Industry Recommended Subsea Dispersant Monitoring Plan

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Contents

Acronyms and Abbreviations

3-D	Three-Dimensional
CTD	Conductivity, Temperature, Depth
DEMU	Dispersant Environmental Monitoring Unit
DGPS	Differential Global Positioning System
DOC	Department of Commerce
DOI	Department of the Interior
DWH	Deepwater Horizon
EB	Ecotoxicity Benchmark
EU	Environmental Unit
FIR	Fluorescence Intensity Ratio
FOSC	Federal On-Scene Coordinator
ft	feet
GC-MS	Gas Chromatography-Mass Spectroscopy
GPS	Global Positioning System
hr	hour
ICS	Incident Command System
LEL	Lower Exposure Limit
LISST	Laser In-Situ Scattering and Transmissometry
NCP	National Contingency Plan
NOAA	National Oceanographic and Atmospheric Association
NRDA	Natural Resource Damage Assessment
NRT	National Response Team
OSHA	Occupational Safety and Health Administration
PAH	Polycyclic Aromatic Hydrocarbon
PEL	Permissible Exposure Level
ppm	parts per million
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
ROV	Remotely Operated Vehicle
RP	Responsible Party
RRT	Regional Response Team
SMART	Special Monitoring of Applied Response Technologies
SSD	Species Sensitivity Distribution
TPH	Total Petroleum Hydrocarbon
VOC	Volatile Organic Compound
UC	Unified Command

Abstract

During the Deep Water Horizon (DWH) oil spill of 2010, subsea dispersant injection was used as a response option, in addition to other methods that have been more commonly applied during other events. At the time of the spill, there were no standardized methods for monitoring the efficacy and environmental effects of subsea dispersant use. During the DWH response effort, a unique organizational unit of the Incident Command System (ICS) structure, known as the Subsea Monitoring Unit (SMU), was created and monitoring methods were developed and modified as the event progressed. Those methods became the basis for policy and guidance development efforts within governmental agencies and industry. The American Petroleum Institute (API) developed a “model plan” for subsea dispersant monitoring that could be used by its member companies as the basis for facility response plans, or Incident Action Plans for a spill event. The National Response Team (NRT) created a guidance document that addresses “atypical” dispersant uses in general. This guidance is intended to be used by Regional Response Teams (RRT), but also contains specific guidelines that for use by responsible parties (RP).

This document describes a proposed method for monitoring the efficacy and character of subsea dispersant injection to inform operational oil spill response decision-making and Unified Command (UC) strategies for protecting worker health and safety. It is intended to be used as a model which can be modified to meet the needs of a specific facility or incident. This plan is intended to complement the Subsea Dispersant Operations Plan, but does not address surface dispersant operations. However, effective communications with units engaged in surface dispersant application and monitoring is essential.

Industry Recommended Subsea Dispersant Monitoring Plan

1.0 Introduction

This document describes a proposed method for monitoring the efficacy and character of subsea dispersant injection to inform operational oil spill response decision-making and Unified Command (UC) strategies for protecting worker health and safety. It is intended to be used as a model which can be modified to meet the needs of a specific facility or incident. This plan is intended to complement the Subsea Dispersant Operations Plan, and it is imperative that effective communications be maintained between the organizational units that implement both. This plan does not address surface dispersant operations, but effective communications with units engaged in surface dispersants application and monitoring is also essential. Incident Command System (ICS) elements (i.e., Health & Safety, Simultaneous Operations, Logistics, Communications, Data Management, etc.) that may be involved in implementing various aspects of this plan include the Environmental Unit, Source Control Branch, Subsea Well Containment Group Leader, Safety Officer, and potential subordinate organizations of each. If these organizations are not physically co-located, consideration should be given to establishing liaison positions within each to ensure two way communications between operational and monitoring activities.

The subsea monitoring plan proposed here is intended to be consistent with Subpart J of the National Contingency Plan (NCP) (40 CFR 300.910), and applicable National Response Team (NRT) and Regional Response Team (RRT) guidance, plans, or requirements. This document is intended to supplement, not replace, existing RRT pre-authorizations and the Special Monitoring of Applied Response Technologies (SMART) protocols.

The purpose of sampling and monitoring as described in this document are to:

- Determine dispersant efficacy;
- Characterize the nature and extent of subsea, or near surface, dispersed oil plumes; and
- Provide an initial assessment of potential ecological effects as they relate to operational response decision-making.

Information generated through these programs will guide the development of, or modifications to, previously established Action Levels that may inform decisions to continue, modify, or discontinue dispersant applications. Implementation of sampling and monitoring programs as described herein is expected to be implemented in a phased approach to enable rapidly deployable monitoring systems to be put into place and begin providing dispersant efficacy information to operational decision makers. It is envisioned that this initial rapid deployment will be followed by the use of more comprehensive monitoring tools that may assist oil spill responders in determining dispersed oil dilution and its chemical fate. All information generated should be reported to the Environmental Unit (EU) of the UC.

2.0 Purpose of Monitoring Subsea Dispersant Operations

Industry is committed to operating in an environmentally and socially responsible manner. Environmental and human health monitoring plans form an essential element of comprehensive and actionable oil spill preparedness and response plans. This document recommends monitoring activities to support subsea dispersant injection operations. Subsea dispersant injection is a new concept and, to date, has been associated only with catastrophic releases from well blow-outs. The approach involves adding dispersant, via a remotely controlled underwater vehicle or a fixed injection system associated with a capping stack, directly into the released oil flow in the immediate vicinity of the release point. The intent is to limit the formation of a surface oil slick, to minimize the aerial release of volatile compounds at the spill response site (a threat to worker health and safety), to prevent or reduce the potential for floating oil to impact sensitive environmental resources, and to optimize the potential for microbial biodegradation. As it is a new approach, it is important that monitoring be conducted in a manner that provides actionable data for decision-makers within the ICS.

Monitoring data is used to help decide whether to continue or modify subsea dispersant use. The data helps spill responders make more informed and effective decisions about the way to use subsea dispersants, in combination with other spill response technologies, to protect people and the environment from harmful concentrations of oil. A detailed monitoring plan also helps identify the supplies, equipment, staff and activities needed to use subsea dispersant injection effectively in the event of a spill. Addressing these requirements through response planning helps produce more efficient and effective results during the response effort.

This Subsea Dispersant Injection Monitoring Plan describes a monitoring program to evaluate and document the effectiveness of subsea injection of dispersants. These monitoring activities provide data to inform decisions regarding ongoing subsea injection of dispersants. This document contains a recommended approach to monitoring and includes a list of resource requirements as well as data management and safety considerations for implementing an effective monitoring program.

Monitoring team members will consist of personnel specially trained not only for the technical operation of the equipment, but also interpretation of the data to support operational decisions. Consistent with other spill response environmental assessment protocols, National Oceanographic and Atmospheric Association (NOAA) Scientific Support Coordinators should be the lead Federal representative working with industry environmental scientists to implement the described dispersant monitoring operations. U.S. Coast Guard National Strike Team members should also be involved with operational support consistent with current surface SMART protocols. Subsea dispersant application is still a relatively novel spill response method, so other local, state, and Federal agencies, particularly those with concurrence roles established in the NCP, may also be present in the UC, the EU, the Dispersant Environmental Monitoring Unit (DEMU), and other ICS elements.

3.0 Description of Monitoring Approach

Monitoring plans must be adjusted to the magnitude, location and complexity of the response. Therefore, this monitoring plan utilizes an adaptive, scientifically-based approach and is designed to meet incident-specific response requirements. In some incidents, a basic monitoring program may be adopted to gain initial regulatory approval for subsea dispersant use prior to the execution of a more comprehensive monitoring program. Incidents that involve greater oil volumes and/or continue for longer time periods have the potential to result in greater environmental impact, and the level of monitoring may escalate as the size or duration of an incident increases. Traditional surface dispersant application has utilized the tiered SMART protocol for dispersant effectiveness monitoring. When using SMART protocols, monitoring begins with visual observations to determine dispersant efficacy, and decisions to escalate to higher tiers of the monitoring plan are based on operational needs and the time available to implement additional monitoring systems.

Subsea oil spill scenarios differ somewhat in that it may take several days to initiate subsea dispersant injection. Although the protection of worker health and safety, and potentially sensitive surface and shoreline environmental areas requires initiation of subsea dispersant injection as soon as possible after a well control incident, in most cases it may be possible to have monitoring assets in position to initiate more sophisticated monitoring procedures concurrently with dispersant injection.

The existing NRT Guidance for *Environmental Monitoring for Atypical Dispersant Operations*, and EPA Region VI currently require that monitoring assets be in place prior to dispersant injection. FOSC approval should be sought for any required deviation from those policies.

The purpose of the monitoring program outlined in this document is to obtain data that support real-time or near real-time operational decision-making. As such, its primary focus is to collect data on dispersant effectiveness, dispersed oil dilution, and dispersed oil fate. It is not designed to collect data on environmental impacts. Although it is important to collect this data, it is challenging to use it in real-time as it takes time to analyze, interpret, and draw conclusions about the environmental significance of the dispersant application operation. Separate vessels and field teams should be utilized, as appropriate, to support efforts to assess any environmental damage (i.e., NRDA) resulting from the oil spill.

Finally it should be noted that this subsea monitoring plan may be integrated into other company-specific operational plans for source control, capping and containment, dispersant operations, data and sample quality control, worker health and safety, etc.

4.0 Subsea Dispersant Application Monitoring Guidelines

Introduction

Subsea dispersant injection has not been integrated into standard industry references on dispersant operations as it is a relatively new concept. The basic operations are as follows:

- A surface vessel carries and supplies dispersants to the spill site.
- Dispersant is injected from the surface vessel through a line that is connected to a nozzle held at the spill source by a Remotely Operated Vehicle (ROV).
- The ROV positions the nozzle to directly inject dispersant into the flow of oil as close to the release point as possible. If possible, the nozzle should be inserted into the release point to inject dispersant into the oil before it discharges to the environment.
- Dispersant is pumped at a controlled rate from the deck of the surface vessel through the nozzle and into the oil.
- Increasingly, well-capping structures are being equipped with dispersant injection ports built into them facilitating dispersant application in some instances. This monitoring plan is adaptable and applicable to this type of subsea injection as well.

The subsea dispersants monitoring program is designed to complement the dispersant application program and is divided into three sections, organized chronologically, and in increasing level of complexity. Under optimal circumstances, all sections would be implemented simultaneously, but logistical considerations may require implementation in the order presented. The phased approach was developed to allow implementation of subsea dispersant injection with only Phase 1 monitoring in the event that delays in implementing more complex stages would delay injection. If this were to occur, additional monitoring would be implemented as soon as practical. The three sections that follow address dispersant efficacy, delineation of resultant dispersed oil plumes, and chemical characterization of dispersed oil in the water column.

4.1 Phase 1: Confirmation of Dispersant Effectiveness Near the Discharge Point and Reduction in Surface Volatile Organic Compounds (VOCs)

Description of Operation

The initial question that must be answered by the subsea monitoring program is, "Is the dispersant injection effective?" Efficacy monitoring of subsea dispersant injection is conducted in four ways:

- Visually by ROV equipped with video cameras;
- Visually by analyzing the surface expression of oil using aerial imaging;
- Analytically by air monitoring the VOCs and % lower exposure limit (%LEL) on vessels in close proximity to the well site; and
- An ROV (other than the one implementing subsea dispersant injection) equipped with video cameras may be stationed at the spill source to collect video before and after initiation of subsea dispersant injection to determine if the visible cloud of oil is changing color and/or changing shape. Such changes are indicative of oil being reduced to micron-sized droplets.

In addition, visual monitoring may include observations of the surface expression of oil before and after initiation of subsea dispersant injection using aerial over flights. This technique provided strong evidence that subsea dispersant injection was working during the Deepwater Horizon (DWH) incident (Figure 1).

Figure 1 – *Use of aerial surveillance to help assess effectiveness of subsea dispersant injection in reducing amounts of surface oiling during the Deep-water Horizon incident. The left image was taken the day before subsea dispersant injection was initiated and the right image was taken 11 hours after initiation.*

The final technique will involve monitoring of the VOCs and %LEL on vessels and platforms located near the well-site before and after initiation of subsea dispersant injection. Surface slicks of fresh oil near the well-site should cause elevated concentrations of VOCs. If subsea dispersant injection is efficiently dispersing oil, surface slicks will be minimized causing a reduction in surface VOCs and %LEL, thereby, minimizing VOC exposure to workers in the source control zone.

Basic Monitoring Methodology

ROV Monitoring

1 Images collected from video cameras on the ROV before and during injection are used to determine if the color of the visible oil cloud is changing, which indicates the oil is being dispersed.

2 The ROV will be raised upwards through the water column keeping a constant distance from the cloud. The video images will be used to detect changes in the cloud density and shape as the oil, gas, and dispersant mixture rises through the water column and is dispersed by local currents.

Aerial Monitoring

1. Aerial monitoring will be conducted before and during the application of the dispersant to determine if the use of dispersant is reducing the amount of oil reaching the surface [1]

2. Flights will be conducted before and during the application of dispersant. These flights will occur only after sufficient time has elapsed to allow oil to fully express on the surface. Depending on the water depth, this could require several hours. Flights before dispersant application must allow sufficient time for untreated oil to reach the surface after initiation of the well-control event. Flights during dispersant application must allow time for the water column to clear of untreated oil and the surface slicks to transfer out of the observation area. Observations will be documented using visual assessments by trained observers and documented using photographic resources. Aerial monitoring efforts must take into account local currents that can potentially transport the rising oil (dispersed or not) some distance from the spill site, depending on the strength, depth, and direction of the currents.

VOC and %LEL Monitoring

1. VOC and %LEL monitoring equipment and trained users will be stationed on vessels located near the well site. Significant reductions in VOCs will indicate a reduction in fresh oil slicks near the well site. As with aerial monitoring, efforts must take to account local currents that can transport the rising oil (dispersed or not) some distance from the spill site and local wind direction that can transport VOCs away from surface vessels. VOC and %LEL measurement will be affected by surface conditions such as wind speed/direction and location of the monitoring device relative to the surface slick location. For example, vessels upwind of surface slicks could have low VOCs and %LEL even with surface slicks nearby. These additional variables could complicate interpretation of the VOC and %LEL data. These complications may limit the ability to draw definitive conclusions on the effectiveness of subsea dispersants from this data. Weather conditions should be reported along with all VOC data. Corresponding representative water samples should be collected and analyzed for individual constituents. A diagram should be prepared identifying the time and location of all VOC samples taken. VOC and %LEL data should also be provided to the FOSC, and the UC Safety Officer for gauging potential threats to workers.

2. Workers will be equipped with exposure badges to monitor Permissible Exposure Levels (PELs) to VOCs per OSHA standards. The resulting data should be reported to the IC, the DEMU, and the Safety Officer.

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1 Note: An approved field guide is “Open Water Oil Identification Job Aid for Aerial Observation” published by NOAA, Nov 2007, and is available on line at http://response.restoration.noaa.gov/

Basic Requirements List

- Ship-based VOC and %LEL monitoring instruments with trained operators
- Worker detection badges for PEL monitoring
- Two ROV's equipped with video cameras – one for dispersant application and one to monitor dispersant effectiveness
- Trained ROV operators
- Trained observers in the ROV control room and on the aerial platform with an approved field guide and camera
- Aerial platform - aircraft (either fixed-wing or helicopter) with appropriate communication and Global Positioning System (GPS) navigation suit

4.2 Phase 2: Characterization of Dispersed Oil Concentrations at Depths in Water Column

Description of Operation

Water column monitoring seeks to determine the location, extent, and characterization of the dispersed oil plume at depth. The extent of such monitoring increases with the length and volume of the release. Local oceanographic data together with hydrodynamic models, if available, will determine the likely direction of movement of the sub-surface oil.

A monitoring vessel will conduct sampling casts using a Conductivity Temperature Depth (CTD) instrument, outfitted with a fluorometer and a dissolved oxygen sensor. Additionally, LISST-Deep particle size analyzer will be deployed just above the subsea dispersant application location, if an ROV is available to support the operation. Water samples will be collected and stored for subsequent detailed chemical analysis from depths determined by the results of the CTD casts for selected stations.

Water samples for shipboard dissolved oxygen measurements, shipboard TPH analysis (per Phase 3), and shore-based analyses (per Phase 3) should be collected at depths above, in and below any observed increase in fluorometric response. In addition, water samples defined as background should be collected outside the plume at equivalent depths. These samples will be brought to the surface for DO analysis to periodically confirm DO readings provided by the DO sensor that is deployed with the CTD.

The LISST particle size analyzer will provide near real-time *in situ* measurements of the dispersed oil (and gas) droplet-size distributions. In addition, the LISST particle size analyzer provides real-time volume based concentrations of dispersed oil and gas. LISST devices are available that may be used *in situ* (i.e., LISST-Deep), which is preferable, or samples may be collected at depth and analyzed at the surface. After effective dispersant application, the reduced droplet size of the oil combined with the buoyancy of the gas should cause the oil droplets and gas to separate. Measurements taken at a significant distance from the source should primarily be of dispersed oil as the gas will have a faster upward velocity. Median oil droplet sizes below 100 microns are indicative of effective dispersion. A 100 micron droplet is estimated to require approximately 10 days to rise through 5000 ft of water, assuming no turbulent re-entrainment or trapping. Droplets less than 100 microns are expected to be entrained and trapped at depth where they will be subject to natural biodegradation. The purpose of this data is to assess the effectiveness of the subsea dispersant operations, to characterize the lateral and vertical movement of the dispersed oil, and to document the concentration of oil as it moves away from the site where it was released.

Basic Monitoring Methodology

Efficacy monitoring using an ROV, aerial imaging, and ship-based VOC and PEL monitoring will be continued.

Subsea Water-column Dispersed Oil Measurements

1. The determination of where to sample should be based on information from a reliable, 3-D subsea oil and dispersed oil model. If no data are available, a sampling grid should be developed centered on the spill location. Stations should be occupied in a radial pattern moving out from the center and fluorometer readings from CTD casts should be used to determine the path of the dispersed oil. It is recommended that consideration be given to using two vessels (in rotation between sampling and resupply) which allows for more continuous and complete coverage.

2. Maneuver vessel onto location.

3. Determine water depth to assess CTD/Fluorometer/oxygen sensor deployment depth.

4. Lower the instruments to the seabed while observing the real-time CTD / fluorometer / oxygen data display to determine if the dispersed oil is detected. [2]

5. If the oil is detected, the depths at which water samples will be collected will be made per the standard operating procedure prepared as part of the detailed monitoring plan.

6. On the up cast, the sample bottles will be triggered and samples collected.

7. Following retrieval of the instruments, the samples will be transferred to sample containers and stored appropriately onboard until shipment to a certified/accredited laboratory.

8. If practical, vessels should have onboard Gas Chromatography-Mass Spectroscopy (GC-MS) with flame ionization detector capability to determine total petroleum hydrocarbons (TPHs)

9. Water sample analysis (on vessel where practical) should include:

   i. GC-MS analysis of aliphatic hydrocarbons; monocyclic and polycyclic aromatic hydrocarbons; appropriate biomarker compounds; TPHs; and VOCs;

   ii. Dispersant constituents; and

   iii. Turbidity.

Basic Requirements List

- See Efficacy list, plus
- Research vessel(s) with fathometer capable of measuring water depth in area of operation
- Differential GPS (DGPS) navigation system
- CTD system with winch, data cable, and deployment davit or A-frame

[2] In 5000 ft depth, it will take approximately 2 hours for down casting, sampling, and up casting of sampling array.

- Sensors on CTD include:
  - Fluorometer
  - Conductivity/Temperature/Depth Sensors
  - Dissolved oxygen sensor
- Water sample capability on CTD (Niskin bottles on remotely fired rosette sampler)
- Data logging computer/printer and software
- Water sample containers/storage capability
- Sample handling and transfer plan
- Depth gauge for intermediate water column depth measurements
- Hand held optical dissolved oxygen meter
- Particle size analyzer (LISST-Deep or equivalent) capable of operating at Source Control

4.3 Phase 3: Detailed Chemical Characterization of Water Samples

Description of Operation

This phase of monitoring seeks to fully characterize all water samples collected during operations addressed in Section 4.2 using shipboard gas chromatography (if possible) and a certified and accredited contract laboratory capable of processing large volumes of samples, and using state-of-the-art laboratory analytical techniques for petroleum analytes and dispersant marker analysis. Shipboard gas chromatography will be used to define total petroleum hydrocarbon concentrations (if possible). Once water samples are collected, they must be returned to port for transfer via ground vehicle to a certified, accredited laboratory utilizing appropriate chain-of-custody procedures. Vessel transit time, sample transfer time, and laboratory processing equates to a minimum of five (5) days to process a sample. In the case of a larger spill event where significant numbers of samples are collected, ICS should assume that it will take a minimum of 7 to 10 days to receive detailed analytical results that have met quality assurance and control (QA/QC) standards. Thus, due to safety concerns noted above for elevated VOCs and %LEL, subsea dispersant application should commence as soon as monitoring described in Section 4.1 is available.

Basic Monitoring Methodology

1. Properly label all water samples collected during monitoring and store on ice. [3]
2. Transit the vessel back to port to offload samples to a vehicle that can transfer samples to a shipping facility, while maintaining appropriate chain-of-custody.
3. Ship samples on ice to a certified and accredited analytical laboratory for analysis and QA/QC data management.
4. Provide sample results to Environmental Unit to inform subsea dispersant use decision-making.

[3] Duplicate samples should be taken, where practical.

Basic Requirements List

- Ship-capable gas chromatograph with flame ionization detector or equivalent instrument capable of measuring total petroleum hydrocarbons
- Transfer vehicles to shuttle samples from port to a shipping facility
- Shipping facility to transport samples to a laboratory
- Contract laboratory that is certified and accredited for hydrocarbon chemical analysis

5.0 Communication Plan

The communication plan will include a protocol addressing sample tracking, data management, data format, and an accessible digital data storage platform mutually agreed upon by the UC. Data managers should be designated for ensuring the collection and distribution of all data elements described hereafter. These include data generated by the units responsible for implementation of the Subsea Dispersant Operations Plan, the Subsea Dispersant Monitoring Plan, air monitoring data generated through implementation of the Safety Plan, and Source Control activities. All data collected and/or analyzed by the RP or the government (with the exception of data and/or analysis strictly associated with NRDA or legal investigations) will be available to the UC. Unless otherwise instructed by the UC, the communications plan may be based, to the extent applicable, on the NRT guidance for Environmental Monitoring for Atypical Dispersant Operations. Data reporting will be on a daily basis, when feasible, unless otherwise approved by the FOSC. The communications plan shall include, but may not be limited to:

- Air and Water quality data generated by activities described in Section 4.
- The amount of dispersant applied for the previous 24-hour period, in hourly intervals, if possible.
- Variations in the planned dispersant application +/-10% of the previous daily average.
- Water column dispersed oil loading reports.
- Dispersing potential assessment reports and recommendations.
- Daily subsea transport estimate of oil, dispersant, and dispersed oil plumes using the most current trajectory modeling available.

6.0 Quality Assurance Project Plan

The Quality Assurance Project Plan (QAPP) will address sample collection methodology, handling, chain of custody, and decontamination procedures to ensure the highest quality data will be collected and maintained. The QAPP will be developed in accordance with EPA Quality Assurance Project Plans 4 and 5, and recommendations from the UC. The QAPP should be based, as appropriate, on the NRT guidance on *Environmental Monitoring for Atypical Dispersant Operations*.

Discrete samples will be tested at a laboratory approved by the OSC, with the concurrence of EPA and, as appropriate the states, and in consultation with DOC and DOI. The QAPP will include:

- An introduction that identifies project objectives and the project staff.
- A site description and background. The site description will include bathymetry, subsea currents (including temporal variations), and other relevant geological features. The site description will identify

any relevant oil seeps or other potential sources of contamination (e.g., recent oil discharges), and relevant oil and/or natural gas infrastructure (e.g., oil platforms, subsea pipelines).

- A description of the sampling and monitoring protocols, data quality objectives, and health and safety implementation strategies included in this monitoring plan.

- Quality assurance (QA) to address chain of custody procedures, field records including logs, and qualitative data handling including photographs.

7.0 Ecological Toxicity Assessment

An ecological toxicity (ecotoxicity) assessment plan will be developed in consultation with the UC, and will use the best available technology. The primary method assumed to be relevant to this spill involves comparison of water quality data developed through implementation of this plan, to ecotoxicity benchmarks (EBs), established through consultation with the UC. The EBs would be based on species sensitivity distributions (SSDs). Ecotoxicity would be assessed by comparing TPH concentrations in water samples collected at appropriate depths to TPH based EBs. The ecotoxicity assessment would also be performed in areas where no dispersant has been applied to allow determination and comparison of ecotoxicity from physically dispersed and chemically dispersed oil.

Chronic toxicity benchmarks may be derived, if instructed by the UC, by applying a safety factor to the acute toxicity EB.

It is anticipated that the UC may also consider additional ecotoxicity testing methods, in consultation with subject matter experts, to monitor whole water samples with considerations for:

- Site conditions (e.g., location of the discharge, weather conditions at the discharge, field water temperature);

- Operational relevance;

- Field ecological receptors at risk; and

- Test organism availability and availability of testing equipment and/or laboratories.

If directed to do so, all sample collection and testing will be conducted using standardized sampling and test protocols, or as otherwise directed by the UC.

8.0 Action Levels

The UC should establish action levels, which may serve as trigger points for convening appropriate agencies and technical resources to review current dispersant operations. These action levels should be used to alert the UC to findings of potential environmental impacts that could warrant changes to the dispersant use plans.

It is anticipated that the UC will establish action levels that could include measured dissolved oxygen levels that approach hypoxia (i.e., 2.0 ppm), measured concentrations of dispersant marker compounds, oil, and dispersed oil, and the EBs established in the ecological toxicity assessment.

Reporting requirements established by the UC for comparisons of monitoring data to these action levels will be assumed to be on a 24-hr basis, and will be included in the communication plan.

AMERICAN PETROLEUM INSTITUTE

1220 L Street, NW
Washington, DC 20005-4070
USA

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