- ☐ Radios and cell phone coverage in all parts of the operational area are verified.
- ☐ Radio channels are established for:
 - ☐ Command and Control.
 - ☐ Ignition Team.
 - ☐ Fire Surveillance Team (where needed).
 - ☐ Air Quality Monitoring Team.
 - ☐ Other teams, as deemed necessary and appropriate.
- ☐ Ignition equipment, hand-held (drip torches, propane weed burners, etc.), and/or helicopter-deployed capability [helitorch or plastic sphere dispensers (PSDs)] are in place (Appendix E). In cold conditions, these must be able to provide high-temperature and sustained heat to ignite cold oils.

Location Considerations

Terrestrial Burning

- ☐ Fire suppression equipment and personnel to operate it, are sufficient and in place.

- ☐ Water supply for fire suppression of ISB meets these requirements:
 - ☐ Suitable apparatus is available.
 - ☐ Sources identified.
 - ☐ Sufficient capacity verified.
 - ☐ Delivery time and quantities adequate.
- ☐ Firebreaks have been constructed where needed (Appendix D). In ice and snow conditions berms may be constructed of ice and snow.

Open and Flowing Water

- ☐ Fire-resistant boom of sufficient length is available (Appendix D). A typical length is 500 ft per burn team towing unit.
- ☐ Conventional containment boom (for diverting or defecting oil to the burn containment operation) is available.
- ☐ Towing gear (non-metallic towlines, 200–500 ft at each end of towed boom) is available.
- ☐ Anchors, boom vanes, and shore mooring points are available in quantities needed for deflection booms and burn containment operations.
- ☐ Boat or shore access is available for:
 - ☐ Boom deployment (towing capacity of boat engines is critical).
 - ☐ Fire surveillance.
 - ☐ Air quality monitoring.
 - ☐ Rescue team.

- Recovery of unburned residues.
- Decontamination for boats and boom.

Ice Conditions

- For ISB on solid ice over water:
 - Thickness and integrity of ice is verified for all operations that require any personnel or equipment on ice.
 - Chain saws and ice augers are available in needed sizes.
 - Lifting equipment is available to remove ice blocks from trenches.
 - Storage/containment areas for any oiled ice are established.
 - Appropriate equipment if constructing snow berms on ice.
- For ISB on broken ice on water:
 - Booms to contain oil when ice coverage is less than 20%.
 - Chemical herder and an application system to increase the thickness of oil when it is not naturally contained at an ignitable thickness by the confining action of the ice.
- Refer to the companion API Technical Report 1252, *Field Operations Guide for In-Situ Burning of On-Water Oil Spills*.

Monitoring, Notifications, and Documentation

Monitoring

- Air monitoring equipment for particulates, lower explosive limit levels, volatiles, and poly aromatic hydrocarbons are functional, calibrated and deployed (Appendix G).

- ☐ Equipment for unburned residue recovery is identified and in place:
 - ☐ Large sheets of plywood or similar materials laid over marsh/tundra can distribute the weight of personnel and minimize trampling oil into substrate.
 - ☐ Sorbents.
 - ☐ Rakes, shovels, pitch forks, nets.
 - ☐ Heavy equipment (e.g. excavators, track hoes, bobcats, bulldozers, etc.).
 - ☐ Storage facilities (lined pits, containers, etc.).
- ☐ Equipment for recording pre- and post-burn status (cameras, water- and beach-sampling materials as appropriate). Documentation of fire size, location, and duration of burn for burn volume estimates. Recording of multiple burns, amount of burn residue produced and collected, etc.

Public Safety Notifications

- ☐ Local emergency management and law enforcement agencies have been notified, particularly with respect to potential visibility impacts to local roads and highways (aircraft, road and waterborne traffic, and spill response personnel).
- ☐ Roads, where visibility can be impacted by smoke, are closed and traffic detoured.
- ☐ FAA has been notified of possible smoke impacts to air traffic, as appropriate.
- ☐ Nearby residents have been notified and/or temporarily relocated if likely to be impacted by smoke.
- ☐ The local 911 public safety answering service has been briefed on the burn and any likely smoke plume concerns.

- ☐ Public relations contact has been identified and briefed.

ISB Plan Components of an Incident Action Plan

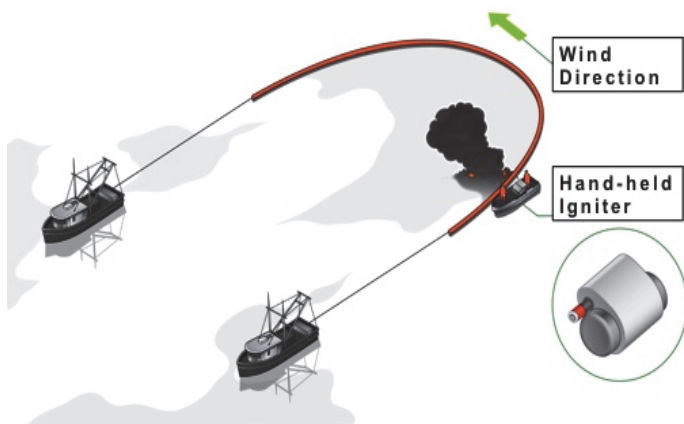
- ☐ An ICS for this ISB has been established (Appendix I).
- ☐ Incident Command conditions and requirements for ISB have been incorporated into plans, as necessary.
- ☐ Requirements of all local, state, and federal permits have been communicated, and incorporated into plans, as necessary.
- ☐ **Site Safety Component** (Appendix B) including:
 - **Emergency Contingency Component** addressing:
 - Monitoring (wind/weather conditions, visibility, temperature, etc.).
 - Fire control (type, amount, location, personnel).
 - Medical/Rescue (air ambulances will usually not transport contaminated patients).
 - Emergency communications.
 - Rapid notification and evacuation of response personnel.
- ☐ **Ignition Plan Component** requirements:
 - Personnel are identified.
 - Burn time estimated and ignition timing criteria are established.
 - Ignition equipment function is checked.
 - Ignition tactics identified (examples are below):
 - For marshes, deserts, tundra, and upland areas including fields, prairies, and savanna, tactics might include ignition upwind, downwind backfires, and

sequencing of ignition to give better control depending upon wind direction and safety considerations.

- For open water, tactics might include towed fire boom, wind herding, and prop wash herding.
 - For flowing water, tactics might include deflection booming and towed fire boom (with or against current).
 - Consider batch burning of slick segments for better control of fire propagation.
 - Firebreaks are verified for desert, marsh, tundra, and upland areas including fields, prairies, and savanna.
 - Test burn is conducted with the igniter of choice, particularly for emulsified (consider using an emulsion breaker) or weathered oil.
- **Fire Surveillance** requirements:
- Observation locations are identified.
 - Personnel are assigned.
 - Action criteria are established.
- **Fire Suppression** requirements:
- Apparatus/equipment is available (even on water: fire extinguishers/monitors are on boats and shore-side burn locations).
 - Personnel are assigned.
 - A sufficient water supply, or other materiel (e.g. foam), is accessible for suppression.
 - When using towed booms on water, consider a rapid-release tow harness.
 - Foam: supply and deployment plans exist.

□ **Oil Concentration Component** for surface water:

- Increase oil thickness to burnable depth (minimum of 2–3 mm) and concentrate oil thickness to increase efficiency of burn.
- Use wind or prop wash to concentrate oil on fire boom or along non-vulnerable shoreline.
- Use diversion boom to deflect oil in current to burn area (boom with shorter skirts is used to reduce entrainment).
- Use two boats to capture oil in a fire boom catenary pocket.
- Use a two-boat task force moving with current to capture oil in fire boom catenary (boom to have relative velocity to stream flow of less than 0.7 knots) for burning.



**Fire Boom Deployed Using Two Vessels
with Hand-Held Ignition**

Drawing courtesy of BP.

- In conjunction with above tactic, use two additional and more widely separated boats towing a diversion boom upstream in a V or funnel configuration, which collects oil over greater water area because the funnel feeds concentrated oil towards the burn.

□ **Oil Collection** requirements for snow:

- For oiled snow on any hard surface, if the snow can be gathered and the oil absorbed to snow concentrated, then it is possible to burn. Mechanical equipment can be used to move large volumes of oiled snow.
- Best results have been with oiled snow collected into cone or volcano shapes so oil settles near the bottom at higher concentrations. For these conditions, an ignition aid could be needed.
- Ignitability will depend on oil type, quantity, and winds. If snow: oil volume is ~25%–40% near the bottom center of a cone, then it is possible to ignite. Ignition may be possible at higher snow ratios.



Burning Oiled Snow

Photo courtesy of ACS.

- **Oil Collection** requirements for broken ice on water:
 - As ice conditions increase beyond 20% to 30%, controlled ISB operations without boom can often be done successfully where the ice limits the spreading of oil and the minimum oil thickness for ignition is maintained.
 - Use hand-held igniters or helitorch to ignite oil between ice leads.
- **Oil Collection** requirements for solid ice on water:
 - Assess ice strength for tolerance of equipment and responders.
 - Slots cut in ice to collect oil to be 1.5 to 2 times as wide as ice is thick, oil will migrate to slots.
 - If flowing water is under ice, angle slots 30 degrees to the current flow.
 - A hole in the ice surface or in an ice trench may release trapped oil, which can be burned.
- **Aviation Operations** requirements (if used)
 - Aerial observation criteria are defined and communicated.
 - Aerial ignition systems operations procedures are established.
- **Air Quality Monitoring** requirements (Appendix G):
 - Monitoring locations are identified.
 - Personnel and equipment are assigned.
 - Monitoring frequency and reporting times are established.
 - Action criteria are established.