IN-SITU BURNING, ON WATER

OBJECTIVE & STRATEGY

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The objective of the In-situ Burning, On Water tactic is to conduct a controlled burn of spilled oil while it is pooled on the water's surface. In-situ Burning, On Water may be used to augment mechanical removal of oil under certain conditions. It is most effective when it is deployed as soon as possible after the oil has impacted an area so that volatile components can be utilized in burning the oil.

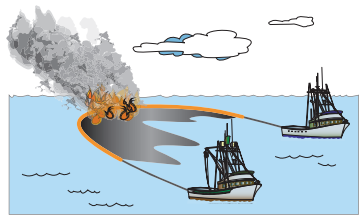

Figure ISw-1. In-situ Burning On Water deployment "U" configuration.

The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing Discharge Tracking, On Water and/or trajectory analysis.
2. Determine that conditions are appropriate for in-situ burning by reviewing the current version of the In-situ Burning (ISB) Guidelines.
3. Obtain regulatory approval through the Unified Command.
4. Review and follow the current In-situ Burning Guidelines.
5. Plan burning operation so as not to interfere with other on-water operations.
6. Select equipment and a configuration that best supports the operating environment.
7. Mobilize personnel, response equipment, and fire suppression equipment to the location.
8. Encounter the oil and concentrate it on the water's surface to a thickness of 2-3 mm (1/16 to 1/8 inch) using fire-resistant boom.

9. Ignite the oil.
10. Constantly monitor the burn and surrounding area to ensure safe operations and containment of the fire.
11. Remove any burn residuals from the water's surface.

TACTIC DESCRIPTION

In-situ burning systems on water generally consist of a containment mechanism, an ignition system, and fire suppression equipment. Oil must be fresh (less than 2-3 days of exposure), collected in sufficient enough amounts to sustain combustion and have a minimum thickness of:

- 1 mm (< 1/16 inch) for fresh, volatile crude oil
- 2-5 mm (1/16 - 3/16) for aged, unemulsified crude oil and diesel fuel
- 5-10 mm (3/16 - 3/8) for emulsions and intermediate fuel oils.

In order for the burning operations to be effective, the EPA recommends that the oil not be more than 25% emulsified or more than 30% evaporated. In order for a burn to be successful, wind speeds should be less than 20 knots and wave height should be less than 3 feet in choppy, wind-driven seas and less than 5.7 feet in large swells (wave period >6 seconds). Like conventional oil boom, fire boom cannot usually be effectively deployed in currents greater than 1 knot. For optimal burning conditions, currents should be less than .75 knots. In some cases, it may be possible to contain the oil in a higher current, if the boom array and towing vessels drift down-current while holding a relative velocity of less than 1 knot.

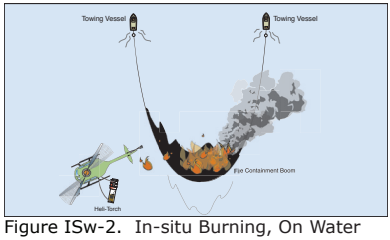

Figure ISw-2. In-situ Burning, On Water deployment configuration.

Oil must be contained within fire-resistant boom (Figure ISw-2) using the techniques shown in the On-water Free-oil Recovery tactic. Fire boom deployment is subject to the same weather and operational constraints as boom used in mechanical recovery, although

the fire boom is typically heavier and less flexible. Fire boom is typically constructed of either fabric coated with a fire-resistant substance or metal. Some types of fire boom use a seawater cooling system. Oil may also be contained by ice.

With fire suppression equipment/plans and adequate response personnel present, the oil can be ignited. Ignition systems for small fresh oil spills can be a handheld weed burner/torch or incorporate gelled fuel (NAPALM) that is placed in the oil and ignited. For larger areas, a heli-torch may be used to ensure rapid ignition and provide aerial monitoring of the burn.

The ignitability of oil slicks on water is affected by oil type, wind speed, emulsification of the oil, igniter strength, ambient temperatures, and sea state. When oil is ignited and begins to burn, it is actually the oil vapor that burns, and not the oil itself. In order for an oil slick to burn, the fire must be hot enough to maintain a vapor flow. Most oils will burn on water if the oil is present in sufficient thickness to avoid the heat sink effect, caused when heat from the oil layer is transferred to the water and thus extinguishes the fire.

The burning is done in a controlled fashion and requires adequate personnel and equipment to monitor the burning process. If burn residues from heavy oils and crude are produced, these should be mechanically removed. Downwind emissions must be below threshold levels for sensitive populations.

In-situ Burning, On Water is initiated only after authorization is granted by the Alaska Department of Environmental Conservation, the US Environmental Protection Agency, and the US Coast Guard; and consultation with the U.S. Department of the Interior and the US Department of Commerce (National Oceanic and Atmospheric Administration, National Marine Fisheries Service). Specific requirements are set forth in the ISB Guidelines. Plume delineation or other methods should be used to ensure that downwind emissions do not threaten sensitive populations.

Operating Environments

In-situ burning may be used in Open, Protected, Calm water, or Broken-Ice environments assuming other physical and environmental parameters are within safe operating limits. In any case, a safe distance must exist between the burn

site and human populations. On water that is more than 3 miles from shore, the safe distance between the burn and downwind human populations is considered to be 1 mile. On water that is less than 3 miles from shore, the safe distance is 3 miles.

In-situ burning may be used in sea ice under certain conditions. In circumstances where the ice concentrates the oil and prevents it from spreading (usually in ice concentrations greater than 70%), burning may be able to remove a high percentage of the slick. Solid ice may also slow the evaporative loss process. However, broken ice conditions may complicate vessel operations and fire boom deployment if booming is necessary to concentrate the oil. During spring breakup, oil may accumulate in melt pools, while subsurface oil slowly migrates to the surface through brine channels and cracks. During freeze-up, spilled oil becomes contained by new thin or slush ice.

Deployment Configurations

When towing fire boom, two response vessels deploy the fire-proof boom between them in a "U" configuration, with one end attached to each vessel (Figure ISw-3). The boom is typically between 300-500 feet in length and is towed by the two vessels at speeds of between one-half and three-fourths of a knot. It is not essential that all of the boom used in this tactic be fire boom, but instead, may be a combination, i.e. regular boom for the legs and fire boom for the apex.

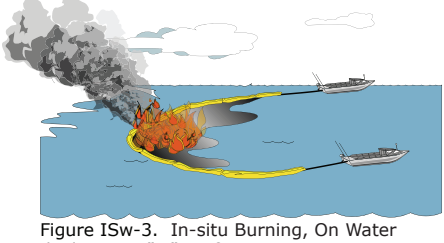

Figure ISw-3. In-situ Burning, On Water deployment "U" configuration.

Oil that gathers inside the "U" is moved to a location away from the main spill slick where it is ignited. By controlling the speed of the vessels, the rate of the burn can be increased, decreased, or even extinguished. Any residues left in the boom after the burn must be recovered by conventional means.

In-situ burn operations may involve one or more U-boom configurations organized into task forces. Vessel pairs may

work independently, with each pair towing and then burning a portion of the oil slick; or, they may coordinate their efforts, with one or more pairs towing oil in conventional booms and concentrating the oil into one or more fire boom containment areas.

In-situ burn operations are generally conducted in one of two distinct modes. In "batch" mode, oil is collected in a section of fire-resistant boom towed by two vessels until the back third of the boom is filled. Next, the filled boom is maneuvered to a safe distance crosswind. The contained oil is then ignited, and the oil is burned then extinguished. The burn residue is collected and the boom is inspected for damage and replaced as needed. Finally, the boom is towed back to the slick to collect more oil and begin the process again.

"Continuous" mode operations involve positioning the fire boom at a safe down-drift distance from a continuous oil leak, such as a well blowout, and then burning the oil continuously or intermittently as it accumulates at the back of the boom. Caution must be taken to make sure the fire does not burn back up the slick to the source. This mode of operations can also be carried out without the use of fire boom in instances where uncontained oil slicks are thick enough to support combustion.

The burn can be extinguished in several ways. The tow speed can be increased to force the oil under the boom; however this has the potential to temporarily increase the burn diameter by as much as 10 times before the slick is extinguished. A second method involves the release of the boom by one of the vessels or the stopping of both vessels, allowing the oil to spread and become too thin to sustain a burn. This, too, can temporarily increase the burn diameter by as much as tenfold.

Monitoring

In-situ Burning, On Water is initiated only after authorization is granted by the Alaska Department of Environmental Conservation, the US Environmental Protection Agency, and the US Coast Guard; and consultation with the US Department of the Interior and the US Department of Commerce (National Oceanic and Atmospheric Administration and National Marine Fisheries Service). Specific requirements

are set forth in the ISB Guidelines. Plume delineation or other methods should be used to ensure that downwind emissions do not threaten sensitive populations. NOAA has developed a Special Monitoring of Advanced Response Technologies (SMART) protocol for use with in-situ burning operations.

Residue Recovery

The amount and type of residue that remains after burning operations may vary depending upon a number of factors. Most burns result in taffy-like layers of weathered, viscous material that is relatively buoyant. Some residues may become neutrally or negatively buoyant quickly after combustion and/or sediment uptake. If the residue is sufficiently buoyant, it may be possible to retain it in the apex of the U-boom configuration. By combining the residue with fresh oil in subsequent burns, a major portion of the residue may be eliminated.

If the residue remains buoyant and it is practical to recover it before collecting and burning additional oil, the residue can be released to secondary containment booms or nets. Whether recovered from secondary booms or the fire boom, the burn residue can normally be picked up with large strainers or hand tools, with viscous-oil sorbents, or with standard viscous-oil skimmers (Figure ISw-4).

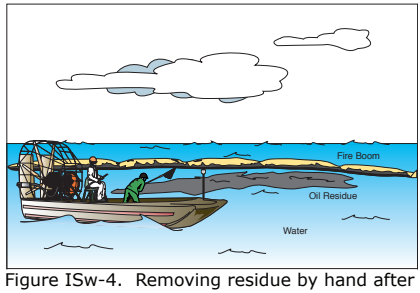

Figure ISw-4. Removing residue by hand after a burn.

If it is not recovered, burn residue will usually break up into smaller tar balls or tar mats and sink or disperse.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Consider the possible effects of smoke on responders, populated areas, and wildlife.
- Fire retardant clothing and other PPE should be worn by responders as required by the incident-specific Site Safety Plan.

- Evaluate the need for respiratory protection for responders. This protection should be readily available in case the wind shifts.
- Communication and clear understanding of responsibilities is crucial to execution and safety during the burn process.
- Secondary fires need to be anticipated and prevented. Allow residue to cool before approaching.
- ADEC, USCG, and EPA approval (through the Unified Command) must be obtained using the ARRT "Application for In-situ Burning."
- Wind conditions should be monitored to ensure responder safety and fire control, burning should not be commenced in wind greater than 20 knots.
- Vessels towing boom need to be ready to cast off or cut the lines towing the boom in an emergency.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- If possible, vessels in transit to/from an operation or staging area should transit in pairs.
- A communications schedule should be established and followed, between vessels in transit and the Operations Section or Radio Dispatcher.

DEPLOYMENT

- Conventional boom combined with fire boom in the apex can be used to form a boom array, if enough fire boom is not available.
- Refined products generally burn more efficiently and produce less residue, but can contain higher toxicity.
- ADEC, USCG, and EPA approval (through the Unified Command) must be obtained prior to commencing burn operations.

REFERENCES TO OTHER TACTICS

Other tactics associated with In-situ Burning, On Water:

- On-water Free-oil Recovery
- Discharge Tracking On Water

EQUIPMENT AND PERSONNEL RESOURCES

Resources for this tactic include vessels, fire boom, ignition systems, fire suppression equipment and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, and resource availability. Resource sets may need to be refined as site-specific requirements dictate.

In-situ Burning, On Water

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Equipment	Function	Quantity	Notes
Ignition system (handheld burner, propane tank and hoses, heli-torch, or gelled fuel)	Burn collected oil	Site-specific	Depending on configuration, oil concentration
Fire suppression system	Control burn if necessary	Site-specific	Use of multiple hand held fire extinguishers is acceptable onboard vessels
Fire boom with tow lines and bridles	Contain oil to sufficient thickness for burning	300-500 ft. per U-boom configuration	Fire boom has a limited number of cycles, so replacement boom should be available
Anchors	Moor boom when not in use	1 or more	Optional
Boom repair kit	Repair boom	1	
Vessel/Aircraft	**Function**	**Quantity**	**Notes**
Tow vessels with crews	Pull fire boom	2 to 8 per task force	Crews should have in-situ burning training
Helicopter with crew	Ignite oil and provide area monitoring	1	Necessary if using heli-torch ignition system
Aircraft with aerial observer	Tracking	1	
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Operate ignition systems and direct general technicians	2 to 4	Depending on number of vessels in operation
General Technicians	Work under the direction of skilled technicians to prep areas for burning	0 to 4	Depending on number of vessels in operation

Residue Recovery

Equipment	Function	Quantity	Notes
Hand tools	Recovery	Site-specific	
Large strainers	Recovery	Site-specific	
Viscous-oil sorbent	Recovery	Site-specific	
Viscous-oil skimmers	Recovery	Site-specific	
Fire extinguisher	Fire suppression	Site-specific	
Vessel	**Function**	**Quantity**	**Notes**
Work boat with crew	Recovery platform	1 to 2	Class 3, 4, or 5
Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Skilled Technicians	Conduct residue recovery operations	2 to 4	Depending on area covered
General Technicians	Work under the direction of skilled technicians to recover residue.	2 to 4	Depending on area covered