REVIEW OF
ASTM STANDARDS
FOR OIL SPILL RESPONSE EQUIPMENT

Final Report

Submitted to:

U.S. Department of the Interior

Bureau of Safety and Environmental Enforcement

Prepared by:

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February 17, 2015

DISCLAIMER

This final report has been reviewed by the BSEE and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the BSEE, nor does mention of the trade names or commercial products constitute endorsement or recommendation for use.

ACKNOWLEDGMENT

This study was funded by the Bureau of Safety and Environmental Enforcement (BSEE), U.S. Department of the Interior, Washington, D.C., under Contract E13PC00010.

Table of Contents

1. Background

ASTM, formerly the American Society of Testing and Materials, is a globally recognized leader in the development and delivery of standards relating to the quality of products, measuring systems performance, and safety. ASTM's F20 committee on Hazardous Substances and Oil Spill Response was established in 1975, and currently has jurisdiction over 58 standards related to spill response equipment and their application. Some of these standards may be wholly or partially applicable to the Bureau of Safety and Environmental Enforcement's (BSEE) role in regulating the exploration and development of offshore oil and natural gas on the U.S. Outer Continental Shelf, in particular new and proposed developments in Arctic waters.

ASTM standards are developed by consensus among members of the various committees, with a balance of membership among producers (i.e., equipment manufacturers and suppliers), users (i.e., regulatory bodies, spill response organizations), and general interest (members who cannot be classified as a producer or user). For example, the current ASTM membership is made up of approximately 100 members, with a close to equal mix of producers, users, and general interest classifications such that voting on standards for approval is not dominated by one sector.

The usual course for the modification of existing standards or development of new standards is for a member to spearhead the effort by making a proposal to the applicable subcommittee, establishing a scope for the standard in discussions with the subcommittee, developing a draft for discussion purposes, then shepherding it through series of drafts based upon discussions at the semi-annual F20 meetings and through interaction with working groups consisting of subcommittee members between meetings.

This report describes a review of existing ASTM standards that could be used to assist in BSEE's regulatory mandate, and recommends and initiates additional standards that would be applicable.

2. Project Objective

The objective of the proposed work is to review existing standards in the area of oil spill response, determine those that may be applicable to assist in BSEE's regulatory mandate, suggest modifications where appropriate, and recommend and initiate additional standards that would be applicable.

3. Project Description

The work involved four main tasks.

1. Establishing the scope of potential standards to meet BSEE needs.
2. A review of existing ASTM standards to determine which may be applicable to BSEE's mandate and to determine significant gaps in standards.
3. Initiation of potential new ASTM standards and/or modification of existing ones based on the results of Tasks 1 and 2.
4. Draft and final reports, including draft ASTM standards, with recommendations on future initiatives in this area.

3.1 Establish Scope of Potential Standards for BSEE Needs

The project was initiated by identifying the areas in which ASTM standards could be used by BSEE in their role as regulator of offshore oil activities, and particularly their role in promoting safety and protecting the environment. This was accomplished in conjunction with BSEE staff in a project kickoff meeting, referencing BSEE literature including 30 CFR 254 Subpart B--Oil-Spill Response Plans for Outer Continental Shelf Facilities. This document sets out the contingency planning requirements for offshore operators, and contains specific guidance on such topics as:

- Equipment inventory
- Worst case discharge scenario
- Dispersant use plan
- In-situ burning plan
- Training and drills

These contingency planning requirements were reviewed in detail for potential use of standards to stipulate, for example, minimum equipment specifications and operational procedures.

3.2 Review of Existing ASTM Standards

Existing standards were also reviewed for their potential applicability to BSEE’s regulatory mandate and any special considerations for spill response in Arctic conditions. ASTM F20 is made up of nine subject area subcommittees, listed below, each with a number of active standards and work items under their respective jurisdiction.

- F20.11 Control (aka containment booms)
- F20.12 Removal (aka recovery skimmers)
- F20.13 Treatment (aka dispersants and other treatment chemicals)
- F20.15 In-Situ Burning
- F20.16 Surveillance and Tracking
- F20.17 Shoreline Countermeasures
- F20.21 Initial Response Actions (including responder training)
- F20.22 Mitigation Actions (including sorbents)
- F20.24 Bioremediation

Each of the existing standards was reviewed for potential applicability, either as is or with modification.

Arctic conditions is one area of particular interest, and existing standards were reviewed to determine if simple modification could expand the range of conditions and therefore the applicability of the standard or if an entirely new standard would be required. For example, test standards for response equipment may simply require an extension of test conditions to include the effects of the Arctic climate. Another example would be standards that provide guidance on equipment selection, that currently do not specifically recognize issues in Arctic response, in which case additional text on Arctic considerations could be added. The results of the first two tasks are summarized in Appendix A. The Appendix includes a summary of all existing ASTM standards that were reviewed, a description of their potential utility in the context of BSEE’s mandate, and a description of potential new standards that could be considered.

In consultation with BSEE, the following were selected for additional work.

- Proposed New Standard: Use of Chemical Herding Agents for Spill Containment

- Proposed New Standard: Inspection of Recovery Equipment subjected to Storage Conditions
- F631 − 99 (2008) Standard Guide for Collecting Skimmer Performance Data in Controlled Environment (modify to include ice conditions)
- F1780 − 97 (2010) Standard Guide for Estimating Oil Spill Recovery System Effectiveness
- Proposed New Standard: Guide on Surveillance to Support On-Water Operations
- F2327 − Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water (modifications to existing standard)
- Potential new standard: Address issues relate to simultaneous operations in large-scale response "Standard Guide for Containment and Control of Oil Spills on Water by Response Personnel"

3.3 Initiation of New Potential Standards

In general terms, each of the selected work items was initially introduced to the respective ASTM subcommittees as outlines of the intended objective and main areas of content. This was done as part of the April 2014 ASTM meetings and included, for each work item, an outline with rationale and scope. Following acceptance of the broad principles of each recommended standard, an initial draft was prepared for subcommittee consideration at the October 2014 meeting.

The results for each of the seven work items and their current status, incorporating results from the October 2014 ASTM meeting, are included in this report as Appendices B through H. Brief comments on each item are listed below.

<u>Proposed New Standard: Use of Chemical Herding Agents for Spill Containment</u>

This was presented to the subcommittee on containment, who were very interested in this topic as a work item given the renewed interest in the use of herders in recent years, and their importance to successful in-situ burning in certain ice conditions that would otherwise have a significant response gap. A draft standard has been prepared (Appendix B) based on comments from the fall meeting relating to graphical display of herder application, typical amounts used, and ultimate herder disposition.

Proposed New Work Item: Inspection Protocols for Recovery Equipment

The subcommittee on containment had recently talked about developing such a standard for containment booms, but the effort had languished and not progressed past the outline stage. At the fall meeting it was decided to meld the two concepts and develop a new standard on general inspection and maintenance requirements for containment and recovery equipment. A draft standard is included as Appendix C.

F631 − 99 (2008) Standard Guide for Collecting Skimmer Performance Data in Controlled Environment (modify to include ice conditions)

The original intent was to modify F631 to include a subsection on dealing with ice conditions. However, at the fall meeting it was decided that there were too many unique issues to testing in ice and consequently a new standard would be required. The subcommittee had strong interest in this as a topic given the recently completed "Ice Month" tests at Ohmsett, in which a variety of skimmers were tested in drift ice conditions. The resulting draft standard is included as Appendix D.

F1780 − 97 (2010) Standard Guide for Estimating Oil Spill Recovery System Effectiveness

This existing ASTM standard, F1780, has a similar approach to that recommended in the recent Genwest report to BSEE on calculation of Effective Daily Recovery Capacity (EDRC), and it was thought that F1780 could be modified to better reflect new thinking in this area as well as recent spill experiences. Frankly, there was not particularly strong interest in this topic by the ASTM subcommittee given the perceived difficulties at arriving at a consensus on some of the more contentious issues involved. Nonetheless, the subcommittee did agree to review additional discussion on this topic which, given its nature, is better left as a discussion paper for the time being (Appendix E).

Proposed New Standard: Guide on Surveillance to Support On-Water Operations

Protocols dealing with specific technologies or platforms currently exist within the F20.16 subcommittee but an overall guide to reference satellite, plane/helicopter, aerostat, and onboard capabilities was missing. An initial draft standard was presented at the recent ASTM meeting in October 2014. Initial comments and updates have been incorporated but the protocol will undergo a detailed technical review to identify and validate information provided by manufacturers related to the capabilities of their respective products. A small working group will undertake this initial technical review (Appendix F).

F2327 − Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water (modifications to existing standard)

This existing ASTM standard, F2327, was due for review and partially updated by the subcommittee chair. It was reviewed at the recent ASTM meeting. Comments from the subcommittee were integrated into the standard at the meeting. Manufacturer's claims of abilities to determine the presence and thickness of oil were challenged and not accepted unless scientific evidence was provided to back-up claims. Additional investigations into multiple technologies will take place to update the technical capabilities of a range of equipment (Appendix G).

Potential new standard: Standard Guide for Containment and Control of Oil Spills on Water by Response Personnel (simultaneous operations in large-scale response)

A draft protocol of this proposed standard was presented at the recent ASTM meeting in October 2014. This proposed new standard would tie in a large number of currently available protocols from a range of subcommittees, putting their information into context for responding to a large-scale incident. There was a large amount of support for this protocol from members of Mitigation Actions subcommittee. A working group will provide a review and suggested updates will be brought forward for consideration in advance of the next meeting (Appendix H).

Overall comments

In the experience of SL Ross, the development of an ASTM standard, from initiation to final approval requires a minimum of two years and more typically three to five years. The shorter time period is only possible when the standard has an active proponent to gain consensus and produce draft revisions based on subcommittee interactions, and even then the process can be delayed through the objections of subcommittee members.

As such, no commitment can be made as to the eventual outcome of the draft standards. At a minimum, at the conclusion of the project each of the draft standards has been developed to the extent that only minor editing will be required for initial ballot action, and this task will be carried on by the project team over the next few meeting cycles as long as the respective ASTM subcommittee continues to accept the topic as a work item.

4. Conclusions

Existing ASTM standards and BSEE contingency planning documents were reviewed to determine if ASTM standards could assist in BSEE's regulatory mandate.

A preliminary list of work items was proposed, and in consultations with BSEE, seven standards were selected for additional work and consideration by ASTM.

Outlines and objectives were summarized for each of the seven items and presented to ASTM and their appropriate subcommittees at the semi-annual April 2014 meetings.

Based on discussions at those meetings and feedback from committee members and discussion papers, initial draft standards were prepared (or updated) for consideration at the October 2014 meetings.

As a result of discussions at the October 2014 meetings and feedback from committee members, the draft standards and/or discussion papers have been updated and are included with this report.

Work will continue on each of these seven items in terms of shepherding them through the approval process, making minor revisions as required, and serving as technical contact until each gains Committee approval.

Appendix A: Results of Initial Review

Review of American Society for Testing and Materials (ASTM) Standards for Oil Spill Response Equipment

Progress Report #2

February 4, 2014

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Contents

List of Tables

Introduction

Progress Report #2: February 4, 2014, amended

The project was initiated with a project kickoff meeting held by conference call 2013.11.19 including contract and technical representatives of BSEE. Progress report #1 was submitted 2013.12.27, with a revised version submitted 2014.01.10. The report summarized the work to date including partial completion of both Tasks 1 and 2.

Tasks 1 and 2 have now been completed, with the overall objective of defining potential standards development for BSEE's role as regulator.

Work thus far has comprised review of the following:

- 30 CFR 254 Subpart B--Oil-Spill Response Plans for Outer Continental Shelf Facilities
- Existing ASTM standards
- Notes from previous ASTM meetings
- Genwest report on EDRC methodologies

Based on this review, a series of summary tables have been generated. They identify links between current and proposed ASTM standards and 30 CFR 254. The tables are presented below.

In addition, a list of potential work items was identified and grouped, for convenience, by ASTM subcommittee. This list of work items was discussed with the BSEE Contracting Officer's Representative on January 16 in Herndon, VA in BSEE's offices. The following summarizes the recommended work for Task 3 of the project, with standards development work noted according to:

- Items with Significant Input Required
- Items with Minimal Input Required
- Items Rejected from Further Review

Part of the ASTM process is that any approved standard must be reviewed and re-approved on a five-year basis. For each of the existing ASTM standards listed below, the current status is noted as Current, Review for Ballot, or Ballot Action Required indicating where each one is in the five-year cycle.

Items with Significant Input Required
Higher priority

- Proposed new Standard: Use of Chemical Herding Agents for Spill Containment
- Proposed new Work Item: Inspection Protocols for Recovery Equipment
- F631 − 99 (2008) Standard Guide for Collecting Skimmer Performance Data in Controlled Environment (modify to include ice conditions)
- F1780 − 97 (2010) Standard Guide for Estimating Oil Spill Recovery System Effectiveness
- Proposed new Standard: Guide on Surveillance to Support On-Water Operations
- F2327-08 Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water
- Potential new Standard: Address issues relate to simultaneous operations in large scale response

Lesser priority

- Proposed New Standard: Evaluation of Dispersant-Use Systems Effectiveness
- Proposed New Standard: Evaluation of In-Situ Burning Systems Effectiveness
- Potential New Standard: Guide to Setting Priorities for Shoreline Cleanup

Items with Minimal Input Required

For the most part, these items will simply require a short brief to be presented to the ASTM subcommittee and, if there is interest, establishment of a Task Group of subcommittee members to investigate further with our guidance.

Items rejected from Further Review

For review purpose these items are include in Appendix A.

Future Work

In Task 3 of this project, draft outlines will be prepared for the higher priority items noted above, including potential new standards and other items noted as requiring significant input. The drafts will be submitted for BSEE approval by mid-March such that they can be reviewed in advance of their submission to ASTM's April meeting.

Summary Tables by ASTM Subcommittees

Table 1 - Summary Table of F20.11 on Control

Standard	Title	Recommendation	Justification
F625/F625M-94(2011)e2	Standard Practice for Classifying Water Bodies for Spill Control Systems Status: Current	No recommendation.	
F715-07(2012)	Standard Test Methods for Coated Fabrics Used for Oil Spill Control and Storage (Status: Current)	No recommendation.	
F818-93(2009)	Standard Terminology Relating to Spill Response Barriers (Status: Ballot Action Required)	No recommendation.	
F962-04(2010)	Standard Specification for Oil Spill Response Boom Connection: Z-Connector (Status: Review for Ballot)	No recommendation.	
F1093-99 (2012)	Standard Test Methods for Tensile Strength Characteristics of Oil Spill Response Boom (Status: Current)	No recommendation.	
F1523-94(2013)	Standard Guide for Selection of Booms in Accordance With Water Body Classifications Status: Current	Include reference to F1523 in 30 CFR (§254.23)	Helping develop Emergency Response Plan (§ 254.23 G4, G5). This guide covers the selection of containment boom that may be used to control spills of oil and other substances that float on water.
F1599-95(2009)	Standard Guide for Collecting Performance Data on Temporary Storage Devices Status: Ballot Action Required	Include reference to F1599 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G6). Update in light of experience in the Macondo response and other field or tank trials if applicable.
F1657/F1657M-96(2012)e1	Standard Practice for Emergency Joining of Booms with Incompatible Connectors Status: Current	Include reference to F1657 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G4, G5). Update in light of experience in the Macondo response and other field or tank trials if applicable.
F2084/F2084M-01 (2012)e1	Standard Guide for Collecting Containment Boom Performance Data in Controlled Environments (Status: Current)	No recommendation.	

Standard	Title	Recommendation	Justification
F2438-04 (2010)	Standard Specification for Oil Spill Response Boom Connection: Slide Connector (Status: Review for Ballot)	No recommendation.	
F2682-07(2012)e1	Standard Guide for Determining the Buoyancy to Weight Ratio of Oil Spill Containment Boom Status: Current	No recommendation.	
F2683-11	Standard Guide for Selection of Booms for Oil-Spill Response Status: Current	Include reference to F2683 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G4, G5). Update in light of experience in the Macondo response and other field or tank trials if applicable.
WK37298	New Test Method for determining storage life of coated fabric products	Monitor (not yet a standard): Incorporate into 30 CFR § 254.23 re: verification inspection of boom inventories	Will help provide lifecycle information for equipment used to contain spills.
WK37299	New Guide for specifying oil boom reels	No recommendation.	
WKtbd	Proposed New Standard: Use of Chemical Herding Agents for Spill Containment	Proposed new standard	Address technical and operational considerations for this recently developed technique which may be important for response to spills in ice.

Table 2 - Summary Table of F20.12 on Removal

Standard	Title	Recommendation	Justification
F631-99 (2008)	Standard Guide for Collecting Skimmer Performance Data in Controlled Environments Status: Overdue	Include reference to F631 in 30 CFR (§ 254.23 and § 254.26)	Helping develop Emergency Response Plan (§ 254.23 G5, G6; and § 254.26 a). Update in light of recent Ice Month skimmer test program.. Present focus is inclusion of response in ice-affected waters.
F1084-08 (2013)	Standard Guide for Sampling Oil/Water Mixtures for Oil Spill Recovery Equipment Status: Current	No recommendation.	
F1607-95(2013)	Standard Guide for Reporting of Test Performance Data for Oil Spill Response Pumps Status: Current	No recommendation.	
F1778-97(2008)	Standard Guide for Selection of Skimmers for Oil-Spill		

Standard	Title	Recommendation	Justification
	Response Status: Overdue		
F1780-97(2010)	Standard Guide for Estimating Oil Spill Recovery System Effectiveness Status: Review for Ballot	Include reference to F1780 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G6). Review in light of recent work on EDRC report.
F2008-00(2012)e1	Standard Guide for Qualitative Observations of Skimmer Performance Status: Current	No recommendation.	
F2709-08	Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems Status: Overdue	Include reference to F2709 in 30 CFR (§ 254.23) and 30 CFR (§ 254.45) Modify to include more precise documentation of skimmer components and ancillaries used in tested model.	Helping develop Emergency Response Plan (§ 254.23 G6) and § 254.45 (b),(c)) which is referenced in • § 254.44 (b), referenced in • § 254.26(d)(1), referenced in • § 254.47 (3)(b), referenced in • § 254.26 a. The listed issues relating to de-rating factors should be described more fully, and the existing standard should be expanded to include more precise documentation of skimmer components and ancillaries used in the tested model.
WKtbd	Proposed new Work Item: Inspection Protocols for Recovery Equipment	Include reference to WKtbd in 30 CFR § 254.43 which is referenced in § 254.24	Providing background data for "Equipment inventory" appendix 30 CFR (§ 254.43 (a),(b)) which is referenced in CFR (§ 254.24 (b)). The objective here would be to produce a similar standard guide to F1780 for inspecting skimmers and their ancillaries to ensure equipment in inventories is functional when needed.

Table 3 - Summary Table of F20.13 on Treatment

Standard	Title	Recommendation	Justification
*F1012-86	Standard Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response – the Arctic Status: Withdrawn 2002	Review for possible update and reinstatement	This standard was withdrawn in 2002 as part of an effort by the F20.13 subcommittee to consolidate various dispersant-use standards under a much smaller number of habitat categories. With renewed interest in operations in Arctic and sub-Arctic areas, the proposed work is to re-visit this previously approved standard to

Standard	Title	Recommendation	Justification
			ensure that elements unique to Arctic operations are included in the broader dispersant-use standards, and to ensure that the standards also reflect tank- and field trials over the most recent decade.
F1209-08	Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Ponds and Sloughs Status: Overdue	No recommendation.	
F1210-08	Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Lakes and Large Water Bodies Status: Overdue	No recommendation.	
F1231-08	Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Rivers and Creeks Status: Overdue	No recommendation.	
F1279-08	Standard Guide for Ecological Considerations for the Restriction of the Use of Surface Washing Agents: Permeable Land Surfaces Status: Overdue	No recommendation.	
F1280-08	F1280-08 Standard Guide for Ecological Considerations for the Use of Surface Washing Agents: Impermeable Surfaces Status: Overdue	No recommendation.	
F1413-07(2013)	Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems Status: Current	No recommendation.	
F1460-07(2013)	Standard Practice for	No recommendation.	

Standard	Title	Recommendation	Justification
	Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems Status: Current		
F1693-13	Standard Guide for Consideration of Bioremediation as an Oil Spill Response Method on Land Status: Current	No recommendation.	
F1737/F1737M-10	Standard Guide for Use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems Status: Review for Ballot	Include reference to F1737 in 30 CFR § 254.27	Consideration should be given to include reference to F1737 in the CFR § 254.27, (d), to the effect that any dispersant equipment listed in a contingency plan meet the specifications in the standard.
F1738-10	Standard Test Method for Determination of Deposition of Aerially Applied Oil Spill Dispersants Status: Review for Ballot	No recommendation.	
F1872-12	Standard Guide for Use of Chemical Shoreline Cleaning Agents: Environmental and Operational Considerations Status: Current	No recommendation.	
F2059-06(2012)e1	Standard Test Method for Laboratory Oil Spill Dispersant Effectiveness Using The Swirling Flask Status: Current	Include reference to F2059 in 30 CFR § 254.27 – add section on tested effectiveness (perhaps expand (b))	Consideration should be given to include reference to F2059 in the CFR § 254.27, (b), to include effectiveness data along with the requested toxicity data to help in the decision making process: possible deployment of dispersant.
F2205-07(2013)	Standard Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response: Tropical Environments Status: Current	No recommendation.	
F2465/F2465M-05(2011)e1	Standard Guide for Oil Spill Dispersant Application Equipment: Single-point	Include reference to F2465 in 30 CFR § 254.27	Consideration should be given to include reference to F2465 in the CFR § 254.27 (d), to the effect that any

Standard	Title	Recommendation	Justification
	Spray Systems Status: Current		dispersant equipment listed in a contingency plan meet the specifications in the standard.
F2532-13	Standard Guide for Determining Net Environmental Benefit of Dispersant Use Status: Current	Include reference to F2532 in 30 CFR § 254.27	Consideration should be given to include reference to F2532 in the CFR § 254.27 (e), to the effect that any contingency plan that includes a dispersant-use option use the standard in making NEBA decisions.
WKtbd	Proposed New Standard: Evaluation of Dispersant-Use Systems Effectiveness	Create, then include reference to WKtbd in 30 CFR § 254.27	Consideration should be given to include reference to F2532 in the CFR § 254.27 (e). The proposed standard would be similar in approach to F1780 for evaluating containment and recovery systems, and would include a methodology for estimating effectiveness.

Table 4 - Summary Table of F20.15 on In-Situ Burning

Standard	Title	Recommendation	Justification
F1788-08	Standard Guide for In-Situ Burning of Oil Spills on Water: Environmental and Operational Considerations Status: Overdue	Include reference to F1788 in 30 CFR § 254.28 (e).	Consideration should be given to include reference to F1788 in the CFR § 254.28 (e) to provide background information on the circumstances in which in situ burning may be appropriate.
F1990-07 (2013)	Standard Guide for In-Situ Burning of Spilled Oil: Ignition Devices Status: Current	Include reference to F1990 in 30 CFR § 254.28 (a)(b)	Consideration should be given to include reference to F1990 in the CFR § 254.28 (a)(b), to the effect that any ignition equipment listed in a contingency plan meet the specifications in the standard.
F2152-07 (2013)	Standard Guide for In-Situ Burning of Spilled Oil: Fire-Resistant Boom Status: Current	Include reference to F2152 in 30 CFR § 254.28 (a)(b)	Consideration should be given to include reference to F2152 in the CFR § 254.28 (a)(b), to the effect that any fire-resistant booms listed in a contingency plan meet the specifications in the standard.
F2230-08	Standard Guide for In-situ Burning of Oil Spills on Water: Ice Conditions Status: Overdue	Include reference to F2230 in 30 CFR § 254.28 (b)(c)(e)	Consideration should be given to include reference to F2230 in the CFR § 254.28 (b)(c)(e) to provide background details on the technique of In-situ Burning.
F2533-07 (2013)	Standard Guide for In-Situ Burning of Oil in Ships or Other Vessels Status: Current	No recommendation.	
F2823-10	Standard Guide for In-Situ	No recommendation.	

Standard	Title	Recommendation	Justification
	Burning of Oil Spills in Marshes Status: Review for Ballot		
WK37324	Guide for Estimating Volume of Oil Consumed in a Burn	Include reference of WK37324 in 30 CFR § 254.28 (e)(f)	Provides a method for estimating burn volumes. Consideration should be given to include reference to WK37324 (when approved) in CFR § 254.28 (e)(f).
WKtbd	New Standard Guide for Evaluation of In-Situ Burning Effectiveness		The proposed standard would be similar in approach to F1780 for evaluating containment and recovery systems, and would include a methodology for estimating effectiveness based on various system components.

Table 5 - Summary Table of F20.16 on Surveillance and Tracking

Standard	Title	Recommendation	Justification
F1779-08	Standard Practice for Reporting Visual Observations of Oil on Water Status: Overdue WK43851 Draft Under Development	Include reference to F1779 in 30 CFR (§ 254.23)	Assist in procedures for the early detection of a spill (§ 254.23 F). This practice can be used by surveillance and tracking staff to report visual observations leading to the preparation of maps of the oil-slick location and Training and Drills (§ 254.21 3vi).
F2067-13	Standard Practice for Development and Use of Oil-Spill Trajectory Models Status: Current	Include reference to F2067 in 30 CFR (§ 254.23) and (§ 254.26)	Helping develop Emergency Response Plan (§ 254.23 G2). This practice describes the features and processes that should be included in an oil-spill trajectory and fate model. Also helps define and predict "Worst case discharge scenario" appendix – trajectory analysis (§ 254.26 b)
F2327-08	Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water Status: Overdue	Include reference to F2327 in 30 CFR (§ 254.23)	Assist in procedures for the early detection of a spill (§ 254.23 F). This practice provides information and criteria for selection of remote sensing systems for the detection and monitoring of oil on water.
F2534-12	Standard Guide for Visually Estimating Oil Spill Thickness on Water Status: Current	Review in light of Macondo experience.	Assist in procedures for the early detection of a spill (§ 254.23 F) and Training and Drills (§ 254.21 3vi). This guide provides information and criteria for estimating the thickness of oil on water using only visual clues.
F2926-12	Standard Guide for Selection and Operation of Vessel-	Review in light of Macondo experience.	Assist in procedures for the early detection of a spill (§ 254.23 F) and

	mounted Camera Systems Status: Current	Transmitting images/video, along with positive id for presence of oil	Training and Drills (§ 254.21 3vi). This guide provides information and criteria for the selection of camera remote sensing systems that are vessel mounted for the detection of oil on water.
WK41247	New Test Method for Standard Test Method for Method for the Evaluation of the Stability of Water-in-oil Mixtures Formed from Crude Oil and Petroleum Products Mixed with Saline Water	No recommendation.	

Table 6 - Summary Table of F20.17 on Shoreline Countermeasures

Standard	Title	Recommendation	Justification
F1686-09e1	Standard Guide for Surveys to Document and Assess Oiling Conditions on Shorelines Status: Ballot Action Required	Include reference to F1686 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G3). This guide covers field procedures by which data may be collected in a systematic manner to document and assess the oiling conditions on shorelines.
F1687-09	Standard Guide for Terminology and Indices to Describe Oiling Conditions on Shorelines Status: Ballot Action Required	Include reference to F1687 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G3). This guide covers the standardized terminology and types of observational data and indices appropriate to describe the quantity, nature, and distribution of oil and physical oiling conditions on shorelines that have been contaminated by an oil spill.
F2204-09	Standard Guide for Describing Shoreline Response Techniques Status: Ballot Action Required	Include reference to F2204 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G4). This guide describes methods of cleaning and remediating shorelines containing stranded oil. The primary goal of any shoreline countermeasure is to aid recovery while minimizing additional impact.
F2464-12	Standard Guide for Cleaning of Various Oiled Shorelines and Habitats Status: Current	Include reference to F2464 in 30 CFR (§ 254.23)	Helping develop Emergency Response Plan (§ 254.23 G7). This guide provides information on shoreline types and sensitive habitats that can be used as guidance for selecting appropriate cleaning techniques following an oil spill. This guide does not address protected archaeological, historical, or cultural sites.

Table 7 - Summary Table of F20.21 on Initial Response

Standard	Title	Recommendation	Justification
F1011	Standard guide for developing a hazardous materials training curriculum for initial response personnel	Include reference to F1011 in 30 CFR (§ 254.21)	Helping format Emergency Response Plan (§ 254.21 b 3 vi). This guide covers a format for a hazardous materials spill initial response team training curriculum. This guide is designed to assist trainers of initial response personnel in assessing the content of training curriculum by providing guidelines for subject content against which these curricula may be evaluated.
F1129	Standard guide for using aqueous foams to control the vapor hazard from immiscible volatile liquids	No recommendation.	More applicable to land based or chemical spills

Table 8 - Summary Table of F20.22 on Mitigation Actions

Standard	Title	Recommendation	Justification
F716-09	Standard Test Methods for Sorbent Performance of Absorbents Status: Ballot Action Required	No recommendation.	Applicable to smaller spills, final clean-up, or chemical spills
F726-12	Standard Test Method for Sorbent Performance of Adsorbents Status: Current	No recommendation.	Applicable to smaller spills or final clean-up
F1127-07 (2013)	Standard Guide for Containment of Hazardous Material Spills by Emergency Response Personnel Status: Current	No recommendation.	More applicable to land based or smaller spills. Review to encompass large scale oil recovery operations.
F1524-95 (2013)	Standard Guide for Use of Advanced Oxidation Process for the Mitigation of Chemical Spills Status: Current	No recommendation.	More applicable to chemical spills
F1525/ F1525M-09	Standard Guide for Use of Membrane Technology in Mitigating Hazardous Chemical Spills Status: Ballot Action Required	No recommendation	More applicable to chemical spills
NEW	Large scale mitigation techniques – logistics of skimming, pumping to	Possible new protocol	Variation on F1127 to deal with larger spills. May provide logistical suggestions based upon previous spill experiences.

Standard	Title	Recommendation	Justification
	temporary storage, disposal		

Table 9 - Summary Table of F20.24 on Bioremediation

Standard	Title	Recommendation	Justification
F1600-95a(2013)	Standard Terminology Relating to Bioremediation Status: Current	No recommendation	NOTE: Under ballot for withdrawal

Detailed Analysis of Standards

F20.11 Control: Selected for further review

Items with Significant Input Required

Proposed New Standard: Use of Chemical Herding Agents for Spill Containment

In recent years there has been significant research on the use of chemical herding agents for spill containment, particularly in moderate ice conditions: when there is too much ice for the effective use of fire-resistant booms and too little ice to contain oil on its own. Inasmuch as the use of herders appears to offer a unique advantage in ice conditions, a significant capability gap currently exists. The proposed standard would address selection of appropriate herding products, criteria for effective use, requirements for approval for their use, and reference key milestones in the research leading to their development.

Items with Minimal Input Required

F1523-94(2013) Standard Guide for Selection of Booms in Accordance With Water Body Classifications (Status: Current)

This guide covers the selection of containment boom that may be used to control spills of oil and other substances that float on water. It is essentially a table that specifies minimum dimensions, recommended minimum buoyancy-to weight ratios, and recommended minimum tensile strengths for containment boom according to water body classifications of Calm, Protected, and Open Water.

The Guide was recently re-balloted; however, consideration should be given to revisiting the recommended minimum values for various parameters in light of experience in the Macondo response and other field or tank trials if applicable.

F1599-95(2009) Standard Guide for Collecting Performance Data on Temporary Storage Devices (Status: Ballot Action Required)

This provides a guideline for measuring the performance parameters of full-scale temporary storage devices that would be used to store oil and oil-water mixtures.

The Guide is due to be re-balloted soon; consideration should be given to revisiting the test procedures in light of experience in the Macondo response and other field or tank trials if applicable.

F1657/F1657M-96(2012)e1 Standard Practice for Emergency Joining of Booms with Incompatible Connectors (Status: Current)

This practice provides a standard practice for the joining of oil spill containment boom connectors in emergencies. It includes design and operational criteria intended to define mating requirements that will allow the emergency or occasional connection of unlike connectors.

The Guide was recently re-balloted; however, consideration should be given to revisiting the guide in light of experience in the Macondo response and other field or tank trials if applicable.

F2683-11 Standard Guide for Selection of Booms for Oil-Spill Response (Status: Current)

This guide covers the selection of booms for the containment and recovery of marine oil spills.

The Guide was recently re-balloted; however, consideration should be given to revisiting the guide in light of experience in the Macondo response and other field or tank trials if applicable.

WK37298 New Test Method for determining storage life of coated fabric products

This is a recently initiated work item with the objective of providing an economical method to determine the shelf life in storage of coated fabric products without having to conduct destructive testing on the products themselves. The fabrics from which booms, storage tanks, some skimmers and other floating devices are all subject to UV aging, thermal aging, moisture, abrasion and other combinations of environmental attack during storage and handling. Establishing a method of determining shelf life without actual destructive testing of the materials can help responders determine life cycle costs, plan for scheduled replacement, and evaluate material suitability for the proposed tasks over their lifetime.

This work item would be judged to be a relatively high priority; however it has a strong and active proponent and the support of the subcommittee and will require minimal input as part of this project.

F20.12 Removal: Selected for further review

Items with Significant Input Required

Proposed new Work Item: Inspection Protocols for Recovery Equipment

The F20.11 subcommittee recently initiated a work item to produce a standard guide for inspecting booms and other equipment made from coated fabrics (see WK37298 under F20.11). The objective here would be to produce a similar standard guide for inspecting skimmers and their ancillaries to help responders determine life cycle costs, plan for scheduled replacement, and evaluate material suitability for the proposed tasks over their lifetime.

F631 – 99 (2008) Standard Guide for Collecting Skimmer Performance Data in Controlled Environments (Status: Overdue)

This standard provides a guide for determining performance parameters of full-scale oil spill removal devices in recovering floating oil when tested in controlled environments. It was based on and essentially summarizes the skimmer testing protocol that has been used at Ohmsett for years.

The proposed work would be to either adapt F631 to include the recommended parameters for skimmer testing in ice conditions, or develop a new parallel standard with the same objective. The standard would draw heavily on the experiences gained in the 2013 test program at Ohmsett in which ten different devices were tested in 3/10ths and 7/10ths ice coverage.

F1780 – 97 (2010) Standard Guide for Estimating Oil Spill Recovery System Effectiveness (Status: Review for Ballot)

This guide provides a methodology for estimating the overall effectiveness of containment and recovery systems that may be used to assist in the control of oil spills on water. It contains many of the elements and overall approach as those contained in the recent Genwest report on EDRC methodologies.

The proposed work would provide additional details to the standard using the EDRC review as a guideline in the following potential areas:

- Provide an expanded schedule of slick thickness, which may vary according to spill type (i.e., blowout vs. batch release), spill size, and time
- Provide default values for an expanded list of variables (e.g., encounter speed, swath width, transit speeds, offloading rates, emulsification of spilled oil, skimmer efficiency)

- The default values would provide a “conservative” base: in most cases a response system would exceed the defaults but it would be up to a proponent to provide defensible justification for improved values
- Inclusion of a variable to account for downtimes due to weather and sea conditions specific to the operating area of interest
-

Items with Minimal Input Required

F2709 – 08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems (Status: Overdue)

This test method defines a method for quantifying the nameplate recovery rate of a stationary skimmer system under ideal conditions. If a determination of a skimmer’s capabilities in realistic conditions (that is, advancing or waves) is required, testing should be performed according to F631 or equivalent. It includes the option of testing to determine recovery efficiency. The standard states that, “It is accepted that the nameplate recovery rate as determined by this test method will not likely be achievable under actual conditions of a spill. The nameplate recovery rate should be used in conjunction with a de-rating factor to account for such issues as changing encounter rate, changes in other recovery conditions, changes in oil properties and slick thickness, number of daylight hours, operator downtime, less than ideal control of skimmer settings, and inclement weather.”

The proposed work is twofold. The listed issues relating to de-rating factors should be described more fully, and incorporated into the F1780 standard (above). Second, the existing standard should be expanded to include more precise documentation of skimmer components and ancillaries used in the tested model, which can be a concern with skimmers that are modified post-testing in a way that may affect physical characteristics (e.g., weight, draft) and operating characteristics (e.g., changes to hydraulics or other power supply).

F20.13 Treatment: Selected for further review

Items with Significant Input Required

F1012-86 Standard Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response – the Arctic (Status: Withdrawn 2002)

This guide covers recommendations for the use of chemical dispersants to assist in the control of oil spills. This guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis upon which recommendations are made. Aesthetic and socioeconomic factors are not considered, although these and other factors are often important in spill response.

This standard was withdrawn in 2002 as part of an effort by the F20.13 subcommittee to consolidate various dispersant-use standards under a much smaller number of habitat categories. With renewed interest in operations in Arctic and sub-Arctic areas, the proposed work is to re-visit this previously approved standard to ensure that elements unique to Arctic operations are included in the broader dispersant-use standards, and to ensure that the standards also reflect tank- and field trials over the most recent decade.

F2059 – 06 (2012) Standard Test Method for Laboratory Oil Spill Dispersant Effectiveness Using the Swirling Flask (Status: Current)

This test method covers the procedure to determine the effectiveness of oil spill dispersants on various oils in the laboratory. This test method covers the use of the swirling flask test apparatus and does not cover other apparatuses nor are the analytical procedures described in this report directly applicable to such procedures.

The proposed work would be to develop a new standard involving other meso-scale and full-scale test methods that have proved their value in recent years (e.g., SL Ross tank and Ohmsett tank protocols).

Proposed New Standard: Evaluation of Dispersant-Use Systems Effectiveness

The proposed standard would be similar in approach to F1780 for evaluating containment and recovery systems, and would include a methodology for estimating effectiveness based on various system components such as:

- Initial slick properties and thickness and changes with time in slick thickness and oil properties due to weathering and emulsification
- Variations in slick conditions as a result of spill type (i.e., batch versus blowout) and breakup into patches and windrows

- Mobilization and transit times for the different classes of spraying platforms (vessels, helicopters, small and large fixed-wing aircraft)
- Dispersant pumping rate, swath width and spraying speed for different classes of spray platforms
- Repositioning time for different classes of spraying platforms
- Dispersant payloads, endurance and resupply/refueling times for different classes of spraying platforms

Items with Minimal Input Required

F1737/F1737M – 10 Standard Guide for Use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems (Status: Review for Ballot)

This guide covers considerations for the maintenance, storage, and use of oil spill dispersant application systems.

Consideration should be given to include reference to F1737 in the CFR, to the effect that any dispersant equipment listed in a contingency plan meet the specifications in the standard.

F2465/F2465M – 05 (2011) Standard Guide for Oil Spill Dispersant Application Equipment: Single-point Spray Systems (Status: Current)

This guide covers performance criteria, requirements, material characteristics, and essential features for oil spill dispersant application systems. The guide covers vessel-based spray systems employing single-point spray nozzles, including designs that have been based on or evolved from "fire-monitor" systems, and is not fully applicable to other systems such as spray boom/ nozzle or aircraft systems.

Consideration should be given to include reference to F2465 in the CFR, to the effect that any dispersant equipment listed in a contingency plan meet the specifications in the standard.

F2532–13 Standard Guide for Determining Net Environmental Benefit of Dispersant Use (Status: Current)

This guide covers considerations in assessing net environmental benefit of dispersant use on oil spills. Net environmental benefit analysis (NEBA) of all response options should be conducted as part of oil spill contingency planning.

Consideration should be given to include reference to F2532 in the CFR, to the effect that any contingency plan that includes a dispersant-use option use the standard in making NEBA decisions.

F20.15 In-Situ Burning: Selected for further review

Items with Significant Input Required

Proposed New Standard: Evaluation of In-Situ Burning Systems Effectiveness

The proposed standard would be similar in approach to F1780 for evaluating containment and recovery systems, and would include a methodology for estimating effectiveness based on various system components such as:

- Mobilization and transit times
- Variations in slick conditions as a result of spill type (i.e., batch versus blowout)
- Changes in slick thickness
- Changes in slick composition and emulsification
- Lengths of fire-resistant boom that can be effectively managed, and based on this, swath widths
- Slick encounter speeds
- Burn rates
- Degradation of boom as a result of heat exposure

Note that a current work item of F20.15 involves estimating burn volumes, which would form one component of the standard proposed here.

Items with Minimal Input Required

F1788–08 Standard Guide for In-Situ Burning of Oil Spills on Water: Environmental and Operational Considerations (Status: Overdue)

This guide covers the use of in-situ burning to assist in the control of oil spills on water. The purpose of the guide is to provide information that will enable spill responders to decide if burning will be used as part of the oil spill cleanup response.

This standard is presently under review by the subcommittee in order to incorporate lessons from the Macondo response.

F1990–07 (2013) Standard Guide for In-Situ Burning of Spilled Oil: Ignition Devices (Status: Current)

This guide relates to the use of in-situ burning of spilled oil. The focus of the guide is in-situ burning of oil on water, but the ignition techniques and devices described in the guide are generally applicable to in-situ burning of oil spilled on land as well. The purpose of the guide is to provide information that will enable oil-spill responders to select the appropriate techniques and devices to successfully ignite oil spilled on water.

Consideration should be given to include reference to F1990 in the CFR, to the effect that any ignition equipment listed in a contingency plan meet the specifications in the standard.

F2152 – 07 (2013) Standard Guide for In-Situ Burning of Spilled Oil: Fire-Resistant Boom (Status: Current)

This guide covers a set of criteria to evaluate the performance, material characteristics, and essential features of fire-resistant oil spill containment boom. This guide covers two types of fire-resistant oil containment boom: those that are intrinsically fire-resistant through the use of fire-resistant materials, and those that provide fire-resistance through the use of coolants. This guide may not be fully applicable to other types of fire-resistant boom.

Consideration should be given to include reference to F2152 in the CFR, to the effect that any fire-resistant booms listed in a contingency plan meet the specifications in the standard.

F2230–08 Standard Guide for In-situ Burning of Oil Spills on Water: Ice Conditions (Status: Overdue)

This guide addresses in-situ burning as a response tool for oil spills occurring on waters with ice present. The purpose of the guide is to provide the user with general information on in-situ burning in ice conditions as a means of controlling and removing spilled oil. The guide outlines procedures and describes some equipment that can be used to accomplish an in-situ burn in ice conditions. The guide includes a description of typical ice situations where in-situ burning of oil has been found to be effective.

The standard is presently under review and will include reference to experiments performed as part of the 2008/09 JIP in the Barents Sea.

WK37324 New Guide for Standard Guide for Evaluation of In-Situ Burning Effectiveness

The objective of this work item is to provide guidance to spill workers to calculate the amount of oil burned with the approximate area of burn as input. This becomes a very important item in spill countermeasures and litigation afterwards.

F20.16 Surveillance and Tracking: Selected for further review

Items with Significant Input Required

Proposed New Standard: Guide on Surveillance to Support On-Water Operations

Justification: Develop a common methodology for integrating surveillance systems with recovery to ensure safe and effective operations when visibility is limited or reduced. Use of such a guide would help to expand the window of operations, and would increase overall response system effectiveness.

F2327-08 Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water (Status: Overdue)

This guide provides information and criteria for selection of remote sensing systems for the detection and monitoring of oil on water. The guide applies to the remote sensing of oil-on-water involving a variety of sensing devices used alone or in combination. The sensors may be mounted in helicopters, fixed-wing aircraft, or lighter-than-air platforms. Excluded are situations where the aircraft is used solely as a telemetry or visual observation platform and exo-atmosphere or satellite systems.

Reference to F2327 should be included in CFR (§ 254.23). Use of the guide would assist in procedures for the early detection of a spill (§ 254.23 F). This practice provides information and criteria for selection of remote sensing systems for the detection and monitoring of oil on water, and helps to identify the extent and general characteristics of a spill so that the OSC can direct resources in the most effective manner.

F2327 should also be revised to include reference to recent work by Ocean Imaging and their development of a capability for detection and measurement of slick thickness.

Items with Minimal Input Required

F1779-08 Standard Practice for Reporting Visual Observations of Oil on Water (Status: Overdue): WK43851 Draft Under Development

This practice covers methods of reporting and recording visual observations of oil on water and related response activities. While a similar set of codes could be used for classifying oil on beaches, this subject is not discussed in this practice. It does not cover the use of remote-sensing equipment from aircraft, which is discussed in a separate standard. This does not include observations of dispersed oil.

Reference to F1779 should be included in CFR (§ 254.23). Use of this standard would assist in procedures for the early detection of a spill (§ 254.23 F). This practice can be used by surveillance and tracking staff to report visual observations leading to the preparation of maps of the oil-slick location and Training and Drills (§ 254.21 3vi). Overall, use of this guide would help to provide common characterizations to OSC, ensuring a better understanding of the characteristics and extent of an oil spill. Minor updates should be performed to incorporate lessons learned during Macondo response.

F2067-13 Standard Practice for Development and Use of Oil-Spill Trajectory Models (Status: Current)

This practice describes the features and processes that should be included in an oil-spill trajectory and fate model. This practice applies only to oil-spill models and does not consider the broader need for models in other fields. This practice considers only computer-based models, and not physical modeling of oil-spill processes.

Reference to F2067 should be included in CFR (§ 254.23) and (§ 254.26). The practice would assist in developing Emergency Response Plans (§ 254.23 G2). This practice: describes the features and processes that should be included in an oil-spill trajectory and fate model; helps define and predict “Worst case discharge scenario” appendix – trajectory analysis (§ 254.26 b); and helps to provide justification for marshalling resources where they are needed most and to help protect sensitive areas.

F2534-12 Standard Guide for Visually Estimating Oil Spill Thickness on Water (Status: Current)

This guide provides information and criteria for estimating the thickness of oil on water using only visual clues. The thickness values obtained using this guide are at best estimates because the appearance of oil on water may be affected by a number of factors including oil type, sea state, visibility conditions, and weather.

The guide should be reviewed in light of Macondo experiences. Use of this guide would assist in procedures for the early detection of a spill (§ 254.23 F) and Training and Drills (§ 254.21 3vi). This guide provides information and criteria for estimating the thickness of oil on water using only visual clues, and helps to provide the OSC a better understanding of the characteristics and extent of an oil spill.

F2926-12 Standard Guide for Selection and Operation of Vessel-mounted Camera Systems (Status: Current)

This guide provides information and criteria for the selection of camera remote sensing systems that are vessel mounted for the detection of oil on water. This guide applies to the detection of oil-on-water involving cameras of IR, visible, ultra-violet, or night vision types. The context of camera use is addressed to the extent it has a bearing on their selection and utility for certain missions or objectives.

This guide should be reviewed in light of Macondo experiences. Use of this guide would assist in procedures for the early detection of a spill (§ 254.23 F) and Training and Drills

(§ 254.21 3vi). This guide provides information and criteria for the selection of camera remote sensing systems that are vessel mounted for the detection of oil on water. Minor updates should be performed to incorporate lessons learned during Macondo response.

F20.17 Shoreline Countermeasures: Selected for further review

Items with Significant Input Required

Potential new standard: Guide to setting priorities for shoreline cleanup

Using NEBA principles, set guidelines for setting priorities for shoreline cleanup to assist OSCs in tactical planning.

Items with Minimal Input Required

F1686-09e1 Standard Guide for Surveys to Document and Assess Oiling Conditions on Shorelines (Status: Ballot Action Required)

This guide covers field procedures by which data may be collected in a systematic manner to document and assess the oiling conditions on shorelines. This guide does not address the terminology that is used to define and describe shoreline oiling conditions, the ecological character of oiled shorelines, or the cultural or other resources that may be present. The guide is applicable to marine coasts (including estuaries) and may also be used in freshwater environments (rivers and lakes).

Reference to F1686 should be included in CFR (§ 254.23). Use of this guide would help in the development of Emergency Response Plans (§ 254.23 G3). This guide covers field procedures by which data may be collected in a systematic manner to document and assess the oiling conditions on shorelines and assists an OSC prioritize response options for impacted shorelines. Minor updates should be performed to incorporate lessons learned during Macondo response.

F1687-09 Standard Guide for Terminology and Indices to Describe Oiling Conditions on Shorelines (Status: Ballot Action Required)

This guide covers the standardized terminology and types of observational data and indices appropriate to describe the quantity, nature, and distribution of oil and physical oiling conditions on shorelines that have been contaminated by an oil spill. This guide does not address the mechanisms and field procedures by which the necessary data are gathered; nor does it address terminology used to describe the cultural resource or ecological character of oiled shorelines, spill monitoring, or cleanup techniques. This guide applies to marine shorelines (including estuaries) and may also be used in freshwater environments (rivers and lakes).

Reference to F1687 should be included in CFR (§ 254.23). Use of this guide would help in the development of Emergency Response Plans (§ 254.23 G3). This guide covers the standardized terminology and types of observational data and indices appropriate to describe the quantity, nature, and distribution of oil and physical oiling conditions on shorelines that have been contaminated by an oil spill. Ensures common descriptors are used and helps the OSC prioritize response options for impacted shorelines. Minor updates should be performed to incorporate lessons learned during Macondo response.

F2204-09 Standard Guide for Describing Shoreline Response Techniques (Status: Ballot Action Required)

This guide describes methods of cleaning and remediating shorelines containing stranded oil. The primary goal of any shoreline countermeasure is to aid recovery while minimizing additional impact. This guide describes 22 different tactics that are available for consideration. These options range from natural recovery to active intervention. This guide describes technical considerations for selecting one technique or another, or both.

Reference to F2204 should be included in CFR (§ 254.23). Use of this guide would help in the development of Emergency Response Plans (§ 254.23 G3). This guide describes methods of cleaning and remediating shorelines containing stranded oil. The primary goal of any shoreline countermeasure is to aid recovery while minimizing additional impact. Helps to avoid confusion and ensures clear communications between response personnel. Minor updates should be performed to incorporate lessons learned during Macondo response.

F2464-12 Standard Guide for Cleaning of Various Oiled Shorelines and Habitats (Status: Current)

This guide provides information on shoreline types and sensitive habitats that can be used as guidance for selecting appropriate cleaning techniques following an oil spill. This guide does not address protected archaeological, historical, or cultural sites. This guide’s emphasis is on typical physical and biological attributes of coastal and inland habitats that could be at risk from oil spills. It reviews and encompasses the entire spectrum of shoreline types representing a wide range of sensitivities.

Reference to F2464 should be in CFR (§ 254.23). Use of this guide would help in the development of Emergency Response Plans (§ 254.23 G3). This guide provides information on shoreline types and sensitive habitats that can be used as guidance for selecting appropriate cleaning techniques following an oil spill. This guide does not address protected archaeological, historical, or cultural sites. Helps to avoid confusion and ensures clear communications between response personnel.

F20.21 Initial Response: Selected for further review

Items with Significant Input Required

None

Items with Minimal Input Required

F1011–07 (2013) Standard guide for developing a hazardous materials training curriculum for initial response personnel (Status: Current)

This guide covers a format for a hazardous materials spill initial response team training curriculum. This guide is designed to assist trainers of initial response personnel in assessing the content of training curriculum by providing guidelines for subject content against which these curricula may be evaluated. The guide should be tailored by the trainer to fit specific circumstances that are present in the community or industry where a spill may occur. Currently the Code of Federal Regulation 40 CFR 112, 40 CFR 265, and 49 CFR 173 specify that producers, handlers, and shippers of hazardous materials shall plan and train for hazardous spill response. The broad interpretation of these regulations could include the requirement to train state and local response organizations that may be required to handle hazardous materials in an emergency spill situation. Regardless of the above regulatory requirements, training is essential to a proper response in an emergency.

Reference to F1011 should be included in CFR (§ 254.21). Us of this guide would help in formatting Emergency Response Plans (§ 254.21 b 3 vi). This guide covers a format for a hazardous materials spill initial response team training curriculum. This guide is designed to assist trainers of initial response personnel in assessing the content of training curriculum by providing guidelines for subject content against which these curricula may be evaluated. Helps ensure a consistent and comprehensive training curriculum is developed for initial response personnel. Minor updates should be performed to incorporate lessons learned during Macondo response.

F20.22 Mitigation Actions: Selected for further review

Items with Significant Input Required

Potential new standard: Address issues relate to simultaneous operations in large scale response

Variation on F1127 to deal with larger spills. May provide logistical suggestions based upon previous spill experiences. Aids the decision making process when selecting, mobilizing and engaging available equipment and techniques including booms, skimmers, pumps, storage devices, dispersant application and in-situ burning to optimize the recovery effort. Helps ensure best practices are used when responding to spills derived from net environmental benefits, operational optimization and historical information.

Items with Minimal Input Required

None

F20.24 Bioremediation: Selected for further review

Items with Significant Input Required

None

Items with Minimal Input Required

None

Appendix A-1: Current ASTM Standards rejected from further review

F20.11 Control: Rejected from further review

F625/F625M-94(2011)e2 Standard Practice for Classifying Water Bodies for Spill Control Systems (Status: Current)

This practice creates a system of categories that classify water bodies relating to the control of spills of oil and other substances that float on or into a body of water. It is essentially a table listing maximum wave heights for Calm, Protected Water, and Open Water, primarily for use as a reference for F1523.

F715-07(2012) Standard Test Methods for Coated Fabrics Used for Oil Spill Control and Storage (Status: Current)

These test methods cover laboratory-conducted performance tests for coated fabrics used in spill control barriers or in temporary storage devices.

F818-93(2009) Standard Terminology Relating to Spill Response Barriers (Status: Ballot Action Required)

This document defines the terminology used in the field of spill response barriers. Only those terms commonly used or peculiar to this field have been included; no attempt has been made to list all terms used. Terminology is included for the following categories: barrier design terminology, barrier engineering terminology, and barrier performance terminology

F962-04(2010) Standard Specification for Oil Spill Response Boom Connection: Z-Connector (Status: Review for Ballot)

This specification covers design criteria requirements, design geometry, material characteristics, and desirable features for oil spill response boom connections. These criteria are intended to define minimum mating characteristics and are not intended to be restrictive to a specific configuration.

F1093-99(2012) Standard Test Methods for Tensile Strength Characteristics of Oil Spill Response Boom (Status: Current)

These test methods cover static laboratory tests of the strength of oil spill response boom under tensile loading.

F2084/F2084M-01(2012)e1 Standard Guide for Collecting Containment Boom Performance Data in Controlled Environments (Status: Current)

This guide covers the evaluation of the effectiveness of full-scale oil spill containment booms in a controlled test facility. It is essentially a summary of the test protocol for boom performance used for years at Ohmsett.

F2438-04(2010) Standard Specification for Oil Spill Response Boom Connection: Slide Connector (Status: Review for Ballot)

This specification covers design criteria requirements, design geometry, material characteristics, and desirable features for oil spill response boom slide connections. These criteria are intended to define minimum mating characteristics and are not intended to be restricted to a specific configuration.

F2682-07(2012)e1 Standard Guide for Determining the Buoyancy to Weight Ratio of Oil Spill Containment Boom (Status: Current)

This guide describes a practical method for determining the buoyancy to weight (B/W) ratio of oil spill containment booms.

F20.12 Removal: Rejected from further review

F1084–08 (2013) Standard Guide for Sampling Oil/Water Mixtures for Oil Spill Recovery Equipment (Status: Current)

This guide is intended for sampling flowing or stationary oil/water mixtures. It is intended for use with oil spill recovery devices either in testing or in documentation of field performance.

F1607–95 (2013) Standard Guide for Reporting of Test Performance Data for Oil Spill Response Pumps (Status: Current)

This guide is intended as a guideline for the standardized reporting of performance data of pumps and pump systems that may be considered for use in oil spill response operations. It is essentially a reporting guideline to aid in the comparative evaluation of various devices.

F1778–97 (2008) Standard Guide for Selection of Skimmers for Oil-Spill Response (Status: Overdue)

This guide covers considerations for selecting skimmer systems for the recovery of marine-oil spills. The purpose of this guide is to provide oil spill response planners, equipment manufacturers, users, and government agencies with a standard on the equipment selection process for the removal of oil from the marine environment.

F2008–00 (2012) Standard Guide for Qualitative Observations of Skimmer Performance (Status: Current)

This guide covers evaluating a number of qualitative performance parameters for full-scale oil spill removal systems or individual components of those systems. It is intended to complement the quantitative testing covered in Guide F631.

F20.13 Treatment: Rejected from further review

F1209–08 Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Ponds and Sloughs (Status: Overdue)

This guide covers the use of oil spill dispersants to assist in the control of oil spills. The guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered, although these and other factors are often important in spill response.

F1210–08 Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Lakes and Large Water Bodies (Status: Overdue)

This guide covers the use of oil spill dispersants to assist in the control of oil spills. The guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered, although these and other factors are often important in spill response.

F1231–08 Standard Guide for Ecological Considerations for the Use of Oil Spill Dispersants in Freshwater and Other Inland Environments, Rivers and Creeks (Status: Overdue)

This guide covers the use of oil spill dispersants to assist in the control of oil spills. This guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered, although these and other factors are often important in spill response.

F1279–08 Standard Guide for Ecological Considerations for the Restriction of the Use of Surface Washing Agents: Permeable Land Surfaces (Status: Overdue)

This guide covers the use of surface washing agents to assist in the control of oil spills. The guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered although these and other factors are often important in spill response.

F1280–08 Standard Guide for Ecological Considerations for the Use of Surface Washing Agents: Impermeable Surfaces (Status: Overdue)

This guide covers the use of surface washing agents to assist in the cleanup of oil spills. This guide is written with the goal of minimizing the environmental impacts of oil spills; this goal is the basis on which the recommendations are made. Aesthetic and socioeconomic factors are not considered although these and other factors are often important in spill response.

F1413–07 (2013) Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems (Status: Current)

This guide covers design criteria, requirements, material characteristics, and essential features for oil spill dispersant application systems. The guide covers spray systems employing booms and nozzles and is not fully applicable to other systems such as fire monitors, sonic distributors, or fan-spray guns.

F1460–07 (2013) Standard Practice for Calibrating Oil Spill Dispersant Application Equipment Boom and Nozzle Systems (Status: Current)

This practice covers uniform procedures for determining and reporting the dosage rate of oil spill dispersant application equipment. This practice is applicable to spray systems employing booms and nozzles and is not fully applicable to other systems such as fire monitors, sonic distributors, or fan-spray guns.

F1693–13 Standard Guide for Consideration of Bioremediation as an Oil Spill Response Method on Land (Status: Current)

The goal of this guide is to provide recommendations for the use of biodegradation enhancing agents for remediating oil spills in terrestrial environments. This is a general guide only, assuming the bioremediation agent to be safe, effective, available, and applied in accordance with both manufacturers' recommendations and relevant environmental regulations. As referred to in this guide, oil includes crude and refined petroleum products. The guide addresses the application of bioremediation agents alone or in conjunction with other technologies, following spills on surface terrestrial environments.

F1738–10 Standard Test Method for Determination of Deposition of Aerially Applied Oil Spill Dispersants (Status: Review for Ballot)

This test method covers the measurement of the deposition of an aerially applied dispersant on the surface of the ground or water. The test method of obtaining these measurements is described, and the analysis of the results, in terms of dispersant use, is considered. There are a number of techniques that have been developed, and this test method outlines their application. These measurements can be used to confirm or verify the specifications of a given equipment set, its proper functioning, and use.

F1872–12 Standard Guide for Use of Chemical Shoreline Cleaning Agents: Environmental and Operational Considerations (Status: Current)

This guide covers the use of chemical cleaning agents on oiled shorelines. This guide is not applicable to other chemical agents nor to the use of such products in open waters. The purpose of this guide is to provide information that will enable spill responders to decide whether to use chemical shoreline cleaning agents as part of the oil spill cleanup response.

F2205–07 (2013) Standard Guide for Ecological Considerations for the Use of Chemical Dispersants in Oil Spill Response: Tropical Environments (Status: Current)

This guide covers recommendations for use of chemical dispersants to assist in the control of oil spills and is written with the goal of minimizing the environmental impacts of oil spills. Aesthetic and socioeconomic factors are not considered; although, these and other factors are often important in spill response.

F20.15 In-Situ Burning: Rejected from further review

F2533–07 (2013) Standard Guide for In-Situ Burning of Oil in Ships or Other Vessels (Status: Current)

This guide covers the use of in-situ burning directly in ships and other vessels. The guide is applicable to situations in which the vessel and cargo are not salvageable. After the burn, the vessel will never be salvageable. It is intended that the in-situ burning of oil spills in ships be a last resort option.

F2823–10 Standard Guide for In-Situ Burning of Oil Spills in Marshes (Status: Review for Ballot)

This guide addresses in-situ burning as a response tool for oil spills that occur in marshes. The purpose of this guide is to provide the user with general information on in-situ burning in marshes as a means of controlling and removing spilled oil.

F20.16 Surveillance and Tracking: Rejected from further review

WK41247 New Test Method for Standard Test Method for Method for the Evaluation of the Stability of Water-in-oil Mixtures Formed from Crude Oil and Petroleum Products Mixed with Saline Water

This proposed new standard provides a laboratory test method for the determination of the water-in-oil emulsion and mixture tendencies of crude oils and petroleum products there is no current procedure or standard covering this important item.

F20.17 Shoreline Countermeasures: Rejected from further review

None

F20.21 Initial Response: Rejected from further review

F1129/F1129M–12 Standard guide for using aqueous foams to control the vapor hazard from immiscible volatile liquids (Status: Current)

This guide restricts itself to addressing the application of foam to water immiscible liquid and some water reactive compounds with boiling points above 15°C for vapor control or fire suppression of land spill or contained spills on water.

F20.22 Mitigation Actions: Rejected from further review

F716-09 Standard Test Methods for Sorbent Performance of Absorbents (Status: Ballot Action Required)

These test methods cover the development of laboratory test data which describe the performance of absorbent materials used to remove oils and other compatible fluids from water.

F726-12 Standard Test Method for Sorbent Performance of Adsorbents (Status: Current)

This test method covers laboratory tests that describe the performance of adsorbents in removing non-emulsified oils and other floating, immiscible liquids from the surface of water.

F1127-07 (2013) Standard Guide for Containment of Hazardous Material Spills by Emergency Response Personnel (Status: Current)

This guide describes methods to contain the spread of hazardous materials that have been discharged into the environment. It is directed toward those emergency response personnel who have had adequate hazardous material response training.

F1524-95 (2013) Standard Guide for Use of Advanced Oxidation Process for the Mitigation of Chemical Spills (Status: Current)

This guide covers the considerations for advanced oxidation processes (AOPs) in the mitigation of spilled chemicals and hydrocarbons dissolved into ground and surface waters.The guide addresses the application of advanced oxidation alone or in conjunction with other technologies.

F1525/ F1525M-09 Standard Guide for Use of Membrane Technology in Mitigating Hazardous Chemical Spills (Status: Ballot Action Required)

This guide covers considerations for the use of membrane technology in the mitigation of dilute concentrations of spilled chemicals into ground and surface waters. The guide addresses the application of membrane technology alone or in conjunction with other technologies.

F20.24 Bioremediation: Rejected from further review

F1600-95a(2013) Standard Terminology Relating to Bioremediation (Status: Under ballot for withdrawal)

This terminology defines the terminology used in test methods, specifications, guides, and practices related to bioremediation technology. The definitions are written to ensure that standards related to bioremediation technology are understood and interpreted properly.

Appendix B: Proposed New Standard: Use of Chemical Herding Agents for Spill Containment

Second draft: 15.01

Standard Guide for
Use of Chemical Herding Agents in Conjunction with In-Situ Burning

1. Scope

1.1 This guide relates to the use chemical herding agents in conjunction with in-situ burning of spilled oil.

1.2 The purpose of this guide is to provide information that will enable oil-spill responders to select the appropriate techniques and devices to successfully collect and ignite oil spilled on water.

1.3 This standard guide is one of several related to in-situ burning. Other standards cover specifications for fire-containment booms and the environmental and operational considerations for burning.

1.4 This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

1.5 In particular, the storage, transport, and use of chemical herding agents may be subject to regulations that will vary according to the jurisdiction. While guidance of a general nature is provided in this document, users of this guide should determine regulations that apply to their situation.

2. Referenced Documents

ASTM Standards

D 971 Test Method for Interfacial Tension of Oil Against Water by the Ring Method

3. Terminology

Herding agent – (aka surface collection agent) chemical product that can be applied to the water surface surrounding an oil slick to concentrate the slick and thicken it to enhance countermeasures such as in-situ burning or recovery.

4. Significance and Use

4.1 This guide describes the use of chemical herding agents for the purpose of in-situ burning. It is intended to aid decision-makers and spill-responders in contingency planning, spill response, and training, and to aid manufacturers in developing effective chemical herding agents.

4.2 This guide describes criteria for the selection and use of herding agents to facilitate in-situ burning applications.

4.3 This guide is not intended as a detailed operational manual for the use of chemical herding agents or the burning of spilled oil.

5. Overview of the Use of Herding Agents for Burning Spilled Oil on Water

5.1 The focus of this standard guide is on the in-situ combustion of marine oil spills in drift ice conditions. The use of herding agents on calmer ice-free water is also possible.

5.2 The main requirement for the effective use of in-situ burning of a marine oil spill is an adequate slick thickness to support combustion. Slicks of greater than 1 mm are required to allow ignition and sustain combustion. Thicknesses of 2 to 3 mm will ensure superior oil removal efficiency.

5.3 For spills that are not naturally contained against a shoreline, ice edge, or amongst ice pieces, artificial containment will be required to achieve burnable slick thicknesses.

5.4 Collection and containment using fire-resistant boom is possible in open water and drift ice concentration up to 3 to 5/10ths, but is slower than in open water. In drift ice concentrations of 7/10ths and greater, natural containment may be adequate for in-situ burning. Chemical herding agents (aka herders) may be useful when ice concentrations do not allow the use of booms and when natural containment is not afforded. Herding agents can be used to contain and concentrate oil for the purpose of in-situ burning.

5.5 Herding agents sprayed onto the water surrounding an oil slick result in the formation of a monolayer of surfactants on the water surface (Figure 1). These surfactants reduce the surface tension of the surrounding water significantly. When the surfactant monolayer reaches the edge of a thin oil slick it changes the balance of interfacial forces acting on the slick edge and causes the oil/water and oil/air interfacial tensions to contract the oil into thicker layers.

5.6 Although commercialized in the 1970s, herding agents were not used offshore because they only worked in relatively calm conditions: physical containment booms were still needed to hold or divert slicks in wind speeds above 2 m/s and breaking waves disrupted the herder layer. Recent research has re-examined the use of herding agents in the context of in-situ burning in ice conditions, where breaking waves are generally less of an issue.

5.7 Herding agents do not affect the physical or chemical properties of the oil, and will not affect the ability to subsequently disperse or mechanically recover the oil, beyond any effect related to thickening the oil slick.

5.8 The ultimate fate of herding agents will generally be dispersion into the water column due to wave action. Given the low application rate, the concentration of herding agent in the water will generally be very low.

5.9 A more thorough description of herding agent development is contained in Appendix A.

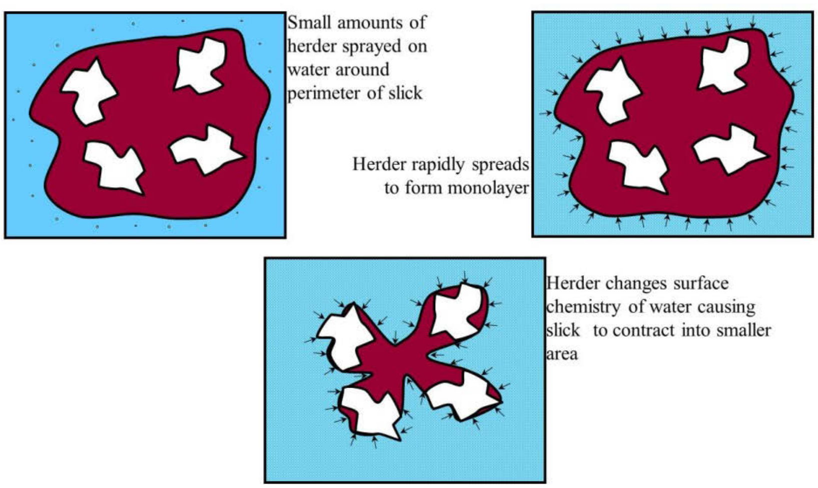

Figure 1: Depiction of herding agent application

6. Guidelines for Use

6.1 The use of specific chemical surface-active agents, sometimes called oil herders or surface oil collection agents, to clear and contain oil slicks on an open-water surface is well known.

6.2 Herding agents are applied to the water surface around the periphery of a slick, not onto the slick itself.

6.3 These agents have the ability to spread rapidly over a water surface into a monomolecular layer, as a result of their high spreading coefficients, or spreading pressures. The most effective herding agents have spreading pressures in the mid-40 mN/m range, whereas most crude oils have spreading pressures in the 10 to 20-mN/m range.

6.4 Consequently, small quantities of these surfactants (approximately 15 L per kilometre or 150 mg/m^2) will quickly clear thin films of oil from large areas of water surface, contracting the oil into thicker slicks.

6.5 For example, a 10 m^3 spill with an average thickness of 0.1 mm would have a perimeter of approximately 1100 metres, and would require approximately 16 L of herding agent. In this example the herding agent to oil ratio is 1:600.

6.6 Depending on the scale of the application, herding agent may be applied drop-wise or in low volume streams. In either case, care should be taken to avoid mixing the herding agent into the water column or spraying it onto the slick.

6.7 Herding agents in common use may gel at sub-freezing temperatures. Gelling can be avoided by limiting the exposure of herding agent to ambient conditions, the use of insulated application containers, and the use of heat.

7. Herding Agent Effectiveness Test

7.1 With renewed interest in the use of herding agents there has been renewed interest in developing and evaluating new and existing products. To be accepted as a spill control agent in US waters, a herding agent must pass a floating persistence test and an environmental effects test. To be judged as useful for the application, the following effectiveness test is recommended.

7.2 The following is intended as a simple test to evaluate the ability of a chemical herding agent to concentrate a slick for in-situ burning. The test does not consider operability factors such as safe deployment of the herding agent, accuracy of deployment, and reliability of any deployment device.

7.3 The test parameters are intended to reflect minimum conditions for acceptable performance. More stringent conditions such as higher wind speed or the use of weathered or emulsified oils may be considered for some herding agents, depending on the application.

7.4 The recommended oil for the effectiveness test is a light to medium weight crude oil. Diesel could be used, but should be tinted to aid in visual measurement techniques.

7.5 The following test can be performed using fresh water underlying the oil. Present-day herding agents work equally well in fresh water and in seawater. Depending on the intended application, the inconsequence of water salinity should be confirmed or, preferably, both conditions tested.

7.6 The general procedure for a 1-m^2 pan experiment is:

7.6.1 Place 20 L (a depth of 2 cm) of room-temperature water in each 1-m^2 pan lined with freshly rinsed (using tap water) new plastic film.

7.6.2 Take a sample of the water from the surface using a Petri dish and measure the water-air interfacial tension (IFT) using a DuNuoy Ring Tensiometer (ASTM D971-12). If the IFT reading is less than 60, replace the water and film and retry.

7.6.3 Carefully pour 1 L of the test oil on the water; making sure that it doesn't stick to the plastic on the bottom of the tray while being poured.

7.6.4 Allow the oil to spread to equilibrium and take a digital photograph from overhead, preferably directly overhead the center of the pan, for subsequent oil area coverage analysis.

7.6.5 Apply prescribed amount (150 µL) of herding agent to open water area with micropipette.

7.6.6 Allow the oil to contract and take another digital photograph after one minute, 10 minutes, 30 minutes and 1 hour.

7.6.7 Empty water from pan, remove plastic film, dry with paper towels.

7.6.8 The slicks (including any oil sheen) in the photographs must be corrected for perspective and the area measured. Average slick thickness is estimated by dividing the volume of oil by the calculated area.

7.6.9 The error in estimating area should be quite small, less than 5% taking into account parallax errors at the sides of the pans. Errors in average slick thickness would increase as time progresses, unless evaporation losses are taken into account, but in a quiescent lab environment over the period of an hour would not likely exceed 10%.

7.7 An effective herder will thicken a light to medium crude from an initial equilibrium thickness of approximately 1 mm to a thickness greater than 3mm in a few minutes and maintain the herded slick thickness at 3mm or greater for the one hour test.

8. Regulatory Considerations

8.1 In most jurisdictions, application of a chemical product in a marine environment is subject to regulatory approval.

8.2 In the U.S., the Environmental Protection Agency would approve or disapprove of such a product based on two criteria: toxicity testing and tendency for the product to mix into the water column. Should a product meet these two criteria EPA will list it on the National Contingency Plan (NCP) Product Schedule.

9. Safety

9.1 SDS information should be consulted prior to the use of any chemical herding agent.

9.2 In general, the use of chemical herding agents does not present any particular safety concerns to response personnel. Standard Personal Protection Equipment should be used to avoid ingestion, inhalation, and prolonged contact.

10. Shipping and storage

10.1 In general, the currently available chemical herding agents do not present any particular concerns regarding shipping and storage regulations.

10.2 Herding agens should be stored in sealed containers in a warm facility, shielded from sunlight and avoiding extreme temperatures.

10.3 The estimated shelf life of the product should be stated by the manufacturer. Existing herding agents have a known shelf life of five years or more.

CHEMICAL HERDER - APPENDIX : Brief History of Herder Development

A1 Background

Herding agents were initially developed in the 1970's as a method of thickening oil slicks prior to mechanical recovery. Unfortunately, it was discovered during field tests that herded slicks began to re-spread in tens of minutes in all but relatively calm seas. They were never applied during an actual offshore spill because mechanical recovery requires longer periods to implement.

A research program initiated in 2003 found that herding agents persisted long enough to enable in-situ burning of relatively fresh, fluid oils in broken or drift ice. This multi-year, multi-partner program involved:

- A small scale (1 m^2) preliminary assessment of a shoreline-cleaning agent with oil herding properties was carried out in 2003 to assess its ability to herd oil different oils on cold water and among ice.
- Small-scale (1 m^2) experiments were carried out in 2005 to explore the relative effectiveness of three oil hydrocarbon-based herding agents in simulated ice conditions; followed by larger-scale (10 m^2) quiescent pan experiments to explore scaling effects; small-scale (2 to 6 m^2) wind/wave tank tests to investigate wind and wave effects on herding efficiency; and finally, small ignition and burn tests. These tests identified ThickSlick 6535 as an effective herding agent on cold water and in ice conditions.
- Experiments were done with the ThickSlick 6535 herder at the scale of 100 m^2 in the indoor Ice Engineering Research Facility Test Basin at the US Army Cold Regions Research and Engineering Laboratory (CRREL) in November 2005.
- Experiments were undertaken with the ThickSlick 6535 herder at the scale of 1000 m^2 at Ohmsett in artificial pack ice in February 2006.
- A series of 20 burn experiments were carried out in 2007 with the ThickSlick 6535 herder at the scale of 30 m^2 in a specially prepared test basin containing broken sea ice in November 2006 at the Fire Training Grounds in Prudhoe Bay, AK with fresh crude oil.
- Field tests in pack ice in the Barents Sea were done in 2008. One experiment involved the release of 630 L of fresh Heidrun crude in a large lead. The free-drifting oil was allowed to spread for 15 minutes until it was far too thin to ignite (0.4 mm), and then ThickSlick 6535 herder was applied around the slick

periphery. The slick contracted and thickened for approximately 10 minutes at which time the upwind end was ignited using a gelled gasoline igniter. A 9-minute long burn ensued that consumed an estimated 90% of the oil.

- Studies on better herding surfactants were completed between 2008 and 2010. It was during this testing that the OP-40 silicone-based herder was identified as being more efficient at herding.
- Work on developing techniques for applying herding agents to slicks in ice-affected water commenced in 2010.

As a result of the success with herders for ISB in ice, a two-year program of R&D in the lab and at Ohmsett was undertaken in 2009 to determine if there was a potential to use herding agents to improve other areas of marine oil spill response, specifically:

- Employing herding agents in drift ice to enhance recovery of spilled oil with skimmers;
- Using herders to clear oil from marsh areas; and,
- Applying chemical herders around oil slicks on the open ocean to improve the operational effectiveness of subsequent dispersant application

In 2011 a research program was carried out to explore the use of herding agents for in-situ burning in open water conditions as a rapid-response technique for oil spills offshore. The research was conducted in two parts: the first involved laboratory testing to identify the best herding agent(s) for warmer water conditions; the second involved experiments at Ohmsett to quantify the persistence of the herder monolayer in waves. The results showed that the monolayer of each of the two best herders will survive for more than 45 minutes in a calm sea. The presence of breaking or cresting waves rapidly disrupts the herder monolayer and the oil slick resulting in the production of many small slicklets from the herded slick and the re-spreading of the oil to thin slicks. The monolayer survives for considerable periods of time in a swell condition, but the constant stretching and contracting of the herded slick results in elongating the oil slick and slowly breaking the slick into smaller segments.

Desmi-AFTI worked in conjunction with S.L. Ross Environmental Research to get approval to use herders in North American waters. The prescribed test data from an accredited laboratory in Louisiana on three candidate herding agents (also called surface collecting agents) was submitted to the U.S. EPA for approval to list them on the National Contingency Plan (NCP) Product Schedule. Two herders, Siltech OP-40 and ThickSlick 6535, have been placed on the list and are now commercially available. These two can be used, with the FOSC's concurrence, for spill response operations in U.S. waters. Samples of all three herders have been sent to Environment Canada, along with all the EPA test data, for their consideration. Quantities (200 L) of the two herders listed on the NCP Product Schedule have been produced and are stockpiled at Desmi-AFTI in Buffalo, NY.

No herders have been approved for use in other Arctic waters, thus the data and results from this project are crucial as the basis for performing a robust environmental risk evaluation of herders in relation to use of ISB in high arctic seas.

An application system, consisting of a pump, controls and reservoir has been designed to be placed inside an appropriate helicopter. It incorporates a reel-able hose that is used to lower the application nozzle to the correct height above the water for herder application. Dry land, static trials were conducted in September 2013 and helicopter flight trials are planned for the near future. A back-pack sprayer system for herder application from a small vessel is available off-the-shelf, with only minor modifications required for cold-temperature use. Additional field work to demonstrate the effectiveness of this application system are planned for May 2015.

Appendix C: Proposed New Work Item: Inspection Protocols for Recovery Equipment

DRAFT

Standard Protocol for the Inspection of Recovery Equipment subjected to Storage Conditions

1. **Scope**
   1.1. This protocol covers the visual inspection and test operation of oil spill recovery equipment such as skimmers and their ancillary equipment (pumps, power packs, hydraulic hoses, etc.) to help responders determine life cycle costs, plan for scheduled replacement, and evaluate material suitability. Manufacturers' recommendations should always be followed, but may not cover specific storage conditions. This document offers guidance on inspection detail and frequency.
   1.2. This protocol does not deal with products manufactured from coated fabrics such as boom. Testing of Coated Fabrics is covered within protocol F715.
   1.3. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.
2. **Referenced Documents**
   2.1. ASTM Standards:
      2.1.1.
   2.2. Federal Standard:
      2.2.1.
3. **Significance and Use**
   3.1. This protocol provides information, procedures and requirements for the inspection of recovery equipment including skimmers and their ancillary equipment (pumps, power packs, hydraulic hoses, etc.) used in oil spill response
   3.2. This protocol provides information on requirements for storage and inspection (maintenance suggestions) of skimmers and their ancillary equipment (pumps, power packs, hydraulic hoses, etc.)
   3.3. This protocol will aid responders in ensuring that equipment is stored in an appropriate manner and that issues related to the degradation of materials of construction through ageing and environmental factors are promptly identified. Prompt replacement of suspect parts can ensure the operating performance and safety of equipment.

4. Visual Inspection

4.1. Inspection Frequency – materials of construction will dictate the recommended frequency of inspection. Larger components will typically be manufactured from coated steel, stainless steel, and marine grade aluminum. It is relatively easy to determine if coatings have been compromised through the identification of scratches or dents. Other components may have internal seals or connections that are manufactured from other materials that may be impacted by repeated exposure to either hydrocarbon products, salt water, cleaning solutions, large temperature fluctuations, or elevated temperatures. In addition to obvious contaminants such as oil or fuel, salt water can impact the wetted parts of equipment and should be flushed with fresh water prior to storage.

4.1.1. Arctic Storage

- 4.1.1.1. PVC, PU, Nitrile components - 2 years
- 4.1.1.2. Rubber, PTFE components - 5 years
- 4.1.1.3. Metal components - 5 years

4.1.2. Temperate or indoor storage

- 4.1.2.1. PVC, PU, Nitrile components - 1 years
- 4.1.2.2. Rubber, PTFE components - 5 years
- 4.1.2.3. Metal components - 5 years

4.1.3. Tropical or outdoor storage

- 4.1.3.1. PVC, PU, Nitrile components - 1 year
- 4.1.3.2. Rubber, PTFE components - 3 years
- 4.1.3.3. Metal components - 3 years

4.2. Inspection Details

4.2.1. Four characteristics should be included in any inspection report:

- 4.2.1.1. Any indications of color change associated with degradation of materials. This may be caused by UV degradation, chemical incompatibility, or rubber and plastic components being subjected to elevated temperatures. Steel will rust if coatings are compromised, and stainless steel is not completely impervious to corrosion. Aluminum components may corrode to a white powder.
- 4.2.1.2. Any indications of cracking, cuts or abrading that may have happened during use of equipment or during storage. Seals, gaskets and hoses may be impacted, which can dramatically shorten their useful life. Additionally, damage such as cuts or holes may be caused by rodents or other vermin who may use the materials for nesting or other purposes.
- 4.2.1.3. Any blisters, which may indicate damage due to exposure to elevated temperatures.

4.2.1.4. Any indications of swelling or warping, which may be caused by chemical incompatibility, failure to properly decontaminate equipment, or subjecting equipment to elevated storage temperatures.

4.2.1.5. Any indications of changes in flexibility – either an increase in rigidness (hardening) or softening of seals may lead to leaks that will adversely impact the operation of equipment.

4.3. Inspection details

4.3.1. Visual observations will be performed, but some physical manipulation may be required to determine if changes have taken place with any of the equipment or components. As an example, flexing of hydraulic hose to the Manufacturer's provided minimum bend radius helps to evaluate changes in flexibility and enables easier determination as to the extent of any abrasions or cracks.

Note to working group (Comment from reviewers with US Navy):

Rubber/coated fabric products (booms, bladders, etc) is stored inside or completely covered from the elements and is inspected every 3 years.

Other equipment is inspected and maintained annually. This has been found to be effective for two reasons: all equipment is ready to deploy and has a low failure rate in the field due to equipment issues, and it provides familiarity of the equipment to the operators in between exercises because their operators are the maintainers. Hydraulic hoses are inspected annually and pressure-tested on a 5 year cycle.

Sample checklists for post-operational, maintenance, and inspection procedures will be circulated in advance of the April 2015 ASTM meeting (courtesy of USN).

5. Component Shelf Life

5.1. Items such as hydraulic hose will have a shelf life and degrade even if it is not being used. The shelf life of bulk rubber hose is 10 years form the date of manufacture according to the Society of Automotive Engineers (SAE), although this number is limited to seven years by ISO/TS 17165-2. This duration can be reduced by a number of factors including exposure to direct sunlight, rain, heaters, humidity, solvents, corrosive materials or fumes, insects or rodents, close proximity to electrical equipment (ozone), even space allowance and bends. Recommendations also suggest that storage temperature should never exceed 38°C.

6. Safety Precautions

6.1. Care must be taken when dealing with hydraulic systems as there are multiple areas where failures could pose a safety concern to operators and others in proximity to the equipment.

6.1.1. Fluid injections caused by impingement of high pressure hydraulic fluid can penetrate skin and cause severe tissue damage.

6.1.2. Whipping hoses resulting from a fitting failure can impact causing blunt force injury.

6.1.3. Hydraulic fluids can reach elevated temperatures that can cause burns to skin.

6.1.4. Hydraulic fluids can generate static electricity as they move through a hose. In addition, fluids releasing from a highly pressurized system can mist or form a fine spray that may be an explosion risk upon contact with an ignition source.

7. Pre-Deployment

7.1. If the equipment or components thereof still raise concerns then additional evaluations should be conducted to determine fitness for duty.

8. Sample Inspection Checklist

8.1 Post-Operational Procedure – powered devices

1. Disconnect all hydraulic hoses, discharge hoses, and air supply hoses from skimmer/pump/drive units.
2. Prepare for storage/shipping.
3. Pressure-wash external surfaces with cleaner/degreaser/ mild detergent and water. Allow to air dry.
4. Wipe inside of intake and discharge areas of pump and exposed, non-painted surfaces with spray preservative.
5. Inspect and clean all fittings for damage. Preserve fittings with a light coating of spray preservative.
6. Reinstall the hydraulic fitting protective caps and plugs.
7. Grease plate wheel and fittings with general-purpose grease.
8. Drain water from air compressors.

8.2 Inspection procedures

1. Inspect external surfaces for damage or wear.
2. Inspect hydraulic hoses, discharge hoses, and air supply hoses for deterioration, cracks, and tightness.
3. Inspect lifting points for damage and for proper operation.
4. Inspect all gaskets and seals.
5. Inspect for missing or damaged bolts. Tighten loose and replacement bolts to standard torque specifications.
6. Remove protective caps from hydraulic fittings. Inspect fittings for damage, dirt, and foreign Material.
7. Inspect and/or test all discharge hoses and any hydraulic hose assemblies that have operating pressures of 600 psi or greater.

9. Keywords

Appendix D: Proposed New Standard: Standard Guide for Collecting Skimmer Performance Data in Ice Conditions

First draft: 14.11

Method for Determining Oil Skimmer Recovery Rate on Drift Ice Conditions

1. Scope

1.1 This standard defines a test method and measurement criteria to quantify the recovery rate and efficiency of a stationary skimmer system in drift ice conditions.

1.2 The suggested test method and test parameters are intended to provide conditions typical of relatively light drift ice and relatively dense drift ice.

1.3 It is accepted that the recovery rate as determined by this test method will not likely be achievable under actual conditions of a spill. The test method in this standard does not account for such issues as changing recovery conditions, number of daylight hours, operator downtime, less than ideal control of skimmer settings, and inclement weather.

1.4 This test method involves the use of specific test oils that may be considered hazardous materials. It is the responsibility of the user of this guide to procure and abide by necessary permits and regulations for the use and disposal of test oil.

1.5 This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the end user of this standard to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.

2. Referenced documents

2.1 ASTM Standards

D971 Standard Test Method for Interfacial Tension of Oil Against Water by the Ring Method.

D1298 Standard Test Method for Density, Relative Density. (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum

D2983 Standard Test Method for Low-Temperature Viscosity

D4007 Standard Test Method for Water and Sediment in Crude Oil by the Centrifuge Method (Laboratory Procedure)

F631 Collecting Skimmer Performance Data in Controlled Environments.

F2709 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems

3. Terminology

Operational Efficiency (OpEff): the ratio, expressed as a percentage, of the time spent actually skimming to the total test time, having deducted time spent out of the water to re-position the device. (Note: This may be of particular interest in dense ice cover, when a significant portion of the test period may be spent re-positioning the skimmer to find thick patches of oil.)

Oil recovery effıciency (ORE): the ratio, expressed as a percentage, of the volume of oil recovered to the total volume of fluids recovered.

Oil recovery rate (ORR): the volume of oil recovered by the device per unit of time (m^3/h). Note that the measurement is of oil only, after netting out free and emulsified water.

Skimmer system: a skimmer along with its associated power supply, hydraulic lines, offloading pump, control apparatus, and accessories.

Total test time: the period of time from the start to end of collecting recovered fluids for measurement.

4. Significance and use

4.1 This standard establishes test conditions that will provide a measured recovery rate and efficiency for a skimmer operating in drift ice.

4.2 End users need a test method to quantify optimum performance data for planning and selection of equipment.

4.3 This test method will assist in verifying and accurately reporting skimmer system performance.

4.4 Tests will be conducted under well documented conditions and generate repeatable results. Other detailed testing and collection of skimmer performance data are covered under existing standards (F631, F2709).

5. Test Facilities

5.1 Tests should be performed within a tank or boomed area that will contain the oil and floating ice pieces. The minimum lateral dimensions of the test tank shall be three times the length and width of the skimmer device. For example, a skimmer with a lateral footprint of 2 m by 3 m would require a minimum test area of 6 m by 9 m. Note that the test area may have to be increased beyond the minimum test area to ensure that the skimmer has access to enough oil for a 30 second minimum collection time. The following calculation can be made to determine the minimum test area that will contain adequate oil for a 30 second skimmer test, based on estimated skimmer performance:

Min Test Area (m^2) = [predicted recovery rate (m^3/h) x (length of test (h)] ÷ (1 - % ice coverage) x (oil thickness)

Where length of test is .00833 h

Oil thickness is 0.025 m

Predicted recovery rate is minimum recovery rate expected for the skimmer

5.2 The tank depth shall accommodate the skimmer without grounding during the test.

5.3 Test oils shall be identified by industry-accepted name and are recommended to fall within the five categories defined in Guide F 631. It is recommended the skimmer system be tested in two or more oil types for comparison purposes.

5.4 The preferred test oil is a medium viscosity refined product, which will provide a stable test fluid over the test period (i.e., minimal evaporation and emulsification) and present no breathing hazard related to oil vapours.

5.5 The oils used for testing will be characterized from samples taken at the start of a test series and when oil is replenished from a new source. A test oil log shall be generated and will indicate test oil type, sample number, temperature, and test date.

5.6 The following tests are to be conducted on test oils: viscosity (Test Method D 2983), bottom solids and water (Test Method D 4007), specific gravity (Test Method D 1298), surface, and interfacial tension (Test Method D 971). Viscosity may also be established using a published temperature/ viscosity chart for the test oil. Viscosity shall be reported for the temperature at which the test is performed.

5.7 Manual temperature measurements of the test oil will be taken in or near the skimmer sump with an accuracy of +/- 1°C. Note that if testing outdoors, solar effects may significantly increase surface oil temperature. If steam or heat is introduced into the skimmer system as part of its design, additional measurements are to be taken before such heating to accurately gauge the properties of the oil.

5.8 Ambient air test temperature shall be recorded.

5.9 Record water salinity if applicable.

5.10 Tanks are required for recovered product for subsequent volume measurements. The collection tanks shall be elevated above the test oil surface to accommodate a required static head on the skimmer system equal to 3.5 m of fluid.

5.11 Alternatively, a restriction may be imposed within the discharge hose to mimic the desired static and dynamic head at the pump discharge at expected flow rates. Ensure that the restriction is valid for all flow rates expected.

5.12 For skimmers that do not include a discharge pump, the recovery rate shall be measured as oil accumulates in the skimmer's sump.

5.13 When applicable, hydraulic pressure and flow measurements shall be made during the tests. Pressure and flow values shall not exceed manufacturer recommendations.

5.14 *Ice conditions:* Tests should be performed using two different ice concentrations, 30% and 70% coverage. These ice concentrations are generally regarded as thresholds for mechanical recovery in ice: below 30% concentration, oil movement is minimally affected by the presence of ice, and above 70% concentration oil movement is severely restricted and, while skimming may be possible, it may require moving the skimmer from oil pocket to oil pocket within the ice.

5.15 Ice for the tests can be salt-water or freshwater. (Note: an ongoing project (BSEE Project 1023) is examining the feasibility of developing surrogate ice modules that could be used to test oil spill response equipment in various, repeatable, simulated arctic conditions.)

5.16 Prior to testing, ice will be added to the test area, as required, to make up desired coverage and the target piece size distribution (55% 1 x 1 m + 30% 0.5 x 0.5 m + 15% small fragments). This relative size distribution is based on an analysis of fields of broken pack ice and has been used in previous oil-in-ice experiments involving herders and skimmers.

5.17 If produced as larger size pieces, ice can be broken manually to produce the specified sizes. Ice coverage will be estimated initially by measuring the area of the ice pieces added to the test area, and will be confirmed subsequent to the test for documentation in the test report using an image area analytical technique of overhead digital photographs or other comparable technique.

5.18 Ice thickness should be on the order of 200 mm (8 inches) or greater to allow for adequate freeboard.

5.19 *Slick thickness:* Tests should be performed with a slick thickness of 25 mm (1 inch). This thickness is selected to allow comparison with previous testing performed as part of the SINTEF skimmer development and testing program. It is also representative of batch-type spill in moderate to dense ice conditions, such as a release from a ship or storage tank.

5.20 Each test will continue until approximately one-third of the 25-mm thick slick has been removed (note: this concurs with the general principle of the ASTM F2709 nameplate test standard). Additional oil should be added to the test area as part of the initial volume to account for hold-up in hoses at the start of the test series, priming of oleophilic surfaces, and for skimmer operation as it achieves steady-state conditions. This will be calculated for each skimmer as it will vary depending on the specific skimmer being tested.

5.21 To give some indication of skimmer performance at a lesser slick thickness, during the final test run in each series, performance measurements will continue to be taken as the slick declines. This will involve collecting discrete volumes in separate containers to allow separate rate and efficiency measurements.

5.22 Slick thickness will be controlled initially by distributing a volume of oil, calculated as the amount required to produce the target thickness on the open-water portion of the tests area (i.e., the total test area less the percentage covered by ice). As testing proceeds, an “oil-on-water” budget will be maintained, estimating the amount of oil removed from the test area in a given test to determine the volume of oil to be added to restore the 25-mm thick oil layer and any holdup required to bring the system to a steady-state condition. Prior to each test, the approximate slick thickness will be confirmed using a sight-glass measuring device or other comparable technique. Each test series will start with an initial measured volume of oil to re-zero the “oil-on-water” budget.

5.23 An accurate means of determining oil slick thickness while the oil slick thickness is declining is desirable. Typical means of accomplishing include manual soundings from tank edge to oil surface or using a submerged translucent tube (sight glass) with an internal index.

5.24 The collection tank shall be calibrated to accurately quantify the volume of fluid collected. Measurement accuracy shall be determined and documented.

5.25 The collection tank shall provide a means to decant free water from the volume of recovered fluid.

6. Skimmer System Set-up

6.1 The skimmer components shall be fully documented. This shall include: dimensions, draft and freeboard, weight, specifications of skimmer, hydraulic power unit, discharge pump and hoses, and so forth. Components other than those provided by the manufacturer and necessary to assemble a functional skimmer system shall be reported.

6.2 If a discharge pump is offered by the manufacturer as part of the system, the normal commercially offered pump shall be used in this test. It may be installed in the skimmer head or remotely but shall be configured as designed.

6.3 The manufacturer supplied power supply, hydraulic lines, control apparatus, and accessories shall be used to operate the skimmer.

6.4 Control lines, hydraulic lines, and discharge hoses should not interfere with the normal operation of the skimmer. Route hydraulic and discharge hoses to minimize effect on skimmer freeboard.

6.5 The pump and power supply shall be operated within its normal operating range or duty point for the system.

6.6 When applicable, the operational speed of the recovery device shall be recorded, that is, rotational speed of drum or disc, or lineal speed of mop or brush. Various means may be employed, for example, mechanical or manual counters, measuring hydraulic flow correlated to rotational speed and so forth, but must be validated as part of each test series.

6.7 The skimming system will be equipped with a discharge hose at least 15 m long and of the manufacturer intended diameter. The discharge hose shall be routed to a collection tank. The end of the discharge hose opening shall be elevated 3.5 m above the test oil surface unless the head is simulated as described in 5.11. Alternatively a portion of the hose can be raised to 3.5 m as long as an anti-siphon valve is used.

7. Procedure

7.1 This test method defines the procedure for quantifying skimmer system recovery rate in ice conditions.

7.2 Most skimmers are designed to be operated in the stationary or slowly-advancing mode. Given the viscosity of the oil and the presence of ice, oil recovery could potentially be limited by the absence of oil in the immediate vicinity of the skimmer, so the skimmers can be slowly moved through the test area during the test at the discretion of the skimmer operator. Alternatively, the skimmer may be lifted from the water and replaced in another part of the test area when it has skimmed all or most of the oil in its immediate vicinity.

7.3 The speed of advance will vary with the specific skimmer being tested, and may be adjusted through the three-test series (per ice condition). The intention is to ensure that skimmers are not being starved of oil by remaining in one location for a test, and can be moved through the entire test area during the process of one test.

7.4 The duration of the measurement period will depend on the recovery rate of the skimmer. The measurement period should be a minimum of 30 s. The skimmer system shall be at a steady state operating condition before the collection period begins and measurements are obtained.

7.5 Deliver preload volume of oil and measure the slick thickness.

7.6 Measure the water temperature below the oil surface.

7.7 Start the power supplies for the skimmer and discharge pump.

7.8 If applicable, start data collection systems; (it is beneficial to obtain hydraulic pressure and flow measurements, supply tank volume, and so forth.)

7.9 Start the skimmer discharge pump and, if applicable, recovery device simultaneously.

7.10 Recover fluid to a secondary tank until flow is established and operational adjustments have been completed.

7.11 When the skimmer is operating to the satisfaction of the skimmer operator and steady state recovery is established, recovered fluid shall be diverted to the dedicated collection tank. Simultaneously start the collection period timer.

7.12 Recover fluids until the appropriate collection time or recovered fluid volume criteria are met.

7.13 The measurement period shall start when the slick thickness is approximately 25 mm, shall be a minimum of 30 s after steady state conditions are achieved, and shall end when the slick thickness approaches 17 mm.

7.14 During the recovery period, confirm operational parameters, e.g., drum rotational speed, discharge pump speed, and so forth.

7.15 Stop the skimmer and discharge pump or redirect flow to the secondary collection tank. Simultaneously stop the collection period timer.

7.16 Stop the data collection system.

7.17 Measure and record the total volume of fluid (oil and water) in the dedicated collection tank(s). Volume typically is determined by sounding the tank and knowing volume/depth the total volume of fluid calculated.

7.18 Measure the temperature of the oil collected in the recovery.

7.19 Decant the free water from the dedicated collection tank(s) Determine the volume of remaining fluid. The remaining fluid may contain water due to emulsification.

7.20 Take a representative sample of fluid from the dedicated collection tank(s). Perform analysis to determine water content (Test Method D 4007). Mixing of the recovered product will ensure a representative sample has been obtained. Label sample with test number, tank designation (if applicable), date, and time.

7.21 If necessary, replenish the test area with the volume of oil to provide the proper slick thickness for the next test and any additional holdup required..

7.22 The tests shall be conducted three times for any given set of parameters. Test result values shall be considered valid if no values deviate more than 20% from the arithmetic mean. If values fall outside this range they should be discarded and the test repeated.

8. Skimmer Performance Calculations

8.1 Skimmer performance is calculated from three measured quantities: the oil volume recovered by the skimmer (V_{oil}), the oil collection time (t), and volume of water recovered by the skimmer. The primary performance values measured during these tests are oil recovery rate (ORR) oil recovery efficiency (ORE), and OpEff.

8.2 The total volume of fluid recovered by the skimmer is calculated from volumetric calculations specific to the collection tank used.

8.3 The volume of oil recovered is calculated from the volume of remaining fluid, determined after the free water has been decanted and corrected for the percent water in oil.

8.4 The oil collection time is the elapsed time that the skimming system is recovering oil at steady state conditions, and the discharge directed to a specific collection tank.

8.5 The start and end time is measured with a calibrated stopwatch by the test director.

9. Report

9.1 Computer-gathered data files, manually recorded data, analytical data, and photo and video documentation shall be used to produce a final report.

9.2 For the three qualifying tests, the skimmer oil recovery rate, recovery efficiency, operational efficiency, oil viscosity, oil and water temperature, oil slick thickness, and speed of skimmer system pump, powerpack, and rotating elements (including hydraulic flow rates where applicable) should be recorded and included in the final report.

9.3 The final report shall include a full description of the equipment tested and the test.

9.4 A table of skimmer characteristics will be generated. This table will document the physical parameters of the skimming system including but not limited to skimmer dimensions, oleophilic surface area, power pack capacity, discharge hose diameter, pump data, hose length, and other details as appropriate.

Appendix E: F1780 − 97 (2010) Standard Guide for Estimating Oil Spill Recovery System Effectiveness

Modifications to F1780: Standard Guide for Estimating Oil Spill Recovery System Effectiveness (F20.12)

1. Background

Guide F1780 provides a methodology for estimating the overall effectiveness of containment and recovery systems that may be used to assist in the control of oil spills on water. It contains many of the elements and overall approach as those contained in the recent Genwest report on EDRC methodologies.

The proposed modifications would provide additional details to the standard using the EDRC review as a guideline in a number of key areas.

A draft scope was presented to the ASTM F20.12 (Recovery) subcommittee at the April 2014 meeting, and was accepted as a work item. At the October 2014 meeting, a draft discussion paper was presented and discussed, outlining suggested improvements to F1780. It was agreed that, given the scope of the proposed changes, rather than produce a re-drafting of the standard at this point the changes would be produced as a discussion paper for further consideration at the April 2015 ASTM meeting.

2. Scope

Modify existing standard F1780 to include the specification of key operational parameters to allow evaluation of a broad range of response systems in the context of both tanker spills and blowout spills.

In general, default values are proposed for significant operational parameters that would provide a “conservative” base: in most cases a response system would exceed the defaults but it would be up to a proponent to provide defensible justification for improved values.

3. Key parameters to include

3.1 Blowout versus batch-type discharges

This was discussed at length at the October 2014 ASTM meeting. Here was general consensus that a clear distinction needed to be made between the two types of spills, for the following reasons:

- Initial slick thicknesses could be much lower for blowouts, particularly for deep-water blowouts.
- The primary thrust of countermeasures for a blowout spill are likely to be near the spill site, where the oil would have had little time to weather, specifically in terms of evaporative losses and emulsification.
- As a result, countermeasures would likely be dealing with relatively fresh oil on an ongoing basis. In contrast, a single batch-type discharge (i.e., from a tanker spill) would result in significant changes in slick thickness, oil viscosity, and water content over time.
- For the response to a blowout spill, the relatively small area would lend itself to an effective surveillance program, which could direct countermeasures to areas of relatively thick oil for maximum overall effectiveness.

3.2 Encounter rate

Encounter rate is an important limiting factor in overall recovery effectiveness, and varies with slick thickness, encounter speed, and swath width of the containment system described in order.

3.2.1 Encounter rate: Slick thickness

Presently, F1780 suggest the use of a computer-based spill model to estimate slick thickness over time, and provides a simplified graph for slick thicknesses for a range of spill volumes, for an instantaneous spill. The EDRC report suggests a simplified version of this, namely the following three slick thicknesses for three time periods:

Table 1: Recommended slick thickness, Genwest report (page 34)

Time from start of spill, h	Slick thickness, inches	Slick thickness, mm
12	0.1	2.5
36	0.05	1.3
60	0.025	0.63

Given that the context of F1780 and other similar evaluation schemes is with regards to Worst Case Discharges, the slick thicknesses above should be treated with caution: they are significantly greater than would be estimated for many blowout spills (and particularly deep-water blowout releases), and are significantly less than may be estimated for an instantaneous release (i.e., worst-case tanker spill).

For example, Figure IIIC-5 (page 33) of the Genwest report indicates slick thicknesses 10 times greater (and more in some instances) for a range of spill sizes and oil types, all batch-type releases. This would only be appropriate as an input to a countermeasures model involving skimming or in-situ burning if an effective aerial surveillance program were in place to direct response teams to thicker areas of oil (ref¨ F2327-08 Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water).

Blowout releases are not discussed specifically, and there is little empirical guidance on the subject there having been little research or field measurements of blowout spill thicknesses. However, modeling results indicate slick thickness on the order of 0.05 mm (50 um) for deepwater release. Blowouts in non-deepwater locations may be greater, on the order of 0.1 mm, near the blowout location. Again, thicker portions of oil may be present, but would only be appropriate to use as an input to a countermeasures model involving skimming or in-situ burning if an effective aerial surveillance program were in place to direct response teams to thicker areas of oil.

As noted above, a distinction must be made between blowout spills and tanker spills.

Recommendation

Tanker spills: worst-case discharges

- Use the recommended Genwest thickness values as a default for batch releases
- Allow the use of computer spill modeling for larger batch releases that may have greater initial slick thickness
- Allow the use of increased slick thicknesses (i.e., greater than default) only if the overall response plan includes the use of aerial surveillance to target thick slicks for maximum effectiveness

Blowout spills

- Use 0.010 mm (10 µm) as the default slick thickness for near-source countermeasures
- Allow the use of computer spill modeling for blowout releases, using a maximum value of 0.05 mm for near source countermeasures only if the overall response plan includes the use of aerial surveillance to target thick slicks for maximum effectiveness

3.2.2 Encounter rate: Encounter speed

A default encounter speed of 0.7 knots is proposed, which is the speed at which most containment systems begin to lose oil due to entrainment. However, there are several recent boom designs that offer containment at speeds of 3 knots and greater. If a specified system utilizes such a system, and its performance at speeds greater than 0.7 knots has been documented in field or tank tests, then an improved encounter speed can be used.

3.2.3 Encounter rate: Swath width

A default swath width of 50 metres is proposed, based on a 150-metre (approximately 500 feet) length of boom towed with a gap ratio of 1:3; a maximum swath width of 100 metres is proposed, based on a 300-metre (approximately 1000 feet) length of boom. If a greater boom length can be demonstrated based on field experimentation (ref: F2084/F2084M-01(2012)e1 Standard Guide for Collecting Containment Boom Performance Data in Controlled Environments), then it could be used instead.

3.3 Transit speeds

Transit to and from the spill site, at the outset of the spill, for re-supply, and shuttling of laden storage vessels is assumed to be a maximum of 10 knots. If greater transit speeds can be documented given the vessels in use and the specific weather and sea conditions in the area of concern then these can be used.

3.4 Emulsification of spilled oil

Emulsification has a significant effect on overall effectiveness, presenting two issues for recovery systems. First, viscosity increases may render recovery skimmers less effective. This is an issue in equipment selection, and it is not proposed to address this here. The second problem is that of increased volume of product that must be recovered, and that will fill storage vessels, and this should be taken into account.

Not all oils emulsify, but as a default it should be assumed that all crude oils and heavy refined products would to some extent. The following emulsification schedule should be used unless documented otherwise through laboratory analysis and computer modeling (ref: WK41247 * New Test Method for Standard Test Method for Method for the Evaluation of the Stability of Water-in-oil Mixtures Formed from Crude Oil and Petroleum Products Mixed with Saline Water).

Table 2: Recommended emulsification schedule

Time from start of spill, h	Emulsified water content, %
24	33
48	50
72	75

3.5 Skimmer rate and efficiency

The preferred method for establishing skimmer rates and efficiencies would be testing of the device according to ASTM test standard (ref: F2709-08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer Systems). In the absence of such information, the following default values should be used (Note: the committee suggested the use of very conservative values to encourage the use of actual test results):

- Skimmer rate: 20% of stated nameplate value (as per original EDRC method)
- Skimmer efficiency:
    - weir and suction skimmers: 20% efficiency
    - oleophilic devices: operate at 50% efficiency.

3.6 Storage of recovered oil and water

The effect of including an emulsification factor and the use of a recovery efficiency factor has a significant effect on the total volumes of fluid that must be stored, transported, and ultimately disposed of. This could limit the overall effectiveness of a system if there are limits to available storage.

A possible solution is to decant recovered water, which is technically possible if the water has not been emulsified into the oil by the skimmer's pump or by any subsequent transfer pump. Decanting of free water may be a regulatory issue in some jurisdictions, so a procedure to gain regulatory approval must be part of the response plan for this to be considered.

As well, it may be possible to use demulsifying chemicals to break water-in-oil emulsions. Some skimming systems allow the injection of demulsifying chemicals in the skimmer transfer pump, providing good mixing of the chemical into the oil and some contact time as the recovered fluid is moved to storage. Because the effectiveness of demulsifying chemicals is highly variable depending on the parent oil properties and demulsifying chemical being used, this option could only be considered if there were lab-scale testing to prove the effectiveness under the conditions that would be experienced in the spill, including the following variables:

- specific parent oil type
- degrees of weathering
- degrees of emulsification
- temperatures

3.7 Limitations related to weather and sea conditions

Overall effectiveness results should be modified to account for downtimes due to weather and sea conditions specific to the operating area of interest.

A proposed method of doing this is to consider the “Fraction of Time Recovery is Possible”, with a maximum possible effectiveness first estimated assuming ideal weather and sea conditions and 24-hour operations. In reality this is not possible so this maximum possible effectiveness is reduced to reflect the fraction of time that recovery is possible.

For this purpose, it is assumed that containment and recovery operations are possible when there is:

- daylight
- visibility greater than 0.5 kilometres, and
- waves are less than 1 metre high for all wave periods and when waves are between 1 and 2 metres high but have periods of 6 seconds or greater

The frequency of these conditions for the waters of interest should be tabulated and an overall estimate of applicability calculated, preferably by season.

Appendix F: Proposed New Standard: Guide on Surveillance to Support On-Water Operations

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Standard Guide on Surveillance to Support On-Water Operations

1. Scope

1.1. This guide develops a common methodology for integrating surveillance systems with recovery to ensure safe and effective recovery operations, including conditions when visibility is limited or reduced.

1.2. This guide includes references to satellite imagery, plane/helicopter, aerostat, or onboard ship surveillance systems.

1.3. This guide is generally applicable to all types of crude oil and most petroleum product spills, under a variety of marine or fresh water environments.

1.4. Many visual technologies exhibit limitations with respect to discrimination between the target substances under certain states of weathering, lighting, wind and sea, or various camera settings.

1.5. General remote sensing systems are used to detect and delineate the overall slick. Shipboard systems are used primarily to provide a tactical image near the recovery vessel.

1.6. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1. ASTM Standards:

2.1.1. F2327 Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water

2.1.2. F2926 Standard Guide for Selection and Operation of Vessel-mounted Camera Systems.

3. Significance and Use

3.1. This guide provides information, along with the current advantages and disadvantages of selected surveillance technologies used to support spill detection and response operations.

3.2. The information includes satellite imagery, planes/helicopters, and onboard ship surveillance systems and will help spill response operations by enhancing the detection of oil, along with helping expand the window of opportunity for recovery operations.

3.3. Sensors are able to assist in the detection of slicks when they are not observed by persons operating at, or near, the water's surface or at night.

4. Background

4.1. It may be difficult to visually differentiate oil from background materials such as weeds, algae, small pancakes, or oil that has become overwashed with waves. This will depend heavily on the oil type, thickness of the spill, and weather conditions.

4.2. Fog, darkness, or low cloud ceiling may limit response efforts.

4.3. There has been continued development of technologies surrounding spill detection and surveillance. Developing a common methodology for integrating surveillance systems with recovery will facilitate safe and effective operations during typical responses to oil spills and expand operations when visibility would otherwise be limited or reduced.

5. Satellite Surveillance Systems

5.1. Rational for use

Satellite systems enable a strategic overview of a spill area and can be useful in identifying assets as well as areas with possible oil contamination and the extent of spill.

5.2. Advantages

5.2.1. They allow for the detection of items in remote and difficult to reach areas.

5.2.2. Multi-temporal imaging can provide information on the rate and direction of oil movement which help provide data for oil spill models and can help target clean-up efforts.

5.2.3. Space based Synthetic Aperture Radar (SAR) sensors can provide data under poor weather conditions and during darkness.

5.2.4. Newer satellites have enhancement including improved resolution for target detection and identification (down to 3 m).

5.3. Disadvantages

5.3.1. Repurposing a satellite to one specific area may simply not be possible, or may have higher costs associated with its operation than mobilizing one of the other surveillance systems for repeated scans in a specific area to monitor the movement of oil, or the progress of containment and/or recovery efforts.

5.3.2. Low wind speed conditions cause the generation of false positives and upper wind limits do not permit oil detection

5.3.3. May be difficult to differentiate oil on ice as it gets confused with sediment.

6. Aircraft Surveillance Systems

6.1. Rationale for use

6.1.1. Aircraft systems can provide tactical or short-term windows on the extent of spills and recovery efforts.

6.2. Advantages

6.2.1. Side-Looking Airborne Radar (SLAR) and SAR provide data under poor weather conditions and during darkness. Operating at high altitudes they can be very useful for large slicks offering rapid mapping capabilities.

6.2.2. Integrated Airborne Sensor Systems offer the integration of multiple optical and microwave sensors which helps reduce false positive signals. They can offer a real-time graphical display of oil slick location, along with relative thickness of the oil. Technologies include SLAR, IR/UV, Forward Looking Infrared (FLIR), Microwave Radiometer (MWR) and Laser Fluorosensors. This information can be transferred to vessels or ground stations through direct link or satellite uplink.

Note to working group:
This could be expanded to address how this happens…what do the ground stations have to have in terms of compatible equipment and personnel to correctly interpret raw data.

6.3. Disadvantages

6.3.1. SLAR and SAR come with a high cost and typically require dedicated aircraft and crew. The technology can have issues in differentiating signals – sometimes resulting in many false positives. Near shore confined areas such as narrow channels and cliff areas may pose difficulties to airborne operations.

6.3.2. Range and duration of operation may be limited due to fuel and payload requirements

6.3.3. There are limited private sector operators of Integrated Airborne Sensor Systems

7. Aerostat Systems

7.1. Rational for use

7.1.1. Aerostat (moored balloons) provide tactical (short-term) through strategic (long-term – up to 30 days deployment) windows on the extent of spills and recovery efforts.

7.1.2. Aerostats are typically launched from a pad containing a fixed or mobile mooring system with a large winch and tether cable.

7.2. Advantages

7.2.1. Platform can operate a range of technologies, from radar systems through visual camera systems.

7.2.2. Payloads of up to 1000 kg are commercially available, smaller units (payloads in the 100 kg range) are currently more readily available.

7.3. Disadvantages

7.3.1. Payload limitations may limit the type of technology that can be deployed.

7.3.2. More than 1 operator may be required to operate and maintain system

8. Shipboard Surveillance Systems

8.1. Rationale for use

8.1.1. Shipboard systems offer immediate and ongoing feedback to the operators of spill containment and recovery equipment to the location and approximate thickness of oil in the immediate vicinity.

8.2. Advantages

8.2.1. Helps to direct recovery efforts by providing feedback to direct the path of the vessel for the most effective recovery.

8.2.2. Optical sensors including cameras working in the visible, infrared and ultraviolet range are relatively economical and more readily available.

8.3. Disadvantages

8.3.1. Limited to detection in the immediate vicinity of the vessel, constrained by the height of the mounted sensors to provide images and data. Cameras should be mounted at or near Brewster's angle (approximately 53º from the vertical).

8.3.2. Stabilization systems may need to be employed to maintain a useful image in rough seas.

9. Drones

9.1. Rationale for use

9.1.1. Unmanned Aerial Vehicles are aircraft with no pilot on board. They can be flown by a pilot at a ground station, or autonomously through a pre-programmed flight plan that typically relies on precise GPS coordinates for waypoints and destination.

9.2. Advantages

9.2.1. Ease in launching UAVs from multiple platforms

9.2.2. Can be brought to remote sites and launched with minimal equipment/logistics support.

9.2.3. Commercially available units already contain powerful cameras in the visual and infra-red spectrum, general payload may accommodate other equipment (plume sampling, as an example)

9.3. Disadvantages

9.3.1. Currently undergoing regulatory review in multiple jurisdictions over their commercial and private use

9.3.2. May require a trained operator (pilot) and spotter, depending upon size and complexity of design

9.3.3. Coordination requirements when other aircraft are in the vicinity

10. Operational Considerations

10.1. Integration of two or more of these surveillance systems may be desirable to support response efforts from a tactical as well as strategic standpoint.

10.2. Considerations when integrating multiple systems include:

10.2.1. Compatibility of data from multiple systems to provide timely strategic as well as tactical data/information to the response organization.

10.2.2. Possibility of conflicting information based upon the limits of the technology(ies).

11. Keywords

slick, common operating picture, tactical, strategic

Appendix G: F2327 − Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water (modifications to existing standard)

Standard Guide for

Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water[1]

This standard is issued under the fixed designation F2327; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (´) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This guide provides information and criteria for selection of remote sensing systems for the detection and monitoring of oil on water.

1.2 This guide applies to the remote sensing of oil-on-water involving a variety of sensing devices used alone or in combination. The sensors may be mounted in helicopters, fixed-wing aircraft, unmanned aerial vehicles (UAVs) or aerostats. Excluded are situations where the aircraft is used solely as a telemetry or visual observation platform and exo-atmosphere or satellite systems.

1.3 The context of sensor use is addressed to the extent it has a bearing on their selection and utility for certain missions or objectives.

1.4 This guide is generally applicable for all types of crude oils and most petroleum products, under a variety of marine or fresh water situations.

1.5 Many sensors exhibit limitations with respect to discriminating the target substances under certain states of weathering, lighting, wind and sea, or in certain settings.

1.6 This guide gives information for evaluating the capability of a remote surveillance technology to locate, determine the areal extent, as well as measure or approximate certain other characteristics of oil spilled upon water.

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

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[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 F20.16 on Surveillance and Tracking.

Current edition approved Sept. 15, 2008. Published September 2008. Originally approved in 2003. Last previous edition approved in 2003 as F2327 – 03. DOI:
10.1520/F2327-08.

1.8 Remote sensing of oil-on-water involves a number of safety issues associated with the modification of aircraft and their operation, particularly at low altitudes. Also, in some instances, hazardous materials or conditions (for example, certain gases, high voltages, etc.) can be involved. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.

2. Significance and Use

2.1 The contributions that an effective remote sensing system can make are:

2.1.1 Provide a strategic picture of the overall spill,

2.1.2 Assist in detection of slicks when they are not visible by persons operating at, or near, the water's surface or at night, 2.1.3 Provide location of slicks containing the most oil,

2.1.4 Provide input for the operational deployment of equipment,

2.1.5 Extend the hours of clean-up operations to include darkness and poor visibility,

2.1.6 Identify oceanographic and geographic features toward which the oil may migrate,

2.1.7 Locate unreported oil-on-water,

2.1.8 Collect evidence linking oil-on-water to its source,

2.1.9 Help reduce the time and effort for long range planning,

2.1.10 A log, or time history, of the spill can be compiled from successive data runs, and

2.1.11 A source of initial input for predictive models and for "truthing" or updating them over time.

3. Remote Sensing Equipment Capabilities and Limitations

3.1 The capability of remote sensing equipment is, in large measure, determined by the physical and chemical properties of the atmosphere, the water, and the target oil. There may be variations in the degree of sophistication, sensitivity, and spatial resolution of sensors using the same portion of the electromagnetic spectrum and detector technology. Sensors within a given class tend to have the same general capabilities and typically suffer from the same limitations.

3.2 Combinations of sensors offer broader spectral coverage which, in turn, permit better probability of detection, better discrimination, and effective operation over a broader range of weather and lighting conditions. Certain combinations, or sensor suites, are well documented, and their use is particularly suited to oil spill response missions.

3.3 The performance of virtually all sensors can be enhanced by a variety of real-time, near real-time or post processing techniques applied to the acquired data or imagery. Furthermore, image or data fusion can greatly enhance the utility of the remote sensing output or product. Similarly, there exists a variety of technological considerations and organizational ramifications that relate to the delivery of the remote sensing information to the user.

3.4 Certain parameters need to be identified and quantified to provide an oil spill response decision-maker with all of the information needed to best respond to a spill. These are:

3.4.1 Location—of the approximate center and edges of the spill,

3.4.2 Geometry—source or origin, total area, orientation and lengths of major and minor axes, fragmentation, and distribution,

3.4.3 Physical conditions—oil appearance, entrained debris,

3.4.4 Environmental conditions—wave height and direction; water temperature; position of oceanic fronts, convergence and divergence zones,

3.4.5 Proximity of threatened resources, and

3.4.6 Location of response equipment.

3.5 Remote sensing can contribute to all of the above data needs. Depending on the spill situation and the employment of remote sensing, some of this information may already be available, or can be determined more cost effectively by other means. For example, in a response mode, or tactical employment of remote sensing, it is likely that the source, general location and type of oil have been reported well in advance of the launch of the remote sensing platform. In a regulatory or patrol context, this information may not be available. The spill situation influences the priorities among the elements of information and, thereby, influences the selection priorities for sensors.

3.6 A responder may require the data on an oil spill, 24 hours per day, independent of the prevailing weather.

3.7 Information from remote sensing is required in a timely manner. Strategic or enforcement information, such as the overall extent and location of a spill, should be available preferably within two to four hours from information gathering to presentation.

3.8 Tactical information, such as steering information for response vessels, should be available in as little as five minutes from detection to communication. The acceptable data delivery time is a function of the dynamics of the slick, proximity to critical areas, and the availability of clean-up resources.

3.9 The passive microwave sensor is currently available to give information on oil thickness.

3.10 Table 1 lists sensors based upon their mode of operation. Summary information on their advantages and disadvantages is presented.

3.11 Table 2 presents a summary of key attributes which generally influence the selection of remote sensing instrumentation.

3.12 Table 3 addresses the mission specific aspects of sensor selection.

4. Summary

4.1 The information presented in this guide should be considered a starting point for sensor selection. In addition to the context of use and the attributes of the various types of sensors, the system planner will have to give due consideration to the capabilities of the aircraft and the information needs of the users before finalizing the system design. Both sensor technology, and image and data analysis capabilities are evolving rapidly. Most equipment is not commercially available and requires assembly and in some cases requires development. Up to two years lead time may be required for some equipment.

TABLE 1 Sensor Characteristics

Sensor/ Band	Principal of Operation	Positive Features	Limitations
Visual	Operate in, and near, the (human) visible spectrum (400 to 750 nm). Using photographic films, scanners with one or more narrow band detectors or charge coupled devices (CCD) to capture an image.	Equipment is widely available, generally inexpensive, light and easily accommodated on most any aerial platform. Imagery is in every-day use and the layman can easily relate to its content. This characteristic makes the imagery an excellent base for recording and presenting other data.	Oil is generally perceptible over the entire visible spectrum, but not uniquely so. As such, instances of not being able to discriminate the oil from its background, or differentiate it from other substances or phenomena in or on the water's surface, lead to frequent non-detects and false positives .Night vision cameras may extend the operational window, but visual technologies are limited by available light.
Infrared	While the infrared (IR) spectrum ranges from 750 nm to 1 mm, the bulk of the available remote sensing systems operate in the thermal or midIR, 3 µm (3000 nm) to 30 µm (30 000 nm). Within this range there are two predominant subgroups operating at 3 to 5 µm and 8 to 12 or 14 µm. The latter range offers the most useful data for oil spills.	Fresh oil shows a contrast to open water in the thermal infrared. This characteristic is not unique to hydrocarbons. Slicks thicker than about 20 to 70 µm[A] can be seen. Newer IR cameras have excellent thermal discrimination, fairly good resolution, are light-weight, have modest power demands, and typically have both digital and video outputs.	Small patches, thin, or significantly weathered oil may not be detectible. Other heterogeneities such as high seaweed or debris content, oil in or on ice, oil on beaches, etc. may render the oil undetectable in the IR. There is no relationship between slick thickness and the intensity of the IR image. In the daytime, thick oil is hotter than water and oil of intermediate thickness is cooler. (The cross over with water occurs when the oil is about 20 to 150 µm thick.[B]) At night this relationship reverses (unless the spill is fresh and the oil is hotter than the water when it arrives at the surface). This results in two periods per day with poor discrimination.
Ultraviolet	Oil is highly reflective in the ultraviolet (UV–200 to 400 nm).	Very thin (<10 nm) layers of oil can be detected in the UV.[C] Thus, even sheen, a common regulatory definition of oil pollution, can be delineated.UV cameras have fairly good resolution, are light-weight and have minimal power demands.	High UV reflectance is not unique to oil. Sun glint, biogenic and other materials and phenomena can yield strong returns in the UV. This technology is limited to available light situations, and is best used in combination with other sensors, typically IR.

Radar	Oil has a damping effect on high frequency, low amplitude (1 to 10 cm) capillary waves. These waves, yielding a "rougher" surface, return considerably more radar energy to the receiver than calm water. As such, under the proper conditions, oil can appear as a low return, dark area in a larger, bright field of un-oiled waves. Specially tuned Side Looking Airborne Radar (SLAR) and Synthetic Aperture Radar (SAR) are two types suited to oil detection. Ship-borne radars can be optimized to detect oil slicks.	Radar has some unique advantages over other oil spill sensors: it can operate day or night; it can operate in times of reduced visibility; it can operate at higher, safer and more fuel-efficient altitudes. Typical airborne ranges are 10 to 50 km. Ship-mounted radars have a range of typically 25 km.	Oil is not the only source of calms. Other, naturally occurring substances and phenomena can give rise to smooth water.[D] If the prevailing wind is less than about 1.5 m/s, there will not be enough "roughness" in un-oiled water to create the necessary roughness contrast. Likewise, above about 6 m/s the calming effect of, at least thin, oil begins to diminish.[E] The potential for false positives is high. Airborne radar equipment is expensive and it requires fairly extensive modifications to an aircraft, thus adding to both the acquisition and the operational costs.
Microwave Radiometer	Oil is a stronger emitter of microwave radiation than water (emissivity factor of 0.8 versus 0.4, respectively).[F] Therefore it shows up as a bright area against a darker background.	The passive microwave radiometer has been demonstrated to detect oil on water even under low visibility conditions. Multi-frequency units can be calibrated to measure thickness	The technology is subject to the same limitations as radar. This is an evolving technique requiring additional development and demonstration before a commercial unit is marketable. Current units are installed in dedicated aircraft and this trend is likely to continue in the near term.
Fluorosensors	Oil targeted or illuminated with UV light will adsorb this energy and re-emit, or fluoresce, in the visible band. Other materials fluoresce as well, but there is enough spectral uniqueness to oil to render it readily discernable. In fact it is possible that various generic types of oil and petroleum products can be differentiated.The coherent light from a laser permits the delivery of more energy from greater distances making airborne fluorosensors feasible.	The laser fluorosensor permits the positive identification of oil and even permits some discrimination between types of oil. It appears to be the only sensor available today that permits the detection of oil against complex backgrounds as is the case with oil on beaches and in, or with, the ice.	Laser fluorosensors are fairly bulky and require significant modifications to relatively large, dedicated aircraft.

[A] Fingas, M., and C. Brown, "Review of Oil Spill Remote Sensing," *Marine Pollution Bulletin*, (83), 1, pp. 9-23, 2014.
[B] ibid.
[C] ibid.
[D] Frysinger, G. S., Asher, W. E., Korenowski, G. M., Barger, W. R., Klusty, M. A., Frew, N. M., and Nelson, R. K., "Study of Ocean Slicks by Nonlinear Laser Processes in Second Harmonic Generation," *Journal of Geophysical Research*, 1992.
[E] Wisman, V., Alpers, W., Theis, R., and Hühnerfuss, H., "The Damping of Short Gravity-Capillary Waves by Monomolecular Sea Slicks Measured by Airborne Multi-frequency Radars," *Journal of Geophysical Research*, 1993.
[F] Ulbay, F. T., Moore, R. K., and Fung, A. K., *Microwave Remote Sensing: Active and Passive*, ArchtHous, Inc., 1989. ***(Note to M. Fingas (standard author): There may be newer references such as the new API guidance for surveillance document.***

TABLE 2 Key Attributes for Sensor Selection[A]

Sensor	State of Development	Experience in Use[B]	Specific to Oil	Immunity to False Targets	Acquisition Cost Range k$	Special Aircraft Requirements[C]
Still Camera—Film	High	High	Poor	Poor	0.25 to 5	no
Still Camera—CCD	High	High	Poor	Poor	1 to 20	no
Video	High	High	Poor	Poor	1-10	no
IR Camera (3 to 5 μm)	High	Medium	Poor	Poor	4 to 40	no
IR Camera (8 to 14 μm)	Medium	Medium	Medium	Medium	20 to 200	no
UV Camera	Medium	Medium	Poor	Poor	4 to 20	no
Multi-spectral Scanner	Medium	Medium	Poor	Poor	100 to 300	some
Radar	High	High	Medium	Poor	2000 to 6000	yes-Dedicated
Microwave Radiometer	Medium	Medium	Medium	Medium	400 to 2000	yes-Dedicated
Laser Fluorosensor	Medium	Low	Good	Good	300 to 2000	yes-Dedicated

[A] Information presented in this table was adapted from: Fingas, M. F. and Brown, C. E., "An Update on Oil Spill Remote Sensors," in *Proceedings of the Twenty-eighth Arctic and Marine Oil Spill Program Technical Seminar*, Environment Canada, Ottawa, Ontario, 2005, pp. 825–860. [B] The Experience in Use refers to the amount of historical use. [C] This column refers to *physical* requirements. A thorough review of regulatory requirements is in order in *all* instances.

TABLE 3 Sensor Suitability for Various Missions

Context or Mission		Tactical / Operational						
			Strategic / Command and Control					
			Regulatory					
Sensor	Support for Cleanup	Night Operations	Fog Operation	Detection of Oil with Debris	Oiled Shoreline Survey	Spill Mapping	Ship Discharge Surveillance	Enforcement and Prosecution
Still Camera—Film	n/a	n/a	n/a	n/a	1	1	3	3
Still Camera—CCD	4	n/a	n/a	2	2	2	2	2
Video	4	n/a	n/a	2	2	2	2	2
IR Camera (8 to 14 μm)	4	2	n/a	1	n/a	3	3	3
UV Camera	2	n/a	n/a	n/a	n/a	3	2	1
UV/IR Scanner	4	2	2	1	n/a	4	3	3
Multi-spectral Scanner	3	n/a	n/a	n/a	1	2	1	1
Airborne or Space Radar	1	4	4	n/a	n/a	4	3	2
Ship-mounted Radar	4	4	4	n/a	n/a	4	2	2
Microwave Radiometer	1	3	3	n/a	n/a	2	2	1
Laser Fluorosensor	4	3	n/a	5	5	1	5	5

[A] Information presented in this table was adapted from: Fingas, M. F. and Brown, C. E., "An Update on Oil Spill Remote Sensors," in *Proceedings of the Twenty-eighth Arctic and Marine Oil Spill Program Technical Seminar*, Environment Canada, Ottawa, Ontario, 2005, pp. 825–860.

Key: n/a = not applicable; numerical values represent a scale from 1 = poorly suited to 5 = ideally suited.

4. Summary

4.1 The information presented in this guide should be considered a starting point for sensor selection. In addition to the context of use and the attributes of the various types of sensors, the system planner will have to give due consideration to the capabilities of the aircraft and the information needs of the users before finalizing the system design. Both sensor technologies, and image and data analysis capabilities are evolving rapidly. Most equipment is not commercially-available and requires assembly and in some cases requires development. Up to two years lead time may be required for some equipment.

Appendix H: Potential new standard: Address Issues Related to Simultaneous Operations in Large Scale Response

DRAFT

Standard Guide for Containment and Control of Oil Spills on Water by Response Personnel

1. **Scope**
   1.1. This guide describes methods to contain and control of oil spills on water.
   1.2. This guide is directed toward those emergency response personnel who have adequate safety training in oil spill response.
   1.3. This guide is generally applicable to all types of crude oil and most petroleum product spills, under a variety of marine or fresh water environments.
   1.4. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. **Referenced Documents**
   2.1. ASTM Standards:

F631-99 (2008) Standard Guide for Collecting Skimmer Performance Data in Controlled Environments.
F715-07 (2012) Standard Test Methods for Coated Fabrics Used for Oil Spill Control and Storage
F726-12 Standard Test Method for Sorbent Performance of Adsorbents
F1523-94 (2013) Standard Guide for Selection of Booms in Accordance with Water Body Classifications.
F1599-95 (2009) Standard Guide for Collecting Performance Data on Temporary Storage Devices
F1607-95 (2013) Standard Guide for Reporting the Test Performance Data for Oil Spill Response Pumps.
F1737-10 Standard Guide for Use of Oil Spill Dispersant Application Equipment During Spill Response: Boom and Nozzle Systems
F1779-08 Standard Practice for Reporting Visual Observations of Oil on Water
F1788-08 Standard Guide for In-Situ Burning of Oil Spills on Water: Environmental and Operational Considerations
F2067-13 Standard Practice for Development and Use of Oil-Spill Trajectory Models

F2327-08 Standard Guide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water
F2532-13 Standard Guide for Determining Net Environmental Benefit of Dispersant Use
F2534-12 Standard Guide for Visually Estimating Oil Spill Thickness on Water
F2683-11 Standard Guide for Selection of Booms for Oil-Spill Response.
F2709-08 Standard Test Method for Determining Nameplate Recovery Rate of Stationary Oil Skimmer System
F2926-12 Standard Guide for Selection and Operation of Vessel-mounted Camera Systems

3. Terminology

3.1. Definitions of Terms Specific to This Standard:

3.1.1. Tbd

4. Significance and Use

4.1. This guide provides information on current techniques and technologies related to large scale response operations.

4.2. This standard should aid the decision making process when selecting, mobilizing, and engaging available equipment and techniques including booms, skimmers, pumps, storage devices, dispersant application and in-situ burning to optimize recovery efforts.

5. Site Assessments

5.1. Assessments of the risks associated with a particular oil spill are important in providing a mechanism to identify areas or objects of concern that may require an elevated level of attention. Assessments can be performed over water as well as along shorelines and on land, depending upon the areas of oil impacts.

6. Surveillance and Tracking

6.1. Remote sensing of oil spills can be accomplished using a range of different technologies on multiple operating platforms, including satellites, aircraft, and ships. The type of technology and platform will dictate whether the information being collected is providing a strategic overview of an incident, or tactical in providing direct input to help responders during recovery efforts (see ASTM F2327-08, F2926-12).

6.2. Visual observations have a role in helping determine the location, size, and type of oil during response efforts (see ASTM F1779-08, and ASTM F2534-12)

6.3. Data and observations are collected, logged, and can be used as input into spill modelling to help predict how the oil will behave and where it will go (see ASTM F2067-13).

7. Containment

7.1. Once an oil spill response starts, containment of the released oil is a high priority. Booms are commonly used to prevent or divert the migration of oil so that recovery operations can be more efficient.

7.2. Booms can be selected based upon the environment in which they will be placed (see ASTM F1523) and by a range of operating criteria (also see ASTM F2683)

7.3. Booms are physical barriers placed on the water to accomplish multiple tasks including: containing, excluding, deflecting and diverting oil.

7.4. Oil contained within a boom is prevented from spreading and thinning; however most larger spill responses will have vessels operating in an advancing mode with booms being used to corral oil for removal, then a collection device such as a skimmer will be used to move the oil to a storage device.

7.5. The effectiveness of booms has limitations and they will fail due to a few factors including the following:

7.5.1. Anchor failure

7.5.2. Strength member failure

7.5.3. Splash-over from breaking waves or wind

7.5.4. Changes in the tide or current

7.5.5. Being subjected to a velocity in excess of 0.7 knots. (Some booming systems are capable of higher net water speed operations, but containment will generally fail at around 0.7 knots by having oil submerge and be entrained below the containment area, then rise beyond it).

8. Removal

8.1. Skimmers are often used to remove contained oil from the surface of water. The type of skimmer used to recover oil will depend to some extent on the type of oil being recovered as many different types of skimmers exist, and are often matched to specific pump and/or pumping systems. They all have distinct performance capabilities (see ASTM F631-99 (2008), ASTM F2709-08, and F1607-95 (2013)) and should be matched to the recovery system.

8.2. Temporary storage devices sometimes used to hold oil during recovery operations (see ASTM F1599-95 (2009), and ASTM F715-07 (2012)).

8.3. Sorbents are often used during response efforts, although their use is primarily limited to either cleaning smaller spills or as a polishing step for larger scale recovery operations (see ASTM F726-12)

8.4. Alternate methods of removing oil from the water surface have been used during recent spill responses and have demonstrated their effectiveness

8.4.1. Dispersant application (see ASTM F2532, and ASTM F1737)

8.4.2. In situ burning (see ASTM F1788)

9. Temporary Storage

9.1. The storage of collected oil can often be a limiting factor when dealing with larger spills. The ability of booms and sweep systems to collect oil may be limited once they have reached their collection capacity. Responders must wait for additional resources such as temporary storage devices, barges or tankers to offload the collected oil for disposal or processing at an off-site storage facility.

9.2. Transit times for vessels such as barges or tankers becomes an important criteria in assessing the efficiency and effectiveness of recovery operations as minimal downtime is a primary goal

9.3. Decanting may be approved by the appropriate authorites which can increase the amount of oil stored.

10. Disposal

10.1. Disposal issues surrounding an oil spill pertain not simply to the oil that initially spilled, which may have emulsified – increasing the volume of waste that has to be dealt with, but also of oiled debris, equipment, personal protective equipment (PPE), along with shoreline sediments, and flora and fauna.

10.2. The logistics of dealing with wastes can require considerable resources to accommodate.

10.3. Efforts should be taken to minimize the quantity of wastes being generated by using selective clean-up techniques where suitable so that clean materials are not gathered with oiled materials.

10.4. Washing and re-using equipment and resources can help minimize wastes

10.5. Reprocessing oil through a refinery or recycling plant are options to consider

10.6. In many cases, wastes that cannot be recycled or reprocessed end up in landfill sites or being incinerated.

11. Environmental Considerations

11.1. Each of the techniques described above pertaining to the collection and recovery of oil must be assessed for their ability to reduce the impact of the oil on the environment and while minimizing any environmental damage caused through their use.

11.2. Weather can have a dramatic impact on the behavior and weathering of oil. It will affect the tactics used during response efforts, and will also impact the speed at which resources can be mobilized to assist with any spill response efforts.

11.3. Waste removal and disposal resulting from response efforts can become an increasingly important issue linked to the size of the spill and response effort. These are often shore-based efforts which may seem relatively easy to deal with from a logistics perspective, but spills in remote or sensitive areas can quickly compound problems associated with access.

12. Integration of Resources

12.1. All good response efforts require an integration of resources so that equipment and personnel can work efficiently, effectively and safely.

12.2. Matching capacities of equipment and the careful planning of support operations can help maintain recovery and collection efforts during a response.

13. Key words