

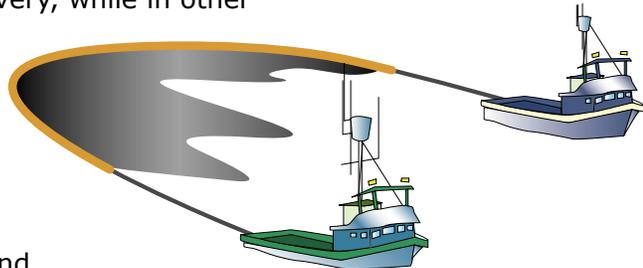


ON-WATER FREE-OIL RECOVERY

OBJECTIVE & STRATEGY



The objective of the Free-Oil Recovery tactic is to contain and recover spilled oil on the water, thus minimizing impact to the environment. In some situations, the Unified Command may task the free-oil recovery team with maximizing oil recovery, while in other situations the objective may be to maximize protection of a sensitive area by encountering oil that is on a trajectory to impact that area.



The general strategy is to:

1. Identify the trajectory and location of the spilled oil by performing over-flight surveillance and trajectory analysis.
2. Select a deployment configuration that best supports the operating environment and available resources.
3. Mobilize to a location downstream and upwind of the slick and deploy free-oil recovery teams.
4. Encounter the oil and concentrate it in oil boom.
5. Recover the oil with available skimming systems.
6. Store the recovered fluid in a primary storage device, until it can be transferred to secondary storage.

TACTIC DESCRIPTION

Free-oil recovery systems are comprised of vessels with oil boom for containment and concentration, skimming systems for recovery, and primary storage devices for temporary storage. There is a great variation in the way these systems are configured depending on the operation environment, type of oil and state of weathering, and the available deployment platforms. Examples of skimming systems and primary storage devices may be found in the Marine Recovery tactics sheet.

Operating Environments



OPEN WATER

Free-oil recovery system components (vessels, boom and skimmers) for open water operations should be able to deploy and operate in

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seas up to 6 feet and in winds up to 30 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Open water free-oil recovery systems are usually based on large vessels with high volume skimmers and large primary storage devices, such as barges (see Figure FO-1). In many cases, the components of these systems are dedicated to oil spill response. Open water systems are usually deep draft, operating at depths of greater than 6 feet.

FO-P FO-S PROTECTED WATER

Vessels, boom and skimmers for protected water free-oil recovery systems should be able to deploy and operate in seas up to 3 feet and in winds up to 25 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Protected water free-oil recovery systems are often based on vessels of opportunity, such as fishing vessels, fitted with portable skimmers and primary storage devices. Protected water systems may be deep draft or shallow draft, depending on the water body.

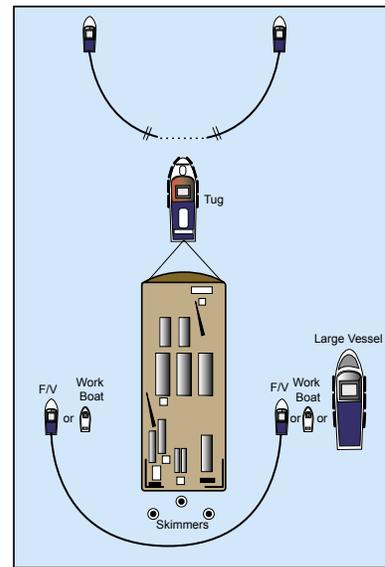


Figure FO-1. Open water barge-based free-oil recovery system.

FO-C CALM WATER

Calm water free-oil recovery systems are composed of vessels, booms and skimmers that should be able to deploy and operate in seas of 1 foot and in winds up to 15 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Calm water free-oil recovery systems are usually based on small fishing vessels, work-boats or skiffs fitted with portable skimmers and primary storage devices. Calm water free-oil recovery systems typically work in depths as shallow as three feet.

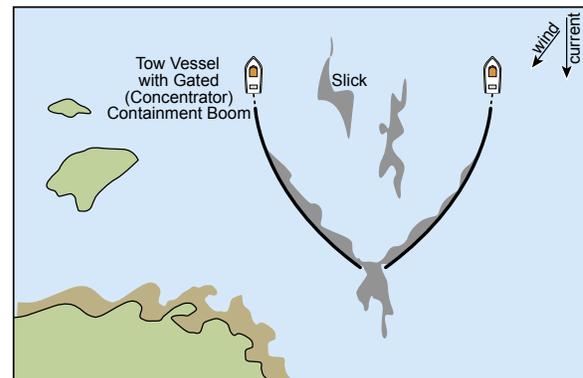


Figure FO-2. Gated U-boom concentrator boom, towed in front of free-oil recovery.

FO-F FAST WATER

Fast water free-oil recovery 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 skimmers used in tidal waters should be able to deploy and operate in seas up to 1 feet in winds up to 15 knots. Vessels, boom and skimmers used in river waters should be able to deploy and operate in waves up to 2 feet



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in winds up to 15 knots. Vessels setting and tending the boom should be able to safely transit seas which exceed the boom's operating limitation. Fast water current free-oil recovery systems are equipped with high-current boom and skimmers. These systems are usually deployed from small vessels or skiffs.

FO-B **BROKEN ICE**

Free-oil recovery in broken ice may be difficult to deploy and operate because of ice interfering with the boom and skimming system. Free-oil recovery systems deployed in broken ice should be highly maneuverable, utilizing vessels that can safely operate in ice. Sometimes, ice leads can act to contain and concentrate oil so that a Marine Recovery system can be used for collection. Oleophilic rope skimmers are preferred over brush or wier skimmers in broken ice, because ice tends to clog wier and brush skimmers. Skimming system efficiency is generally reduced in broken ice.

Deployment Configurations

There are three typical deployment configurations for Free-Oil strike teams.

U - BOOM CONFIGURATION

The U-Boom System consists of vessels towing boom in a "U" configuration concentrating spilled oil into the back of the pocket formed by the boom (see Figure FO-3). This technique can also be used solely for oil concentration by leaving an opening secured by chain in the apex of the boom (see Figure FO-2). This is referred to as a "gated U-Boom". Typically, combinations of these configurations are used to enhance concentration and

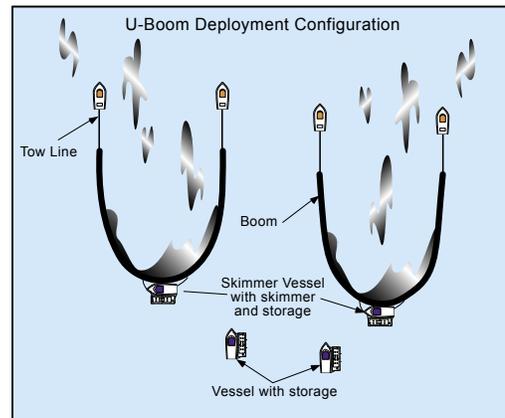


Figure FO-3. U-boom configuration.

containment effectiveness. The spilled oil is then collected with a recovery device (skimmer), typically deployed by an additional vessel, and stored in a primary storage device.

V-BOOM CONFIGURATION

The V-Boom Configuration consists of vessels towing boom and a recovery device (skimmer) in a "V" configuration (see Figure FO-4). The spilled oil is concentrated with the boom toward the back apex where a skimmer is located for oil

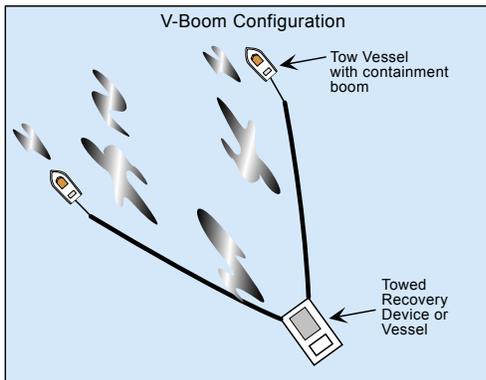


Figure FO-4. V-boom Configuration.

recovery. Typically, these recovery systems are designed with a limited amount of storage built in and are either offloaded frequently or are augmented with additional storage devices and transfer systems.

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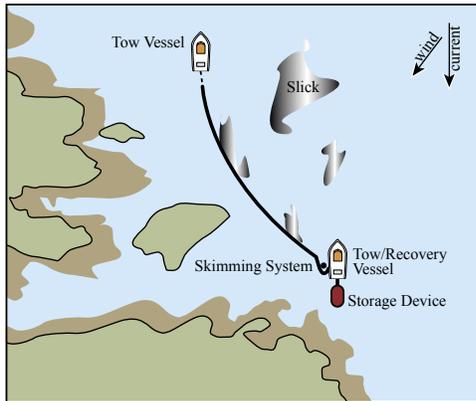


Figure FO-5. J-boom configuration.

J-BOOM CONFIGURATION

The J-Boom Configuration consists of vessels towing boom in a “J” configuration, concentrating the spilled oil for recovery into the back of the pocket formed by the boom (see Figure FO-5). The rear towing vessel is outfitted with a recovery device (skimmer) for deployment along the vessel side where the apex of the boom is formed. The oil is then collected with the skimmer and stored in a primary storage device, such as a mini barge. This system is often utilized in place of the U-Boom system, when the response

is limited by the amount of vessels available and when maneuverability is not as critical.

BOOM CONTROL AND ENHANCED RECOVERY DEVICES

Recent improvements in boom control devices, such as the Boom Vane™, allow a single vessel to deploy and control a U-Boom system (Figure FO-6). Enhanced recovery devices, such as the Current Buster™, allow for greater speed of advance for the boom system and concentrate oil to a deeper depth for more efficient collection (Figure FO-6). These improvements can improve system efficiency and reduce the costs of operation.

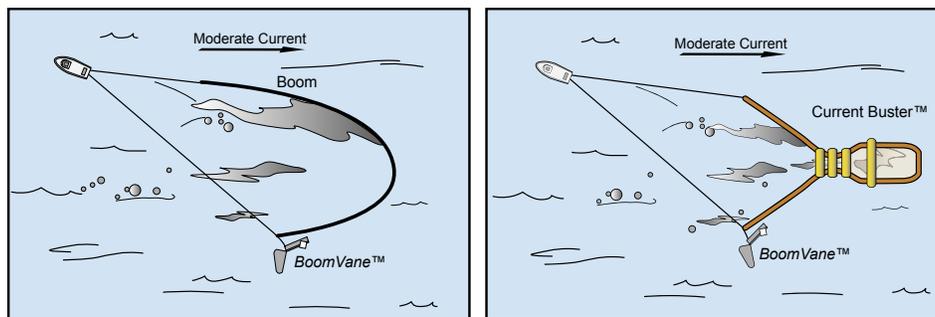


Figure FO-6. Free-oil recovery using a BoomVane™ to control one end of a U-boom and a Current Buster™.

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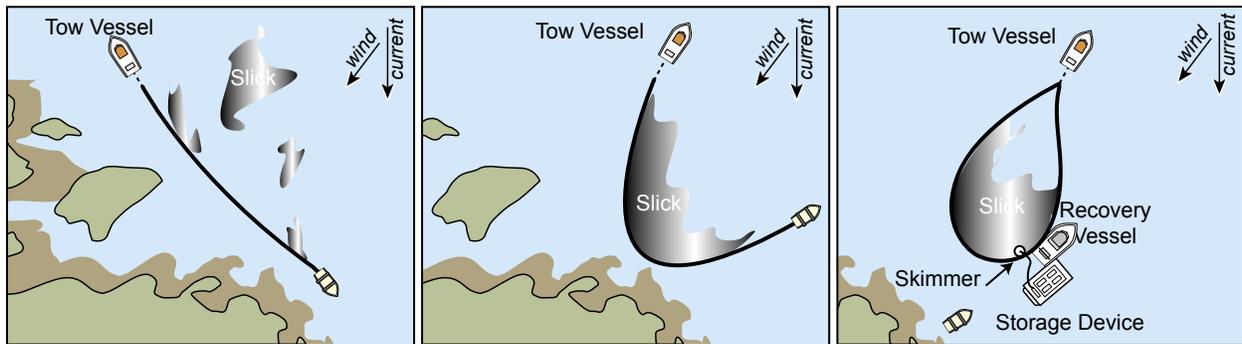


Figure FO-7. Nearshore trapping, boom-towing boats collect oil then tow the trapped oil to deeper water for recovery.

NEARSHORE TRAPPING

Shallow draft vessels can be used to capture oil in shallow water by encircling it and slowly dragging the slick into deep water. A marine recovery system is then used to remove the oil (see Figure FO-7).

DEPLOYMENT CONSIDERATIONS AND LIMITATIONS

SAFETY

- Daily fair and foul weather evaluations are recommended, and should include distance to safe harbor, transit times and exposure of vessels.
- Vessel masters should have experience in the appropriate operating environment and local knowledge is preferred.
- Vessels setting and tending the boom should be able to safely transit seas which exceed the boom’s operating limitation.

DEPLOYMENT

- Site conditions may influence deployment configuration options.
- Combinations of free-oil recovery and diversion tactics are often used together.
- Combinations of configurations may optimize recovery.
- Procedures and permits for decanting recovered water should be considered.
- Open water systems, typically operate two 12 hr. shifts per day. Other systems typically operate one 12 hr. shift per day.
- Logistics for oil transport and disposal should be considered.

REFERENCES TO OTHER TACTICS

Other tactics associated with free-oil recovery include:

-  Marine Recovery
-  Diversion Boom
-  Marine Based Storage and Transfer

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EQUIPMENT AND PERSONNEL RESOURCES

Commonly used resources for this tactic include vessels, boom, skimmers, primary storage devices, and personnel. Configuration type and quantity of strike teams 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 Free-oil Recovery System

| Typical Equipment | Function | Quantity | Notes |
|--------------------------------|--|---|---|
| Oil boom, > 42" height | Contain and concentrate oil | 1,000 to 3,000 ft. | Depending on configuration and oil concentration |
| Skimming system(s), open water | Recover concentrated oil | 1 minimum | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Enhanced recovery device | Concentrate oil | 1 optional | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Primary storage device | Store recovered fluid | 2 times the effective daily recovery capacity of the skimming system(s) | Typically large barges or bladders are used for open water systems. |
| Decanting system | Removing recovered water | 1 optional | Permit is required to decant. |
| Typical Vessel | Function | Quantity | Notes |
| Class 1 or 2 | Platform for skimming and handling recovery device | 1 or 2 | Depending on configuration |
| Class 3, 4, 5 or 6 | Boom towing | 1 to 4 | Depending on configuration |
| Typical Personnel | Function | Quantity | Notes |
| Field Team Leader | Supervise operations | 1 | |
| Vessel Operators, Open water | Masters of response vessels | 2 to 5 | Depending on number of vessels |
| Skilled Technicians | Crews vessels and operates response equipment | 4 to 7 | Depending on number of vessels |
| General Technicians | Work under the direction of skilled technicians | 2 to 5 | Depending on number of vessels |

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Protected Water Free-oil Recovery System

| Typical Equipment | Function | Quantity | Notes |
|--|--|---|---|
| Oil boom, 18" to 42" height | Contain and concentrate oil | 500 to 1,000 ft. | Depending on configuration and oil concentration. |
| Enhanced recovery device | Concentrate oil | 1 optional | Examples are: Current Buster™ or River Lagoon™. |
| Boom control device | Control one end of boom array | 1 optional | May be used in place of one vessel |
| Skimming system(s), protected water | Recover concentrated oil | 1 minimum | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Primary storage device | Store recovered fluid | 2 times the effective daily recovery capacity of the skimming system(s) | Typically mini-barges or small bladders are used for protected water systems. |
| Decanting system | Removing recovered water | 1 optional | Permit is required to decant. |
| Typical Vessel | Function | Quantity | Notes |
| Class 1, 2, or 3 | Platform for skimming and handling recovery device | 1 | Depending on configuration |
| Classes 3, 4, 5, or 6 | Boom towing | 1 to 3 | Depending on configuration |
| Typical Personnel | Function | Quantity | Notes |
| Field Team Leader | Supervise operations | 1 | |
| Vessel Operators, Protected/Calm water | Masters of response vessels | 2 to 4 | Depending on number of vessels |
| Skilled Technicians | Crews vessels and operates response equipment | 1 to 4 | Depending on number of vessels |
| General Technicians | Work under the direction of skilled technicians | 1 to 4 | Depending on number of vessels |



Calm Water Free-oil Recovery System

| Typical Equipment | Function | Quantity | Notes |
|--|--|---|---|
| Oil boom, 6" to 24" height | Contain and concentrate oil | 200 to 1,000 ft. | Depending on configuration and oil concentration |
| Enhanced recovery device | Concentrate oil | 1 optional | Examples are: Current Buster™ or River Lagoon™. |
| Boom control device | Control one end of boom array | 1 optional | May be used in place of one vessel |
| Skimming system(s), open water | Recover concentrated oil | 1 minimum | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Primary storage device | Store recovered fluid | 2 times the effective daily recovery capacity of the skimming system(s) | Typically mini-barges or portable tanks are used for calm water systems. |
| Decanting system | Removing recovered water | 1 optional | Permit is required to decant. |
| Typical Vessel | Function | Quantity | Notes |
| Classes 4, 5, or 6 | Platform for skimming and handling recovery device | 1 | Depending on configuration |
| Classes 4, 5, or 6 | Boom towing | 1 to 3 | Depending on configuration. Use of a boom control device, such as a Boom-vane™, may necessitate less vessels. |
| Typical Personnel | Function | Quantity | Notes |
| Field Team Leader | Supervise operations | 1 | |
| Vessel Operators, Protected/Calm water | Masters of response vessels | 2 to 4 | Depending on number of vessels |
| Skilled Technicians | Crews vessels and operates response equipment | 1 to 2 | Depending on number of vessels |
| General Technicians | Work under the direction of skilled technicians | 0 to 4 | Depending on number of vessels |

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Fast Water Free-oil Recovery System

| Typical Equipment | Function | Quantity | Notes |
|--|--|----------------|---|
| Oil boom, 8" to 24" height | Contain and concentrate oil | 200 to 500 ft. | Depending on configuration and oil concentration |
| Enhanced recovery device | Concentrate oil | 1 optional | Examples are: Current Buster™ or River Lagoon™. |
| Boom control device | Control one end of boom array | 1 optional | May be used in place of one vessel |
| Skimming system(s), calm water current | Recover concentrated oil | 1 minimum | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Primary storage device | Store recovered fluid | 1 | Typically mini-barges or small bladders are used for fast water systems. |
| Decanting system | Removing recovered water | 1 optional | Permit is required to decant. |
| Typical Vessel | Function | Quantity | Notes |
| Classes 5 or 6 | Platform for skimming and handling recovery device | 1 | Depending on configuration |
| Classes 5 or 6 | Boom towing | 1 to 2 | Depending on configuration. Use of a boom control device, such as a Boom-vane™, may necessitate less vessels. |
| Typical Personnel | Function | Quantity | Notes |
| Field Team Leader | Supervise operations | 1 | |
| Vessel Operators, Protected/Calm water | Masters of response vessels | 2 to 3 | Depending on number of vessels |
| Skilled Technicians | Crews vessels and operates response equipment | 1 to 3 | Depending on number of vessels |
| General Technicians | Work under the direction of skilled technicians | 0 to 3 | Depending on number of vessels |

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Broken Ice Free-oil Recovery System

| Typical Equipment | Function | Quantity | Notes |
|---|--|----------------|---|
| Oil boom, 8" to 24" height | Contain and concentrate oil | 200 to 500 ft. | Depending on configuration and oil concentration |
| Enhanced recovery device | Concentrate oil | 1 optional | Examples are: Current Buster™ or River Lagoon™. |
| Skimming system(s), calm or protected water | Recover concentrated oil | 1 minimum | Type and capacity of skimmer depends on oil type, oil weathering state and operating environment. |
| Primary storage device | Store recovered fluid | 1 or 2 | Typically mini-barges with sufficient hull strength for ice. |
| Decanting system | Removing recovered water | 1 optional | Permit is required to decant. |
| Typical Vessel | Function | Quantity | Notes |
| Classes 2, 3, or 4 | Platform for skimming and handling recovery device | 1 | Depending on configuration |
| Classes 2, 3, or 4 | Boom towing | 1 to 2 | Depending on configuration. |
| Typical Personnel | Function | Quantity | Notes |
| Field Team Leader | Supervise operations | 1 | |
| Vessel Operators, Open/Protected/Calm water | Masters of response vessels | 2 to 3 | Depending on number of vessels |
| Skilled Technicians | Crews vessels and operates response equipment | 1 to 3 | Depending on number of vessels |
| General Technicians | Work under the direction of skilled technicians | 0 to 3 | Depending on number of vessels |

