EXECUTIVE SUMMARY OF EU-MOP PROJECT SUITABLE FOR PUBLICATION

The EU-MOP project developed a new concept for oil spill response featuring autonomous unmanned robot vessels that operate as a swarm in order to efficiently collect the spilled oil.

A comprehensive overview of the legislative framework, available tools, and methodologies for clean-up and oil spill response was the starting point of the EU-MOP project. An EU-wide antipollution equipment inventory identified existing gaps in the anti-pollution arsenal, in order to target the recorded weaknesses. The marine oil pollution status was drawn from oil spill data sources, such as state maritime authorities, international organizations, EU-MOP partners, and others, in order to develop a state-of-the-art baseline regarding operational and strategic aspects of pollution confrontation and control.

The generic marine oil spill scenarios to be incorporated in the EU-MOP project were also formulated in order to define, at a preliminary stage, the spectrum of operational demands for the EU-MOP units.

In the architectural and technical design of the EU-MOP units, the Catamaran and Monocat concepts were studied with criteria based on size, volume, weight, skimming device selection, load carrying potential, speed performance, stability, as well as the sub-systems technical requirements and the integration of the engines and propulsion architecture, and the energy sources definition. The Catamaran and Monocat concepts featured distinctive advantages. A small unit was also designed.

Having acknowledged that the two EU-MOP designs (catamaran and monocat) are completely new, no literature data and computer software could be found to provide accurate results for the propulsion resistance. The consortium, therefore decided to perform experiments to estimate as accurately as possible the resistance for both designs. Tank tests were performed for both the catamaran and the monocat design. In addition, to estimate the increase in the propulsion resistance due to navigating through fresh and emulsified oil, computational fluid dynamics calculations were performed.

The selected EU-MOP energy source and propulsion system benefited from the model test results which indicated significant reduction in the required power for both the Monocat and Catamaran designs. The energy source, propulsion and steering system of the units were adequately designed.

A simulation framework was developed to assess the preferred sensor configurations and control systems. In order to achieve better and more realistic results, an integrated approach was adopted, which simulated both the robots and the oil slick.

The EU-MOP swarm simulation was visualized, while several swarm strategies were developed, in the process of identifying the most efficient ones. Recommendations were given for sensors, control systems, AI architectures and swarm strategies. In the validation of the swarm behaviour, the main objective was to demonstrate physically the swarm behaviour via studying mobile land-based robots to collect "oil" which was projected onto the floor with the help of a video projector.

A methodology was developed to measure various skimmer configurations performance and the final selection was made. Three separate simulation modules were developed and integrated: the oil fate, robot, and visualisation programs. A visualisation model was developed to animate the fate of the oil slick and to illustrate the removal of the oil by the robots, and the movements of the robots. The coastal outline was represented by overlaid electronic charts. A multi-criteria selection procedure was also developed to assess the effectiveness of the EU-MOP units.

A model was developed addressing the strategic planning of stockpiling EU-MOP units in candidate (port) facilities, so as to optimally respond to potential oil spill incidents in a nearby risk area. The tactical level decision-making methodology (model) was also developed.

Research on storage and transport requirements for the EU-MOP units was undertaken. The research focused on the possibility of using different container types for storage, and the handling during transport and while loading on the support vessel. In this context a tool was developed to simulate the transport configuration. The required communication and information chain for the usage of EU-MOP units was also evaluated.

A number of real scenarios of spill incidents in European seas (specifically Greece, Spain and UK) were formulated and response management / logistics simulations were performed on all levels.

The basis for the Cost Benefit Assessment was the creation of a calculation model integrating all cost and benefit information and offering the possibility to create scenarios for cost and benefit calculation by selecting different basic parameters (e.g. number and type of units, oil collection capacity, lifetime of units, time horizon, frequency of spills, etc.). The Cost Benefit Assessment was done on two different levels, the tactical and the strategic level. As indices, the Discounted Present Value, the Net Present Value, the Internal Rate of Return and the Payback Period (time) were used. Comparison with conventional response methods demonstrated a significant Cost-Benefit advantage potential for the EU-MOP concept.