Section 9407

In-Situ Burning Operations Planning Tool

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In-Situ Burning Operations Planning Tool

This is the Region 10 Regional Response Team (RRT 10) *In-Situ* Burning Operations Planning Tool for ocean and coastal waters and the inland zone. It is structured to guide the user through the In-Situ Burning Decision Tree and a series of tools to ensure the best decision is made within a short time-frame. The *In-Situ* Burning Application form and the RRT 10-modified Special Monitoring of Applied Response Technologies (SMART) Protocol are provided at the end of this plan for ease of use.

The requirements below apply to all in-situ burning operations under the provisions of the policy provided in Section 4617, "Region 10 In-Situ Burning Policy and Plan."

9407.1 In-Situ Burning Decision Tree

Prior to any *in-situ* burning operations, the Federal On-Scene Coordinator (FOSC)/Unified Command (UC) will use the decision tree provided in Figure 9407-1.

The policies on which the decision tree is based are found in Section 4617, "Region 10 *In-Situ* Burning Policy and Plan."

9407.1.1 Imminent and Substantial Threat to Human Life

As outlined in Subpart J of the National Oil and Hazardous Substances Pollution Contingency Plan, the FOSC may authorize the use of burning agents for any oil spill, when in the judgment of the FOSC, the use of burning agents is necessary to prevent or substantially reduce a hazard to human life [40 Code of Federal Regulations (CFR) 300.910(d)].

9407.1.2 Mechanical Recovery

Within Region 10, mechanical recovery is anticipated to be the primary response technique for the majority of on-water oil spills. *In situ* burning shall be considered by the FOSC/UC as another response tool to reduce the impacts of oil spills, as appropriate, in combination with mechanical and other response techniques. Note that provisions must be made for mechanical collection of burn residue following any burn(s).

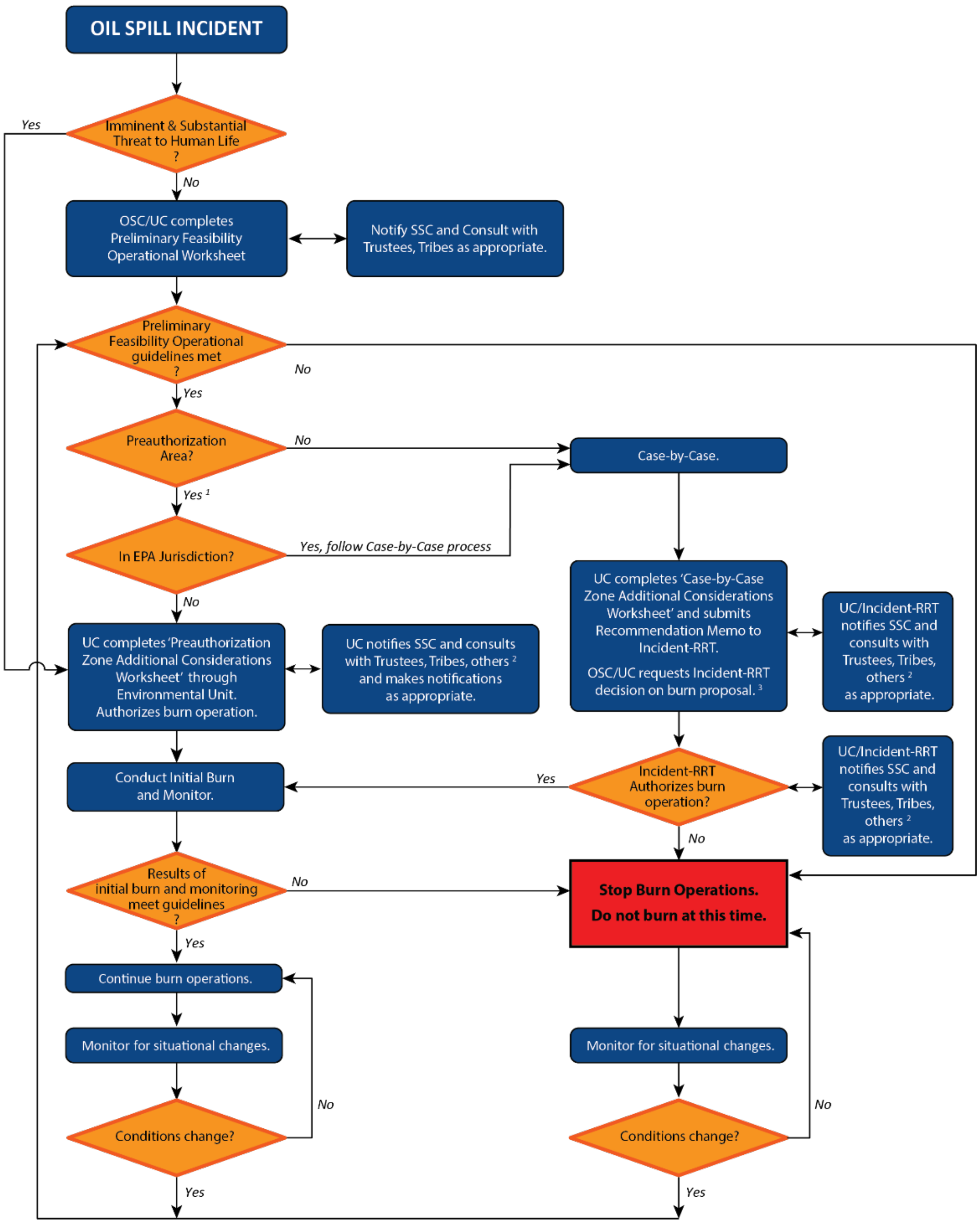
9407.1.3 Typical/Recommended Timing and Work Flow for an *In-Situ* Burn Decision

The typical in situ burn use review and authorization process is anticipated to follow these general steps. Key members for this process may need to be involved remotely, depending upon the timing of the request and deployment schedules.

Each spill response is unique and the exact steps used in this process and their timing may vary between responses).

- UC establishes an Objective to consider the use of in situ burning.
- Mobilize necessary response resources.
- Planning Section Chief (PSC) will inform (directly or by delegation) the Environmental Unit Leader (EUL) of the need to start (a) evaluating the use of in situ burning and (b) the development of the In-Situ Burn Decision Support tools.
- For spills within Pre-Authorization or Case-by Case use zones the tools should be developed as appropriate to capture key decision points and to maintain a clear record of decisions.
- The PSC should, in coordination with the EUL, establish a timeline for completion of the In-Situ Burn Decision Support tools which coordinates with a schedule for setting a time to (a) brief the FOSC/UC about the completed In-Situ Burn Decision Support Tools, and (b) (for Case-by-Case zones) a meeting/conference call for the FOSC/UC to brief the RRT 10 members on the In-Situ Burn Decision Support Tools and for the UC to make their request to the appropriate RRT 10 members for authorization to use in-situ burning.
- The EUL will then establish a group of technical experts (which will likely include the National Oceanic and Atmospheric Administration Scientific Support Coordinator (SSC), as well as resource trustees, agency representatives, and industry/consultant technical experts, regional air authorities, and other representatives as appropriate) to evaluate whether the use of in-situ burn is feasible and appropriate for the specific incident, and to complete the In-Situ Burn Decision Support Tools.
- The EUL will also ensure (either directly or through delegation) critical coordination with the Operations Section Chief and Operations members, Safety Officer, Liaison Officer, Information Officer, and other key personnel as appropriate.

Figure 9407-1 RRT X In Situ Burning Decision Tree



Key:
[1] Indicates that the initial burn decision will be made by the UC.
[2] Other includes but not limited to: State & Local Health Departments, Air Agencies, Emergency Management Agencies.
[3] Incident RRT approval not required if burning agent not used.

9407.1.4 Emergency Notification and Consultation

9407.1.4.1 Endangered Species Act, Essential Fish Habitat, National Historic Preservation Act Consultation

Emergency consultations[1] shall be initiated by the lead federal response agency as soon as practicable after notification of a major discharge where *in-situ* burning will be used, and listed species or critical habitat is present in the area or nearby. Section 4314 "Endangered Species Act" outlines the FOSC's responsibilities for Endangered Species Act (ESA) consultation. Sections 4314 and 9404, "Region 10 Regional Response Team/Northwest Area Committee Endangered Species Act Compliance Guide for Federal Responders during Emergency Response" provide additional information and resources regarding ESA consultation. *In-situ* burning will be conducted in accordance with emergency consultations with the United States Fish and Wildlife Service and the National Marine Fisheries Service.

Prior to beginning an *in-situ* burn, an on-site survey will be conducted to determine if any threatened or endangered species are present in the burn area or otherwise at risk from any burn operations, fire, or smoke. Appropriate natural resource specialists, knowledgeable regarding any special resource concern in the area and representing the resource trustee, will be consulted prior to conducting any *in-situ* burn. Measures will be taken and documented to prevent risk of injury to any wildlife, especially endangered or threatened species. Examples of potential protection measures may include moving the location of the burn to an area where listed species are not present; temporary employment of wildlife deterrence techniques, if effective; and physical removal of individuals of listed species only under the authority of the trustee agency.

In-situ burning will be conducted in accordance with emergency consultations with the State Historic Preservation Office. Section 106 of the National Historic Preservation Act [16 United States Code 470(f)] requires federal agencies to consult with the State Historic Preservation Office if they are proposing an action that may affect historic properties. Section 9403, "Compliance Guide for National Historic Preservation Act during an Emergency Response" discusses obligations required of state and federal responders to protect cultural historic properties during an emergency response and procedures to follow to meet those obligations.

9407.1.5 Tribal Notification and Emergency Coordination

Emergency notification of tribes shall be initiated by the lead federal response agency as soon as practicable after notification of a major discharge.

When the United States Environmental Protection Agency (EPA) or United States Coast Guard (USCG) responds to an emergency using their FOSC authority, the

[1] "*Emergency Consultation"* is a process wherein the lead federal action agency contacts the United States Fish and Wildlife Service and/or National Marine Fisheries Service (Services) as soon as possible about the response situation for advice on measures that would avoid or minimize effects of the response. This contact need not be in writing. The Service(s) will follow the initial contact with a written summary of the conversation. If the initial review indicates that the response may result in jeopardy or adverse modification, and no means of reducing or avoiding this effect are apparent, the agency should be so advised, and the Service(s)' conclusions documented.

FOSC will, as soon as practicable, notify and offer emergency coordination to all affected tribes, through appropriate tribal natural or cultural resources or environmental staff, regarding oil spills and the use of *in-situ* burning operations that potentially could affect tribal interests. For incidents that occur upon tribal land or waters, tribes are encouraged to send a fully qualified Tribal Incident Commander to participate in the UC.

9407.1.6 Preauthorization Area

The *In Situ* Burning Preauthorization Area is described as follows:

- Any area that is more than 3 miles from human population. Human population is defined as 100 people per square mile.
- EPA does not intend to utilize preauthorization to apply burning agents without incident specific RRT approval in the inland zone.
- View a map of the pre-authorization areas at http://waecy.maps.arcgis.com/apps/webappviewer/index.html?id=13a6c63a1f9a438583726292e0adb816

The FOSCs have the authority and responsibility for managing oil spills in the Preauthorized Area as part of a UC structure. This *In Situ* Burning Policy and Plan authorizes the FOSC/UC to do the following without RRT approval:

1. Under proper conditions, ignite the spilled oil without using burning agents.
2. Utilize burning agents, as appropriate, if the burning conditions are suitable. EPA does not intend to utilize preauthorization to apply burning agents without incident specific RRT approval in the inland zone.

9407.1.7 Case-by-Case Areas

The *In Situ* Burning Case-by-Case areas are described as follows:

- Any areas within 3 miles of human population. Human population is defined as 100 people per square mile.
- View a map of the case by case areas at http://waecy.maps.arcgis.com/apps/webappviewer/index.html?id=13a6c63a1f9a438583726292e0adb816

FOSCs have the authority and responsibility for responding to oil spills in the Case-by-Case areas based upon their jurisdictional boundaries. Within UC, the FOSC is authorized to do the following in the Case-by-Case areas without RRT approval:

1. Under proper conditions, ignite the spilled oil without burning agents.
2. Utilize burning agents to initiate/sustain *in situ* burn when, in the FOSC's judgment, the use of burning agents are necessary to prevent or substantially reduce a hazard to human life.

The FOSC is authorized to do the following in the Case-by-Case areas after RRT approval:

1. Utilize burning agents to initiate and sustain *in situ* burning to mitigate spilled oil within any constraints provided by RRT 10.

9407.2 Decision Support Tools Summary for the Development of an *In-Situ* Burn Use Recommendation

Several tools have been developed to support and document in-situ burning use decisions. The *In-Situ* Burning Application Forms, provided at the end of this section, shall be completed for all burns as applicable and provided to RRT 10 members in a timely manner for documentation and informational purposes as depicted in Figure 9407-1 RRT 10 In Situ Burning Decision Tree.

Tools	Purpose	Who is Responsible
Tool 1: In-Situ Burning Preliminary Operational Feasibility Worksheet (9407.1)	The purpose of the checklist is to determine if field conditions may allow burning. If this worksheet indicates that in-situ burning will not work, no further consideration of in-situ burning is warranted unless conditions change.	FOSC/UC or designee (EUL or PSC)
Tools 2 & 3: Pre-Authorization Zone and Case-by-Case Zones Additional Considerations Worksheets	If Tool 1 indicates in-situ burning may be feasible, Tool 2 or Tool 3 should be used. The purpose of these tools is to document incident-specific information on whether burning is appropriate for use, tradeoffs in their use, recommended best practices or constraints, and to document concerns of trustee agencies who participated in the decision making process.	EUL with support from Safety, Joint Information Center (JIC), and Operations
Tools 4: Environmental Unit (EU) Recommendation Memorandum to the FOSC/UC	This memorandum provides the FOSC and UC with a formal recommendation to burn/not burn from the EUL. It is based on input from Tool 2 or Tool 3, and is signed by the trustees who were involved in the recommendation.	EU
Tool 5: RRT 10 Record of In-Situ Burn Decision	The purpose of this tool is to provide a formal record of the decision RRT 10 makes regarding authorizing the use on in-situ burning in case by case authorization areas.	PSC
Tool 6: In-Situ Burning Operation Considerations and Plan	This is written by the Operations Section and must incorporate the constraints from the EU memorandum, approved and delivered through the planning cycle and Incident Action Plan production. Oil Spill Removal Organizations typically have their own. Offshore In-Situ Burning Guidelines are provided for reference after the Tools.	Operations Section

Tools	Purpose	Who is Responsible
Tool 7: Tribal and other Trustee Technical Coordination Master List	The purpose of this tool is to gather a comprehensive list of all the Tribal agency resource trustee and other key representatives who should be coordinated with and engaged on a technical level for input into the overall tradeoff discussion which is part of the EU Recommendation process.	EU/Liaison Officer

The *In-Situ* Burning Application Forms, provided at the end of this section, shall be completed for all burns as applicable and provided to RRT 10 members in a timely manner for documentation and informational purposes as depicted in figure 9407-1 RRT 10 Decision Tree.

9407.2.1 Regional Response Team Notification and Participation

The FOSC agrees to make every effort to continuously evaluate the decision to burn by considering the advice of the EPA, United States Department of the Interior (DOI), United States Department of Commerce (DOC), and affected state(s), other member of the RRT 10, and any other agencies, groups, or information sources that may be available and appropriate for the specific incident. *In-situ* burning will be discontinued if so requested by the RRT representative of the EPA, the affected state(s), DOI, or DOC. Such a request may be verbal followed by written documentation.

9407.3 During an In-Situ Burn

9407.3.1 Responder Health and Safety

Ensuring worker health and safety is the responsibility of employers and the On-Scene Coordinator (OSC)/UC who must comply with all Occupational Safety and Health Administration (OSHA) regulations.

RRT 10 has developed a Health and Safety Job Aid (see Section 9203, “Health and Safety Job Aid”) to provide guidance and example Health and Safety Plans to be utilized at oil/hazardous materials incidents in the Pacific Northwest.

9407.3.2 Public Health/Safety and In-Situ Burning Air Monitoring Program

The monitoring program is designed to enhance the decision making process undertaken by the FOSC during *in-situ* burning in fulfillment of his/her responsibilities to ensure an appropriate and timely response to mitigate the effects of oil spills. These responsibilities are established by the Clean Water Act and defined in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300. The monitoring program is designed to provide the FOSC and UC with data to inform a decision to continue or discontinue with an *in-situ* burn.

Public health will be protected during an *in situ* burn by conducting air monitoring and/or sampling at appropriate locations downwind of the burn operations. In a case where smoke plumes are not predicted to cross over populated or environmentally sensitive areas, an inability to conduct air monitoring will not be automatic grounds for discontinuing or prohibiting *in situ* burn operations.

It is RRT 10's policy to utilize EPA's National Ambient Air Quality Standards for particulate matter up to 2.5 microns in diameter (PM 2.5) and particulate matter up to 10 microns in diameter (PM 10) as Levels of Concern (LOCs) during *in-situ* burning operations (see Table 9407-1 "In-Situ Burning Pollutants and Exposure Limits" in Section 9407). The NAAQS are based on a 24-hour time weighted average sample, and LOCs for particulates for the general public are 150 micrograms per cubic meter (PM 10) and 35 micrograms per cubic meter (PM 2.5). While conducting an in situ burn, responders will use the same LOCs from a 1-hour time weighted average sample. This is a very conservative LOC. If at any time it is anticipated, or measurements indicate, that the public are being or will be exposed to levels of particulates exceeding the identified LOCs, as a result of *in-situ* burning operations, then then the decision to continue in-situ burning operations will be reviewed with input from public health professionals. The NAAQS does not publish levels for shorter average times (e.g., 1- to 3-hour or 8-hour averages). As such, responders will have to determine how to assess the threats posed when particulates have not been present nor measured for 24-hours. Additional guidance can be found in Attachment B of Section 9418 (Emergency Response Community Air Monitoring).

In addition to monitoring/sampling both PM 10 and PM 2.5, RRT 10 recommends that the FOSC/UC conduct monitoring for other applicable chemical-specific air contaminants such as carbon monoxide, nitrogen dioxide, and sulfur dioxide as conditions and available response equipment allow (see Table 9407-1). State, county, and/or tribal health departments, as well as local air agencies, should be notified of the burn activity as soon as practicable. NWACP Section 9418 (Emergency Response Community Air Monitoring) provides a sample Community Air Monitoring Plan.

Table 9407-1 *In-Situ* Burning Pollutants and Exposure Limits

Pollutant	OSHA Permissible Exposure Limits*[1]	National Ambient Air Quality Standards (Primary)[2]
SO_2	5 ppm	75 ppm (1 hour averaging time, 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years)
NO_2	5 ppm	100 ppb (1 hour averaging time, 98th percentile, averaged over 3 years) 53 ppb (annual averaging time, annual mean)
PAH	0.2 mg/m^3 (volatile)	
CO	50 ppm	35 ppm (1 hour averaging time, not to be exceeded more than once per year); 9 ppm over 8 hours (8-hour averaging time, not to be exceeded more than once per year)

Pollutant	OSHA Permissible Exposure Limits*[1]	National Ambient Air Quality Standards (Primary)[2]
Particulates	5 mg/m^3 for particulates < 3.5 mm	PM 10: 150 $\mu g/m^3$ over 24 hours, not to be exceeded more than once per year on average over 3 years PM 2.5: 35 $\mu g/m^3$ 24-hour, 98th percentile, averaged over 3 years.

Sources:
[1] https://www.osha.gov/dsg/annotated-pels/index.html
[2] https://www.epa.gov/criteria-air-pollutants/naaqs-table

Notes:
*Time-weighted average concentration over 8 hours.

Key:

CO	carbon monoxide
mg/m^3	milligrams per cubic meter
mm	millimeters
OSHA	Occupational Safety and Health Administration
PAH	polyaromatic hydrocarbons
PM 10	particulate matter up to 10 microns in diameter
PM 2.5	particulate matter up to 2.5 microns in diameter
ppb	parts per billion
ppm	parts per million
RRT	Regional Response Team
SO_2	sulfur dioxide

In the coastal zone, the USCG National Strike Force (NSF) will provide on-site monitoring during *in-situ* burning operations. In the Inland Zone, EPA Region 10 Emergency Management Program (EMP) and EMP contractors will provide on-site monitoring during *in-situ* burning operation. In both zones, the NSF and EPA EMP can augment the monitoring program with technical assistance, equipment, and staff. The NSF and/or EPA EMP have a proven ability to quickly respond to the OSC's technical needs during an oil spill with properly trained and equipped personnel and logistical support. The NSF and EPA EMP will perform on-site monitoring with the guidance of the SSC's scientific support team. Having a government agency collect data is partially dictated by the need for data to remain in the public domain and to ensure timely availability and objective presentation of the data to the FOSC/UC.

The NSF, EPA EMP, and/or responsible party and associated contractors will utilize the RRT 10-modified SMART protocols (attached at the end of this document and the Community Air Monitoring Plan described in Section 9418), which will provide the basis for the air monitoring/sampling program to minimize exposure of sensitive populations to levels anticipated to affect public health. Ideally, burning should not occur within 3 miles of sensitive human population centers (i.e., hospitals, schools, day cares, retirement communities, nursing home); however, this will depend on the magnitude of the spill and the severity of the threat. The FOSC/UC will give consideration to the direction of the wind and the possibility of the wind blowing precipitate over population centers or sensitive resources. A safety margin of 45 degrees of arc on either side of predicted wind vectors should be considered for shifts in wind direction.

Burning should be stopped if it is determined that it becomes an unacceptable health hazard due to concerns about smoke exposure for responders or the general public. If at any time, exposure limits are expected to exceed national federal air quality standards in nearby populated areas, as a result of *in-situ* burning operations, then the decision to continue in-situ burning operations will be reviewed with input from public health professionals.

Representatives of the USCG, EPA, federal trustee agencies, the affected state(s), OSHA, and the responsible party may have the opportunity to observe *in situ* burning operations if logistics and safety considerations permit. This decision will be made by the UC at the time of the incident.

9407.3.3 Local Air Agencies and Public Health Departments

The FOSC/UC will notify and coordinate with the state, local, and/or tribal air agencies prior to conducting and during an *in situ* burning operation. Consultation with local air authorities should be conducted in conjunction with the ESA and Essential Fish Habitat consultation. A map of Clean Air Agencies for Washington State is provided in Figure 9407-3, and associated contacts for the agencies are provided in Table 9407-2. A State of Oregon Counties map is provided in Figure 9407-4, and an Oregon State Department of Environmental Quality/Air Quality Division list of contacts is provided in Table 9407-3. An Idaho State Air Quality Control map and list of contacts is provided in Figure 9407-5.

In addition to the UC–led air monitoring/sampling activities outlined specifically in Section 9407.3.2, above, the FOSC/UC will coordinate with the state, local, and/or tribal air agencies to identify regulatory air monitors/samplers in the anticipated plume path. In the event that there are exceedances of air quality standards or measurements of regulatory significance during or after an *in-situ* burning operation, the FOSC/UC will work with the air agency to determine if the event qualifies as an Exceptional Event as governed by the "Treatment of Data Influenced by Exceptional Events" rule (72 Federal Register 13560, March 22, 2007) including any amendments thereto.

9407.3.3.1 Role of Local Air Agencies and Public Health Departments

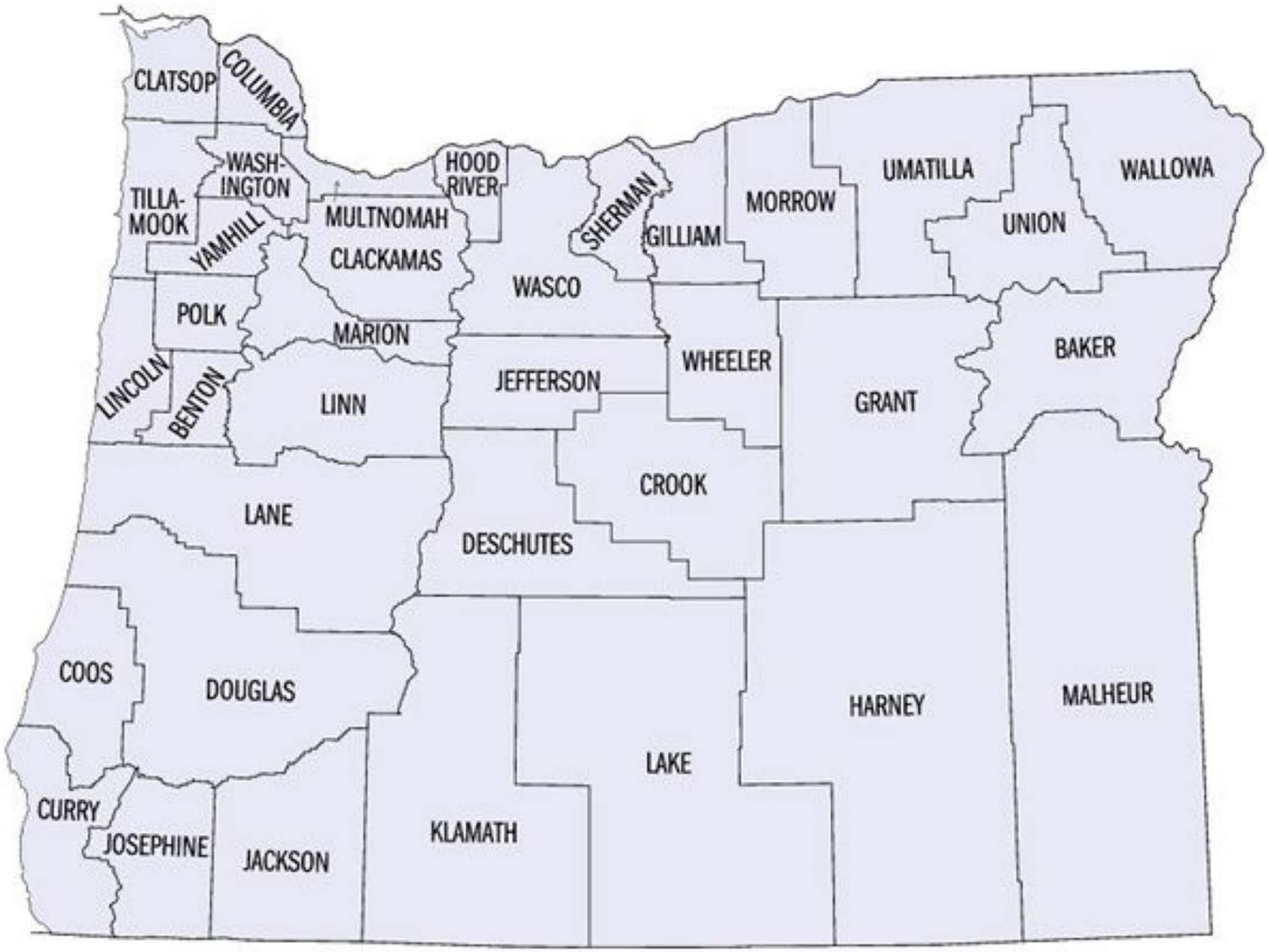
Air authorities and public health agencies will be notified and consulted in all case-by-case decision areas. Air authority staff will be provided with an opportunity to participate as subject matter experts during spills. The subject matter experts may fill roles in the command post or virtually by participating in the EU or via communication with the Liaison Section. Support may include but is not limited to developing smoke plume forecasts, reviewing monitoring plans and action levels, assisting to identify monitoring resources, providing monitoring resources, and assisting to identify and develop messaging for potentially at risk populations.

Figure 9407-3 Washington Clean Air Agencies

Table 9407-2 Washington Air Authorities Contact Information

Agency/Counties Covered	Address	Contact Person	Telephone/Fax	e-mail address/internet page
Olympic Region Clean Air Agency (Clallam, Grays Harbor, Jefferson, Mason, Pacific, Thurston)	2940 B Limited Ln NW Olympia, WA 98502	Fran McNair, Executive Director	Phone: 360-539-7610 or 800-422-5623 Fax: 360-491-6308	fran.mcnair@orcaa.org www.orcaa.org
Department of Ecology – Northwest Regional Office (San Juan)	3190 160th Ave SE Bellevue, WA 98008			https://ecology.wa.gov
Northwest Clean Air Agency (Island, Skagit, Whatcom)	1600 S Second St Mt. Vernon, WA 98273	Mark Burford, Executive Director	Phone: 360-428-1617 800-622-4627 (Island & Whatcom) Fax: 360-428-1620	Markb@nwcleanair.org, info@nwcleanair.org www.nwcleanair.org
Puget Sound Clean Air Agency (King, Kitsap, Pierce, Snohomish)	1904 3rd Ave, Ste 105 Seattle, WA 98101	Craig T. Kenworthy, Executive Director	Phone: 206-343-8800 800-552-3565 Fax: 206-343-7522	craigk@pscleanair.org www.pscleanair.org
Southwest Clean Air Agency (Clark, Cowlitz, Lewis, Skamania, Wahkiakum)	11815 NE 99th St, Ste 1294 Vancouver, WA 98682	Uri Papish, Executive Director	Phone: 360-574-3058 800-633-0709 Fax: 360-576-0925	uri@swcleanair.org www.swcleanair.org
Department of Ecology – Central Regional Office (Chelan, Douglas, Kittitas, Klickitat, Okanogan)	15 W Yakima Ave, Ste 200 Yakima, WA 98902			https://ecology.wa.gov
Yakima Regional Clean Air Agency	329 N 1st St Yakima, WA 98901	Keith Hurley, Executive Director	Phone: 509-834-2050 800-540-6950 Fax: 509-574-1411	mailto:keith@yrcaa.org www.yakimacleanair.org
Department of Ecology – Eastern Regional Office (Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Stevens, Walla Walla, Whitman)	4601 N Monroe St. Spokane, WA 99205	Karen Wood	Phone: 509-329-3409 Fax: 509-329-3529	kwoo461@ecy.wa.gov https://ecology.wa.gov
Spokane Regional Clean Air Agency	3104 E Augusta Ave Spokane, WA 99207	Julie Oliver, Interim Director	Phone: 509-477-4727 Fax: 509-477-6828	publicinfo@spokanecleanair.org www.spokanecleanair.org
Benton Clean Air Agency	526 S Clodfelter Rd Kennewick, WA 99336	Robin Bresley Priddy, Executive Director	Phone: 509-783-1304 Fax: 509-783-6562	email@bcaa.net www.bentoncleanair.org
Department of Ecology – Air Quality Program	P.O. Box 47600 Olympia, WA 98504	Marilyn Turnbow	Phone: 360-407-6879 Fax: 360-407-7534	matu461@ecy.wa.gov https://ecology.wa.gov/Air-Climate

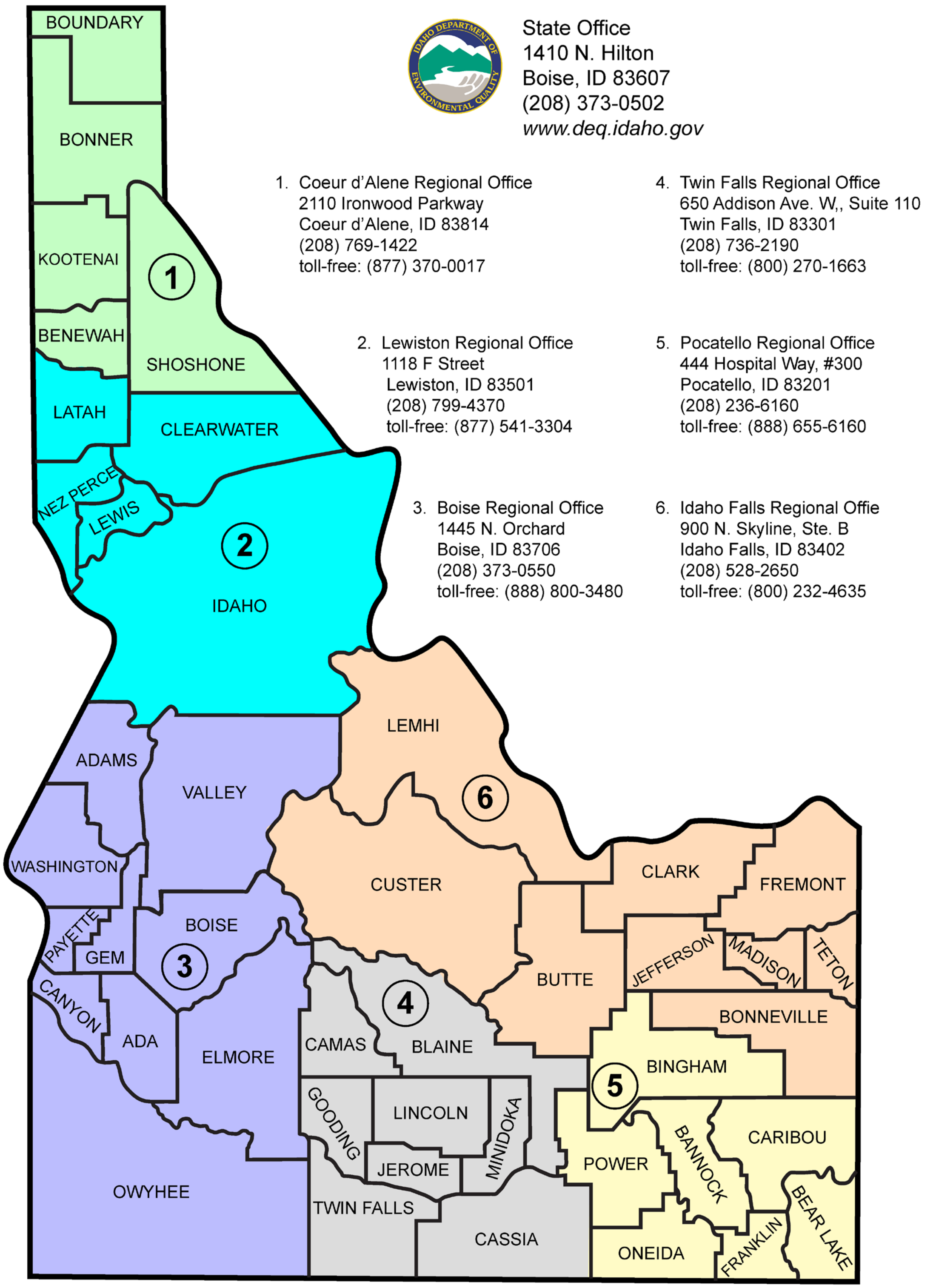
Figure 9407-4 Oregon Counties Map



9407-3 Oregon Air Quality Contact Information

Sources of Information about Air Pollution in Oregon State	
1.	**Oregon Department of Environmental Quality-Air Quality Division** 811 SW Sixth Avenue, Portland, OR 97204 503-229-5359, FAX 503-229-5676 Contact: Brian Finneran, Senior Non-Point Source Specialist, 503-229-6278 http://www.oregon.gov/DEQ/AQ/Pages/index.aspx
2.	**Oregon Department of Environmental Quality Northwest Region Air Quality** Clatsop, Columbia, Multnomah, Washington, Tillamook and Clackamas Counties 2020 SW Fourth Avenue # 400, Portland, OR 97201-4987 503-229-5263, FAX 503-229-6945, TTY 503-229-5471 Contact: David Monro, Air Quality Manager, 503-229-5160
3.	**Oregon Department of Environmental Quality, Western Region-Salem** Yamhill, Polk, Marion, Linn, Benton and Lincoln Counties 750 Front Street NW, Suite 120, Salem OR 97301 503-378-8240, FAX 503-378-4196, TYY503-378-3684 Contact: Claudia Davis, Air Quality Manager WR-North, 503-379-5078
4.	**Oregon Department of Environmental Quality Western Region-Medford** Douglas, Coos, Curry, Josephine and Jackson counties 221 Stewart Ave, Suite 201, Medford, OR 97501 541-776-6010, FAX 541-776-6262, TTY 541-776-6105 Contact: Byron Peterson, Air Quality Inspector, WR-South 541-776-6052
5.	**Oregon Department of Environmental Quality Eastern Region** Hood River, Wasco, Sherman, Gilliam, Jefferson, Wheeler, Crook, Deschutes, Klamath, Lake, Morrow, Umatilla, Union, Wallowa, Grant, Baker, Harney and Malheur counties 475 NE Bellevue, Suite 110, Bend, OR 97701 541-388-6146, FAX 541-388-8283 Contact: Mark Bailey, Air Quality Manager, 541-633-2006
6.	**Lane Regional Air Protection Agency** Lane County 1010 Main Street, Springfield, OR 97477 541-736-1056, FAX 541-726-1205 Contact: Sally Markos, Public Information and Education/Outreach 541-736-1056 X217 http://lrapa.org/

Figure 9407-5Idaho Air Authority Contact Information



9407.3.4 Burn Control

Burning will be conducted in a way that allows for effective control of the burn, to the maximum extent feasible, including the ability to rapidly stop the burn if necessary. Contained and controlled burning is recognized as the preferred method of burning using fire-resistant boom.

9407.3.5 Ignition Control

All practical efforts will be made to control and contain the burn and prevent accidental ignition of the source. Generally, it is not recommended that the source or adjacent uncontained slicks be allowed to ignite during *in-situ* burning operations. Certain circumstances, however, may warrant consideration of carefully planned source ignition.

9407.3.6 Documentation during a Burn

Detailed information about the burn must be recorded, including duration, residue type and volume, water depth before/after the burn, visible impacts, post-burn activities (e.g., residue removal methods), etc.

Air monitoring/sampling data will be collected by the UC–led monitoring teams using the RRT 10–Modified SMART Protocol, during *in situ* burning operations. These data will be shared with the state, local, and/or tribal air agencies responsible for the areas with regulatory monitors/samplers potentially impacted by smoke plumes resulting from *in situ* burning operations. Incident data may be utilized by the impacted air agencies in implementing requirements for the treatment of air quality monitoring data influenced by exceptional events as governed by the "Treatment of Data Influenced by Exceptional Events" rule (72 Federal Register 13560, March 22, 2007) including any amendments thereto.

9407.3.7 Burn Residue

All burns must incorporate monitoring procedures currently being supported by the NSF and EPA EMP that will include visual monitoring at the burn site to record the disposition of burn residues. Provisions must be made for collection of burn residue following the burn(s).

Results from larger-scale laboratory and meso-scale field tests suggest that the most important factors determining whether an *in-situ* burn residue will float or sink are:

Water Density

Burn residues that are denser than the receiving waters are likely to sink. The density of fresh water is 0.997 grams per cubic centimeters (g/cm^3) at 25 degrees Celsius, and the density of seawater is 1.025 g/cm^3.

Properties of the Starting Oil

Studies predict that burn residues will sink in sea water when the burned oils have a) an initial greater density than about 0.0865 g/cm^3 (or American Petroleum Institute gravity less than about 32) or b) a weight percent distillation residue (at >1000 degrees Fahrenheit) greater than 18.6%. When these correlations are applied to 137 crude oils, 38% are predicted to sink in seawater, 20% may sink, and 42% will float.

Thickness of the Oil Slick

Residues from burns of thick crude oil slicks are more likely to sink than residues from burns of thin slicks of the same crude oils, because higher-molecular weight compounds concentrate in the residue as the burn progresses.

Efficiency of the Burn

Factors affecting burn efficiency include original slick thickness, degree of emulsification and weathering, areal coverage of the flame, wind speed, and wave choppiness. For efficient burns, removal efficiencies are expected to exceed 90% of the collected and ignited oil. Rules of thumb for predicting residue thickness are:

- Un-emulsified crude oil up to 10–20 millimeters (mm) thick, residue will be about 1 mm thick.
- Thicker slicks result in thicker residues (up to 3–6 mm thick).
- Emulsified oils can produce much thicker residues.
- Light/medium refined products, the residue will be about 1 mm thick, regardless of slick thickness.

Burn residues sink only after cooling. Models of cooling rates predict that ambient water temperature will be reached in less than 5 minutes for 3-mm-thick residues, and in 20 to 30 minutes for 7-mm-thick residues.

9407.4 Operational Tools

Operational guidance is provided as follows:

Tools	Purpose	Who is Responsible
Tool 1: In-Situ Burning Preliminary Operational Feasibility Worksheet (9407.1)	The purpose of the checklist is to determine if field conditions may allow burning. If this worksheet indicates in-situ burning will not work, no further consideration of in-situ burning is warranted unless conditions change.	FOSC/UC or designee (EUL or PSC)
Tools 2 & 3: Pre-Authorization Zone and Case-by-Case Zones Additional Considerations Worksheets	If Tool 1 indicates in-situ burning may be feasible, Tool 2 or Tool 3 should be used. The purpose of these tools is to document incident-specific information on whether burning is appropriate for use, tradeoffs in their use, recommended best practices or constraints, and to document concerns of trustee agencies who participated in the decision making process.	EUL with support from Safety, Joint Information Center (JIC), and Operations
Tools 4: Environmental Unit (EU) Recommendation Memorandum to the FOSC/UC	This memorandum provides the FOSC and UC with a formal recommendation to burn/not burn from the EUL. It is based on input from Tool 2 or Tool 3, and is signed by the trustees who were involved in the recommendation.	EU
Tool 5: RRT 10 Record of In-Situ Burn Decision	The purpose of this tool is to provide a formal record of the decision RRT 10 makes regarding authorizing the use on in-situ burning in case by case authorization areas.	PSC

Tools	Purpose	Who is Responsible
Tool 6: In-Situ Burning Operation Considerations and Plan	This is written by the Operations Section and must incorporate the constraints from the EU memorandum, approved and delivered through the planning cycle and Incident Action Plan production. Oil Spill Removal Organizations typically have their own. Offshore In-Situ Burning Guidelines are provided for reference after the Tools.	Operations Section
Tool 7: Tribal and other Trustee Technical Coordination Master List	The purpose of this tool is to gather a comprehensive list of all the Tribal agency resource trustee and other key representatives who should be coordinated with and engaged on a technical level for input into the overall tradeoff discussion which is part of the EU Recommendation process.	EU/Liaison Officer

Tool 1: In Situ Burning Preliminary Operational Feasibility Worksheet

This worksheet is intended to be filled out by the FOSC or delegate (typically the EUL) to initially assess the operational feasibility of conducting in-situ burn operations based on the spill scenario.

Proposed burn area: see map of Northwest Area Contingency Plan (NWACP) In-Situ Burn policy

	Y/N
Is the proposed burn location within an area defined in the NWACP as an in-situ burn "pre-authorization" area?	
Is the proposed burn location within an area defined in the NWACP as an in-situ burn "case-by-case" area?	
What is the estimated spilled volume? _____________ (bbls)	
Comments: ____________________	
Oil Conditions	
What type of oil was spilled? ____________________	
Is the spilled oil type considered to be a burnable product?	
Is the oil relatively fresh (i.e. not emulsified)?	
Comments: ____________________	
Environmental Conditions	
Are the projected wind conditions expected to be low enough to enable burn operations (recommend winds < 20 knots)	
Are wave conditions conducive to burn operations? (Recommended less than 2–3 ft. short period waves)	
Are current conditions conducive to burn operations? (Recommended <.75 knots)	
Are precipitation conditions anticipated to be suitable for burning? (Note heavy rainfall could affect ignition or burn efficiency)	
Is visibility sufficient to see oil and vessels towing boom, and suitable for aerial overflight for burn observation? (Recommend ceiling >500' + visibility >1/2 mile)	
Comments: ____________________	
Availability of Personnel and Equipment	
Are fire booms, tow boats, and igniters available to conduct the burn?	

	Y/N
Are adequate aerial assets available to direct/assess the burn operations and to make observations of wildlife in the area?	
Is equipment available to use accelerants or herders?	
(Note* *the igniter is not considered an accelerant)*	
Comments: (consider attaching an equipment list with estimated arrival times; a Safety Data Sheet for the accelerant and/or herder; details about the application rates and application devices for accelerants and herders if applicable) ____ ____ ____ ____ ______________________	
Is in-situ burning considered to be operationally feasible?	
Do the considerations warrant further analysis of in-situ burning?	

Position/Name: Date/Time:

Tool 2: Preauthorization Zone Additional Considerations Worksheet

Note: to be filled out by the EUL with support from others in the EU, Safety, JIC and Operations for burns planned to be conducted within the Pre-authorization area.

	Y/N
Overall Summary of Proposed Burn	
Provide maps showing the location of the spill source, location of proposed burn(s), location of nearest population centers, boundary of population centers, locations of simultaneous response operations, plume forecast with 45 degree safety margin.	
Potential quantity of spilled oil: ____________________	
Number of burn task forces to be deployed: ________	
Likely amount of oil that may be burned today: tomorrow: (Assuming each burn task force burns approximately ___ - ___ gallons/day per burn)	
Reason(s) In-Situ Burn is being considered:	
Remove oil to prevent spread to sensitive sites or over large area	
Reduce the generation of oily wastes, especially where transportation or disposal options are limited.	
Access to the site is limited by shallow water, soft substrates, thick vegetation, or the remoteness of the location	
Other (specify):	
Proximity Conditions	
Can burn operation be conducted without interference with other response activities (dispersants, source control etc.)?	
Can burn operation be conducted concurrently with mechanical recovery?	
Comments: (consider attaching a map of the proposed burned location, indicating nearest population centers) ____ ____ ____ ____ ______________________________________	
Safety Considerations (to be filled out by Safety Officer)	
Can ignition and burn be conducted in a way to prevent unintentional ignition of the spill source and at a safe distance from and response vessels?	
Is there a site safety plan for the incident that specifically addresses the proposed burning operations?	
Will response personnel be briefed on this plan before burning starts?	
Are personnel trained and equipped with safety gear appropriate to burn operations?	
Is a communication system available and working that allows communication between aircraft, vessels, and a control base?	
Can the fire be extinguished and are the procedures in place for addressing this contingency?	

	Y/N
Will oil collection at night be considered (for daylight in-situ burning operations)?	
Comments: (consider attaching Site Safety and Communication plans if available, describe if not available) ____ ____ ____ ____ ____	
Timing- External Stakeholder Outreach	
Can appropriate notices to mariners, aircraft, and key stakeholders be issued within the proposed time?	
Are the above conditions expected to remain in effect for the next 24 hours?	
Are the above conditions expected to remain in effect for the next 48 hours?	
Comments: (consider attaching a list of stakeholders that have been notified about the potential use of in-situ burning in response to the spill and press releases or fact sheets that will be used to communicate about the use of in-situ burning) ____ ____ ____ ____ ____	
Spill Impact Mitigation Assessment (SIMA)/Net Environmental Benefit Analysis (NEBA)	
Has a resource at risk analysis for the proposed burn area been completed?	
Are there sensitive species and habitats in the area that require specific considerations related to burn operations?	
Can appropriate natural resource/environmental monitoring personnel/equipment be mobilized and on-site within the proposed time?	
Have mechanical recovery efforts been deemed insufficient to adequately protect sensitive shorelines and other natural resources?	
Is it expected that burn operations will reduce impacts to sensitive shorelines and other resources, without further endangering human health or wildlife in the area?	
Has an Endangered Species Act Consultation been initiated?	
Will an on-site survey be conducted by a natural resource specialist to identify sensitive bird concentrations or marine mammals in the proposed area before the burn operation commences and monitoring continue during burn operations (aerial overflight)?	
Is there a plan to recover the burn residue?	
Is the use of herders and/or accelerants being proposed?	
Have you considered the trade-offs/impacts of herders or accelerants?	
If yes to above, is the proposed herder listed on the EPA Schedule J Products list?	

	Y/N
Comments: (consider attaching the most current ICS Form 232 developed for the incident, the Endangered Species Act Consultation Form, the Safety Data Sheet from the spilled product, and any details provided about mitigating factors being considered for sensitive species) ____ ____ ____ ____ _______________________________________	
Monitoring Plan?	
Will a community air monitoring plan be developed and implemented prior to burn operations commencing?	
Will a SMART monitoring plan be developed and implemented prior to burn operations commencing to evaluate the effectiveness?	
Will air sampling be conducted in *In-Situ* Burning area?	
Comments: (consider attaching your Community Air Monitoring Plan, Sampling Plan, and details of your SMART monitoring application) ____ ____ ____ ____ _______________________________________	

Tool 3: Case by Case Zone Additional Considerations Worksheet

Note: to be filled out by the EUL with support from others in the EU, Safety, Joint Information Office and Operations for burns planned to be conducted in case-by-case areas.

	Y/N
Overall Summary of Proposed Burn	
Provide maps showing the location of the spill source, location of proposed burn(s), location of nearest population centers, boundary of population centers, locations of simultaneous response operations, plume forecast with 45 degree safety margin.	
Potential quantity of spilled oil: ____________________	
Number of burn task forces to be deployed: _______	
Likely amount of oil that may be burned today: tomorrow: (Assuming each burn task force burns approximately ___ - ___ gallons/day per burn)	
Reason(s) *In-Situ* Burning is being considered:	
Remove oil to prevent spread to sensitive sites or over large area	
Reduce the generation of oily wastes, especially where transportation or disposal options are limited.	
Access to the site is limited by shallow water, soft substrates, thick vegetation, or the remoteness of the location	
Other (specify):	
Proximity Conditions	
Can burn operation be conducted concurrently with other response operations?	
Do you have knowledge of at risk populations within three miles of the proposed burn area? Describe? ____ ____ _________________________________	
Are evacuations necessary?	
Comments (consider attaching a map of the proposed burned location, indicating nearest population centers): ____ ____ ____ ____	
Safety Considerations (to be filled out by Safety Officer)	
Can ignition and burn be conducted in a way to prevent unintentional ignition of the spill source and at a safe distance from and response vessels?	
Has the burn been isolated (e.g. by fire breaks?) Can it be?	
Is there a site safety plan for the incident that specifically addresses the proposed burning operations?	

	Y/N
Will response personnel be briefed on this plan before burning starts?	
Are personnel trained and equipped with safety gear appropriate to burn operations?	
Is a communication system available and working that allows communication between aircraft, vessels, and a control base?	
Can the fire be extinguished and are the procedures in place for addressing this contingency?	
Will oil collection at night be considered (for daylight *In-Situ* Burning operations)?	
Comments (consider attaching Site Safety and Communication plans if available, describe if not available): ____ ____ ____ ____ _______________________________________	
Timing	
Can appropriate notices to mariners, aircraft, regional air authorities, tribes and other key stakeholders be issued within the proposed time?	
Are the above conditions expected to remain in effect for the next 24 hours?	
Are the above conditions expected to remain in effect for the next 48 hours?	
Comments (consider attaching a list of stakeholders that have been notified about the potential use of *In-Situ* Burning in response to the spill and press releases or fact sheets that will be used to communicate about the use of *In-Situ* Burning): ____ ____ ____ ____	
Spill Impact Mitigation Assessment (SIMA)/Net Environmental Benefit Analysis (NEBA)	
Has a resource at risk analysis for the proposed burn area been completed?	
Are there sensitive species and habitats in the area that require specific considerations related to burn operations?	
Have mechanical recovery efforts been deemed insufficient to adequately protect sensitive shorelines and other natural resources?	
Is it expected that burn operations will reduce impacts to sensitive shorelines and other resources, without further endangering human health or wildlife in the area?	
Has an Endangered Species Act Consultation been initiated?	
Will an on-site survey be conducted by a natural resource specialist to identify sensitive bird concentrations or marine mammals in the proposed area before the burn operation commences?	
Will on-site monitoring be conducted by a natural resource specialist during burn operations?	
Is there a plan to recover the burn residue?	

	Y/N
Have you considered the trade-offs/impacts of herders or accelerants?	
Are accelerants or herders being recommended? If so, which product?	
Is the proposed accelerant or herder listed on the EPA Schedule J?	
Comments (consider attaching the most current ICS Form 232 developed for the incident, the ESA Consultation Form, the Safety Data Sheet(s) from the spilled product, and any details provided about mitigating factors being considered for sensitive species):	
Monitoring Plan	
Will a community air monitoring plan be developed and implemented prior to burn operations commencing?	
Will a SMART monitoring plan be developed and implemented prior to burn operations commencing to evaluate the effectiveness?	
Will air sampling be conducted in *In-Situ* Burning area?	
Comments (consider attaching your Community Air Monitoring Plan, Sampling Plan, and details of your SMART monitoring application):	
Additional Required Coordination with Response Partners and Stakeholders for *In-Situ* Burning Operations in Case-by-Case areas	
Have local fire and police been notified?	
Please list all trustees who will be consulted. (See Tool 7)	
Have you consulted regional air authorities and health departments?	
Is there any concerns or identified or additional considerations for at risk populations?	
Will regional air authorities be provided with real time monitoring data?	
What is the communication plan for sharing readings above permissible exposure limits?	
Comments (list the trustees, health departments and air authorities that were consulted and any relevant feedback):	

Tool 4: Environmental Unit Recommendation Memo

This memo has been developed by the EU in accordance with National Contingency Plan and NWACP in-situ burn use policy, in coordination with other Incident Management Team members and key members. The memorandum provides the FOSC and UC with a recommendation on appropriate action regarding in-situ burn operations for this incident.

The EUL **Does/Does Not** recommend authorizing the use of in-situ burning at this time. (Differing opinions are captured on attached memo as applicable).

This document provides summary information that went into the tradeoff discussions and other input that lead to the EU's recommendation on the use/no use of in-situ burning for this incident.

As appropriate, this document may also include recommendations on whether to start with a trial use before deciding on a thorough application.

Summary of the trade-offs- discussion Describe the trade-off discussion, who participated and different perspectives brought to the conversation.
Tribal Coordination Input Describe which tribes and specifically which members of each tribe (and their title) were coordinated with on a technical level during the development of the Decision Support Tools. Describe specific concerns and requested/recommended actions to take to ensure tribal concerns are appropriately addressed. (Continue on additional sheets as needed).
Signature Page for Technical Specialists and Other Contributors *The following is a list of technical specialists and other members that contributed to the EU recommendation. In order that all views can be considered by the UC / RRT, each technical specialist may provide a statement in support of his or her opinion to be included in the recommendation package.*

Name and Agency/Organization (Print)	**Signature**	**Recommendation**

This memo was developed and reviewed by:		
ICS ROLE	**Signature**	**Name (PRINT)**
Environmental Unit Leader		
Planning Section Chief		
Operations Section Chief		
Safety Officer		
Information Officer		
Liaison Officer		
Attach relevant checklists and supporting tools and ICS forms		

Tool 5: RRT10 Record of In-Situ Burn Decision

Incident Name and Location:
Date and time of RRT 10 consultation:

It is RRT 10 policy that any in-situ burn use within a Case-by-Case Approval Zone requires concurrence from the EPA and state representatives to the RRT 10 with jurisdiction over the area threatened by the release or discharge.

For purposes of this record of decision, the applicable In-Situ Burn Decision Tools have been developed and area (attached), the UC formally recommends the use/recommends against the use of in-situ burning and requests an in-situ burn use decision from the appropriate members of RRT 10.

RRT 10 was convened on this date with these agencies in attendance:

- *List all agencies and state whether decision makers or monitoring role.*

The following decision(s) was made (Note: the RRT 10 should add any pertinent rationale for the decision) (circle one):

RRT 10 does not concur with the use of in-situ burning for this incident.

RRT 10 concurs with the use of in-situ burning as outlined in the attached plan.

RRT 10 concurs with the use of in-situ burning with the following modifications to the in-situ burning plan:

Signatures will be obtained once the decision is made. This document will be retained to record the decision.		
	Signature	**Name and Title (PRINT)**
EPA Co-Chair (Concurrence)		
State Representative to the RRT (concurrence)		
Department of the Interior (Consultation)		
Department of Commerce (Consultation)		

Tool 6: In Situ Burning Operation Considerations and Plan

OFFSHORE *IN-SITU* BURN GUIDELINES
Introduction
This document is provided as a general guide for the planning and implementation of controlled in-situ burns under offshore/nearshore open-water conditions. Recommended tactics and procedures do not include inland/onshore burns, nor do they address the unique challenges and opportunities of burning under extreme cold conditions, including the presence of ice. It should be recognized that any burn operation will depend upon a number of location- and spill-specific conditions. These include:

- Federal, State and Local Authorization to conduct the burn(s),
- A comprehensive Health, Safety and Environment Plan,
- An Incident-Specific I Operations Plan that includes unique circumstances of the spill, specific guidance and constraints from regulators, and procedures on how, where and when burning can be conducted without interference of other important activities (e.g., source control, rescue operations, salvage, and other spill removal/elimination efforts).
- The Operational Plan must contain a chronological checklist of specific tactics and procedures to be used before, during and after ignition, as well as details on vessel/aircraft deployment, fire boom and igniter resources, weather forecasting, monitoring procedures, etc.

The following information is provided as a summary of key In-Situ Burning activities and guidelines for controlled burning – it is intended as reference document from which material may be cited or excerpted for the development of a Site-Specific In-Situ Burning Operations Plan. This document was prepared by Alan A. Allen, under contract to Shell Oil, in preparation for the Worst Case Discharge Puget Sound Refinery Exercise to be conducted by Shell Oil and its contractors during the last week of September, 2016.

1. General In-Situ Burning Guidelines
The topics addressed in this section deal with activities that normally take place during the planning and execution of controlled in-situ burns on open water. They include:
1.1 Response Organization and Personnel Responsibilities
1.2 Surveillance and Spotting
1.3 Oil Access and Containment
1.4 Oil Ignition
1.5 Fire Control and Emergency Response
1.6 Residue Recovery
1.7 Monitoring and Documentation

Issues involving the health and safety of response personnel and the general public, the monitoring and protection of wildlife, and potential environmental impacts, are not addressed in this operational guide.

1.1 Response Organization and Personnel Responsibilities
Should In-Situ Burning operations be approved, all personnel, vessels, aircraft and equipment to be deployed must be organized and closely coordinated with other tactical

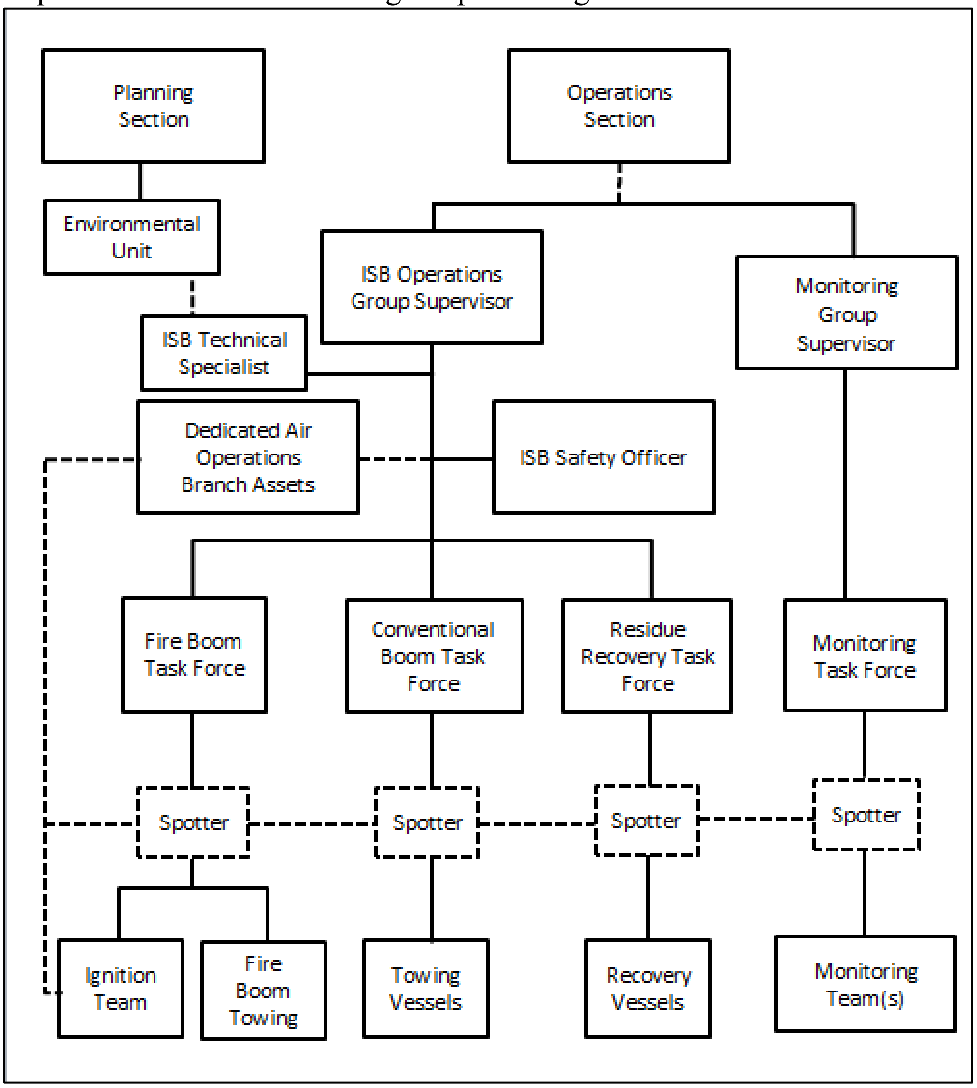
operations. All activity should be conducted in accordance with procedures established during pre-burn briefings, operational plans (e.g., ICS-215), assignment lists (e.g., ICS-204 and ICS-234), communications plans (e.g., ICS-205), and In-Situ Burning plans addressing health, safety and the environment. Resources needed to conduct In-Situ Burning operations should be arranged for through the Resource Unit and mobilized as soon as possible. Since an actual "burn" does not take place until spilled oil is "ignited", every effort should be made to move equipment toward a proposed burn area as soon as possible and begin collecting oil for a potential burn. The direction to commence ignition (normally by the In-Situ Burning Operations Group Supervisor) is given when all safety concerns have been fully addressed and cleared by the In-Situ Burning Safety Officer, the readiness of surface and air support teams has been confirmed, and authorization to burn has been granted.

Prior to ignition of the contained oil and throughout a burn, the In-Situ Burning Operations Group Supervisor ensures that the onsite In-Situ Burning Safety Officer is fully apprised of the status/control of the proposed burn; that the location of the burn and its smoke plume are acceptable and within plan guidelines; that spotting and monitoring teams are in place; and that burn residue recovery teams are ready to move in when safe to do so. Descriptions of specific tasks for these teams are addressed in this section, along with guidelines for other activities such as the possible use of conventional open-apex boom configurations. Working upstream of a fire boom, towed in a U-configuration, such open-apex systems can be used to intercept a wide swath of oil patches, concentrate the oil, and feed it to a fire boom immediately downstream.

A representative response organization chart for In-Situ Burning operations is provided below for a single fire boom task force with possible conventional boom support, spotting teams, and personnel for safety and monitoring of the burn. ICS organizational structures should remain flexible and adaptable to accommodate various types, sizes and locations of spills, while striving to accomplish the objectives of the UC. An organizational chart, similar to the one presented here, should be structured for the spill underway and the number and type of personnel and resources available. Regardless of the size and makeup of the organization, it is imperative that there be constant and reliable radio and telephone communications between organizational and tactical resources. An Incident Communications Plan should be developed including specific communications equipment, frequencies, procedures and protocols. The plan should be prepared on a standard ICS Form 205, so that response activities and objectives can be passed between various groups while allowing for updates to reflect changing incident conditions. There must be guidelines for the accurate and timely exchange of information between each of the In-Situ Burning operational teams on the surface, air operations for spotting and monitoring, safety personnel, etc. It is also critical that all appropriate notifications to mariners, airports, stakeholders and the general public be maintained, and that UC be kept apprised of the status of burn activity.

Experience has shown that one of the most important communication links at an operational level is that involving aerial spotters and the fire boom towing vessels. While such radio links are coordinated with each In-Situ Burning Task Force Leader and the In-Situ Burning Safety Officer, it is the frequent direct guidance given to the boom-tending vessel captains that is essential for directing them to, and keeping them in, the heaviest oil concentrations. More specific information and guidelines for the role of spotters is addressed in the following Section 3.1.2 on Surveillance and Spotting.

Representative In-Situ Burning Response Organizational Chart



While the Operations Section has the lead in controlling In-Situ Burning tactics implementation and related field operations, the analysis of burning feasibility and recommendation to burn is prepared by the Environmental Unit Leader, the NOAA SSC, In-Situ Burning Technology Specialist(s) and other subject matter experts. The NWACP includes detailed policy and process tools to guide In-Situ Burning use decisions. Typical position titles and responsibilities for key In-Situ Burning functional positions are provided below. Depending upon the size of the spill, actual tactics to be employed, and personnel available, one individual may actually be assigned multiple roles.

<u>In-Situ Burning Operations Group Supervisor:</u>

- Reports to Operations Section Chief
- Responsible for all In-Situ Burning operations

- Provides input to the In-Situ Burning and Monitoring Plans
- Implements and coordinates approved In-Situ Burning and Monitoring Plans
- Manages dedicated In-Situ Burning resources & Air Operations Branch assets while coordinating these activities with other response operations
- Briefs In-Situ Burning Safety Officer and Task Force Leaders on In-Situ Burning and Monitoring Plans
- Establishes Safe Burn Area and emergency/evacuation procedures
- Coordinates oil collection & burn volume monitoring and estimation results
- Monitors communications between Spotters and Ignition/Fire Boom vessels
- Manages and communicates frequently with all In-Situ Burning Task Force Leaders

In-Situ Burning Safety Officer

- Reports to In-Situ Burning Operations Group Supervisor
- Ensures worker health and safety during all In-Situ Burning operations
- Implements Site Safety and Health Plans, working from Command or Dedicated Fire Safety Vessel
- Conducts pre-burn safety briefings on all operational goals and procedures
- Monitors changing conditions and identifies potential emergencies
- Provides emergency communication protocols and emergency burn-termination criteria
- Assigns and monitors activities of Deputy Safety Officers onboard individual Task Force vessels as needed
- Liaison with other Site Safety personnel from other organizations
- Reports, as needed, to the FOSC via the In-Situ Burning Operations Group Supervisor

Fire Boom Task Force Leader

- Reports to In-Situ Burning Operations Group Supervisor
- Oversees tactical burn operations for safety of personnel and efficiency of operations
- Works closely with the In-Situ Burning Safety Officer to ensure efficient communications with and between the boom-towing vessels, aerial spotters and the ignition teams.
- Coordinates timing and approval to initiate each burn, and terminate if necessary
- Works with Conventional Boom Task Force Leader and Residue Recovery Task Force Leader as needed to enhance oil encounter rate and maximize efficiency of operations
- Provides backup support to Monitoring Task Force Leader for help with monitoring and documentation (duration and area of burns), presence and avoidance of wildlife, smoke plume trajectories, etc.

Fire Boom Towing Team

- Reports to Fire Boom Task Force Leader with status of oil collection ignition readiness
- Lead Vessel (selected one of two boom-towing vessels) communicates directly with spotter and Fire Boom Task Force Leader to enhance oil encounter rate,

establish when collection area is satisfactory for burn, and when ignition should take place
- Works closely with Fire Boom Task Force Leader, Spotter and Ignition Team for the safe and efficient ignition of any contained oil
- Keeps watch for any signs of large debris or wildlife that could approach or enter the towed U-boom configuration
- Maintains a continuous watch of each burn for size and condition of fire and smoke plume, direction of plume relative to towing vessels and other activities/resources in the area, structural integrity of the fire boom, and start/completion time of each burn

Ignition Team
- Reports to Fire Boom Task Force Leader for guidance on timing and preferred location for start of ignition process. Ignition personnel may be on one of the boom towing vessels, or on a dedicated igniter boat.
- Maintains a ready supply of hand-held igniters onboard and takes position upwind or side-wind to the oil collection area
- Upon direction to ignite the oil, carries out the release of one or more igniters (as per the In-Situ Burning Burn Plan), then moving to a safe location to help monitor the condition of the burn and fire boom
- If requested, assists aerial surveillance/spotting teams in locating heavy oil patches in the area for possible additional burns

Conventional Boom Task Force Leader
- Reports to In-Situ Burning Operations Group Supervisor
- Briefs Conventional Talk Force personnel on the goals, tactics and timing of the mission
- As needed, coordinates the towing of an open-apex U-boom configuration forward of a towed fire boom configuration in order to concentrate and funnel oil for enhanced encounter rate and filling of the fire boom
- As needed, provides backup support to the Residue Recovery Task Force for the possible recovery and storage of burn residue
- As needed, may also provide backup for boom/igniter supply, maintenance and repair

Residue Recovery Task Force Leader
- Reports to In-Situ Burning Operations Group Supervisor
- Manages viscous oil (i.e., burn residue) recovery and storage operations following the completion of each burn
- Briefs assigned Task Force recovery personnel on the safe and effective modes for recovery of such residue
- Documents the nature and approximate volume of residue collected, and takes samples for subsequent laboratory analysis

Monitoring Group Supervisor
- May report directly to the Operations Section Chief, or depending upon the size and nature of the spill event, may report to or coordinate with other Section

Chiefs or Group Supervisors for oil recovery, dispersant application, wildlife monitoring, shoreline protection/cleanup, etc.

- Oversees and coordinates all Monitoring Team activities, the collection of field data/photos/video/samples, and helps with the processing of such information for the interpretation and use of the In-Situ Burning Technical Specialist.
- Ensures that all data, photos etc. are collected, preserved, processed with appropriate chain-of-command documentation, and stored for possible analysis/litigation later on

In-Situ Burning Technical Specialist (or Subject Matter Expert, SME)

- Provides scientific and technical support for In-Situ Burning operations (and other response options as needed)
- Provides input, as needed, to the UC regarding strategies, tactics, equipment, personnel, trade-offs, etc. for In-Situ Burning and/or other response options
- Offers input to the Planning and Operations Sections, as well as the supervisors and leaders of other functional groups as needed.
- Provides help, as needed, with any documentation of the process and/or results of all response, monitoring and sampling efforts

1.2 Surveillance and Spotting

The provision of trained aerial observers and suitable aircraft for surveillance and spotting is essential for the successful execution of any oil spill response plan. The timely use of such observers can provide:

- ✓ Early estimates of the location and extent of oil over a large area.
- ✓ Information on the nature and distribution of oil within that area.
- ✓ Latitude and longitude of the heaviest oil concentrations for response teams (skimming, burning & applying dispersants) to focus their efforts.
- ✓ Ongoing guidance (“spotting”) to keep such response teams in the thickest oil concentrations thereby maximizing oil encounter rate.
- ✓ Monitoring of system configuration and performance.
- ✓ Estimates of oil volume encountered, recovered, and burned.
- ✓ Input for Operational Supervisors and Task Force Leaders conducting simultaneous operations where skimming, burning and/or dispersant operations must not interfere with each other.
- ✓ Monitoring of smoke plumes, dispersant application zones, vessel traffic, wildlife, and oil sampling activity.
- ✓ Documentation (photos, video, voice recordings and sketches) of activity, location and timing of resource arrival & departure, oil slick changes and transport, etc.

These and other benefits can result from the careful planning and use of dedicated air support teams and aircraft. Unmanned Aerial Vehicles, UAVs, (fixed or rotary wing) and Aerostats (tethered balloons) with cameras, video and a variety of remote sensing systems can also provide opportunities to achieve some of the above benefits. UAVs may also provide operational support for the release of chemical herders (i.e., to thicken oil slicks for recovery or burning), and for the release of igniters onto contained oil.

One of the most important benefits of "eyes in the sky" involves the enhanced access and collection of oil slicks for controlled burning in place. Depending on the transit time from staging (airstrip, refueling, etc.) to the offshore burn area, the number of observers, aircraft, and pilots will have to be anticipated for relief, refueling, documentation transfer, etc.

Onsite guidance of boom towing vessels requires that radio communications (frequencies, call-signs, language, terminology, etc.) be established for all air and surface crews; that protocols be in place for brief and clear communications; and that individual vessels be marked for quick and easy identification. A common practice is to place large numbers or colored sheets on flat surfaces of the wheel house roof, the deck, or stretched between poles for both ease of identification from the air and possible shading of personnel from direct sunlight. Another method for vessel identification and tracking of specific vessel movements involves a well-known, global service known as AIS (Automatic Identification System). AIS provides a means of locating and tracking each vessel that has a transmitting beacon. While terrestrial-based AIS systems are available, satellite AIS systems are provided by many companies, and can be set up quickly to help responders in the air, on vessels or back at Command to accurately identify and track the movements of every vessel on location.

With clear and concise directions from aerial spotters, In-Situ Burning vessels can be alerted to other vessels/operations nearby, warn of slick conditions ahead, monitor smoke emissions, and provide important feedback for towing speed, course corrections, and preparations for reaction to fire boom failure, vessel loss of power, and any need to extinguish a burn. All of these activities depend upon pre-planning, training, reliable communications, and well organized Site Safety Plans for the start of each Operational Period. The following sections provide additional information on tasks and procedures for the safe and effective containment, ignition, and sustained combustion of oil.

1.3 Oil Access and Containment

The number and type of vessels making up a given Fire Boom Task Force may vary considerably depending upon the size and nature of the oil slicks to be accessed and burned. During a large spill event where multiple fire boom configurations may be needed, the burn plan may involve a Command Vessel, a Fire-Control/Safety Vessel, one or more Ignition Boats, and a Fire Boom Towing Team consisting of two boom-tending boats and a fire-resistant boom in a U-configuration (Figure 9407-6).

Figure 9407-6: Boats pulling fire boom in a U-configuration (DWH Spill – 2010)

As the need increases for additional Fire Boom Towing Teams the Task Force may grow to include 4 or 5 Burn Teams, each under the direction of the Command Vessel, and with support from the Fire-Control/Safety Vessel. Should the burning operations go on for several days or longer, it may be necessary to mobilize an additional vessel or barge for food and lodging of backup crews, maintenance and supply of booms and igniters, refueling of vessels, etc. All vessels should provide adequate accommodations to support In-Situ Burning operations for at least a week. In the meantime, backup vessels, personnel and supplies should be secured and readied for mobilization as needed.

Should the burn plan involve only a single test burn or a small number of burns for the Operational Period, it may be acceptable to combine the Command and Fire-Control/Safety functions on a single vessel. The number and type of vessels may also depend upon the type of spill source and the proximity of the burn operations to that source. A spill source may produce a continuous release of oil for several days to even months (e.g., an offshore blowout), or it may involve a "batch" release of short duration (e.g., a pipeline or tanker accident). The positioning of all vessels, especially In-Situ Burning Burn Teams, for a continuous release will depend upon the flammability of the product released, and whether the spill source is already burning. A task force may need to operate at a considerable distance from an unignited source in order to prevent a flash-back of vapors to the source, or an accidental burn-back of thick oil to the source. If the source is already ignited and allowed to continue to burn, and if personnel have been evacuated, it may be safe and effective to capture oil that escapes from the burning source relatively close and downstream (Figure 9407-7).

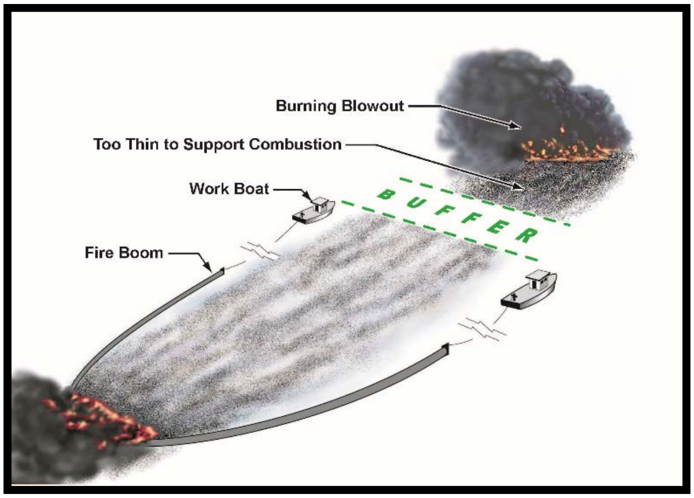


Figure 9407-7: Burning in close proximity to an ignited source

Depending on the size and nature of the burning source and the size and maneuverability of the boom-tending vessels, it may be possible to position the boats well upstream of the source with long tow lines so that oil and unburned residue escaping the fire can be collected immediately downstream and burned.

Whether the source is a batch release or a continuous spill, conditions may require that all burns be conducted well downstream of the source where slicks will then have spread, become emulsified and/or thinned down to layers that will not support combustion. With most fire boom configurations involving boom lengths of around 500 to 600 feet in length, working with swaths (distance between the towing vessels) of typically 150 feet, and towing speeds of a knot or less, the oil encounter rates must be considered as they could preclude the possible interception of enough oil to justify a burn within a reasonable amount of time. A fire-boom U-configuration with a length of 500 feet, towed with a nominal "gap ratio" (i.e., swath-to-length ratio) of 0.3, or a swath of 150 feet, and a towing-speed of ¾ knot through oil approximately 1/10th inch thick (~2 ½ mm), would have an oil encounter rate of about 710 gallons/min.

Example Calculation:
EnR (gallons/min) = 63.13 x Swath (feet) x Speed (knots) x Avg. Oil Thickness (inches)
Where EnR = the Encounter Rate of the moving system
and 63.13 is a conversion factor for "feet" x "knots" x "inches"
Therefore,
EnR (gallons/min) = 63.13 x 150 (feet) x 0.75 (knot) x 0.1 (inch)
EnR = ~ 710 gallons/min.

A boom in this configuration, with oil in its downstream apex and the upstream edge of the oil about 1/3rd of the way toward the boom's leading ends, could hold approximately 100 barrels (~4,200 gallons) of oil per inch of oil depth. An accumulation of that volume (4,200 gallons) collected at an encounter rate of 710 gallons/min. would require only about 6 minutes. The thickness of 1/10th inch for the encountered slick is, however, a heavy oil layer and is normally encountered relatively close to a major spill event, during the early stage of release, or when thickened by natural forces (wind or currents), coldwater, and/or swath-enhanced deflection systems (e.g., a large open-apex boom configuration). The actual accumulation of 100 barrels would also take longer under normal conditions since the encountered slick would rarely consist of a continuous, uniform layer of oil across the entire system swath.

Under conditions where spilled oil had spread over time to an average thickness of 1/100th inch (ten times thinner than the slick described above), the oil appearance would change from a “Dark” oil condition to a “Transitional” stage where it is discontinuous in color and somewhat translucent (NOAA, 2000). Using the same swath and speed values above, the Oil Encounter Rate for the same U-boom configuration would drop to about 71 gallons/min., and require a collection time of about 60 minutes to fill to 100 barrels. While the ignition of a 100-barrel accumulation is sufficient for a “test” burn, a preferred burn during normal operations would typically involve an accumulation of 500 to 1,000 barrels. The two examples for “thick” and “thin” slicks suggest, therefore, that a range of 500 to 1,000 barrels collected for burning could require 5 to 10 times the collection periods above, that is: ½ hour to 1 hour for the thick oil slick, and 5 hours to 10 hours for the thin slick. Potential oil encounter rates and associated collection times must be considered along with typical ignition and sustained burn times when planning In-Situ Burning operations within an approved time frame.

Assuming that a successful oil encounter, capture and burn can be accomplished within the constraints of an approved In-Situ Burning Plan, the Command, Fire-Control/Safety and Ignition vessels would normally take position up-wind or cross-wind of the fire boom towing vessels as they collect oil. Fire boom towing teams would select a path to take advantage of oil slick size, shape and thickness, thereby maximizing their oil encounter rate. With one of the two boom-tending vessels designated as “lead” boat, its Captain would take directional information from a Spotter aircraft, coordinate such information and configuration changes with the other towing boat, and closely monitor the condition and filling of the fire boom. Should minimal oil encounter rates be experienced, the Fire Boom Task Force Leader might request the support of a towed open-apex boom system to enhance the interception of oil (Figure 9407-8). Multiple towed fire boom configurations could take advantage of the increased oil encounter rate with the open-apex system by moving out of position once full and letting another empty fire boom take its place behind the open apex. As discussed in the next section, very high burn rates for most oils could result in the elimination of 500 to 1,000 barrels of oil within an hour or less often matching the times required for oil collection and transits between the collection area and the offset burn sites (typically around a quarter of a mile).

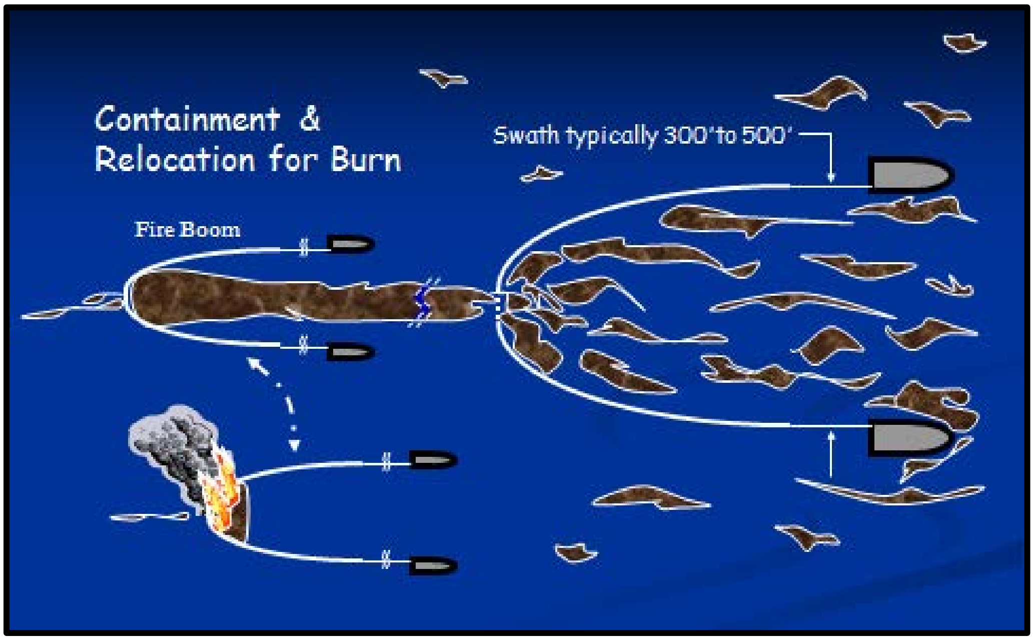


Figure 9407-8: Conventional Open-Apex Boom feeding oil to towed fire booms

1.4 Oil Ignition

When a sufficient amount of oil has been collected within a fire boom, and ignition of the oil has been approved, all vessels except the fire boom towing and ignition vessels should remain clear and upwind of the approved burn area. Vessels and aircraft should make every effort to avoid direct contact with the smoke plume throughout a burn. If such contact cannot be avoided, appropriate respiratory protection equipment should be worn as per the specific Site Health and Safety Plan for the incident.

Pre-ignition: Ignition of the contained oil may involve the use of a helicopter-slung Heli-Torch or the use of hand-held igniters released at the surface. Prior to ignition with either method it is important that the release of the ignition source (i.e., globules of burning gelled fuel from the Heli-Torch or from a hand-held device) be from a location upwind and at a safe distance from the contained oil. If conventional boom has been attached to the leading ends of fire boom to enlarge the U-configuration, care must be taken to avoid any contact of the igniter(s) with the conventional boom. Should the entire boom configuration consist of fire boom, igniters could be released from one of the boom towing boats, or by a dedicated ignition boat at or just forward of a leading end of the fire boom. Every effort must be made to remain safely removed from any premature ignition of vapors from the contained oil by staying upwind. Once the igniters have been released, all vessels should remain at a safe distance of at least 5 fire diameters from the oil containment area (a "fire-diameter" being the approximate diameter of the fire within the contained oil area).

Preparation for ignition should also include a confirmation from the spotter aircraft that the ignition and sustained burn of oil within the boom can be conducted free of any contact with other large concentrations of oil in the area. Especially when fresh, highly-volatile oil is being burned, every precaution must be made to prevent the ignition of oil slicks that could be intercepted forward of the ongoing burn within the boom. Specific "Burn Control" measures are addressed in the following section.

Once an initial test burn has been completed and the volatility (or ease of ignition) of the surface slicks has been determined, the In-Situ Burning Operations Group Supervisor, with input from the Safety Officer, may modify the pre-ignition and sustained burn procedures to improve the safety and efficiency of operations. When the oil being collected is weathered and/or emulsified, the flame propagation on water (especially into the wind) is very slow. In such cases (as during the DWH spill – Figure 9407-9), oil slicks could be approached and collected safely while burning within the boom. This tactic can result in the continuous burning of oil for many hours (Mabile, 2012; Allen, 2010).

Figure 9407-9: Safe and efficient feeding of low-volatility oil to an ongoing burn (DWH, 2010).

Prior to ignition it is essential that a "Go/No Go" policy for ignition be understood by everyone involved at all levels. The In-Situ Burning Safety Officer and any Deputy Safety Officers must have the authority to terminate an ignition or sustained burn operation. Every vessel captain and crew member must also feel compelled to notify immediately the Fire Boom Task Force Leader or onboard Deputy Safety Officer of any condition that presents an unsafe condition or immediate threat to personnel or equipment.

Immediately prior to ignition a designated Communications Officer or the In-Situ Burning Operations Group Supervisor aboard the Command Vessel confirms that:

- Each vessel involved has clear radio contact and is aware of the intention and approximate time for ignition,

- That the FOSC has issued a final approval to the Command Vessel to conduct the burn,
- That the towed fire boom configuration is pointed into, or nearly into, the wind with an oil-free area ahead.

Hand-Held Ignition: Oil-on-water ignition systems have been developed over several decades, the best proving that the heating and ignition of the oil should take place with a gentle (non-explosive) flame. Depending on the volatility of the oil, its water content (emulsion), temperature, and the wind speed, enough heat must be applied to bring the oil to its fire point for sufficient vapors to ignite, spread and sustain combustion. One of the simplest, safest and most economical ways to achieve such ignition is with the use of a marine flare attached to a plastic bottle filled with gelled fuel (typically gasoline and/or diesel). As shown in Figure 9407-10, a typical hand-held igniter can hold about a gallon of the gelled fuel, the gelling compound already included with the bottle. Once activated by striking the flare, the unit can be released and allowed to float back into the contained oil. Shortly after releasing the igniter from a safe distance upwind or cross-wind to the oil, the flare burns back so that its flame reaches and melts the plastic bottle. The gelled fuel then ignites, spreading to a floating patty of several square feet, and drifts into the oil. The gelled fuel patty burns for several minutes, heating the adjacent oil, and normally resulting in a sustained combustion over the entire oil surface. If ignition is unsuccessful, multiple igniters may then be released to create a larger initial flame.

Figure 9407-10: Hand-held Igniter and release upwind of contained oil.

If multiple ignition attempts fail, the contained oil may be so weathered and/or emulsified that combustion is no longer feasible. The In-Situ Burning Operations Group Supervisor may then consult with the Operations Section Chief and In-Situ Burning Safety Officer to consider and possibly seek approval for the use of an ignition promoter (or, accelerant). If approved, a small quantity of flammable liquid (gasoline or diesel oil) released to the leading edge of the contained oil, followed by the release of an igniter upwind and upstream, may then be sufficient to promote ignition of the oil. Should these efforts fail, the contained oil may still be recoverable with skimmers for transfer to backup storage and disposal.

Heli-Torch Ignition: As with the use of hand-held igniters, the ignition of contained oil with a Heli-Torch must first meet with all environmental and operational conditions prescribed by the RRT Unified Command during the In-Situ Burning Approval Process. Each of the guidelines described above for authorization, radio communications, proximity of vessels to the intended burn, etc. must be met for this mode of ignition as well.

The Heli-Torch ignition system, suspended from a helicopter, involves the release of individual globules of burning gelled fuel, typically at a speed of 20 to 40 mph with an altitude of 25 to 50 feet. The helicopter normally makes a pass forward of the fire boom's leading ends, and at right angles to the path of the towed fire boom (Figure 9407-11). The burning globules land on the water, normally across the entire swath of the towed U-boom configuration, and drift back into the contained oil. The burning globules of gelled fuel spread into patties, sometimes combine with each other on the surface, and provide a "gentle" exchange of heat between the igniter flame and the oil.

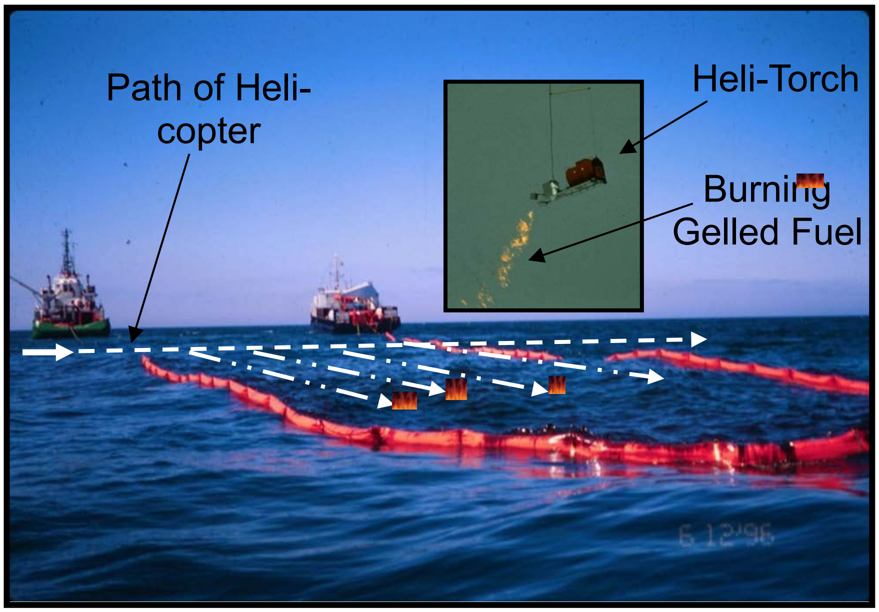


Figure 9407-11: Heli-Torch release of igniters forward of contained oil.

The ignition of contained oil with a Heli-Torch, as compared with hand-held igniters, requires much more planning and resources, including: a helicopter, Heli-Torch, onshore staging area, equipment for mixing gelled fuel, training of ground crews and pilots, compliance with Federal regulations for sling loads of combustible products, etc. The path of the helicopter from staging to the burn area must not transit over populated areas, and the entire offshore operation must be coordinated closely with other air operations. These include: surveillance and spotting, documentation and monitoring of response activities, possible aerial application of dispersants, and flight path/altitude constraints related to nearby airports.

If all of the restrictions and constraints can be met, the Heli-Torch is a proven, safe and effective means of delivering multiple ignition points without the need for a potentially large supply of hand-held igniters, surface ignition boats and personnel, and the relatively slow deployment of igniters. The Heli-Torch also provides a means of creating a large and intense area of burning gel for the ignition of a highly weathered and/or emulsified layer of oil. If the oil is difficult to ignite, the accompanying low level of vapors over the contained oil would allow the release of burning gel directly onto the oil. The initial release should take place from a higher than normal altitude (150 to 200 feet) to provide both additional safety during ignition and less disturbance of the oil/igniter flames due to the prop-wash of the helicopter.

Regardless of the ignition mode used (hand-held igniters or a Heli-Torch), all pre-burn requirements must be met as described in the FOSC-approved In-Situ Burning Application to burn and detailed operational checklists.

1.5 Fire Control and Emergency Response

Once ignited, control of the fire within the boom may involve an enlargement or reduction of the burn area during an ongoing burn. The reasons for conducting each activity and the methods by which each effort can be conducted safely are addressed in this section along with guidelines for emergency response and termination of a burn.

Enlargement of Burn Area: The boom-towing vessels can control the shape and size of the area for oil containment by speeding up or slowing down. They can also change the distance between them, and therefore the swath of the towed U-boom configuration. Most towed boom configurations with a "U" shape for collection of oil work effectively with a Gap ratio of about 0.3 (i.e., the ratio of the swath of the "U" to the length of the boom). Working with a boom length of 500 feet, the swath (or distance between the towing vessels) would be approximately 150 feet. The maintenance of a shape of this size, towed at between ¾ knot and 1 knot, normally creates a favored condition for the containment of oil with minimal loss through entrainment of oil beneath the boom at its apex. By reducing the speed of the tow vessels while maintaining the same swath, the oil within the boom will creep forward, become thinner, and increase in area. Since the volume elimination rate for burning oil on water is directly proportional to the surface area of the oil being burned, the rate of elimination can be increased substantially by simply slowing down.

While this technique may be favored for a short time, the increased area of burn will expose more of the fire boom to intense heat and increase the safe operating distance for personnel. It will also mean that the duration of a burn will be reduced because of the thinner oil layer, going out quickly as the average oil thickness approaches about $1/10^{th}$ of an inch (a few millimeters). While a larger fire for a shorter period of time may be desirable, it may be better to keep the oil thicker, even over a smaller area, toward the end of a burn for a greater total elimination of as much oil as possible. As towing vessel captains get more experienced with this process (especially with good aerial spotting support), the control of oil area and thickness can lead to improved efficiency of burn. This improvement will also lead to a reduction in the amount of burn residue left upon completion of a burn (normally only a few percent of the original volume burned). Note, as discussed in Section 1.6 on residue recovery, that a significant portion of burn residue can be left and mixed with the oil of a second containment and burn operation, further reducing the overall volume of residue collected.

Reduction of Burn Area: A reduction of the burn area would not normally be desired unless the burn was nearly over and a thickening of the oil layer was needed to sustain the burn a bit longer and reduce the volume of burn residue remaining. There could, however, be other reasons to increase the speed of the towing vessels and thereby reduce the size of a burn. Should the operation involve oil of relatively low volatility (i.e., bunker oil, weathered or emulsified oil, etc.), the collection and burn tactic might be approved for the simultaneous encountering of oil while burning. During such burns the fire may become so large that the leading edge of the burn area becomes unacceptably close to the leading ends of the boom. A decision may be made to speed up and drive the forward edge of burning oil back into the U-configuration. There could also be a decision to speed up and change course to avoid any further introduction of oil to the burn. These maneuvers could cause oil to thicken beyond the holding capacity of the boom and entrain beneath it or splash over it. Depending upon the volume already contained by the system, this condition may be avoided; however, if it cannot, the oil that is lost behind the boom would be extinguished or burn out quickly as it spreads and thins down without containment.

Throughout the ignition and controlled burning of oil, the Command /Support Vessel and possibly a dedicated Fire/Safety Vessel would be available on location. They would coordinate with the In-Situ Burning Safety Officer and aerial Spotters, maintaining communications and ongoing directional support for each Fire Boom Burn Team. The availability of trained aerial observers for such operations is critical for the safety and monitoring of all vessels and ongoing burns. They have a unique perspective on the spacing of vessels, the nature and distribution of oil in the area, the early warning of weather changes and visibility, and the altitude and direction of smoke plumes relative to population centers and other sensitive resources.

Emergency Response: The role of Command, Safety personnel and aerial Spotters extends into other aspects of fire monitoring and control, especially those activities associated with emergency or unexpected events. Should there be a failure of a fire boom, tow line or any other component of the fire boom assembly (e.g., water feed lines for water-cooled fire booms), there would be a need to alert all vessels of the potential course change for the boom towing vessels and/or the possible accidental or intentional release of burning oil from the U-boom configuration. Should an equipment failure result in the sudden release of a large volume of burning oil, one of two natural conditions will take place – both operationally of positive value. If the amount of burning oil released is relatively small, and/or wind and sea conditions are such that the oil spreads out quickly, the burning oil will be quite visible and remain downstream of the towed boom track, and away from all support vessels. The oil will reach its natural extinction thickness of a millimeter or two, typically within minutes, and go out.

If, on the other hand, the volume of oil released is large, and sea conditions relatively calm, the burn area may be of sufficient size and intensity that even without boom containment, the rising hot air over the burn may cause a significant radial movement of cooler air (or, induced wind) toward the fire (Figure 9407-12). This flow of air at sea level will not only bring in oxygen to enhance the burn, it is likely that surrounding slicks will be transported by the induced wind toward and into the fire. For a short time the natural concentration of nearby oil by induced wind will simply add to the desired elimination of spilled oil.

Figure 9407-12: Thermally induced flow of air and oil toward uncontained slick (DWH, 2010)

Another emergency that must be anticipated is the loss of power by one of the boom-tending vessels, or the loss of a man overboard. In either case, the second towing vessel will turn immediately toward the powerless vessel or the individual needing assistance for recovery. The reasons for long tow lines (200 feet to as much as 500 feet) include thermal and smoke protection of personnel on the boats, but also the provision of time for emergency response in moving the powerless boat out of harm's way, or in recovering someone from the water. The boom towing speeds of a knot or less and the proximity of the boats to each other, are sufficient for assistance of the kind described here. During the transit of one vessel to assist the other it may be best to release or quickly cut one or both tow lines, to allow greater speed and maneuverability of the assisting vessel. Additional fire control and protection for vessels/personnel can be provided by another vessel with fire monitors onboard. The high-pressured flow of water from a vessel-mounted monitor has been used to provide support in driving back and helping to extinguish oil burning on water.

1.6 Residue Recovery

At the end of a burn any remaining debris and burn residue will usually be too hot to handle or recover for about 10 to 15 minutes, depending on the sea state and any cooling by water splashed onto the residue. In some case the burn residue and any unburned oil may remain at the surface long enough to then be mixed with new oil being encountered and collected within the boom. Being coated by and mixed with the new oil, a portion of the residue may be burned thereby reducing its volume during an additional burn. If a second collection and burn cannot be completed right away, the burn residue may remain at the surface for only an hour or less, depending upon its density, water content, and bubbles of gas often entrained temporarily within the residue. The burn residue should be collected before it begins to sink following the residue recovery plan.

While every effort should be made to remove as much oil as possible (including burn residue) during a spill response, it should be recognized that the volume of oil eliminated during burning is already high, typically 90% to 98%. The time and resources needed to recover the remaining residue should be weighed against the benefits of doing so. The decision is not easy, since even the small percentage of residue could still have significant impact on some sea life, especially in shallow waters. The potential impacts should be weighed carefully against the benefits for a given region and possible biological exposures prior to a spill so that meaningful decisions can be made quickly during an actual spill event.

1.7 Monitoring and Documentation

The monitoring and documentation of conditions and activities related to the controlled in-situ burning of oil may involve:

- Environmental conditions (wind, waves, visibility, etc.),
- Location and condition of spilled oil,
- Location and readiness of In-Situ Burning resources to conduct a burn,
- Tactics and procedures while conducting ignition and sustained burning of oil,
- Approximate area and duration of each burn, including volume burned,
- Appearance and transport of combustion by-products (primarily smoke plume and burn residue),
- Sampling and analysis of combustion by-products (including pre-burn baseline data),
- Presence/Absence of wildlife in the area, and
- An In-Situ Burn Final Report (provided by the OSC or a designated staff member, and presented at an RRT 10 meeting, if requested).

Most of these activities would be completed immediately prior to and during In-Situ Burning operations by personnel on location, under the direction of the Monitoring Group Supervisor, reporting to the Operations Section Chief. All monitoring and sampling requirements, procedures and results would be coordinated with scientific support specialists and shared with appropriate federal, state and local/tribal organizations. The monitoring, sampling and documentation of combustion by-products (including burn residue) are addressed in the Health, Safety & Environment section prepared by Shell Oil. The actual air monitoring/sampling data are collected by Unified Command-led monitoring teams using RRT-10 Modified SMART (Special Monitoring of Applied Response Technologies) protocols (Northwest Area Contingency Plan, 2016).

In-Situ Burning Monitoring Teams, consisting of observers in Surveillance/Spotting aircraft and on vessels will record environmental conditions that most influence the feasibility of conducting a burn safely and effectively. The proximity of a burn or the path of its smoke plume to population centers and other sensitive resources prior to ignition and throughout a burn should be noted and recorded. Any potentially unacceptable variations from the approved Site-Specific In-Situ Burning Plan should be provided to the In-Situ Burning Group Supervisor and Monitoring Group Supervisor immediately. Prevailing wind and atmospheric conditions, modeling output (if available), and input from state and local health officials, should be considered in determining if and where monitoring teams should be deployed for possible harmful exposures of people to smoke. It should be noted that, while visual monitoring is conducted continuously as long as a burn takes place, air sampling using SMART is not needed if there is no potential for human exposure to the smoke. While response personnel conducting a burn make every effort to avoid exposure to the products of combustion, industrial hygiene specialists should be available to ensure the safety of personnel on vessels and the proper use of personal protective equipment (PPE), as needed.

Aerial and surface monitoring personnel should also note and record the movement of any non-response vessels or aircraft in the vicinity of the burn that could interfere with, or be impacted by, the In-Situ Burning response activities or the smoke plume. Notices to Aviators and to Mariners should go out routinely to the Federal Aviation Administration, the USCG and other local authorities prior to and during In-Situ Burning operations.

In addition to the monitoring of vessel movements during oil collection, ignition and sustained burns, one of the most important monitoring and documentation functions involves the collection of photos and intermittent video of each burn. These recordings, together with data collected by aerial observers on burn area and duration are of great value in making estimates of the volume of oil eliminated during each burn. Since burn rates are well known for a variety of oil types and conditions (Fingas and Punt, 2000), usually expressed in gallons/minute of oil burned per square foot, the volume of oil eliminated from a burn of a given size (i.e., area in square feet), can be estimated by multiplying the burn rate (gallons/min./ft^2) times the duration of that burn (min.) times the area of the burn (ft^2). For example, a burn of lightly emulsified crude oil that could burn at about 0.07 gallons/min./ft^2, involving a burn area of about 50 ft. by 100 ft. (i.e., 5,000 ft^2), and lasting about 15 minutes would likely result in the elimination of approximately 125 barrels of oil. A sample calculation follows:

Volume Burned (gallons) = 0.07 gallons/min./ft^2) x 5,000 ft^2 x 15 min. = 5,250 gallons (125 barrels)

By recording the approximate size and duration of a contained burn, noting variations of the approximate area and timing of changes in the burn, it is possible to make a rough estimate of the total volume of oil eliminated. During the Deepwater Horizon (DWH) Spill of 2010, the burning of more than 400 individual burns offered ample opportunity to develop and practice the estimation of burn volumes using this procedure. Conservative burn rates were used to calculate minimum and maximum estimates oil volumes eliminated during each burn. The assumptions, guidelines and figures used to help collect data during each burn and make burn volume estimates are provided in Appendix A, “A Protocol for Estimation of Oil Volumes Removed During Controlled Burns” (Allen and Mabile, 2010). This document was prepared during the spill event, and includes its own appendices and sample calculations. A copy is provided along with this report.

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Tool 7: Tribal and other Trustee Technical Coordination Master List

The purpose of this tool is to gather a comprehensive list of all the Tribal, agency resource trustee and other key representatives who should be coordinated with and engaged on a technical level for input into the overall tradeoff discussion which is part of the EU Recommendation process. This list is designed to be completed at the time of an incident, and will most likely be different during each incident. This form should be completed by the EUL with help from the Liaison Officer, Public Information Officer.

Organization Name	POC Names and Contact Information	Comments

Protocols RRT 10 Modification – 2014 Special Monitoring of Applied Response Technologies (SMART)

v. 8/2006

SPECIAL MONITORING of APPLIED RESPONSE TECHNOLOGIES

RRT X MODIFICATION –2014
Modified text is red in color with gray shading.

Developed by:

U.S. Coast Guard
National Oceanic and Atmospheric Administration
U.S. Environmental Protection Agency
Centers for Disease Control and Prevention
Minerals Management Service

Smoke rising from the *New Carissa*, February 1999. Photo by USCG

SMART is a living document

SMART is a living document. We expect that changing technologies, accumulated experience, and operational improvements will bring about changes to the SMART program and to the document. We would welcome any comment or suggestion you may have to improve the SMART program.

Please send your comments to:

SMART Mail
NOAA OR&R
7600 Sand Point Way N.E.
Seattle, WA 98115
USA

Fax: (206) 526-6329

Or email to:
smart.mail@noaa.gov

SMART approval status

As of January, 2001 EPA Regions II, III, and VI adopted SMART. It was reviewed and approved by the National Response Team (NRT).

Acknowledgments

Gracious thanks are extended to the members of the SMART workgroup for their tireless efforts to generate this document, to the many reviewers who provided insightful comments, and to the NOAA OR&R Technical Information Group for assistance in editorial and graphic design.

SMART is a Guidance Document Only

Purpose and Use of this Guidance:
This manual and any internal procedures adopted for its implementation are intended solely as guidance. They do not constitute rulemaking by any agency and may not be relied upon to create right or benefit, substantive or procedural, enforceable by law or in equity, by any person. Any agency or person may take action at variance with this manual or its internal implementing procedures. Mention of trade names or commercial products does not constitute endorsement or recommendation for their use by the USCG, NOAA, EPA, CDC, or the Government of the United States of America.

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INTRODUCTION

The need for protocols to monitor response technologies during oil spills has been recognized since the early 1980s. Technological advances in dispersant applications and in situ burning (referred to as *applied response technologies*) have resulted in their increased acceptance in most regions in the U.S. Many regions have set up pre-approval zones for dispersant and in-situ burn operations, and established pre-approval conditions, including the requirement for monitoring protocols. This reaffirms the need for having national protocols to standardize monitoring, especially when the Federal Government assumes full responsibility for the response under the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40 CFR Part 300). Protocols are also needed to serve as guidelines for assisting or overseeing industry's monitoring efforts during spills.

In November 1997, a workgroup consisting of Federal oil spill scientists and responders from the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Environmental Protection Agency, and the Centers for Disease Control and Prevention, convened in Mobile, Alabama to draft guidelines for generating this protocol. The workgroup built upon currently available programs and procedures, mainly the Special Response Operations Monitoring Program (SROMP), developed in 1994, and lessons learned during spill responses and drills. The result of this collaboration is the Special Monitoring of Applied Response Technologies (SMART) program.

SMART establishes a monitoring system for rapid collection and reporting of real-time, scientifically based information, in order to assist the Unified Command with decision-making during in situ burning or dispersant operations. SMART recommends monitoring methods, equipment, personnel training, and command and control procedures that strike a balance between the operational demand for rapid response and the Unified Command's need for feedback from the field in order to make informed decisions.

SMART is not limited to oil spills. It can be adapted to hazardous substance responses where particulate air emissions should be monitored, and to hydrocarbon-based chemical spills into fresh or marine water.

General Information on SMART Modules

A. General Considerations and Assumptions

Several considerations guided the workgroup in developing the SMART guidelines:

1. SMART is designed for use at oil spills both inland and in coastal zones, as described in the National Oil and Hazardous Substances Pollution Contingency Plan.

2. SMART does not directly address the health and safety of spill responders or monitoring personnel, since this is covered by the general site safety plan for the incident (as required by 29 CFR 1910.120).

3. SMART does not provide complete training on monitoring for a specific technology. Rather, the program assumes that monitoring personnel are fully trained and qualified to use the equipment and techniques mentioned and to follow the SMART guidelines.

4. SMART attempts to balance feasible and operationally efficient monitoring with solid scientific principles.

5. In general, SMART guidelines are based on the roles and capabilities of available federal, state, and local teams, and NOAA's Scientific Support Coordinators (SSC). The SSC most

often fills the role of Technical Specialist, mentioned throughout the document. Users may adopt and modify the modules to address specific needs.

6. SMART uses the best available technology that is operationally practical. The SMART modules represent a living document and will be revised and improved based on lessons learned from the field, advances in technology, and developments in techniques.

7. SMART **should not** be construed as a regulatory requirement. It is an option available for the Unified Command to assist in decision-making. While every effort should be made to implement SMART or parts of it in a timely manner, **in situ burning or dispersant application should not be delayed** to allow the deployment of the SMART teams.

8. SMART is not intended to supplant private efforts in monitoring response technologies, but is written for adoption and adaptation by any private or public agency. Furthermore, users may choose to tailor the modules to specific regional needs. While currently addressing monitoring for in-situ burning and dispersant operations, SMART will be expanded to include monitoring guidelines for other response technologies.

9. It is important that the Unified Command agree on the monitoring objectives and goals early on in an incident. This decision, like all others, should be documented.

B. Organization

The SMART document is arranged in modules. Each module is self-sustaining and addresses monitoring of a single response technology. The modules are divided into three sections:

Section 1: Background Information provides a brief overview of the response technology being used, defines the primary purpose for monitoring, and discusses monitoring assumptions.

Section 2: Monitoring Procedures provide general guidelines on what, where, when, and how to monitor; information on organization; information flow; team members; and reporting of data.

Section 3: Attachments provide detailed information to support and expand sections 1 and 2.

MONITORING DISPERSANT OPERATIONS

1. BACKGROUND

1.1 Mission Statement
To provide a monitoring protocol for rapid collection of real-time, scientifically based information, to assist the Unified Command with decision-making during dispersant applications.

1.2 Overview of Dispersants
Chemical dispersants combine with oil and break a surface slick into small droplets that are mixed into the water column by wind, waves, and currents. The key components of a chemical dispersant are one or more surface-active agents, or surfactants. The surfactants reduce the oil-water interfacial tension, thus requiring only a small amount of mixing energy to increase the surface area and break the slick into droplets.

Several actions must occur for a surface oil slick to be chemically dispersed:
- The surfactant must be applied to the oil in an appropriate ratio;
- The surfactant must mix with the oil or move to the oil/water interface;
- The molecules must orient properly to reduce interfacial tension;
- Energy (such as waves) must be applied to form oil droplets; and
- The droplets must not recoalesce significantly.

Dispersants can be applied by air from airplanes and helicopters, by land using pumping/spray systems, or by boat. They are usually applied in small droplets and in lower volumes than the oil being treated.

1.3 Monitoring Dispersant Application
When dispersants are used during spill response, the Unified Command needs to know whether the operation is effective in dispersing the oil. The SMART dispersant monitoring module is designed to provide the Unified Command with real-time feedback on the efficacy of dispersant application. Data collected in Tier III of the SMART dispersant protocol may be useful for evaluating the dilution and transport of the dispersed oil. **SMART does not monitor the fate, effects, or impacts of dispersed oil.**

Dispersant operations and the need to monitor them vary greatly. Therefore, SMART recommends three levels (or tiers) of monitoring.

1. Tier I employs the simplest operation, visual monitoring, which may be coupled with Infra Red Thermal Imaging or other remote detection methods.

2. Tier II combines visual monitoring with on-water teams conducting real-time water column monitoring at a single depth, with water-sample collection for later analysis. **While fluorometry remains the most technologically advantageous detection method, other approaches may be considered. The performance-based guidelines provided in attachment 10 define SMART Dispersant Module Criteria for instrument selection and validation**

3. Tier III expands on-water monitoring to meet the information needs of the Unified Command. It may include monitoring at multiple depths, the use of a portable water laboratory, and/or additional water sampling. Tier III monitoring might for example include the redeployment of the monitoring team to a sensitive resource (such as near a coral reef system) as either a protection strategy or to monitor for evidence of exposure. In addition, Tier III might include the use of the monitoring

package for activities unrelated to actual dispersant operations such as monitoring of natural dispersion or to support surface washing activities where water column concerns have been identified. Any Tier III operation will be conducted with additional scientific input from the Unified Command to determine both feasibility and help direct field activities. The Scientific Support Coordinator or other Technical Specialists would assist the SMART Monitoring Team in achieving such alternative monitoring goals.

2. MONITORING PROCEDURES

2.1 Tier I: Visual Observations

Tier I recommends visual observation by a trained observer. A trained observer, using visual aids, can provide a general, qualitative assessment of dispersant effectiveness. Use of guides such as the NOAA *Dispersant Application Observer Job Aid* is recommended for consistency. Observations should be photographed and videotaped to help communicate them to the Unified Command, and to better document the data for future use.

When available, visual monitoring may be enhanced by advanced sensing instruments such as infrared thermal imaging. These and other devices can provide a higher degree of sensitivity in determining dispersant effectiveness.

Visual monitoring is relatively simple and readily done. However, visual observations do not always provide confirmation that the oil is dispersed. Tier II provides a near real-time method using water column monitoring via a direct reading instrument and water sampling.

2.2 Tier II: On-Water Monitoring for Efficacy

Sometimes dispersant operations effectiveness is difficult to determine by visual observation alone. To confirm the visual observations, a monitoring team may be deployed to the dispersant application area to confirm the visual observations by using real-time monitoring and water sampling. SMART defines it as Tier II monitoring.

Tier II prescribes single depth monitoring at 1-meter but rough field conditions may force continuous flow monitoring at increased depths of up to 2 meters. Water sampling may be conducted in concert with in-situ monitoring rather than collecting samples from the flow-through hose. Such a change may reduce direct comparisons between field instrument and laboratory verifications, but the data is still expected to meet mission requirements.

A water-column monitoring team composed of at least one trained technician and a support person is deployed on a suitable platform. Under ideal circumstances, the team collects data in three primary target locations: (1) background water (no oil); (2) oiled surface slicks prior to dispersant application, and (3) post-application, after the oil has been treated with dispersants. Data are collected in real-time by both a built-in data-logging device and by the technician who monitors the readings from the instrument's digital readout and records them in a sampling log. The sampling log not only provides a backup to the data logger, but allows the results to be communicated, near real-time, to the appropriate technical specialist in the Unified Command. Data logged by the instrument are used for documentation and scientific evaluation.

The field team should record the time, instrument readings, and any relevant observations at selected time intervals. Global Positioning System (GPS) instruments are used to ascertain the exact position of each reading.

If feasible, water samples should be collected in bottles to validate and quantify monitoring results. Samples should be collected at the outlet port or discharge side of the monitoring instrument to ensure the integrity of the readings. Exact time and position is noted for each sample taken to correlate the instrument reading. The number of water samples taken reflects the monitoring effort. Generally, five samples collected for each data run is considered adequate in addition to background samples. The water samples are stored in a cooler and sent to a laboratory for future analysis.

2.3 Tier III: Additional Monitoring

Tiers I and II provide feedback to the Unified Command on the effectiveness of dispersant application. If dispersants are effective and additional information on the movement of the dispersed oil plume is desired, SMART Tier III procedures can address this need.

Tier III follows Tier II procedures, but collects information on the transport and dispersion of the oil in the water column. It helps to verify that the dispersed oil is diluting toward background levels. Tier III is simply an expanded monitoring role that is intended to meet the needs of the Unified Command.

Tier III monitoring may be conducted as follows:

1. Multiple depths with one instrument: This monitoring technique provides a cross-section of relative concentrations of dispersed oil at different depths, measuring the dilution of dispersed oil down to background levels. When transecting the dispersant-treated slick (as outlined for Tier II) the team stops the vessel at location(s) where elevated readings are detected at 1 meter and, while holding position, the team monitors and collects samples at multiple increments down to a maximum depth of 10 meters. Readings are taken at each water depth, and the data recorded both automatically in the instrument data logger and manually by the monitors. Manual readings should be taken at discreet time intervals of 2 minutes, 5 minutes, etc. as specified by the Monitoring Group Supervisor or as indicated in a written sampling plan developed by the Dispersant Technical Specialist.

2. Transect at two different depths: This technique also looks at changes in concentration trends, but uses two monitoring instruments at different depths as the monitoring vessel transects the dispersed oil slick while making continuous observations. It is done as follows:

   Monitoring is conducted at two different depths, 1 and 5 meters, or any two water depths agreed upon by the Incident Commander or the Unified Command. Two sampling setups and two separate monitoring instruments are used on a single vessel. The vessel transects the dispersant-treated slick as outlined in Tier II, except that now data are collected simultaneously for two water depths. While the data logger in each instrument automatically records the data separately, the monitoring team manually records the data from both instrument simultaneously at discrete time intervals of 2 minutes, 5 minutes, etc, as specified by the Monitoring Group Supervisor or the sampling plan developed by the Dispersant Technical Specialist. Comparison of the readings at the two water depths may provide information on the dilution trend of the dispersed oil.

3. Water parameters: In addition to instrument data, the Unified Command may request that water physical and chemical parameters be measured. This can be done by using a portable lab connected in-line with the instrument to measure water temperature, conductivity, dissolved oxygen content, pH, and turbidity. These data can help explain the behavior of the dispersed oil. The turbidity data may provide additional information on increased concentrations of dispersed oil if turbidity is elevated. The other physical and chemical parameters measure the characteristics of the water column that could possibly affect the rate of dispersion.

4. As in Tier II, water samples are collected, but in greater numbers to help validate instrument readings.

Calibration and documentation used for Tier II are valid for Tier III as well, including the use of a check standard to verify instrument response. Because of the increased complexity of Tier III, a dispersant technical specialist (e.g., member of the scientific support team) should be on location to assist the monitoring efforts.

A critical point to keep in mind is that in the hectic and rapidly changing conditions of spill response, flexibility and adaptability are essential for success. The sampling plan is dictated by many factors such as the availability of equipment and personnel, on-scene conditions, and the window of opportunity for dispersant application. The need for flexibility in sampling design, effort, and rapid deployment (possibly using a vessel of opportunity), may dictate the nature and extent of the monitoring. To assist the monitoring efforts, it is important that the unified command agrees on the goals and objectives of monitoring and chooses the Tier or combination thereof to meet the needs of the response.

2.4 Mobilizing Monitoring Resources

Dispersant application has a narrow window of opportunity. Time is of the essence and timely notification is critical. It is imperative that the monitoring teams and technical advisors are notified of possible dispersant application and SMART monitoring deployment as soon as they are considered, even if there is uncertainty about carrying out this response option. Prompt notification increases the likelihood of timely and orderly monitoring.

The characteristics of the spill and the use of dispersants determine the extent of the monitoring effort and, consequently, the number of teams needed for monitoring. For small-scale dispersant applications, a single visual monitoring team may suffice. For large dispersant applications several visual and water-column monitoring teams may be needed.

2.5 Using and Interpreting Monitoring Results

Providing the Unified Command with objective information on dispersant efficacy is the goal of Tier I and II dispersant monitoring. When visual observations and on-site water column monitoring confirm that the dispersant operation is not effective, the Unified Command may consider evaluating further use. If, on the other hand, visual observations and/or water column monitoring suggest that the dispersant operation is effective, dispersant use may be continued.

When using fluorometry, the readings will not stay steady at a constant level but will vary widely, reflecting the patchiness and inconsistency of the dispersed oil plume. Persons reviewing the data should look for trends and patterns providing good indications of increased hydrocarbon concentrations above background. As a general guideline only, a fluorometer signal increase in the dispersed oil plume of five times or greater over the difference between the readings at the untreated oil slick and background (no oil) is a strong positive indication. This should not be used as an action level for turning on or off dispersant operations. The final recommendation for turning a dispersant operation on or off is best left to the judgment of the Technical Specialist charged with interpreting the data. The Unified Command, in consultation with the Technical Specialist, should agree early on as to the trend or pattern that they would consider indicative or non-indicative of a successful dispersant operation. This decision should be documented.

2.6 SMART as Part of the ICS Organization

SMART activities are directed by the Operations Section Chief in the Incident Command System (ICS). A "group" should be formed in the Operations Section to direct the monitoring effort. The head of this group is the Monitoring Group Supervisor. Under each group there are teams: Visual

Monitoring Teams and Water Column Monitoring Teams. At a minimum, each monitoring team consists of two trained members: a monitor and an assistant monitor. An additional team member could be used to assist with sampling and recording. The monitor serves as the team leader. The teams report to the Monitoring Group Supervisor, who directs and coordinates team operations, under the control of the Operations Section Chief.

Dispersant monitoring operations are very detailed. They are linked with the dispersant application, but from an ICS management perspective, they should be separated. Resources for monitoring should be dedicated and not perform other operational functions.

2.7 Information Flow and Data Handling

Communication of monitoring results should flow from the field (Monitoring Group Supervisor) to those persons in the Unified Command who can interpret the results and use the data. Typically this falls under the responsibility of a Technical Specialist on dispersants in the Planning Section of the command structure. For the U.S. Coast Guard, the technical specialist is the Scientific Support Coordinator. Note that the operational control of the monitoring groups remains with the Operations Section Chief, but the reporting of information is to the Technical Specialist in the Planning Section.

The observation and monitoring data will flow from the Monitoring Teams to the Monitoring Group Supervisor. The Group Supervisor forwards the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data and, most importantly, formulates recommendations based on the data. The Technical Specialist communicates these recommendations to the Unified Command.

Quality assurance and control should be applied to the data at all levels. The Technical Specialist in the Planning section is the custodian of the data during the operation. The data belongs to the Unified Command. The Unified Command should ensure that the data are properly stored, archived, and accessible for the benefit of future monitoring operations.

3. ATTACHMENTS

The following attachments are designed to assist response personnel in implementing the SMART protocol. A short description of each attachment is provided below. Attachments may be modified as required to meet the stated objectives. **These attachments are still valid related to the use of the Turner Design AU-10 instrument package. Should monitoring teams choose to change to alternative instrument packages, like protocols would be required to insure proper training, documentation, and QA/QC.**

Number	Title	Description
3.1	Roles and Responsibilities	Detailed roles and responsibilities for responders filling monitoring positions
3.2	Command, Control, and Data Flow	An ICS structure for controlling monitoring units and transferring monitoring results
3.3	Dispersant Observation General Guidelines	General guidelines for Tier I monitoring
3.4	Dispersant Observation Training Outline	Outline of what should be covered for Tier I observation training
3.5	Dispersant Observation Checklist	Equipment and procedure checklist for Tier I monitoring
3.6	Dispersant Observation Pre-Flight List	A checklist for getting air resources coordinated and ready for Tier I monitoring
3.7	Dispersant Observation Reporting Form	A form for recording Tier I observations
3.8	Dispersant Monitoring Training Outline	A training outline for water column monitoring done in Tiers II and III
3.9	Dispersant Monitoring Job Aid Checklist	A list of the tasks to accomplish before, during, and after the monitoring operations
3.10	Dispersant Monitoring Performance Guidelines	A list of performance guidelines for monitoring dispersants
3.11	Dispersant Monitoring Field Guidelines	Field procedures for using Tier II and III monitoring protocols
3.12	Dispersant Monitoring Water Sampling	Procedures for collecting water samples for Tiers II and III
3.13	Dispersant Monitoring Recorder Sheet	A form for recording fluorometer readings for Tiers II and III

3.1 Roles and Responsibilities

3.1.1 Visual Monitoring Team

The Visual Monitoring Team is ideally composed of two persons: a Monitor and an Assistant Monitor.

The Monitor:
- Functions as the team leader
- Qualitatively measures dispersant effectiveness from visual observation
- Communicates results to the Monitoring Group Supervisor.

The Assistant Monitor:
- Provides photo and visual documentation of dispersant effectiveness
- Assists the Monitor as directed.

3.1.2 Water-Column Monitoring Team

The Water-Column Monitoring Team is composed of a minimum of two persons: a Monitor and Assistant Monitor. They shall perform their duties in accordance with the Tier II and Tier III monitoring procedures.

The Monitor:
- Functions as the team leader
- Operates water-column monitoring equipment
- Collects water samples for lab analysis
- Communicates results to the Monitoring Group Supervisor.

The Assistant Monitor:
- Provides photo and visual documentation of dispersant effectiveness
- Assists Monitor as directed
- Completes all logs, forms, and labels for recording water column measurements, water quality measurements, interferences, and environmental parameters.

3.1.3 Monitoring Group Supervisor

The Monitoring Group Supervisor:
- Directs Visual Monitoring and Water Column Monitoring teams to accomplish their responsibilities
- Follows directions provided by the Operations Section in the ICS
- Communicates monitoring results to the Technical Specialist in the Planning Section
- The Monitoring Group Supervisor may not be needed for a Tier I deployment. In these cases, the Visual Monitoring Team monitor may perform the duties of the Monitoring Group Supervisor.

3.1.4 Dispersant Monitoring Technical Specialist (Federal: NOAA SSC)

The Technical Specialist or his/her representative:
- Establishes communication with the Monitoring Group Supervisor
- Advises the Group Supervisor on team placement and data collection procedures
- Receives the data from the Group Supervisor
- Ensures QA/QC of the data, and analyzes the data in the context of other available information and incident-specific conditions
- Formulates recommendations and forwards them to the Unified Command
- Makes the recommendations and data available to other entities in the ICS
- Archives the data for later use, prepares report as needed.

3.2 Command, Control, and Data Flow

In general, dispersant monitoring operations take place as an integral part of the Incident Command System (see Figures 1 and 2).

Dispersant monitoring operations are tactically deployed by the Operations Section Chief or deputy, in cooperation with the Technical Specialist (SSC) in the Planning Section regarding the specifics of the monitoring operations, especially if they affect the data collected. The Monitoring Group Supervisor provides specific on-scene directions to the monitoring teams during field deployment and operations.

The observation and monitoring data flow from the Monitoring Teams to the Monitoring Group Supervisor. After initial QA/QC the Group Supervisor passes the data to the Technical Specialist to review, apply QA/QC if needed, and, most importantly, formulate recommendations based on the data. The Technical Specialist forwards these recommendations to the Unified Command.

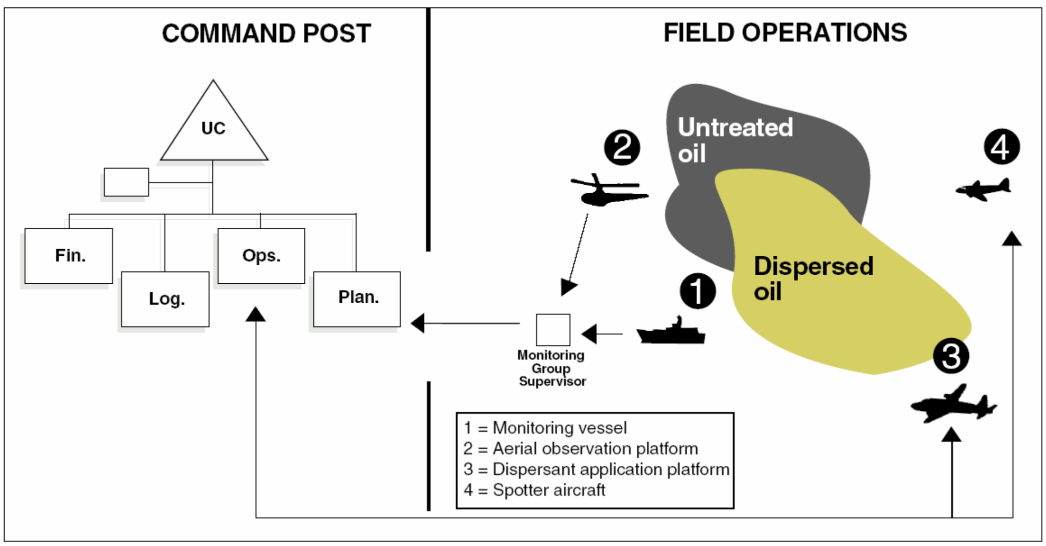

Figure 1. Command, control, and data flow during dispersant monitoring operations.

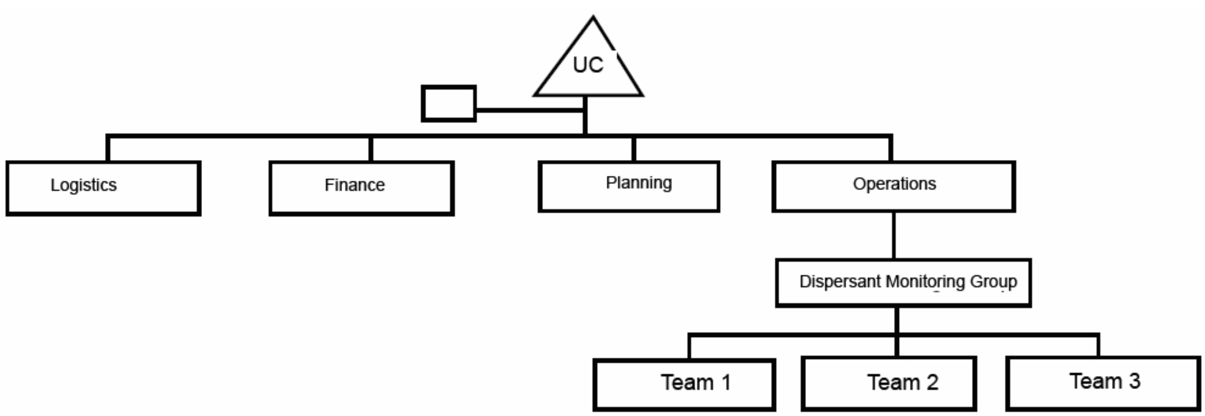

Figure 2. The Dispersant Monitoring Group in the ICS structure.

3.3 Dispersant Observation General Guidelines

3.3.1 Goal

The goal of Tier I monitoring is to identify oil, visually assess efficacy of dispersants applied to oil, and report the observations to the Unified Command with recommendations. The recommendations may be to continue, to modify, or to evaluate further monitoring or use because dispersants were not observed to be effective.

3.3.2 Guidelines and Pointers

3.3.2.1 Reporting Observations

- The observer does not make operational decisions, e.g., how much dispersant to apply, or when and where to apply it. These decisions are made at the Operations Section level, and the observer makes observations based on those decisions.

- Different observers at the same site may reach different conclusions about how much of the slick has been dispersed. For that reason, a comprehensive standard reporting criteria and use of a common set of guidelines is imperative. Use of the NOAA *Dispersant Application Observer Job Aid* is highly encouraged.

3.3.2.2 Oil on the Water

- Oil surface slicks and plumes can appear different for many reasons including oil or product characteristics, time of day (different sun angles), weather, sea state, rate at which oil disperses. The use of the NOAA *Open Water Oil Identification Job Aid for Aerial Observation* is highly recommended.

- Low-contrast conditions (e.g., overcast, twilight, and haze) make observations difficult.

- For best viewing, the sun should be behind the observer and with the aircraft at an altitude of about 200 - 300 feet flying at a 30-degree angle to the slick.

3.3.2.3 Dispersant Applications

- During dispersant application, it may be impossible to determine the actual area of thickest oil concentrations, resulting in variable oil/dispersant application rates. This could lead to variations in the effectiveness of application. The observer should report these conditions.

- Initial applications may have a herding effect on the oil. This would cause the slick to appear to be shrinking when, in fact, it is the dispersant "pushing" the oil together. Due to this effect, in some cases, the oil slick may even disappear from the sea surface for a short time.

- After dispersant application, there may be color changes in the emulsified slick due to reduction in water content and viscosity, and changes in the shape of the slick, due to the de-emulsification action of the dispersant.

- Many trials have indicated that dispersants apparently modify the spreading rates of oils, and within a few hours treated slicks cover much larger areas than control slicks.

- In some situations, especially where there may be insufficient mixing energy, oil may resurface.

3.3.2.4 Effective/Ineffective Applications

- Dispersed oil plume formation may not be instantaneous after dispersant application. In some cases, such as when the oil is emulsified, it can take several hours. A dispersed oil plume may not form at all.

- The appearance of the dispersed plume can range from brown to white (cloudy) to no visible underwater plume (this is why Tier II may be necessary).

- Sometimes other things such as suspended solids may resemble dispersed oil.

- The visibility of the dispersed plume will vary according to water clarity. In some cases, remaining surface oil and sheen may mask oil dispersing under the slick and thus interfere with observations of the dispersed oil plume.

- Dispersed oil plumes are often highly irregular in shape and non-uniform in concentration. This may lead to errors in estimating dispersant efficiency.

- If a visible cloud in the water column is observed, the dispersant is working. If a visible cloud in the water column is not observed, it is difficult to determine whether the dispersant is working.

- If there are differences in the appearance between the treated slick and an untreated slick, the dispersant may be working.

- Boat wakes through oil may appear as a successful dispersion of oil; however, this may be just the vessel wake breaking a path through the oil (physically parting the oil), not dispersing it.

3.4 Dispersant Observation Training Outline

Below is a suggested outline for dispersant observation training.

Topics and sub-topics	Duration
Observation Platforms	30 min.
• Helo or fixed-wing, separate from application platform • Safety considerations: daylight; safe flying conditions • Logistical considerations: personnel; equipment; communication • Planning an over-flight	
Oil on water	1 hour
• Physical properties • Different types of oil • Chemistry, crude vs. refined product • Appearance and behavior • Effects of wind, waves, and weather	
How dispersants work	45 min.
• Method of action • Compatible/incompatible products • Appropriate environmental conditions (wave energy, temperature, salinity, etc.) • Oil weathering • Oil slick thickness • Beaching, sinking, etc.	
Dispersant application systems	45 min.
• Platform: boat, helo, plan • Encounter rate • Importance of droplet size • Dispersant-to-oil ratio (dosage)	
• Effective application	45 min.
• Hitting the target • Dispersal into water column • Color changes • Herding effect	
• Ineffective application	30 min.
• Missing the target • Oil remaining on surface • Coalescence and resurfacing	
• Wildlife concerns	30 min.
• Identifying marine mammals and turtles • Rafting birds	
• Documenting observations	30 min.
• Estimating surface coverage • Photographs: sun reflection effects, use of polarizing filter, videotaping • Written notes and sketches	
• Reporting observations	30 min.
• Calibrating eyeballs • Recommended format • Information to include • Who to report to • Coordination with water-column monitoring	

3.5 Dispersant Observation Checklist

Below is a dispersant observation checklist. Check √ the items/tasks accomplished.

Check √	Item
	Observation Aids
	Base maps / charts of the area
	Clipboard and notebook
	Pens / pencils
	Checklists and reporting forms
	Handheld GPS with extra set of batteries
	Observation job aids (*Oil on Water & Dispersant Observation*)
	Still camera
	Extra film
	Video camera
	Binoculars
	Safety Equipment
	Personal flotation device
	Emergency locator beacon
	Survival equipment
	NOMEX coveralls (if available)
	Coldwater flotation suit (if water temperature requires)
	Intercom
	Direct communications back to the Incident Command Post
	Safety Brief
	Preflight safety brief with pilot
	Safety features of aircraft (fire extinguishers, communications devices, emergency locator beacon, flotation release, raft, first aid kit, etc.)
	Emergency exit procedures
	Purpose of mission
	Area orientation / copy of previous over-flight
	Route / flight plan
	Duration of flight
	Preferred altitude
	Landing sites
	Number of people on mission
	Estimated weight of people and gear
	Gear deployment (if needed, i.e., dye marker, current drogue)
	Frequency to communicate back to command post

3.6 Dispersant Observation Pre-Flight List

Spill Information	
Incident Name:	
Source Name:	
Date / Time Spill Occurred	
Location of Spill: Latitude	Longitude
Type of Oil Spilled:	Amount of Oil Spilled:

Weather On Scene	
Wind Speed and Direction	
Visibility:	Ceiling:
Precipitation:	Sea State:

Aircraft Assignments

Title	**Name**	**Call Sign**	**ETD**	**ETA**
Spotter (s)				
Sprayer (s)				
Observer (s)				
Monitor (s)				
Supervisor				

Safety Check

Check all safety equipment. Pilot conducts safety brief

Entry/Exit Points

	Airport	**Tactical Call Sign**
Entry:		
Exit:		

Communications (complete only as needed; primary/secondary)

Observer to Spotter (air to air)	VHF	UHF	Other
Observer to Monitor (air to vessel)	VHF	UHF	Other
Observer to Supervisor (air to ground)	VHF	UHF	Other
Supervisor to Monitor (ground to vessel)	VHF	UHF	Other
Monitor to Monitor (vessel to vessel)	VHF	UHF	Other

3.7 Dispersant Observation Reporting Form

Names of observers/Agency: ____

Phone/pager: ____________________ Platform: ______________________

Date of application: ___________ Location: Lat.:__________Long.: __________

Distance from shore: _________________

Time dispersant application started: __________ Completed: ______________

Air temperature: _______ Wind direction ________ Wind speed: __________

Water temperature: ______ Water depth: ______ Sea state: ___________

Visibility: ______________________

Altitude (observation and application platforms): ________________________

Type of application method (aerial/vessel): ____________________________

Type of oil: __________________________________

Oil properties: specific gravity_______viscosity_________pour point __________

Name of dispersant: ____

Surface area of slick: ____

Operational constraints imposed by agencies: ______________________________

Percent slick treated: _____ Estimated efficacy: _________________________

Visual appearance of application: _______________________________________

Submerged cloud observed?____

Recoalescence (reappearance of oil): _____________________________________

Efficacy of application in achieving goal (reduce shoreline impact, etc.): ___________

____

Presence of wildlife (any observed effects, e.g., fish kill): ____________________

Photographic documentation: ____

Lessons learned: ____

____

3.8 Fluorometry Monitoring Training Outline

3.8.1 General[1]

Training for Tier II and III monitoring consists of an initial training for personnel involved in monitoring operations, Group Supervisor training, and refresher training sessions every six months. Emphasis is placed on field exercise and practice.

3.8.2 Basic Training

Monitor Level Training includes monitoring concepts, instrument operation, workprocedures, and a field exercise.

Topic	Duration
Brief overview of dispersant monitoring. Review of SMART: What is it, why do it, what is it good for.	1 hour
Monitoring strategy: who, where, when. Reporting	1 hour
Basic instrument operation (hands-on): how the fluorometer works, how to operate: brief description of mechanism, setup and calibration, reading the data, what the data mean, troubleshooting; using Global Positioning Systems; downloading data; taking water samples	3 hours
Field exercise: Set up instruments within available boat platforms, measure background water readings at various locations. Using fluoroscein dye or other specified fluorescent source monitor for levels above background. Practice recording, reporting, and downloading data.	3-4 hours

3.8.3 Group Supervisor Training

Group Supervisor training may include:

- Independent training with the monitoring teams; or
- An additional structured day of training as suggested below

Topic	Duration
Review of ICS and role of monitoring group in it, roles of Monitoring Group Supervisor, what the data mean, QA/QC of data, command and control of teams, communication, and reporting the data.	1 hour
Field exercise. Practice deploying instruments in the field with emphasis on reporting, QA/QC of data, communication between teams and the Group Supervisor, and communication with the Technical Specialist.	3-6 hours
Back to the base, practice downloading the data.	30 min.
Lessons learned.	30 min.

[1] This training is designed for fluorometers. Other instruments could provide valid results, and may be suitable for SMART operations.

3.8.4 Refresher Training

Topic	Duration
Review of SMART: What is it, why do it, what is its purpose.	15 min.
Monitoring and reporting: Who, where, and when; level of concern; what the data mean; communication; and reporting the data	30-45 min.
Basic instrument operation (hands-on): how the fluorometer works and how to operate it; brief description of the mechanism, setup, calibration, reading data, and troubleshooting; using GPS.	2 hours
Downloading data	30 min.
Field exercise: Outside the classroom, set up instrument on a platform, and measure background readings. Using fluorescence or other common input sources, monitor fluorescence levels. Practice recording, reporting, and downloading data.	1-3 hours
Lessons learned	30–45 min.

3.9 Dispersant Monitoring Job Aid Checklist

This checklist is designed to assist SMART dispersant monitoring by listing some of the tasks to accomplish before, during, and after the monitoring operations.

Check √	Item	Do
	Preparations	
	Activate personnel	• Contact and mobilize the monitoring teams and Technical Specialist (SSC where applicable)
	Check equipment	• Check equipment (use checklists provided) • Verify that the fluorometer is operational • Include safety equipment
	Obtain deployment platforms	Coordinate with incident Operations and Planning Section regarding deployment platforms (air, sea, land)
	Amend site safety plan	Amend the general site safety plan for monitoring operations.
	Monitoring Operations	
	Coordinate plan	• Coordinate with the Operations Section Chief • Coordinate with Technical Specialist
	Conduct briefing	• Monitoring: what, where, who, how • Safety and emergency procedures
	Deploy to location	Coordinate with Operations Section.
	Setup instrumentation	• Unpack and set up the fluorometer per user manual • Record fluorometer response using the check standards
	Evaluate monitoring site	• Verify that the site is safe • Coordinate with spotter aircraft (if available)
	Conduct monitoring (See attachment 11 for details)	• Background, no oil present • Background, not treated with dispersants • Treated area
	Conduct data logging (see attachment 12)	• Date and time • Location (from GPS) • Verify that the instrument data logger is recording the data • Manually record fluorometer readings every five minutes • Record relevant observations
	Conduct water sampling (see attachment)	• Collect water samples post-fluorometer in certified, clean, amber bottles for lab analysis
	Conduct photo and video documentation	• Document relevant images (e.g., monitoring procedures, slick appearance, evidence of dispersed oil)
	Conduct quality assurance and control	• Instrument response acceptable? • Check standards current? • Control sampling done at oil-free and at untreated locations? • Water samples in bottles taken for lab analysis? • Date and time corrected and verified? • Any interfering factors?

	Report (by Teams)	Report to Group Supervisor: • General observation (e.g., dispersed oil visually apparent) • Background readings • Untreated oil readings • Treated oil readings
	Report (by Group Supervisor)	Report to Technical Specialist: • General observation • Background readings • Untreated oil readings • Treated oil readings
	Report by Technical Specialist (SSC)	Report to Unified Command: • Dispersant effectiveness • Recommendation to continue or re-evaluate use of dispersant.
	Post monitoring	
	Conduct debrief	• What went right, what can be done better • Problems and possible solutions • Capture comments and suggestions
	Preserve data	• Send water samples to the lab • Download logged data from fluorometer to computer • Collect and review Recorder data logs • Correlate water samples to fluorometer readings • Generate report
	Prepare for next spill	Clean, recharge, restock equipment

3.10 Dispersant Monitoring Performance Guidelines

SMART does not require nor endorse a specific instrument or brand for dispersant monitoring. Rather, SMART specifies performance criteria, and instruments meeting them may be used for monitoring.

1) Instrument package must be field rugged and portable. Instrument package must be able to operate from a vessel or small boat under a variety of field conditions, including air temperatures between 5 and 35°C, water temperatures between 5 and 30°C, seas to 5 feet, humidity up to 100%, drenching rain, and even drenching sea spray. The criteria for field deployment should be limited by the safety of the field monitoring team and not instrument package limitations.
2) Instrument package must be able to operate continuously in real-time or near-real time mode by analyzing seawater either in-situ (instrument package is actually deployed in the sea) or ex-situ (seawater is continuously pumped from a desired depth).
3) Monitoring depth must be controllable to between 1 meter and 3 meters. Discrete water sampling for post-incident laboratory validation is required at the same depths as actual instrument monitoring. Note, actual analysis of water samples collected may or may not be required by the FOSC.
4) Instrument must be able to detect dispersed crude oil in seawater. To allow a wide range of instruments to be considered, no specific detection method is specified. If fluorometry is used, the excitation and emission wavelengths monitored should be selected to enhance detection of crude oil rather than simply hydrocarbons, in order to reduce matrix effects (for the Turner AU-10, long wavelength kits developed for oil detection are preferred over the short wavelength kits developed by the manufacture for other applications).
5) Instrument must be able to provide a digital readout of measured values. Given that different oils that have undergone partial degradation due to oil weathering will not provide consistent or accurate concentration data, measured values reported as "raw" units are preferred for field operations over concentration estimations that might be misleading as to the true dispersed oil and water concentrations.
6) In additional to a digital readout (as defined above), the instrument must be able to digitally log field data for post-incident analysis. Data logging must be in real-time, but downloading of achieved data is not required until after the monitoring activity, i.e., downloading the raw data to a computer once the boat has returned from the field operation is acceptable.
7) For instrument validation prior to operational use, the instrument must have a minimum detection limit (MDL) of 1 ppm of dispersed fresh crude oil in artificial seawater and provide a linear detection to at least 100 ppm with an error of less than 30% compared to a known standard. The preferred calibration oil is Alaskan North Slope Crude or South Louisiana Crude (the oils specified by the EPA's Dispersant Effectiveness). Similar dispersible crude oils may be used if availability is a limitation (diesel fuel is not a suitable substitute). Some method of instrument calibration or validation is required on-scene prior to any operational monitoring for Quality Assurance/Quality Control (QA/QC). In the past, the use of a fluorescent dye at a concentration that would provide an equivalent value of 18 ppm for fresh ANS Crude was used for both calibration and field validation.

3.11 Dispersant Monitoring Field Guidelines

3.11.1 Overview

Dispersant monitoring with fluorometers employs a continuous flow fluorometer at adjustable water depths. Using a portable outrigger, the sampling hose is deployed off the side of the boat and rigged so that the motion of the boat's propeller or the wake of the sampling boat does not disrupt the sampling line. The fluorometer is calibrated with a check standard immediately prior to use in accordance with the operator's manual. In addition, water samples are collected for confirmation by conventional laboratory analysis.

3.11.2 Tier II Monitoring Operations

3.11.2.1Monitoring Procedures

Monitoring the water column for dispersant efficacy includes three parts:
1. Water sampling for background reading, away from the oil slick;
2. Sampling for naturally dispersed oil, under the oil slick but before dispersants are applied; and
3. Monitoring for dispersed oil under the slick area treated with dispersants.

3.11.2.2Background sampling, no oil

En route to the sampling area and close to it, the sampling boat performs a monitoring run where there is no surface slick. This sampling run at 1-meter depth (or deeper depending on sea state conditions) will establish background levels before further sampling.

3.11.2.3Background sampling, naturally dispersed oil

When reaching the sampling area, the sampling boat makes the sampling transects at 1-meter depths across the surface oil slick(s) to determine the level of natural dispersion before monitoring the chemical dispersion of the oil slick(s).

3.11.2.4Monitoring of dispersed oil

After establishing background levels outside the treated area, the sampling boat intercepts the dispersed subsurface plume. The sampling boat may have to temporarily suspend continuous sampling after collecting baseline values in order to move fast enough to intercept the plume. The sampling boat moves across the path of the dispersed oil plume to a point where the center of the dispersed plume can be predicted based on the size of the treatment area and the locations of new coordinates. The sampling boat may have to be directed by an aerial asset to ensure correct positioning over the dispersed slick.

When conducting the monitoring, the transects consist of one or more "legs," each leg being as close as possible to a constant course and speed. The recommended speed is 1-2 knots. The monitoring team records the vessel position at the beginning and end of each leg.

The instrument data may be reviewed in real time to assess the relative enhanced dispersion of the water-soluble fraction of the oil. Figure 1 shows an example of how the continuous flow data may be presented.

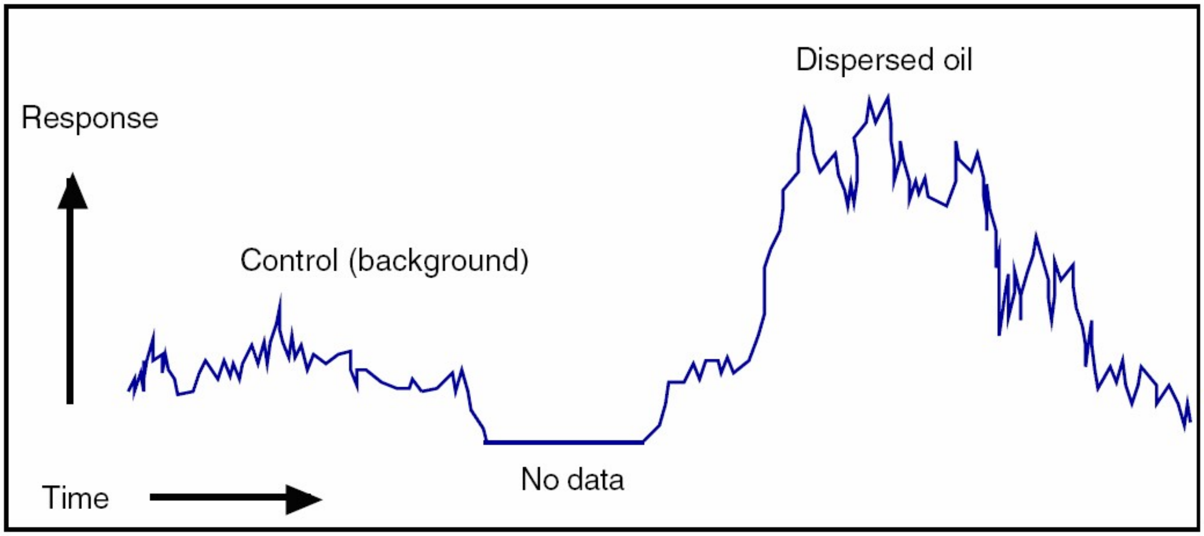

Figure 1. Example of a graphical presentation of fluorometer data.

3.11.3 Tier II Monitoring Locations: The Box Coordinates Method

The observation aircraft identifies the target slick or target zone for the sampling vessel by a four-corner box (Figure 2). Each corner of the box is a specific latitude/longitude, and the target zone is plotted on a chart or map for easy reference. The sampling vessel positions near the slick and configures the fluorometer sampling array. The pre-application sampling transect crosses the narrow width of the box. After completing the sampling transect, the sampling vessel waits at a safe distance during dispersant application. Data logging may continue during this period. Fifteen to twenty minutes after dispersants have been applied, the observation aircraft generates a second box by providing the latitude and longitude coordinates of the four corners corresponding to any observed dispersed oil plume. The post-application transect is identical to the pre-application transect. If no plume is observed, the sampling vessel samples the same transect used for pre-application.

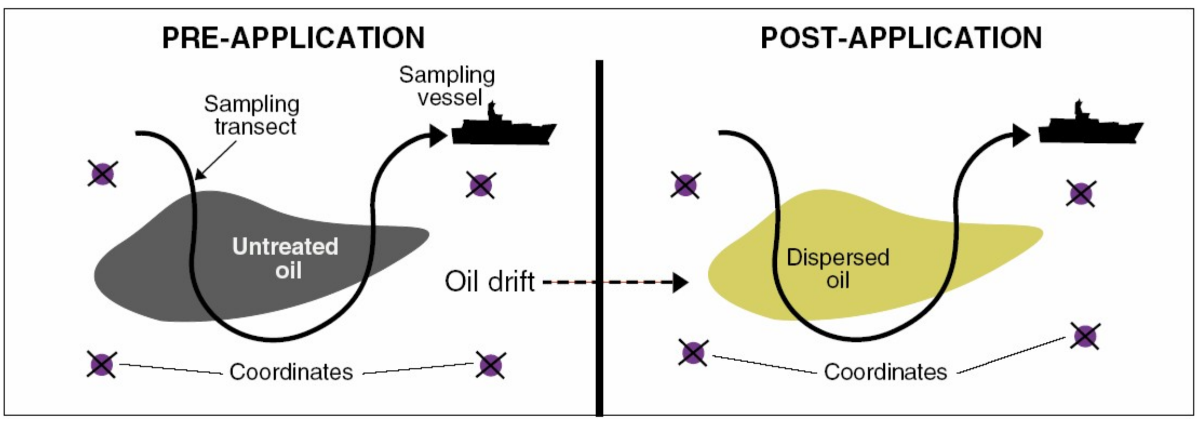

Figure 2. The box coordinates Method.

3.11.4 Tier III Monitoring Operations

If monitoring indicates that dispersant application is effective, the Unified Command may request that additional monitoring be done to collect information on the transport and dilution trends of the dispersed oil. Tier III may be conducted to address this information need. Tier III is highly flexible. Any Tier III operation will be conducted with additional scientific input from the Unified Command to determine both feasibility and help direct field activities. The Scientific Support Coordinator or other Technical Specialists would assist the SMART Monitoring Team in achieving such alternative monitoring goals.

3.11.4.1Multiple Depths with One Instrument

This monitoring technique provides a cross section of relative concentrations of dispersed oil at different depths. To conduct this operation, the team stops the vessel while transecting the dispersant-treated slick at a location where the fluorometry monitoring at the one-meter depth indicated elevated readings. While holding steady at this location, the team lowers the fluorometer sampling hose at several increments down to approximately ten meters (Figure 7). Monitoring is done for several minutes (2-3 minutes) for each water depth, and the readings recorded both automatically by the instrument's data logger and manually by the monitoring team, in the data logging form. This monitoring mode, like Tier II, requires one vessel and one fluorometer with a team to operate it.

3.11.4.2Simultaneous Monitoring at Two Different Depths.

If two fluorometers and monitoring setups are available, the transect outlined for Tier II may be expanded to provide fluorometry data for two different water depths (one and five meters are commonly used). Two sampling set-ups (outriggers, hoses, etc.) and two separate fluorometers (same model) are used, all on a single vessel, with enough monitoring personnel to operate both instruments. The team transects the dispersant-treated slick as outlined in Tier II, but simultaneously collect data for two water depths (Figure 7).

While the data logger in each instrument is automatically recording the data separately, the monitoring teams manually record the data from both instruments at the same time. Comparison of the readings at the two water depths may provide information on the dilution trend of the dispersed oil.

If requested by the Unified Command, water chemical and physical parameters may be collected by using a portable water quality lab in-line with the fluorometer to measure water temperature, conductivity, dissolved oxygen content, pH, and turbidity. These data can help explain the behavior of the dispersed oil.

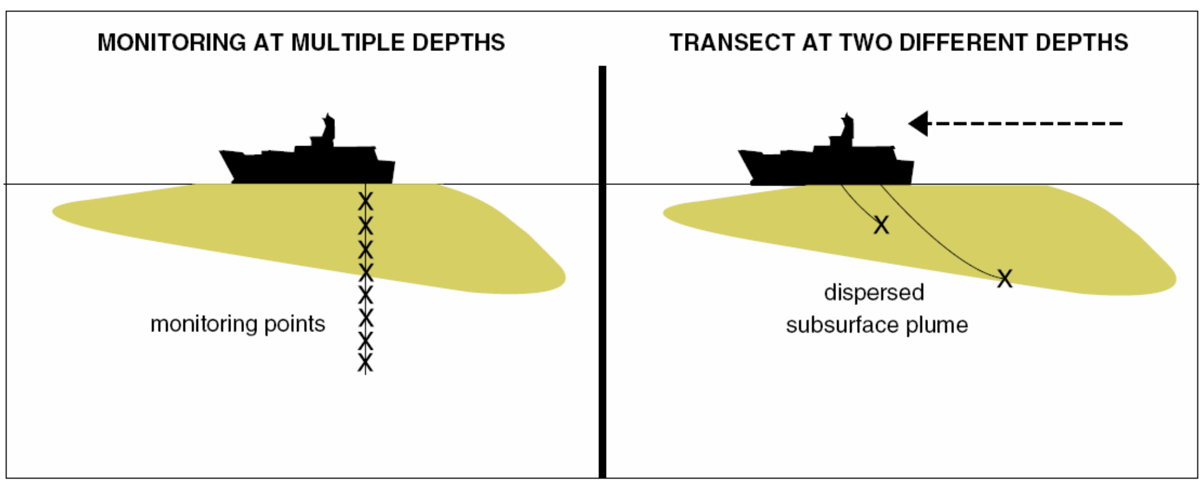

Figure 3: Monitoring options for Tier III.

3.12 Dispersant Monitoring Water Sampling

3.12.1. Purpose

Collection of water samples during Tier II and III monitoring should assist in correlating instrument readings in the field to actual dispersed oil concentrations in the water column. The samples provide validation of the field monitoring. The following guidelines were drafted for flow-through fluorometers. The procedures must be modified for alternative instruments. Such modifications might include discrete water sampling in concert with monitoring. The guidelines provided below are general, and should serve as an initial starting point for water sample collection. The number of samples collected may vary, depending on the operation and the need for verification.

3.12.2. Guidelines

<u>3.12.2.1Equipment</u>

1. Certified pre-cleaned amber 500-ml bottles with Teflon™-lined caps.
   - For Tier II, a minimum of six bottles is required.
   - For Tier III, a minimum of thirteen bottles is required.

2. Labels for bottles documenting time and location of collection.

3. Observation notes corresponding fluorometer readings to water sample collection, and any other observations.

<u>3.12.2.2Procedure</u>

1. Open valve for water sample collection and allow water to run for ten seconds before opening and filling the bottle.

2. Fill the bottle to the top and allow no headspace in bottles after sealing.

3. Label bottle with exact time of initial filling from the fluorometer clock as well as sampling depth, transect, and the distance of water hose from the outflow port of the fluorometer to the actual collection point of the water sample (to account for residence time of water in the hose)

4. Store filled bottles in a cooler with ice while on the monitoring vessel. Keep refrigerated (do not freeze) after returning to shore and send to the laboratory as soon as possible.

5. Measure and record the length of the hose between the fluorometer outlet and the bottle end, hose diameter, and flow rate (by filling a bucket). This will assist in accurately linking water sample results to fluorometer readings.

<u>3.12.2.3Number of Samples</u>

1. Collect one water sample per monitoring depth during the background (no oil) transect. The fluorometer readings prior to collection should be relatively constant.

2. Collect two samples per monitoring depth during the pre-dispersant monitoring (under untreated oil slick). Try to collect water samples correlating with representative fluorometer values obtained.

3. Collect approximately three samples per monitoring depth during the post-dispersant transects. These samples should represent the range of high, middle, and low values obtained from the fluorometer screen.

4. Label the bottles and store them in a cooler with ice. Do not freeze. Enter water sample number, time, and correlated fluorometer reading in the Recorder Log for future data processing

3.13 Dispersant Monitoring Recorder Form

Date:_________________ Fluorometer #:______________
Project: _______________________ Platform: _________________________

Monitoring Start/End Time: __________
Team members: ____ On-scene weather (log all possible entries) Wind direction from:_________Wind speed: ________
Sea state:___________Cloud cover:______________Visibility: ______________
Air temp. :__________Sea temp.: ______________

Comments should include: Presence or lack of surface oil or dispersed oil plume, whether conducting background run, transect in relation to slick, instrument or gear problem, or any other noteworthy event. Positions should always be recorded when a sample is taken. Otherwise, a log entry every five minutes is sufficient.

Time	Water depth	Fluorometer reading	GPS reading	Sample taken?	Comments & observations
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
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MONITORING IN-SITU BURNING OPERATIONS

1. BACKGROUND

1.1 Mission Statement
To provide a monitoring protocol for rapid collection of real-time, scientifically based information to assist the Unified Command with decision-making during in situ burning operations.

1.2 Overview of In situ Burning
In situ burning of oil may offer a logistically simple, rapid, and relatively safe means for reducing the net environmental impact of an oil spill. Because a large portion of the oil is converted to gaseous combustion products, in situ burning can substantially reduce the need for collection, storage, transport, and disposal of recovered material. In situ burning, however, has several disadvantages: burning can take place only when the oil is not significantly emulsified, when wind and sea conditions are calm, and when dedicated equipment is available. In addition, in situ burning emits a plume of black smoke, composed primarily (80-85%) of carbon dioxide and water; the remainder of the plume is gases and particulates, mostly black carbon particulates, known as soot. These soot particulates give the smoke its dark color. Downwind of the fire, the gases dissipate to acceptable levels relatively quickly. The main public health concern is the particulates in the smoke plume.

With the acceptance of in situ burning as a spill response option, concerns have been raised regarding the possible effects of the particulates in the smoke plume on the general public downwind. SMART is designed to address these concerns and better aid the Unified Command in decisions related to initiating, continuing, or terminating in situ burning.

2. MONITORING PROCEDURES

2.1 General Considerations
In general, SMART is conducted when there is a concern that the general public may be exposed to smoke from the burning oil. It follows that monitoring should be conducted when the predicted trajectory of the smoke plume indicates that the smoke may reach population centers, and the concentrations of smoke particulates at ground level may exceed safe levels. Monitoring is not required, however, when impacts are not anticipated.

Execution of in situ burning has a narrow window of opportunity. It is imperative that the monitoring teams are alerted of possible in situ burning and SMART operations as soon as burning is being considered, even if implementation is not certain. This increases the likelihood of timely and orderly SMART operations.

2.2 Sampling and Reporting
Monitoring operations deploy one or more monitoring teams. SMART recommends at least three monitoring teams for large-scale burning operations. Each team uses a real-time particulate monitor capable of detecting the small particulates emitted by the burn (~~ten microns~~ in diameter or smaller), a global positioning system, and other equipment required for collecting and documenting the data. Each monitoring instrument provides an instantaneous particulate concentration as well as the time-weighted average over the duration of the data collection. The readings are displayed on the instrument's screen and stored in its data logger. In addition, particulate concentrations are logged manually every few minutes by the monitoring team in the recorder data log.
Region 10 will monitor both PM 2.5 or smaller and PM 10 or smaller.

The monitoring teams are deployed at designated areas of concern to determine ambient concentrations of particulates before the burn starts. During the burn, sampling continues and readings are recorded both in the data logger of the instrument and manually in the recorder data log. After the burn has ended and the smoke plume has dissipated, the teams remain in place for some time (15-30 minutes) and again sample for and record ambient particulate concentrations.

During the course of the sampling, it is expected that the instantaneous readings will vary widely. However, the calculated time-weighted average readings are less variable, since they represent the average of the readings collected over the sampling duration, and hence are a better indicator of particulate concentration trend. When the time-weighted average readings approach or exceed the Level of Concern (LOC), the team leader conveys this information to the In-Situ Burn Monitoring Group Supervisor (ISB-MGS) who passes it on to the Technical Specialist in the Planning Section (Scientific Support Coordinator, where applicable), which reviews and interprets the data and passes them, with appropriate recommendations, to the Unified Command.

2.3 Monitoring Locations

Monitoring locations are dictated by the potential for smoke exposure to human and environmentally sensitive areas. Taking into account the prevailing winds and atmospheric conditions, the location and magnitude of the burn, modeling output (if available), the location of population centers, and input from state and local health officials, the monitoring teams are deployed where the potential exposure to the smoke may be most substantial (sensitive locations). Precise monitoring locations should be flexible and determined on a case-by-case basis. In general, one team is deployed at the upwind edge of a sensitive location. A second team is deployed at the downwind end of this location. Both teams remain at their designated locations, moving only to improve sampling capabilities. A third team is more mobile and is deployed at the discretion of the ISB-MGS.

It should be emphasized that, while visual monitoring is conducted continuously as long as the burn takes place, air sampling using SMART is not needed if there is no potential for human exposure to the smoke.

2.4 Level of Concern

The Level of Concern for SMART operations follows the National Response Team (NRT) guidelines. As of March 1999, the NRT recommends a conservative upper limit of ~~150 micrograms of PM-10~~ per cubic meter of air, averaged over one hour. Furthermore, the NRT emphasizes that this LOC does not constitute a fine line between safe and unsafe conditions, but should instead be used as an action level: If it is exceeded substantially, human exposure to particulates may be elevated to a degree that justifies precautionary actions. However, if particulate levels remain generally below the recommended limit with few or no transitory excursions above it, there is no reason to believe that the population is being exposed to particulate concentrations above the EPA's National Ambient Air Quality Standard (NAAQS). Region 10 will use a conservative upper limit of 35 micrograms of PM 2.5 per cubic meter of air, averaged over one hour.

It is important to keep in mind that real-time particulate monitoring is one factor among several, including smoke modeling and trajectory analysis, visual observations, and behavior of the smoke plume. <u>The Unified Command must determine early on in the response what conditions, in addition to the LOC, justify termination of a burn or other action to protect public health.</u> The Unified Command should work closely with local Public Health organizations in determining burn termination thresholds.

When addressing particulate monitoring for in situ burning, the NRT emphasizes that concentration trend, rather than individual readings, should be used to decide whether to continue or terminate the burn. For SMART operations, the time-weighted average (TWA) generated by the particulate monitors should be used to ascertain the trend. The NRT recommends that burning not take place if the air quality in the region already exceeds the NAAQS and if burning the oil will add to the particulate exposure concentration. SMART can be used to take background readings to indicate whether the region is within the NAAQS, before the burn operation takes place. The monitoring teams should report ambient readings to the Unified Command, especially if these readings approach or exceed the NAAQS.

2.5 SMART as Part of the ICS Organization

SMART activities are directed by the Operations Section Chief in the Incident Command System (ICS). It is recommended that a "group" be formed in the Operations Section that directs the monitoring effort. The head of this group is the Monitoring Group Supervisor. Under each group there are monitoring teams. At a minimum, each monitoring team consists of two trained members: a monitor and assistant monitor. An additional team member could be used to assist with sampling and recording. The monitor serves as the team leader. The teams report to the Monitoring Group Supervisor who directs and coordinates team operations, under the control of the Operations Section Chief.

2.6 Information Flow and Data Handling

Communication of monitoring results should flow from the field (Monitoring Group Supervisor) to those persons in the Unified Command who can interpret the results and use the data. Typically, this falls under the responsibility of a Technical Specialist on in-situ burning in the Planning Section of the command structure.

The observation and monitoring data will flow from the Monitoring Teams to the Monitoring Group Supervisor. The Group Supervisor forwards the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data and, most importantly, formulates recommendations based on the data. The Technical Specialist communicates these recommendations to the Unified Command.

Quality assurance and control should be applied to the data at all levels. The Technical Specialist is the custodian of the data during the operation, but ultimately the data belongs to the Unified Command. The Unified Command should ensure that the data are properly archived, presentable, and accessible for the benefit of future monitoring operations.

3. ATTACHMENTS

The following attachments are designed to assist response personnel in implementing the SMART protocol. A short description of each attachment is provided below.

Number	Title	Description
3.1	Roles and Responsibilities	Provides detailed roles and responsibilities for responders filling monitoring positions
3.2	Command, Control, and Data Flow	A suggested ICS structure for controlling monitoring units and transferring monitoring results
3.3	ISB Monitoring Training Outline	General training guidelines for ISB monitoring
3.4	ISB Monitoring Job Aid Checklist	A checklist to assist in assembling and deploying SMART ISB monitoring teams
3.5	ISB Monitoring Equipment List	A list of equipment needed to perform SMART operations
3.6	ISB Monitoring Instrumentation Requirements	Abbreviated performance requirements for particulate monitors
3.7	ISB Monitoring Recorder Sheet	A template for manual recording of burn data
3.8	ISB Monitoring Possible Locations	An example of monitoring locations for offshore ISB operations
3.9	ISB Monitoring Data Sample: Graph	An example of real ISB data

3.1 Roles and Responsibilities

3.1.1 Team Leader

The Team Leader
- Selects specific team location
- Conducts monitoring
- Ensures health and safety of team
- Ensures monitoring QA/QC
- Establishes communication with the group supervisor
- Conveys to him/her monitoring data as needed

3.1.2 Monitoring Group Supervisor

The Group Supervisor
- Oversees the deployment of the teams in the group
- Ensures safe operation of the teams
- Ensures QA/QC of monitoring and data
- Establishes communication with the field teams and the command post
- Conveys to the command post particulate level trends as needed
- Addresses monitoring technical and operational problems, if encountered

3.1.3 In-Situ Burn Technical Specialist

The Technical Specialist or his/her representative
- Establishes communication with the Monitoring Group Supervisor
- Receives the data from the Group Supervisor
- Ensures QA/QC of the data
- Analyzes the data in the context of other available information and incident-specific conditions, formulates recommendations to the Unified Command
- Forwards the recommendations to the Unified Command
- Makes the recommendations and data available to other entities in the ICS, as needed
- Archives the data for later use

Role and function	**Training**	**Number**
Monitoring Team Leader Leads the monitoring team	SMART Monitor Training	3
Monitor Assistant Assists with data collection.	SMART Monitor Training	3
Group Supervisor Coordinates and directs teams; field QA/QC of data; links with UC.	SMART Monitor training. Group Supervisor training	1 per group
Technical Specialist Overall QA/QC of data; reads and interprets data; provides recommendations to the Unified Command	SMART Monitor training. Scientific aspects of ISB	1 per response

3.2 Command, Control, and Data Flow

In general, in situ burn monitoring operations take place as an integral part of the Incident Command System (Figures 1 and 2).

ISB monitoring operations are directed by the Operations Section Chief or deputy. The Operations Section Chief provides the Monitoring Group Supervisor with tactical directions and support regarding deployment, resources, communications, and general mission as adapted to the specific incident. The Operations Section consults with the ISB monitoring Technical Specialist about the specifics of the monitoring operations, especially if they affect the data collected. The Monitoring Group Supervisor provides specific direction to the monitoring teams during field deployment and operations.

The observation and monitoring data flow from the Monitoring Teams to the Monitoring Group Supervisor. After initial QA/QC the Group Supervisor passes the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data, applies QA/QC if needed, and, most importantly, formulates recommendations based on the data. The Technical Specialist forwards these recommendations to the Unified Command.

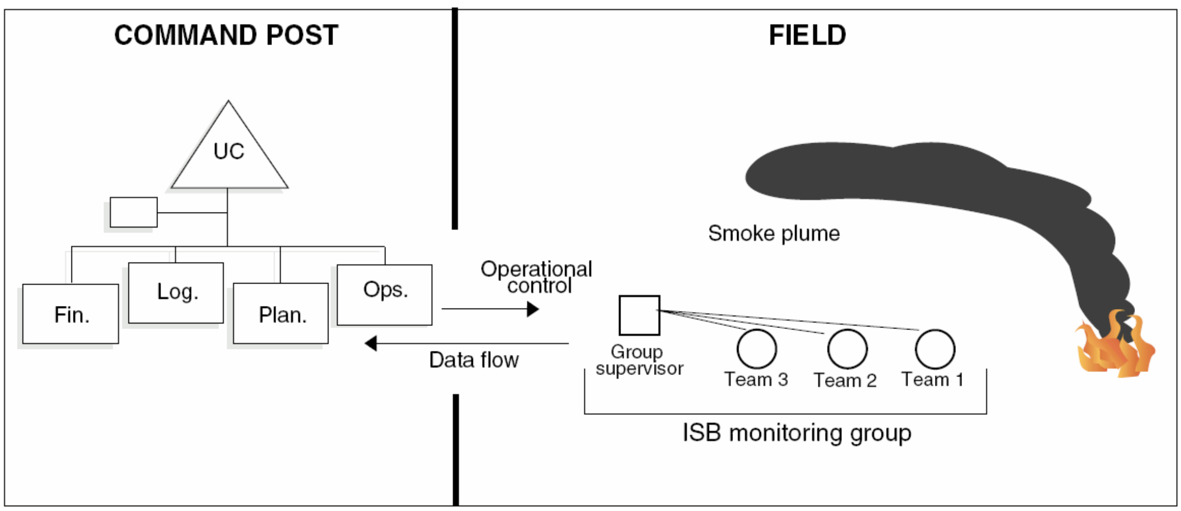

Figure 1. Command, control, and data flow during in-situ burning monitoring operations.

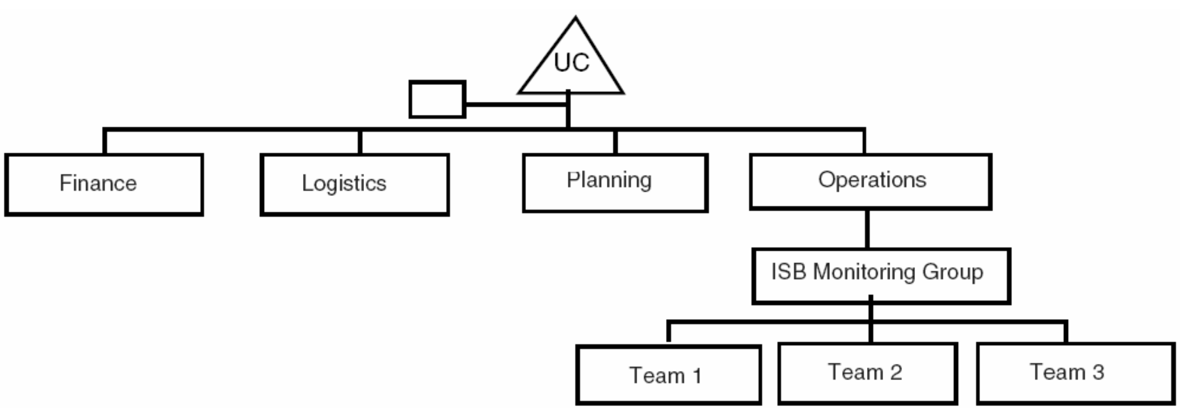

Figure 2. ISB Monitoring Group in the ICS organization.

3.3 ISB Monitoring Training Outline

3.3.1 General

Training for in-situ burning monitoring operations consists of an initial Monitor Level Training for all, Group Supervisor Training for supervisors, and refresher training sessions every six months for all.

3.3.2 Monitor Level Training

The Monitor Level Training includes monitoring concepts, instrument operation, work procedures, and a field exercise.

Topic	Duration
• Brief review of in-situ burning. • Review of SMART: What is it, why do it, what is it good for.	1 hour
• Monitoring strategy: Who, where, when. • Open water, inland. • Reporting: What and to whom • LOC: What is the LOC, how to report it. • Instantaneous reading vs. TWA, use of recorder data sheet	1 hour
• Basic instrument operation (hands-on): How the particulate monitoring instrument works, and how to operate it: brief description of mechanism, setup, and calibration, reading the data, what do the data mean; trouble shooting. • Using GPS • Downloading data	2 hours
Field exercise: Set up the instruments outdoors and measure background readings. Using a smoke source monitor for particulate levels, practice recording the data and reporting it. When done, practice downloading the data.	4 hours

3.3.3 Group Supervisor Training

Group Supervisor training may include two options:
- Independent training at each unit; or
- An additional structured day of training as suggested below

Topic	Duration
• Review of ICS and the role of the Monitoring Group in it • Roles of Monitoring Group Supervisor • What the data mean • QA/QC of data • Command and control of teams • Communication with the Technical Specialist	1 hour
Field exercise: Practice deploying instruments in the field with emphasis on reporting, QA/QC of data, communication between teams and the group supervisor, and group supervisor to the Technical Specialist.	3-6 hours
Back to the base, practice downloading the data	30 min.
Lessons learned	30 min.

3.3.4 Refresher Training

Topic	Duration
Review of SMART: What is it, why do it, what is it good for.	15 min.
• Monitoring and reporting: Who, where, and when • Level of concern • What do the data mean • Reporting the data • Work with the Technical Specialist (SSC).	30-45 min.
• Basic instrument operation (hands-on): How the monitoring instrument works, how to operate it; brief description of mechanism, setup, and calibration; • Reading the data, trouble-shooting. • Using GPS.	2 hours
Downloading data	30 min.
• Field exercise: Outside the classroom, set up the instrument and measure background readings. Using a smoke source, monitor particulate levels. • Practice recording the data and reporting it. • Back to the base, download data.	1-2 hours

3.4 ISB Monitoring Job Aid Checklist

This checklist is designed to assist SMART in situ burning monitoring by listing some of the tasks to accomplish before, during, and after the monitoring operations.

Check √	Item	Do
	Preparations	
	Activate personnel	Notify monitoring personnel and the Technical Specialist (SSC where applicable)
	Conduct equipment check	• Check equipment using equipment checkup list. • Verify that the monitoring instruments are operational and fully charged • Include safety equipment
	Coordinate logistics	Coordinate logistics (e.g., deployment platform) with ICS Operations
	Amend Site Safety Plan	Amend site safety plan to include monitoring operations
	Monitoring Operations	
	Monitoring Group setup	• Coordinate with Operations Section Chief • Coordinate with Technical Specialist
	Conduct Briefing	• Monitoring: what, where, who, how • Safety and emergency procedures
	Deploy to location	Coordinate with Operations Section Chief
	Select site	• Safe • Consistent with monitoring plan • As little interference as possible • Communication with Group Supervisor and UC possible
	Set up instrumentation	Unpack monitoring instruments and set up, verify calibration, if applicable
	Mark position	• Use GPS to mark position in recorder sheet • Re-enter position if changing location
	Collect background data	Start monitoring. If possible, record background data before the burn begins
	Collect burn data	• Continue monitoring as long as burn is on • Monitor for background readings for 15-30 minutes after the smoke clears
	Record data	Enter: • Instantaneous and TWA readings every 3-5 minutes, or other fixed intervals • Initial position from GPS, new position if moving • Initial wind speed and direction, air temperature, relative humidity, re-enter if conditions change
	Conduct quality assurance and control	• Verify that instrument is logging the data • Record data, location, relative humidity, temp, wind, interferences in the recorder data sheet • Note and record interference from other sources of particulates such as industry, vehicles, vessels

	Report by team	Report to Group Supervisor: • Initial background readings • TWA readings (every 15 min.) • TWA readings when exceeding 150 $\mu g/m^3$, (every 5 min.) • Interferences • Safety problems • QA/QC and monitoring problems
	Report by Group Supervisor	Report to the Technical Specialist (SSC): • Initial background readings • TWA, when exceeding ~~150~~ $\mu g/m^3$ see note 1 • Data QA/QC and monitoring problems
	Report by Technical Specialist (SSC)	Report to the Unified Command: • TWA consistently exceeding ~~150~~ $\mu g/m^3$ see note2 • Recommend go/no-go
	Post Monitoring	
	Debrief and lessons learned	• What went right, what went wrong • Problems and possible solutions • Capture comments and suggestions
	Preserve data	• Download logged data from monitoring instrument to a computer • Collect and review Recorder data logs • Generate report
	Prepare for next burn	Clean, recharge, restock equipment

1. TWA, when exceeding 35 micro-grams/cubic meter of PM 2.5

2. TWA consistently exceeding 35 micro-grams/cubic meter of PM 2.5

3.5 ISB Monitoring Equipment List

(For each team, unless otherwise noted)

Check √	Item	Qty	Remarks
	Particulate monitoring instrument, accessories and manuals	1 or more	
	Computer and cables	1/group	Should include downloading software
	Printer	1/group	
	Recorder data sheets	10	
	Write-in-the-rain notebooks, pens	3	
	Job aid check list	1	
	GPS	1	
	Extra batteries for GPS	1 set	
	Radio	1	
	Cell phone	1	
	Binoculars	1	
	Stop watch	1	
	Camera	1	digital camera or camcorder optional
	Film	3	
	Thermometer	1	
	Humidity meter	1	
	Anemometer	1	

3.6 Particulate Monitor Performance Requirements

SMART does not require nor endorse a specific brand of particulate monitoring instrument. Rather, SMART specifies performance criteria, and instruments meeting them may be used for ISB monitoring.

Performance Criteria

- Rugged and portable: The monitor should be suitable for field work, withstand shock, and be easily transportable in a vehicle, small boat or helicopter. Maximum size of the packaged instrument should not exceed that of a carry-on piece of luggage
- Operating temperature: 15-120 ºF
- Suitability: The instrument should be suitable for the media measured, i.e., smoke particulates
- Operating duration: Eight hours or more
- Readout: The instrument should provide real-time, continuous readings, as well as time-weighted average readings in ug/m3
- Data logging: The instrument should provide data logging for 8 hours or more
- Reliability: The instrument should be based on tried-and-true technology and operate as specified
- Sensitivity: A minimum sensitivity of 1 µg/m^3
- Concentration range: At least 1-40000 µg/m^3
- Data download: The instrument should be compatible with readily available computer technology, and provide software for downloading data

3.6.1 Additional Performance Criteria for Region 10

Particulate Matter Size Fraction

- Include instruments capable of sampling both the PM10 and the $PM_{2.5}$ fractions.

- Generally two types of equipment currently available in Region 10 are able to sample the PM 2.5 fraction. These are the Data Ram 4000 and the BGI-PQ200 sampler with a PM 2.5 sampling head added.

R10 update 8/2014

3.7 ISB Monitoring Possible Locations

Monitoring locations are dictated by the potential for smoke exposure to human populations. In general, the monitoring teams deploy where the potential for human exposure to smoke is most probable. Precise monitoring locations should be flexible and determined on a case-by-case basis. In the figure below, one team is deployed at the upwind edge of a sensitive location (e.g., a town). A second team deploys at the downwind end of this location. Both teams stay at the sensitive location, moving only to improve sampling capabilities. A third team is more mobile, and deploys at the discretion of the Group Supervisor.

It should be emphasized that, while visual observation is conducted continuously as long as the burn takes place, air sampling using SMART is not required if there is no potential for human exposure to the smoke.

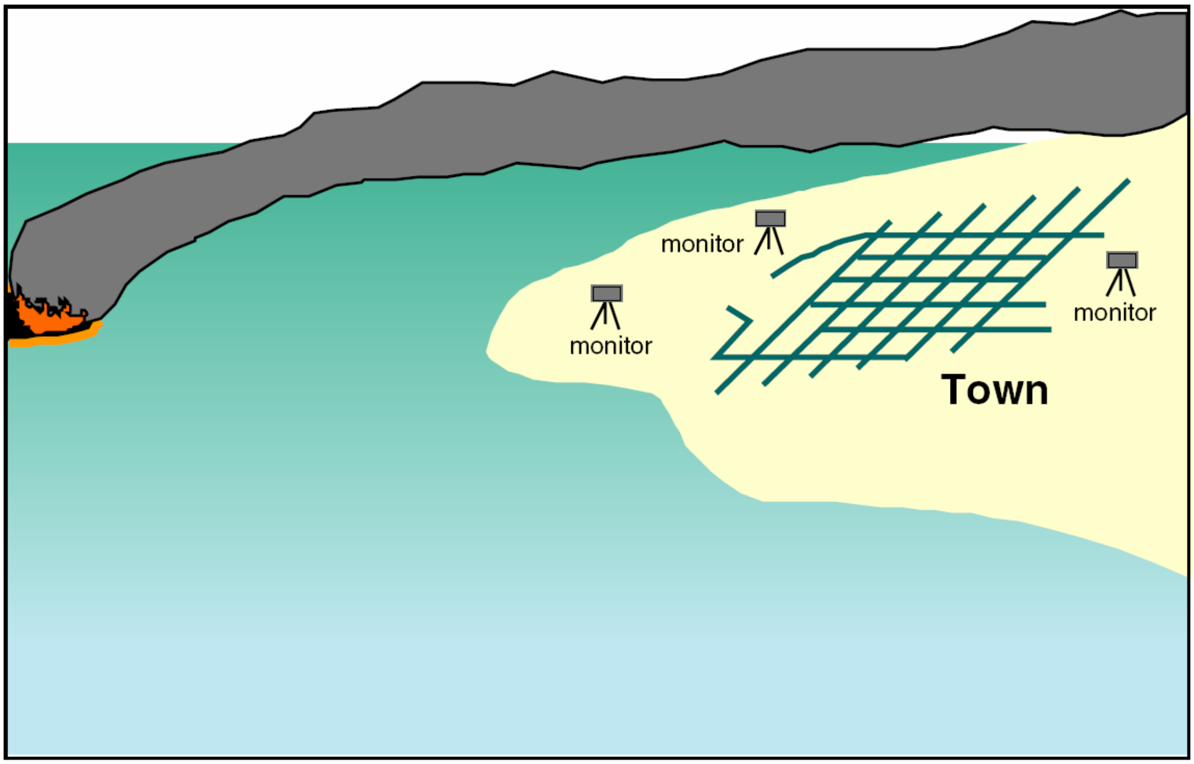

Figure 1. Possible locations of monitors (not to scale).

3.8 ISB Monitoring Recorder Sheet

Date: ___________ General Location: ____________________________________

General information	Weather information
Recorder name	Temperature
Operator name	Wind direction
Vehicle/vessel #	Wind speed
Monitoring Instrument #	Relative humidity
Burn #	Cloud cover
Calibration factors:	

Comments should include: location of the smoke plume relative to the instrument, interfering particulate sources, any malfunction of the instrument

Time	GPS reading	Particulates concentration	Comments & observations
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
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	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	
	lat:________________ long:	Inst: ________ TWA:	

3.9 ISB Monitoring Data Sample: Graph

The graph below represents field monitoring data from a test burn smoke plume near Mobile, Alabama, on September 25, 1997, after the data were downloaded from the instrument. The graph (Figure 1) portrays the differences between the transient instantaneous readings (Conc.) and the time weighted average readings (TWA). Note that while instantaneous readings varied widely, the TWA remained relatively constant throughout the burn. The TWA provides an indication of the concentration trends, which is a more stable and reliable indicator of exposure to particulates.

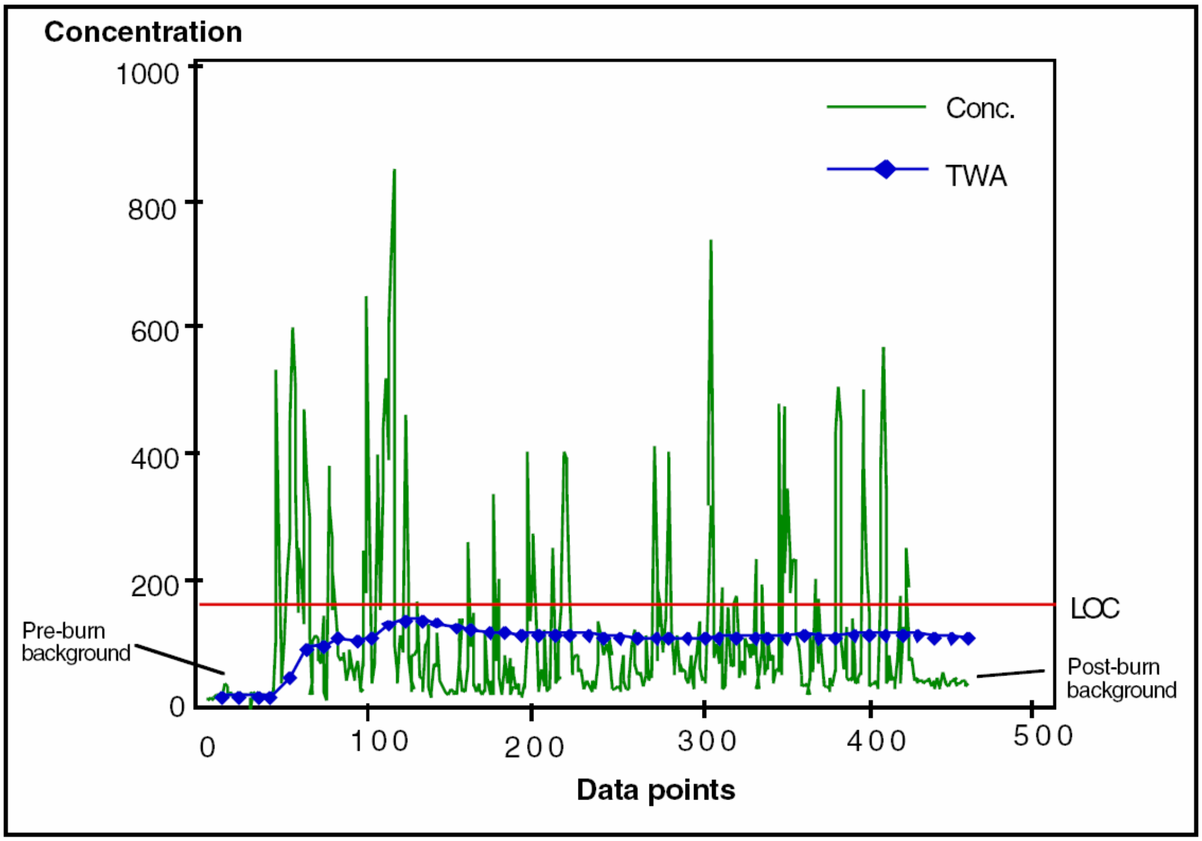

Figure 1. Graph of instantaneous and TWA particulate concentrations

SMART RESOURCES

Comments and suggestions on the SMART program and document
Fax: (206) 526-6329; Email: smart.mail@noaa.gov

SMART Web Sites
http://response.restoration.noaa.gov/smart

In-situ Burning Page
http://response.restoration.noaa.gov/ISB

Dispersant Guided Tour
https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/dispersants-guided-tour.html

Dispersant Application Observer Job Aid
https://response.restoration.noaa.gov/oil-and-chemical-spills/oil-spills/resources/dispersant-application-observer-job-aid.html

US Coast Guard
http://www.uscg.mil/

USCG National Strike Force
https://www.dco.uscg.mil/Our-Organization/National-Strike-Force/

NOAA OR&R
http://response.restoration.noaa.gov

EPA ERT
http://www.ert.org

CDC
http://www.cdc.gov/

BOEM Oil Spill Modeling Program
http://www.boem.gov/Oil-Spill-Modeling-Program/

OHMSETT Facility
http://www.ohmsett.com/