GUIDANCE FOR DEVELOPING A SITE SAFETY PLAN FOR MARINE *IN SITU* BURN OPERATIONS

October 1997

National Response Team

Science & Technology Committee

Introductory Note: Response situations expose personnel, and sometimes the general public, to potentially hazardous situations. *In situ* burn (ISB) operations in marine/open water situations add an additional element to safety considerations. The precautions necessary for the safety of personnel in an ISB response effort to a marine spill must include safety protocols for burning, in addition to those for conventional cleanup using boats/ vessels.

The following site safety plan was written to assist the Regional Response Teams (RRTs) and On Scene Coordinators (OSCs), as part of the contingency planning process, to respond to a marine/open water spill. The plan includes those elements unique to ISB for response personnel. It does not address public health. [Refer to the general site safety and health plan for spill response safety considerations not related directly to ISB]. This plan is designed as an appendix to the umbrella site safety plan for the overall response. It is not a standard, but rather a suggested starting point. This ISB site safety plan is a Aliving@ document and is based on limited field experience gained at *in situ* burn responses thus far. However, as additional experience with *in situ* burning is gained in the field, this sample will be updated to reflect lessons learned, or to reflect any regulatory changes.

Annex C of the plan contains some operational aspects that should be included in plans for ISB but may create redundancy with ISB operations plans. If a specific operation demands a particular safety consideration because of ISB, then the operation is included in this plan. If the aspects presented in this guidance are covered in other parts of incident operations plans, they need not be included in the ISB SSP to avoid redundancy.

This guidance was developed by representatives from the following agencies: US Navy, Supervisor of Salvage (SUPSALV); National Oceanic and Atmospheric Association (NOAA), including regional Scientific Support Coordinators; Environmental Protection Agency (EPA), including their Emergency Response Teams (ERTs); US Coast Guard (USCG), including the National Strike Force Coordination Center (NSFCC); Center for Disease and Control (CDC); National Institute of Standards and Testing (NIST); and the Occupational Safety and Health Administration (OSHA). Technical reviews were performed by members of the following Regional Response Teams: RRT X, RRT VI , RRT V, Alaska, and Oceania. Additional comments and input were provided by the following National Response Team Members: Department of Interior (DOI), Federal Emergency Management Agency (FEMA), National Response Center (NRC), Department of Agriculture (USDA), and Department of Justice (DOJ).

Any questions or comments should be sent electronically to the NRT's Science & Technology Committee via their First Class account or internet account.

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1 ISB SITE DESCRIPTION Refer to the general site safety plan for entire spill location.

To ensure coordination with other response operations, the exact location of the *in situ* burn must be determined and documented. Additional information describing the ISB site is also necessary for safety of response personnel and the public (such as weather conditions, potential sensitive areas, secondary sources of ignition, etc.). Maps depicting this information should be created and made readily available for use during the ISB effort. The following table may be used to describe the conditions present at the ISB site for reference during the planning process. The information should be updated and presented during the safety briefing.

Site Description	**NO**	**YES**	**Comments**
A. Geographic Location of Burn Site(s)	NA	NA	Lat: Long:
B. Hazards	9 9 9 9	9 9 9 9	Oil Type: (See General SSP) Burn Promoters (see Annex E): Combustion by-products: Heat/Flame:
C. Weather Conditions: (Used to determine trajectory of boom sweep and smoke plume)	NA	NA	Wind Velocity/direction: Current velocity/direction: Comments:
D. Population Centers at Risk: (Indicate directions, distance, and demographic information --e.g. rural, urban, residential, etc.)	9	9	1. 2. 3.
E. Sensitive Areas (e.g., endangered species habitat, commercial fisheries, cultural/historical areas)	9	9	1. 2. 3.
F. Secondary Fuel Sources: (e.g., nearby oil storage facilities, pipelines, or vegetation)	9	9	1. 2. 3.
G. Secondary Sources of Ignition: (e.g., flares, explosion hazards)	9	9	1. 2. 3.
H. Maps (see Annex E) Attachment xx	9 9 9 9 9 9 9 9	9 9 9 9 9 9 9 9	Directions of response sweep Burn path/trajectory of smoke plume Population centers Sensitive Areas Contamination zones Exclusion zones Hazardous zones Other:
I. Medical Emergencies (ISB-related) (Verify that the hospital has been contacted and that burn and/or smoke inhalation victims can be handled)	9	9	First Aid Location: Hospital Name Phone: **2 BURN ENTRY OBJECTIVES**

All work shall be conducted in accordance with procedures established during pre-burn briefings and attached work plans. A work plan is necessary to avoid confusion and guarantee that a clear objective is known and carried out during the *in situ* burn effort. Good communication of these objectives are very important to ensure the safety of response personnel at all stages of the burn. Elements of a sample work plan is provided as an attachment in Annex C.

Initial Objectives: Recovery of oil/fuel spill, implementing booming strategies, performing initial ISB operations.

Other activities/objectives: Detailed objectives will be developed daily as part of the overall burn plan described in Section 4.1 of this plan (or refer to the applicable elements of burn operations in Annex C). In order to guarantee all ISB responders are aware of daily objectives, the objectives will be communicated to personnel during the pre-departure safety briefing. Communication is extremely important to ensure the safety of personnel during the ISB or any marine spill response operations.

3 RESPONSE ORGANIZATION

3.1 ICS/UC Integration.

3.1.1 Command Staff. The Site Safety and Health Officer (SSHO), here on referred to as the Safety Officer, is the person responsible for developing and implementing the On-Scene Coordinator's site-specific site safety plan, which would include ISB operations. The Safety Officer designates a ISB Site Safety and Health Supervisor (ISB SSHP) to act as an on-scene liaison between the ISB Group/Task Force and the Safety Officer at the command post.

3.1.2 Operations. Depending on the extent of the response management system in place to address the incident, the personnel who carry out the *in situ* burn operation will most likely be designated as an *In Situ* Burn AGroup@ or ATask Force@ within the Operations Section (see Figure 1). The *In Situ* Burn Group Supervisor or Task Force Leader is in charge of the ISB operation and reports to the next highest level in the organization.

3.1.3 Planning. If the ISB preparations are planned well in advance, and the Incident Command System (ICS) well established, an A*In Situ* Burn Technical Specialist@ may also be assigned within the Planning Section to facilitate planning for the burn, including elements of site safety. If the ISB is to be conducted on short notice, the ISB Group Supervisor or Task Force leader will assume duties as the incident commander at the burn site and be responsible for the immediate planning of the burn.

3.1.4 State and Local Responders. Local government is a key emergency response element that protects public health and the environment for most emergencies under the jurisdiction of the National Response System. As a result, where state and local response agencies are involved in a response, they will be included in the Unified Command directing spill response operation and thus will participate in the decision whether to conduct an ISB. Participating agencies will also ensure that all surrounding communities are alerted to the planned burn.

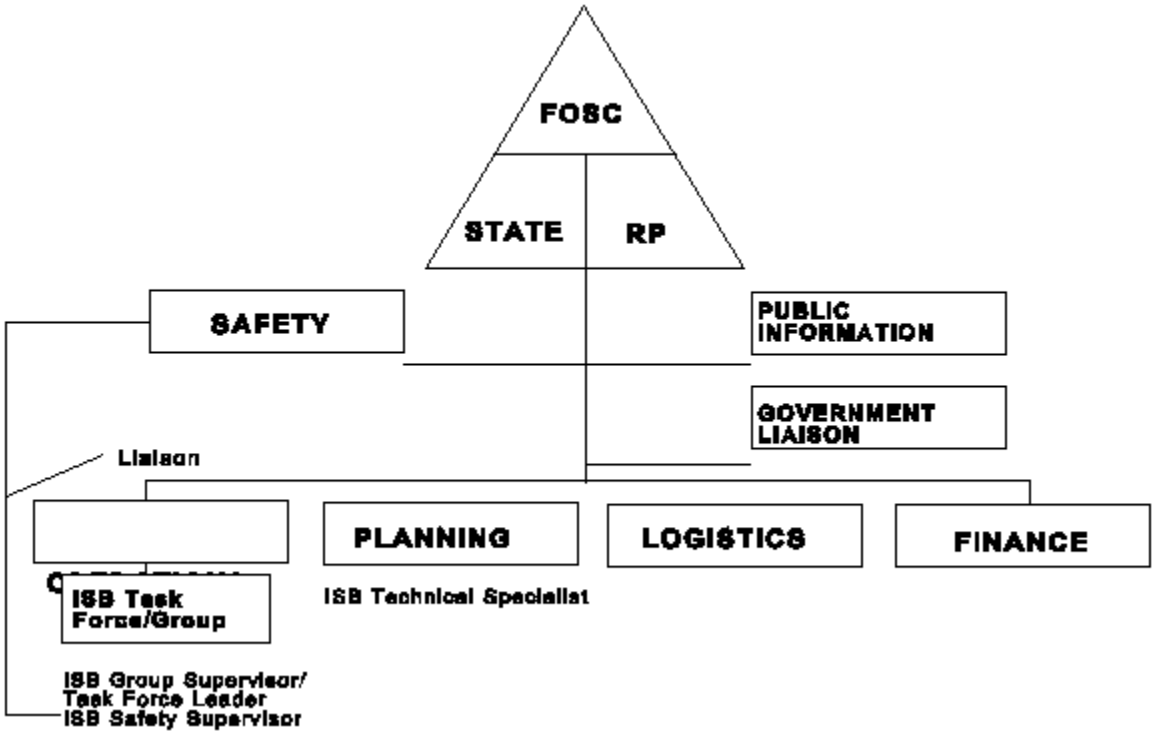

Figure 1 - Response Organization during ISB Operations

3.2 Functions Performed for an ISB Operation. The following section describes site safety functions that the incident Safety Officer and the ISB Task Force Leader/Group Supervisor should consider when planning and conducting an *in situ* burn.

3.2.1 Oversight of ISB Site Safety. As the designated by the Safety Officer, ISB Safety Supervisor (SSHP) is the individual in the field responsible for enforcing the Safety Officer's ISB site-specific site safety and health plan (ISB SSP). The ISB Site Safety Supervisor must be on-site at the burn area at all times while the Safety Officer may be with the OSC or at other locations. Responsibilities of the ISB Site Safety Observer might include (but are not limited to):

- Assuming responsibility of ensuring worker health and safety during burn operations;
- Using generic ISB site safety plan to develop an incident-specific ISB site safety plan;
- Coordinating implementation of the plan;
- Conducting pre-burn safety briefing on operational procedures and goals;
- Identifying potential emergencies;
- Being aware of any changes to emergency procedures implemented by vessels involved in the ISB operation;
- Explaining emergency communication protocols and emergency burn-termination criteria;
- Monitoring overall site safety onboard the ISB Command Vessel (see Section 3.3.1) during the burn operation; and
- Maintaining this plan and providing daily updates (as needed).

3.2.2 Monitoring and Tracking the Condition of the Fire. Personnel should be designated to monitor and track the condition of the fire. One might be designated for each vessel or boat involved in the ISB operation. These would be Operations personnel within the ISB Group/Task Force assigned to this specific job.

Other responsibilities might include:

- Receiving briefing from the ISB Site Safety Supervisor;
- Conducting burn safety meeting onboard vessel to discuss safety measures specific to the particular vessel;
- Ensuring that vessel/ boat personnel understand emergency communications and procedures; and
- Monitoring and surveying all safety aspects of the ISB response as it pertains to the particular vessel or boat.

3.2.3 Communications. ISB communications procedures and designated frequencies should be part of the incident communications plan and the ISB operations plan (see Section 4.2). The ISB Task Force Leader/Group Supervisor should take appropriate measures to:

- Ensure the effectiveness of overall communication during burn operations;
- Verify communication links to each vessel, boat, and aircraft prior to ignition; and
- Ensure emergency procedures are well understood by all ISB response personnel.

3.2.4 Air Operations. Helicopters or fixed-wing aircraft may be used for aerial surveillance support or for the igniter deployment. Aerial support operations should be specified, and pilot input included. The ISB Task Force Leader/Group Supervisor should ensure appropriate personnel from the Air Operations Branch are briefed on intended operations by the ISB Task Force Leader/ Group Supervisor and are informed of safety issues by the ISB Site Safety Supervisor

3.3 Operational Safety Considerations Regarding Vessels. The ISB Task Force Leader/Group Supervisor should consider the following elements for the ISB Task Force/Group response to ensure safety. The Safety Officer will assign a ISB Site Safety Supervisor to ride onboard the ISB command vessel or boat. For each vessel involved with ISB operations, one crew member should have the responsibility of monitoring the burn. These designated personnel should have radio contact with ISB Task Force Leader/Group Supervisor to report any emergency or safety concerns. In addition, vessel crews should review onboard emergency procedures (e.g. man overboard, steering casualty, grounding or collision, etc.) and consider if changes are needed due to the burning oil slick, deployed boom, or restricted maneuverability.

3.3.1 ISB Command Vessel. The ISB Command Vessel is responsible for all aspects of the burn. The Safety Observer aboard the ISB command vessel is responsible for the following:

- Conducting a pre-departure safety briefing providing details of the expected procedures and potential emergencies;
- Ensuring overall safety, including adequacy of designated ISB location; absence of other sources of secondary ignition nearby (enforce no-smoking policy); and safety of projected path of the sweep (while burning) for operators as well as the public;
- Communicating with all personnel involved in the burn to ensure awareness of events taking place before, during, and after the burn;
- Delivering or delegating final command for ignition of the burn;
- Maintaining communication with the Incident Commander/Unified Command via the Safety Officer; and
- Terminating burn if worker or public health are threatened.

3.3.2 Safety Vessel. The safety vessel personnel's responsibilities include:

- Cross-checking to verify that all safety requirements of the burn are addressed;
- Monitoring and maintaining pre-designated Afire-free@ zones;
- Reporting all hazards to command vessel/ boat;
- Preparing firefighting equipment (optional) onboard for accessibility and use; and
- Assisting command vessel with burn observations and safety.

3.3.3 Boom-Towing Vessels/Boats. Once in the preferred AU@ configuration, one of the boom-towing vessels (usually the right-handed boat facing the direction of travel) should be the **designated lead vessel.** The lead vessel sets the pace of the course and the speed of the sweep during oil collection. Also, the lead vessel maintains control of the boom shape and ensures that collected oil is not lost underneath the boom apex (drainage failure). Boom-towing vessel personnel safety responsibilities include:

- Performing emergency termination procedures; and
- Maintaining pre-designated towing course and avoiding Afire-free@ or hazardous zones.

3.3.4 Onboard Fire-Protective Equipment. The inclusion of fire-protective equipment onboard boom-towing vessels is left to the discretion of the Incident Commander, Safety Officer, and ISB Task Force Leader/Group Supervisor. In some organizations (such as the U.S. Navy Supervisor of Salvage), vessels carry fire-protective clothing for each person onboard and small fire pumps as added safety measures. Also, protective equipment is advised when using a manually-deployed igniter. People with protective equipment, however, may tend to assume adequate protection, and move too close to the fire. As a general rule, if people are close enough to the flames to need fire-protective equipment, the vessel or boat is also in danger. The ISB Site Safety Supervisor shall ensure all personnel remain at a safe distance from the fire at all times and that all ISB personnel have had OSHA training per 29 CFR 1910.120. For additional information on PPE requirements, see Annex A.

3.4 Contact List. See Annex B.

4 BURN AREA CONTROL

4.1 Site Control. Anyone entering or departing a burn area, or associated control zones, reports to the ISB Task Force Leader/Group Supervisor. Prior to ignition of the oil slick, the ISB Task Force Leader/Group Supervisor must ensure that the ISB site is clear and all members of the ISB Task Force/Group are in their designated positions. All persons entering the burn area must understand and subscribe to the ISB portion of the approved Site Safety and Health Plan. All personnel will have adequate training on *in situ* burn operations, and on hazardous waste operations safety and health (see Section 9 for training requirements).

4.2 Communications. Constant communication and coordination is essential for the safety of workers and the public. The ISB Group Supervisor/ Task Force leader should ensure that adequate communication procedures are in place to minimize the opportunity for incorrect or inappropriate actions by ISB Task Force/Group personnel or other responders and that the unified command is informed and updated on ISB response operations.

4.2.1 Radio Communication. Dedicated radio links with specific frequencies will be established for vessel-to-vessel, vessel-to command, vessel-to-air, and air-to-air communications. Repeater stations will be arranged, as appropriate, for distant or blocked communication paths.

Primary Command Channel (for general command communications):
Freq:_Channel: (VHF_UHF_CB_Other)

Boom-Towing Vessel Channel (dedicated for boom-towing vessels):
Freq:_Channel: (VHF_UHF_CB_Other)

Safety Vessel Channel (dedicated for routine communication):
Freq:_Channel: (VHF_UHF_CB_Other)

Aircraft Channel (dedicated for aircraft):
Freq:_Channel: (VHF_UHF_CB_Other)

Emergency Channel (dedicated for emergency communications):
Freq:_Channel: (VHF_UHF_CB_Other)
Command Center (dedicated for updating UC on ISB Operations by ISB Group Supervisor/ Task Force Leader):
Freq:_Channel: (VHF_UHF_CB_Other)

Other:
Freq:_Channel: (VHF_UHF_CB_Other)

4.3 Traffic Control. Movement of non-response vessels and aircraft in the vicinity of the burn may be affected by ISB response vessel activity and smoke production. Prior to and during burn operations, the response activity must be coordinated with the local airports, the FAA for Notice to Aviators, and the USCG for Notice to Mariners. Exclusion zones and traffic control corridors must be identified prior to ignition.

In recognition of the fact that an ISB, especially when viewed from a distance, may be

mistaken for a vessel fire or even a building, industrial, or wildland fire, it is important to ensure that all surrounding communities are alerted to the planned burn. Participating agencies in the ICS/UC will be responsible for ensuring that all potentially impacted communities are alerted to the planned burn operations. Depending on the burn location, it may be necessary to notify organizations such as the Captain of the Port, Marine Safety Office, fire departments, law enforcement agencies, marine search and rescue organizations, and beach patrol or life guards, assuring their appropriate participation.

4.4 Vessel Location. An important consideration in maintaining the safety of response personnel is the location and placement of response vessels in relation to the burning slick. Location and movement of all vessels throughout the response effort will be planned prior to ignition of the burn and reviewed during daily safety and operations briefings. All vessels will remain out of the downwind quadrant. Ancillary vessels and aircraft non-essential to the burn must remain in pre-designated safety zones, traveling upwind and up current from the burning slick. To avoid exposure to excessive heat and emissions, all vessels and personnel will remain at least five fire diameters away and upwind from the burn. For additional information on vessels during burn operations, refer to Appendix C.

During the burn, towing vessels should be positioned so that there is an absolute minimal chance of being surrounded by, or coming into contact with, concentrations of oil that could pose a threat due to deliberate or accidental ignition.

4.5 Igniters

4.5.1 Ignition Safety. Ignition of the oil slick should receive careful consideration. Aircraft operations to ignite oil with gel or other aerial ignition methods must be well-coordinated with surface vessels. Weather and water conditions should be kept in mind, and proper safety distances adhered to at all times. Given the range of igniter types and ignition methods, manufacturer specifications for proper deployment will be followed.

4.5.2 Helitorch or Other Air-Deployable Igniter Systems.

IMPORTANT NOTE: The helicopter or fixed-winged aircraft deploying a Helitorch ignition or other air-deployable igniter will maintain flight paths perpendicular to the boats and boom to avoid flying over any vessels.

Type of Igniter:
Additives:
Manufacturer:
Point of Contact:
An MSDS for additives and igniter contents should be included in Annex E.

4.5.3 Hand-held Igniter Systems. The person deploying the hand-held igniter will be trained in the use of the igniter. Follow safety recommendations of manufacturer.

Type of Igniter:
Additives:
Manufacturer:
Point of Contact:
An MSDS for additives and igniter contents should be included in Annex E.

4.6 Premature and Secondary Ignition Sources. As with conventional oil containment measures, premature or accidental ignition of the slick must be avoided at all costs. Proper consideration must be given to the proximity of potential ignition sources to any combustible slicks up until the time of deliberate ignition. Also, before deliberate ignition, the wind and direction of tow will be considered to ensure that no one is within or near any potential large concentrations of vapors which might flash upon ignition. Communication of igniter procedures to all personnel is essential for success of ignition and safety of all involved. If atmospheric conditions are very still, considerable concentrations of ignitable vapors may collect in the atmosphere above the slick; ignition should commence from a safe distance. Periodic monitoring of vapor concentrations should be considered to rule out unintentional ignition.

4.7 "Go/No Go" Policy. The response organization must ensure delegation of authority of veto power, prior to ignition. Each designated fire monitor can veto the commencement or continuation of the burn based upon safety concerns within each area of responsibility. Each commander must ensure that all personnel are in the correct and safe place and that all equipment is in proper working order before ignition of the burn. **If an emergency situation arises after ignition of the burn, anyone can terminate the burn by following emergency communication procedures (see Section 8.4).**

4.8 Termination of Burn. In most circumstances, the FOSC or IC should plan to allow an oil slick to burn to completion once it has ignited. However, premature termination of a burn may be necessary if worker and public health is threatened due to a wind or weather shift, or if a secondary ignition of another slick is a possibility. The fire may be extinguished prematurely by releasing the tow line from one of the towing vessels while the other moves ahead at several knots. This procedure allows the oil to spread out quickly to a thickness that cannot support combustion. A second alternative is to move both towing vessels ahead at several knots, forcing the oil beneath the boom and removing it from the combustion zone. Refer to the applicable burn operations plan in Annex C for more details on terminating a burn.

4.9 Pre-Ignition Checks.

1. ISB Task Force Leader/Group Supervisor ensures that a radio check is performed and that each vessel/ boat involved is aware of time remaining before the ignition to burn. Also, ISB Task Force Leader/Group Supervisor verifies that each vessel is aware of the designated burn trajectory.
2. ISB Command Vessel communicates with the incident commander/unified command (IC/UC) to obtain final approval to burn.
3. ISB Command Vessel communicates with helicopter and obtains verification of a clear burn path ahead (assuming helicopter is available).
4. Safety Observer on board the ISB Command Vessel ensures that boats and boom are pointed upwind (into the wind).
5. Safety Observer reiterates the locations of oil-free safe areas where vessels can retreat and regroup, should an emergency arise.

Contained oil should be ignited only after all pre-burn checks and requirements, as outlined in the FOSC approval applications and operational checklists, are met and confirmed via radio link with all vessel commanders and key participants.

The final ignition command from the ISB Task Force Leader/Group Supervisor to designated response personnel must be verified back to the command vessel prior to ignition action to ensure clear communications.

(Refer to Annex C or the burn operations plan for detailed burn operations.)

5 HAZARD EVALUATION

5.1 Airborne Particulates. An action level for worker exposure would be based on OSHA's PEL for respirable dust.

Hazard Description: Particulates with an aerodynamic diameter less than 10 microns (millionths of a meter)can reach the deep portion of the lungs (the critical gas exchange area) and become a burden on the respiratory system. Thus, current air quality standards are expressed as a fraction of particulates smaller than 10 microns in diameter (annotated as PM-10). The median size of particulates in the smoke from oil fires is 0.5 microns, posing a definite hazard to respiration. Studies show that the ground level concentrations of PM-10 nearby *in situ* burn events usually remain below safety thresholds (except for the area directly in the smoke plume). For most people, exposure to inert particulates becomes a problem only at high concentrations. However, sensitive individuals may develop problems at levels much lower than that.

Permissible Exposure Limits (PEL) for PM-10. For **response personnel**, the following exposure limits apply:

OSHA PEL: 15 milligrams per cubic meter (mg/m3) total particulate 8 hour mean
5 mg/m3 respirable particulates (PM-10) 8 hour mean

Symptoms of Overexposure: Excessive PM-10 will burden the respiratory tract and may cause breathing difficulties.

Basic Precautions: Initially, responders are equipped with the highest level of protection. Once sampling data is available to the Safety Officer, the action level for PPE requirements can be downgraded. Monitoring PM-10 as well as the other major constituents of the plume is necessary to provide the appropriate level and type of protection. Using respirators and eye protection suitable for particulate matter will reduce exposure. The best precaution, however, is to avoid overexposure altogether. Keep vessels and personnel out of the smoke plume.

Smoke plume trajectory is influenced by the burn size, wind speed, direction, and atmospheric stability. These conditions may vary during the burn time and over the path of the smoke plume. Computer models are being developed to assist in predicting the smoke plume behavior. Additionally, the release of small, helium-filled, Aparty@ balloons has been found to be useful for visualizing the initial trajectory of the smoke plume.

For hazards associated with other burn emissions constituents, refer to Annex D.

5.2 Environmental Monitoring for Chemical Hazards. To ensure the health and safety of responders, the site safety plan must restrict all responders and response vessels

from entering the smoke plume or from approaching the fire perimeter. Data analyzed from the Newfoundland Offshore Burn Experiment (NOBE) demonstrated that PM-10 levels were low upwind and outside of the smoke plume. Until further experience is gained, however, it is strongly recommended that PM-10 levels be monitored for worker's health and safety. Guidance on monitoring is forthcoming from the NRT Science & Technology Committee. This document will be updated after such guidance is released.

Data on other ISB gaseous emissions suggest that concentrations do not seem to pose a risk if responders and vessels remain safe distances and upwind from the burn. If for some reason, a responder must move close to the burn, proper personal protection equipment and monitoring must be administered. Additionally, a multiple burn scenario has not been tested. Should multiple burns be proposed, sampling for other hazards such as carbon monoxide, carbon dioxide, and polynuclear aromatic hydrocarbons, in addition to PM-10, is highly advised.

The following types of monitoring may be conducted: combustible gas; heat stress; noise; particulates; and other specific chemicals. If used, monitoring equipment will be calibrated and maintained in accordance with the manufacturer's instructions (electronic equipment will be calibrated before each day's use).

POTENTIAL HAZARD	INSTRUMENTATION	FREQUENCY
Combustible gas		___continuous, ___hourly, ___ daily, Other:
Heat stress		___continuous, ___hourly, ___ daily, Other:
Noise		___continuous, ___hourly, ___ daily, Other:
Chemical Specific Monitors (calorimetric/electronic)		
Particulate Monitors		___continuous, ___hourly, ___ daily, Other:
other		___continuous, ___hourly, ___ daily, Other:
other		___continuous, ___hourly, ___ daily, Other:

Zones of potentially hazardous substances may be encountered based upon wind and weather patterns. Projected extent and direction of the vapors plume prior to burn and smoke plume during the burn (along with any other applicable hazards found during the site survey) will be marked on the attached site maps in Annex E.

5.3 Burn Hazards. Although safe practices should eliminate the possibility of a responder getting burned during an ISB, contingencies for such a scenario must be identified. Depending on the severity of the burn, damage inflicted will vary from superficial reddening of the skin to extensive surface blistering and death of underlying

tissues. However serious, the correct first aid treatment is to cover the burnt surface with loosely applied, dry, sterile dressings. To reduce the dangers of infection, handling the burnt area must be reduced to a minimum and any temptation to clean its surface resisted. All burns of more than a trivial nature should be referred to the hospital.

5.4 Other Hazards

***Heat Proximity*.** Exposure of personnel to uncomfortable or dangerous levels of heat can be minimized or eliminated with proper considerations for vessel placement during a burn. Vessels should come no closer than five fire diameters for any extended length of time.

Heat stress. In an *in situ* burn event, the combination of hot weather and flame radiation can pose potentially dangerous situations for response personnel. Certain safety problems are common to hot environments. Heat tends to promote accidents due to slippery palms, dizziness, lower mental alertness, or fogging of safety glasses. If the victim is conscious and able to drink fluids, provide caffeine-free, cold liquids, preferably water.

Heat exhaustion is caused by the loss of large amounts of body fluid and salt through sweating. A victim suffering heat exhaustion usually still sweats, but experiences weakness or fatigue, giddiness, nausea, or headaches. Severe cases may exhibit vomiting or unconsciousness. The skin is clammy and moist, the complexion is pale or flushed, and the body temperature is normal. Treatment requires rest in a cool place and intake of liquids (caffeine-free).

Heat stroke is a serious condition which occurs when the body's temperature regulatory system fails and sweating becomes inadequate. A heat stroke victim's skin may be hot, usually dry, red, or spotted, and the victim may be mentally confused, delirious, or unconscious. Unless the victim receives quick and appropriate treatment, brain damage and/or death can occur. Any person with signs or symptoms of heat stroke requires immediate hospitalization; however, first aid should be administered immediately with the intent to lower the body temperature. Move the victim to a cool area, thoroughly soak the clothing with cold water, and vigorously fan the victim.

For more detailed information on heat stress considerations, including all of the above conditions, refer to the general site safety plan. USCG's generic site safety plan, in particular, has a thorough section on heat stress considerations.

Other hazards not ISB-specific. For other hazards refer to the general oil spill site safety plan for the incident.

6 PERSONAL PROTECTIVE EQUIPMENT (PPE)

According to safe *in situ* burn practices, workers should be kept out of the smoke plume and at a safe distance from the fire. People with fire protective equipment may feel overconfident in their protection and move too close to the fire. If personnel are close enough to the flames to need this type of equipment, the vessel will also be in danger. Therefore, it is unlikely that higher level PPE requirements are necessary. The level of PPE should be evaluated based on the threats identified in the site characterization and

hazard evaluation. Refer to Annex A for PPE policy and ensembles.

7 DECONTAMINATION PROCEDURES

Contaminated personnel, and personnel entering contaminated areas, will be decontaminated in accordance with the current work plan or attached decontamination layout.

8 EMERGENCY PROCEDURES

8.1 Emergency Medical Procedures

Refer to applicable section of the general site safety plan for the incident. If an ISB-specific injury occurs, take the following course of action:

- Contact the appropriate hospital or first aid station identified in section 1, as appropriate.
- Dispatch medical aid from shoreside, as required.
- The ISB Task Force Leader/Group Supervisor will enlist assistance of crew from any vessel capable of rendering additional assistance.
- Medical evacuation by helicopter to the pre-identified hospital will be decided by the ISB Task Force Leader/Group Supervisor in conjunction with the Safety Officer.

8.2 Emergency Fire Procedures

- DO NOT attempt to fight fires other than small fires. A small fire is generally considered to be a fire in the early stages of development, which can readily be extinguished with personnel and equipment in the immediate area in a few minutes time.
- DO NOT take extraordinary measures to fight fires.
- You MUST sound the appropriate fire signal (three blasts with an air or foghorn) if fire cannot be put out quickly.
- Alert nearby personnel to call for assistance.
- Notify supervisor.
- The Safety Officer will ensure that the fire is extinguished before restarting work.

8.3 Emergency Termination of Burn. Refer to Section 4.8 for burn termination procedures.

8.4 Emergency Communications. An emergency can be communicated or declared using any of the frequencies listed in Section 4.2. All working frequencies will be monitored throughout the ISB effort by the command vessel and safety vessel. Once an emergency situation has been declared and identified, all response vessels will monitor the dedicated emergency radio channel for emergency instructions. The command vessel will request any further changes in radio channel selection as appropriate.

As part of the AGo/No-Go@ policy, each fire monitor may stop the response effort by declaring an emergency. In declaring an emergency, the party must identify its vessel or operating unit and must provide a description of the problem.

In the event of radio equipment failure on any vessel, instructions to switch to other frequencies will be given by the communications officer on the command vessel.

8.4.1 Emergency Phone Numbers

Incident Commander/Unified Command:
(_)(_voice_fax_cellular_pager_home)
(_)(_voice_fax cellular_pager_home)

Site Safety and Health Officer:
(_)(_voice_fax_cellular_pager_home)
(_)(_voice_fax cellular_pager_home)

ISB Task Force Leader/Group Supervisor:
(_)(_voice_fax_cellular_pager_home)
(_)(_voice_fax cellular_pager_home)

Hospital:
(_)(_voice_fax_cellular_pager_home)
(_)(_voice_fax cellular_pager_home)

If a victim is en route, alert the hospital for incoming patient with burn-related injuries.

9 TRAINING AND SITE SAFETY MEETINGS

9.1 Training. Prior to any response effort, all personnel must be OSHA and HAZWOPER training certified, as per 29 CFR 1910.120 (q). Thereafter, classroom and/or hands-on refresher training must be completed by all personnel annually, emphasizing the particular hazards of a burn event to response personnel, equipment, and the general public. Training must also include experience with equipment and general response techniques, such as vessel operation, fire resistant boom deployment and towing, oil and residue recovery, ignition techniques, etc., to ensure safe operations.

9.2 Burn Safety Meetings. Prior to the commencement of the ISB response effort, a safety orientation for all personnel should be conducted. Burn safety meetings will then be held aboard each vessel prior to the ignition of the burn led by the ISB Site Safety Supervisor. At a minimum, these meetings will describe the work to be accomplished, safety procedure changes, and site-specific safety considerations.

Safety Officer:
ISB Site Safety Supervisor
(aboard ISB Command Vessel)

9.3 Sign Up Sheet

Team Member (Print Name)	Contact Number (Phone, Pager)	Signature	Date

Annex A: Personal Protective Equipment

A.1 General Policy. Employers are responsible for supplying personal protective equipment (PPE), as required by OSHA [29 CFR 1910.120 (g)]. Level of PPE should be evaluated based upon the threats identified in the site characterization and hazard evaluation. If an employer is providing equipment, including respirators [29 CFR 1910.134], OSHA regulations for training, selection, maintenance, and medical examination and monitoring must be followed.

According to safe *in situ* burn practices, workers should be kept out of the smoke plume and at a safe distance from the fire. People with fire protective equipment may feel overconfident in their protection and move too closely to the fire. If personnel are close enough to the flames to need this type of equipment, the vessel will also be in danger. Therefore, it is unlikely that higher level PPE requirements are necessary.

The recommended PPE ensemble is Level D for the entire burn response operation. During pre-ignition and the burn phase, personnel should have access to Level C PPE, such as respirators and goggles. As a precautionary measure, flame and fire-resistant coveralls may be necessary for personnel on the safety vessel. (Refer below to specific ensemble configurations PPE levels C and D.)

Other issues to keep in mind include:

- Vessel of opportunity systems (VOSS) personnel must be properly fitted and trained prior to commencing operation;
- People handling burn residue need protective clothing; and
- People handling igniters should use flame-resistant coveralls.

A.1.1 Coverall Specification. For those personnel working with igniters, coveralls will be of flame and fire resistant type, and lightweight to prevent overheating. Coveralls will be worn at all times by response personnel potentially at risk to exposure. When directly handling spilled oil fire-resistant coveralls should not be worn, since any oil that gets on the suit is potentially flammable. In these instances, personnel may where level D protection (i.e. oil-resistant coveralls).

A.1.2 Respirator Specification. Appropriate respirator protection will be provided in accordance with the requirements of 29 CFR 1910.134 including proper fitting, training, physical fitness, and respirator maintenance for all personnel involved in the response effort. Those personnel required to wear a respirator must remove facial hair to enable a proper seal of the respirator against the face. During fit testing of respirators, responders will be given the option to select the most comfortable respirator.

A-2 PPE Ensembles

Level D Ensemble:

- Oil-resistant coveralls

OPTION: Street clothing may be worn by supervisory personnel, technicians, specialist, etc., that will not be exposed to oil or the immediate flame proximity.

- Rubber steel toe/shank safety boots with textured bottoms

OPTION: deck shoes with textured soles (for boat operations)

- Rubber/latex or leather work gloves
- Rubber rain pants, jacket, and hood (as needed)
- Rubber apron (as needed)
- Personal Flotation Device (PFD)
- Quart bottle to carry fluids (during heat stress alert)
- Hearing protection (ear plugs)
- Insect repellent (if necessary)
- Hard hat (not required on vessel decks unless overhead equipment is operating)
- Safety goggles
- Sunscreen

Level C Ensemble:

- Fire-resistant coveralls

- NFPA rated fire-resistant gloves
- Half or full mask cartridge respirator
- Fire-resistant hood
- Face shield, as required
- Dust, fume, mist cartridge
- Organic vapor cartridge (on-hand for oil vapors prior to burn)
- Goggles

Annex B: Contact List

Function and Name	Phone Number	Radio Contact
Incident Commander		
Site Safety and Health Officer/ISB Designee		
ISB Site Safety Supervisor (onboard ISB Command Vessel)		
Boom-Tow Vessel #1		
Boom Tow Vessel #2		
Safety Vessel		
Communications Unit Leader		
Air Operations Leader		
Scientific Support Coordinator		
Local Fire Department		
Local Police Department		
Other		

Annex C: Burn Operations

C.1 Burn Operations Plan. To provide an organized response effort, a site-specific burn plan, or *in situ* burn application, will be drawn up prior to ignition of the burn. The plan must include the following elements:

- Organizational chart: Identification of people in charge of burn and their responsibilities;
- Burn Feasibility: Verification that window of opportunity exists based on weather and oil conditions for sufficient loft of smoke plume;
- Operational checklists: A chronological checklist of all operations critical for completion before, during, and after ignition, including availability of trained personnel;
- Communications Plan: Identification of radio frequencies and communication procedures for igniting the burn and addressing emergency situations;
- Action plan: Supplemental to the operational checklists, a plan that details vessel deployment, method of ignition, weather forecasts, and water conditions for the specific geographic area; and
- Burn termination procedures: Definition of termination criteria (e.g. worker/public health threats and termination procedures.

C.2 Equipment Operations

C.2.1 Boom Deployment. Boom deployment will be consistent with the boom instruction manual. Deployment of the boom in an ISB response situation will be made easier and safer with planning and training of personnel well in advance of any response effort. Preparations for the following considerations should be completed in advance.

- Ensure that the boom is properly stored in the tray or storage container as specified so deployment is feasible without snagging or twisting. A single twist of the boom can render it nearly useless for oil containment at or near the twist. Attempting to untwist the boom by hand after deployment presents a hazard to personnel.
- During deployment, anticipate drag forces induced by vessel movement and natural currents. Avoid standing on or holding down boom during adjustments. Use proper techniques to eliminate tension in the portion of the boom on which work is being done.
- Ensure that all tie-downs, tow lines, tow posts, etc., are strong enough to withstand the average and peak drag forces that may be experienced by the fire resistant boom in tow.
- Check boom and tow lines for damage and proper deployment before collecting oil. Fire damaged boom should be assessed to determine if it can be safely used even though the oil collection efficiency may be reduced.
- Provide adequate communications between the boom-towing vessels and the personnel tending the boom out of its container or tray. Dedicated radio links and hand signals should be pre-designated in case of an emergency.

C.2.2 Boom Towing. Boom towing will be consistent with the boom instruction manual. The following are safety considerations during towing operations.

- To avoid overexposure to the intense heat of the flames, all vessels must remain at least 5 fire diameters from the flame perimeter. Downwind of the burn, the minimum approach distance will be necessarily greater to avoid emission exposure to personnel. For operations using 660 feet or less of boom, use tow lines approximately equal to the length of the boom. For boom lengths greater than 660 feet, tow lines may be less than the length of the boom. This allows for adequate distance between the towing vessels and the burning oil contained in the bottom third of the boom in a AU@ configuration. Also, ensure that strength of tow lines can withstand the maximum anticipated tension forces induced by the drag force of the boom.
- Ensure that qualified aerial support is prepared with established communication lines to inform all responders of the location of boom-towing vessels relative to the target oil slick; other oil slicks in the same general area; other vessels in the area; and the anticipated region of influence from combustion products.
- Prior to ignition, ensure that all personnel on-site are positioned upwind or crosswind from the target slick.
- If response operations commence at or near the spill source, personnel and equipment will be positioned at a safe distance from any potential explosion or premature ignition of oil at or within the source.

- **Contained oil should be ignited only after all pre-burn checks and requirements, as outlined in the FOSC approval applications and operational checklists, are met and confirmed via radio link with all vessel commanders and key participants.**

C.2.3 Boom and Boat Handling. Refer to the instruction manual for boom and boat handling instructions. The designated boom commander ensures effective communication between the boom-towing vessels and other vessels. Once the oil is ignited, the boom handler remains in contact with the fire monitor personnel described in Section 3.2.3. Proper attention to the status of the burn, the speed and positions of the towing vessels, and the proximity of the burn to other vessels, slicks, etc., must be maintained for quick response to dangerous situations. The boom-towing vessels will have a pre-determined plan of communication and action for defined situations, such as: modification of the rate of burn (by modifying the size); requests of and offers for assistance to the sister towing vessel; and termination of the burn.

C.3 ISB Operations

C.3.1 Ignition Safety. Ignition of the oil slick should receive careful consideration. Aircraft operations to ignite oil with gel or other aerial ignition methods must be well-coordinated. Weather and water conditions should be kept in mind, and proper safety distances adhered to at all times. Given the range of igniter types and ignition methods, manufacturer specifications for proper deployment will be followed.

C.3.2 Fire Control. Depending upon response operation circumstances, the ISB command vessel may wish to manipulate the combustion rate of the oil slick. The rate of combustion is directly controlled by the forward velocity of fire resistant boom-towing vessels. A slower velocity will increase the burn rate by increasing the spread of the oil, thus increasing the fire diameter. On the other hand, a faster velocity will decrease the overall rate of combustion. Care must be taken when manipulating the burn rate. Too thick of a slick will cease to burn, while too fast of a tow will cause oil splash-over and/or entrainment.

C.3.3 Burn Effectiveness Monitoring. The dedicated safety vessel assists the command vessel with monitoring the burn=s effectiveness. The safety vessel crew monitors the status of the burn in relation to the proximity of the burn to towing vessels and other response vessels. It also monitors and maintains pre-designated Afire-free@ zones as needed between response vessels or between the burn and specified sensitive areas. Also, this vessel can provide backup support for deployment and containment operations, and provide extra personnel and equipment, where needed.

C.3.4 Aerial Surveillance. When available, aerial surveillance should continue to provide updates on status of spill and capabilities, including oil sources ahead of the lead vessel. Aerial surveillance should also provide early warning for wind and weather shifts which may impact the direction of the smoke plume.

C.3.5 Termination of Burn. In most circumstances, the FOSC should plan to allow an oil slick to burn to completion once it has ignited. However, premature termination of a burn may be necessary if the wind or weather shifts unexpectedly, or if secondary ignition of another slick is a possibility. The fire may be extinguished prematurely by

releasing the tow line from one of the towing vessels while the other moves ahead at several knots. This allows the oil to spread out quickly to a thinness that cannot support combustion. A second alternative is to move both towing vessels ahead at several knots, forcing the oil beneath the boom and removing it from the combustion zone.

C.3.6 Residue Collection. The safety boat is in charge of collection of left-over debris or residue.

C.3.7 Routine Communications. The ISB command vessel will provide general command functions for burn operations, and it will serve as the primary communications post. All radio frequencies will be continuously monitored by command personnel and the ISB Site Safety Supervisor aboard the ISB command vessel, and safety command personnel aboard the safety vessel.

Instructions regarding general response procedures will be communicated as necessary by the ISB command vessel. Direct communication between the boom-towing vessels is necessary to ensure coordination of boom-handling procedures; this communication will be continuously monitored by the ISB command vessel. Coordination of aircraft activity will be done through the command vessel.

Annex D: ISB Emissions

In addition to particulate matter less than ten microns in diameter (PM-10), other substances are emitted during an ISB event. For example, small amounts of toxic gases, including sulfur dioxide (SO2), nitrogen dioxide (NO2), and carbon monoxide (CO), are produced. Also, small amounts of polynuclear aromatic hydrocarbons (PAHs) present in the unburned oil are emitted from the fire as a product of incomplete combustion.

The above substances were sampled and analyzed extensively in the multi-national, multi-agency 1993 Newfoundland Offshore Burn Experiment, commonly referred to as ANOBE.@ From experience gained, data suggest that emitted gases pose minimal threats to worker health and safety, if vessels and personnel remain safe distances from the fire, and upwind from the smoke plume. Until further data are gathered to repeat and validate NOBE=s findings, questions still remain and caution must be taken as initial burns are tested in an operational response setting. Secondly, different ISB scenarios such as multiple burns have not been studied. Therefore, should a responder need to move close-in to the fire PPE and monitoring should be administered.

The following table summarizes the health hazards associated with an ISB event.

Type of Gas	***Hazard Description***	***Exposure Limits***	**Symptoms of Overexposure**
Particulate Matter < 10 microns (PM-10): particulates less than 10 microns (millionths of a	The median size of particulates in the smoke from oil fires is 0.5 microns, posing a definite hazard to respiration. Studies show that the ground level concentrations of PM-10	OSHA PEL: 15 milligrams per cubic meter (mg/m3) total particulate 8 hour mean 5 mg/m3	Symptoms of Overexposure: Excessive PM-10 will burden the respiratory tract and may cause breathing

meter) in diameter can reach the deep portion of the lungs (the critical gas exchange area) and become a burden on the respiratory system. Thus the air quality standards are expressed as a fraction of particulates smaller than 10 microns in diameter (annotated as PM-10).	nearby *in situ* burn events usually remain below OSHA PELs (except for the area directly in the smoke plume). For most people, exposure to inert particulates becomes a problem only at high concentrations. However, sensitive individuals may develop problems at levels much lower than that.	respirable particulates (PM-10) 8 hour mean	difficulties.

Type of Gas	***Hazard Description***	***Exposure Limits***	***Symptoms of Exposure***
Polynuclear Aromatic Hydrocarbons (PAH): a group of hydrocarbons found in both unburned oil and the smoke plume. PAHs have very low vapor pressures, and most are not very flammable. In ISB, PAHs adsorb to particulates. Studies show that concentrations in the smoke remain below 0.01 ppm, below exposure limits.	Some PAHs are suspected carcinogens over a long-term exposure; the target organs being the skin and lungs. The hazard is minimal in *situ* burn events. Because of the high temperatures, most PAHs are burned in the combustion process, and the concentration is usually higher in the oil than in the smoke.	OSHA PEL: 0.2 mg/m3 for 8 hours for coal tar pitch volatiles (benzene, soluble fraction), athracene, BaP, phenanthrene, acridine, ohrysene, and pyrene.	None.
Sulfur dioxide (SO2) **:** colorless nonflammable poisonous gas with a pungent odor. The concentration emitted in a burn is directly related to the sulfur	Highly toxic and corrosive gas, strong irritant to tissues (eyes, skin, and mucous membranes) by forming Sulfurous Acid (H2 SO3) on contact with most surfaces. The gas may reach to deep pockets of	- NAAQS: 0.14 ppm for 24 hours - OSHA PEL: 5 ppm for 8 hours	Irritation of eyes, skin, mucous membranes, and suffocation of respiratory system.

content of the oil.	the lung because of its lesser solubility in the blood. The danger form in situ burning is minimal because studies indicated that Sulfur dioxide emissions remain significantly below the unsafe exposure limits.		
***Nitrogen dioxide (NO2)*:** toxic gaseous by-product of oil combustion. It is normally a red-brown gas with an irritating odor.	Extremely toxic, inhalation may be fatal. Corrosive to moist tissues, eyes and respiratory tract. Compared to Sulfur dioxide, it is less soluble in blood, and could reach deeper portions of the lungs	- NAAQS: 0.053 ppm for 24 hours - OSHA PEL: 5 ppm for 8 hours	Irritation of eyes, skin, and mucous membranes.
***Carbon Monoxide (CO)*:** product of incomplete combustion of oils. It is a colorless, odorless gas that is toxic to humans.	The toxicity of carbon monoxide is acute: it has a high affinity to hemoglobin in the blood, displacing oxygen and ultimately causing oxygen deprivation in the body=s cells. The hazard of carbon monoxide from burn emissions is minimal. Data so far suggest that concentrations in oil fire smoke remain below 5 ppm 150 meters downwind; well below exposure limits.	- NAAQS: 9 ppm - OSHA PEL: 50 ppm for 8 hours	Headache, nausea, dizziness, confusion; at high concentrations asphyxia and death may result.

Annex E: Additional Information

Any additional information, such as maps, MSDS=s, etc., should be included in this section.

Annex F: References

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