CONVERSION OF A U.S. COAST GUARD SKIMMING BARRIER INTO A SINGLE-VESSEL SKIMMING SYSTEM[1]

Kevin R. McManus
Offshore Devices, Inc.
Summit Industrial Park
Peabody, Massachusetts 01960

ABSTRACT: *This paper proposes a pilot program to convert one or more U.S. Coast Guard open water oil containment and recovery systems, or skimming barriers, into single-vessel skimming systems, and a three-year period of testing and evaluation, using both drills and actual spills of opportunity. This paper describes and evaluates the performance of the proposed single-ship unit, and proposes a conversion plan and a means to evaluate this pilot program.*

An ongoing program of equipment development and evaluation is necessary to successfully implement the federal open ocean spill response policy. The U.S. Coast Guard, as the federal agency responsible for assuring prompt and effective response to coastal and offshore oil spills, is continually evaluating new technologies for responses to these incidents. The single-vessel skimming system (SVS) described below adapts the technology of the open water oil containment and recovery systems (OWOCRS) for use by a single vessel.

Description of SVS unit

The proposed SVS would utilize, to the greatest extent possible, existing Coast Guard equipment and performance capabilities. The SVS includes a skimming barrier section which is towed alongside by an aluminum outrigger boom (Figure 1). An aluminum rack is used to deploy and store the skimming barrier. The barrier, when deployed, has a total sweep width of 40 feet (plus half the vessel beam).

When not in use, the SVS skimming barrier is wrapped around the storage rack's long center tube, and individual struts rest on channel sections; the tops of struts are secured to the center section using brackets and quick-release pins. This rack allows the skimming strut flotation bags to be inflated, and the hose and line connections to be made while the barrier is still on deck. The barrier is deployed by lowering the entire rack (with barrier) into the water; individual struts float off as the rack is lowered into the water.

The outrigger is a 45-foot long aluminum section with a universal joint fitting on the inboard end and a foam-filled float on the outboard end. The outrigger float incorporates an underwater tow point for the outboard end of the barrier. The outrigger is held perpendicular to the vessel side by a two-part forward guy line to the vessel bow.

The existing USCG double-acting diaphragm pumps would be used to remove the collected oil. Three pumps would be mounted on a tubular aluminum rack, providing a total pumping capacity of 750 gallons per minute. New 3-inch petroleum recovery hoses would be used to transfer oil from the skimming strut weirs to the pollution pumps and storage. The system would be driven by the USCG's ADAPTS system, a portable diesel-hydraulic powerpack which is currently used to run pumps for the OWOCRS.

SVS operating criteria

The SVS can be installed on any vessel over 70 feet, with over 250 square feet of working deck space, and adequate low speed maneuverability (for towing operations).

The SVS can be transported to staging areas on a flatbed truck, or airlifted on pallets; the system's total weight is approximately 2,800 pounds; it requires approximately 800 cubic feet of storage or transport space. Once it arrives at the spill site or staging area, it can be lifted by crane, using stainless steel lifting bridles.

The SVS can normally be deployed by 3–4 persons in 15–20 minutes, provided the vessel has a 1-ton crane available for deployment and retrieval. In rough sea conditions which prevent use of a crane, additional personnel may be required to manually deploy the barrier.

The SVS may be used to collect oil windrows (long narrow slicks of oil formed by wind and wave action), or wider, thinner oil slicks, by supplementing the barrier's sweep width with additional containment boom. The containment boom is used to direct and concentrate the slick into the skimming barrier section. For very large spills, the SVS can be combined with an OWOCRS to increase sweep width. If necessary, the SVS can be moored, with or without additional containment boom.

The SVS tow speed, like that of the OWOCRS, is normally 1–2 knots. Above 1 knot, oil may be entrained and lost underneath the barrier, particularly in thick oil slicks. For thinner slicks, the pumping rate can be increased to prevent oil loss at these higher tow rates. The SVS can be streamed from the outboard end of the outrigger, or the stern of the vessel, at speeds up to 6 knots, if necessary, to move between distinct oil patches.

The system will collect oil in a 4 to 6 foot chop (larger swells), and winds of 25 knots. It can survive conditions much more severe than these; however, deployment becomes more difficult and dangerous, and oil cleanup minimal, in these marginal conditions. In addition, the high rates of dissolution and evaporation in seas exceeding 6 feet, and winds of 25–35 knots usually disperse an oil slick to very low concentrations.

Advantages of SVS unit

The SVS unit's maximum oil recovery rates and its wave following abilities are similar to those of the OWOCRS. The system components require far less storage and transport space, fewer towing vessels, and less crane hoist capacity (approximately one-sixth of that

1. The opinions expressed herein are solely those of the author.

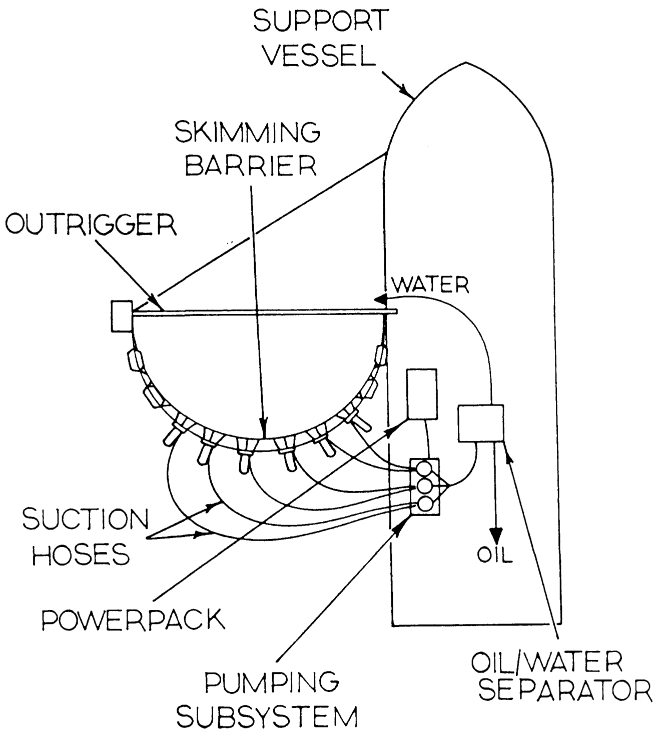

Figure 1. Proposed single-vessel skimming system[2]

required for the OWOCRS). Individual components may be shipped together or separately, using either aircraft or truck. Fewer personnel (3–5 strike team members, as compared to the 12 required with the OWOCRS), are required to operate the SVS.

The SVS provides strike teams with numerous options in deployment modes, pre-siting, and vessel use. The strike teams will be able to respond to coastal and bay spills, as well as offshore spills in which the spiller does not, or cannot handle the response.

Disadvantages of SVS unit

The principal disadvantages of the proposed SVS unit include (1) the capital investment in the new equipment; (2) the need for additional strike team training exercises on the new equipment; and (3) the loss of sweep width (from 400 to 50–55 feet). These concerns must be weighed against the long-term objectives of the USCG's Marine Environmental Response program, and the availability of operating resources for the strike teams.

Case histories of SVS performance

The SVS has been used several times for responses to actual offshore spills. The most extensive data on spill performance comes from the Louisiana Offshore Oil Port (LOOP). The first spill on which the equipment was used occurred in 1982, at LOOP's deepwater port facility 18 miles off the Louisiana coast.[5] Approximately 1,000 to 2,000 gallons of light Saudi Arabian crude oil were spilled. At the time of the spill, seas were 2–4 feet, with winds of 10–15 knots.

LOOP personnel deployed the SVS unit in 15 minutes from a 70-foot converted shrimper used for a support vessel. The system was deployed and began skimming 5½ hours after the initial notification of the spill. The skimming operations continued for approximately 20 hours (no skimming was done at night); 1,000 gallons of oil were recovered and stored onboard the response vessel. The system was retrieved in 10 minutes, by 5 LOOP personnel. According to the best estimates of total spill volume, the SVS unit recovered virtually all the spilled oil possible. No significant damage was observed as a result of the spill.

LOOP used the SVS again at the deepwater terminal in May 1984, to respond to a spill of approximately 7,000 gallons of Mexican Isthmus crude oil. At the time of the spill, seas were 3–5 feet and winds were moderate. The SVS began skimming narrow oil patches which had escaped beneath a containment boom deployed earlier. The skimming operations lasted about one hour, recovering between 1,100 and 1,500 gallons of oil (15–21 percent of the initial spill volume). Weather conditions prevented further recovery, as squalls built seas to 8–10 feet and greatly reduced visibility.[2]

In another "spill," an SVS unit owned and operated by the Clean Seas oil spill cooperative in Santa Barbara, California demonstrated its oil recovery capacity to the USCG and the California Coastal Commission (CCC). The test, arranged as a condition of granting consistency for an OCS oil development program, involved the skimming oil released from natural seeps in the sea floor off Coal Oil Point.[6]

The seas were 2–3 feet, and winds were light during the test. Two SVSs were deployed, one on each side of the vessel; total deployment time for both was approximately 40 minutes. Oil was contained effectively at towing speeds of 1–2 knots, although there was some evidence of oil entrainment at speeds above 1.5 knots. The amount of entrained oil was minimal and could not be confirmed.

Clean Seas SVS units were used again to respond to the tanker *Puerto Rican* oil spill off San Francisco Bay in November 1984. The SVS units recovered approximately 1,100 barrels of oil/water emulsion during 4 days of skimming. The recovery operations were generally conducted in seas of 5–8 feet.[1]

Conversion procedures and costs

The OWOCRS conversion involves (1) the removal of the six center skimming struts from the OWOCRS; (2) the assembly of a new barrier, using these struts; (3) the fabrication and assembly of an outrigger, pump rack, flotation struts, tension line, and suction hoses; and (4) the installation of six containment struts to replace the ones removed from the OWOCRS.

The proposed procedure will not require any changes in the Coast Guard pumping subsystem (aside from installation of USCG pumps on the new rack), the hydraulic control system, and ADAPTS diesel-hydraulic powerpack. The OWOCRS used for the conversion will be available for use as an oil containment barrier.

An estimated $60,000 to $70,000 would be required to convert one OWOCRS into an SVS. This total must be evaluated against the present costs incurred by the USCG to maintain and operate the OWOCRS. The cost of repairing and troubleshooting an OWOCRS after use in a spill, based upon recent contract data, is approximately $32,000. The reimbursable strike team expenses for the barrier transportation, deployment, and repacking at the *M/V Alvenus* spill totalled approximately $101,000 over a two-week period.[8]

Proposed testing program

Testing of the SVS unit can be accomplished using both simulated responses to spills and actual responses to spills of opportunity. The OWOCRS has been tested extensively at the Environmental Protection Agency's OHMSETT testing facilities.[4] As a result, the system's performance characteristics, which will not change as a result of the conversion, are well-documented. However, much more information is needed on deployment capabilities, personnel training and requirements, and system performance during realistic spill conditions.

Simulated spills can be useful in this regard. The proposed testing program would involve responses to three hypothetical spills, each of which represents very different logistical problems. The important element for each exercise is a minimum amount of prior notification, in order to maintain a realistic spill situation.

The first scenario would be a response to an offshore tanker collision and spill in the Gulf of Mexico, under conditions similar to the *M/V Alvenus* or *Burmah Agate* spills. The second scenario would involve a port facility spill in Delaware Bay (or another east coast

Table 1. Potential USCG single-vessel system support vessels[7]

Vessel	Sea state operating capability	Note
Buoy tender	1–5	Might have steerage problem from wind
Medium-endurance, 210 foot cutter	1–5	Might have steerage problem from wind
82 foot cutter	1–3	Cannot operate at required low speeds
30 to 40 foot cutter	1–3	Might have steerage problem from wind
25 foot, 8 inch motor	1–2	Unsatisfactory except under ideal daylight conditions
Ocean-going tugs	1–5	Probably cannot operate at required low speeds
High-endurance cutter	1–5	Probably cannot operate at required low speeds with satisfactory steerage

inlet), in order to test the unit's inshore capabilities and maneuverability. The third scenario would involve a response to a spill in Alaska (possibly in Prince William Sound or Cook Inlet), in order to test the ability to move the equipment great distances by air, and its performance in higher sea states and strong currents.

To the extent possible, these responses should not be planned for specific dates; advance notice should be limited to senior program managers and strike team commanders. These conditions should provide a more accurate assessment of a strike team's ability to respond to a real spill, and coordinate their actions with the necessary USCG district offices and/or private contractors.

The use of the SVS at actual spills should also be encouraged, although equipment deployment decisions will obviously have to be made at the discretion of the federal on-scene coordinator (OSC). However, potential OSC's should be advised of the availability of the SVS unit, should it be needed. Documentation from actual spill responses will be of paramount importance for the evaluation of this pilot program. Three years should provide sufficient time to thoroughly test and evaluate the system.

Siting considerations

If three OWOCRS were converted, one could be sited at each of the strike teams' facilities. If only one SVS was developed, it would be best sited at the Gulf Strike Team's facility in Mobile, Alabama, due to the area's petroleum development and transportation activities. Conversion of the OWOCRS could be done at the strike team's facility, assuming a suitable work space could be arranged. This option would eliminate the costs of shipping an OWOCRS to and from a contracting facility, and would allow strike team personnel to become more familiar with the unit during the assembly and inspection process.

SVSs also could be rotated for one-year periods at each of the strike teams, in coordination with the approximate spill simulation dates. Units could be moved in response to new oil exploration and development activities. Because the SVS can be readily transported by a variety of methods, pre-siting may not be a critical issue, at least during the pilot program.

Suitable USCG SVS support vessels

The USCG utilizes 16 classes of vessels. Most are unavailable for pollution response, due to their specialized missions, such as oceanography, icebreaking, navigation, and training. Table 1 lists the vessels which would likely be available for SVS support; these vessels are currently slated for use during pollution incidents, as OWOCRS towing and support craft.[7]

As the table indicates, virtually all the vessels could have difficulties maneuvering for extended periods at the required slow speeds. The 180-foot buoy tenders appear to be the best choice for a support vessel, due to their location in most major U.S. ports; available work space and lifting capacity (for buoy maintenance); ability to operate untended at close quarters; and capabilities in higher sea states. The buoy tenders are often used now to deploy and tow the OWOCRS. Their relatively low freeboard (7 feet) at the working deck level would greatly assist strike team personnel in the deployment, operation, and retrieval of the SVS. In addition, it is likely that any steerage problems resulting from winds would probably occur when skimming operations are not practicable (due to high sea states).

The SVS can be installed on many types of vessels available in the private sector. Units have been installed on converted shrimp boats, offshore crew boats, offshore supply vessels, and dedicated pollution response vessels.

Conclusion

The proposed conversion of an OWOCRS into an SVS will provide the Coast Guard with a new option for use during responses to marine oil spills in bays, coastal waters, and offshore. The system retains the seakeeping abilities and skimming capacity of the OWOCRS, but requires fewer personnel and less handling equipment for deployment and operation.

References

1. Clean Bay, 1985. Clean Bay's Response to the *"Puerto Rican"* Spill. Clean Bay Cooperative, Concord, California, pp4-4 to 7-6
2. Dalton, William and A. J. Heikamp, Jr., 1985. Early experiences with a single-vessel offshore spill cleanup system. *Proceedings of the 1985 Oil Spill Conference,* American Petroleum Institute, Washington, D.C., pp57–60
3. Doherty, Chad, et al., 1980. Open ocean pollution response—the Coast Guard system. *Proceedings of the 1980 Offshore Technology Conference,* Offshore Technology Conference, Dallas, Texas, pp245–254
4. Environmental Protection Agency, 1981. Summary of U.S. Environmental Protection Agency's OHMSETT Testing, 1974–1979. EPA Office of Research and Development, Cincinnati, Ohio. pp53–62, 162–192
5. Heikamp, A. J., 1982. Louisiana Offshore Oil Port. Notes on *M/V London Trader* Spill. September, 1982 (unpublished)
6. Onstad, L. A., 1984. Memorandum on Test of Clean Seas Advancing Skimmer. U.S. Coast Guard, September 4, 1984
7. U.S. Coast Guard, 1982. Skimming Barrier Operations and Maintenance Manual. U.S. Coast Guard Office of Engineering, Washington, D.C. pp1-1 to 2-54
8. U.S. Coast Guard, 1984. Incident Summary: *M/V Alvenus* Grounding and Oil Spill. U.S. Coast Guard Gulf Strike Team, Mobile, Alabama