Putting SIMA into Action for Spill Response Planning in the US

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The term Spill Impact Mitigation Assessment (SIMA) is used to describe the risk-based decisions that are made when considering response options during oil spills, and is offered here as a replacement for the historically used term Net Environmental Benefit Analysis (NEBA). Despite many papers, fact sheets, and presentations on the topic, the term still means different things to different people. Most agree that the concept of SIMA is an important one, but trying to put SIMA into action for contingency planning – or a response - may mean something very different to a regulator or stakeholder than it means to a responsible party or an oil spill removal organization. In Summer 2015, the global oil and gas industry association for environmental and social issues (known as IPIECA), released a NEBA "Good Practice Guide" (GPG) that incorporates NEBA into the response strategy selection process primarily during the contingency planning stage. This paper applies those concepts within the United States (US) regulatory framework, highlights how SIMA can be applied not only to contingency planning, but to response actions and drills, and provides case studies on the use of SIMA in the US.

INTRODUCTION

The term NEBA has been used extensively over the years to describe a process used by the oil spill response community for guiding selection of the most appropriate response option(s) to minimize the net impacts of spills on people and the environment. Given that the selection of the most appropriate response action(s) has in practice been guided by more than just environmental considerations, the oil and gas industry has sought to transition to a term that better reflects the process, its objectives, and the suite of shared values which shape the decision-making framework. Over the past year, industry introduced the term Spill Impact Mitigation Assessment (SIMA) as a replacement for NEBA. While the transition to SIMA (formerly known as NEBA) will take some time, it more accurately describes this long-standing practice and its objectives. The change was made to eliminate use of the word "benefit" when considering spill response options, in lieu of the more appropriate concept of "mitigate" (i.e., to make less severe). Additionally, unlike NEBA, the SIMA concept encompasses not only the "environment", but also cultural and socio-economic factors.

In 2015, IPIECA-IOGP published a Good Practice Guide document which discussed the use of SIMA in a global context (IPIECA-IOGP 2015). That document describes the SIMA process in four stages, as depicted in Figure 1:

1. **Compile and evaluate data** to identify an exposure scenario and potential response options, and to understand the potential impacts of that spill scenario.
2. **Predict the outcomes** for the given scenario, to determine which techniques are effective and feasible.
3. **Balance trade-offs** by weighing a range of ecological, socio-economic and cultural benefits and drawbacks resulting from each feasible response option.

Figure 1. *SIMA process (IPIECA, 2015)*

4. **Select the best response options** for the given scenario, based on which combination of tools and techniques will minimize impacts.

Regardless of the term used, this four-stage process can be applied to many preparedness and response activities, and can support the goals of a variety of U.S. regulations. The purpose of this paper is to: (a) describe how SIMA relates to the US regulatory environment; (b) provide an overview of SIMA application; and (c) present hypothetical and actual case studies of how SIMA has been used in the US. A more detailed description of these concepts can be found in the report, *Response Strategy Development Using Spill Impact Mitigation Assessment (SIMA) in the United States* (Coelho, *et al.* 2017).

SIMA IN THE US REGULATORY FRAMEWORK

In the US, oil spill preparedness and response activities are governed by a complex framework of legislation, regulations, executive orders, and policies that are collectively referred to as the "National Response System" (NRS). This system establishes roles and responsibilities for all levels of government, as well as industry, and applies to oil exploration and production (E&P), fixed facilities, vessels, pipelines, and other transportation modalities. The major components of the NRS, and their emergency preparedness and response roles in the system, are defined in the National Oil and Hazardous Substances Contingency Plan (NCP). These include the National Response Team (NRT), Regional Response Teams (RRTs), Area Committees (ACs), On-Scene Coordinators (OSC), state and local government, and industry representatives.

Specific regulatory programs that create oil spill preparedness and response requirements for industry are implemented by Federal agencies that include the Environmental Protection Agency (EPA), the US Coast Guard (USCG), Department of Transportation Pipeline and Hazardous Materials Safety Administration (PHMSA) -Office of Pipeline Safety and the

Department of Interior-Bureau of Safety and Environmental Enforcement (BSEE). In general, authority over spills is divided into four broad areas: Inland, Marine, Pipelines, and Offshore, per the regulations summarized in Table 1.

Table 1. Oil Pollution Act Facility and Vessel Response Plan Regulations

Facility/Vessel Type and Regulatory Name of Plan	Regulations	Responsible Department/Agency
Tank vessels – *Vessel Response Plan*	33 CFR part 155	USCG
Offshore facilities – *Oil Spill Response Plan*	30 CFR part 254	DOI/BSEE
Onshore facilities/Non-transportation related – *Facility Response Plan*	40 CFR 112.20	EPA
Onshore facilities/Transportation related – *Response Plan (for Marine-Transportation-Related Facility)*	33 CFR part 154	USCG
Pipeline facilities (onshore oil pipelines) – *Response Plan*	49 CFR part 194	DOT/PHMSA
Rolling stock – *Response Plan (Comprehensive written plan, 49 CFR 130.31(b))*	49 CFR part 130	DOT/PHMSA

The US NCP describes the requirements, and procedures for authorizing the use of "alternative response technologies" such as oil spill dispersants, in-situ burning, and bioremediation. Subpart J of the NCP specifically addresses requirements for pre-authorizing the use of such technologies, or authorizing their use at the time of a spill. Pre-authorization would normally be addressed in a Regional Contingency Plan (RCP) developed by a RRT, or a geographic subset of an RCP known as an Area Contingency Plan (ACP).

Contingency planning occurs within virtually all levels of the NRS, and industry plans are required to comply with the applicable USCG, BSEE, EPA or PHMSA, as well as state regulations. In addition, all contingency plans must be "consistent" with government plans such as the NCP, RCPs and ACPs. These planning regulations and standards require contingency plans to contain a variety of spill response information including guidelines on initial actions to be taken, resource availability, incident management team structure and staffing, candidate response options, training and exercise types and frequencies. To reduce confusion, and improve coordination within the overall emergency response community, a policy known as the National Preparedness for Response Exercise Program (PREP) was developed by regulatory agencies and clarifies that multiple regulatory requirements for exercises may be satisfied through a single integrated series of drills. Those drills include participation by regulatory agencies that have also agreed to be part of PREP, which has the effect of improving overall coordination between the regulating, and regulated sectors.

None of the US legislation or regulations contain specific requirements for conducting a SIMA as part of contingency plan development or during response actions. Even though existing US legislation and regulations do not specifically require use of SIMA, many of the activities involved in conducting a SIMA are required as part of the contingency planning process. For example, a hazards analysis and identification of available response options, which are performed during a SIMA, are also key steps in the development of virtually any oil spill contingency plan. Thus, it seems likely that if a SIMA is performed during planning activities, much of the information produced will be useful for a variety of regulatory compliance purposes (Figure 2).

History has shown that SIMAs are invaluable during actual spill responses. If a SIMA is not done prior to a spill response, SIMA principles can still be utilized to aid in selection of optimal response techniques, and to adjust response strategies as the response progresses. In the US, response actions are managed through use of the National Incident Management System – Incident Command System (ICS). The ICS provides a common, functional organizational structure, nomenclature and terminology, and it is used by both regulatory agencies and industry for their Incident Management Teams (IMTs). In this system, the use of SIMA would occur

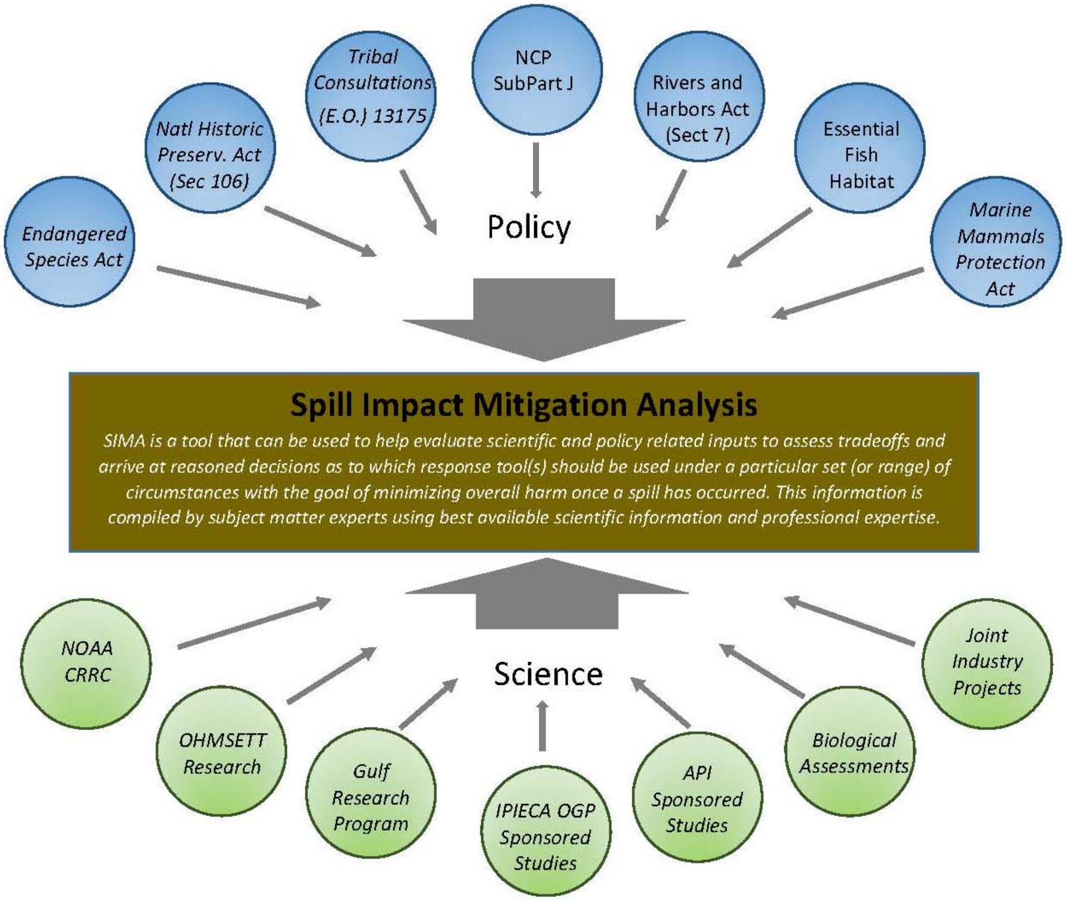

Figure 2. *SIMA brings together elements of regulations and policies with best available current scientific information to aid decision-makers in developing an overall response strategy. This figure provides some examples of policy and scientific initiatives that might be evaluated during the SIMA process.*

primarily within the Environmental Unit (EU), which contains industry and agency personnel, and advises the incident commander on environmental issues.

SIMA is one of the strategies used to select spill response tools that will minimize overall harm to ecological, cultural, and socio-economic shared values. In the US, there is no comprehensive policy on appropriate uses of SIMA, but the USCG has conducted many SIMAs that have informed response strategy development. In most offshore regions of the US, this was accomplished in the form of the Consensus-Based Ecological Risk Assessments (CERA) process used by the USCG (Aurand et al., 2000), and supported by NOAA, EPA, other Federal and state agencies, and academia. More than twenty workshops were held in various locations around the continental US, Caribbean, and Alaska from 1995 to 2011 to compare the benefits and risks of various response options when considering resource trade-off decisions. All workshops resulted in final publications (available from USCG) that were delivered to the Area Committees and Regional Response Teams to assist with response planning. One example of how this CERA/SIMA process was used to inform dispersant use decision-making is summarized in several papers authored by regulators in the state of California (Addassi and Faurot-Daniels, 2005; Addassi et al., 2005). The applicability of the CERA/SIMA process as a tool for facilitating dispersant decision-making during spill response and planning was also evaluated by NOAA (Mearns and Evans, 2008). Ultimately, the USCG and EPA used their CERAs to help establish dispersant pre-authorization zones in some US waters. CERAs use the same basic processes as SIMA, but typically do not address socio-economic considerations.

THE USE OF SIMA IN CONTINGENCY PLANNING AND RESPONSE PHASES

The SIMA process can be applied to both the oil spill contingency planning and response phases, although its application during the response phase will differ to some degree depending on if a SIMA was conducted in the planning phase. The primary objective in either case is to ensure the response options utilized will maximize the effectiveness of the response while minimizing overall harm to environmental, socio-economic, and cultural resources.

Several US regulations require that specific spill scenarios be addressed through planning and permitting processes. These generally include the Worst Case Discharge or very large spills, Maximum Most Probable or medium spills, and Average Most Probable or small spills.

Due to the extensive planning requirements of the NRS, some planning activities occur with varying levels of intensity throughout most areas of the US. Local Emergency Planning Committees (LEPCs) prepare plans that typically address “all hazards” and cover counties, Area

Committees prepare ACPs, and the RRTs produce multi-state Regional Contingency Plans (RCPs) for each of the ten standard Federal regions, plus Alaska, the Caribbean, and the Pacific Basin. In addition, regulatory requirements requiring some form of contingency planning extend to virtually all facilities, pipelines, or vessels that use or store significant quantities of oil or hazardous materials. As a result, appropriate stakeholders can generally be identified, and some level of information on sensitive environmental resources and available response options should be available to support the SIMA process.

The SIMA process during a spill can work two ways. One where the specifics of an actual event are sufficiently close to a pre-spill SIMA developed during the planning phase that the pre-spill SIMA can be tweaked and validated. A second is where the real event is novel (i.e., does not match up with a planning scenario where a SIMA has been performed). In this event a SIMA is performed in a matter of hours using an approach that relies heavily on expert judgment. Obviously extensive stakeholder input is not always possible here.

The SIMA process conducted during a spill is considerably different than SIMA evaluations conducted during the planning phase. Response option tradeoff analysis conducted during the spill is conducted over “several hours”, whereas planning SIMA’s can take substantially more time. During a response in the US, the EU quickly assess real-time spill conditions (oil type, quantity and trajectory), reconfirms information about actual resources at risk in the vicinity of the spill, and then adapts conclusions from planning SIMAs, as appropriate, to the actual spill conditions.

During a spill, the SIMA process is cyclical, and is repeated as data becomes available or is updated, or as conditions evolve. For example, surveillance and monitoring of the spill and response activities creates data that are incorporated into the SIMA process. This is used to support validation or adjustment of the response strategy, and ultimately in defining response end points. When the ICS system is used, a planning cycle will be established. The length of the planning cycle will be dependent on spill conditions but is usually 24 hours. Each planning cycle will culminate in preparation of an incident action plan that will guide response actions during the following cycle. The SIMA process can be used to advise the ongoing planning process and recommend appropriate strategies as the response progresses.

Whether the SIMA process is conducted during contingency planning phase or the response phase, participants must carefully assess any assumptions that have been made in the underlying data, and ensure that strategy selection is made with flexibility and adaptability in mind. The following section describes both hypothetical and actual spill cases where the SIMA process is applied.

CASE STUDY 1: SIMA APPLICATION INVOLVING LOSS OF CONTAINMENT OF A DEEP SEA WELL

For this case study, a hypothetical spill event is used to illustrate how the SIMA process can be used to inform environmental resource trustees and regulatory officials on response strategies with the greatest potential to minimize overall harm from a well event.

Scenario

The scenario selected for use in this case study is typical for a loss of well containment event in the Gulf of Mexico. In this scenario, an exploration well suffers loss of control including failure of the blowout preventer. Crude oil and gas are released, with the oil estimated to be flowing at 3,000 m3 (19,000 bbls) per day. Use of a comprehensive, Incident Data Sheet helps ensure that all appropriate scenario descriptive information is supplied, as follows:

- The well is at a water depth of 1,100 meters.

- Surfacing oil slicks are drifting towards the shore under the influence of a prevailing 15-knot wind and surface current.
- The subsea current runs parallel to the coast.
- Wave height is about 1.5 meters.
- There are fishing grounds closer to the coast and seagrass beds in shallow water.
- Coastal resources that could be impacted by the oil include an estuarine mudflat that supports a large population of wading birds. An offshore island supports a seabird colony. There are three popular tourist resorts in the vicinity.

Evaluate data

Although this event is hypothetical, a number of potential data sources exist that can be used to help predict potential environmental outcomes. If the scenario involves an existing exploration well, existing environmental conditions should be well documented in the drilling permit application and the OSRP. The ACP may also contain relevant environmental sensitivity information. The Natural Resource Trustees and environmental regulatory agencies may also have real time information that should be considered, and lists of resources at risk can be requested. Trajectory analyses produced through 3-D modelling will be very important for indicating the horizontal and vertical distribution of oil in the water column.

Since there are no pre-authorizations for subsea dispersant injection (SSDI) use in place for this scenario, it will be necessary to provide the information necessary to obtain an incident specific authorization to the Unified Command (UC) leading the IMT. The UC will use that information (described in the preceding section) for briefing the RRT and seeking concurrence from the EPA and the State if the SIMA process indicates that SSDI use can minimize overall environmental harm by promoting faster ecosystem recovery. In an actual event, the IMT would be established quickly, and most of the data evaluation and other phases of the SIMA process would occur in the EU. Much of the information required would be generated through the "emergency consultation" process, which will be conducted by natural resource trustees under the leadership of the Department of Commerce and Department of the Interior. For drills, the time frames used do not normally allow for full participation by all regulatory organizations and stakeholders, so the data evaluation, and other phases of the SIMA process are conducted by the drill sponsor and their technical specialists.

For this scenario, with no intervention, and under prevailing conditions, modelling predicts an 80% probability that surfacing spilled oil would reach the shore, and that the oil would reach the coast after 4 days. During this time the spilled oil would become progressively 'weathered' and emulsified. The spilled oil volume would initially decrease due to evaporative loss, but then increase due to emulsification. This could result in up to 10,000 m3 (63,000 bbls) per day of emulsified oil threatening the coast after 4 days. Gas released within the well fluids would dissolve before reaching the surface.

Predict Outcomes

The nearshore and coastal sensitivities are very high, and their protection from oil is a high priority. The estuarine mudflats and marsh areas are biologically productive and difficult to either protect with booms or to clean up if oiled. The seabird colony does not contain threatened or endangered species but adds to the attraction of the area for tourists, with daily boat trips. The tourist resorts are a major part of the regional economy, relying on popular sandy beaches and watersports. The tourism is seasonal but this scenario falls within the main season. The threat to beaches would cause significant immediate disruption and has the potential to dent confidence in the area and reduce future reservations. The inshore fishery is locally important but economically small in relation to tourism. In addition, experience in the US has shown that fisheries are likely to be shut down initially if oil impacts an area, with or without dispersant use. Fisheries would likely re-open only after monitoring and sampling programs ensure food safety.

Balance Trade-offs

At-sea mechanical recovery or in-situ burning alone could not deal with the amount of spilled oil in the time available. Surface use of dispersant is possible; the crude oil is tested to be amenable to dispersant use prior to emulsification, with a window of opportunity of around 24 hours. The prevailing conditions of 5-foot (1.5 m) wave height and 15-knot wind are good for dispersant use. However, the surfacing oil would rapidly spread and fragment, presenting challenges for targeting and encountering the floating oil even using a combination of vessels and aerial systems. Approximately 40,000 gallons of dispersant would need to be applied each day, based on a dispersant-to-oil ratio (DOR) of 1:20. An aerial application system is available within 24 hours, capable of applying up to 25,000 gallons of dispersant per day. First response is available from a standby vessel with a boat spray system and stock of 1,300 gallons of dispersant.

Mobilizing a subsea dispersant injection system as part of a capping response would allow treatment to commence within days. Injection at the well head would greatly increase both the targeting of the dispersant operation and the volume of oil being dispersed. The DOR could be decreased to 1:50 or less (possibly 1:100), reducing the volume of dispersant used per day by more than 50%. Surface dispersant application could then be scaled down generally, and potentially restricted to the area around the well head site, if needed, to reduce volatile organic compounds to safe working levels for workers on vessels in the vicinity engaged in source control activities.

In this case study, we assume that dispersant injection would pose a heightened risk to marine life within the water column within a few kilometers of the well location. However, dilution of dispersed oil would (i) reduce concentrations to below anticipated toxicity levels in the wider area, (ii) enhance biodegradation and (iii) greatly mitigate gross oiling of the sensitive coastal zone.

It is anticipated that the well would be capped within 15 days.

Select best options

Based on the trade-off discussion above, the following optimized strategy is identified:

- Initial surface dispersant use on the floating spilled oil, followed by subsea injection as soon as it can be mobilized, would be effective and would be the primary response tool.
- Nearshore containment and recovery operations would be mobilized and targeted around the ecologically sensitive areas.
- Shoreline assessment and clean-up would be carried out on contaminated shorelines.

Summary for Case Study 1

The use of SIMA processes to support operational decision making during response actions has been well documented. Unfortunately, the use of SIMA to evaluate the potential benefits of SSDI as a response method is limited by the fact that SSDI has only been used once, and the use of SIMA, while undertaken, was not well documented. Use of SIMA as a planning tool, and to support decision making during drills, offers an opportunity to promote constructive engagement between industry and the key agencies and officials of the US NRS on how to best utilize SSDI in the future. While drills must be based on certain assumptions and have artificialities, they remain a key component of the preparedness and response culture in the US and offer unique opportunities to evaluate evolving policies and practices. The regulations governing SSDI use, and the regional policies that will implement them are subject to change, but use of the SIMA process as a decision support tool should continue to improve common understanding of the trade-offs offered by the use of SSDI under the right circumstances.

Data and findings from previous SSDI SIMA efforts should be applied to other well sites and locales, providing the scenario is similar. Rather than developing new SIMA's, existing efforts should be carefully reviewed for applicability, and adapted or revised as needed for new geographic regions.

CASE STUDY 2: SIMA APPLICATION FOR NEAR SHORE DISPERSANT USE

Preauthorization zones have been created for the use of dispersants on surface oil spills in the US. In the Gulf of Mexico, they apply to waters more than three miles from shore and more than 10 meters deep. Any proposed dispersant use closer to shore or in shallower waters needs the approval of the RRT.

On September, 2004, Hurricane Ivan passed over the Mississippi River delta region and caused many underwater landslides that damaged oil platforms and pipelines. Numerous oil spills occurred, and one in Main Pass Block 69 released about 7,000 gallons of light crude oil over a 20-day period before the source was controlled. The primary response was mechanical skimming with up to four skimming vessels. However, the United States Fish and Wildlife Service reported that some 2000 birds on an exposed sandbar nearby were at immediate risk and that there were thousands of other birds in the general area. The skimming vessels were not able to fully protect the birds.

This area of the Mississippi delta contains the Delta National Wildlife Refuge and is the home for thousands of migratory birds. Resource agencies consider the birds to be the primary resource in the area to be protected and often in the past asked spilled responders to prioritize them over other non-avian species when considering spill response techniques. The spill was located in an area outside the preauthorization zone because it was too close to shore and too shallow, but RRT 6 did approve limited use of dispersants to protect birds deemed to be at risk from the oil. They deemed the possible impacts on species living in the water column to be acceptable in order to protect the birds.

A total of 350 gallons of Corexit 9527 dispersant was applied by a specifically designed fire monitor system near the spill source, and 5000 gallons of Corexit 9500 dispersant were applied during five aerial sorties on two different days (Henry, 2005). Overall, dispersant effectiveness received mixed reports. Dispersants were highly effective when there was sufficient surface energy to provide mixing, but when the winds and sea state slackened, the effectiveness was much less, at least initially, but may have increased later when winds and waves increased.

It is very easy to develop a near shore scenario where dispersants would not be appropriate. An oil spill in the Florida Keys might similarly threaten migratory birds, but the use of dispersants might also threaten coral reefs in the area. The RRT could reasonably not approve the use of dispersants because the coral reefs were deemed to be more valuable than the birds.

CASE STUDY 3: SIMA APPLICATION FOR SHORELINE CLEANUP

Some of the most difficult decisions during an oil spill response are made regarding cleanup methods and cleanup endpoints for contaminated shorelines. Oil spilled on water or quickly flowing into water can be transported great distances and can contaminate long stretches of shoreline. Responders should choose appropriate cleanup measures that remove the oil with the least amount of additional damage to the environment. The process for assessing and treating shorelines is similar for inland and coastal spills and includes choosing response options and developing cleanup endpoints.

The decision-making process often involves representatives from the responsible party; federal, state, and local response agencies; natural resource trustees; and stakeholders from the local communities affected. It is typical that at least some of the representatives are not familiar with the fate and behavior of spilled oil or the negative effects of the various cleanup techniques that could be employed. Many will also not understand that, in certain situations, leaving some oil in place to undergo natural removal is preferable to the potential damage from the cleanup techniques used.

The assessment of shoreline conditions, the selection of response options, and the development of cleanup endpoints involves considerations of the types of shorelines and habitats, the type of oil spilled, the differences in the effects of the potential cleanup techniques, and the degree of residual oiling deemed acceptable. Difficult issues can arise that have no right or wrong answer, and the resulting discussions can be quite contentious. Successful resolution of these issues has occurred with negotiations by special scientific teams representing the parties involved. Here are some specific examples:

Kalamazoo River, Michigan (Dollhopf, and Durno, 2011; Dollhopf, et al., 2014)

In July, 2010 approximately 20,000 barrels (840,000 gallons) of heavy crude oil composed of bitumen diluted with natural gas condensate (dilbit) was released from a ruptured oil pipeline near Marshall, Michigan and flowed into a tributary of the Kalamazoo River at a point approximately 80 miles upstream from Lake Michigan. About 38 miles of the river's channels, as well as associated backwaters, floodplains, islands, and wetlands were contaminated. The spill occurred during a flood event, and some of the heavy oil attached to suspended sediments and settled to the bottom of the river.

Initial response removal actions along the shorelines and floodplains included manual recovery with sorbents, soil excavation, soil flushing, and vegetation removal. Oil collected on the river was removed using skimmers and adsorbents. A mechanized vegetation removal device was used to harvest heavily oiled submerged vegetation in the Kalamazoo River. After ecological screening of areas with submerged oil, sediment flushing with river water, sediment raking, and aeration were used to liberate submerged oil for surface recovery. Sediment dredging was used in some locations. These submerged oil recovery activities lasted through the 2011 response season.

In 2012 a SIMA process was developed to help make response decisions for the remaining areas of submerged oil in the Kalamazoo River. After accounting for human health and safety factors, the SIMA was used to evaluate the ecological risks associated with removing the oil with collection activities, as compared to leaving the residual submerged oil in place to degrade naturally. The SIMA conceptual design resulted in relative risk matrices for eight recovery actions for use on eight habitat types, and six ecological resource categories. Risks of exposure via five pathways were also considered in terms of magnitude of impact and length of recovery. No new recovery techniques were deployed after these new analyses, but the existing techniques were used with more thought given to the consequences.

Red Butte Creek, Utah (Whelan, et al., 2014)

A crude oil pipeline break released approximately 1,000 barrels of oil in June, 2010 and significantly oiled three miles of Red Butte Creek, an urban stream in Salt Lake City, Utah, that is a tributary of the Great Salt Lake. Because the oiled creek ran right through the community, the local public paid a lot of attention to the cleanup and were very concerned that all of the oil be removed.

The IMT worked with a large group of government, community and academic stakeholders to determine what the main concerns were, what cleanup methodologies were acceptable, and their potential to minimize environmental harm. The discussion led the IMT to determine that the top priority was the sediment's macroinvertebrate community and the shoreline vegetation and trees. Because these biologic receptors were less sensitive to trace amounts of oil than they were to erosion and sedimentation, the group selected a low-impact response method that would minimize bank erosion. This decision also meant that the responders had to leave some residual staining on rocks and in culverts. This example demonstrates an expedited SIMA performed during a spill response.

Cosco Busan (ISPR, Jan. 2008; ISPR, May 2008)

The Cosco Busan spilled over 50,000 gallons of Heavy Fuel Oil in November 2007 in San Francisco Bay. In the initial response, skimmers were deployed and protective booming implemented. Shoreline cleanup involved the use of manual labor to recover the oil and debris. In addition, sediment relocation (surf washing), tilling, and surface washing agents were used, and some limited bioremediation tests were conducted. Local media attention was very high, and members of the public, frustrated by the perceived slow shoreline cleanup response efforts, cleaned beaches on their own with no supervision from the IMT.

The cleanup methods used were not controversial, but the public wanted to see all of the oil removed and did not want to accept that it might be better for the environment to leave some oil behind. As a result, setting cleanup endpoints was difficult. The SCAT process included representation from a variety of stakeholders from government agencies and the public. Through sometimes contentious negotiations, a SIMA-like process was used to establish cleanup endpoints, which ultimately enabled the response to proceed to a satisfactory conclusion.

CONCLUSIONS:

The concept of SIMA has been in use in the US for more than two decades, initially conducted as a US Coast Guard process known as CERA. While the process was originally restricted to examining ecological effects, it has since expanded to include socio-economic, cultural shared values, and worker health and safety. The SIMA process can take on various formats, ranging from multiple stakeholder workshops conducted over months to inform ACPs, to less formal desktop sessions and decision-making conducted over a few hours during a specific spill response. In either format, the core concepts remain the same:

- evaluate the impacts of reasonable response options that are available;
- consider the trade-offs of each option across all resources potentially impacted; and
- select the combination of response options to optimize the overall response strategy.

The SIMA process can be a one-time planning session, or can be an iterative process during a response to monitor the effectiveness of ongoing response actions. In any given format, the SIMA process:

- assesses worker health and safety conditions for various response activities;
- provides a process to evaluate changing spill conditions and the potential impacts of ongoing response actions; and
- facilitates ongoing cooperative communications between industry, regulators, and stakeholders.

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