DESIGN AND DEVELOPMENT OF OIL SPILL RESPONSE CRAFT ECO-13

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Abstract: *The Oil Spill Response Craft ECO-13 is the primary High Speed Oil Recovery Craft for accidental marine spills response in Croatia. The first ECO-13 was built in 2000, the second one in 2001, and the third and fourth craft will be finished in 2003. This paper reviews the requirements for the high speed oil spill response craft, and describes the design development of ECO-13. The paper highlights design features of ECO-13 and outlines its special equipment.*

Key words: *Sea Ecology*, *Oil Spill, Oil Spill Response, Oil Spill Response Craft, Contingency Plan for* Accidental Marine Pollution

INTRODUCTION

Oil spills are rare and highly variable occurrence. The environmental impact is, however, determined by much more than size - by the nature of oil, the rate of spillage, sea and weather conditions, the sensitivity of the environment, location of beaches, ports etc., and the marine life in the region. The Adriatic Sea as a whole is a very sensitive area from the viewpoints of sea ecology, fisheries, protected part of nature, mariculture farms, cultural monuments, facilities important for economic use of the sea and for tourism in particular. Over the last 20 years, many mechanical oil recovery devices have been developed (e.g. suction and weir skimmers, skimmers with a moving belt, oil-absorbent rope, etc.). These cannot recover useful amounts of oil from the thin layers once the oil has spread. Successful oil recovery has thus tended to be limited to small spills in sheltered waters, harbors, etc. Experience of large tanker spills in open seas is that little oil can be recovered. In the case of the Exxon Valdez, 6-8% was recovered at sea, even in waters which were relatively sheltered and calm. Rapid reaction to spills by specially designed oil spill recovery vessels capable of collecting oil from the sea is therefore very important. These systems have the advantage of being complete, with on-board oil/water separation capability and storage capacity. Their disadvantages include their high cost and the time likely to be required to steam to the site of a spill.

Oil spill response at open sea is a challenging task, and is normally only initiated if the oil pollution threatens a shoreline or important marine life. Our knowledge about the sea currents and the weather makes it possible to predict the most probable route which the spilt

oil will follow. PC software is available for trajectory analysis. Surveillance is done by satellites or from aircrafts. Once it has been decided by the responsible authority to launch a response operation, the basic pattern should follow the instructions in the contingency plan for the area.

Experience in clearing up the Exxon Valdez spill emphasized the value of dual type vessels in oil spill response operation. Such vessels should be a combination of special designed smaller oil spill response craft with high speed and other low speed vessels such as barges or small tankers, adapted for recovery purposes, with their storage capacity used for oil. Due to high cost and high probability of occurrence of smaller spills, modern oil spill craft tend to be of smaller size and higher speed. Besides the oil recovery, they are intended to perform various other mission such as: environmental patrol, firefighting, search and rescue, sea water sampling etc.

OIL SPILL RESPONSE

There are many possible ways of technical response to a larger oil spill situation, as described in the Table 1. Each method, dispersant, mechanical recovery etc. has its own advantages and limitation, and the best approach needs to be assessed in the light of individual circumstances. Booms tend to be ineffective in currents much over 1 to 1.5 knots and wave heights over 1.8 to 2.5 meters. Successful oil recovery has thus tended to be limited to small spills in sheltered waters, harbors, etc. The best environmental option is clearly to offload the oil before it can pollute the sea and foreshore. In calm waters, this can be a straightforward operation if smaller tankers can be brought alongside. Where seas are too rough and the site of accident cannot be approached, safety considerations may rule against off-loading at sea. If a tanker is aground on rocks near land, a land based operation could be considered. This would require floating pipelines and pumping to temporary storage tanks or into road tankers. The main difficulty would be to assemble sufficient receiving capacity.

Containment booms (Offshore)
Containment booms (Inshore)
Skimmers and transfer pumps
Temporary oil storage facilities (Offshore)
Temporary oil storage facilities (Inshore)
Dispersant equipment: Offshore spray units, Inshore spray units, Beach clean up units
Planes for transport and spraying

Table 1. Equipment for oil spill response

A Contingency Plan for Accidental Marine Pollution in the Republic of Croatia [1]

identifies the abatement measures in case of larger accidental marine pollution, the entities responsible for implementing the measures and their authorizations, and a method of implementation. The plan covers the territorial sea, the internal sea waters to the line separating the continental waters and the sea waters, and the sea coastline as described in Figure 1. The entities participating in the Plan implementation are Headquarters for the Plan Implementation (HQ). and Operational Headquarters (OHQ).

The HQ members are designated by the Government of the Republic of Croatia among the representatives of the Ministry of Interior, the Ministry of Maritime Affairs, Transport and Communications, the Ministry of Agriculture and Forestry, the Ministry of Health, the Ministry of Defense, the Ministry of Finance, the Ministry of Tourism, the Ministry of Physical Planning, Building and Housing, the Ministry of Economy, the Ministry of Culture, the State Directorate for Environment, the State Directorate for Waters, the State Weather Bureau, and the State Institute of Hydrography. The Commander of the Operational Headquarters will decide on the method of surveillance of oil and/or oil-mixture slick and its behaviour and movement. Generally, the surveillance is carried out by aircraft or helicopters. Should that not be possible, the slick surveillance will be carried out from the sea going vessels. Based on the surveillance data, meteorological data, sea and air currents data, the characteristics and quantity of oil and/or oil-mixture spilled, the OHQ Commander will decide on the response measures to be taken to eliminate the pollution. In case of oil and/or oil-mixture spillage, the pollution clean-up will be carried out by specialized companies registered for such jobs following the order issued by the Operational Headquarters.

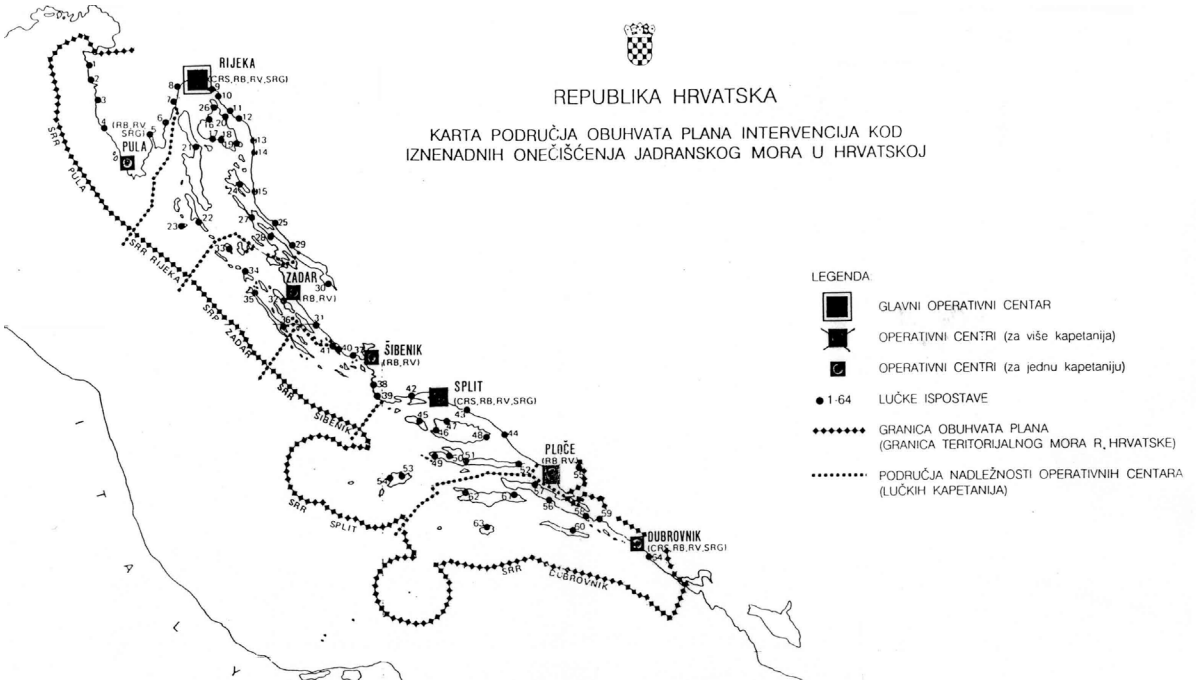

Figure 1. A Organizational Chart for Accidental Marine Pollution in the Republic of Croatia

DEVELOPMENT OF ECO-13

The formation of the State Directorate for Environmental Protection Vessel Acquisition Committee for Preparation and Evaluation of International Tender for Oil Spill Response Craft in 1998 [2] and its announced intentions to introduce up to 6 craft into the existing Croatian System for Accidental Marine Pollution understandably sparked the attention of the marine community in Croatia and abroad. As a result, the Committee received 6 proposals on the International Tender for Procurement of oil spill response craft in 1998. These proposals, not unexpectedly offered a broad spectrum of proposed craft performance and characteristics and most importantly price. Due to financial constraints, none of them was awarded a contract. In 1999. a new tender package for the procurement of an oil spill boat compromising new Statement of Requirements document was outlined. This second call included a request from those who had previously submitted proposals. Following an extensive tender evaluation process by the Oil Spill Response Craft Acquisition Committee, in 1999. the contract for procurement was signed with Punat Shipyard, which in collaboration with Brodarski Institute – Marine Research & Special Technologies Special Design Department offered the ECO-13 design. The comparison of the main technical characteristics of the ECO-13, M-1 Battle tank, and Boeing 777 aircraft are given in Table 2.

CHARACTERISTICS	M-1 Battle tank	Boeing Airliner	ECO-13
Weight (t)	65	250	10
Length (m)	7,6	61	13
Number Systems	25	40	30
Crew Size	4	10 (2 pilots)	3
Patrol Duration (hr)	24	8 - 14	15
Number of Parts	14 000	100 000	20 000
Assembly Man-Hour	5 500	50 000	11 000
Production time (month)	7,5	14	6

Table 2. Comparison of Main Technical Characteristics

DESIGN FEATURES

The general arrangement plan of the ECO-13 is shown in Figure 2. The arrangement is based upon a number of considerations including operational requirements, habitability, producibility, and access for personnel, and equipment maintenance. The maximum speed of the craft is 29 knots and the range 300 Nm at 25 knots. The aluminum hull is divided into five

watertight compartments: fore peak, crew compartment, oil spill structural tank, machinery compartment and aft peak. The arrangement of the aft deck was primarily influenced by the housing and handling requirements for a deck crane, booms and skimmer, Figure 3. Location forward from the wheelhouse is used for the fitting of mooring and anchoring equipment. There is also a railing which facilitates easy transfer of boarding party to other craft.

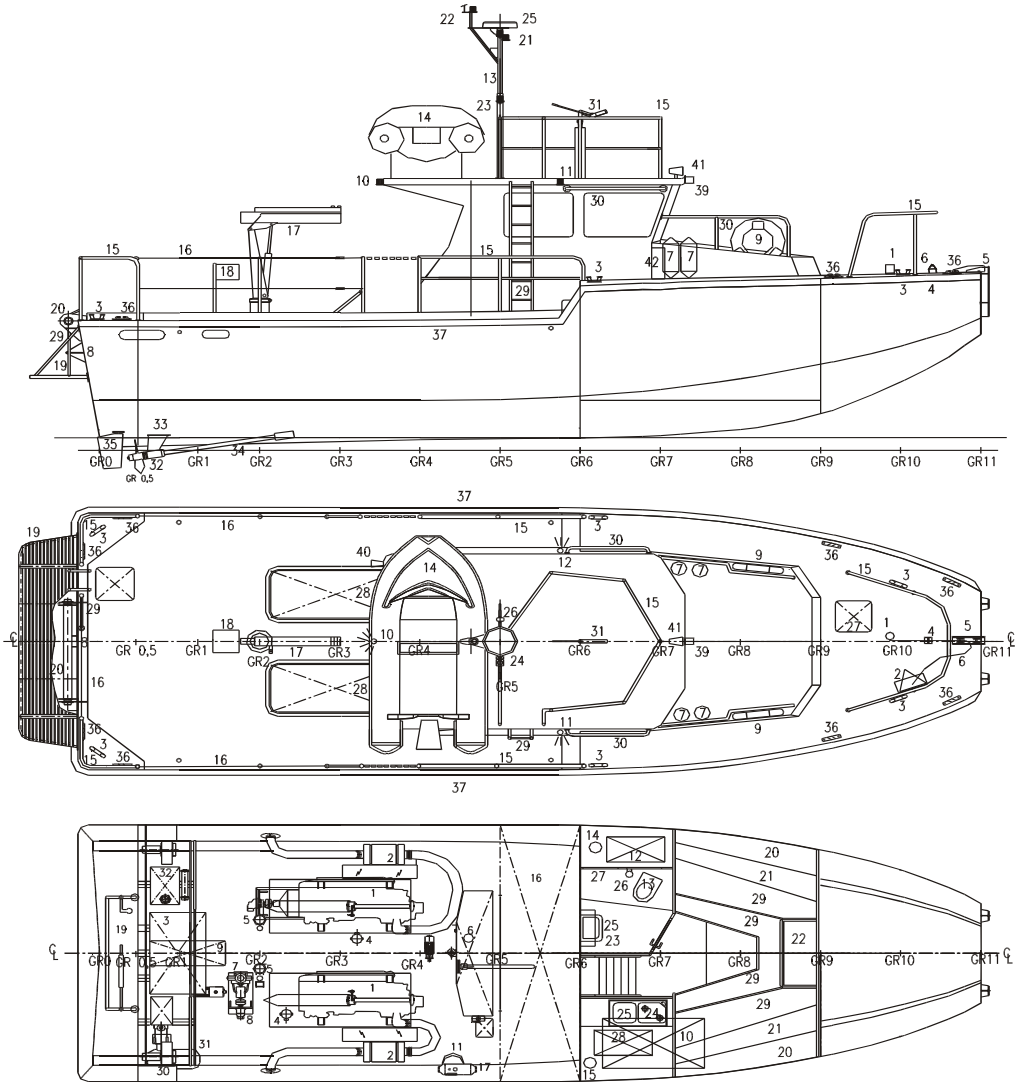

Figure 2. General Arrangement of the ECO-13

The crew compartment situated in the hull is equipped with four berths, one locker, galley, toilet, shelves and emergency exit through a waterproof deck window. Access to the superstructure is through the athwarthship passage equipped with stairs. The superstructure contains a wheelhouse compartment situated on the port side and an saloon on the starboard. The enclosed wheelhouse bridge, Figure 4. includes full engines instrumentation and alarm, and communication, navigation and electrical equipment. Reverse sloped windows are fitted to reduce internal and external glare and maximize interior volume.

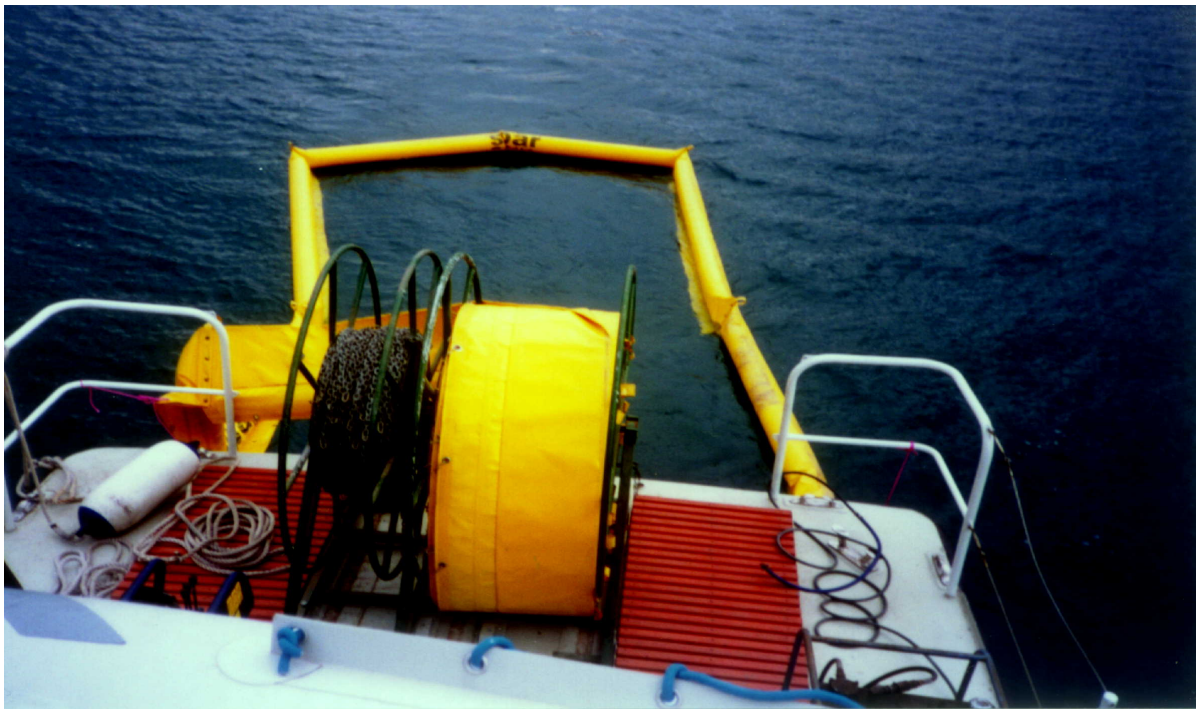

Figure 3. ECO-13 inflatable oil containment booms in operation

The machinery compartment houses main propulsion engines consisting of two Volvo TAMD 74 C EDC each developing 330 kW at 2600 rpm coupled via flexible couplings to the reverse reduction gearbox IRM 302V-LD equipped with trolling valves, two fuel tanks, hydraulic oil tank, firefighting pump, air compressor, dispersant system, heating unit, and other equipment. The electric system consist of a 24 V DC power generation and 12 V and 24 V DC power distribution systems and a 220 V AC, single phase, distribution system. All loads vital to the operation of the craft and safety of the crew are supplied from the DC power distribution system. The electric main switchboard and general-purpose batteries are located in the superstructure.

Figure 4. ECO-13 wheelhouse bridge

SPECIAL EQUIPMENT

For the purpose of oil spill recovery, the ECO-13 is equipped with: free floating skimmer, oil spill temporary tank, deck crane, oil containment booms, air compressor and dispersant systems [3]. An oil skimmer equipped with a transfer pump is used to recover floating oil from or near the surface of water. During the operation, skimmer is assisted with a deck crane to be within the sight of the operator that should be able to handle debris found at the spill site, such as plastic bags, aluminum cans, bottles, etc. Oil containment booms are primarily used to deflect oil to prevent that the oil slick hits sensitive areas and for containment of oil for later recovery by a skimmer. The standard ECO-13 booms package include 200 meters of inflatable booms or 400 meters of foam filled buoyancy chamber booms. The oil recovered by the skimmer is pumped into a temporary storage tank. In the case when the temporary tank onboard the ECO-13 is critical, it is suitable to use a floating flexible towable storage tank or other vessels such as barges, small tankers etc. In order to increase the efficiency of storage tank capacity, recovered water can easily be decanted from the storage tank, to be discharged in front of the sweep. In this way, any oil in the decanted water will be recovered again. For removing oil from the sea surface, particularly when mechanical recovery by skimmer is not possible, the ECO-13 is equipped with a spraying dispersant system. The system is equipped with a separate water pump and a dispersant tank and applies a dispersant diluted with water. In order to minimize losses due to wind drift, spraying nozzles are positioned on portable outboard booms situated near the sea surface in working condition. For firefighting purposes the ECO-13 standard equipment includes a firefighting monitor situated on the superstructure deck. Other ECO-13 special equipment, such as debris recovery system could be tailored on customers request.

CONCLUSION

Despite the large amount of research worldwide over the last 20-30 years, the most effective form of environmental protection remains to minimize the spills occurring. The experience from large spills shows that booms, spraying etc., offer at best only limited protection against environmental damage caused by oil spill. Therefore, the introduction of high speed response vessel capable of rapid reaction is one of the easiest ways for improving the oil spill response at sea. After two years in operation of the ECO-13 prototype craft and half year in operation of the first series craft, the basic decision, choices and tradeoffs of the craft type, power, configuration and deployment, as well as procurement process have been vindicated as demonstrated by the proven performance of the craft.

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