APPENDICES

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Appendix A
Glossary

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GLOSSARY

This glossary was partially developed using definitions found in the following:

- Using Oil Spill Dispersants on the Sea, Committee on Effectiveness of Oil Spill Dispersants, National Academy Press, Washington, D.C., 1989.
- Spill Response Glossary, Compiled by: National Oceanic and Atmospheric Administration, Hazardous Materials Response and Assessment Division, Scientific Support Coordination Branch.
- Glossary of Terms Related to Health, Exposure, and Risk Assessment, Air Risk Information Support Center (Air RISK), USEPA, 1989.
- Oil Spill Response: Products and Technology Reference Guide, USEPA, Scientific and Environmental Associates, Research Planning, Inc., Ecosystem Management & Associates, Inc., 1998.

absorb / absorption The take up of a substance *into* another substance.

accelerant An agent used to promote ignition or spreading of a fire, such as gelled gasoline, diesel/gasoline mixes, and fuel-soaked rags.

acute toxicity The inherent potential or capacity of a material (e.g., oil, chemicals) to cause adverse effects in a living organism after only a short period of exposure (generally less than 4 days).

ADDS Airborne Dispersant Delivery System

adjacent lands for the purpose of this document, adjacent lands are described as land that can or does affect surface waters, including marsh, wetlands, manmade structures, storm drains, beaches, creeks, ditches, or ponds.

adsorb / adsorption The take-up of a liquid *at the surface* of a substance. Involves molecular attraction at the surface of the substance.

aerobic Air breathing; aerobic organisms require free oxygen to breathe.

sorbents These are true sorbents that act in the same manner as other sorbents do. They are only referred to as being 'alternative' because they are not made of the materials typically associated with sorbents. (i.e., not made of polypropylene, cotton, etc.).

ambient Surrounding. Ambient conditions are those in the surrounding environment, such as ambient temperature, humidity, etc.

anaerobic Refers to the absence of molecular oxygen. Anaerobic organisms are able to live and grow where there is no air or free oxygen.

API Gravity A scale of specific gravities for petroleum fluids. Based on a simple inverse relationship with specific gravity. API Gravity = (141.5/Specific Gravity)-131.5

aromatic Aromatic hydrocarbons are composed solely of carbon and hydrogen atoms in various arrangements that include at least one benzene ring. Aromatic hydrocarbons are generally considered to include compounds that can be toxic, carcinogenic, or both, and give oil its smell.

ARTES Applied Response Tool Evaluation System

barrel Equal to 42 United States gallons at 60° F.

benthic Pertaining to the bottom of a body of water.

biodegradation The process by which bacteria and other living organisms break down oil. The ultimate end products from biodegradation are carbon dioxide and water.

biological additive Microbiological cultures, enzymes, or nutrient additives that are deliberately introduced into an oil discharge for the specific purpose of encouraging biodegradation to mitigate the effects of the discharge.

bioremediation Acceleration of natural microbial degradation of a material by adding or enhancing one or more of the key rate-controlling factors, such as nutrients, oxygen, temperature, surface area, and moisture.

bioremediation agents means microbiological cultures, enzyme additives, or nutrient additives that are deliberately introduced into an oil discharge and that will significantly increase the rate of biodegradation to mitigate the effects of the discharge.

biosurfactant A naturally occurring surfactant.

booms Floating barriers used for the collection, diversion, deflection, and containment of spreading liquids.

brackish Intermediate in salinity (0.50 to 17.00 parts per thousand) between fresh water and seawater.

burning agents means those additives that, through physical or chemical means, improve the combustibility of the materials to which they are applied.

centipoise (cP) a unit of measurement for dynamic viscosity.

centistoke (cSt) a unit of measurement for kinematic viscosity.

CERCLA The Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986.

chemical agents means those elements, compounds, or mixtures that coagulate, disperse, dissolve, emulsify, foam, neutralize, precipitate, reduce, solubilize, oxidize, concentrate, congeal, entrap, fix, make the pollutant mass more rigid or viscous, or otherwise facilitate the mitigation of deleterious effects or the removal of the pollutant from the water. Chemical agents include biological additives, dispersants, miscellaneous oil spill control agents, and burning agents, but do not include sorbents.

chemical treating agents Products used in treating oil spills, including dispersants, bioremediation agents (nutrient additions), herding agents, emulsion treating agents, solidifiers, elasticity modifiers, surface washing agents, and miscellaneous oil spill control agents.

chronic / chronic toxicity An effect in which the organism of interest is exposed to the contaminant for a significant stage of its life cycle, generally weeks to years.

coastal waters for the purpose of this document is defined as water in the open ocean.

contact angle The angle that the liquid makes when it is at equilibrium with the other phases in contact with it, which is related to the interfacial free energies per unit area of those phases.

countermeasure An action implemented to counter the effects of an oil or hazardous material spill.

CWA Clean Water Act.

deadmen a buried anchor point on the shoreline.

desorb To remove a sorbed substance. Infers an active process, such as high-temperature thermal desorption.

discharge Any emission (other than natural seepage), intentional or unintentional, and includes, but is not limited to, spilling, leaking, pumping, pouring, emitting, emptying, or dumping. Discharge as defined by section 311(a)(2) of the CWA, includes, but is not limited to, any spilling, leaking, pumping, pouring, emitting, emptying, or dumping of oil, but excludes discharges in compliance with an NPDES permit under section 402 of the CWA, discharges resulting from circumstances identified and reviewed and made a part of the public record with respect to a permit issued or modified under section 402 of the CWA, and subject to a condition in such permit, or continuous or anticipated intermittent discharges from a point source, identified in a permit or permit application under section 402 of the CWA, that are caused by events occurring within the scope of relevant operating or treatment systems. For purposes of the NCP, discharge also means substantial threat of discharge.

dispersant Those chemical agents that disperse, emulsify (oil-in-water emulsions), or solubilize oil into the water column or promote the surface spreading of oil slicks to facilitate dispersal of the oil into the water column.

dispersant:oil ratio The amount of dispersant required to treat the oil in question. A 1:20 ratio would mean one gallon of is dispersant needed for each 20 gallons of oil to be treated.

disperse To break oil into small particles that are then mixed into the water column.

dissolution The process of dissolving into water. Petroleum hydrocarbons dissolve slowly due to their low solubility and mineral salts present in the oil.

eduction using a flow of air or water to pick up another liquid in a sort of vacuum (e.g., a way of pumping using the Venturi Principal). Eduction equipment is often used with dispersants; a process that mixes the neat dispersant with water or seawater for application.

effectiveness / efficacy The ability to produce the desired effect.

effluent: washwaters, runoff, outflow.

elasticity modifier A product which imparts elasticity to the oil. Although the viscosity of the oil is increased, it remains a liquid.

emulsion A suspension of oil in water or water in oil. Water-in-oil emulsions may contain 20% - 80% water. Emulsions may be temporary or permanent.

emulsion breaker An emulsion treating agent that breaks an emulsion into separate oil and water phases.

emulsion inhibitor An emulsion treating agent that, if applied to spilled oil before emulsification occurs, prevents emulsion formation.

emulsion treating agent A product that breaks or prevents water-in-oil emulsions by modifying the properties of the oil-water interface to inhibit or destabilize water-in-oil emulsions.

encapsulate To surround an oil droplet with a surfactant which prevents the droplet from re-coalescing. This term is often used by vendors in describing how their products work, meaning the same process as chemical dispersion.

environment As defined by section 101(8) of CERCLA, means the navigable waters, the waters of the contiguous zone, and the ocean waters of which the natural resources are under the exclusive management authority of the United States under the Magnuson Fishery, Conservation and Management Act; and any surface water, ground water, drinking water supply, land surface or subsurface strata, or ambient air within the United States or under the jurisdiction off the United States.

enzyme Natural or man-made proteins which are used to speed up the rate of chemical reactions, such as the chemical breakup of oil into final products of carbon dioxide and water.

ETA Emulsion treating agents

exposure The contact reaction between a chemical or physical agent and a biological system (plant, animal, bacteria, etc.).

fertilizer A substance or agent used to promote the growth of plants, bacteria, and other organisms. Nitrogen and phosphorous are common constituents fertilizers.

fresh / freshwater salinity or salt content less than 0.5 parts per thousand (ppt).

gelling agent A two-component product which, when mixed together, turns into a solid.

habitat The chemical, physical, and biological setting in which a plant or animal lives.

herding agent A product that pushes or compresses an liquid on the surface of the water column by exerting a higher spreading pressure than the liquid.

hydrophilic "water loving": attracted to water, mixes easily with water.

hydrophobic "water hating": separates from water, does not mix well with water. Oil is typically hydrophobic.

imbibe To take in, as moisture into a sponge.

immiscible Describing liquids that will not mix with each other, such as oil and water.

***in situ* burning** The burning of spilled oil in place.

incident Any occurrence or series of occurrences having the same origin, involving one or more vessels, facilities, or any combination thereof, resulting in the discharge or substantial threat of discharge of oil.

indigenous Existing or growing naturally in a region; native.

inland waters For the purposes of this document, inland waters is defined as water in a Bay, Harbor, Inlet, Estuary, Slough, River, or Lake.

inland zone The environment inland of the coastal zone, excluding the Great Lakes and specified ports and harbors on inland rivers. The term inland zone delineates an area of federal responsibility for response action. Precise boundaries are determined by USEPA/USCG agreements and identified in Federal regional contingency plans (RCP).

interfacial tension The tendency of a liquid surface, in contact with an immiscible liquid, to contract. The imbalance of forces at the liquid-liquid interface is due to the difference in molecular forces in the two immiscible liquids.

intertidal The part of the shoreline that lies between the highest and lowest tide levels.

IPIECA International Petroleum Industry Environmental Conservation Association

ITOPF International Tanker Owners Pollution Federation Limited

LC50 or LC_{50} Lethal concentration of a product that causes 50 percent mortality to the test organism over a stated period of time. Length of exposure is usually 24 to 96 hours.

lipophilic "lipid loving": a substance that is attracted to oil, lipids and fats.

marine Of, or on, the sea. Waters with a salinity above 17 parts per thousand and typically connected to the sea.

mechanism of action The fundamental physical and/or chemical processes involved in, or responsible for, the interaction between a chemical treating agent and spilled oil.

metric ton a metric unit of weight =1000 kg (2,204 lbs)

micelle / micellization Micellization is the formation of micelles, which are ordered aggregates of surfactant molecules, with the hydrophobic (water hating) portion of the molecule facing inward, away from the water, and the hydrophilic (water loving) portion facing outward towards the water. For purposes here, these are essentially tiny drops of oil surrounded by dispersant or surfactant and in an aqueous medium.

microbe A single-cell organism such as a bacterium.

miscellaneous oil spill control agent is any product, other than a dispersant, surface washing agent, surface collecting agent, bioremediation agent, burning agent, or sorbent that can be used to enhance oil spill cleanup, removal, treatment, or mitigation.

miscible capable of being mixed at any ratio without separation of the two liquids.

mobile oil Oil on the land or water that is not contained.

National Strike Force Coordination Center (NSFCC), authorized as the National Response Unit by CWA sections 311(a)(23) and (j)(2) and amended by the section 4201 of the Oil Pollution Act of 1990 (OPA), means the entity established by the Secretary of the department in which the USCG is operating at Elizabeth City, North Carolina with responsibilities that include administration of the USCG Strike Teams, maintenance of response equipment inventories and logistic networks, and conducting a national exercise program.

natural resources Includes land, fish, air, wildlife, biota, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States (including the resources of the exclusive economic zone), any State or local government or Indian Tribe, or any foreign government.

NCP National Oil and Hazardous Substances Pollution Contingency Plan 40 CFR Parts 9 and 300.

neat to apply without dilution.

non-persistent Non-persistent oils are those refined oil products that will be completely removed from the affected environment through natural weathering processes.

non-surfactant-based solvents A sub-class of shoreline cleaners that lower the viscosity of the oil and are primarily petroleum distillates similar to kerosene.

OHMSETT a US national oil spill response test facility in Atlantic Highlands, NJ. Currently operated and maintained by MAR, Incorporated under contract to the US Department of Interior, Minerals Management Service (MMS). This facility is a dedicated to testing full-scale oil spill response equipment; conducting research on innovated spill response technology; and conducting training sessions with oil.

oil as defined by section 311(a)(1) of the CWA, means oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil. Oil, as defined by section 1001 of the OPA means oil of any kind or in any form, including, but not limited to, petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil, but does not include petroleum, including crude oil or any fraction thereof, which is specifically listed or designated as a hazardous substance under subparagraphs (A) through (F) of section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. 9601) and which is subject to the provisions of that Act.

oleophilic "oil loving": a substance that is attracted to, or mixes well with, oil.

on-scene coordinator (OSC) The Federal OSC is predesignated by EPA or the USCG to coordinate and direct Federal responses under Subpart D, or the official designated by the lead agency to coordinate and direct removal actions under Subpart E, of the NCP. The state OSC is predesignated by state statues.

operational monitoring A real-time evaluation process which provides measurement or observation activity (using trained observers) to ensure the success of a response and, in particular, to direct or redirect the response decision.

Orimulsion a fuel developed in Venezuela from an emulsification technique, which leaves microscopic bitumen particles suspended as an oil-in-water emulsion, has its origin in Venezuela's Orinoco district. Natural bitumen is very challenging to handle due to its extremely high viscosity. Orimulsion, has the viscosity of a light fuel oil and therefore is relatively easy to pump, and can be transported via pipelines and tankers like oil.

ORSANCO Ohio River Valley Water Sanitation Commission

oxidation agent A product which enhances photo-oxidative degradation of a material.

parts per billion Parts per billion (ppb) unit of concentration. One ppb is roughly equivalent to one teaspoon in 1,300,000 gallons.

parts per million Parts per million (ppm) unit of concentration. One ppm is roughly equivalent to one teaspoon in 1,300 gallons.

parts per thousand Parts per thousand (ppt) unit of concentration. One ppt is roughly equivalent to one teaspoon in 1.3 gallons.

penetration For purposes here, penetration refers to the ability of a substance, such as a chemical product, to work through thick oil, or seep into oil coated substrate.

photo-oxidation The process by which the components in oil are chemically transformed through a photo-chemical reaction (in the presence of oxygen) to produce compounds which tend to be both more water soluble and toxic (in the short term) than the parent compounds.

ppb See parts per billion.

ppm See parts per million.

ppt See parts per thousand.

release as defined by section 101(22) of CERCLA, means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (including the abandonment or discarding of barrels, containers, and other closed receptacles containing any hazardous substance or pollutant or contaminant). See NCP for list of exclusions.

remove / removal As defined by section 311(a)(8) of the CWA, refers to the removal of oil or hazardous substances from the water and shorelines or the taking of such other actions as may be necessary to minimize or mitigate damage to the public health or welfare or to the environment. As defined by section 101(23) of CERCLA, remove or removal means the cleanup or removal of hazardous substances from the environment; such actions as may be necessary taken in the event of the threat of release of hazardous substances into the environment; such actions as may be necessary to monitor, assess and evaluate the release or threat of release of hazardous substances; the disposal of removed material; or the taking of such other actions as may be necessary to prevent, minimize, or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release. The term includes, in addition, without being limited to, security fencing or other measures to limit access, provision of alternate water supplies, temporary evacuation and housing of threatened individuals not otherwise provided for, action taken under section 104(b) of CERCLA, post-removal site control, where appropriate, and any emergency assistance which may be provided under the Disaster Relief Act of 1974. For the purpose of the NCP, the term also includes enforcement activities related thereto.

response niche Application for which a countermeasure is best suited. The appropriate application is determined by considering: the type and volume of oil spilled; spill location; habitats affected; weather/time of year; and other factors.

risk characterization Final phase of a risk assessment – risks are estimated and interpreted, and the strengths, limitations, assumptions, and major uncertainties are summarized.

saline Containing salt; e.g., saline water.

salinity The concentration of salt in a solution, such as water. Usually measured as Parts per thousand (ppt). Ocean water is typically 35-36 ppt.

sheen A thin layer of floating oil. May appear as silver (0.00007 mm), rainbow (0.00015 mm) or gray (0.001 mm), depending on thickness.

shoreline pre-treatment agent A product which prevents oil from adhering to the shoreline by reducing the oil adherence (a wetting agent) and penetration (a film-forming agent).

sinking agents means those additives applied to oil discharges to sink floating pollutants below the water surface, as described in 40 CFR Part 300.910(e).

slick / oil slick A smooth area on the water due to a thin layer of floating oil.

SMART Special Monitoring of Applied Response Technologies

solidifier A product which mixes with oil to turn it into a rubber-like solid.

soluble / solubility A product is considered "quite soluble" in water if its solubility is greater than 1 ppt. A product is considered "sparingly soluble" in water if its solubility is between 1 ppt and 1 ppm. A product is considered "very sparingly soluble" in water if its solubility is between 1 ppm and 1 ppb. A product is considered "essentially insoluble" in water if its solubility is 1 ppb or less.

solvent Any substance into which another substance will dissolve (e.g., sugar will dissolve in water, which is a common solvent). For purposes here, a solvent is generally any chemical agent that will dissolve oil.

sorbent Any oleophilic material which is used to take up oil through absorption or adsorption. Essentially made from inert and insoluble materials that are used to remove oil and hazardous substances from water through adsorption, in which the oil or hazardous substance is attracted to the sorbent surface and then adheres to it; or by absorption, in which the oil or hazardous substance penetrates the pores of the sorbent material; or a combination of the two.

specific gravity The ratio of the mass of a liquid compared to the mass of an equal volume of pure water, at the same temperature.

spreading pressure The force exerted against a fixed barrier as a liquid is compressed into a smaller surface area.

substrate The substance or base on which, or the medium in which, an organism lives and grows, or the surface to which a fixed organism is attached; e.g., soil or rocks.

subtidal The part of the coastal zone that lies below the lowest low tide level, so that it is always underwater.

surface collecting agent Those chemical agents that form a surface film to control the layer thickness of oil.

surface tension The tendency of a liquid surface, in contact with air, to contract. This is because of the imbalance of forces on the molecules in the bulk liquid as opposed to those at the liquid surface in contact with air.

surface washing agent any product that removes oil from solid natural and man-made surfaces, such as beaches, rocks, concrete, and asphalt, through a detergency mechanism and does not involve dispersing or solubilizing the oil into the water column. This product is normally applied as a soaking treatment during low tide so that it has time to work prior to flushing as the tide rises.

surface collecting agent means those chemical agents that form a surface film to control the layer thickness of oil.

surfactant Also referred to as surface-active agents, this is a chemical compound that contains both an oil-soluble and water-soluble ends on the molecule. Both naturally occurring and chemically manufactured varieties exist.

toxic Poisonous.

toxicity The inherent potential or capacity of a material (e.g., oil, chemicals) to cause adverse effects in a living organism.

vapor suppression For oil spills; the light weight components of oil evaporate and if confined in an enclosed space could cause an explosion. Certain chemical products can reduce the evaporation (suppress the vapors) of light-weight components (e.g., fire fighting foams).

varsol commercial degreaser, cleaner product.

viscosity Flow resistance; viscosity may be reported in one of two ways for oil spill related issues. **dynamic viscosity (μ)** referring to internal friction of a substance (e.g., oil) that is a function of the oil type and temperature and is measured in Centipoise units (cP). The lower the viscosity, the thinner the fluid (e.g., water = 1 cP, molasses = 100,000 cP). **Kinematic viscosity (ν)** the fluids dynamic viscosity divided by its density which is measured in stoke (St) units and is often reported as centistoke (cSt). Since the density of oil is not too different from that of water, rough calculations of oil viscosity are not very sensitive, numerically, to interchanging values between dynamic and kinematic viscosities.

volatility The tendency for the components in a liquid to vaporize.

weathering Alteration of the physical and chemical properties of a material through natural processes, including evaporation, dissolution, photo-oxidation, emulsification, and biodegradation.

wetting agent A shoreline pre-treatment agent that causes the oil not to adhere to the shoreline.

window of opportunity An interval of time during which conditions are favorable and an opportunity exists for the countermeasure to be implemented effectively.

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Appendix B
Request Form Template to the RRT for Product Use

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DATE: ______________________

TO: Region ___________ Regional Response Team Members
FROM: Federal On-Scene Coordinator, _____________________________
SUBJECT: Request for Use of _______________________________________ Product(s) on the NCP Product Schedule

The purpose of this letter is to solicit approval from the Region ___ Regional Response Team (RRT) for the use of ______________________ product or technology in treating the oil from the ___________________________ spill in _________________________. The proposed use of this product or technology is outlined below, including conditions of use:

1. Description of the cleanup problem to be addressed by use of the product:

2. Outline why the product(s) or technology was selected:

3. Summary of any toxicological or environmental data on the product, to assist in evaluation of its toxicity:

4. Description of the general areas where the product will be used: *[also describe areas where use of the product will be prohibited (attach lists and/or maps with more details on specific areas proposed for product use)]*:

5. Estimate of the amount of product to be used, either in each area or in total:

6. Description of actions to be taken to minimize environmental impact:

7. Description of any testing or monitoring programs that will be implemented during product evaluation and use:

8. Is it believed that the use of this product in the environments selected will provide a net environmental benefit over other cleanup strategies?
Yes. No.

9. Other pertinent information:

Signed:

______________________________	USCG	______________________________	USEPA
______________________________	(state)	______________________________	DOI
______________________________	NOAA	______________________________	(other)

Official	Agency/Dept.	Official	Agency/Dept.
Official	Agency/Dept.	Official	Agency/Dept.

Appendix C

Example of Certification Letter from USEPA for an
Applied Sorbent Product's Exclusion from the NCP Product Schedule

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Example of Certification Letter from USEPA for an Applied Sorbent Product's Exclusion from the NCP Product Schedule. *(DRAFT)*

NOTE:	Any certification letter provided by the vendor for any product, must be on official USEPA Oil Program Center Letterhead and have a valid signature of the NCP Product Schedule Coordinator. If there is any question on any document, contact the Oil Program Center.

Dear ____________:

We have received and reviewed the information you submitted on your company's sorbent ______(product name)________. Our review indicates that this product meets the definition of a "sorbent" as specified in Title 40 of the Code of Federal Regulations (CFR), sections 300.5 and 300.915(g) of the National Contingency Plan (NCP). Based on this review, ___(product name)_________ is not required to be listed on the NCP Product Schedule.

So that you may be prepared to provide On-Scene Coordinators with a certification as referenced in section 300.915(g)(4) of the NCP, the following statement should be reproduced, dated, and signed on your corporate letterhead:

> [SORBENT NAME] is a sorbent material and consists solely of the materials listed in section 300.915(g)(1) of the NCP.

Enclosed for your review is a copy of section 300.915(g) from the NCP. Should you have questions, please contact me at (703) 603-9918.

Sincerely,

William Nichols
EPA Oil Program Center (5203G)

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Appendix D
History and Status of Applied Technologies

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History and Status of Non-Floating Oil Tracking and Recovery

Most of the world's oil spill response strategies are based on the principal that oil primarily floats in water (fresh or saline). However, the utilization/transportation of heavier fuel oils (Group V fuels) and other non-floating oils (e.g., burn residue and heavy oils that have incorporated sediments) have forced responders to rethink their basic strategies for dealing with spilled oil that travels in the water column or moves/settles along the bottom. Beginning with the *Torrey Canyon* spill in March of 1967 off of England, on through the early 1980's, incidents where oil sank, due to its density or other factors, responders could only wait until the unaccounted for oil mysteriously appeared, was tracked by divers after the spill, or was presumed lost to the environment.

In December 1976, the Tanker SS *Sansinena* exploded while berthed at Pier 46 in Los Angeles, CA while loading a bunker fuel oil with an API gravity between 7.9º to 8.8º and a viscosity of approximately 180 at 60 ºF (refer to Table 22 for relative viscosity comparison). Nearly 1.4 million gallons of bunker fuel oil was released and recovered over a sixteen-month period. The majority of the oil sank (reported by diver surveys) and collected in depressions as pooled oil up to three meters deep. Initial recovery operations used vacuum trucks and separation tanks mounted on a barge. This method was abandoned because the divers were having difficulty moving the suction along the bottom. Next, diver-guided hydraulic pumps were used; however, the divers were immediately covered in oil after reaching the bottom, so they had to direct the pumps by "feel." This method was terminated after the thick, pooled oil close to the pier was removed. The next step involved the designing of special pumping units that were mounted on a barge that could move to collect the oil from various depressions that were out of reach of the diver-guided hydraulic pumps. This method was determined to only be marginally successful once the large pockets of pooled oil had been recovered. In total, nearly 675,000 gallons of the sunken oil had been recovered to this point. However, finally a suction head and pump device was designed on-site to address recovery of the remaining oil. This pump had to be operated using directions from a diver because some of the oil pools had become silted over, making the oil difficult to locate.

In March 1984, the tanker *Mobiloil* spilled 168,000 gallons of a heavy No. 6 fuel oil (API gravity of 5.5º and a pour point of 30ºF) into the Columbia River. Due to the density of the river water (freshwater), the majority of the oil was incorporated into the water column and along the riverbed, being transported by the river currents, often within one meter of the river bottom. The mid-water oil rose to the surface once the salinity of the water increased near the river mouth. However, in the lower sections of the river (near the salt wedge), the bottom oil slowed as it became caught up in the salt wedge circulation pattern (Scholz *et al.*, 1994). This was the first spill when oil tracking techniques were focused on non-floating oil. During this incident, the location and subsequent transport of the missing oil was attempted by lowering weighted sorbents (sorbent pads wrapped around anchors) to the river bottom (NOAA, 1992).

In January 1988, the tank Barge *MCN-5* capsized and eventually sank in 120 feet of water in Puget Sound, WA near the Rosario Straits. The *MCN-5* carried heavy cycle gas oil with a specific gravity of 1.086 and a pour point of 40ºF. During the incident, 91,500 gallons of the heavy cycle oil was released and sank. Due to heavy currents and tidal changes in the area, initial response efforts focused on the sunken barge and its remaining cargo. NOAA staff conducted experiments to observe the oil behavior in the water column and predict its fate (Scholz *et al*., 1994). Using disposable diapers attached to a cannonball weight, responders were able to detect the presence of the heavy oil on the bottom (NOAA, 1992).

In September, 1988, the ESSO *Puerto Rico* released 23,000 barrels of carbon black feedstock (API gravity of 2.0º to –1.5º) while traveling along the Mississippi River toward the Gulf of Mexico. The carbon black feedstock rapidly emptied out of the cargo tank and into the river. The oil appeared to be churned into tiny globules and droplets by the action of the vessel's propwash. The oil quickly dissipated with the river currents. Hand leadlines wrapped with a cotton rag were lowered onto the river bottom in an attempt to locate the oil. Additionally, absorbent pads attached to the underside of clump weights on the end of a winch wire determined that there were no major oil pockets along the river. Except for small traces of material found in deep locations along the riverbed, the intensive investigations found no recoverable quantities of the spilled product except for one 10 barrel pool of oil directly below the vessel at anchorage (NOAA, 1992).

In June 1989, the M/V *Presidente Riviera* ran aground on the Delaware River near Claymont, DE south of Marcus Hook, PA. Approximately 7,300 barrels of a No. 6 fuel oil (API gravity between 7º to 14º) was released. The heavy oil congealed into pancake-like, tar globs that floated with the river currents. The thick, sticky nature of the product made it very hard to physically remove from both the water and the shorelines. Vacuum trucks and conventional skimmers were ineffective because of the oil's viscosity. Supersucker trucks were only able to pick up small chunks of oil, but were a slow process and cleanup/ maintenance of the equipment was difficult. One of the most effective methods of oil recovery was through the use of a fishing vessel with a stern trawl net. The net became so fouled that it could not be used again, but it recovered 8 tons of oil and oiled debris along the river (NOAA, 1992).

In August 1993, three vessels collided at the entrance to Tampa Bay, FL, releasing an estimated 325,000 gallons of No. 6 fuel oil. The API gravity of the oil was between 10º and 11º. The oil weathered on the water surface for nearly 5 days before it came ashore during a storm. Surface oil and shoreline oiling were successfully removed; however, thick mats of submerged oil were found in the nearshore subtidal habitats. In several areas, the submerged oil was removed using vacuum transfer units mounted on barges and grounded on the flat at low tide. Diver/aerial surveys found numerous mobile tarballs and pancakes ranging in density as well as a three mats of submerged oil ranging in size from 150-200 feet long, 10-20 feet wide, and two inches thick. These mats had picked up sediments in the water column or after being stranded onshore. The submerged oil remained on the bottom and had the consistency similar to peanut butter. Attempts to remove the submerged oil included various vacuum-pumping strategies, which failed due to the viscous nature of the oil. After careful study and evaluation, it was determined that manual removal by divers was the most feasible option for certain areas. However, the offshore mats were not removed, and oil continued to wash ashore for at least six months following the spill (NOAA, 1993; Scholz *et al*, 1994).

In January 1994, the *Morris J Berman* barge grounded off San Juan, Puerto Rico, releasing 750,000 gallons of a group V fuel oil (API gravity of 9.5º). Although much of the oil floated, extensive quantities of submerged oil were found in both offshore areas and in sheltered bays because the affected areas had clear, shallow waters. The submerged oil did not emulsify and remained fluid enough to flow with a consistency described as similar to maple syrup. Over time the oil became more viscous and mixed with sediments in some areas. This oil also tended to refloat every afternoon, when the winds picked up and "re-melted" the oil. This submerged oil complicated the cleanup response. Three different methods were used to recover the submerged oil: diver-directed vacuuming of the more liquid oil; manual pickup by divers for the more viscous patches; and dredging. The diver-directed strategy was effective, but slow. Due to the need to open the re-open the beaches, dredging was finally used to recover the remaining submerged oil (Scholz et al, 1994; Petrae, 1995).

In October 1998, the Fleming Environmental Co successfully used sonar for the underwater detection of spilled Orimulsion (a heavy bitumen fuel source that is mined from the Orinoco district of Venezuela). The bitumen is emulsified as an oil-in-water emulsion that has the viscosity of a light fuel oil and is easy to pump, can be transported via pipelines and tankers like liquid oils. The accidental release of Orimulsion in salt water results in the Orimulsion going into suspension in the upper 2-3 meters below the sea surface offering a significant challenge in terms of spill detection. Being able to use sonar to detect this Orimulsion suspension provides a significant response strategy. In the spring of 1999, a small-scale tank test of a spilled Orimulsion was conducted. The results of this test were very encouraging. The Orimulsion cloud in the tank could be detected up to 17 meters away; due to the confinement of the tank, the sonar could only be used as 6% of its full power due to disturbing tank side- and bottom-reflections. It was therefore concluded that sonar in open water will be operational at the 100 to 200 m range, making Orimulsion tracking much easier.

History and Status of Bioremediation Use

Bioremediation is the addition of adding fertilizers or other materials to contaminated environments, to accelerate the natural biodegradation process. On land, the practice of bioremediation has been used extensively and successfully for many years to treat wastes and wastewater in controlled facilities. The use of bioremediation to treat hazardous waste on land (in-situ treatment or land farming), including petroleum products, has only been the focus of research and study over the last two decades. In the coastal zone, bioremediation of spilled oil has primarily been considered a spill response tool over the last 10 years ever since the demonstration in the 1989 *Exxon Valdez* spill in Alaska. Today there are numerous application methods and products available for use in the US. Numerous laboratory, field, and spills of opportunity tests have be conducted using bioremediation agents in the form of nutrient addition, microbe additions, and using a combination of nutrients and microbes.

In June 1990, the M/V *Mega Borg* released large quantities of Angolan crude into the Gulf of Mexico following an explosion. An open-water application of a microbial product on a portion of the slick was conducted by the Texas Water Commission. The product was applied twice, six and nine days following the initial release. Results were inconclusive on the affect of bioremediation agents on surface slicks on the open water.

In August 1990, a collision between three APEX barges and the tanker *Shinoussa* spilled nearly 700,000 gallons of partially refined oil into Galveston Bay. A trial application of a microbial product to impacted marsh habitat was conducted where mechanical recovery was not feasible. No statistically significant differences in degradation rates were found in samples of the treated and the untreated sites. It was theorized that as the test area is subject to chronic oil pollution, the introduction of microbes would not be beneficial over the short time period for this study and would not be measurable relative to indigenous populations.

In November, 1990, a well blowout offshore of Seal Beach, CA, released 400 gallons of crude oil into the atmosphere, oiling 2-3 acres of marshes in the Sea Beach National Wildlife Refuge. The oiled marshes were treated with a microbial product plus fertilizer one week after oiling, followed by an application of additional fertilizer two weeks later. Measures of degradation showed no differences between oiled and treated grasses and oiled grasses with no treatment.

In 1994, the USEPA funded and conducted a full-scale field experiment on a sandy beach in Delaware using nutrient addition to treat weathered Prudhoe Bay crude oil. Product application was determined to be effective (although not significantly). In January 1990, a pipeline break in Linden, New Jersey resulted in the use of a slow-release fertilizer (nutrient addition) to a gravel beach as a final cleanup measure. This study demonstrated that biodegradation was occurring, but that differences were not significantly different due to the high variability in the background levels of petroleum hydrocarbons in the environment.

Even with the inconclusive results of many previous tests, the long history of bioremediation on land continues to drive the use of bioremediation for oil contaminated sediments as a polishing tool or where other recovery options are not feasible. Testing methodology continues to develop. Researchers continue to develop tests that more accurately determine the extent of biodegradation as well as refine products.

History and Status of Dispersant Use

Since 1967, when solvent-based degreasing agents were used in an attempt to clean up the *Torrey Canyon* oil spill, the use of chemicals, especially dispersants, to control marine oil spills, has elicited debate among government, industry and other interest groups. Dispersant composition has evolved significantly since then. Today, dispersants are composed of chemicals that are much less toxic than the *Torrey Canyon* degreasers and generally less toxic than the spilled oil itself. Consequently, the potential for adverse impacts on biota has been significantly reduced, while the potential for net environmental benefit has been substantially increased.

A great deal of our dispersant information comes from numerous laboratory research, field testing, and actual application, but only a handful of studies from actual spills or field tests can be found in the literature documenting the effects of dispersed oil. Boyd *et al.* (in press) summarized the field test results from several studies that evaluated the toxic effects of the spilled oil relative to the chemically/naturally dispersed oils, including:

The Searsport study of 1981

Baffin Island Oil Spill Project (BIOS) of 1981

The TROPICS study of 1984 and again in 1994

The *North Cape* oil spill in 1996

Sea Empress oil spill of 1996

In general, the majority of these test/trials reported adequate mixing and dilution of the dispersed oil in the water column with fewer toxic effects than if the oil had been cleaned up using conventional response options. The one exception was the *North Cape* oil spill when heavy seas naturally dispersed more than 80 percent of a number 2 fuel oil into the water column. High mortalities of benthic organisms and birds were recorded.

In another case of natural dispersion the entire cargo of Gullfaks crude oil spilled from the Braer in 1993 and was quickly dispersed into the water column in very heavy seas. Very few impacts on the marine environment were noted. (Kingston 1999)

History and Status of Elasticity Modifiers Use

Elasticity modifiers have been tested and used extensively since the 1980's. Two forms of elasticity modifiers, Elastol slurry and Elastol liquid, have been extensively tested by Environment Canada (Bobra *et al.,* 1987; Bobra *et al*., 1988; Seakem Oceanography, Ltd., 1990) and recently used during several oil spills in the US (Michel *et al.,* 1993; DESA, Inc. and ERR, Inc., 1993). In field tests, Elastol was applied to ten test slicks of Alberta Sweet Crude and a mixture of the crude oil and Bunker A oil (Bunker C cut with 20 percent diesel fuel) off the coast of Nova Scotia. Based on observations taken at various time intervals after application of the agent as well as laboratory measurements of the treated slicks, the researchers concluded that Elastol increased the viscoelasticity of the oil to a greater extent than found in previous laboratory tests (Seakem Oceanography, Ltd., 1990).

During a 1993 spill of diesel oil into Sugarland Run in Virginia, Elastol was used to increase the recovery rates of drum skimmers without additional water. It also appeared to reduce emulsification of the oil (DESA, Inc. and ERR, Inc., 1993).

Elastol slurry was also tested on a spill of Kuwaiti crude oil in Port Neches, Texas in 1993 (Michel *et al.,* 1993). The agent was applied to small pockets of floating oil in shallow areas adjacent to marshes where workers could not reach the oil, even with small boats. It was hoped that once Elastol was applied, it would modify the viscosity of the oil enough that the treated oil could be pulled out with rakes. Three hours after application, the treated oil, which had drifted away from the shoreline, appeared thicker, more viscous and stickier compared to untreated oil; however it was not possible to physically "pull" the treated oil as a coherent mass or sheet. It was found that Elastol had been over applied, at about 75 times the recommended rate; it is not known what effect over-application had on the changes in oil property, such as the formation of a sticky gel-like material. The treated oil was recovered with a small, double drum skimmer specially designed for use with Elastol-treated oil (Michel *et al*., 1993).

Elastol was used to recover a chronic oil discharge from an underground source in the Port of New York (Levine, 1993). The treated oil was rapidly recovered with skimmers, whereas the untreated oil was spread too thin to skim, requiring recovery with sorbent material. The treated oil was reprocessed, in comparison with sorbent use that generated a large amount of waste. Elastol is not currently listed on the NCP Product Schedule.

History and Status of Emulsion Treating Agents Use

Emulsion inhibitors have been used for many years to prevent the formation of an emulsion when crude oil is produced from the well, especially for crude oils that have a relatively high paraffin content and are known to quickly form water-in-oil emulsions. To prevent emulsification during production and pipeline transportation, demulsifiers are added to the oil at the wellhead, at concentrations of about 20 ppm (Walker *et al*., 1993). Manufacture of emulsion treating agents for use in petroleum production and transportation is a mature industry with many established companies in the market.

A more recent proposed use of emulsion inhibitors is aerial application to slicks on the water to prevent emulsion formation, thus extending the window of opportunity for dispersant use (Buist and Ross, 1987), and possibly in-situ burning. During field trials in the North Sea in 1992, on slicks treated with an emulsion treating agent (at a rate between 1:100 and 1:200, agent to oil) from spray aircraft, emulsion formation slowed or reversed and the oil dispersed faster than control slicks (Lunel and Lewis, 1993).

Oil spill applications of emulsion breakers include breaking water-in-oil emulsions during the final stages of treatment or recovery, after free water has separated, using both heat and chemicals. However, there has been little documentation of the actual use of emulsion breakers during oil spills, except for the *Amoco Cadiz* spill where they were used on shore in pumping chains and storage tanks. They were found to be successful in breaking the emulsions, thereby allowing for more effective storage and transport of the recovered oil. However, emulsion breakers were only used in several limited locations during this spill (Bocard *et al*., 1979). Application rates of emulsion breakers are very low, in the range of 0.01 percent.

The latest proposed use of emulsion breakers is injection of the agent into the emulsion early in the recovery process while at sea, such as in the containment boom, skimmer pump, skimmer reservoir, settling tank, or storage barge. Injection at the skimmer pump head could improve pumping as well as increase mixing and subsequent separation of the water. The objective is to decrease the on-scene storage requirements for recovered oil. There are commercially available skimmers with injection systems capable of using emulsion treating agents. Breaking of emulsions and decanting of the released water in skimmers could be extremely important during large spills, since storage of recovered product can be a limiting factor in the rate of oil recovery. A high-volume skimmer (e.g., GT-185 or DESMI) can exceed its on-board storage capacity for recovered product within the first few hours of operations. Operationally, the critical issue is the time needed to break the emulsion in the skimmer, which should be accomplished within minutes, rather than hours. Environmentally, the critical issue is whether regulatory agencies would allow the discharge of the released water back into the sea without treatment. Specific permits may be required if the water contains regulated chemicals.

History and Status of Fire-Fighting Foams Use

The use of fire fighting foams has become increasingly widespread, as they have evolved since their development in the 1960's. Foams are most commonly used by city/county fire departments, wildfire responders, airport fire teams, and the military. Their ability to control fire better than water by the combined mechanisms of cooling, separating the flame source from the product surface, suppressing vapors, and smothering is what has made them so popular. Their use originated with the military, being used on liquid fires resulting from aviation vehicles and water vessel engine rooms.

The original formula for these fire-fighting foams contained the chemical perfluoro-octanyl sulfonate (PFOS), which later was found to be harmful to the environment. Today the U.S. Military is still one of the largest consumers of fire fighting foams and has specifically taken notice to the environmental impacts foams have on the environment. 3M, previously one of the largest producers of fire fighting foams with PFOS, has decided to discontinue production. Also, the EPA will prevent any company form marketing products containing PFOS in the Unites States under the proposed Significant New Use Rule (SNUR) and is currently assessing the foams being manufactured by other companies. With approximately a dozen fire fighting foam manufacturing companies and over a dozen types of foam today, PFOS foams will continue to exist. However, as the concern increases, companies are developing new formulas that will better suit the environment. Although, fire fighting foams should always be recovered and disposed of properly, this is not always the case. Therefore, the biodegradation of foams is an aspect that is considered in the new development. Not only is complete biodegradation essential but also quick biodegradation is important as well. This prevents the spreading of runoff and prevents oxygen consumption as a result of the biodegradation process.

History and Status of *In Situ* Burning on Land

In situ burning (ISB) of oil spilled on land occurs quite regularly in inland areas of the country, particularly in remote areas along oil transport pipelines. ISB on land is considered a viable option because it can effectively prevent spilled oil from further impacting local resources and help reduce the impacts to groundwater and riverine systems. Long-term studies of actual ISB uses on land are not often reported in the public literature; therefore many of the lessons learned are lost.

In March 1995, a pipeline break occurred spilling gas-condensate across a brackish marsh at the Rockefeller Wildlife Refuge on the Louisiana coast (Pahl *et al,* 1999). The decision was made to conduct an ISB on the product spill and a 3-year investigation was started. The authors compared the extent of vegetative cover, stem density, and biomass for three growing seasons between a control (no ISB) and the treated area. After 3 growing seasons, little difference could be determined between the control and test area. The authors concluded that the results of this test support the conclusion that ISB can be relied upon as an effective cleanup response to hydrocarbon spills in wetlands (Pahl *et al.,* 1999).

Zengel *et al.* (1999) studied the effects of ISB on inland and upland habitats as an alternative to more injurious techniques commonly practiced to date. Thirty-one case histories were studied and summarized for evaluation. The ISB case histories examined show that ISB is environmentally feasible and acceptable, and is clearly suited for use in certain environmental settings/habitats.

History and Status of *In Situ* Burning on Water

(*The majority of this information is taken from USCG, 1999*)

Following the *Torrey Canyon* spill, the spill response community devoted considerable effort for the development and evaluation of safe and effective *in situ* burn (ISB) technology. This research resulted in various products to support open-water burning of oil, including fire-resistant booms and ignition devices which are still part of the spill responders' took kit when considering in situ burning on water (USCG, 1999).

Since 1967, ISB has been employed as a response option for various oil spills with varying degrees of success. ISB was considered an alternate spill countermeasure in the 1980s, especially in Arctic regions where isolation, extreme conditions and the presence of ice would hinder the use of conventional technologies. In nearshore and offshore areas of the US lower 48, ISB was not considered as an alternative technology until 1989 when fire-resistant booms were used during the initial stages of the *Exxon Valdez* to effectively burn nearly 15,000 gallons of the spilled oil in Prince William Sound, AK (Allen, 1991).

Following the *Exxon Valdez* spill, research efforts were revitalized to "improve the fire-resistant boom designs, refine operational procedures, and resolve issues associated with air contamination from burning." These research efforts culminated in an international, multi-agency test burn in 1993 offshore of St. Johns, Newfoundland known as the Newfoundland Offshore Burn Experiment or NOBE" (USCG, 1999). NOBE provided the proof that ISB operations could be safely conducted and provide an effective means for removing oil from the water surface.

This progression in ISB technology and use has resulted in a general trend by US decision-makers for a growing acceptance of this option as a standard countermeasure for larger, offshore spills and certain inland, on-water spills in isolated locations.

History and Status of Shoreline Pre-treatment Agent Use

The idea of a product that could coat the shore and protect it from oiling prior to landfall was the focus of an API series of three studies in the 1970s. The initial study used a three-phased program to evaluate the technique of applying sprayable coatings to protect shorelines against oil spills. Of the nine products identified in the effort, four were tested in simulated field tests of which one showed considerable promise. Then in 1978, Woodward-Clyde Consultants and subcontractors conducted additional research efforts under a joint EPA/API sponsored project to evaluate under field conditions, the effectiveness of selected products in protecting beaches and salt marshes from oil spills and their value in assisting in the cleanup of shorelines previously contaminated by a slick. Of the eight products identified during this research effort, only three products were actually tested in the field. All three products were seen as effective to some degree. In 1979, Woodward-Clyde did a continuation of the 1978 project using additional laboratory and field tests of shoreline pre-treatment agents to determine product effectiveness. No products were ever commercialized and none are available for use.

History and Status of Solidifier Use

In the early 1970s, the USEPA and Exxon conducted research on the potential use of solidifiers in a scenario where a vessel was in imminent danger of sinking or breaking up, but still contained most of its oil. The strategy was to solidify the oil in the vessel holds to prevent its release to the water.

These products are contained in pillows and booms and provide the sorbent-type of oil encounter area. The polymer capsules have a very high internal surface area, much like a sponge, which is extremely oil-selective and water-avoidant; oil is wicked inside the internal pore space where the polymer and the oil chemically interact. This interaction causes the oil to dissolve into the polymer, which locks up the oil into the structure and precludes water from interacting with the oil. However, unlike a sponge, this chemical interaction prevents the oil from being squeezed back out, even under pressure; recovered oil does not rub off upon contact or drop-off the material when the product is removed from water as is the case with sorbents. The recovered oil/polymer capsules, which over time can become a gelatinous mass inside the bags or blankets, are recyclable using a low-temperature catalytic distillation.

Solidifiers are most commonly used during very small oil spills on land or restricted waterways. There has been little documented use of solidifiers on large spills or open water. Based on laboratory tests and limited field tests, solidifiers may be useful in situations when all oil, including sheens, needs to be recovered and where the product can be easily collected similar to sorbent materials. The oil must be fairly non-viscous to be wicked up by the product. Consequently, heavy oils or heavily weathered oils may not lend themselves to effective recovery with this countermeasure.

History and Status of Surface Collecting Agents Use

The use of surface-active agents to control oil slicks on the water surface was first reported by Zisman (1942) who studied their use during World War II to push burning oil away from tankers. Surface collecting agents were used in Hawaii in the 1970s on diesel spills in harbors (Benson, 1993) and have been tested by researchers at Warren Spring Laboratory (Nightingale and Nichols, 1973). In laboratory tests, Surface collecting agents were evaluated for their effectiveness in concentrating Alaskan North Slope Crude Oil at various temperatures. The agents were found to be equally effective in concentrating the thin films of oil by as much as 95 percent within one minute. The efficiency of the agents decreased only slightly with air temperatures below 0°C (Pope *et al,.* 1985). Surface collecting agents have also been used to prevent oil from contacting a marsh where the water was too shallow to deploy conventional boom (Goodman, 1993). No commercial products are currently listed on the NCP Product Schedule.

History and Status of Surface Washing Agents Use

Early attempts to use chemicals to increase the effectiveness of shoreline cleanup consisted of applying chemical dispersants on the shoreline. In the 1970s, water-based surface cleaner and a non-aromatic, hydrocarbon-based surface cleaner were used to clean Bunker C oil off the seawall following the grounding of the *Delian Appollon* in Tampa Bay (Canevari, 1979).

In 1989, Corexit 9580 was applied as a surface washing agent in large-scale field tests following the *Exxon Valdez* spill in Alaska (Fiocco *et al*., 1991). Many operational tests were conducted and the results indicated that the products were effective in removing the oil while minimizing dispersion of the oil into the water column (Fiocco *et al.,* 1991). Concurrently, Lees *et al.* (1993) evaluated the short-term biological effects of various shoreline treatment methods, including the use of Corexit 9580, on the intertidal biota in Prince William Sound following the *Exxon Valdez* spill. The Corexit 9580 treatments appeared to be accompanied by the smallest number of significant changes in abundance.

Since 1990, several laboratory and field studies, as well as spills of opportunity have been used to evaluate Corexit 9580 (Teas *et al.,* 1992), PES-51 (Benggio, 1993; Tesoro, 1993; Hoff, 1994) or both (NOAA, 1994) to determine their effectiveness as surface washing agents. Various tests were done using cold water flushing, air knives, or high-pressure, heated water for rinsing the treated shorelines. In general, these tests found that the agents were more effective than if water alone was used to flush the oil from the affected substrates. Dispersion of the treated oil occurred at high water temperatures and pressure rates. Based on the study conducted by NOAA (1994), the Caribbean RRT approved the operational use of Corexit 9580 based on effectiveness, toxicity, and cost considerations, but required an ecological effects monitoring plan to be conducted during the initial applications.

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Appendix E

Understanding Toxicity, Exposure, and Effects Related to Spill Response Countermeasures

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UNDERSTANDING TOXICITY, EXPOSURE, AND EFFECTS RELATED TO SPILL RESPONSE COUNTERMEASURES

INTRODUCTION

This brief guidance information was developed to assist the decision-maker in determining the potential impacts/injuries to resources from the spilled oil and from oil treated with various spill countermeasure products. This is an overview on toxicity, exposure, and effects from contact with spilled oil. Due to the nature and breadth of this topic, only generalities are provided for exposure effects. Decision-makers will need to coordinate with resource specialists to gather and evaluate species-specific information on toxicity, exposure, and effects.

Determining adverse impacts consists of a three-step process:

1. Evaluate the toxicity of the spilled substance and how the toxicity may change when spill response countermeasures (products) are used to combat the spilled oil,
2. Determine the resources at risk, routes of exposure to the oil and/or the oil mixed with the spill countermeasures products; and
3. Determine and document potential toxic effects exhibited by the resources of concern.

Decision-makers need to have a clear understanding of what toxicity is, potential routes of exposure, and potential toxic effects from exposure to understand how adverse effects can occur during oil spills. The reader is reminded that adverse effects can occur both from spilled oil and the countermeasures used to control the oil. To determine the options that result in the optimal environmental benefit, the toxicities of various control options must be compared to each other and the toxicity of the spilled oil.

The following information in this overview was developed from Boyd *et al*., (2001).

WHAT IS TOXICITY?

Rand and Petrocelli (1985) define toxicity as the “inherent potential or capacity of a material [e.g., oil or chemically treated oil] to cause adverse effects in a living organism.” Adverse effects are responses outside the “normal” range for healthy organisms and can include behavioral, reproductive, or physiological changes, such as slowed movements, reduced fertility, or death. Toxic effects are a function of both the duration of exposure to the chemical and the concentration of the chemical. In the aquatic environment, the concentration of a chemical, as well as its transport, transformation, and fate, is controlled by:

Physical and chemical properties of the compound (such as a compound’s solubility or vapor pressure);

Physical, chemical, and biological properties of the ecosystem (such as salinity, temperature, or water depth); and

Sources and rate of input of the chemical into the environment (Rand and Petrocelli, 1985; Capuzzo, 1987; Gilfillan, 1992).

How is Toxicity Measured?

To determine the toxic impact of a chemical on a living resource, an estimate of the range of chemical concentrations that produce some selected, readily observable, and quantifiable response during a given time of exposure needs to be defined (Rand and Petrocelli, 1985). This is referred to as a dose-response relationship and is usually measured in parts per million (ppm) or parts per billion (ppb).

Often, toxicity data are expressed as the **L**ethal **C**oncentration required to kill **50** percent of the test species (LC50) or the **E**ffective **C**oncentration required to adversely affect **50** percent of the test species (EC50) in some specified way. LD50 is the **L**ethal **D**ose of a toxicant (through direct ingestion) required to kill **50** percent of the animals tested.

LC50 vs. EC50

For LC50, the endpoint is mortality over a specified time. Length of exposure is usually 24 to 96 hours. In some tests, the endpoint is not mortality, but a non-lethal response such as immobility, developmental abnormality, etc. In these cases, results are expressed as EC50, where a significant, defined, effect is seen in 50% of the population over a specified time period, usually 24 or 48 hours (Rand and Petrocelli, 1985). Table E-1 provides some generalities on rating toxicity data for various generic categories of resources.

Toxicity testing provides us with important information about the effects of oil; however there are some complicating factors that one should keep in mind when looking at toxicity data. Markarian *et al.* (1993) cautions that use of the term “Lethal Concentration” is inappropriate for testing with oil products. This is because an LC50, for example, should measure the lethal concentration of a single compound. However, oil is a mix of compounds and often the exact mixture is not known. Seeing an LC50 result for oil does not immediately indicate how the measured concentration was developed. This can make comparisons of oils difficult, because various approaches can provide different results, which are of different scientific relevance (Markarian *et al.*, 1993). Although experts concur that LC50 data are not the best suited measure of toxicity for oil, it is very often the only type of measurement available.

Another complicating factor for those reading toxicity tests with oil products is how the concentration is expressed. Concentrations expressed as the total oil per unit volume (nominal concentration) are misleading because much of the oil is not soluble in the water and, therefore, not available to water column organisms. Using this nominal concentration will produce overestimates of exposure concentrations and toxicities (NRC, 1989; Lewis and Aurand, 1997). More realistic testing methods measure concentration based on the water-accommodated fraction (WAF) of the oil, which is the fraction of an oil product that remains in the water phase after mixing and settling (CONCAWE, 1983; Singer and Tjeerdema, 1994).

Table E-1. Relative toxicity of substances (adapted from USFWS, 1984; Hunn and Schnick, 1990).

Toxicity Rating	Aquatic 96-hour LC50	Avian Oral 96-hour LD50 ($mg_{substance}/Kg_{bird}$)	Mammalian Oral 96-hour LD50 ($mg_{substance}/Kg_{animal}$)
Practically Non-toxic	100 – 1,000 mg/L	> 5,000	>15,000
Slightly Toxic	10-100 mg/L	1,000-5,000	5,000-15,000
Moderately Toxic	1-10 mg/L	200-1,000	500-5,000
Highly Toxic	0.1-1.0 mg/L	40-200	50-500
Extremely Toxic	<0.1 mg/L	<40	5-50

WHAT IS EXPOSURE?

Exposure refers to the amount of contact an organism has with a chemical, physical, or biological agent. When assessing toxicity, it is necessary to know the exposure. The most significant factors are the kind, duration, and frequency of exposure, as well as the concentration of the chemical (Rand and Petrocelli, 1985). NOAA's Damage Assessment Center summarized the factors to be considered when assessing exposure to subtidal and intertidal organisms along shorelines (NOAA, 1996):

Oil type – physical and chemical characteristics of the oil.

Spill volume – size of the discharge or amount in shoreline area.

Duration and frequency – how often and for how long organisms are exposed to oil and or chemical countermeasures.

Shoreline type – high-energy shorelines may reduce the chance for long-term aquatic exposure, but may also result in the oil being deposited along or above the high tide line. Sediment grain size will also affect exposure, with coarse-grained sediments allowing for more rapid and deeper penetration.

Tide stage – subtidal organisms are at less risk than intertidal organisms, since they won't come in contact with the floating oil.

Weather conditions – floods or storm-driven tides may strand oil in places it would not normally go. Weather conditions can also accelerate or retard oil weathering.

Toxic effects can be produced by acute (short-term) or chronic (long-term) exposures. Acute exposures occur when an organism is in contact with a chemical for a brief time period. Toxicity testing for acute effects usually involves effects that occur within a four-day period (96 hr) or less. In the case of oil spills, negative effects from acute exposure are usually seen early in the spill. This is because the oil, including the light and medium-weight components that may evaporate, is most concentrated during the first few days. Alternatively, chronic exposures are longer duration (weeks to years), and generally involve daily exposure to smaller amounts of oil or residual weathering compounds from oil.

Routes of Exposure

Following a spill on water or on land, resources can be exposed to oil through four different routes:

1. **Direct contact** – This is the most visible route of exposure to an observer. When a plant or animal comes into direct contact with oil, it may only become lightly oiled. However, it could also become completely coated with oil, making it unable to move, function, or survive. Once an organism is physically coated with oil, the chances of exposure through the other three methods described below will increase dramatically.

2. **Ingestion** – Both direct and indirect. Direct ingestion occurs when an organism eats food coated with oil or even ingests the oil itself. Direct ingestion of oil may occur accidentally, such as when a bird attempts to clean oil from its feathers. Indirect ingestion occurs when an organism eats prey or food tainted with oil. This food is not necessarily coated with oil itself, but has been exposed to it previously. For example, an eagle could ingest oil indirectly by eating an animal that swallowed oil during a spill the week before.

3. **Inhalation** – Inhalation may occur when animals breathe in evaporating oil components or oil mists created from storm and wave action. Inhalation usually occurs when animals on the surface (e.g., seabirds, otters, and seals) breathe while swimming in/through a slick.

4. **Absorption** – This occurs when an organism absorbs the oil, or toxins from the oil, directly through its skin or outer membranes. Typical examples of organisms to which this could apply are benthic or intertidal mollusks, worms, fish, and plants.

ADVERSE EFFECTS

Potential Effects

NOTE: *The information presented in this section is very general and should only be viewed as a starting point in your understanding of how adverse effects can occur. Specific impacts are very species- and situation-dependent. For spill preparedness and incident response, experts on the local resources must always be consulted and consider the implications of scenario- or incident-specific conditions.*

As mentioned previously, adverse effects are responses outside the "normal" range for healthy organisms and can include behavioral, reproductive, or physiological changes, such as slowed movements, reduced fertility, or death. Table E2 provides general guidance on potential effects experienced by various resource categories that are typically affected by spills of oil.

Often, toxicity is viewed as the ability of a substance to kill an organism. **It is important to keep in mind that toxic substances usually cause effects other than death in most organisms.** Actual effects depend on a number of variables. Sublethal effects are often difficult to quantify or even observe and may, or may not, be important to the future survival of the organism. Mackay and Wells (1981), NRC (1985), and Mielke (1990) summarize factors that determine the severity of ecological impacts from an oil spill. These include:

- Concentration of oil and the duration of the exposure;
- Type of oil involved;
- Whether the oil is fresh, weathered, or emulsified;
- Whether a coastal, estuarine, or open ocean area is involved and whether it is a nesting, wintering, or migratory ground for sea birds;
- Season of the year with respect to bird migration and whether organisms are dormant or actively feeding and reproducing;
- Oceanographic conditions such as currents, sea state, coastal topography, and tidal action;
- Whether adult or juvenile life forms are present;
- Whether the oil is in solution, suspension, or adsorbed onto suspended particulates or sediment;
- Distribution of oil in the water column;

- Effects of oil on competing biota;
- An ecosystem's previous history of exposure to oil or other pollutants; and
- Cleanup procedures used.

Table E-2. Generalized list of effects, by resource category and route of exposure. Adapted from Scholz *et al.*, (1992) and RPI (1991).

		Routes of Exposure			
Resource Category	**Examples**	**Direct Contact**	**Ingestion**	**Inhalation**	**Absorption**
Birds	Seabirds Gulls and terns Raptors Shorebirds Wading birds Waterfowl	• Fouling of plumage / matting • Hypothermia • Loss of buoyancy • Reduced egg survival • Nest abandonment • Reduced reproductive success • Death	Preening, consuming oiled prey can result in: • Anemia • Pneumonia • Intestinal irritation • Kidney damage • Altered blood chemistry • Decreased growth • Impaired osmoregulation • Decreased production and viability of eggs • Death		
Fish	Anadromous Marine pelagic Demersal groundfish Reef fish Estuarine fish	Changes in: • Feeding • Growth • Development • Recruitment	• Adults ingesting oil metabolized into water-soluble compounds that are excreted as feces or urine • Tumor production and other abnormalities • Death		• Chemosensory ability may be reduced • Changes in feeding, avoidance behavior, reproduction • Elevated respiration, decreased respiration • Reduction in activity in larvae • Reduced schooling behavior • Reduced growth with long-term exposure • Death
Marine	Whales	• Irritation to eyes and skin	• Direct Consumption can result in:	• Absorption into the circulatory system	

		Routes of Exposure			
Resource Category	**Resource Examples**	**Direct Contact**	**Ingestion**	**Inhalation**	**Absorption**
Mammals	Dolphins Porpoises Seals Sea lions Walruses Sea otter	• Increased metabolism • Inhibition of thermoregulation • Temporary reduction in feeding efficiency • Loss of insulative property for fur bearers • Death	• Irritation/destruction of intestinal linings • Organ damage • Neurological disorders • Bioaccumulation of toxins • Death • Indirect Consumption can result in: • Transfer of toxins to young via lactation • Obsessive grooming behavior • Degenerative liver lesions, kidney failure • Endocrine imbalances • Diarrhea • Death	• Mild irritation/permanent damage to respiratory surfaces and mucosal membranes • Death May also affect: • Lungs and other organs • Nervous system	
Reptiles	Sea turtles Alligators Marine Lizards	• Increased number of eggs remaining unhatched • Hatchling morphology (weight, size) • Reddening and sloughing off of skin • Reduced viability • Increased chance for infection • Coated flippers • Contaminated mouthparts • Death	• Reduction in feeding efficiency • Starvation • Death •	• Increased dive time and diving deeper in young turtles • Increased respiratory rates • Decreased blood glucose levels • Death	• Impairment of immune system can result in increased production of white blood cells • Interference of salt gland can result in water imbalance and internal ion regulation • Death
Shellfish	Shrimp Lobster Crab Oyster Clam Mussel	• Decreased or abnormal growth • Increased mucous production • Damage to soft tissues • Decreased respiration • Death	• Tainting • Decreased Feeding • Death		

Resource Category	Resource Examples	Routes of Exposure: Direct Contact	Ingestion	Inhalation	Absorption
	Scallop Squid Octopus				
Other Invertebrates	Corals Annelid Worms Polychaetes Urchin Starfish	• Impaired larval settlement • Growth reduction • Bleaching or expulsion of Zooxanthellae (corals) • Death	• Impaired feeding response • Impaired polyp retraction (corals) • Increased mucous production • Impaired sediment clearance ability (corals) • Death		For Corals: • Reduced growth • Reduced reproduction / gonad damage • Muscle atrophy • Tissue death • Death
Plankton	Phytoplankton Bacterioplankton Zooplankton		• May exhibit an increase in abundance due to increased food supply, i.e., spilled oil (zoo) • Excretion of oil droplets as unmodified oil in fecal pellets (zoo) • Death		• Reduced photosynthetic efficiency (phyto) • Reduction in algal growth (phyto) • Decreases in biomass (zoo) • Lower feeding rates (zoo) • Lower reproduction rates (zoo) • Death
Marine Plants	Algae Kelp Seagrasses	• Smothering • Bleaching			• Sloughing off of leaves • Death of plant

		Routes of Exposure			
Resource Category	**Resource Examples**	**Direct Contact**	**Ingestion**	**Inhalation**	**Absorption**
	Wetland plants	• Sloughing off of leaves • Death of plant			

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Some biological species produce large numbers of young to overcome natural losses (e.g., most invertebrates) making it less likely that any localized impacts will have a discernible effect on the adult population (ITOPF, 1987). Although most vertebrates of concern during a spill do not do this (e.g., seabirds, marine mammals), it is still unlikely that there will be serious effects on the overall population in most spill situations. However, it must be emphasized that this is not always the case, especially with threatened and endangered species. The loss of only a few individuals of a threatened or endangered species could have a large impact on the entire population. Also, early life stages (larvae and juveniles) of most resources are generally more sensitive to the effects of oiling than adults (ITOPF, 1987). This increased sensitivity may be related to life stage-specific or seasonal dependency on metabolic processes that are not critical functions in the adult forms (Capuzzo, 1987; Lewis and Aurand, 1997).

Changes in Effects From Exposure to Oil Treated with Spill Countermeasure Products

Table E3 provides a visual summary of the changes in potential routes of exposure following the addition of spill countermeasure products.

Bioremediation Agents

Bioremediation agents are seldom used during the emergency phase of a spill, and are typically used as a polishing tool after other techniques have been used to remove free product or when further response options are likely to be destructive, ineffective or cost-prohibitive. Therefore, the addition of these products to the spilled oil is only likely to occur after extensive weathering of the product has occurred. Exposures are assumed to remain unchanged when oil is treated with bioremediation agents relative to oil that is left untreated.

Dispersants

When dispersants are applied during a spill, they act to break up the oil into droplets, removing it from the surface and downward into the water column. Dispersants can be used as an isolated response option for a particular portion of the spill or as the response option of choice to deal with the spill as a whole. In either case, dispersants will increase oil exposure to some organisms while reducing exposure for others. When dispersants are applied, exposure to oil will typically decrease for surface-dwelling and intertidal resources, but increase for water column and bottom-dwelling resources. This is one reason that dispersants are not usually applied to a spill directly over a shallow coral reef. Without dispersant application the oil may stay on the surface and not contact the reef, whereas with dispersant application the reef may be showered with droplets of oil.

Elasticity Modifiers and Solidifiers

Both elasticity modifiers and solidifiers, when added to spilled oil, are designed to change the viscosity of the oil, allowing for easier pick up/removal. These products are only used for contained oil and all product/oil mixtures are to be recovered; therefore their potential for altering exposure to resources is limited to small spill volumes. The product/oil mixture is designed to remain floating and reject any products that might cause the oil to sink. When applied, these products will not alter the routes of exposure; surface dwelling and intertidal resources could still be affected by the spilled oil/mixture. Elasticity modifiers make the oil more sticky and the treated oil is more likely to adhere to fur, feathers, vegetation, and dry shorelines, thus potentially increasing exposure to resources.
Solidifiers can reduce the vapor pressure of volatile oils and transform the spilled oil into a coherent mass. The potential for physical disturbance of habitats, as well as smothering may be an additional factor when determining potential exposures to the oil/product mixtures.

Emulsion Treating Agents

Emulsion treating agents (ETAs) are used to prevent emulsification of the oil on the water surface and to increase the window of opportunity for other response options (e.g., dispersants, *in situ* burning, skimming). Most are composed of water-soluble surfactants that modify the properties of the oil/water interface, thus inhibiting/neutralizing the emulsification process. Over time (rate undetermined) ETAs will leach out of the oil/product mixtures and emulsions may form. It is speculated that the ETAs may enhance the solubility of the oil into the water. The potential for exposure is not likely to change for surface-dwelling or intertidal species as the ETAs do not displace the oil within the water column. However, water column resources may be exposed if the ETA enhances the solubility of the oil into the water.

In situ Burning

In situ burn technology is designed to remove oil from the water surface or on land by burning the oil in place. When used effectively, *in situ* burns can achieve removal rates of 50,000 gal/hour for a burn area of 10,000 ft^2 and removal efficiencies can exceed 90%. This makes *in situ* burning a response option for further consideration when you want to prevent the spread of oil to sensitive sites or over large areas. However, burning oil generates large volumes of black smoke. Site conditions (particularly wind speed and direction) will determine whether the smoke plume poses a threat to the public, thus each spill has been evaluated on a case-by-case basis. In general *in situ* burning removes the threat from the oil slick from the water surface through combustion of the oil product; effectively removing the oil from the water surface to the atmosphere. However, *in situ* burns are not 100% effective, and can form a semi-solid, tar-like layer that may need to be recovered from the water surface. Also, some of the burn residue from crude oil burns may sink, thus exposing water column and bottom-dwelling resources to the oil in a new form.

Shoreline Pre-treatment Agents

Shoreline pre-treatment agents are designed to be utilized when oil is heading towards a sensitive shoreline resource (e.g., marsh, sheltered tidal flat) or a resource of historical/archaeological importance. Pre-treatment agents are applied to the substrate prior to oil landfall to prevent oil from adhering to or penetrating the substrate. Because of the nature of these products, there is a narrow window of opportunity for their use. Timing of an application is critical; products need to be applied to the oil/shoreline interface just prior to stranding of oil for effective use. As these products are not directly applied to the oil, they do not change the exposure of resources to the oil. They do however, work to reduce impacts to shoreline habitats from the surface slicks. Exposure to surface dwelling resources is not likely to change, except that these products may reduce potential exposures to isolated resources and intertidal resources if applied effectively.

Surface Collecting Agents

Surface collecting agents are designed to push or compress the oil on the water surface into a smaller area to form thicker slicks that are more readily recovered. Surface collecting agents are applied to the water, not the oil. These products are not used as the sole response option and are designed to be used to protect a specific, finite resource. As these products are not directly applied to the oil, they do not change the exposure of resources to the oil. They do however, work to reduce the area exposed by the surface slick. Exposure to surface dwelling and intertidal resources within the slick is not likely to change, except that these products may reduce the *potential* for exposures to isolated resources.

Surface Washing Agents

Surface washing agents are designed to clean the oil from substrates using a combination of surfactants, solvents and/or other additives. They are not applied to surface slicks on the water; they are applied to assist in the removal of weathered oil and for oil that is trapped in inaccessible areas where wash waters can be recovered and treated. Surface washing agents come in two forms: “lift and float” products and “lift and disperse” products. Surface coatings treated with lift and float products will reintroduce oil to the surface dwelling resources in the treatment area as the treated substrates are washed off; these products should be used in conjunction with sorbent booms to recapture the oil. Lift and disperse products would change exposures from surface dwelling resources to potentially include intertidal, water column, and bottom-dwelling resources.

Table E-3. Generalizations on the changes in routes of exposure from spilled oil* for resources before and after spill countermeasures products are applied.

	Surface-dwelling	**Water Column**	**Bottom-dwelling**	**Intertidal**
Generic Resource Exposure to Spilled Oil*, by Location	High	Low	NE	High
Changes in Resource Exposure With Treated Oil, by Response Countermeasure				
Bioremediation Agents	—	—	—	—
Dispersants	⬇⬇	⬆⬆	⬆	⬇
Elasticity Modifier	↑	—	—	↑
Emulsion Treating Agents	—	↑	—	—
***In situ* Burning (on water)**	⬇⬇	⬆	↑ to ⬆	⬇
***In situ* Burning (on land)**	⬇	—	—	⬇
Shoreline Pre-treatment Agents	—	—	—	↓ to ⬇
Solidifiers	↑	—	—	↑
Surface Collecting Agents	↓	—	—	↓ to ⬇
Surface Washing Agents	↑a; —b	—a; ↑b	—a,b	↑a,b

* This exposure rating assumes a spill of a medium crude oil from a tanker in offshore waters, with the potential for shoreline impacts, likely.

a –"lift and float" products; **b** –"lift and disperse" products

Key to Table

NE	minimal to no potential exposure expected
—	not likely to change potential exposure
↓	small reduction in potential exposure possible
⬇	moderate reduction in potential exposure likely
⬇⬇	dramatic reduction in potential exposure likely
↑	small increase in potential exposure possible
⬆	moderate increase in potential exposure likely
⬆⬆	dramatic increase in potential exposure likely

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Appendix F

40 CFR 300.900;

Subpart J – Use of Dispersants and Other Chemicals

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Subpart J-Use of Dispersants and Other Chemicals

Source: 59 FR 47453, Sept. 15, 1994, unless otherwise noted.

§ 300.900 General.

(a) Section 311(d)(2)(G) of the CWA requires that EPA prepare a schedule of dispersants, other chemicals, and other spill mitigating devices and substances, if any, that may be used in carrying out the NCP. This subpart makes provisions for such a schedule.

(b) This subpart applies to the navigable waters of the United States and adjoining shorelines, the waters of the contiguous zone, and the high seas beyond the contiguous zone in connection with activities under the Outer Continental Shelf Lands Act, activities under the Deepwater Port Act of 1974, or activities that may affect natural resources belonging to, appertaining to, or under the exclusive management authority of the United States, including resources under the Magnuson Fishery Conservation and Management Act of 1976.

(c) This subpart applies to the use of any chemical agents or other additives as defined in subpart A of this part that may be used to remove or control oil discharges.

§ 300.905 NCP Product Schedule.

(a) Oil Discharges.

(1) EPA shall maintain a schedule of dispersants and other chemical or bioremediation products that may be authorized for use on oil discharges in accordance with the procedures set forth in §300.910. This schedule, called the NCP Product Schedule, may be obtained from the U.S. Environmental Protection Agency, Oil Program Center, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. The telephone number is 1-202-260-2342.

(2) Products may be added to the NCP Product Schedule by the process specified in §300.920.

(b) Hazardous Substance Releases. [Reserved]

§ 300.910 Authorization of use.

(a) RRTs and Area Committees shall address, as part of their planning activities, the desirability of using appropriate dispersants, surface washing agents, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents listed on the NCP Product Schedule, and the desirability of using appropriate burning agents. RCPs and ACPs shall, as appropriate, include applicable preauthorization plans and address the specific contexts in which such products should and should not be used. In meeting the provisions of this paragraph, preauthorization plans may address factors such as the potential sources and types of oil that might be spilled, the existence and location of environmentally sensitive resources that might be impacted by spilled oil, available product and storage locations, available equipment and adequately trained operators, and the available means to monitor product application and effectiveness. The RRT representatives from EPA and the states with jurisdiction over the waters of the area to which a preauthorization plan applies and the DOC and DOI natural resource trustees shall review and either approve, disapprove, or approve with modification the preauthorization plans developed by Area Committees, as appropriate. Approved preauthorization plans shall be included in the appropriate RCPs and ACPs. If the RRT representatives from EPA and the states with jurisdiction over the waters of the area to which a preauthorization plan applies and the DOC and DOI natural resource trustees approve in advance the use of certain products under specified circumstances as described in the preauthorization plan, the OSC may authorize the use of the products without obtaining the specific concurrences described in paragraphs (b) and (c) of this section.

(b) For spill situations that are not addressed by the preauthorization plans developed pursuant to paragraph (a) of this section, the OSC, with the concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOC and DOI natural resource trustees, when practicable, may authorize the use of dispersants, surface washing agents, surface collecting agents, bioremediation agents, or miscellaneous oil spill control agents on the oil discharge, provided that the products are listed on the NCP Product Schedule.

(c) The OSC, with the concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOC and DOI natural resource trustees, when practicable, may authorize the use of burning agents on a case-by-case basis.

(d) The OSC may authorize the use of any dispersant, surface washing agent, surface collecting agent, other chemical agent, burning agent, bioremediation agent, or miscellaneous oil spill control agent, including products not listed on the NCP Product Schedule, without obtaining the concurrence of the EPA representative to the RRT and, as appropriate, the RRT representatives from the states with jurisdiction over the navigable waters threatened by the release or discharge, when, in the judgment of the OSC, the use of the product is necessary to prevent or substantially reduce a hazard to human life. Whenever the OSC authorizes the use of a product pursuant to this paragraph, the OSC is to inform the EPA RRT representative and, as appropriate, the RRT representatives from the affected states and, when practicable, the DOC/DOI natural resources trustees of the use of a product, including products not on the Schedule, as soon as possible. Once the threat to human life has subsided, the continued use of a product shall be in accordance with paragraphs (a), (b), and (c) of this section.

(e) Sinking agents shall not be authorized for application to oil discharges.

(f) When developing preauthorization plans, RRTs may require the performance of supplementary toxicity and effectiveness testing of products, in addition to the test methods specified in §300.915 and described in appendix C to part 300, due to existing site-specific or area-specific concerns.

§ 300.915 Data requirements.

(a) Dispersants.

(1) Name, brand, or trademark, if any, under which the dispersant is sold.

(2) Name, address, and telephone number of the manufacturer, importer, or vendor.

(3) Name, address, and telephone number of primary distributors or sales outlets.

(4) Special handling and worker precautions for storage and field application. Maximum and minimum storage temperatures, to include optimum ranges as well as temperatures that will cause phase separations, chemical changes, or other alterations to the effectiveness of the product.

(5) Shelf life.

(6) Recommended application procedures, concentrations, and conditions for use depending upon water salinity, water temperature, types and ages of the pollutants, and any other application restrictions.

(7) Effectiveness. Use the Swirling Flask effectiveness test methods described in appendix C to part 300. Manufacturers shall submit test results and supporting data, along with a certification signed by responsible corporate officials of the manufacturer and laboratory stating that the test was conducted on a representative product sample, the testing was conducted using generally accepted laboratory practices, and they believe the results to be accurate. A dispersant must attain an effectiveness value of 45 percent or greater to be added to the NCP Product Schedule. Manufacturers are encouraged to provide data on product performance under conditions other than those captured by these tests.

(8) Dispersant Toxicity. For those dispersants that meet the effectiveness threshold described in paragraph (a)(7) above, use the standard toxicity test methods described in appendix C to part 300. Manufacturers shall submit test results and supporting data, along with a certification signed by responsible corporate officials of the manufacturer and laboratory stating that the test was conducted on a representative product sample, the testing was conducted using generally accepted laboratory practices, and they believe the results to be accurate.

(9) The following data requirements incorporate by reference standards from the 1991 or 1992 Annual Books of ASTM Standards. American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103. This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51.1

(i) Flash Point-Select appropriate method from the following:

(A) ASTM-D 56-87, "Standard Test Method for Flash Point by Tag Closed Tester;"

(B) ASTM-D 92-90, "Standard Test Method for Flash and Fire Points by Cleveland Open Cup;"

(C) ASTM-D 93-90, "Standard Test Methods for Flash Point by Pensky-Martens Closed Tester;"

(D) ASTM-D 1310-86, "Standard Test Method for Flash Point and Fire Point of Liquids by Tag Open-Cup Apparatus;" or

(E) ASTM-D 3278-89, "Standard Test Methods for Flash Point of Liquids by Setaflash Closed-Cup Apparatus."

(ii) Pour Point-Use ASTM-D 97-87, "Standard Test Method for Pour Point of Petroleum Oils."

(iii) Viscosity-Use ASTM-D 445-88, "Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)."

(iv) Specific Gravity-Use ASTM-D 1298-85(90), "Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method."

(v) pH-Use ASTM-D 1293-84(90), "Standard Test Methods for pH of Water."

(10) Dispersing Agent Components. Itemize by chemical name and percentage by weight each component of the total formulation. The percentages will include maximum, minimum, and average weights in order to reflect quality control variations in manufacture or formulation. In addition to the chemical information provided in response to the first two sentences, identify the major components in at least the following categories: surface active agents, solvents, and additives.

(11) Heavy Metals, Cyanide, and Chlorinated Hydrocarbons. Using standard test procedures, state the concentrations or upper limits of the following materials:

(i) Arsenic, cadmium, chromium, copper, lead, mercury, nickel, zinc, plus any other metals that may be reasonably expected to be in the sample. Atomic absorption methods should be used and the detailed analytical methods and sample preparation shall be fully described.

(ii) Cyanide. Standard calorimetric procedures should be used.

(iii) Chlorinated hydrocarbons. Gas chromatography should be used and the detailed analytical methods and sample preparation shall be fully described. At a minimum, the following test methods shall be used for chlorinated hydrocarbon analyses: EPA Method 601-Purgeable halocarbons (Standard Method 6230 B) and EPA Method 608-Organochlorine pesticides and PCBs (Standard Method 6630 C).2103

(12) The technical product data submission shall include the identity of the laboratory that performed the required tests, the qualifications of the laboratory staff, including professional biographical information for individuals responsible for any tests, and laboratory experience with similar tests. Laboratories performing toxicity tests for dispersant toxicity must demonstrate previous toxicity test experience in order for their results to be accepted. It is the responsibility of the submitter to select competent analytical laboratories based on the guidelines contained herein. EPA reserves the right to refuse to accept a submission of technical product data because of lack of qualification of the analytical laboratory, significant variance between submitted data and any laboratory confirmation performed by EPA, or other circumstances that would result in inadequate or inaccurate information on the dispersing agent.

(b) Surface washing agents.

(1) Name, brand, or trademark, if any, under which the surface washing agent is sold.

(2) Name, address, and telephone number of the manufacturer, importer, or vendor.

(3) Name, address, and telephone number of primary distributors or sales outlets.
(4) Special handling and worker precautions for storage and field application. Maximum and minimum storage temperatures, to include optimum ranges as well as temperatures that will cause phase separations, chemical changes, or other alterations to the effectiveness of the product.
(5) Shelf life.
(6) Recommended application procedures, concentrations, and conditions for use depending upon water salinity, water temperature, types and ages of the pollutants, and any other application restrictions.
(7) Toxicity. Use standard toxicity test methods described in appendix C to part 300.
(8) Follow the data requirement specifications in paragraph (a)(9) of this section.
(9) Surface Washing Agent Components. Itemize by chemical name and percentage by weight each component of the total formulation. The percentages will include maximum, minimum, and average weights in order to reflect quality control variations in manufacture or formulation. In addition to the chemical information provided in response to the first two sentences, identify the major components in at least the following categories: surface active agents, solvents, and additives.
(10) Heavy Metals, Cyanide, and Chlorinated Hydrocarbons. Follow specifications in paragraph (a)(11) of this section.
(11) Analytical Laboratory Requirements for Technical Product Data. Follow specifications in paragraph (a)(12) of this section.

(c) Surface collecting agents.
(1) Name, brand, or trademark, if any, under which the product is sold.
(2) Name, address, and telephone number of the manufacturer, importer, or vendor.
(3) Name, address, and telephone number of primary distributors or sales outlets.
(4) Special handling and worker precautions for storage and field application. Maximum and minimum storage temperatures, to include optimum ranges as well as temperatures that will cause phase separations, chemical changes, or other alterations to the effectiveness of the product.
(5) Shelf life.
(6) Recommended application procedures, concentrations, and conditions for use depending upon water salinity, water temperature, types and ages of the pollutants, and any other application restrictions.
(7) Toxicity. Use standard toxicity test methods described in appendix C to part 300.
(8) Follow the data requirement specifications in paragraph (a)(9) of this section.
(9) Test to Distinguish Between Surface Collecting Agents and Other Chemical Agents.
(i) Method Summary-Five milliliters of the chemical under test are mixed with 95 milliliters of distilled water and allowed to stand undisturbed for one hour. Then the volume of the upper phase is determined to the nearest one milliliter.
(ii) Apparatus.
(A) Mixing Cylinder: 100 milliliter subdivisions and fitted with a glass stopper.
(B) Pipettes: Volumetric pipette, 5.0 milliliter.
(C) Timers.

(iii) Procedure-Add 95 milliliters of distilled water at 22 °C, plus or minus 3 °C, to a 100 milliliter mixing cylinder. To the surface of the water in the mixing cylinder, add 5.0 milliliters of the chemical under test. Insert the stopper and invert the cylinder five times in ten seconds. Set upright for one hour at 22 °C, plus or minus 3 °C, and then measure the chemical layer at the surface of the water. If the major portion of the chemical added (75 percent) is at the water surface as a separate and easily distinguished layer, the product is a surface collecting agent.

(10) Surface Collecting Agent Components. Itemize by chemical name and percentage by weight each component of the total formulation. The percentages should include maximum, minimum, and average weights in order to reflect quality control variations in manufacture or formulation. In addition to the chemical information provided in response to the first two sentences, identify the major components in at least the following categories: surface action agents, solvents, and additives.

(11) Heavy Metals, Cyanide, and Chlorinated Hydrocarbons. Follow specifications in paragraph (a)(11) of this section.

(12) Analytical Laboratory Requirements for Technical Product Data. Follow specifications in paragraph (a)(12) of this section.

(d) Bioremediation Agents.

(1) Name, brand, or trademark, if any, under which the agent is sold.

(2) Name, address, and telephone number of the manufacturer, importer, or vendor.

(3) Name, address, and telephone number of primary distributors or sales outlets.

(4) Special handling and worker precautions for storage and field application. Maximum and minimum storage temperatures.

(5) Shelf life.

(6) Recommended application procedures, concentrations, and conditions for use depending upon water salinity, water temperature, types and ages of the pollutants, and any other application restrictions.

(7) Bioremediation Agent Effectiveness. Use bioremediation agent effectiveness test methods described in appendix C to part 300.

(8) Bioremediation Agent Toxicity [Reserved].

(9) Biological additives.

(i) For microbiological cultures, furnish the following information:

(A) Listing of each component of the total formulation, other than microorganisms, by chemical name and percentage by weight.

(B) Listing of all microorganisms by species.

(C) Percentage of each species in the composition of the additive.

(D) Optimum pH, temperature, and salinity ranges for use of the additive, and maximum and minimum pH, temperature, and salinity levels above or below which the effectiveness of the additive is reduced to half its optimum capacity.

(E) Special nutrient requirements, if any.

(F) Separate listing of the following, and test methods for such determinations: Salmonella, fecal coliform, Shigella, Staphylococcus Coagulase positive, and Beta Hemolytic Streptococci.

(ii) For enzyme additives, furnish the following information:

(A) Listing of each component of the total formulation, other than enzymes, by chemical name and percentage by weight.

(B) Enzyme name(s).

(C) International Union of Biochemistry (I.U.B.) number(s).

(D) Source of the enzyme.

(E) Units.

(F) Specific Activity.

(G) Optimum pH, temperature, and salinity ranges for use of the additive, and maximum and minimum pH, temperature, and salinity levels above or below which the effectiveness of the additive is reduced to half its optimum capacity.

(H) Enzyme shelf life.

(I) Enzyme optimum storage conditions.

(10) For nutrient additives, furnish the following information:

(i) Listing of each component of the total formulation by chemical name and percentage by weight.

(ii) Nutrient additive optimum storage conditions.

(11) Analytical Laboratory Requirements for Technical Product Data. Follow specifications in paragraph (a)(12) of this section.

(e) Burning Agents. EPA does not require technical product data submissions for burning agents and does not include burning agents on the NCP Product Schedule.

(f) Miscellaneous Oil Spill Control Agents.

(1) Name, brand, or trademark, if any, under which the miscellaneous oil spill control agent is sold.

(2) Name, address, and telephone number of the manufacturer, importer, or vendor.

(3) Name, address, and telephone number of primary distributors or sales outlets.

(4) Brief description of recommended uses of the product and how the product works.

(5) Special handling and worker precautions for storage and field application. Maximum and minimum storage temperatures, to include optimum ranges as well as temperatures that will cause phase separations, chemical changes, or other alternatives to the effectiveness of the product.

(6) Shelf life.

(7) Recommended application procedures, concentrations, and conditions for use depending upon water salinity, water temperature, types and ages of the pollutants, and any other application restrictions.

(8) Toxicity. Use standard toxicity test methods described in appendix C to part 300.

(9) Follow the data requirement specifications in paragraph (a)(9) of this section.

(10) Miscellaneous Oil Spill Control Agent Components. Itemize by chemical name and percentage by weight each component of the total formulation. The percentages should include maximum, minimum, and average weights in order to

reflect quality control variations in manufacture or formulation. In addition to the chemical information provided in response to the first two sentences, identify the major components in at least the following categories: surface active agents, solvents, and additives.

(11) Heavy Metals, Cyanide, and Chlorinated Hydrocarbons. Follow specifications in paragraph (a)(11) of this section.

(12) For any miscellaneous oil spill control agent that contains microbiological cultures, enzyme additives, or nutrient additives, furnish the information specified in paragraphs (d)(9) and (d)(10) of this section, as appropriate.

(13) Analytical Laboratory Requirements for Technical Product Data. Follow specifications in paragraph (a)(12) of this section.

(g) Sorbents.

(1) Sorbent material may consist of, but is not limited to, the following materials:

(i) Organic products-

(A) Peat moss or straw;

(B) Cellulose fibers or cork;

(C) Corn cobs;

(D) Chicken, duck, or other bird feathers.

(ii) Mineral compounds-

(A) Volcanic ash or perlite;

(B) Vermiculite or zeolite.

(iii) Synthetic products-

(A) Polypropylene;

(B) Polyethylene;

(C) Polyurethane;

(D) Polyester.

(2) EPA does not require technical product data submissions for sorbents and does not include sorbents on the NCP Product Schedule.

(3) Manufacturers that produce sorbent materials that consist of materials other than those listed in paragraph (g)(1) of this section shall submit to EPA the technical product data specified for miscellaneous oil spill control agents in paragraph (f) of this section and EPA will consider listing those products on the NCP Product Schedule under the miscellaneous oil spill control agent category. EPA will inform the submitter in writing, within 60 days of the receipt of technical product data, of its decision on adding the product to the Schedule.

(4) Certification. OSCs may request a written certification from manufacturers that produce sorbent materials that consist solely of the materials listed in paragraph (g)(1) of this section prior to making a decision on the use of a particular sorbent material. The certification at a minimum shall state that the sorbent consists solely of the materials listed in §300.915(g)(1) of the NCP. The following statement, when completed, dated, and signed by a sorbent manufacturer, is sufficient to meet the written certification requirement:

[SORBENT NAME] is a sorbent material and consists solely of the materials listed in §300.915(g)(1) of the NCP.

(h) Mixed products. Manufacturers of products that consist of materials that meet the definitions of two or more of the product categories contained on the NCP Product Schedule shall submit to EPA the technical product data specified in this section for each of those product categories. After review of the submitted technical product data, and the performance of required dispersant effectiveness and toxicity tests, if appropriate, EPA will make a determination on whether and under which category the mixed product should be listed on the Schedule.

§ 300.920 Addition of products to Schedule.

(a) Dispersants.

(1) To add a dispersant to the NCP Product Schedule, submit the technical product data specified in §300.915(a) to the U.S. Environmental Protection Agency, Oil Program Center, 1200 Pennsylvania Avenue, NW, Washington, DC 20460. The telephone number is 1-202-260-2342. A dispersant must attain an effectiveness value of 45 percent or greater in order to be added to the Schedule.

(2) EPA reserves the right to request further documentation of the manufacturers' test results. EPA also reserves the right to verify test results and consider the results of EPA's verification testing in determining whether the dispersant meets listing criteria. EPA will, within 60 days of receiving a complete application as specified in §300.915(a) of this part, notify the manufacturer of its decision to list the product on the Schedule, or request additional information and/or a sample of the product in order to review and/or conduct validation sampling. If EPA requests additional information and/or a product sample, within 60 days of receiving such additional information or sample, EPA will then notify the manufacturer in writing of its decision to list or not list the product.

(3) Request for review of decision. (i) A manufacturer whose product was determined to be ineligible for listing on the NCP Product Schedule may request EPA's Administrator to review the determination. The request must be made in writing within 30 days of receiving notification of EPA's decision to not list the dispersant on the Schedule. The request shall contain a clear and concise statement with supporting facts and technical analysis demonstrating that EPA's decision was incorrect.

(ii) The Administrator or his designee may request additional information from the manufacturer, or from any other person, and may provide for a conference between EPA and the manufacturer, if appropriate. The Administrator or his designee shall render a decision within 60 days of receiving the request, or within 60 days of receiving requested additional information, if appropriate, and shall notify the manufacturer of his decision in writing.

(b) Surface washing agents, surface collecting agents, bioremediation agents, and miscellaneous oil spill control agents.

(1) To add a surface washing agent, surface collecting agent, bioremediation agent, or miscellaneous oil spill control agent to the NCP Product Schedule, the technical product data specified in §300.915 must be submitted to the U.S. Environmental Protection Agency, Oil Program Center, 1200 Pennsylvania Avenue, NW,

Washington, DC 20460. The telephone number is 1-202-260-2342. If EPA determines that the required data were submitted, EPA will add the product to the Schedule.

(2) EPA will inform the submitter in writing, within 60 days of the receipt of technical product data, of its decision on adding the product to the Schedule.

(c) The submitter may assert that certain information in the technical product data submissions, including technical product data submissions for sorbents pursuant to §300.915(g)(3), is confidential business information. EPA will handle such claims pursuant to the provisions in 40 CFR part 2, subpart B. Such information must be submitted separately from non-confidential information, clearly identified, and clearly marked "Confidential Business Information." If the submitter fails to make such a claim at the time of submittal, EPA may make the information available to the public without further notice.

(d) The submitter must notify EPA of any changes in the composition, formulation, or application of the dispersant, surface washing agent, surface collecting agent, bioremediation agent, or miscellaneous oil spill control agent. On the basis of this data, EPA may require retesting of the product if the change is likely to affect the effectiveness or toxicity of the product.

(e) The listing of a product on the NCP Product Schedule does not constitute approval of the product. To avoid possible misinterpretation or misrepresentation, any label, advertisement, or technical literature that refers to the placement of the product on the NCP Product Schedule must either reproduce in its entirety EPA's written statement that it will add the product to the NCP Product Schedule under §300.920(a)(2) or (b)(2), or include the disclaimer shown below. If the disclaimer is used, it must be conspicuous and must be fully reproduced. Failure to comply with these restrictions or any other improper attempt to demonstrate the approval of the product by any NRT or other U.S. Government agency shall constitute grounds for removing the product from the NCP Product Schedule.

DISCLAIMER

[PRODUCT NAME] is on the U.S. Environmental Protection Agency's NCP Product Schedule. This listing does NOT mean that EPA approves, recommends, licenses, certifies, or authorizes the use of [PRODUCT NAME] on an oil discharge. This listing means only that data have been submitted to EPA as required by subpart J of the National Contingency Plan, §300.915.

Appendix G
Examples of Applied Alternate Sorbent Products Not Required to be Listed on the NCP Product Schedule

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List of Sorbent Products Not Required to be Listed on the NCP Product Schedule.

Product Name	Manufacturer/Vendor	Letter Sent
Abzorbit	Abzorbit, Inc.	03/22/1999
All-Sorb 1	Nature Treat, Inc	09/09/1999
Cansorb	AVP Cansorb	11/22/1995
Cattail Down	c/o Ms. Donna Sorenson	02/21/2001
Cotton Gin Trash	c/o Dr. J.A. Pinkard	01/30/1997
Dica-Sorb	Grefco Minerals Inc.	No letter on file
ENVIRO-BOND 403	Petroleum Environmental Technologies, Inc.	05/01/1998
Envirosorb	Sammie Bonner Construction Co., Inc	
Exsorbet	Waste Solutions, Corp.	11/08/2000
FyBX Fibers	FyBX Corporation	01/05/2000
Geo-Sorb	Trade Development International	01/03/1996
HSS SORB	Hydrocarbon Spills Solution, Corp.	06/25/1999
Imbiber Beads	Imbibitive Technologies	12/11/1995
MEGA Sorbent	PTC Enterprises, Inc.	05/17/2000
Micro-Crumb Rubber	D.K.M., Inc.	01/22/2001
MOP FSC #201	Fundamental Solutions, Inc.	12/02/1998
MOP FSC #301	Fundamental Solutions, Inc.	03/19/2001
MOP FSC #401	Fundamental Solutions, Inc.	12/09/1998
Nature-Sorb	Kenex Hemp LTD	12/15/2000
OARS	AB-TECH Industries	08/05/1996
Oclansorb	Premium Supply Company Inc.	09/19/1995
Oil Gator	Product Services Marketing Group	07/08/1998
Oilik	115 Forster Ave.	No letter on file.
Peat Sorb™	Zorbit Technologies, Inc.	03/14/2000
Pristine Sea	Marine Systems	05/05/1995
RamSorb	Williams Environmental	11/23/1998
Remediator, The	Enviro-Marine	07/07/1999
Rubberizer	Haz-Mat Response Technologies, Inc.	04/07/1998
SD1	Mansfield & Alper, Inc.	04/18/1997

Product Name	Manufacturer/Vendor	Letter Sent
SeaFoam	Huntsman Polyurethanes	03/09/2001
Sea Sweep	Sea Sweep, Inc.	01/13/1995
S.O.A.K	T&H Enterprizes	No letter on file
Sphag Sorb	Environmental Cleanup Systems	05/05/2000
Spill-sorb	Moore Green	01/30/2001
Super-Buoyant Boom	Mansfield & Alper, Inc.	04/18/1997
Suprasec X1002	Brixham Environmental Laboratory	12/1997
Versipad	Mansfield & Alper, Inc.	04/18/1997
Zorbolite	Global Environmental of California	No letter on file

If you have any questions about the claims of a particular product or to verify a product's status on the NCP Product Schedule, contact the USEPA Oil Program Center at 202-260-2342 or 703-603-9918.

Appendix H
Copies of Worksheets/Forms/Templates

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WORKSHEET 1: SELECTION GUIDE DECISION TRACKING/ EVALUATION WORKSHEET

This worksheet is intended to be photocopied for use during drills and incidents

Name(s):

Date:

Incident:

	Mark Choices with an **X**	Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast-Water Booming Strategies	Fire Fighting Foams	In-situ Burn (ISB)	Non-floating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
A.	***Technology Choices of Interest:***																
B.	***Environmental matrix used:***																
C.	***Incident-specific Information:***																
	Response Phase																
	Oil Type																
	Treatment Volume																
	Weather Conditions																
	Decision Authority **NR** - No Spec. Reg. Req.s **PS** - Must be on Prod. Schd. **PA** - Pre-Authorization in Place **CR** - RRT Concurrence Req'd. **SP** - Special permit Req'd.																
	Monitoring **SM** - SMART Monitoring **OM** - Effectiveness or Other																
D. (check)	**Considerations**																
☐	Limited Oil Handling and Storage Capacity																
☐	Oil On Fire or Potential for Fire																
☐	No Oil Containment and Recovery Options																
☐	Oil Contaminated Substrate																
☐	Light Oil Type - Difficult to Recover/Skim																
☐	Oil Will Form an Emulsion																
☐	Oil Has Formed an Emulsion																
☐	Oil Has/Is Likely to Sink																
☐	Buried Oil																
☐	Oil Likely to be Remobilized																
☐	Fast Currents Prevent Effective Booming																
☐	Need to Protect Against Significant Surface and Shoreline Impacts, Including Marshland																
☐	Need to Protect Against Significant Water Column and Benthic Impacts																
☐	Oiled Site is Access Limited																
☐	Oiled Shoreline/Substrate Needs Cleaning Without Significant Impacts																
☐	Significant Problem of Waste Generation																
☐	Vapor Suppression																
☐	Oil on Roadways																
☐	Water Intakes at Risk																
☐	Oil Trapped in Vegetation																
☐	Oil Trapped in Snow and Ice																
☐	Confined Spaces with Water/Vapors? (sewers, culverts, etc.)																
E.	***Habitat and Sensitive Resource Evaluation***																
	Habitats (refer to Table 3, pg. 29)																
	Natural Resources (refer to Table 4, pg. 33)																
F.	***Evaluation Results***																

Top Three Choices:			
Any Major Advantages:			
Any Major Disadvantages:			

Additional Comments/Decisions:

Signatures/Date of Review Team:

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WORKSHEET 2: PRODUCT SELECTION WORKSHEET

This worksheet is intended to be photocopied for each product category evaluated and used during drills and incidents
and Faxed to the Incident Specific RRT for review. This worksheet may be used to evaluate 1, 2 or 3 separate products in an individual category.

Name(s):

Date:

Incident:

A:	**Product Category Being Reviewed:**			
	Products of Interest:	**Product 1**	**Product 2**	**Product 3**
B:	**Product Name:**			
C:	**RRT Approval Required? (Y/N)**			
D:	**Can Product Arrive in Time? (Y/N)**			
E:	**Can Product be Applied in Time? (Y/N)**			
F:	**Can Product be removed from the Environment? (Y/N)**			
G:	**Toxicity (Write in numbers and Toxicity Rating. See App E for more information on toxicity and Toxicity Rating)**	Inland silversides (96h): Mysid Shrimp (48h):	Inland silversides (96h): Mysid Shrimp (48h):	Inland silversides (96h): Mysid Shrimp (48h):
H:	**Mark as 1st, 2nd, or 3rd Choice or mark as Not Applicable for this incident**			

I: Additional Comments/Decisions/Recommendations:

J: Initials/Date of Incident-Specific RRT Review of Information:

Initial Box and Include Date Upon Review

USEPA: ☐	Date:	**STATE:** ☐	Date:____________________
USCG: ☐	Date:	**STATE:** ☐	Date:____________________
NOAA: ☐	Date:	**OTHER:** ☐	Date:____________________
USDOI: ☐	Date:	**OTHER:** ☐	Date:____________________

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WORKSHEET 3: TESTING & MONITORING WORKSHEET

This worksheet is intended to be photocopied for each product category evaluated and used during drills and incidents and Faxed to the Incident Specific RRT for review. Use additional paper if needed to record information.

Name(s):

Date:

Incident:

Products of Interest:		Product 1	Product 2	Product 3
A:	**Product Name:**			
B:	**Has a tailgate test proven that product is effective on oil type at this state of weathering? (Y/N)**			
Products to Consider for Additional Testing:		**Product 1**	**Product 2**	**Product 3**
C:	**Products still being considered:**			
D:	**Has a Field Effectiveness test or Effects Test been carried out? (Y/N)**			
E:	**Describe test protocols:**			
	Test site specifics (environment):			
	Natural resources at risk:			
	Volume of oil to be treated:			
	Application rate(s)/volume used:			
	Application equipment:			
	Other logistical considerations:			
	Physical impacts expected:			
	Is the oil recoverable?:			
	Expected outcomes of test:			
F:	**Recommended Level of Monitoring for this test** (**Refer to Part D to Determine)**			
G:	**Mark as 1st, 2nd, 3rd Choice or Not Applicable for use during this incident**			

H: Additional Comments/Recommendations on the use of product(s):

I: Initials/Date of Incident-Specific RRT Review of Information:

Initial Box and Include Date Upon Review

USEPA:	☐ Date:	**STATE:**	☐	Date:____________________
USCG:	☐ Date:	**STATE:**	☐	Date:____________________
NOAA:	☐ Date:	**OTHER:**	☐	Date:____________________
USDOI:	☐ Date:	**OTHER:**	☐	Date:____________________

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History	**Name of Spill/Vessel/Location:** **Date of Spill (mm/dd/yy):** **Location of Spill:** **Latitude:** **Longitude:** **Oil Product:** **Oil Type (USCG Classification code):** **Barrels:** **Source of Spill:**
Technical Information	**Source of Spill:** **Resources at Risk:** **Applied Technologies/Optional Response Countermeasure(s) Used:** **How This Countermeasure Was Used (*purpose, application quantity, date, method*):** **Shoreline Types Impacted:** **Incident Summary (*specifics*):** **Behavior of Oil Before and/or After Treatment:** **Other Countermeasures and Mitigation:** **Lessons Learned from Optional Response Countermeasure Use:** **Recommendations for future Optional Response Countermeasure Use:** ***Please attach any necessary data and/or reports to this form.***
Contact Information	**Contact Name:**____________________ **Position:** ____________________ **Agency:** ____________________ **Address:**____________________ **Phone:** **FAX:**
Questions?/ Submittal	Contact 843-766-3118 for additional assistance/questions. Submit this form via FAX to 843-766-3115, email dscholz@seaconsulting.com or mail it to Debra Scholz, SEA, Inc. 109 Wappoo Creek Drive, Suite 4B, Charleston, SC 29412. Thank you for your assistance in this matter.

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Appendix I

Draft Press Releases for Applied Technologies

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Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION:

Proposed Use of Bioremediation Agent

In response to oil spill cleanup issues associated with the _______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the bioremediation agent ___________________ as a long-term remediation mechanism for this incident under the following conditions:

The bioremediation action will be monitored by ***(list agencies; contacts if necessary)***

FAQs on Bioremediation

What is Bioremediation?

The objective of bioremediation is to accelerate the rate of hydrocarbon degradation due to natural microbial processes. Naturally occurring microbes, such as bacteria, in the soil and water can consume and digest oil products, reducing the oil to carbon dioxide and water. Bioremediation is usually performed with one, or both, of two basic methods:

Nutrient Enrichment – This is the addition of nutrients (generally nitrogen and phosphorous) to stimulate microbial growth. This method is typically used when scientists believe that natural nutrient levels are low, and that the addition of nutrients will increase microbial growth and numbers.

Natural Microbe Seeding – This is the addition of high numbers of natural oil-degrading microorganisms. This method is used when scientists determine that there are low numbers of the indigenous bacteria types that degrade oil. Typically, nutrients are also included to help support the added microbes. .

Some bioremediation products contain surfactants to break up the oil into droplets. This increases the surface area of the oil, which will increase the rate of microbial degradation.

When is Bioremediation Used?

Typically, bioremediation is used after other techniques have been used to remove free oil and gross contamination or when further oil removal is likely to be destructive, ineffective, or cost-prohibitive. On water, it may be used in small, static water bodies, such as ponds and man-made lagoons.

- Nutrient Enrichment is used when low nutrient levels are limiting the rate of natural biodegradation.
- Natural Microbe Seeding is used when indigenous oil-degrading microbes are present in low numbers ($<10^6$/gram sediment)

What Authority is Required to Use Bioremediation Agents?

Incident–specific Regional Response Team (RRT) approval is required; Bioremediation products must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use.

What are the Health and Safety Issues Associated with Bioremediation Agent Use During This Incident?

Health and safety concerns are typically low for bioremediation. Before being added to the NCP Product Schedule, all products are tested to ensure that they do not contain pathogens.

Are There Any Waste Generation or Disposal Issues Associated With Using Bioremediation Agents?

Effective use of bioremediation agents should significantly reduce the amount of oily wastes generated.

Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION:
Proposed Use of Chemical Dispersants

In response to oil spill cleanup issues associated with the ______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the chemical dispersant ___________________ to promote rapid oil dispersion into the surrounding water column during this incident and under the following conditions (***list any pre-approval agreements, if applicable***):

The dispersant use will be monitored by ***(list agencies; contacts if necessary)*** using the methodology specified in the USCGs (1999) Special Monitoring of Applied Response Technologies (SMART) protocols (***refer/make available the SMART fact sheet and guidance document available from: www.response.restoration.NOAA.gov/oilaids/SMART***/SMART.html) .

FAQs on Dispersants

What are Chemical Dispersants?

Chemical dispersants are chemical mixtures that are composed of chemical compounds referred to as surfactants and solvents. The solvent is the chemical carrier that allows the surfactant to penetrate the oil molecule so that it lines up to break the interfacial tension between the oil and water, allowing the oil to break up into tiny droplets that mix into the water column, thus removing the threat of the oil from the water surface to within the water column.

Dispersion is a natural process that occurs in surface slicks as wind and wave action break up the surface slick. However, naturally dispersed oil droplets tend to recoalesce and return to the water surface and reform as surface slicks. The addition of chemical dispersants allows the wind and wave action to permanently mix the oil droplets into the water column. Typically, water currents beneath the surface then carry the small oil droplets away and dilute the concentration of the droplets in the water column; these dispersed oil droplets are then targeted by indigenous oil-consuming microbes where they are broken down into their ultimate components, carbon dioxide and water.

A simple example can be seen with a bottle of oil and vinegar salad dressing. When first picked up the bottle clearly contains a layer of oil above a layer of vinegar. However, when shaken, the oil mixes in with the vinegar as tiny droplets. This is similar to both natural and chemical dispersion on a very small scale. Like natural dispersion, if over time the agitation source (shaking) is removed, the oil and vinegar will separate out. The addition of chemical dispersants to the oil and vinegar would act to permanently mix the oil into the vinegar.

Why are Chemical Dispersants Used?

Chemical dispersants are typically used because oil dispersion does the following:

- Decreases the size of, or largely removes, the oil slick. As a result of this:
  - Less, or no oil will be blown onto shore to impact beaches and other sensitive areas.
  - Impacts to seabirds and marine mammals living on the surface of the water will be reduced.
  - The hazard to shipping lanes and private boaters from the slick will be reduced.
- Oil is broken into tiny droplets, making it easier for naturally occurring microbes to digest it, thereby transforming the oil into carbon dioxide and water.

When are Chemical Dispersants Used?

- When an oil spill is in the ocean and offshore.
- When dispersing the oil will cause less environmental impact than surface slicks that will strand on shore or impact sensitive water-surface resources, such as sea birds.
- When other response techniques, such as mechanical recovery, are inappropriate due to high seas or other conditions.
- Dispersants are sometimes applied to only part of a large slick in order to allow the available resources to handle the large volume of oil, or to disperse a part of the slick that is posing an imminent threat to a sensitive resource.
- Although dispersants can be an important part of a response, it should be noted that dispersants are not likely to be 100% effective. As a result, the need for mechanical recovery and shoreline cleanup may not be eliminated with their use.

What Authority is Required to use Chemical Dispersants?

Incident–specific Regional Response Team (RRT) approval is required; Chemical dispersant products must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use. In many areas, pre-approval zones for chemical dispersant use have already been predefined.

What are the Health and Safety Issues Associated with the Use of Chemical Dispersants During This Incident?

Response workers must be careful to ensure that personnel do not get sprayed by the dispersants, or come in contact with any of the overspray. Vessels must only be deployed under safe sea conditions.

Are There Any Waste Generation or Disposal Issues Associated With the Use of Chemical Dispersants?

Effective use of dispersant agents should significantly reduce the amount of oily wastes generated.

ATTENTION:
Proposed Use of Emulsion Treating Agents

In response to oil spill cleanup issues associated with the _______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the emulsion treating agent ___________________ to prevent and treat oil in water emulsions during this incident. Use is approved under the following conditions:

Emulsion treating agent use will be monitored by ***(list agencies; contacts if necessary)***

FAQs on Emulsion Treating Agents

What are Emulsion Treating Agents?

When oil is spilled on water it typically floats on, or near, the surface. Wind and wave action can cause this layer of oil to mix with the water, creating what is known as an emulsion. This often occurs in strong seas or as waves crash against sand and rocks along the shoreline. Emulsions typically look like a heavy, frothy layer of oil. Emulsions pose a problem because they contain anywhere from 20-80% water, which will greatly reduce the efficiency of oil skimmers and pumps, which may collect more water than oil due to the emulsion. Most emulsion treating agents are made of water soluble surfactants that act to either prevent the initial formation of an emulsion or to separate, or "break", an emulsion back into its separate oil and water components.

When are Emulsion Treating Agents Used?

<u>Emulsion inhibitors</u> are typically used to increase the window of opportunity for other response options, such as dispersants or *in situ* burning. They are also used to maintain a high recovery rate for oil skimmers.

<u>Emulsion breakers</u> are often used to treat already formed emulsions, so that upcoming response efforts will be more effective. For example, lab tests showed that treatment with emulsion breakers allowed successful burning of otherwise unignitable emulsions. Emulsion breakers are also used to separate oil from water in collection tanks, so that the water can be discharged and the tanks completely filled with oil. Skimmers can quickly fill their tanks with emulsions that are more water than oil. Use of emulsion breakers can extend the operational time and efficiency of collection equipment such as skimmers.

What Authority is Required to use Emulsion Treating Agents?

Incident–specific Regional Response Team (RRT) approval is required; emulsion treating agents must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use during oil spill response operations. RRT approval is not required if they are applied in closed containers and the separated water is sent to a water treatment facility (e.g., wastewater treatment plant).

What are the Health and Safety Issues Associated with the Use of Emulsion Treating Agents during this incident?

Most products require Level D personal protection and a respirator when being handled in confined spaces (e.g., when filling aircraft spray systems).

Are There Any Waste Generation or Disposal Issues Associated With the Use of Emulsion Treating Agents?

Effective use of emulsion treating agents should reduce the amount of oily material generated for handling, transport, and disposal. In containers, separated water would likely have to be tested and/or treated prior to discharge.

Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION:
Proposed Use of *In situ* Burning

In response to oil spill cleanup issues associated with the _______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to conduct *In situ* burning _________(***on land, inland water, coastal marine***) during this incident. Use is approved under the following conditions (***list any pre-approval agreements, if applicable***):

This *In situ* burn will be monitored by ***(list agencies; contacts if necessary)*** using the methodology specified in the USCGs (1999) Special Monitoring of Applied Response Technologies (SMART) protocols (***refer/make available the SMART factsheet and technical document available from: www.response.restoration.NOAA.gov/oilaids/SMART/SMART.html***

FAQs on *In situ* Burning

What is *In situ* Burning?

In some cases, oil spills occur in areas, or under conditions in which it is difficult to recover the spilled oil product. For example, the oil may be spilled in a field covered with brush, or a remote area without easy access, where typical recovery methods will not work or could cause further damage to the habitat. In such cases it may be more practical and safer for the environment to burn the oil where it is before it sinks deep into the ground or spreads to other areas. *In situ* burning is the controlled burning, in place, of the oil released during a spill. After careful consideration of winds, weather, and the location of populated areas, along with the notification of local fire and police departments, the oil is ignited and allowed to burn off. If the oil will not light by itself, a substance, such as diesel fuel mixed with gasoline, will be applied initially and used as an "igniter". Although *in situ* burning typically produces a dark smoke cloud, it is a frequently used method to rapidly dispose of spills and limit impacts.

In situ burning is nearly 100 percent effective, although a burn residue often needs to be dealt with following the controlled burn. This residue is typically very easy to recovery as it is no longer in a "liquid" phase and has been recovered using manual removal equipment in past burns.

When should *In situ* Burning be Used?

- When oil needs to be removed quickly in order to prevent it from spreading to sensitive areas or over a larger area.
- To reduce the generation of oily wastes, especially when disposal or transportation options are limited.
- Where access to the spill site is limited by shallow water, soft substrates, thick vegetation, or the remoteness of the location.
- As a final removal technique, when other methods begin to lose effectiveness or become too intrusive.

What Authority is Required to Perform *In situ* Burning?

For inland burns, approval from the appropriate state agencies (including the agency regulating air quality) is required.

Incident–specific Regional Response Team (RRT) approval is not required unless an accelerant (burning agent) is used. Trustee notification is recommended and required in Region IV.

What are the Health and Safety Issues Associated with the Use of *In situ* Burning during this incident?

Wind and weather conditions must be watched carefully to ensure that the smoke plume will not impact the public. Human health and safety is always of primary concern.

Are There Any Waste Generation or Disposal Issues Associated With the Use of *In situ* Burning?

Effective use of *in situ* burning should significantly reduce the amount of oily wastes generated.

Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION: Proposed Use of Solidifiers

In response to oil spill cleanup issues associated with the ______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the solidifier ______________ during this incident. Use is approved under the following conditions (*also* ***list any pre-approval agreements, if applicable***):

The solidifier use will be monitored by ***(list agencies; contacts if necessary)***

FAQs on Solidifiers

What are Solidifiers?

Technically, most solidifiers are synthetic polymers that either physically or chemically bond with organic liquids. What this means for an oil spill responder is that when solidifiers are mixed with liquid oil, they will turn it into a coherent mass. This action can have many benefits when cleaning up an oil spill. However, the primary benefit that solidifiers usually offer is that they can help to prevent the rapid spreading of liquid oil, in order to protect the surrounding environment and containing the oil for cleanup.

When should Solidifiers be used?

- When oils are volatile. Solidification can reduce the vapor pressure of oil. This means that the spilled oil will emit fewer fumes that may be highly flammable or dangerous to humans and other animals.
- When oil needs to be immobilized so that it does not spread out or sink into the soil. Solidifiers can be applied to all of the spilled oil, or only applied the edges of a spill in order to form a barrier, or dam, to contain the oil.
- To block oil that may be running off into drains or sewers.

What Authority is required to Use Solidifiers?

Incident–specific Regional Response Team (RRT) approval is required; solidifiers must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use during oil spill response operations.

What are the Health and Safety Issues Associated with the Use of Solidifiers during this incident?

Human health and safety is always of primary concern. Typically, solidifiers pose little or no risk for health and safety, as long as they are used with care and as directed.

Are There Any Waste Generation or Disposal Issues Associated With the Use of Solidifiers?

Most solidifiers are not reversible, so disposal options always have to be considered carefully. In some cases, solidified oils can be safely disposed of in non-hazardous landfills after passing leachate tests. In other cases, solidified oils may be used as fuel for cement kilns, incinerators, etc. Disposal options will vary, depending on the oil type and solidifier used.

Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION:
Proposed Use of Surface Collecting Agents

In response to oil spill cleanup issues associated with the _______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the surface collecting agent ______________ during this incident. Use is approved under the following conditions (*also* ***list any pre-approval agreements, if applicable***):

The surface collecting agent use will be monitored by ***(list agencies; contacts if necessary)***

FAQs on Surface Collecting Agents

What are Surface Collecting Agents?

Surface collecting agents are chemicals that "push" or "compress" oil on the water surface, to form thicker slicks that are more readily collected. For example, if a surface collecting agent was applied around the edges of a swimming pool, and some oil was then poured into the center of the pool, the agents would "push" the oil away from the edges and keep it contained in the center. The oil would not come in contact with the sides of the swimming pool. Because of the way they work, these products are also known as "herders". Surface collecting agents do this because they exert a spreading pressure on the water surface that is greater that the oil's spreading pressure. They contain special types of surfactants that act to reduce the surface tension of water to increase their spreading pressure. Effective surface collecting agents have the following characteristics: they have a low evaporation rate, low water and oil solubility, do not disperse or emulsify, and have a high spreading pressure (>35 x 10^{-7} Newtons/m).

When should Surface Collecting Agents be used?

- To push oil out of inaccessible areas, such as underneath piers.
- To collect oil into a smaller and thicker slick to increase recovery rates
- For short term protection of areas where deploying booms is not possible, or could cause more damage
- These products are more effective when they have something to push against, like a bulkhead or inside semi-enclosed inlets.

What Authority is required to Use Surface Collecting Agents?

Incident–specific Regional Response Team (RRT) approval is required; surface collecting agents must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use during oil spill response operations.

What are the Health and Safety Issues Associated with the Use of Surface Collecting Agents during this incident?

Human health and safety is always of primary concern. Typically, surface collecting agents pose little or no risk for health and safety, as long as they are used with care and as directed.

Are There Any Waste Generation or Disposal Issues Associated With the Use of Surface Collecting Agents?

None, the product does not change the physical condition or volume of the oil. The surface collecting agent is not recovered.

Draft Press Release
Regional Response Team ___
Date: ____________

ATTENTION:
Proposed Use of Surface Washing Agents

In response to oil spill cleanup issues associated with the _______________________ oil spill incident, the Region ___ Regional Response Team, in coordination with the Unified Command on scene, has given approval to use the surface washing agent ______________ during this incident. Use is approved under the following conditions (*also* ***list any pre-approval agreements, if applicable***):

The surface washing agent use will be monitored by ***(list agencies; contacts if necessary)***

FAQs on Surface Washing Agents

What are Surface Washing Agents?

Surface washing agents contain surfactants, solvents, and/or other additives that work to clean oil from boats, piers, rocks, etc. Many products work much like dishwashing detergent. They pull the oil off of the substrate (boat, pier, etc.) and it is broken into small droplets, where it is kept in suspension by the surfactant (soap).

When should Surface Washing Agents be used?

- On hard-surface shorelines, where there is a strong desire to remove residual oils
- When oil has weathered, so that it cannot be removed from the substrate with ambient water temperatures and low water pressures
- When oil is trapped in areas inaccessible to physical removal, but which can be flushed out. In such cases the washwaters must be contained. Examples are sewers, storm drains, and ravines.
- For vapor suppression of volatile fuel spills that have entered sewers. Also, to enhance flushing of these types of spills. Again, washwaters must be contained.

What Authority is required to Use Surface Washing Agents?

- **Incident–specific Regional Response Team (RRT) approval is required;** surface washing agents must be on the USEPA National Contingency Plan (NCP) Product Schedule in order to be considered for use during oil spill response operations.
- RRT approval is not required if they are used in a manner in which the runoff, or washwater, is not released into the environment. An example of this would be the use of surface washing agents inside of a holding tank.
- Fire departments and HAZMAT Teams have the authority to "hose down" a spill using a chemical countermeasure if they determine that the spilled oil could cause an explosion or threaten human health.

What are the Health and Safety Issues Associated with the Use of Surface Washing Agents during this incident?

- Human health and safety is always of primary concern. All products require Level D personal protection with splash protection. Care needs to be taken to avoid slips and falls while working on soapy and oily surfaces.

Are There Any Waste Generation or Disposal Issues Associated With the Use of Surface Washing Agents?

- Because released oil must be recovered, waste generation is a function of recovery method. Sorbents are often used with "lift and float" products. Local conditions will determine whether the water must also be collected and treated, or can be discharged safely.
- If situations where the oil is dispersed, all of the washwater must be contained and treated prior to its discharge, often through wastewater treatment plants if the oil concentrations are low. For high oil concentrations, oil recovery can be increased by the use of emulsion-breaking agents.

Appendix J
Applied Technology Case History Summaries

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Bioremediation, On Adjacent Land

Name of Spill/Vessel/Location:	Houston, AK
Date of Spill (mm/dd/yy):	12/25/97
Date of Application (mm/dd/yy):	12/25/97
Location of Spill:	Mat-Su Borough
Oil Product:	Heating Oil
Oil Type (USCG Classification code):	DF2
Barrels spilled:	23 bbls (1,000 gal)
Estimated treatment volume:	23 bbls (1,000 gal)
Source of Spill:	1,000 gallon above ground storage tank
Was Treated Oil on Land, Coastal Waters, or Inland Waters?	On adjacent land

Resources at Risk: Fresh water lake approximately 300 feet down gradient

Oil Spill Applied Technology Used: UC-40 Microbes

How Countermeasure Was Used: Microbes were brewed and injected into ground

Shoreline Types Impacted: None

Incident Summary (specifics): Fuel tank line severed and drained 1,000 gallons of fuel into ground then impacted "French" drainage system. Systems effluent was approximately 150 feet from spill zone, and daylighted outside of a sloped hill.

Behavior of Oil (before and after treatment): Oil has just begun to run out effluent of French drain system, when injection began.

What problem was this technology intended to address?: Bioremediating the spill to stop threat to freshwater lake.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Microbes reduced DRO levels to near non-detectable levels from the effluent. No impact to lake.

Additional References: N/A

Respondent Name:	Bob Dreyer
Incident Contact:	Bob Dreyer
Position:	Environmental Specialist
Agency:	ADEC
Address:	555 Cordova Street, Anchorage, AK 98501
Phone:	907-269-7688
FAX:	907-269-7648
email:	not provided

Surface Washing Agent, On Adjacent Land

Name of Spill/Vessel/Location:	Bouchard 155
Date of Spill (mm/dd/yy):	08/03/93
Date of Application (mm/dd/yy):	08/31/93
Location of Spill:	St. John's Pass, Tampa Bay, Florida
Oil Product:	No. 6 fuel oil
Oil Type (USCG Classification code):	Type IV
Barrels spilled:	7,860 (325,000 gallons)
Estimated treatment volume:	Not calculated; oil coat was treated on a 50 ft^2 area of concrete walkway
Source of Spill:	Three-vessel collision

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On Land

Resources at Risk: nesting loggerhead sea turtles and their nests, brown pelicans, cormorant, tern, egret, heron species, recreational beaches.

Oil Spill Applied Technology Used: PES-51 versus high-pressure, hot-water flushing

How Countermeasure Was Used: On concrete and riprap to remove oil coat; In tests to determine which process worked better

Shoreline Types Impacted: Seawalls and riprap

Incident Summary (specifics): RRT approval was given to use PES-51 to assist in cleaning rock jetties, concrete walkways, metal railings, and wooden walkways in the vicinity of John's Pass and blind Pass that were affected by the spill. However, the PES-51 was not actually used; high-pressure, hot-water was used to clean the John's Pass jetties and walkways.

Behavior of Oil (before and after treatment): Both treatment effects effectively removed the oil coat from the walkway, although slightly less stain remained on the PES-51 treated section. Brushing/scrubbing did not appear to significantly enhance PES-51 effectiveness. Wash water contained mobilized oil. Cleaning was accomplished more quickly with PES-51 than with high-pressure, hot water washing.

What problem was this technology intended to address?: During test on riprap, an over-application of the product occurred.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Verify that the application rates specified are being used. Ensure that sufficient sorbent material is deployed to recovery all oily wash waters.

Additional References:

Respondent Name:	Not provided
Incident Contact:	Ruth Yender or Brad Benggio
Position:	Biological Assessment Team and Scientific Support Coordinator
Agency:	NOAA
Address:	7600 Sand Point Way, NE, Seattle, WA
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FAX:	206-526-6329
email:	ruth_yender@noaa.gov

Surface Washing Agent, On Adjacent Land

Name of Spill/Vessel/Location: Morris J. Berman
Date of Spill (mm/dd/yy): 01/07/94
Date of Application (mm/dd/yy): not available
Location of Spill: San Juan Bay, San Juan, PR
Oil Product: No. 6 fuel oil
Oil Type (USCG Classification code): Type V
Barrels spilled: 17,000 (713,269 gallons)
Estimated treatment volume: surface oil coat/stain
Source of Spill: Grounding of barge on reef north of San Juan Bay, PR
Was Treated Oil on Land, Coastal Waters, or Inland Waters? On adjacent land

Resources at Risk: Seagrasses and its infauna
Oil Spill Applied Technology Used: Corexit 9580, PES-51, and Corexit 7664 as an after cleaning agent
How Countermeasure Was Used: Used as Surface washing agents to clean beach rock and riprap and comparing the chemical products with high-pressure, hot-water washing.
Shoreline Types Impacted: beach rock and riprap
Incident Summary (specifics): On beach rock, water alone was not effective below 175°F and 1,000 psi, the pressure at which friable rock began to chip. On riprap, water up to 1,200 psi and 175°F was effective on smooth surfaces but not on rougher pieces. Both chemical products were more effective than water alone. The Corexit 9580 plots appeared to be cleaner, but the differences were not large. There was no dispersion of the oil treated with PES-51, whereas water flushed from the Corexit 9580 plots contained muddy brown water, indicating some dispersion at the high water pressures used. The Corexit 7664 flush provided no added oil removal. The RRT approved the use of Corexit 9580 based on relative effectiveness and toxicity.
Behavior of Oil (before and after treatment): Heavy oil coated beach rock, riprap and sensitive historic structures that were not successfully cleaned through manual removal options.
What problem was this technology intended to address?: Address the heavy coat of oil on beach rock, riprap and historic structures.
Lessons Learned/Recommendations from Oil Spill Applied Technology Use: In practice, most hard substrates were cleaned with high-pressure, hot-water washing without chemical application because the water alone was effective. However, Corexit 9580 was used extensively with satisfactory results on several hundred yards of beach rock in high-use areas. Although approved for use on sensitive archaeological structures, Corexit 9580 was actually only used for a few test applications on historic masonry structures.
Additional References:
Michel, J. and B.L. Benggio. 1995. Testing and Use of Shoreline Cleaning agents during the Morris J. Berman oil spill. In: IOSC 1995. pp. 197-202.

Petrae , G. (ed.). 1995. Barge Morris J. Berman: NOAA's Scientific Response. HAZMAT Report 95-10, Seattle: Hazardous Materials Response and Assessment Division, NOAA. 63 pp.

Respondent Name: not provided
Incident Contact: Jacqueline Michel and Bradford Benggio
Position: Scientific Support
Agency: Research Planning, Inc. and NOAA
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Phone: 803-256-7322
FAX: 803-254-6445
email: jmichel@researchplanning.com

Surface Washing Agent, On Land

Name of Spill/Vessel/Location: Exxon Valdez, Prince William Sound, AK
Date of Spill (mm/dd/yy): March 1989
Date of Application (mm/dd/yy): July 1-4, 1993
Location of Spill: Sleepy Bay, Segment LA-19A), Prince William Sound, AK
Oil Product: weathered Alaska North Slope crude
Oil Type (USCG Classification code): Type III
Barrels spilled: approximately 260,000 (11,000,000 gallons)
Estimated treatment volume: unknown; oil coat and buried oil
Source of Spill: Exxon Valdez grounding
Was Treated Oil on Land, Coastal Waters, or Inland Waters? On land

Resources at Risk: Mussels, littorine snails

Oil Spill Applied Technology Used: PES-51

How Countermeasure Was Used: Field test application on aged oil (four years old) on surface substrate and subsurface through injection sites

Shoreline Types Impacted: cobble/gravel shoreline

Incident Summary (specifics): It was reported by on-site observers that the Product was quite effective at liberating oil from sediments. As long as water remained on the application area, surface sheens and free-floating brown/black oil could be seen. During and immediately after application a strong citrus smell was observed in the area.

Behavior of Oil (before and after treatment): During treatment the oil/water/PES-51 mixture adhered to the hand, although oil did not stick. The sticky mixture was easily wiped off. Similarly, the mixture did not stick or adsorb onto the rocks. By the next day, the oil did stick to rocks. Light sheens filled the inner boom area within one hour of the application. Very little brown/black oily product was in the boom area. Absorbent pads worked well in absorbing the oily mixture. For at least two hours after application, re-introduction of water liberated more oils/sheens.

What problem was this technology intended to address?: Subsurface oil and weathered oil stain on substrates

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: General consensus that with more water, significantly less PES-51 would be needed. Much of the floating product acted like it had a lot of surfactant; it did not stick and made discrete small droplets

Additional References:

Respondent Name: Not provided
Incident Contact: Debbie Payton and John Whitney
Position: Scientific Support
Agency: NOAA
Address: 7600 Sand Point Way, NE Seattle, WA 98115
Phone: 206-526-6317
FAX: 206-526-6329
email: Debbie_Payton@hazmat.noaa.gov

Elasticity Modifier, On Water-Brackish

Name of Spill/Vessel/Location: UNOCAL facility, Port Neches, TX
Date of Spill (mm/dd/yy): 04/20/93
Date of Application (mm/dd/yy): 04/24/93
Location of Spill: Grays Bayou and the Neches River
Oil Product: Kuwaiti crude oil (API gravity = 33°)
Oil Type (USCG Classification code): Type III
Barrels spilled: 2,100 (88,200 gallons)
Estimated treatment volume: 15 gallons
Source of Spill: not provided
Was Treated Oil on Land, Coastal Waters, or Inland Waters? On water- brackish

Resources at Risk: not identified

Oil Spill Applied Technology Used: Elastol slurry

How Countermeasure Was Used: Applied to oil trapped in the booms adjacent to the shoreline. This patch was the largest single accumulation of oil left on the water surface.

Shoreline Types Impacted: steep clay bank fringed with trees and shrubs

Incident Summary (specifics):

Behavior of Oil (before and after treatment): After three-hour reaction time, most of the treated oil had drifted away from the shoreline and toward the center of the channel where a larger amount of oil waste trapped in the boom. All of the oil appeared as if it had been treated, leading to the conclusion that the treated and untreated oil had mixed. Physical appearance of the oil was different; oil appeared thicker, more textured looking; oil surface was irregular rather than smooth. The oil exhibited a sheeting action when pushed or pulled. It was not possible to physically pull the treated oil as a coherent mass or sheet.

What problem was this technology intended to address?: To aid in the removal of small pockets of oil floating on the water surface adjacent to the marshes and in narrow channels of open water extending into the marshes. There was no intention to apply Elastol to oil on marsh vegetation or to oil floating in the vegetation.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Unable to get product to pour out of shipping container; had to cut top off of container to remove product. Product was hand mixed in hopper to manually break up lumps; however lumps reformed upon standing. No one on scene had previously operated the delivery system; have personnel experience with the product and equipment involved in the application. Do not over apply the product. Application concentration of 200 ppm would have been adequate. Product over applied at about 75 times the recommended application rate.

Additional References: Michel, J, C.B. Henry, and J.M Barnhill. 1993. Use of Elastol during the UNOCAL spill on the Neches River, 24 April 1993. Prepared for Regional Response Team VI. Seattle: Hazardous Materials Response and Assessment Division, NOAA. 10 pp.

Respondent Name:
Incident Contact: Jacqueline Michel
Position: Scientific Support Team
Agency: NOAA
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Elasticity Modifier, On Water-Riverine

Name of Spill/Vessel/Location:	Sugarland Run pipeline spill, Reston, VA
Date of Spill (mm/dd/yy):	03/93
Date of Application (mm/dd/yy):	4/01/93 to 4/01/93
Location of Spill:	Potomac River
Oil Product:	Diesel fuel
Oil Type (USCG Classification code):	Type II
Barrels spilled:	407,000 gallons
Estimated treatment volume:	700 gallons
Source of Spill:	Pipeline break

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On Water - riverine

Resources at Risk: not provided

Oil Spill Applied Technology Used: Elastol, elasticity modifier

How Countermeasure Was Used: applied to approximately 700 gallons of diesel fuel at a 1,000 ppm application rate in a slurry form. Tested elastol versus non treated oil to determine impact of Elastol addition for improving drum skimmer effectiveness.

Shoreline Types Impacted: not provided

Incident Summary (specifics): After application, a set time of 35 minutes. Treated oil showed viscoelasticity relative to untreated. Drum skimmers were activated for treated and un-treated oil slicks; treated oil skimmer was able to recover oil at twice the speed as the skimmer on the untreated oil without any gain in water collection. Clear migration of the diesel fuel towards the skimmer was visible in the treated area as the oil layer became thinner. No such migration was observed in the untreated area. RRT III authorized the deployment of Elastol to the three remaining sites in the catchment areas following this test; large scale deployment of elastol began and all skimming operations were performed normally. OSC then authorized the use of Elastol on all remaining sites in the Sugarland Run recovery sites.

Behavior of Oil (before and after treatment): tended to emulsify; the addition of the elastol changed the color of the treated oil, indicating that the degree of emulsification was being decreased.

What problem was this technology intended to address?: Wanted to assist oil recovery.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Elastol increased recovery rates of drum skimmers without additional water. Reduced emulsification. Need trained crew to avoid over or under treatment. Application rates vary with viscosity of oil. Application requires metered application. Able to herd oil with water hoses without creating emulsions. Existing emulsions were seen to breakdown with application. Drum skimmer recovery rate doubled with application.

Additional References:
DESA. 1994. Sugarland Run Creek Spill Summary, Results and Lessons Learned. Presentation prepared form Region III RRT, Annapolis, MD.
RPI. 1993. Colonial Pipeline Company's Sugarland Run Pipeline Spill. Prepared for Damage Assessment Center, NOAA, Silver Spring, MD. 47 pp. + appendices.

Respondent Name:	not provided
Incident Contact:	not provided
Position:	not provided
Agency:	DESA
Address:	PO Box 7720, Arlington, VA 22207
Phone:	703-534-1144
FAX:	703-534-1172
email:	not provided

Surface Washing Agent, On Adjacent Land-Marsh

Name of Spill/Vessel/Location:	Test Plot, Point aux Chiens Wildlife Management Area, LA
Date of Spill (mm/dd/yy):	August 1995
Date of Application (mm/dd/yy):	1995 and 1996 growing seasons
Location of Spill:	12 – 8' x 8' test plots in *Spartina alterniflora* marsh
Oil Product:	South Louisiana crude
Oil Type (USCG Classification code):	Type III
Barrels spilled:	applied at 2 L/m^{-2} onto plant canopy within plot areas
Estimated treatment volume:	not provided
Source of Spill:	test plot

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On land, marsh grasses

Resources at Risk: marsh grasses and infauna

Oil Spill Applied Technology Used: Corexit 9580 surface washing agent

How Countermeasure Was Used: applied to oiled plant canopy two days after application at a rate of 0.33 L/m^{-2} using a portable garden sprayer and then flushed plant canopy for 5-10 minutes. Plant canopy was observed over the 1 year growing period.

Shoreline Types Impacted: *S. alterniflora* marsh grasses

Incident Summary (specifics): After application, biomass harvests conducted at the end of the growing season revealed that live biomass per unit are of marsh was significantly reduced under all treatments. In 1996, the live biomass had recovered to levels close to those of control plots. Oil can be effectively removed using Corexit 9580 in the field without any detectable adverse effects on plants. In addition, the beneficial effects of Corexit 9580 rapidly restored plant transpiration pathways under field conditions.

Behavior of Oil (before and after treatment): not provided

What problem was this technology intended to address?: This test was designed to determine the impacts to oiled marsh grasses when cleaned with Corexit 9580; particularly during the growing season, when impacts would be most severe.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: S. alterniflora if given adequate time, can recover from oiling with South Louisiana crude.

Additional References:

Pezeshki, S.R., R.D. DeLaune, J.A. Nyman, R.R. Lessard, and G.P. Canevari. 1995. Removing oil and saving oiled marsh grass using a shoreline cleaner. In IOSC 1995. pp. 203-209.

Pezeshki, S.R., R.D. DeLaune, A. Jugsujinda, G.P. Canevari, and R.R. Lessard. 1997. Major field test evaluates a shoreline cleaner to save oiled marsh grass. In IOSC 1997. pp. 397-402.

Respondent Name:	not provided
Incident Contact:	S.R. Pezeshki, R.D. DeLaune, A. Jugsujinda; G.P. Canevari; R.R. Lessard
Position:	not provided
Agency:	Department of Biology, University of Memphis
Address:	U. of Memphis, Memphis, TN 38152
Phone:	not provided
FAX:	not provided
email:	not provided

Elasticity Modifier, On Water - Riverine

Name of Spill/Vessel/Location: St. Louis, MO storage tank fracture
Date of Spill (mm/dd/yy): 01/18/94
Date of Application (mm/dd/yy): 01/23/94
Location of Spill: St. Louis, MO, West bank of the Mississippi River
Oil Product unleaded gasoline
Oil Type (USCG Classification code): Type I
Barrels spilled: 8,690 barrels (365,000 gallons)
Estimated treatment volume: not provided
Source of Spill: tank rupture
Was Treated Oil on Land, Coastal Waters, or Inland Waters? On water - riverine

Resources at Risk: not provided

Oil Spill Applied Technology Used: Elastol

How Countermeasure Was Used: Elasticity modifier to improve skimming

Shoreline Types Impacted: Shoreline between riprap and an ice shelf six feet out where current would pull the Elastol treated product straight to the operating Desmi 250 skimmer.

Incident Summary (specifics): Elastol was applied using the fire department's foam hoses. With no prior training, responders were given protocol test sheets, and they attempted to determine visually if the product was affecting the gasoline. This was hard to do 45 feet above the surface. The Desmi that had clearly been skimming product, did not show any real changes in efficiency. Exactly 20 minutes after application, the fire department applied foam to the area and ended the test.

Behavior of Oil (before and after treatment): No change was observed. However, at an early hand application of the product, the treated diesel fuel jammed the drum skimmer by thick strings of gelled product, evidence of an over application.

What problem was this technology intended to address?: Used as a test application since it was thought that physical effects on wildlife and habitat would be considerably lessened due to the spills' location, cold weather, and presence of ice.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Proper application was one of the main concerns of the RRT.

Additional References:

Hartley, J.M, and D.F. Hamera. 1995. Response to a major gasoline release into the Mississippi river. In IOSC 1995. pp. 453-458.

Respondent Name: not provided
Incident Contact: CDR. Jane M. Hartley,
Position: FOSC
Agency: USCG
Address: 1222 Spruce Street, ST. Louis, MO 63103
Phone: not provided
FAX: not provided
email: not provided

Name of Spill/Vessel/Location:	St. Louis, MO storage tank fracture
Date of Spill (mm/dd/yy):	01/18/94
Date of Application (mm/dd/yy):	01/20/94 and 01/23/94
Location of Spill:	St. Louis, MO, West bank of the Mississippi River
Oil Product	unleaded gasoline
Oil Type (USCG Classification code):	Type I
Barrels spilled:	8,690 barrels (365,000 gallons)
Estimated treatment volume:	6,000 gallons on river ice
Source of Spill:	tank rupture

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On water - riverine

Resources at Risk: Human populations

Oil Spill Applied Technology Used: Aqueous film-forming foam (AFFF)

How Countermeasure Was Used: To suppress vapors from the gasoline that was flowing onto shoreline ice cover.

Shoreline Types Impacted: Riverine and shoreline covered in accessible and inaccessible ice with some snow cover.

Incident Summary (specifics): Fire department placed a foam blanket on the river site on two occasions and once in the tank farm during the emergency phase. Due to the weather the foam froze on the ice pack and the boom. The foam did not seem to affect the skimmers.

Behavior of Oil (before and after treatment): Oil spilled on ice underwent reduced evaporation due to extreme cold, until mid-day temperatures rose and vapor levels increased dramatically.

What problem was this technology intended to address?: oil and ice and vapor suppression

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: As most foams contain surfactants, the actions of the current or boat traffic may increase the rate of dispersion of oil into the water column. BTEX levels in the river were found to be elevated 100 feet downstream. This may have been caused by the foam blocking the evaporation process and forcing higher amounts into the water column. The decision to use the foam was left to the fire chief and not challenged by responders as the fire chiefs concern was solely with the hazard posed by the gasoline vapors around the site, which increased the threat of explosion and fire.

Additional References:

Hartley, J.M, and D.F. Hamera. 1995. Response to a major gasoline release into the Mississippi river. In IOSC 1995. pp. 453-458.

Respondent Name:	not provided
Incident Contact:	CDR. Jane M. Hartley,
Position:	FOSC
Agency:	USCG
Address:	1222 Spruce Street, ST. Louis, MO 63103
Phone:	not provided
FAX:	not provided
email:	not provided

In situ Burning, On Adjacent Land - Marsh

Name of Spill/Vessel/Location: Superior Offshore Pipeline Company, Rockefeller Refuge, Cameron Parish, LA.

Date of Spill (mm/dd/yy): 03/13/95

Date of Application (mm/dd/yy): 03/17/95

Location of Spill: Rockefeller Refuge, Cameron Parish, LA

Oil Product: condensate oil

Oil Type (USCG Classification code): Type III (API Gravity = 40-42)

Barrels spilled: 40 barrels

Estimated treatment volume: approximately 30 barrels

Source of Spill: pipeline leak

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On adjacent land, approx. 50 acres of brackish water marsh were affected by this release.

Resources at Risk: Marsh habitat, wildlife

Oil Spill Applied Technology Used: *In situ* burning

How Countermeasure Was Used: Ignited 20 acres of spill-affected marsh

Shoreline Types Impacted: Marsh

Incident Summary (specifics): All parties present agreed that ISB was appropriate as mechanical was ineffective and actually damaged the marsh habitat. Marsh burns are conducted annual at this site to promote vegetative vigor, remove litter, and protect against lightning fires. As water levels were approx. 2-4 inches above the marsh floor, this water would buffer the plants roots systems from heat damage. A formal burn plan was developed and approved by USCG and RRT VI. USCG strike team set up air-monitoring equipment south of the spill site; unnecessary personnel and equipment were removed from the area; and air boats spread hay along the primary spill boundary north of the leak to facilitate fire ignition. Air boats equipped with propane torches ignited the hay and condensate. Fire burned for approx. 2.5 hours and removed condensate from approx. 20 acres of marsh.

Behavior of Oil (before and after treatment): not provided

What problem was this technology intended to address?: To address the cleanup needs in an effective manner that would reduce the total environmental damage that was being caused by spill response equipment traveling within the marsh zone.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Considered ISB as a viable response technique during early assessment phase of spill response. Booms did not make tight ground seals in dense marsh vegetation and allowed condensate migration toward environmentally sensitive wetlands. Vehicular traffic, human ingress, and mechanical cleanup techniques were causing more damage than the spill. ISB worked.

Additional References:
Hess Jr., T.J, I. Byron, H.W. Finley, and C.B. Henry, Jr. 1997. The Rockefeller Refuge oil spill: a team approach to incident response. In IOSC 1997. pp. 817-821.

Respondent Name: not provided
Incident Contact: Thomas J. Hess, Jr.
Position: not provided
Agency: Louisiana Department of Wildlife and Fisheries
Address: 5476 Grand Chenier Highway, Grand Chenier, LA 70643
Phone: not provided
FAX: not provided
email: not provided

In situ Burning, On Adjacent Land - Marsh

Name of Spill/Vessel/Location: Exxon Pipeline Company spill, Chiltipin Creek, upper Copano Bay, near Bayside, San Patricio County, TX

Date of Spill (mm/dd/yy): 01/07/92

Date of Application (mm/dd/yy): not provided

Location of Spill: high salt-marsh environment in Copano Bay, TX

Oil Product: South Texas light crude oil

Oil Type (USCG Classification code): Type III; API Gravity = 37

Barrels spilled: 2,950 barrels

Estimated treatment volume: 1,150 barrels

Source of Spill: rupture of underground oil transfer pipeline

Was Treated Oil on Land, Coastal Waters, or Inland Waters? On adjacent land – marsh grass areas.

Resources at Risk: Marsh and infauna

Oil Spill Applied Technology Used: *In situ* burning

How Countermeasure Was Used: *In situ* burn remaining oil from marsh grass

Shoreline Types Impacted: High, marsh grass

Incident Summary (specifics): Below-ground root and rhizome systems would be effectively protected against burn injury because of a layer of standing water from recent rainfalls allowing subsequent regrowth in the spring. This report lists the results of a 5-year study.

Behavior of Oil (before and after treatment): not provided

What problem was this technology intended to address?: General consensus was that mechanical removal techniques might result in total loss of the existing marsh and that non-removal might pose a continuing threat to the adjacent unimpacted marsh and Aransas River.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: Results of this study supports the hypothesis that use of in situ burning as a response tool has distinct advantages over other countermeasures.

Additional References:

Hyde, L.J, K. Withers, and J.W. Tunnell, Jr. 1999. Coastal high marsh oil spill cleanup by burning: 5-year evaluation. In IOSC 1999. pp. 1257-1260.

Respondent Name: not provided
Incident Contact: Larry J. Hyde, Kim Withers, and J.W. Tunnell, Jr.
Position: not provided
Agency: Center for Coastal Studies, Texas A&M University – Corpus Christi
Address: 6300 Ocean Drive, Corpus Christi, TX 78412
Phone: not provided
FAX: not provided
email: not provided

In situ Burning, On Adjacent Land - Marsh

Name of Spill/Vessel/Location: Koch Pipeline Company,
Date of Spill (mm/dd/yy): 05/12/97
Date of Application (mm/dd/yy): 05/14/97
Oil Product: Refugio Light crude and Giddings Stream crude
Oil Type (USCG Classification code): Type III
Barrels spilled: 500 – 1,000 barrels
Estimated treatment volume: not provided
Source of Spill: weld failure
Was Treated Oil on Land, Coastal Waters, or Inland Waters? On adjacent land –wetlands environment used as grazing field for cattle

Resources at Risk: Wetland species of sea ox-eye daisy, gulf cord grass, and Carolina wolfberry, cattle

Oil Spill Applied Technology Used: *In situ* Burning

How Countermeasure Was Used: *In situ burn* oil from field

Shoreline Types Impacted: grazing field which led to wetlands habitat

Incident Summary (specifics): This habitat had been burned for vegetation control for the cattle. Using the Region VI Guidelines for In-shore/Near-shore ISB for the burn plan, FOSC determined RRT approval was not necessary. A sample of the floating oil was recovered and put into a basin filled with water where it was successfully ignited on the first attempt. 11 acres of the 40 acre wetland were impacted. The burn was ignited in a "U" fashion using three points of ignition. The oil burned intensely for over 4 hours and continued to burn to various degrees overnight. Inspection the next morning revealed that 5-6 acres had burned with about 90% oil removal rate. Secondary burns were ignited to decrease the oil remaining in the fringe area of the original burn and increased the burn area to approximately 8 acres.

Behavior of Oil (before and after treatment): not provided

What problem was this technology intended to address?: Oil had migrated substantially farther beyond the original perimeters that were controlled by trenching. In light of the rapid migration of the oil, ISB option was selected as the tool of choice for this response.

Lessons Learned/Recommendations from Oil Spill Applied Technology Use: ISB can be conducted outside the expected window of opportunity if conditions are right. Responders should not discount burning simply because more than 24 hours have elapsed since the spill occurred. Conducting small test burns will enable responders to determine if a burn will be successful. Secondary burns are also possibilities to be considered.

Additional References:
Clark, T. and R.D. Martin, Jr. 1999. In situ burning: after-action review (successful burn 48 hours after discharge). In: IOSC 1999. pp. 1273-1274.

Respondent Name: not provided
Incident Contact: Tricia Clark and Robert D. Martin, Jr.
Position: not provided
Agency: Texas General Land Office, Oil Spill Prevention and Response Division
Address: 1700 North Congress Avenue, Austin, TX 78701-1495
Phone: not provided
FAX: not provided
email: not provided

Appendix K

Tables of Products not listed in NCP Product Schedule

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Table K-1. Bioremediation Products Removed from the Product Schedule.

	BR	ENZYT
General Description	Tan, free-flowing powder, yeast odor	Available as liquid or solid (Crystal)
Active Ingredients	Microbes, Enzymes, Nutrients, Surfactant	Microbes
Nutrient Composition	Urea, methylene urea, ammonium phosphate	None, product requires nutrient supplements
How does it change the oil behavior?	No immediate change	No immediate change
Availability (amount per location)	2,000 lbs, Stormville, NY	NP
Application Rate	0.5 lb/ton or 0.5-3 lb per 1,000 ft^2 soil; 2 lb/100,000 gal water	0.5 gal liquid or 1.5 lb solid/yd^3 soil, or /600 gal water
Application Method	Mix product into a slurry (1 lb/gal); apply immediately with low pressure, coarse spray to saturate the area.	Spray solution
Temperature Limitations	35-186°F	50-113°F
EPA Efficacy Test (Reports % reduction of components over a 28 day period)	Alkanes: 52% Aromatics: 27% Gravimetric weight decrease: 25%	Alkanes: 27% Aromatics: 0% Gravimetric weight decrease: 26%
Use in Fresh Water?	Yes	Yes
Use in Salt Water?	Yes, up to 6% salinity	Not effective where salinity is >6%
Inland Silversides 96h	NP	NP
Mysid Shrimp 48h	NP	NP
Solubility in water	NP	Liquid is miscible with water; solid is 90% soluble with water
Other Information	Dispersible	Product works at pH 5.5-9.0, optimally at 6.5-8.5
Application Assistance Information*	Product works at pH 4.5-9.5, optimally at pH 6-7	Acorn Biotechnical Corp. 713-861-6087 800-982-1187 www.acornbiotechnical.com
Unit Cost **	Enviro-Zyme International 914-878-3667 800-882-9904	$8-$13 per gal.
Photograph of Product (photos are added as they become available)	Unit cost = $30 per lb.	

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Table K-2: Solidifier Products Removed for Product Schedule.

	Nochar A650	Nochar A610	SPI Solidification Particulate
General Description	Granular material	Granular material	Sponge-like material, with appearance of ground green erasers
Listed in US?	**NO**	**NO**	**NO**
Availability within 48 h	5,000 lb stockpile, Indianapolis, IN	3,000 lb stockpile, Indianapolis, IN	4,000-5,000 lb stockpile, Windham, ME
Application Rate, % by weight of product to oil (per manufacturer)	10	10	4
Application Rate (Environment Canada, med. crude)	Not tested	Not tested	Not tested
Application Rate (PERF tests)	diesel: 45 medium crude: 45 Bunker C: 50	diesel: 45 medium crude: 45 Bunker C: 50	diesel: 31 medium crude: 42 Bunker C: 67
PERF Test Comments	Formed a firm pancake with gasoline and diesel; diesel pancake was elastic. Works slowly with the crudes taking 1-2 d to form a firm pancake. Bunker C solidified, but the pancake remained weak and broke apart when lifted.	Formed a firm pancake with gasoline and diesel; diesel pancake was elastic. Works slowly with the crudes taking 1-2 d to form a firm pancake. Bunker C solidified, but the pancake remained weak and broke apart when lifted.	All oils solidified but did not form a cohesive mass. Each had a crumbly appearance and broke apart upon lifting
Cure Time	1-2 minutes to 1 hour	1-2 minutes to 1 hour	Immediately, up to hours
Solidification Process	The bond is both chemical and physical	The bond is both chemical and physical	Total absorption into the porous and oleophilic surface of the polymer.
Use in Fresh Water?	Yes	No, use on land	Yes
Use in Salt Water?	Yes	No, use on land	Yes
Can the Oil be Returned to a Liquid	No	No	No
Disposal/Recycling Issues	NP	NP	NP

	Nochar A650	Nochar A610	SPI Solidification Particulate
Toxicity (LC-50, ppm) **Note: a low value = high toxicity**	Mummichug >500,000 (96h); Brine shrimp >500,000 (48h)	NP	NP
Solubility in water	Insoluble	Insoluble	< 1 ppm
Other Information	Preferred for use on water	Preferred for use on water	TBD
Application Assistance Information*	NP	NP	NP
**Unit Cost ** **	NP	NP	NP
Photograph of Product (photos are added as they become available)			

NP = Not provided

* For additional technical assistance on product application, contact the supplier listed on the NCP Product Schedule Notebook.

** Unit costs are based on 2002 information supplied by the vendors, where provided. For a more up-to-date cost estimate, contact the supplier listed in the NCP Product Schedule. Generally, product prices decrease as purchase volume increases, and may also vary between distributors. Product application rates often vary greatly depending on use.

Table K-3: Surface Collecting Agents Removed from Product Schedule.

	Corexit OC-5	Oil Herder
General Description	Liquid with a specific gravity of 0.918	Liquid with a specific gravity of 0.86
Is Product Listed for Use in US?	No	No
Availability within 48 h **(see Note below)**	Unknown at present Previously, a 3-5 day lead time for production of up to 400 drums per day was required	Unknown at present Previously, a 7 day lead time for production of 15,000 gal per day was required
Application Rate (per manufacturer)	1-2 gal per lineal mile	15 gal per lineal mile
Spreading Pressure	High (45 x 10^{-7} Newtons/m)	High (46 x 10^{-7} Newtons/m)
Solubility in water	Insoluble	40%, the solvent is the soluble fraction
Use in Fresh Water?	Yes	Yes
Use in Salt Water?	Yes	Yes
Toxicity (LC-50, ppm) **Note: a low value = high toxicity**	Fathead minnow >4,500 (96h); Zebra fish >10,000 (48h)	Zebra fish <1,000 (96h)
Mummichug 96 h	4,800	>1,000
Brine shrimp 48 h	4,800	2.5
Unit Cost	NP	NP
Photograph of Product (photos are added as they become available)		

NP = Information not provided

Note: As of December, 2002, there were no Surface Collecting Agents on the NCP Product Schedule. The two products listed above are the only two known products to have been developed specifically for and commercially marketed as surface collecting agents. The current availability of these products is not known.

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Appendix L
Synopsis of Document Preparation

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2003 Update

The Selection Guide for Oil Spill Applied Technologies could not have been updated without the dedication and assistance of the following people. The Authors' and Sponsors would like to acknowledge their invaluable assistance in this document preparation.

The 2003 Volume I –Decision-making Development Committee Members include:

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Initial Document Development

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Tom Brennan, Roy F. Weston (SATA Contractor)
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Fred Stroud, USEPA OSC Region IV
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RRT III members
RRT IV members
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Appendix M
Example Scenario for Selection Guide Evaluation

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Example Scenario

On May 12th, an aboveground pipeline discharged approximately 500 gallons of Louisiana Crude into a remote, freshwater cypress swamp area in a National Wildlife Refuge in northern Louisiana. The spill was discovered 8 hours ago. The pipeline has been shut down. The discharge area is a shallow, cypress swamp that is habitat for waterfowl, wading birds, and game fish. There are several threatened and endangered species using this habitat.

Access is limited, and the traditional countermeasures of boom and skimmers are not feasible for all areas impacted. The FOSC is on scene and has asked you to identify alternative response options to address several highly contaminated areas with approximately 200 gallons of product involved, in an area that has limited-to-no access for heavy equipment.

Step 1 & 2: Review the Oil Spill Applied Technologies Overview (Table 1) and familiarize yourself with the technology categories.

Looking over the information contained in Table 1 for the spill conditions, you find that the potential options for dealing with the shallow, highly contaminated areas of the swamp are limited to: Sorbents, Elasticity Modifiers, ISB, Natural Attenuation, and Solidifiers based on a general review of the product categories in Table 1. This is a first cut at evaluating options.

Even though Table 1 also identifies potential limitations with the use of the products or technologies you have chosen, you must evaluate each of the response options further as conventional response options have been determined to not be viable options in some areas.

Continued on Next Page

Example Scenario (Continued)

Step 3 & 4: Use Worksheet 1 to document your decision-making.

Following Steps 1 and 2, fill out the spill information on Worksheet 1 for your incident. On Line A (***Technology Choices of Interest)***, mark an "X" under each technology or strategy that you want to consider further. See Example A-1 below.

Example A-1

WORKSHEET 1: SELECTION GUIDE DECISION-TRACKING/ EVALUATION WORKSHEET

This worksheet is intended to be photocopied for use during drills and incidents

Name(s): John Smith
Date: May 12, 2001
Incident: NWR Pipeline Break, Northern Louisiana

		Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast Water Booming Strategies	Firefighting Foams	In-situ Burn (ISB)	Nonfloating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
A.	***Technology Choices of Interest:*** *(check)*	X			X				X				X			X	
B.	***Environmental Matrix Used:***																
C.	***Incident-specific Information:***																
	Response Phase:																
	Oil Type:																
	Treatment Volume:																
	Weather Conditions:																
	Decision Authority: **NR** - No Spec. Reg. Req.s; **PS** - Must be on Prod. Schd.; **PA** - Pre-Authorization in Place; **CR** - RRT Concurrence Req'd.; **SP** - Special permit Req'd.																
	Monitoring: **SM** - SMART Monitoring; **OM** - Effectiveness or Other Monitoring																

Step 5 & 6: Determine which environmental matrix to use in your evaluation.

In Step 5, you have to determine which environmental matrix to use to assist you in determining the appropriateness of the various applied technologies. For this scenario, we are looking at the inland waters matrix (Table 2a) because the oil is in the water in the cypress swamp at the NWR. Even though the edges of the swamp may be affected, the majority of the oil is in the shallow, still waters of the swamp.

Because we are using the Inland Waters Matrix, write in the words "Inland Waters" on Line B of Worksheet 1.

Continued on Next Page

Example Scenario (Continued)

Step 7 & 8: Incident-specific Information Needs.

Step 7 asks you to record the incident-specific information for the current response under line C of worksheet 1. You would write:

- "Emergency" for the Response Phase as the incident is still within the first 24 hours;
- "Medium Crude" for Oil type since Louisiana crude is considered a Medium oil type (Type III);
- 100-1,000 gallons for treatment volume since current scenario estimates put 200 gallons of product in the area where you are considering the use of applied technologies; and
- "Warm" because it is May in Louisiana and "Low Winds" because there is very little mixing energy in the discharge area.
- See Example A-2 below.

Example A-2

		Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast-Water Booming Strategies	Fire Fighting Foams	In-situ Burn (ISB)	Non-floating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
A.	*Technology Choices of Interest: (check)*	X			X				X				X			X	
B.	*Environmental Matrix Used:* Inland Waters																
C.	*Incident-specific Information:*																
	Response Phase: Emergency																
	Oil Type: Medium																
	Treatment Volume: 100-1,000 gallons																
	Weather Conditions: Warm; Low winds																
	Decision Authority: NR - No Spec. Reg. Req.s; PS - Must be on Prod. Schd.; PA - Pre-Authorization in Place; CR - RRT Concurrence Req'd.; SP - Special permit Req'd.																
	Monitoring: SM - SMART Monitoring; OM - Effectiveness or Other Monitoring																

Continued on Next Page

<u>Example Scenario</u> (Continued)

Steps 9&10: Collect Incident-specific Information from Environmental Matrix Used.

Step 9 asks you to record the corresponding considerations identified in the Environment Specific Matrix in line C of worksheet 1 by writing an "X" in the box. For example, the Inland Waters Matrix considers Sorbents to be viable in an emergency situation, for a medium oil type, for 100 to 1,000 gallons of oil and for a low wind/warm climate. Therefore, an "X" is placed in each of the corresponding boxes. See Example A-3 below.

After this you should begin your process of eliminating any products or strategies that will not work for the conditions being evaluated. For instance, if Surface Collecting Agents were an original choice, you see that there is no "X" in the box under SCA's and Medium Oil in the Inland Waters Matrix. Surface Collecting Agents can be ruled out since they are ineffective on medium oil. However, in this scenario, we have not been able to rule out any product categories yet. See Example A-3 below.

Example A-3

		Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast-Water Booming Strategies	Fire Fighting Foams	In-situ Burn (ISB)	Non-floating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
A.	*Technology Choices of Interest: (check)*	X			X				X				X			X	
B.	*Environmental Matrix Used:* Inland Waters																
C.	*Incident-specific Information:*																
	Response Phase: Emergency	X			X				X				X			X	
	Oil Type: Medium	X			X				X				X			X	
	Treatment Volume: 100-1,000 gallons	X			X				X				X			X	
	Weather Conditions: Warm; Low winds	X			X				X				X			X	
	Decision Authority: NR - No Spec. Reg. Req.s; PS - Must be on Prod. Schd.; PA - Pre-Authorization in Place; CR - RRT Concurrence Req'd.; SP - Special permit Req'd.	NR			PS CR				CR				PS CR			NR	
	Monitoring: SM - SMART Monitoring; OM - Effectiveness or Other Monitoring	OM			OM				SM				OM			OM	

Continued on Next Page

Example Scenario (Continued)

Steps 11&12: Check off relevant considerations (line D) and evaluate

In step 11 you have to determine which considerations are relevant to the incident and need evaluation. There are no cultural or historic resources in danger therefore it does not need to be considered. The oil is not on fire nor is there potential for fire so it is not a consideration either. There is a need to protect against significant water column and benthic impacts so it is checked off for further evaluation.

After determining which considerations need to be evaluated further, you refer to the Environment Specific Matrix again to see if they have a "**+**"(consider for use) or a "**-**" (do not consider for use). Place a "**+**" or a "**-**" in each of the boxes for the considerations that are checked off. See example A-4 below.

NOTE: Because this scenario occurs in a swamp; the oil is in the water, but is also affecting the resources on adjacent land as defined on page 10 of this guide. Therefore, after using the Inland Waters Matrix, you are not restricted to a single environmental matrix when evaluating the considerations for an event.

Example A-4

D. (Check)		Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast-Water Booming Strategies	Fire Fighting Foams	Insitu Burn (ISB)	Nonfloating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
	Technology Choices of Interest: (check)	X			X				X				X			X	
	Considerations																
O	Cultural or Historic Reso																
O	Limited Oil Handling and Storage Capacity																
O	Oil On Fire or Potential for Fire																
✓	No Oil Containment and Recovery Options	−			−				+				−			+	
O	Oil Contaminated Substrate																
O	Light Oil Type - Difficult to Recover/Skim																
O	Oil Will Form an Emulsion																
O	Oil Has Formed an Emulsion																
O	Oil Has/Is Likely to Sink																
O	Buried Oil																
O	Oil Likely to be Remobilized																
O	Fast Currents Prevent Effective Booming																
✓	Need to Protect Against Significant Surface and Shoreline Impacts, Including Marshland	Look at Coastal Waters to address this consideration															
✓	Need to Protect Against Significant Water Column and Benthic Impacts	+							+				+			+	
✓	Oiled Site is Access Limited	?			?				+				?			+	
✓	Oiled Shoreline/Substrate Needs Cleaning Without Significant Impacts	Look at Adjacent Land to address this consideration															
✓	Significant Problem of Waste Generation	−							+				−			+	
O	Vapor Suppression																
O	Oil on Roadways																
O	Water Intakes at Risk																
O	Oil Trapped in Vegetation																
O	Oil Trapped in Snow and Ice																
O	Confined Spaces with Water/Vapors? (sewers, culverts, etc.)																

Continued on Next Page

Example Scenario (Continued)

Steps 11&12 (continued): Check off relevant considerations (line D) and evaluate

Looking to the Adjacent Land (Table 2b) and Coastal Waters (Table 2c) matrices, we are able to determine the considerations for protecting against surface and shoreline impacts and the need to clean oiled shorelines without causing significant impacts.

The consideration, "Oiled Substrate Needs Cleaning Without Significant Habitat Impacts" on the Adjacent Land matrix rated sorbents and natural attenuation as "consider for use"; ISB and Solidifiers as "case-by-case"; and Elasticity Modifiers were rated "Do not consider for use." Under the Coastal Waters matrices, Sorbents, ISB, Solidifiers, and Natural Attenuation were listed as "consider for Use" when addressing the need to protect against impacts to surface and shorelines. Elasticity modifiers were not rated for protecting shorelines for impacts.

Steps 14-19: Evaluation of Habitat and Natural Resources

After locating the Habitat (Table 3) and Natural Resources (Table 4) matrices you need to first compare each technology with the habitat. This particular habitat is considered a Swamp under Land Habitats. As you can see (Example A-5 below), there is a "+" under sorbents for swamps so a "+" was placed under sorbents on Worksheet 1, Line E for Habitats. Continue for the other product categories.

Next you need to take into consideration the wildlife that may be affected by the response option. Wildlife that are indigenous to this habitat may include otter, muskrat, snakes, turtles, waterfowl, wading birds, and fish among others. When comparing Sorbents to these wildlife resources you see that for the majority the impact is considered minimal so a "+" was placed under Line E for Natural Resources. When evaluating Elasticity Modifiers, animals such as fish have a minimal impact where as waterfowl are likely to be impacted. Other resources such as wading birds and snakes have the potential for impact. The wide range of potential impacts resulted in a "?" for Elasticity Modifiers under Line E for Natural Resources.

NOTE: In all response situations, natural resource experts such as the NOAA Scientific Support Coordinators, State and Federal Natural Resource Trustees, etc. should be consulted for their evaluation of the options and the potential risks to their resources due to time of year, life stage, habitat requirements, mobility, etc.

Example A-5

		Sorbents	Bioremediation Agents	Dispersants	Elasticity Modifiers	Emulsion Treating Agents	Fast-Water Booming Strategies	Fire Fighting Foams	Insitu Burn (ISB)	Nonfloating Oil Strategies	Oil Tracking	Shoreline Pre-Treatment Agents	Solidifiers	Surface Collection Agents	Surface Washing Agents	Natural Attenuation	Future Products
	Technology Choices of Interest: *(check)*	X			X				X				X			X	
E.	***Habitat and Sensitive Resource Evaluation:***																
	Habitats (Refer to Table 3, page xx):	+			NA				NA				–			+	
	Natural Resources (Refer to Table 4, page xx):	+			?				?				+			?	

Continued on Next Page

Example Scenario (Continued)

Steps 20&21

After the evaluation of the selected products or strategies and discussion among the Incident Commander, Resource Trustees, Operations, etc., the technologies (up to 3 or more) determined to provide the best option for the given situation need to be identified. Advantages and disadvantages of each technology should be discussed thoroughly.

The incident-specific information and considerations identified in this evaluation resulted in three options: In-Situ Burning (ISB), Sorbents, and Solidifiers. Why? These three product categories were considered viable options when evaluating the product category against the spill-specific information under Steps 9 and 10 of these instructions.

Example A-6

F.	*Evaulation Results:*			
	Top Three Choices:	In Situ	Sorbents	Solidifiers
	Any Major Advantages:	No Product Recovery Minimal foot traffic	Good option for Wildlife Resources	Good option for wildlife resources
	Any Major Disadvantages:	Ignition? Wildlife resources?	Product/Oil Recovery Foot traffic required	Product/Oil Recovery Foot traffic required

Additional Comments/Decisions:

Decision-making reasoning:

- Sorbents: This option would appear to provide value to the response for the remote areas being assessed in this evaluation. However, the use of sorbents requires foot traffic (at a minimum) to utilize, monitor, and recover the sorbent materials used. Transportation of oiled sorbent material would also have to be considered.

- Elasticity Modifiers: When assessing considerations and then impacts to shorelines and natural resources, there are more negatives identified with its use and the shoreline matrix considers elasticity modifiers not applicable for use in this habitat.

- In-Situ Burning: At this point in the evaluation, ISB is the most viable applied technology because its use will solve the problem of leaving wastes behind and recovery of treated oil. If the oil has not spread and can be contained in a thickness conducive to burning, ISB would be a good option.

- Solidifiers: This technology is an option however you are still left with the problem of oil containment and recovery because the site is access limited. The use of solidifiers requires foot traffic (at a minimum) to utilize, monitor, and recover the solidifier materials used. Transportation of oiled solidifier material would also have to be considered.

Example Scenario (Continued)

Steps 20&21, continued

Decision-making reasoning, continued:

- Natural Attenuation: This is also an option for this scenario, however, due to the nature of the oil, there is a substantial risk to resources and endangered species over time. Medium oil will not completely evaporate and will remain in the habitat for an extensive amount of time, potentially affecting resources for years. There is not much mixing energy in this habitat, so burial is unlikely. Shoreline and natural resource impacts are likely.

The development of the top choices should always be a joint effort by the Incident Commander, Operations, Planning, Scientific Support Coordinators, and Natural resource trustees. No decision should be made in a vacuum.

<u>Example Scenario</u> (Continued):

Completing Part B/Worksheet 2

Step 1: Obtain the correct number of worksheets.

Here the decision maker will be evaluating specific products within a product or technology category. You will need a blank worksheet (Worksheet 2: Product Selection Worksheet) for each of the product categories you will be evaluating. If you are considering a category or strategy that does not involve the use of NCP listed products, this worksheet is not needed.

Step 2 & 3: Select individual products from each product category.

In our example, the top three product/strategy options are *in-situ* burning, sorbents, and solidifiers. *In-situ* burning is a strategy, not a product, therefore it is not listed on the NCP Product Schedule and is not evaluated with worksheet 2. However, many regions have already established *in-situ* burning pre-approval policies and zones; review your regional-specific information contained in Volume II of the Selection Guide for more on this topic. *In-situ* burning should be considered and discussed between all decision makers.

For this example, the various stakeholders reviewed the information collected in Part A and decided to do additional research on solidifiers to determine which individual product would be the most beneficial for the given incident conditions; we will continue this scenario focusing on solidifiers. In Line A of Worksheet 2, we would write in “Solidifiers” (See Example B-1 below). In a real situation, you may want to evaluate multiple categories or strategies using separate worksheets for each.

The solidifier table (Table 20) allows us to evaluate characteristics such as availability, cure time, toxicity, and cost among others. There are only four products listed (Alsocup, CI Agent, Waste Set PS 3200, and Waste Set PS 3400) on the NCP Product Schedule. Table 20 also identifies two other products as solidifiers even though they are considered to be sorbents by the EPA (Enviro-Bond 403 and Rubberizer). Additionally, there are two other products that are classified as solidifiers by the Selection Guide, but these products are no longer listed on the NCP Product Schedule (Nochar A610 and Nochar A650); the information on these two products is now maintained in Appendix K should you be interested in evaluating these non-listed products.

We now have six products to evaluate for this situation. We have chosen three products to evaluate for feasibility under these incident conditions (Refer to Line B of Worksheet 2 in example B-1). You may choose to evaluate one or all of the products in this category.

REMEMBER – the Selection Guide is not designed to provide a conclusive answer, each decision-maker and stakeholders must evaluate the technology choices identified in Part A and determine which options provide the best value for the given circumstances and conditions. It may be that after reviewing the information on a technology or product(s), the group consensus might be that none of the evaluated options would work for the existing conditions. At this point, the decision-maker can evaluate additional strategies/technologies or decide to reevaluate traditional countermeasures. The choice is yours. The Selection Guide is provided to assist you through the evaluation and determination process. The decision to use or not to use is one that should be made with input from all stakeholders.

Step 4 & 5: Answer questions C through G on worksheet 2.

After determining which products will be evaluated, Line C through F should be answered. In order to complete Line D and E, the vendor may have to be contacted for this information. Toxicity information (Line G) for each product(s) must also be collected from Table 20. Additional information on toxicity may be found in Appendix E. Two of the Solidifiers being evaluated for our scenario require RRT approval; Rubberizer does not as it is considered a sorbent by EPA. (Example B-1) We are also assuming that all vendors have been contacted and that all products are readily available.

Example B-1:

WORKSHEET 2: PRODUCT SELECTION WORKSHEET

This worksheet is intended to be photocopied for each product category evaluated and used during drills and incidents and Faxed to the Incident Specific RRT for review. This worksheet may be used to evaluate 1, 2 or 3 separate products in an individual category.

Name(s): John Smith
Date: May 12, 2001
Incident: NWR Pipeline Break, Northern Louisiana

A:	Product Category Being Reviewed:	Solidifiers		
	Products of Interest:	Product 1	Product 2	Product 3
B:	Product Name:	Alsocup	Rubberizer	Waste Set 3400
C:	RRT Approval Required? (Y/N)	Yes	Yes	Yes
D:	Can Product Arrive in Time? (Y/N)	Yes	Yes	Yes
E:	Can Product be Applied in Time? (Y/N)	Yes	Yes	Yes
F:	Can Product be removed from the Environment? (Y/N)	Yes	Yes	Yes
G:	Toxicity (Write in numbers and Toxicity Rating. See App E for more information on toxicity and Toxicity Rating)	Inland silversides (96h): >100 Mysid Shrimp (48h): >100	Inland silversides (96h): NP Mysid Shrimp (48h): NP	Inland silversides (96h): >10,000 Mysid Shrimp (48h): >10,000

Step 6, 7, & 8: Compare products, rank them (Lines H and I), and review with RRT.

Upon completing all product information needs, a discussion should be held with all decision-making stakeholders to rank and determine which product(s) will be the most beneficial for the existing conditions. Looking at Table 20 we see that:

- It will most likely take at least 24 hours to receive any of the products
- All products absorb the oil
- All products may be used in fresh or salt water situations
- Waste Set PS 3400 is clearly the least toxic
- None of the products are soluble in water

Other considerations consist of the nature of the highly sensitive environmental area and the limited access to the site. (Example B-2) Following discussion among the members of the Planning Section, we have determined Waste Set PS 3400 to be the most viable option because of its low toxicity level. Alsocup is the second choice because it is more readily available than Rubberizer.

Before using a product, remember, you are not done! You must continue with this evaluation and develop a testing and monitoring strategy in Part C.

This recommendation may be forwarded to the FOSC and Operations prior to developing a testing and monitoring strategy. However, it is strongly suggested that you complete this evaluation (Part C) prior to submitting your recommendation to the FOSC. It is the FOSC's decision whether or not to use your recommendation (in this example a solidifier). In the event that the FOSC decides to use the product, he can forward and discuss the information documented on worksheet 2 with the RRT.

Example B-2:

WORKSHEET 2: PRODUCT SELECTION WORKSHEET

This worksheet is intended to be photocopied for each product category evaluated and used during drills and incidents and Faxed to the Incident Specific RRT for review. This worksheet may be used to evaluate 1, 2 or 3 separate products in an individual category.

Name(s): John Smith
Date: May 12, 2001
Incident: NWR Pipeline Break, Northern Louisiana

A:	**Product Category Being Reviewed:**	Solidifiers		
	Products of Interest:	**Product 1**	**Product 2**	**Product 3**
B:	**Product Name:**	Alsocup	Rubberizer	Waste Set 3400
H:	**Mark as 1st, 2nd, or 3rd Choice or mark as Not Applicable for this incident**	2nd	3rd	1st

I: Additional Comments/Decisions/Recommendations:

- Toxicity and recovery are big issues for USFWS
- This is a highly sensitive environmental area
- Limited-to-no access for heavy equipment

J: Initials/Date of Incident-Specific RRT Review of Information:

Initial Box and Include Date Upon Review

USEPA:		Date:____________	STATE:		Date:____________
USCG:		Date:	STATE:		Date:____________
NOAA:		Date:	OTHER:		Date:
USDOI:		Date:____________	OTHER:		Date:

Note: While Solidifiers were the only product category evaluated you should not overlook Sorbents or ISB. Sorbents may be more beneficial than Solidifiers because of the many natural products that have a low toxicity level. Another thing to keep in mind is limited access, which will make cleanup and recovery of the solidified oil difficult. *In-situ* burning should be considered because it can be applied immediately and will not require as much cleanup as Solidifiers or Sorbents.

Example Scenario (Continued):

Completing Part C/Worksheet 3

Step 1&2: Obtain the correct number of copies of Worksheet 3 and identify products or strategies that are being evaluated.

Begin by obtaining a blank copy of worksheet 3 for each of the product categories being evaluated. Just one worksheet is needed for comparing strategies unless more than 3 strategies are being compared. Here, the decision maker will perform a basic review of monitoring strategies as well as compare effectiveness of the strategy or product being used for the incident-specific response through testing procedures. Also included is information about capturing lessons learned when any of the products reviewed in this guide are used or are reviewed for a response.

For this example, we will only evaluate the same three solidifiers that were evaluated in the Part B/Worksheet 2 scenario, Alsocup, Rubberizer, and Waste Set 3400.

Step 3&4: Conduct tailgate test then continue with evaluation.

Information on the first level of testing, T-1: Tailgate Testing, can be found in Part C. Tailgate testing determines if the product or technology works to some minimum degree with the oil under the current spill conditions. In our evaluation, all three of our products were effective on this oil type (Louisiana Crude). See example C-1 below. If strategies were being reviewed, it is possible that a tailgate test would not be applicable. For instance, Fast-water Booming can only be tested in the field so we would skip to the second level of testing, Field Effectiveness Test. We will now evaluate all three solidifiers further (Line C).

Example C-1

WORKSHEET 3: TESTING & MONITORING WORKSHEET

This worksheet is intended to be photocopied for each product category evaluated and used during drills and incidents and Faxed to the Incident Specific RRT for review. Use additional paper if needed to record information.

Name(s): John Smith
Date: May 12, 2001
Incident: NWR Pipeline Break, Northern Louisiana

Products of Interest:		Product 1	Product 2	Product 3
A:	Product Name:	Alsocup	Rubberizer	Waste Set 3400
B:	Has a tailgate test proven that product is effective on oil type at this state of weathering? (Y/N)	Yes	Yes	Yes
Products to Consider for Additional Testing:		**Product 1**	**Product 2**	**Product 3**
C:	Products still being considered:	Alsocup	Rubberizer	Waste Set 3400

Step 5&6: Conduct Field Effectiveness Test and Effects Test as well as record test protocols.

The objective of the Field Effectiveness Test is to determine if the product(s) or strategy works on the oil under realistic field conditions. The objective of the Effects Test is to determine what effects the products or strategies will have on natural resources compared to other products and strategies. A Field Effectiveness Test was conducted (Line D) and it was discovered that all three solidifier products proved to be effective. We will now describe the test protocols in Line E. See Example C-2.

- The test site is a highly sensitive fresh water marsh as was determined in the beginning of the Example Scenario.
- Natural resources at risk consist of waterfowl, other migrating birds, reptiles, fish and many species of flora.
- The spill amount is 500 gallons of Louisiana Crude from an above ground pipeline.
- The application rates were taken from Table 20 and are mass ratios of product to oil.
- The products may be applied using a broadcast spreader.
- Other logistical considerations are the limited access to the site and the difficulty of removing the solidified oil from the site.
- Solidified oil may adhere to flora and may be difficult to remove from shorelines.
- Solidified oil from these products is recoverable with a shovel or a similar tool.
- Outcomes/Expected Outcomes: If the Field Effectiveness Test or Effects Test have not been conducted, then the decision maker should predict what he/she believes the outcome and best product will be. Then the test should be conducted for confirmation. The Field Effectiveness Test has been conducted and the outcomes are as follows:
    - Alsocup – formed a cohesive mass with the oil however, remained sticky and somewhat difficult to fully recover
    - Rubberizer – solidified the oil but did not remain cohesive long enough to recover fully
    - Waste Set 3400 – Formed a cohesive and solidified mass that was more easily recoverable than the previous two

Note: These are not actual test results. They are purely fictional and created for this example only. Actual test results and product comparisons will vary. This is not an endorsement of any product.

The Effects Test is somewhat of a transition from testing to monitoring. It is difficult to test a product for effects during an emergency situation because of the length of time required to determine negative effects. This level of testing is conducted when the product or strategy is first implemented. It also ties in with the first level of monitoring, M-1: Operational First-Use Monitoring, in that it determines if full-scale operational use of the product or technology is effective and does not have unacceptable impacts.

Example C-2

	Products to Consider for Additional Testing:	Product 1	Product 2	Product 3
C:	Products still being considered:	Alsocup	Rubberizer	Waste Set 3400
D:	Has a Field Effectiveness test or Effects Test been carried out? (Y/N)	Yes	Yes	Yes
E:	Describe test protocols:			
	Test site specifics (environment):	Highly sensitive, fresh water wetlands		
	Natural resources at risk:	Waterfowl, reptiles, fish, and many species of flora		
	Volume of oil to be treated:	500 gal	500 gal	500 gal
	Application rate(s)/volume used:	10%(product:oil)	18%	17%
	Application equipment:	broadcast spreader		
	Other logistical considerations:	limited access and difficult removal of solidified oil		
	Physical impacts expected:	solidified oil may adhere to flora		
	Is the oil recoverable?:	Yes, with shovel	Yes, with shovel	Yes, with shovel
	Expected outcomes of test:	Formed cohesive mass but remained sticky	solidified oil but wasn't cohesive	solidified oil and remained cohesive

Step 7: Record the recommended level of monitoring.

Information on monitoring can be found in Part C under the section titled, "Operational Response Techniques Monitoring Plans & Strategies" as well as "Elements of a Good Testing and Monitoring Program." Monitoring is a mandatory element during an oil spill response. There are two levels of monitoring: M-1 Operational First-Use Monitoring and M-2 Continued Operational Monitoring. M-1 monitoring primarily determines if the implemented product or strategy is effective and ensures that there are no unacceptable impacts. The objective of M-2 monitoring is to routinely monitor the progress of cleanup using the approved technologies and assess the need for modifying cleanup methods. Generally, the cure time for any solidifier is from less than one minute up to one hour. The first level of monitoring should be conducted on all three products to guarantee their proficiency and to make sure there are no negative impacts to the environment. The second level of monitoring should be conducted as well to ensure that no changes take place in the physical properties of the oil and that cleanup doesn't require an alternate response. Both levels of monitoring (M-1 and M-2) are recommended for these products and are recorded in Line F. See example C-3.

Step 8: Review evaluated products, discuss options, and rank products.

When conducting a final review of the products we must also consider product and strategy characteristics that were discussed in Part B/Worksheet 2. A detailed discussion should take place between all decision makers and stakeholders to determine the best possible options. Table 25 lists questions that are of concern when dealing with product categories in various levels of testing and monitoring. This table should be integrated into the discussion and help to aid the decision making process. Summaries of each of the three products are below: **Remember,** these evaluations and results are purely fictional.

- Alsocup – Is readily available, easily recoverable, worked under the <u>Field Effectiveness</u> Test situation for the most part however, is the most toxic of the three solidifiers. Alsocup is the 3rd choice overall because of the nature of the highly sensitive environment of the spill location.
- Rubberizer – Is available although not as readily available as Alsocup, more easily recoverable than Alsocup because the solidified oil is not sticky, works under the Field Effective Test, and is slightly less toxic than Alsocup according to the vendor. Rubberizer is the 2nd choice because it is both more easily recoverable and less toxic than Alsocup.
- Waste Set 3400 – Is readily available, easily recoverable, works under the <u>Field Effectiveness</u> Test, and is much less toxic than Alsocup or Rubberizer. For all of the reasons mentioned, Waste Set is the 1st choice.

Step 9: Record any additional information on the use, review, or implementation of the product.

Limited access to the site, which, has been discussed previously, also limits removal of the oil. The review team has suggested constructing a temporary road with one vehicle access to the site. This will allow personnel, responders, and equipment to access the site as well as allow removal of the oil. The nature of the oil solidified with Waste Set 3400 allows it to be shoveled and transported away for proper disposal. See Example C-3

The use of Waste Set 3200 in addition to 3400 may be of benefit to the swamp shoreline. Waste Set 3200 is developed specifically for land use and considering the availability and low toxicity or 3400, this may protect shorelines and marsh areas where solidified oil has the potential to adhere to the ground and flora.

Example C-3

Products to Consider for Additional Testing:		Product 1	Product 2	Product 3
C:	Products still being considered:	Alsocup	Rubberizer	Waste Set 3400
F:	Recommended Level of Monitoring for this test (Refer to Part D to Determine)	M-1 & M-2	M-1 & M-2	M-1 & M-2
G:	Mark as 1st, 2nd, 3rd Choice or Not Applicable for use during this incident	3rd	2nd	1st

H: Additional Comments/Recommendations on the use of product(s):
Limited access to site
Consider Waste Set 3200 for land use
Consider RRT review

I: Initials/Date of Incident-Specific RRT Review of Information:
Initial Box and Include Date Upon Review

USEPA:	HCJ	Date: 5-14-01	STATE:		Date:
USCG:		Date:	STATE:		Date:
NOAA:		Date:	OTHER:	BRK	Date: 5-14-01 (USFWS)
USDOI:	NDP	Date: 5-14-01	OTHER:		Date:

Step 10:

The fact that the response site is a sensitive environment and a National Wildlife Refuge will draw attention from many environmental agencies. Therefore, review or approval with the RRT is most likely a mandatory step. This worksheet has been reviewed by the EPA, DOI, and USFWS, as can be seen in Example C-3.

> ***Note***: Upon completing Worksheet 3, responders will then decide whether or not to recommend the implementation of a product or strategy to the On Scene Coordinator. This evaluation does not determine the best product or strategy to use for a response. Rather the evaluations and worksheets should help to narrow down these options as well as promote discussion between all decision makers and stakeholders to help determine the most beneficial response action for the incident specific conditions.

Lessons Learned

Sharing information within and among the regions whenever spill countermeasures technologies are used is of vital interest and benefit to the response community. To assure this information is captured, OSCs/users are requested to complete the information questionnaire displayed at the end of Part C.