Job Aid 5

Dispersant Efficacy Monitoring

Job Aid 5 Inclusions **Page**

5.a Special Monitoring of Applied Response Technologies (SMART) Protocols (2006)

General information on the cooperatively designed SMART protocols for use in both dispersant and in-situ burn monitoring may be found here[1]. The actual protocols may be found here[2]. The Dispersant Application Observer Job Aid is available here[3].

In addition, the following supplemental documents may serve as useful and more detailed references for on SMART field data collection and processing/evaluation:

- U.S. Coast Guard Use of Special Monitoring of Applied Response Technology (SMART) Protocols, COMDTINST 16470.1
- U.S. Coast Guard Required Operational Capabilities (ROC) and Projected Operational Environment (POE) for Coast Guard National Strike Force, COMDTINST 3501.57
- U.S. Coast Guard Special Monitoring of Applied Response Technologies (SMART) Tactics, Techniques, and Procedures (TTP), CGTTP 3-75.1, 22-JUL-2016
- C-3 SMART Operator's Guide, ver. 07-02-2014 (Parscal Pacific)
- Processing Guide for SMART Fluorometry Data (Parscal Pacific)
- NOAA SMART Data Processing and Evaluation Manual (In progress)

Key points from the documents are included below for overview purposes but are not intended to be used in lieu of trained personnel (e.g. USCG's National Strike Force, NOAA SSC, ART Lead Technical Specialist).

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i. Monitoring dispersant effectiveness

The SMART Guidelines are a joint project of the U.S. Coast Guard (USCG), National Oceanic & Atmospheric Administration (NOAA), US Environmental Protection Agency (EPA), the Centers for Disease Control & Prevention (CDC) and the Minerals Management Service (now the Bureau of Safety & Environmental Enforcement [BSEE]). In California, SMART will primarily be implemented by the Pacific Strike Team (PST), as requested by the USCG, but the following notes should help responders gain a general understanding of what SMART monitoring can (and cannot) be expected to accomplish.

Objective:

Monitor the effectiveness of dispersant applications in putting surface oil into the water column. This informs tactical decision-making.

Supplemental information:

Though not an objective, SMART monitoring may also aid in understanding the fate of oil in the environment. This type of monitoring does not inform tactical decision-making but may inform the Response.

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[1] http://response.restoration.noaa.gov/smart
[2] http://response.restoration.noaa.gov/sites/default/files/SMART_protocol.pdf
[3] http://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/dispersant-application-observer-job-aid.html

- The monitoring/sampling regime will depend on the availability of monitoring resources and should reflect the spill size, prevailing conditions, and logistical and physical constraints of the response. At a minimum, enough monitoring is needed to characterize natural and chemical dispersion relative to background.
- SMART is not intended to comprehensively characterize the entire dispersed oil plume over time, but instead is meant to spot-check dispersant effectiveness at one or more discrete locations along a given treatment path.
    - Tier I (visual) monitoring. Often conducted from helicopter, it can be on-scene quickly and may be the most efficient operational feedback loop for tactical decision-making. It is the minimum acceptable level of dispersant effectiveness monitoring. Field data includes digital photographs, GPS waypoints and/or tracklines, and datasheets (e.g. ICS-214 Unit Log, photo log, Dispersant Application Observation Reporting Form). Tier I Quality Assessment & Review is conducted by the NOAA SSC and ART Technical Specialist. Interpretation/recommendations are often available the same day.
    - Tier II (single depth) water column monitoring. Often conducted from a small boat, on-scene deployment may be delayed and/or hindered by weather/sea state. Field data includes digital photographs, water quality data (e.g. dissolved oxygen, pH, salinity, temperature, turbidity), fluorometry data package (lat/long, depth, and RFU [Relative Fluorescence Unit] data), GPS waypoints and/or tracklines, datasheets (e.g. ICS-214 Unit Log, photo log), and sometimes water samples. While initial interpretation / recommendations may be available within a day, final data products may be delayed until water sample analysis is complete. Whenever possible, termination of dispersant operations should be based on water column monitoring results.
    - Tier III (multiple depth) water column monitoring. Tier III monitoring is similar to Tier II but performed at multiple depths. This multi-depth data collection provides the most complete picture of dispersant effectiveness and mixing depth of dispersed oil.
- At the FOSC's discretion, supplemental monitoring may be conducted in addition to SMART monitoring to better characterize a dispersed oil plume and address questions of relative toxicity, persistence, mixing depth and dilution rates of dispersed oil. Effective deployment of such supplemental monitoring may be limited by equipment availability, technical expertise, and mobilization times. See also Job Aid 8.

ii. General observation guidelines (as outlined in USCG SMART TTP)

- Aircraft used for SMART should have space for two observers (in addition to the pilot) with visibility on both sides and with direct pilot-observer communications.
- Observations should be photographed and/or videotaped for comparison and documentation. GPS locations and/or tracklines should be recorded.
- Best oil viewing conditions:
    - With the sun behind the observer, flying at a 30-degree angle to the slick.
    - Mid-morning or mid-afternoon, avoiding midday glare off the water and the limited contrast encountered in early morning or early evening.
    - Spill dimensions are generally best viewed from higher altitudes (1,000-2,000 feet), whereas oil color & surface distribution are best from lower altitudes (200-300 feet).
    - Low-contrast conditions (e.g., overcast, twilight, haze) make observations difficult.

- Waves, kelp beds, natural organics, pollen, plankton blooms, cloud shadows, jellyfish and algae can all look like oil under certain conditions.
- Oil close to the coastline is best viewed from a helicopter, ideally with a door or window removed allowing the observer to look straight down on the oil. Further offshore, multi-engine aircraft provide a longer range, higher speeds and wider margin of safety.
- Visual observations cannot always confirm that the oil is dispersed, and physical sampling of water beneath the slick may also be needed.

iii. Water column fluorometry & water samples

- Monitoring/sample collection should ideally be conducted at multiple depths from:
  - Water free of oil contamination (to reflect "background")
  - Water beneath untreated oil (to reflect "natural dispersion")
  - Water beneath dispersant-treated oil (to reflect "chemical dispersion")
- The date, time and precise location (latitude, longitude, depth) of monitoring/sample collection and relevant observations must be recorded. Documentation of fluorometer calibration and verified instrument response should also be available.
- As fluorometry measures induced, water-column fluorescence that may be confounded in the presence of high organic material, water samples should also be collected to characterize oil concentrations and potential matrix effects.

iv. Fate of dispersed oil

- Monitoring a dispersed oil plume at several depths may provide information on dilution rate for the dispersed oil and possibly short-term indications of dispersed oil persistence.
- Trajectory models should be used where available to assist in tracking the plume. Drifters and dye markers may also be considered.

5.b SMART data review

The NOAA SSC and/or Dispersant Monitoring Technical Specialist will review SMART field data (Tier I) and derivative products (Tiers II/III), interpret results and provide recommendation(s) to the FOSC regarding dispersant operation effectiveness. Some factors that should be considered are listed below.

i. Dispersant application issues

- Effective dispersion may vary with differing oil thicknesses (varying oil/dispersant ratios);
- Herding effects of dispersants may "push" the oil together, making thinner patches appear to shrink/disappear from the sea surface for a short time;
- Oil may change color and relative viscosity & thickness as emulsions break (by reducing the oil's water content).

ii. Dispersed oil plumes

- May not form immediately after dispersant application, especially if the oil is emulsified or there is low mixing energy;
- May not be clearly visible and/or may be obscured by surface material (including undispersed oil) or poor water clarity;
- May be mistaken for other things such as suspended solids/turbidity;
- Are often irregular in shape and concentration;
- Can range in appearance from brown to light tan/cloudy. White subsurface plume may be dispersant only, whereas other light colors may indicate dispersion.

iii. Dispersant effectiveness

- A visible oil cloud in the water column indicates the dispersant is working;
- Differences in color, structure/distribution of treated and untreated slicks indicate dispersion is likely;
- Boat wakes may physically part oil (falsely indicating successful dispersion) or help to disperse oil (due to increased local turbulence).

iv. Using and interpreting monitoring results

- Quick turn-around of data & interpretation/recommendations are essential if monitoring results are to guide continued dispersant operations (Tier I may be quickest) and determine when dispersant operations are no longer effective.
- Tier I – An example SMART Tier I Data Quality Assessment & Review form is provided as Figure 1 on pg. 9. Review detailed notes from ICS-214 Unit Log and compare to field photos before & after spray. Look for changes in oil color and structure/distribution (including slick edges), wave dampening, and surface/subsurface oil indicators.
- Tiers II/III – Review graphed fluorometry data for deployed depth(s), background RFU readings and RFU spikes. RFUs five times background strongly indicates dispersion.
- Measured oil concentrations from water samples can verify/document chemically-enhanced dispersion reported by observations and fluorometry, though chemical analysis will take time (days to weeks).

5.c Expected SMART data reporting timelines

Tier I:
- Often available the same day;
- Aircraft-based teams can cover large areas and be on-scene and return to base quickly;
- Reporting of visual data can be quick and review of field data is straightforward;
- May be the only SMART data capable of supporting FOSC's daily tactical decisions.

Tiers II/III:
- Preliminary verbal field reports may be quick, but only if communications are reliable;
- Initial fluorometry data processing & interpretation may take a day or more;
- Chemical analysis of water samples and final data products may take weeks or longer.

5.d Sample ICS-213 RR for Pacific Strike Team (PST) SMART team

- Use observers trained and experienced in identifying oil floating on the sea. Typically, the USCG National Strike Force (NSF) has responsibility for collecting SMART Tier I, II and III data on behalf of the USCG and the Unified Command.
- Below is an example from a California oil spill drill of an ICS-213 RR, requesting deployment of a SMART team from the Pacific Strike Team in Novato, CA. The request was written and submitted by CG personnel requesting a CG resource.

Resource Request Message — Purpose: The 213RR CG is used by all incident personnel to request tactical and non-tactical resources. — ICS-213 RR CG (2/07)

DRILL -- Queen's Gate Incident -- DRILL | 2014.05.01 | 3. Resource Request Number:

Requestor

4. ORDER Note: Use additional forms when requesting different resource sources of supply

a. Qty	b. Kind	c. Type	d. Priority U or R	e. Detailed item description (vital characteristics, brand, specs, experience, etc.) and, if applicable, purpose/use, diagrams, and other info.	f. Requested Reporting Location:	Date/Time:	g. Order # (LSC)	h. ETA (LSC)	i. Cost
1				USCG-Pacific Strike Team SMART Tier 3 fluorometry/observers	Long Beach	2014.05.02/1000			
1				Air plane or helicopter (equivalent to King Air plane)	Long Beach	2014.05.02/1000			
1				Offshore vessel (see note below)	Long Beach	2014.05.02/1000			

USCG Pacific Strike Team from Novato, CA. Personnel sufficient to fill one seat in plane (King Air already on-site or equivalent) for Tier 1 observations, sufficient personnel to conduct Tier 3 fluorometry sampling tows from vessel (capable of operations 10 miles from shore in 3-6' seas, open deck, 30-100' vessel length).

LT Brownie Kuk

7. Section Chief/Command Staff Approval: Date/Time:

Plans

8. RESL - check box (a) if request is for tactical or personnel resources. Then note availability in box 8.b or 8.c. — a. ☐ b. ☐ Resources available as noted in block 12 c. ☐ Resources not available

9. RESL Review/Signature: Date/Time:

Logistics

10. Requisition/Purchase Order #:

11. Supplier Name/Phone/Fax/Email:

13. Logistics Section Signature: Date/Time:

12. Notes:

14. Order placed by (check box): ☐ SPUL ☐ PROC ☐ OTHER _____

Finance

15. Reply/Comments from Finance:

16. Finance Section Signature: Date/Time:

Full instructions on back page. Requestor fills in blocks 1-5, except # 3 & # 4.g-i (shaded area), signs block 6 (do not forget position), gets appropriate Section Chief or Command Staff approval in block 7, and keeps yellow copy (bottom). If applicable, RESL reviews if resource available, signs block 9 and keeps blue copy. Logistics fills in block 4.g and h, and blocks 10-13, and keeps orange copy. Ordorer (LSC or FSC) fills in block 4.i. Finance fills in blocks 15 - 16 and keeps green copy. Pink copy is returned to RESL for tactical/personnel or requestor for non-tactical. White copy goes to DOCL.

5.e Alternatives for SMART Tier I

The PST's SMART assets (personnel and monitoring kits) are quick-deployable and highly mobile but may not always be immediately available. When not available, Tier I (visual) monitoring may be conducted by other trained observers (e.g., USCG personnel) if an observation platform is available. PST members should assume responsibility for all Tiers of SMART data collection once they are on-scene. In either case, the following documentation should be collected:

- Observer Log (e.g., ICS 214 Unit Log)

  Use the Tier I Observer's Log to provide as much description as possible of time on-scene and of all noted observations, spray on/off times, character of untreated (prior to treatment and/or near treated oil) and treated oil, color, distribution, etc. In addition to general pre-spray descriptions of oil character, the observer(s) should focus observations and photos on

visually distinct portions of the slick along the spray path so that these same areas can reliably be returned to for post-spray observations. Logged times will be particularly important, as it will guide reviewers to specific photos based on timestamps.

- Photographs & Photo Log

  Do not delete any photos. Note all relevant photo information in Photo Log (Figure 2 on pg. 10), especially photo # and description of general setting and key elements to focus on when reviewing.

- Completed Dispersant Application Observation Reporting Form

  This form, available in the Dispersant Application Observer Job Aid (also as Figure 3 pg. 11), is filled out as a Tier I summary determination after each dispersant spray survey and allows the observer to conclude: 1) whether dispersion was observed and 2) generally how long it took to occur. If effective dispersion was not obvious at the time of the observations, then compare photos of the same slick areas before and after spray and compare to the Observer Log for those times/photos. Focus should be on slick edges and nearby "open water" areas for visual changes to oil character that dispersants may have caused, even if they may not conclusively indicate effective dispersion. For instance, effective dispersion may be indicated by the classic "cafe au lait" coloration of the upper water column, but other effects to oil character should also be noted such as herding effects, sharp slick edges changing to more diffuse margins, surface oil becoming more patchy and forming a lattice-like distribution or what appear like scattered "tea leaves" across the surface or upper water column.

  It may be difficult to discern surface oil from subsurface oil, although subsurface oil will not dampen small surface ripples (capillary waves) so the surface roughness will appear more like clean water than the "slick" observed with fresh surface oiling.

  If effective dispersion is still not apparent after reviewing the photos, then enter the "No obvious dispersion" determination in the form.

5.f Alternatives for SMART Tiers II/III water sample collection for dispersed oil concentration/toxicity analyses

Though it may be tempting to consider emerging technologies as alternatives to traditional SMART Tiers II/III, they may be better suited as additions to SMART because they:

- May not be quick-deployable;
- May address different objectives/questions than SMART does (e.g. droplet size distribution, droplet behavior, rise velocities, toxicity);
- May require specialized training and/or personnel;
- May not provide results quickly enough to support operational decisions;
- May not replace traditional SMART approach without thorough evaluation by technical experts and possible RRT approval.

5.g Environmental Monitoring for Atypical Dispersant Operations

Although Atypical Dispersant Operations (subsea dispersant application or prolonged surface application) are not expected for California marine oil spills, the National Response Team (NRT) has developed guidance addressing dispersant monitoring in such situations. It is available here[4].

[4] https://nrt.org/sites/2/files/NRT_Atypical_Dispersant_Guidance_Final_5-30-2013.pdf

Figure 1. SMART Tier I Data Quality Assessment & Review

SMART Tier I Data Quality Assessment & Review

Incident Name / Command Post:

SMART Tier I data consists of observations summarized in an Activity Log (Unit Log ICS 214-CG), pre- and post-application photographs, and associated photo log of dispersant spray operations. This form documents the results of a preliminary quality assessment review of these documents.

SMART Air Team #: Date:

Operational Period: From (Date/Time): To (Date/Time):

Data Review (Check documents that were reviewed):

☐ Unit Log – ICS 214-CG

☐ Photographs (How many reviewed? _____)

☐ Photo Log

☐ Dispersant Observation Reporting Form

Assessment (Check appropriate box(s))

☐ Concur with SMART observer findings (reasonableness of findings)

☐ Issues of note from data review. Briefly describe.

☐ Dispersant is effective based on review of Activity Log, photographs, and photo log.

☐ Results inconclusive with respect to dispersant effectiveness.

☐ Other. Briefly describe.

Reviewed by Dispersant Assessment Group Member (Print name, sign, and date)

Name: Signature: Date:

Reviewed by NOAA SSC (Print name, sign, and date)

Name: Signature: Date:

Figure 2. Example of a SMART Tier I photo log

PHOTO LOG

Case / Incident:

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

PHOTO:	DATE/TIME:	TAKEN BY:	DIRECTION:
POSITION:		PHOTO DESCRIPTION:	
COMMENTS:			

Figure 3. Example of a Dispersant Application Observation Reporting Form

DISPERSANT APPLICATION OBSERVATION REPORTING FORM

Time of observations should be recorded from initial application or arrival on scene and then approximately 15 minutes apart until observations are ceased.

Observers:

Date:

Start time: End time:

Platform:

Rank	Standard Phrase	Description	Time	Time	Time
1	No obvious dispersion	Dispersant being washed off the black oil as white, watery solution, leaving oil on surface. Quantity of oil or sea surface not altered by dispersant.			
2	Slow or partial dispersion	Some surface activity (oil appearance altered). Spreading out of oil. Droplets of oil seen rapidly rising back to sea surface, but overall quantity appear to be similar to that before dispersant spraying.			
3	Rapid dispersion	Oil rapidly disappearing from surface. Light brown plume of dispersed oil visible on water under the oil and drifting away from it. Oil in some areas being dispersed to leave only sheen on sea surface, but in other areas still some oil present.			