Experience with efficiency in mechanical recovery in oil spill response

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The paper summarizes the main findings from a literature study addressing the efficiency of mechanical recovery studying historic oil spill events. The review has been carried out by DNV and SINTEF, on behalf of the Norwegian Governmental Forum for Cooperation on R&D concerning Oil Spill Response. The Forum includes three Norwegian governmental agencies: The Norwegian Centre for Oil Spill Preparedness and Marine Environment, The Norwegian Coastal Administration and The Norwegian Environment Agency.

The aim of the study was to obtain reliable and empirical documentation of the mechanical recovery efficiency, based on historical oil spill incidents. The review focused on mechanical containment and recovery from the water surface in marine coastal and offshore waters. Nine scenarios were selected, providing a variety in spill size, duration, oil type, spill location and recovery strategy.

The key questions to be answered were: How much of the released oil was mechanically recovered at sea? How much of the oil available for mechanical recovery was recovered? and Which factors (internal and external) affected/limited the operation? Efficiency of mechanical recovery based on available oil on the sea surface was estimated using SINTEF's Oil Weathering Model (OWM). The model considers factors such as evaporation, water-in-oil-emulsification and down-mixing of oil following a spill.

Availability and quality of detailed information, such as response operation and oil fate, proved to be the most critical criteria and the most difficult to obtain. Data availability and quality varies among scenarios, additionally there might be inconsistency between sources reporting from the same incident. The oil budget should therefore be read cautiously. All cases demonstrate that objectives, strategies, and tactics in oil spill response operations involve trade-offs between pros and cons in the response. However, the cases substantiate that oil spill response remains a consequence-mitigating, and not a consequence-eliminating, measure.

A summary of the findings is presented in Table 1-1. When estimating recovery as percentage of the spilled volume, the efficiency ranges from 4 – 75 %. When estimating the recovery in percentage of available surface oil, the efficiency increases noticeably or significantly in all cases. The results are sensitive to the selected cases.

Table 1-1 Overview of the spills, estimated recovery ratios and reported limiting factors for mechanical recovery.

	Year	Name	Type of incident/spill	Recovery of spilled oil (%)[a)]	Recovery of available oil (%)[b)]	Reported limiting factors for mechanical recovery
Petroleum incidents	2010	Macondo[c)]	Blowout offshore (subsea)	4 %	10 %	• Response strategy • Aerial misguiding • Debris/seaweed • Operational restrictions
	2009	Montara[d)]	Blowout offshore (topside)	9 %	13-22 %	• Response strategy • Oil properties
	2003	Draugen	Spill from pipe offshore (subsea)	23 %	44-51 %	• Delayed response • Surveillance/remote sensing • Slick patchiness
Ship incidents	2011	Godafoss	Ship grounding	57 %	63 %	• Low temperatures and sea ice
	2011	Golden Trader[e)]	Ship collision	9 %	33 %	• Oil properties • Weather conditions • Strategy/decision making
	2009	Full City	Ship grounding	10 %	11 %	• Weather conditions • Nearshore
	2004	Rocknes	Ship grounding	31 %	32-35 %	• Nearshore • Tidal currents • Tactics
	2003	Fu Shan Hai	Ship collision	75 %	80 %	• Oil properties • Strategy/decision making • Weather conditions
	2002	Prestige	Ship (tanker) listing followed by breaking in two	41 %	45 – 57 %	• Oil properties • Strategy/decision making • Weather conditions

Footnotes to Table 1-1:

a) Estimated recovery ratio (%) by mechanical recovery at sea of the total reported spill volume.
b) Estimated recovery ratio (%) by mechanical recovery at sea of the spill volume predicted available on the sea surface.
c) Chemical dispersion was used in addition to mechanical recovery.
d) Surface and subsea chemical dispersion and in-situ burning was used in addition to mechanical recovery.
e) Simplified calculation due to diverging data sources.

Oil spill response is often a complex operation influenced by a range of factors, effecting all aspects from decision-making to recovery efficiency. The nature of the spill itself, type (release conditions), oil characteristics and released volume, defines the framework for the operational strategy. Oil properties is a key factor, which in combination with weather conditions and sea states, may have a significant impact on the decisions regarding response strategies, tactics, and preferred equipment.

The human factor in terms of competence, training and skills in handling the equipment, and the insight of when to stop or change the ongoing operation, is essential. The importance of clear command, control, and communication structure is another core factor. A well-managed operation is closely related to having a good overview and understanding of the situation, where remote sensing is a vital support tool for incident management as well as the individual response systems. In several cases the spilled volumes were underestimated in the initial phases, and there were challenges tracking the spill.

In all cases, mechanical recovery was part of the tactical plan, either exclusively or in combination with other response measures. Where mechanical recovery was the sole strategy, the tactical priority was to recover the oil near the source to, limit spreading and further impact. For the ship incidents, the pattern is to encircle the source with booms, and empty the remaining oil from the ship. Open water recovery systems were used to combat drifting oil slicks, often surpassed by following shoreline clean-up operations.

The available documentation from the historic oil spills does not make it feasible to assess the specific performance on system level, nor the actual duration of engagement. It is therefore recommended that improved guidelines are developed in the future for reporting of effort and efficiency during oil spill response.