RISING TO THE CHALLENGE: THE OUTCOMES OF THE IPIECA THE IOGP OIL SPILL RESPONSE JOINT INDUSTRY PROJECT 2011 – 2016

An article in 7 parts contributed by Rob Cox of IPIECA and Peter Taylor of Petronia Consulting

Rob Cox is Technical Director of IPIECA in London. Rob has over twenty five years of international petroleum industry experience including fifteen years with Caltex/Chevron in Africa, the Middle East and the United States. Rob's background combines field experience in Environment, Health & Safety aspects of shipping, refining, distribution and retail marketing, as well as Environmental Management System implementation and auditing. Until recently Rob was seconded to the position of program manager of the IOGP-IPIECA Joint Industry Project on Oil Spill Response (the OSR – JIP) which was established to understand and implement the oil spill response lessons learned from recent upstream incidents. Rob holds a Bachelor's degree in Chemistry and Biochemistry from the University of Dundee in Scotland and a Postgraduate Diploma in Environmental Practice from Farnborough College of Technology in England.

Peter Taylor is the Principal Consultant at Petronia Consulting Limited. He has a degree in biological sciences and he spent six years in environmental research and consultancy, prior to specializing in oil spill preparedness and response activities for the past 30 years. He has been supporting IPIECA's promotion of effective oil spill contingency planning around the world since 1998. Through IPIECA, he has managed the Oil Spill Preparedness Regional Initiative (Caspian Sea – Black Sea – Central Eurasia), known as OSPRI, since its inception in 2003 to the present. He undertook several activities under the OSR-JIP, including support to the on-going development of a novel NEBA methodology.

Part 1 – Introduction by Rob Cox

The April 2010 Gulf of Mexico (Macondo) oil spill incident, and other similar incidents, such as the Montara incident that took place in the Timor Sea, off the northern coast of Western Australia, have had far-reaching consequences in prompting the re-examination by industry not only of operational aspects of offshore operations, but also of an operator's ability to respond in the event of an oil spill incident or blowout. While the response to the Gulf of Mexico spill is widely recognised to have been successful, lessons can be learned from the response effort which provide an opportunity to inform and further strengthen future preparedness and response initiatives for E&P operations and the maritime community.

In response to the Macondo incident the International Association of Oil and Gas Producers (OGP, now IOGP) formed the Global Industry Response Group (GIRG), tasked with identifying the key questions to prevent recurrence of such an incident and identify learning opportunities on prevention, intervention and response. Three sub-groups were set up (see Figure 1) on Prevention, Capping and Containment, and Oil Spill Response. These groups were comprised of appropriate nominees from OGP member companies, from the IPIECA Oil Spill Working Group, from Oil Spill Response Limited (OSRL), and from other industry organizations, associations, and spill response cooperatives as appropriate. A further group, on Mutual Aid, was formed later.

Figure 1: The GIRG

The OGP GIRG-OSR task force reported on its findings to both the OGP Management Committee and the IPIECA Executive Committee at a joint session in February 2011. Subsequent work was conducted by a joint board-level team to examine the implications of the recommendations of the GIRG-OSR work and develop a recommended structure for the execution of that work. While certain actions recommended by the GIRG-OSR report fell within the remit of existing organisations, it was recognized that the most efficient way to execute the spill response work was for the industry to establish a limited duration Joint Industry Project (JIP), governed by the nineteen funding companies that had expressed interest.

This JIP, which was officially formed in December 2011, executed the recommendations from the report in two phases over a five-year period and is now in a process of drawing all the work to a close. This is expected to be complete by June 2017.

This article highlights the rationale and initial set-up of the OSR - JIP: subsequent articles will focus on the individual component parts in more detail over the coming weeks.

Working through a JIP had several clear benefits:

- It promoted credibility through group consensus and collaboration
- It provided a body of information that can now be used to respond proactively to outside agencies
- The existence of a JIP made it easier for national administrations, intergovernmental organisations and willing third parties to participate in the studies and therefore to build their confidence in the results of the commissioned investigations and research.

The OSR JIP initiated discreet projects or provided support to projects initiated by other trade associations (e.g. API) in the nineteen subject areas resulting from the OGP GIRG-OSR project. The OSR JIP was managed by IPIECA on behalf of OGP in recognition of its long-standing experience with Oil Spill Response matters.

Initially, a total of thirty-three areas of concern were defined; some of these however were of relatively minor significance and/or could be collapsed into related project areas, and some were already being worked on by other entities. Through a process of prioritization nineteen projects were subsequently defined. These fell into four broad categories:

1. <u>Good Practice Guidance</u>

While the IPIECA "Report Series" had been in place for some time, and was regularly updated, it was recognized that in many cases the information contained in them needed to be expanded to include the upstream community. A total of 22 Good Practice Guides were initially envisaged; a further two were added in 2015 and 2016 respectively. The produced guidance is currently being translated into 6 languages.

2. <u>Technical reports</u>

These were a series of short technical reports, developed to communicate technical good practice or to make it accessible to external parties. Subjects included work on dispersant licensing and approvals, dispersant logistics, *In-Situ* Burning equipment, post – spill monitoring, oil spill response preparedness for offshore installations, OSRO assessment and auditing and volunteer management case studies, amongst others.

3. <u>Pure research & longer technical documents</u>

The JIP also commissioned small research projects e.g. to find better methods of bench scale testing dispersants for their efficacy against various crude types and in areas such as residue characterization from *In-Situ* Burning operations

4. <u>Outreach & Communication</u>

Although not initially planned, the JIP soon realized the need for "outreach" materials, and produced a range of simple videos/animations, "Glance/Scan" sound-bite size PowerPoint presentations and "inreach" materials; the "Confident Ambassador" programme was used to train hundreds of industry staff worldwide.

Altogether, the Oil Spill Response JIP took five years, cost nearly eight million dollars, employed over seventy consultants and contractors, made use of nearly two hundred and fifty industry reviewers, and carried out one hundred and forty visits, workshops & seminars.

The OSR-JIP website can be accessed at: www.oilspillresponseproject.org

A series of articles over the coming weeks will explain the materials produced in detail including showcasing some innovative improvements to traditional concepts such as Tiered Preparedness, NEBA, dispersant efficacy testing and risk-based response planning for offshore installations.

Part 2 – Dispersants by Rob Cox

This article continues the story of the IPIECA-IOGP Oil Spill Response JIP, with an explanation of the various projects that the JIP conducted on dispersants, including surface and subsea dispersant Good Practice Guidance (GPGs), dispersant efficacy testing, guidance for regulatory authorities on licensing and approvals, logistics and supply, post-spill monitoring, and outreach and communication materials.

The original IPIECA report series comprised a single volume on dispersants, although the subject was of course mentioned in several other documents including the report series publication on Net Environmental Benefit Analysis (NEBA), which discussed the choices that could be made in the context of the use of dispersants.

Following the Montara and Macondo incidents, the subject of dispersants was never far from the headlines, and it was frustrating that the industry at times struggled to cut through the sensationalism, "sound-bite" science and in some cases even calculation errors to present a balanced factual account of the science surrounding the use of dispersant and the circumstances under which they should or should not be used. Some of these have previously been highlighted in the ISCO newsletter:

http://www.spillcontrol.org/2013-02-05-11-11-41/2013-02-05-11-26-54/doc_download/444-isco-511-newsletter

The OSR-JIP therefore sought to redress this by producing reliable, scientifically sound, peer reviewed guidance in several areas, as follows:

Good Practice Guidance (GPGs)

The OSR-JIP produced two GPGs on dispersants on sub-surface and surface application. The latter highlights the processes involved in dispersion and the formation of water-in-oil emulsions; provides some historical context on the use of dispersants and their changing composition, discusses biodegradability and toxicity, and looks at the limitations of surface dispersant use due to weather conditions. Also discussed is the typical regulatory environment for dispersant use as well as some health and safety aspects of dispersant handling. This document can be accessed at: http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Dispersants-surface_application_2016.pdf

The subsea application document contains sections on the behaviour of oil released subsea and its potential consequences, effects in the water column and on the sea surface, the techniques of subsea response, the mechanism of dispersant action when used subsea, and the capabilities and restrictions of subsea dispersant use. This document can be accessed at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Dispersants-subsea_application_2016.pdf

Technical Documents

The OSR-JIP document *"Regulatory approval of dispersant products and authorization for their use"* was originally intended to assist regulators in developing economies where there had been confusion over the process of approving and licensing; subsequently however we found broader uptake by regulators even in developed nations.

The document provides an overview of the principles of regulations concerning dispersants in terms of the requirements for importation, but also the conditions for their use. This document may be accessed at:

http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/JIP-2-Dispersants-approvals.pdf

A key element of any successful dispersant operation is the ability to supply dispersants in sufficient quantities to meet the demand. The rate of use and the volume required will vary in relation to the application systems in use, and will be governed by the nature of the release. The use of dispersant in an extended subsea event presents logistical challenges that are different from those at the surface where the application window is often limited by weathering and emulsification to a matter of days; subsea dispersant application, however, may require the use of dispersants over an extended period which, in turn, will require an understanding of pre-planning and the logistics of supply. This simple document "*Dispersant logistics and Supply Planning"* helps the reader understand the key factors in planning an extended use dispersant operation. This document can be accessed at:
http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/JIP-3-Dispersant-logistics.pdf

While organizational and regulatory arrangements for seeking approval for the use of dispersants during a spill will vary, it is not uncommon for the regulatory authority to grant a window of opportunity for the use of dispersants during which time the operational entity responsible for executing the spill response must show conclusive evidence

that the use of dispersant is resulting in quantifiable improvements in dispersion under real-world conditions. *"At-sea monitoring of surface dispersant effectiveness*" describes examples of procedures and protocols (including the SMART protocol) for satisfying this requirement. This document can be accessed at:
http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/JIP-4-Surface-dispersant-effectiveness.pdf

Research Projects

The issue of characterizing which dispersant is most effective against which spilled oil is fundamental to effective preparedness. As we shall see in a later issue, not all dispersants work equally well against all crude oils; water salinity may also affect efficacy. While there are many "industry standard" laboratory test methods (including the Swirling Flask Test, Baffled Flask Test, MacKay, Nadeau, Steelman Test, etc.) the OSR – JIP sought to develop a rapid immersive test replicating subsea use of dispersant that could rapidly measure different dispersant – oil combinations. SINTEF and CEDRE were commissioned to develop rapid – screening test methods to evaluate subsea dispersant injection efficacy. These reports can be accessed at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/SINTEF-Dispersant-Testing-Research-Report.pdf

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/CEDRE-Dispersant-Testing-Research-Report.pdf

Outreach & Communication

Along with the American Petroleum Institute (API) the OSR-JIP has developed several media tools to assist in communication around dispersants:

http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/GS-Dispersant-Glance-Scan.pptx

http://www.oilspillresponseproject.org/response/dispersants/#portfolio-video-content-1082

Part 3 - Promoting Effective Training and Exercise Programmes by Peter Taylor

Having competent, practised and confident personnel within an organization's oil spill response and incident management teams is clearly a vital element of effective preparedness.

Two key OSR-JIP GPGs emphasise the importance of training and exercises. They also highlight the value of an integrated implementation programme, rooted in risk assessments and contingency planning.

It is recognised that most emergency response roles will be in additional to personnel's normal jobs. Successful spill prevention measures over the years are an achievement to celebrate but a corollary is reduced opportunity to gain experience through actual response.

Training courses, and the chance to challenge response teams through exercises, have consequently taken on additional importance.

The Training GPG strongly encourages a systematic approach to planning courses and thereby maximising their value. Setting learning objectives is key to ensuring fit-for-purpose courses. Standard courses may be suitable e.g. the IMO's Model OPRC Courses. However, specialized courses can be valuable in either developing specialized advisers or focussing on the needs of specific functions within an incident management team. Customizing courses by adapting them to a local setting and relevant contingency plans should be normal practice.

There is no doubt that learning objectives are most effectively achieved where varied training methods are utilized. The stereotypical 'death by PowerPoint' should be avoided and a course should include a mix of group discussions and challenges, site visits and practical equipment deployments, alongside presentations. It is truism that managers benefit greatly from participation in at least one practical deployment during their training. This encourages appreciation of the realities of field response. Instructors' backgrounds, experience and presentational skills are also critical to a credible and successful course. Evaluation of courses is important for continuous improvement. The Training GPG may be accessed at:

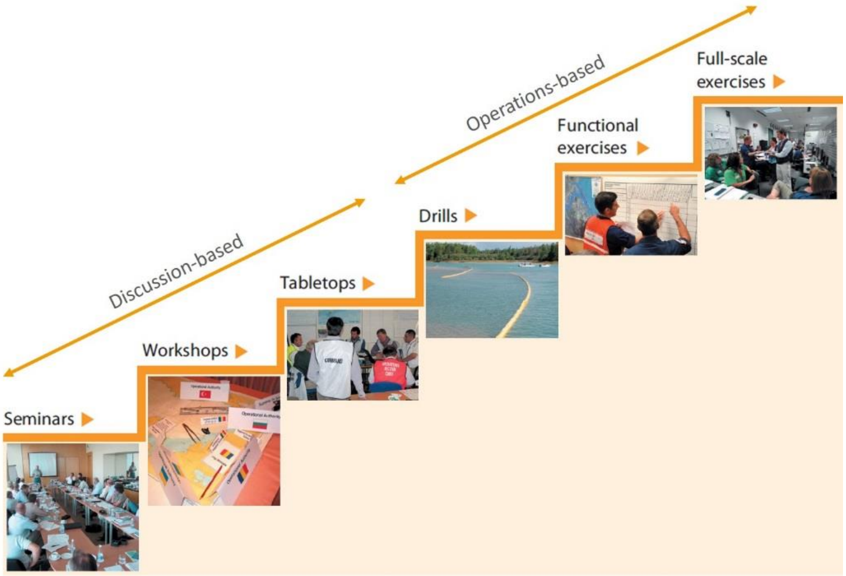
http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Oil_spill_training_2016.pdf.

The Exercising GPG is an update of a former IMO/IPIECA Report Series publication. It addresses the activities to practise and check contingency plans' procedures, including incident assessment and notifications, decision-making, working together (within and between organizations) and the mobilization, deployment and escalation of response.

The Guiding Principles for successful exercising are retained from the earlier publication:

- ✓ Ensure that senior management support and endorse the exercise activity
- ✓ Set clear, realistic and measurable objectives for an exercise
- ✓ Recognize that the thrust of exercising is to improve - not to impress
- ✓ Keep exercises simple and more frequent for faster improvements initially
- ✓ Do not tackle complex exercises until personnel are experienced and competent
- ✓ Do not overcomplicate an exercise with too many activities, locations and participants
- ✓ Ensure successful exercise evaluation
- ✓ Planning and conducting a successful exercise is a significant accomplishment

The GPG broadly follows the approach recommended in the International Organization for Standardization (ISO) Standard on *Societal security—Guidelines for exercises* (ISO 22398:2013), with adaptations for the specifics of oil spill preparedness and response.



A variety of methods are likely to be encompassed within a programme, ranging from discussion-based seminars and tabletops to operations-based drills and full-scale exercises.

Detailed guidance on the planning of elements of a programme is included in the GPG, which may be accessed at: http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Oil_spill_exercises_2016.pdf.

It is incontrovertible that investment in a structured and fit-for-purpose training and exercise programme will pay dividends by facilitating safe and effective response, should an incident occur. Such a programme should receive equal focus as the acquisition and maintenance of specialised pollution combating equipment and supporting logistics.

Many organizations are also recognising that the training and exercising of an incident management team can address all potential emergency situations and risks, not only oil spills, as the organization and procedures are readily adaptable.

Part 4 – Tiered Preparedness and Response by Rob Cox

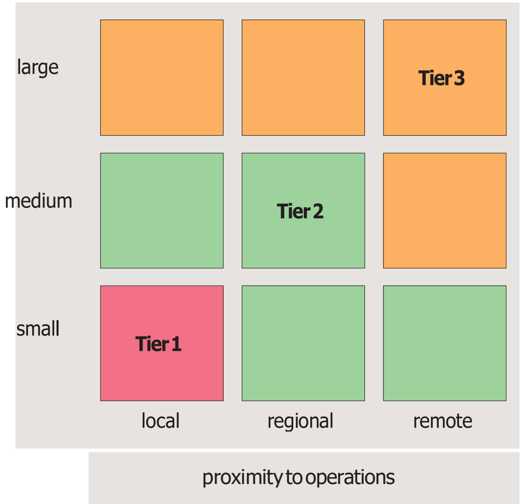
This article continues the story of the IPIECA-IOGP Oil Spill Response JIP, which this week looks at the innovative work carried out on Tiered Preparedness and Response, which is explained fully in the Good Practice Guide of the same name.

Tiered Preparedness and Response is recognized as the basis on which to establish a robust oil spill preparedness and response framework. The established three-tiered structure allows those involved in contingency planning to describe how an effective response to any oil spill will be provided; from small operational spillages to a worst-case release at sea or on land. The structure provides a mechanism to identify how individual elements of capability will be cascaded. The aim is to provide suitable response resources at the right place at the right time, hence the resulting capability should:

- be commensurate with the assessed risk;
- encourage cooperation, mutual assistance and integration of shared resources;
- be fully scalable via a mechanism of escalation through the three tiers;
- be tested, maintained and verified as part of a defined preparedness framework; and
- employ the most appropriate response options, reflecting a NEBA/SIMA approach (more on SIMA next week!)

These principles are consistent with the OPRC Convention, which obliges ratifying States to develop and maintain a national response system and to facilitate international cooperation and mutual assistance when preparing for, and responding to, major oil pollution incidents.

Traditionally, three levels, or 'tiers' were defined, providing a simple structure from which oil spill response capabilities can be identified to mitigate any potential oil spill scenario in terms of response personnel, equipment, and additional support. Collectively these resources were combined to establish response capability, and were categorized according to whether that capability was held locally, regionally or internationally and whether the spill size was small, medium or large. For many years, this was the basis of the system and indeed, it still forms the basis of many National Contingency Plans around the world.

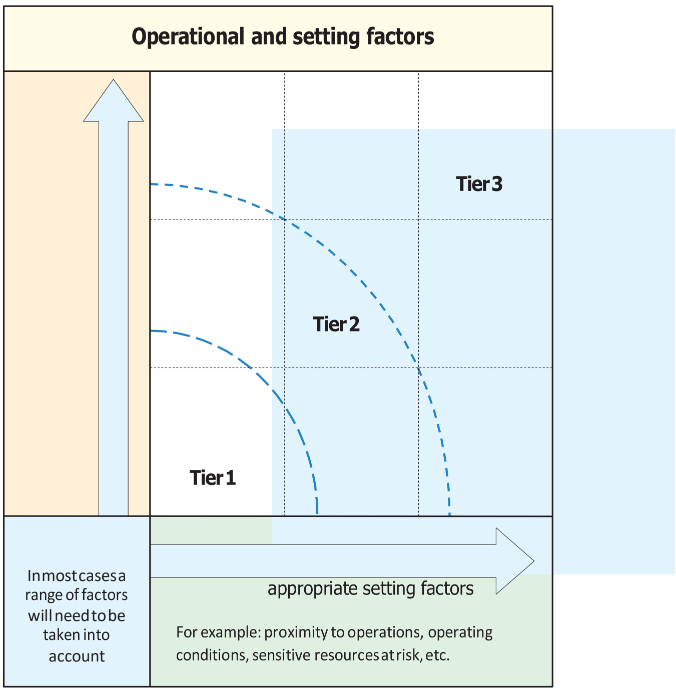


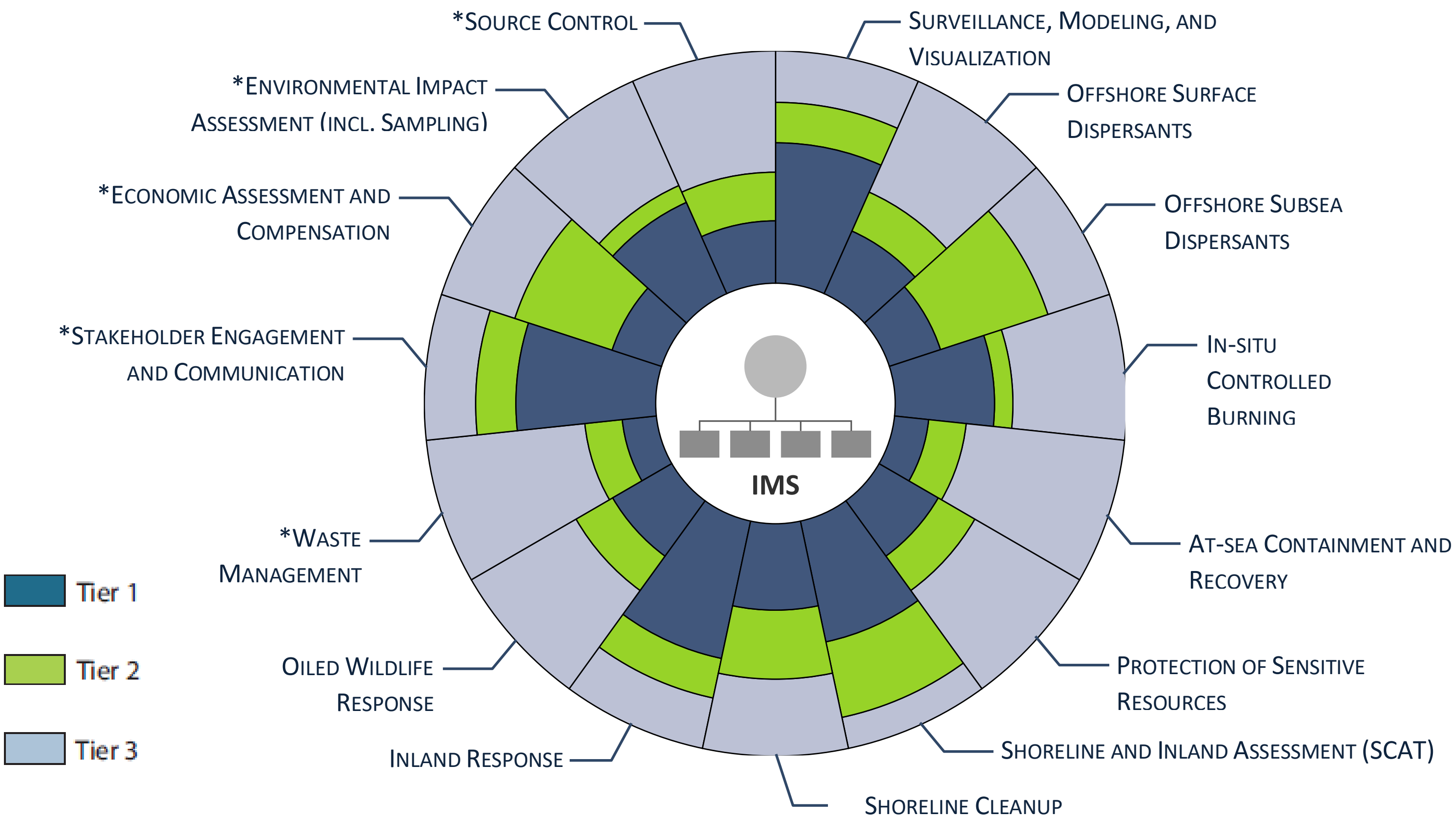
This relatively simple model was then superseded by the concentric circle model, which incorporated a range of operational and setting factors and showed how they interact to influence the boundaries between the three tiers.

Operational factors are those specific to the operation in question, such as potential spill source, oil type and release rate or volume, while
setting factors pertain largely to the location, or setting of the scenario being used for planning, such as to the environmental, socioeconomic or climatic conditions.

While a great improvement on the basic model, the concentric circle model still implied a tangible boundary or threshold between the tiers which led in turn to an artificial classification based on volume, equipment availability, and mobilization thresholds which were all assumed to escalate uniformly in lock-step across the tiers.

The OSR-JIP therefore commissioned OSRL to propose a new model which uses a segmented circle to represent fifteen different categories of response, but also allows contingency planners to represent the response capabilities – in terms of tiers - required to mitigate risk and identify the sources from which these capabilities will be provided. It also gives a higher profile to the importance of an Incident Management system (IMS) in delivering an effective response





Each segment is subdivided to illustrate how that specific response capability will be provided across all three tiers. In some cases there may be no specific local or regional capability, hence there will be full reliance on the provision of Tier 3 resources. In other cases there may be an emphasis on providing the majority of the required response capability locally through Tier 1. In some cases, an activity depicted by a segment may not be applicable and the segment in question will be left blank. The way in which the segments are apportioned is completely qualitative; the pictogram has no scale and it is not designed as prescriptive tool. The contingency planners should give consideration to the various operational and setting factors as mentioned and the relative priority placed on Tier 1, Tier 2 and Tier 3 resources. The GPG provides worked examples of how the requisite capability is built, with each complete segment representing the full capability required to mitigate the identified worst credible case event for that operation or location. The new IPIECA – IOGP Good Practice Guide on Tiered Preparedness and Response is available for download from:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Tiered_preparedness_and_response_2016.pdf

Part 5 – A Novel Methodology for NEBA: Spill Impact Mitigation Assessment (SIMA) by Peter Taylor

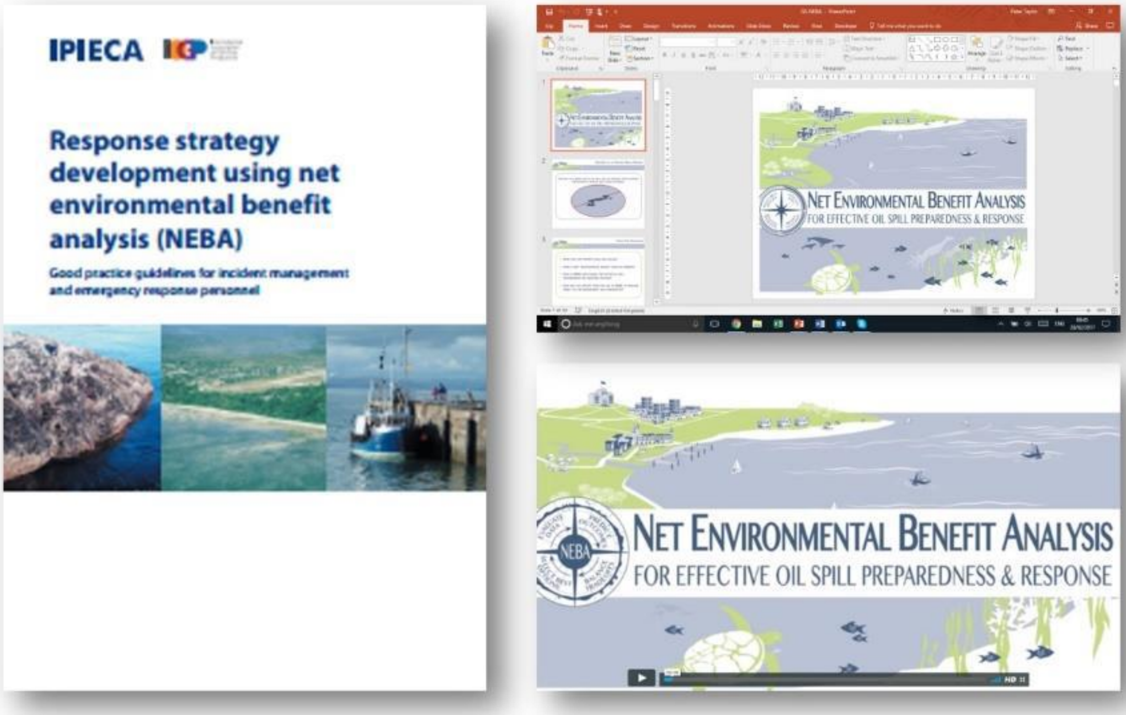
A key objective for any oil spill response is to minimize the impacts to ecological, socio-economic and cultural resources at risk. To that end, the contingency planners and incident managers have traditionally utilized a formal or informal Net Environmental Benefit Analysis (NEBA) for selecting the most appropriate response option(s) to minimize spill impacts and promote recovery. The processes used to conduct a NEBA have varied considerably between industry operators, though the outcomes in terms of strategy development have been similar. This variation in NEBA approaches can lead to challenges with communicating the underlying basis of response strategies to stakeholders. Through the JIP, a Good Practice Guide (GPG) was produced in 2015 to explain the general principles of the NEBA process and facilitate stakeholder involvement.

This GPG, titled *Response strategy development using net environmental benefit analysis (NEBA)*, may be accessed at:
http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/NEBA_2016-2.pdf

An explanatory PowerPoint® presentation and a short, animated video concerning NEBA were also produced by the JIP; both are available at: http://www.oilspillresponseproject.org/strategy/net-environmental-benefit-analysis/

However, with industry's increasing reliance on NEBA to enhance the transparency of response strategy development, a consistent methodology for conducting formal NEBAs was required.

In response to this, key industry Associations (API, IOGP and IPIECA) initiated a collaborative project, aligned within and supported by the JIP, on developing a qualitative NEBA methodology that can be utilized if other, fit-for-purpose NEBA methodologies are not applicable or available. Industry has also begun transitioning to a more representative term for the NEBA process which is 'Spill Impact Mitigation Assessment (SIMA)'. Therefore, the SIMA term is used henceforth but it is important to note that the method described herein is not exclusive to the SIMA term and, as with NEBA, only represents one of many approaches that can be utilized to conduct a SIMA.



This qualitative methodology is designed to give a consistent approach to larger or higher consequence oil spill scenarios, where multiple spill response options are being considered and a formal SIMA is warranted. Several industry spill response specialists participated in this project, resulting in the drafting of *Guidance on Implementing Spill Impact Mitigation Assessment*.

The SIMA guidance document consists of several components including:

- Use of SIMA in pre-spill planning and spill response
- The SIMA four stage process:
    - Compile and evaluate data
    - Predict outcomes/impacts
    - Balance trade-offs
    - Select best response option(s)
- Guidance on assessing relative impact levels and modification factors associated with each response option
- Example applications of the SIMA methodology

These components are described, including a novel methodology that focuses on the 'predict outcomes' and 'balance trade-offs' stages. At the heart of this methodology is a comparative matrix, which considers the potential impacts of selected scenario(s) on key ecological, socio-economic and cultural resources, alongside the potential for each feasible response option to mitigate (or exacerbate) the spill's impact on each of the key resources. The total impact mitigation potential is derived for each response option, allowing informed and transparent decision-making.

i. Resource compartments → **ii. Relative impact** → **iii. Predict effectiveness and impact modification potential for options** → **iv. Impact modification factors**

Resource compartments	No intervention		Contain and recover		Surface dispersant			In-situ burning		Shoreline booming	
		Potential relative impact	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score	Subsea dispersant – not feasible	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score
		A	B1	A x B1	B2	A x B2		B4	A x B4	B5	A x B5
Seabed	None	1	0		0			0		0	
Lower water column	None	1	0		0			0		0	
Upper water coloumn	Low	2	1		-2			0		0	
Water suface	Med	3	1		3			2		0	
Air	Med	3	1		2			-2		0	
Shorelines		3	1		3			2		1	
Saltmarsh	*High*	*4*	*1*		*3*			*2*		*1*	
Estuarine mudflats	*High*	*4*	*1*		*3*			*2*		*1*	
Sandy beaches	*Low*	*2*	*1*		*3*			*2*		*2*	
High value resources	Low	2	0		1			0		1	
Socio-economic		4	1		2			1		3	
Boat harbour	*Med*	*3*	*1*		*2*			*1*		*2*	
Water recreation	*High*	*4*	*1*		*2*			*1*		*3*	
Cultural	None	1	0		2			1		1	

Resource compartments	No intervention		Contain and recover		Surface dispersant			In-situ burning		Shoreline booming	
		Potential relative impact	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score	Subsea dispersant – not feasible	Impact modification factor	Relative impact mitigation score	Impact modification factor	Relative impact mitigation score
		A	B1	A x B1	B2	A x B2		B4	A x B4	B5	A x B5
Seabed	None	1	0	**0**	0	**0**		0	**0**	0	**0**
Lower water column	None	1	0	**0**	0	**0**		0	**0**	0	**0**
Upper water coloumn	Low	2	1	**2**	-2	**-4**		0	**0**	0	**0**
Water suface	Med	3	1	**3**	3	**9**		2	**6**	0	**0**
Air	Med	3	1	**3**	2	**6**		-2	**-6**	0	**0**
Shorelines		3	1	**3**	3	**9**		2	**6**	1	**3**
Saltmarsh	*High*	*4*	*1*		*3*			*2*		*1*	
Estuarine mudflats	*High*	*4*	*1*		*3*			*2*		*1*	
Sandy beaches	*Low*	*2*	*1*		*3*			*2*		*2*	
High value resources	Low	2	0	**0**	1	**2**		0	**0**	1	**2**
Socio-economic		4	1	**4**	2	**8**		1	**4**	3	**12**
Boat harbour	*Med*	*3*	*1*		*2*			*1*		*2*	
Water recreation	*High*	*4*	*1*		*2*			*1*		*3*	
Cultural	None	1	0	**0**	2	**2**		1	**1**	1	**1**
				15		32			11		18
				3rd		**1st**			**4th**		**2nd**

v. Total impact mitigation score and ranking

The SIMA process identifies the response option(s) that will best mitigate the overall impacts of an oil spill.

The preceding figure is an overview of Predict Outcomes (i to iii) and Balance Trade-offs (iv to v) stages used to generate a SIMA comparative matrix, in this case for an offshore surface release of crude oil; hence subsea dispersant is not a feasible response option. A ranking of response options' mitigation potential is the key output from the matrix, forming a fundamental piece of response strategy development.

The methodology was tested at a half-day workshop held in Tampa, Florida during November 2016. The 20 participants at this workshop included representatives from USA resource trustees, agencies and the oil industry. The outcome of the test was broad acceptance that the method was useful and aligned to current NEBA practice. Minor modifications were made to the process in the light of comments received. Similar efforts are planned to obtain feedback on the method from relevant international stakeholders to better ensure global acceptance, prior to publication of the *Guidance on Implementing Spill Impact Mitigation Assessment*, scheduled for later in 2017.

Part 6 – Marine and Shoreline Ecology, Impacts, Assessment and Clean-up by Rob Cox

This article continues the story of the IPIECA-IOGP Oil Spill Response JIP, which this week looks at several interrelated Good Practice Guides (GPGs) on marine and shoreline ecology, impacts, assessment and clean-up produced as part of the Oil Spill Response JIP.

The marine environment is a dynamic and diverse network of habitats and species, interwoven by complex physical and ecological processes that interact with humans and their activities at many levels. To devise fit-for-purpose response strategies which are prioritised to ameliorate damage, it is essential to first understand the impacts that oil spills can potentially have on the resources and functions of the marine environment and how quickly they can recover. *Impacts of oil spills on marine ecology,* which was written for the JIP by Jon Moore, is aimed at operators, governments, businesses and the public, first describes the physical processes that spilled oils go through that are relevant to marine ecological impacts, followed by a section describing the mechanisms and factors that typically affect the impacts of oil spills on marine resources and their rates of recovery. The third section describes some of the more common impacts of oil spills on life forms associated with different ecosystems, and includes references to relevant case studies. The final two sections consider current good practice in spill response and how it is designed to minimize further environmental damage, then summarizes some of the fundamental approaches and requirements of a damage assessment, and the follow-up monitoring necessary to describe recovery. The document is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Impacts_on_marine_ecology_2016.pdf

Similarly, the companion GPG, also written by Jon Moore, *Impacts of oil spills on shorelines* provides an overview of how oil spills can impact shoreline resources covering the habitats and species characteristic of the intertidal zone of marine and estuarine shores. The first section, entitled *oil on shorelines: fate, persistence and natural removal*, describes the fate of oil on different shorelines and the characteristics that are relevant to impacts and recovery. Emphasis is placed on those characteristics and processes that affect oil persistence, as they are most likely to influence long-term effects. The section on Ecological impacts of oil on shorelines provides a general description of the susceptibility of different shoreline organisms to oil, and habitat-specific descriptions of typical impacts, resilience, expected recovery rates and the main factors that determine them. *Shoreline treatment and restoration* considers current good practice for shoreline clean-up; the potential advantages and disadvantages of the main treatment options are discussed, together with examples of past restoration projects. A*ssessment and monitoring of oiled shorelines* summarizes some of the fundamental approaches and requirements of impact assessment. The document is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Impacts_on_shorelines_2016.pdf

Oiled shoreline assessment surveys—also known as Shoreline Clean-up Assessment Technique (SCAT) surveys—are a critical component of a response operation. The information gathered by the survey teams is used by the response managers to set objectives, priorities, constraints and end points, all of which are essential in supporting the planning, decision making and implementation of an effective shoreline response programme. *A guide to oiled shoreline assessment (SCAT) surveys*, written by Ed Owens and Helen Dubach explains why an oiled shoreline assessment programme is an important element of a response, and outlines the benefits of systematic surveys. In addition, the guide explains why and how an effective shoreline assessment programme supports the planning, decision making and implementation process for a shoreline response, and how the key components of shoreline surveys are integrated into the data generation, decision making, and implementation and closure stages of a shoreline response programme. The key elements of the survey process are also outlined with respect to the types of information that are collected and the purpose for which they are used by decision makers. The way data is collected is described, and a checklist is provided as a guide to the specific field and management activities within an oiled shoreline assessment programme. The guide explains the important concept of shoreline segments and segmentation as a method for conducting systematic surveys and managing the data and information that is generated. Examples of the types of recommendations, maps and tables that are produced as part of the data management process illustrate how the field data are used in a shoreline response programme. The document is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/SCAT_2016.pdf

Shoreline clean-up is the most visible element of spill response, and is inevitably a focus for media attention. The shoreline is usually accessible by the media and special interest groups, and with the availability of a wide range of communication channels, disquiet in the local community can quickly spread to a much wider audience with unpredictable repercussions. Decisions such as which clean-up techniques are best suited to which shoreline type, what equipment can be used, the numbers of personnel that should be deployed and the criteria for terminating operations are all finely balanced and need judgement and experience to execute successfully. *A guide to oiled shoreline clean-up techniques,* written by Hugh Parker, is divided into four sections. The first section sets out ten important factors to be considered when contemplating the clean-up of an oiled shoreline, followed by a discussion of the steps to be taken in managing shoreline clean-up operations. The third section describes some of the most frequently used clean-up techniques, and sets out the advantages and limitations of each one, as well as the stages in the overall operation when a particular technique is likely to be most useful. The final section examines the interaction between stranded oil and different shoreline types, and suggests some possible approaches to addressing the challenges that this interaction can present. Two appendices provide examples of a volunteer registration form and daily worksite sheet, respectively. The document is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Shoreline_clean-up_2016.pdf

There are two related documents – a GPG and a document in the JIP "technical series" which may also be of interest to the reader. *Oil spill waste minimization and management* written by David Ord aims to introduce the reader to the principles involved in considering each of the aspects of oil spill waste management highlighted above. These principles are relevant to both offshore and inland spills worldwide, and affect upstream and downstream operations from oil exploration and production, through processing, refining, transport and storage activities. This GPG is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2017/01/Waste_Minimization_and_Management_2016.pdf

Finally, the JIP technical document *Volunteer management* focuses specifically on good practices that relate to volunteer engagement, coordination and management, presenting case studies from the *Rena* oil spill off the coast of Tauranga in New Zealand, written and edited by Bruce Fraser and Pim de Monchy respectively and the *Cosco Busan* oil spill in San Francisco Bay written by Mike Ziccardi. The *Volunteer Management* case study document is available at:

http://www.oilspillresponseproject.org/wp-content/uploads/2016/02/JIP-15-Volunteer-Management.pdf

Part 7 – Surveillance, Modelling and Visualization by Rob Cox

This article continues the story of the IPIECA-IOGP Oil Spill Response JIP, which this week looks at the topic of Surveillance, Modelling, and Visualization (SMV). We also conclude this series with a summary of the ongoing work for 2017 in the IPIECA Oil Spill Working Group.

Surveillance and Modelling

To respond to an oil spill effectively, those involved in the response operations require accurate and timely information on the location, the quantity and characteristics of the oil spilled and the characteristics of the areas likely to be impacted by the spilled oil. This information enables the incident command to effectively determine the scale and nature of the oil spill scenario, make decisions on where and how to respond, control various response operations and, over time, confirm whether the response is effective. Surveillance is key to providing this 'situational awareness' during an oil spill response operation. It is supported by a range of different technologies and techniques, from traditional and well-tested observation from vessels and aircraft to the use of innovative, small-scale unmanned aerial vehicles (UAVs) and video equipped subsurface remotely operated or autonomous underwater vehicles (ROVs and AUVs).

The JIP has produced the following research reports and Good Practice Guidance:

- In–Water Surveillance of Oil Spills GPG (Colin Grant)
- Satellite Remote Sensing of Oil Spills GPG (Jo Wilkin)
- Aerial Observation GPG (CEDRE)
- Three research reports on Airborne/Satellite sensing and their response times (Polar Imaging)
- The Capabilities and Uses of Waterborne Surveillance ROVs for Subsea use (Oceaneering)
- Sensor-Equipped Ocean Vehicles for Subsea and Surface spill Detection / Tracking (Battelle)
- Two research reports on Modelling: Metocean Databases and their validation (Actimar)

The SMV work can be found on the JIP website at:

http://www.oilspillresponseproject.org/response/surveillance-and-modeling/

When devising the work program, the OSR-JIP worked closely with the IOGP Metocean and Geomatics committees as well as OSRL, CEDRE, and other research organizations.

Visualization

The OSR-JIP work on Visualization was prompted by the findings of the U.S. Coast Guard Incident Specific Preparedness Review (ISPR) following the Macondo incident.

Reference should be made to https://www.uscg.mil/foia/docs/dwh/bpdwh.pdf Section I.9 (Common Operating Picture) particularly the finding that "*Barriers to synchronized, total domain awareness during the Deepwater Horizon incident included the [Lack of availability of appropriate interoperable communications technology] and the [Limited ability to push real-time data, both vertically and laterally, throughout the response organization]*" along with the recommendation that "*The Coast Guard should work to resolve compatibility problems between software programs and information technology systems that are used by the public and private sectors during oil spill response operations. The Coast Guard should require developers of these tools to ensure that their products are compatible*".

In a sense, the situation is analogous to the technology in the early days of mobile phone communications – were it not for the development of internationally agreed standards for GSM and SMS messaging, cellular communication and text messaging as we know it today would not have been possible. The JIP worked with the Open Geospatial Consortium (OGC) and Resource Data International (RDI) to develop a "Recommended practice for Common Operating Picture architecture for oil spill response" available here. Several US agencies including NOAA contributed to the study. More work is urgently needed on this aspect of SMV and the ongoing IPIECA Oil Spill Working Group (OSWG) program has this as a priority for 2017.

As the OSR-JIP closes, the IPIECA OSWG will carry on the work of the JIP in certain areas mentioned in these seven short articles, in particular:

- Continuing to work on Wildlife issues, extending the current GPG with a document "*Key principles for the protection and care of animals in oiled wildlife response*"
- Reviewing and confirming responder priorities in two Surveillance, Modelling and Visualization workshops in Europe and Asia Pacific to build on work done in the U.S.
- Maintaining industry ability to use dispersants as a prime response option through development of a set of maintenance, testing and storage Protocols for dispersants
- Hold workshops in Europe and Asia Pacific to test and confirm SIMA (formerly NEBA) good practice, again building on work presented in the U.S.
- Defining, developing and beginning implementation of a "Confident Ambassador" programme to provide training and support for those of us involved in communicating the principles of Oil Spill Response.

Acknowledgements

Altogether, the Oil Spill Response JIP took five years, cost nearly eight million dollars, employed over seventy consultants and contractors, made use of nearly two hundred and fifty industry reviewers, and carried out one hundred and forty visits, workshops & seminars.

At the close of this short series I would like to take the opportunity to thank the nineteen companies and their staff that made the initiative possible: BP, BG-Group, DEA, Cairn, Chevron, ConocoPhillips, Engie, Eni, ExxonMobil, Hess, Marathon Oil, Nexen, Petrobras, Repsol, Shell, Statoil, Total, Wintershall, and INPEX, as well as the unfailing support of Robert Limb and his team at OSRL, the Chairs and Vice Chairs of the OSR-JIP over the five years: Jon Lay, Greg DeMarco, Craig Buckingham, Richard Santner, Jeff Patry, Laurent Routisseau, Paolo Linzi, Brian Horsburgh, and the other contributors too numerous to mention.

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The OSR-JIP website can be accessed at: www.oilspillresponseproject.org

The preceding figure is an overview of Predict Outcomes (i to iii) and Balance Trade-offs (iv to v) stages used to generate a SIMA comparative matrix, in this case for an offshore surface release of crude oil; hence subsea dispersant is not a feasible response option. A ranking of response options' mitigation potential is the key output from the matrix, forming a fundamental piece of response strategy development.

The methodology was tested at a half-day workshop held in Tampa, Florida during November 2016. The 20 participants at this workshop included representatives from USA resource trustees, agencies and the oil industry. The outcome of the test was broad acceptance that the method was useful and aligned to current NEBA practice. Minor modifications were made to the process in the light of comments received. Similar efforts are planned to obtain feedback on the method from relevant international stakeholders to better ensure global acceptance, prior to publication of the *Guidance on Implementing Spill Impact Mitigation Assessment*, scheduled for later in 2017.