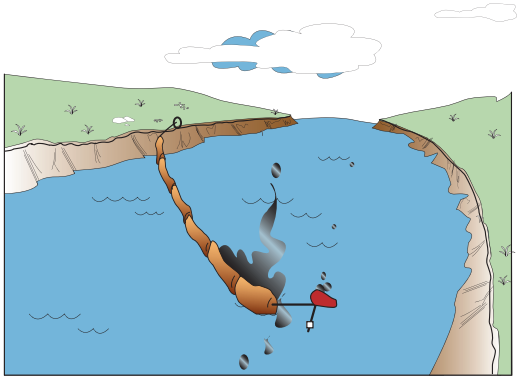
DEFLECTION BOOM

OBJECTIVE & STRATEGY

DF

The objective of Deflection Boom is to direct spilled oil away from a location to be protected or simply to change the course of the slick. For the purposes of maintaining consistent and clear terms, "deflection" is used to describe the tactic where oil is redirected away from an area but not recovered, in contrast with the term "diversion", which is always associated with oil recovery.



TACTIC DESCRIPTION

The Deflection Boom tactic is for water-born spills where there is some current, usually from 0.5 to 3.0 knots. The boom is placed at an optimum angle to the oil trajectory, using the movement of the current to carry oil along the boom and then releasing it into the current again with a new trajectory. The angle is chosen to prevent oil from entraining beneath the boom skirt. Boom may be held in place by anchors, vessels, or a boom control device.

Deflection Boom may be used to temporarily avoid impacts to a sensitive area, but there is no recovery associated with the tactic, thus no oil is removed from the environment. For this reason, Diversion Boom or Free-oil Recovery is preferable to Deflection Boom whenever feasible. However, Deflection Boom may be more effective than Exclusion Boom at protecting a sensitive location, where currents over 0.75 knots exist.

The two alternatives for this tactic are Fixed Deflection and Live Deflection. In Fixed Deflection, boom is anchored to the shoreline or bottom. In Live Deflection, the boom is attached to vessels and held in position by the power of the vessels or one end of the boom is anchored and the other end held in position with a vessel. Live deflection is a very difficult tactic to execute. It should only be utilized where fixed deflection cannot be achieved, usually because deep water precludes anchoring.

The general strategy is to:

1. Identify the location and trajectory of the spill or potential spill.
2. Identify, prioritize, and select sensitive areas to be protected from impact.

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3. Select a deployment configuration that best supports the operating environment and available resources.
4. Mobilize to the location and deploy the tactic.
5. Place boom using secured anchor systems, mooring points, vessels, boom control devices, etc.
6. Monitor and adjust the boom on an appropriate basis.

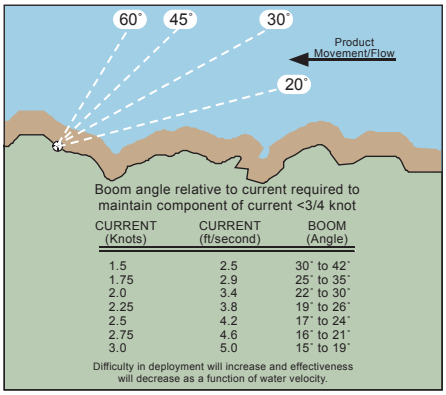

Figure DF-1. Boom angle relative to current.

Boom Angle

Figure DF-1 is used to select the appropriate boom angle to keep oil from entraining under the boom. Note that the angle relative to the current decreases rapidly as the current increases. Where currents exceed 3 knots the boom must be almost parallel to the current to prevent entrainment. In currents exceeding 3 knots, a cascade of boom arrays may be used; the first boom array will slow the velocity of the slick allowing subsequent arrays to deflect the oil.

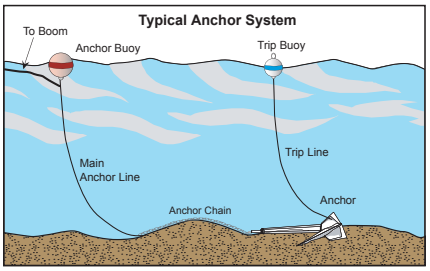

Figure DF-2. Typical anchor system components.

Anchor Systems

Boom is secured in place using standard anchoring systems that are shown in Figure DF-2. Anchor sizes vary depending on the boom type and the operating environment.

Boom Control Devices

Boom control devices are an alternative to anchoring deflection boom on the offshore end. Boom control devices have the advantage of allowing continuous control over the angle and position of the boom. They can also allow the boom to be moved to allow a vessel or drifting debris to pass by without interfering with the deflection operation. One type of boom control device is a vessel, which continuously controls the offshore end of the boom. Controlling a deflection boom with a vessel takes considerable skill and a vessel suited for the purpose. Another type of boom control system is a trolley. Trolleys require that a line be strung from one shoreline to another, thus they are mostly used in rivers. Trolleys may block a river to passage by vessels and they are susceptible to impacts from debris. A relatively new type of boom control device is built on the principle of a wing or rudder. Devices such as

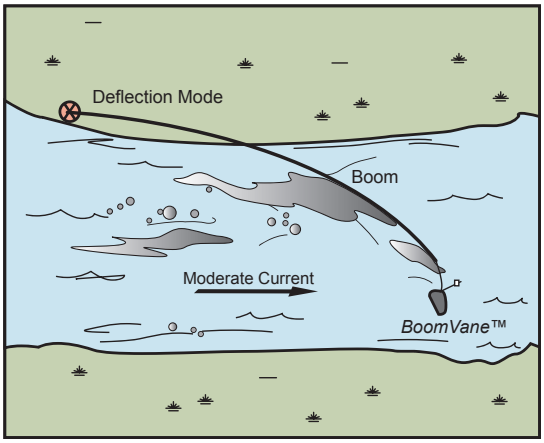

Figure DF-3. Using the BoomVane™ in deflection mode.

the BoomVane™, allow the boom to be deployed and controlled from the shoreline (Figure DF-3). This decreases the need for vessels and anchor systems, while allowing superior control of the boom angle.

Operating Environments

DF-O OPEN WATER

Fixed deflection boom systems are not recommended for the open water environment because of the high probability of fixed boom failure and the difficult of anchoring in this environment. The Live Deflection Booming and On-water Free-oil Recovery tactic may work better in this environment, due to their inherent mobility.

Deflection boom system components (vessel and boom) for open water operations should be able to withstand seas up to 6 feet and winds up to 30 knots.

DF-P PROTECTED WATER

Boom, anchors and vessels for protected water deflection boom systems should be able to withstand seas up to 3 feet and winds up to 25 knots. Vessels deploying deflection boom systems may be deep draft or shallow draft, depending on the water depth.

DF-C CALM WATER

Calm water deflection boom systems are composed of boom and anchors that can operate in seas of 1 foot and in winds up to 15 knots. Vessels deploying calm water deflection boom systems typically work in depths as shallow as three feet.

DF-F FAST WATER

Fast water deflection boom systems are designed to operate in moving water where the current exceeds 0.8 knots. This includes rivers and areas with significant tidal current. Vessels, boom, and anchors used in tidal waters should be able to deploy and operate in seas up to 1 feet and in winds up to 15 knots. Vessels, boom, and anchors used in river waters should be able to deploy and operate in waves up to 2 feet and in winds up to 15 knots.

DF-B BROKEN ICE

Deflection boom systems may be difficult for the broken ice environment because of the high probability of boom failure and loss due to ice encounters.

Deployment Configurations

There are many variations for deployment of Deflection Boom. Several configurations are described below, but responders should consider the actual conditions and modify their deployment accordingly.

Deflection Boom

SINGLE BOOM

Boom is deployed from a site at an optimum angle to the current and anchored to deflect the oil away from a location.

CASCADE

Several booms are deployed in a cascade configuration when a single boom cannot be used because of fast current or because it is necessary to leave openings in the boom for vessel traffic, etc. This configuration can be used in strong currents where it may be impossible to effectively deploy one continuous section of boom. Shorter sections of boom used in a cascade deployment are easier to handle in faster water, thereby increasing efficiency. Additional equipment may be required to set and maintain this system as compared to the single boom configuration.

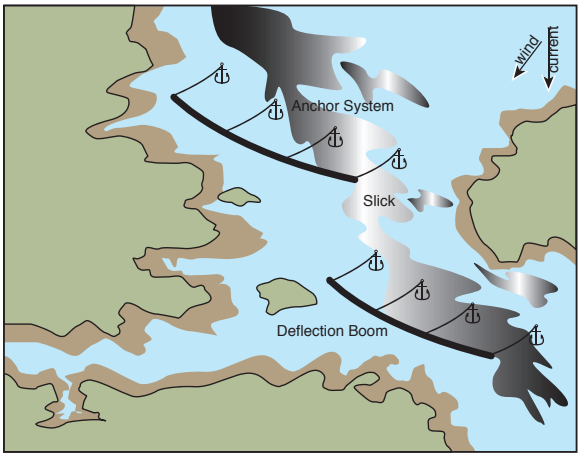

Figure DF-4. Deflection booming, fixed cascaded array.

LIVE

Booms are held in position by vessels. It takes practice and considerable skill in vessel handing to execute this effectively.

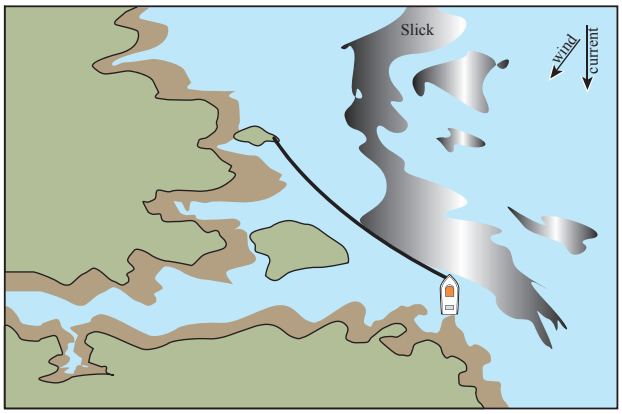

Figure DF-5. Deflection booming, half-live.

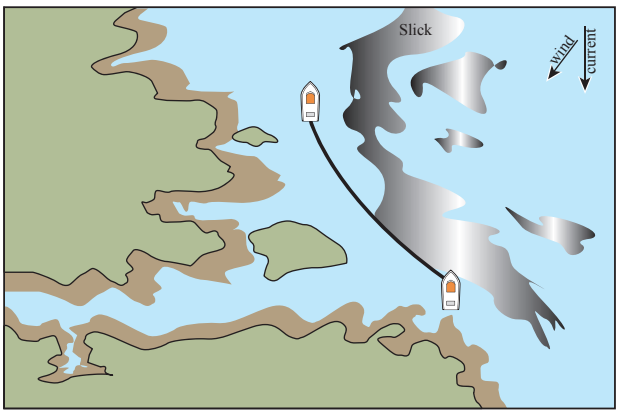

Figure DF-6. Deflection booming, live.

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily weather evaluation is recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment. Local knowledge is preferred.
- Vessels, including skiffs, must have a minimum of two crew aboard.
- Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation.
- 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.
- Anchor trip lines should be made of material strong enough to handle a moderate strain during boom reconfigurations. Responders normally used the trip line to reposition and reset the anchors.
- Buoy lights should be considered for night operations on fixed systems.
- Response personnel should wear PPE as required by the incident-specific Site Safety Plan.

DEPLOYMENT

- Calm/Protected water boom (6" x 24" / 18" x 42") are most commonly used for this tactic.
- Do not assume 100% efficiency with one boom system.
- Readjust angles and widths between boom sections as necessary to meet changing conditions (tides, currents, and winds).
- Constant monitoring of system efficiency is required.
- Deployment planning should be based on average high tidal conditions.
- If oil is being deflected away from the shoreline, tidal-seal boom is not usually required.
- Anchor systems must be selected based on the maximum stress that might be expected to occur on the boom array, considering stronger currents and winds than when the anchor is set.
- The scope of the anchor line should be at least 3 times the depth of the water. If the anchor fails to hold try increasing the line scope to five times the depth of the water and/or double the length of the anchor chain. Finally, if additional anchor holding is required, anchors can be ganged or set in series.

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- All screw pin shackles shall be seized with wire.
- Extreme care should be used when taking strains on anchoring systems using the aft cleats of small vessels and skiffs.
- The type of bottom and slope needs to be considered when selecting anchoring systems for fixed systems.
- If tidal-seal boom is not available, sorbent materials such as pom-poms or snare on rope can be placed next to or attached to conventional boom to hinder oil entrainment under the boom at the beat water interface. Plans should be made to change out oiled sorbent on each low water tide cycle.
- If wildlife or historic properties are encountered, see Wildlife Checklist on page A-19 or Historic Properties Checklist on page A-20.

REFERENCES TO OTHER TACTICS

Other tactics associated with Deflection Boom include:

- DV • Diversion Boom
- C • Containment Boom

EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels; boom; anchoring, mooring, or control systems; and response personnel. Configuration and specific resources required will be determined by site conditions, spilled oil type and volume, area of coverage, as well as resource availability. Resource sets may need to be refined as site-specific requirements dictate.

Open Water Deflection Boom System[1]

DF-O

Typical Equipment	Function	Quantity	Notes
Oil Boom, > 36" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Large anchor systems, boom control devices, or shore-based anchors	Keep boom in selected configuration	Site-specific	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 2, 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 8	Depending on number of vessels and configuration

[1] Not recommended, see Operating Environment.

Deflection Boom

Protected Water Deflection Boom System — DF-P

Typical Equipment	Function	Quantity	Notes
Oil Boom, 18" to 42" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6 At least one vessel with a crane is recommended	Deploying/tending anchors and boom	2 to 4	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	2 to 4	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	2 to 4	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	2 to 4	Depending on number of vessels and configuration

Calm Water Deflection Boom System — DF-C

Typical Equipment	Function	Quantity	Notes
Oil Boom, 6" to 24" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration

Fast Water Deflection Boom System — DF-F

Typical Equipment	Function	Quantity	Notes
Oil Boom, 8" to 24" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Small anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 3, 4, 5, or 6	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervise operations	1	May not always be on-site
Vessel Operators, protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crews vessels and operates response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration

Deflection Boom

Broken Ice Deflection Boom System

DF-F

Typical Equipment	Function	Quantity	Notes
Oil Boom, 8" to 42" height	Deflect oil slick	Site-specific	Depending on configuration, currents, sea states, and oil concentration
Anchor systems, boom control devices, or shore-based anchors	Secure boom in selected configuration	Rule of Thumb – 1 anchor per 200 ft. of boom	Depending on configuration, currents, and sea states
Typical Vessel	**Function**	**Quantity**	**Notes**
Class 1, 2, or 3	Deploying/tending anchors and boom	1 to 3	Depending on configuration, currents, and sea states. Steel hull required.
Typical Personnel	**Function**	**Quantity**	**Notes**
Field Team Leader	Supervises operations	1	May not always be on-site
Vessel Operators, open/protected/calm water	Masters of response vessels	1 to 3	Depending on number of vessels
Skilled Technicians	Crew vessels and operate response equipment	1 to 3	Depending on number of vessels and configuration
General Technicians	Work under the direction of skilled technicians or vessel operators	0 to 3	Depending on number of vessels and configuration