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Standard Guide for Estimating Oil Spill Recovery System Effectiveness¹

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1. Scope

1.1 This guide covers the key factors to consider in estimating the effectiveness of containment and recovery systems that may be used to assist in the control of oil spills on water.

1.2 The purpose of this guide is to provide the user with information on assessing the effective use of spill-cleanup equipment. It is intended for use by those involved in planning for and responding to oil spills.

1.3 Sections of this guide describe calculation procedures for estimating recovery system effectiveness. It should be understood that any such calculations cannot be expected to predict system performance, but are intended to provide a common basis for comparing system performance.

1.4 One of the main reasons that the calculation procedures cannot be used to predict system performance is that the analysis is sensitive to assumptions made on the properties of the oil slick, and particularly the changes in slick thickness and emulsification. It is emphasized that the purpose of this guide is not to provide a standard method for estimating slick property changes, but rather to provide a standard guide for using that information in comparing system performance.

1.5 Consideration should be given to alternative means of estimating response system effectiveness, such as Genwest 2012.²

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:³

F625 Practice for Classifying Water Bodies for Spill Control Systems

F631 Guide for Collecting Skimmer Performance Data in Controlled Environments

F808 Guide for Collecting Skimmer Performance Data in Uncontrolled Environments (Withdrawn 1997)⁴

F1523 Guide for Selection of Booms in Accordance With Water Body Classifications

3. Terminology

3.1 Definitions:

3.1.1 *advancing skimmer, n*—a skimmer that is designed to be used to sweep out the spill area.

3.1.1.1 *Discussion*—The skimmer may be independent or may be attached to containment boom to increase sweep width. In some cases, the skimmer may not be attached to the boom but is positioned in the pocket of the boom for skimming. As long as the skimmer operates while moving, it is considered to be an advancing skimmer. Some skimmers are used in both an advancing and stationary mode. These are classified according to their application.

3.1.2 *contained spills, n*—a spill that is restricted from spreading by containment boom or natural means.

3.1.3 *oil slick encounter rate, n*—the volume of oil slick per unit time actively encountered by the oil spill recovery system, and therefore available for containment and recovery (m^3/h).

3.1.4 *oil spill recovery system, n*—a combination of devices that operate together to recover spilled oil; the system would include some or all of the following components: (1) containment boom, (2) skimmer, (3) support vessels to deploy and operate the boom and skimmer, (4) discharge/transfer pumps, (5) oil/water separator, (6) temporary storage devices, and (7) shore based storage/disposal.

¹ This guide is under the jurisdiction of ASTM Committee F20 on Hazardous Substances and Oil Spill Response and is the direct responsibility of Subcommittee F20.12 on Removal.

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² Genwest Systems, INC. 2012. EDRC Project Final Report. Prepared for Bureau of Safety and Environmental Enforcement. Sterling, VA.

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

3.1.5 *recovery system effectiveness, n*—the volume of oil that is removed from the environment by a given recovery system in a given recovery period.

3.1.6 *recovery period, n*—the time available for recovery systems to carry out cleanup operations.

3.1.7 *response time, n*—the time interval between the spill incident and the start of cleanup operations.

3.1.8 *stationary skimmer, n*—a skimmer that is intended to be used in a fixed location and is moved to new accumulations of oil as skimming progresses.

3.1.8.1 *Discussion*—Some stationary skimmers are used in a containment boom system that moves to collect oil, then pauses to permit the skimmer to recover the oil collected. Even though this system moves periodically, the skimmer is still ranked as a stationary skimmer because it operates when the system is at rest.

3.1.9 *uncontained spill, n*—a spill that continues to spread after the recovery effort begins.

4. Summary of Guide

4.1 In evaluating the effectiveness of containment and recovery systems used in response to oil spills, many factors need to be considered of which skimmer performance is but one. The objective of this guide is to describe a range of factors that must be considered in estimating recovery system effectiveness.

4.2 In order to evaluate a recovery system, there are two general types of information required, a set of information to describe the spill scenario against which the system will be measured, and a set of information to describe the performance characteristics of the recovery system.

4.3 Information on the spill is required to adequately define the problem and thereby provide a focus for the evaluation process. The spill should be defined in sufficient detail as to allow an unambiguous interpretation of its behavior in terms of the operating parameters of the countermeasures system. For certain purposes it may be desirable to develop a set of standard spill scenarios against which response system effectiveness would be measured in a quantifiable manner.

4.4 The performance characteristics must be identified for the recovery system and its various components. In general, the information requirements will include the rates or capacities, or both, the operating limitations, and the support requirements.

4.5 This guide covers equipment-related factors that will affect recovery-system effectiveness. Additional important factors that are not covered in this guide but should be considered as being critical to the success of a spill response include: contingency planning; communications plans; government approvals; logistics of supporting manpower and equipment in the field; and training and exercising of manpower.

5. Spill-related Information

5.1 Spill Type:

5.1.1 Response strategies will depend to some extent on the type of spill. The spill scenario should be defined as to whether

it is an instantaneous or continuous release, whether or not the spill has ceased flowing, and whether the spill is contained or uncontained.

5.2 *Oil Slick Properties*—The following oil slick properties must be specified for the spill scenario. As some of these properties may vary with time, it may be desirable to use computer-based behavior models to produce spill property information for the time period of interest. For certain applications it may be useful to produce standard sets of spill property information that describe spills of interest as a function of time.

5.2.1 *Spill Volume*—The total volume of oil spilled should be specified (m^3). For spills that have not ceased, a spill rate (m^3/h) should also be specified.

5.2.2 *Spill Area*—The total spill area must be estimated in order to calculate estimates of slick thickness. For uncontained spills, the total spill area will increase over time; estimates can be made using computer-based behavior models. Alternatively, a simplified spreading model (Fig. 1: example spreading curves) can be used for first-order estimates.

5.2.3 *Slick Thickness*—Slick thickness is used in subsequent calculations of system encounter rate. Slick thickness is defined as the overall average thickness of the slick, and is estimated by dividing the spill volume by the total spill area at any given time. For this calculation, spill volume should take into account losses from the slick due to evaporation and natural dispersion, and increases to the slick volume due to emulsification. For uncontained spills, natural spreading forces will cause the slick thickness to decline steadily during recovery operations, and may result in a discontinuous slick composed of windows and patches separated by sheen or open water, or both. These factors should be considered in estimating an overall average slick thickness.

5.2.4 *Slick Viscosity*—The viscosity of the spilled product is used as a criteria to evaluate skimmer performance, as many skimming and pumping units will perform less effectively as viscosity increases. The viscosity of the spilled product will generally increase through the recovery period as the oil is subjected to weathering and emulsification processes. The viscosity should be specified as mm^2/s (cSt).

