Benchmark and Legal Framework Study on Oil Spill Prompt Response and Contingency Resources for Oil & Gas Offshore Structures: A Global Cooperation

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ABSTRACT

A well-developed legal and regulatory framework on contingency planning and response arrangements with establishment of clear responsibilities and coordination between government and industry is one of the success keys for an effective oil spill preparedness and response strategy. Furthermore, international co-operation and mutual assistance in preparing for and responding to major oil pollution incidents have become critical in order to reduce potential impacts to the environment and populations.

National policies on oil spill coordination and response vary from nation to nation. Governments are encouraged to ratify the International Convention on Oil Pollution Preparedness, Response and Co-operation of 1990 (OPRC 90) and develop laws and procedures for preparing for and responding to oil spills. This is often accomplished through

the preparation of a national contingency plan under the auspices of an agreed national regulatory authority (IPIECA, 2000).

Following recent oil spills, such as the 2010 *Deepwater Horizon* within the Gulf of Mexico, interest on oil spill legislation has risen among stakeholders, as regional and national policies in some regions of the globe became stricter, notably on the need of available contingency resources, as well as transboundary and coordinated response (as required, for example, by the recent Europewide Safety of Offshore Oil and Gas Operations). In this context, a benchmark and legal framework study on oil spill prompt response and contingency resources for Oil & Gas offshore infrastructures was performed, focusing on six relevant Oil & Gas production areas: United States, Canada, North Sea, India, Southeast Asia, Australia and New Zealand. The continuous process of information gathering, review and consolidation throughout the analysis comprehended an establishment of a cooperation network of Oil & Gas consultant experts from these different areas of interest, including communication with local regulatory agencies in cases of uncertainties.

The intent of this paper is to present the benchmarking and comparison of the legal requirements and regulatory framework on the availability of oil spill prompt response and contingency resources of these six areas of interest, as well as discuss potential legal weaknesses and opportunities for improvements on their regional and national contingency system.

INTRODUCTION

On June 3, 1979 while Mexico's government-owned oil company Pemex drilled exploratory well Ixtoc (ISH-tok) in the southwestern Gulf of Mexico, circulation of drilling mud failed. This caused a blowout, explosion and a fire, resulting in one of the largest offshore oil spills in history and the world's first massive offshore oil spill in a tropical environment.

The well liberated an estimated amount of **140 million** gallons of oil for nearly nine months in the most vulnerable coastal ecosystems in the southwestern Gulf of Mexico (Soto, Botello, Licea-Durán, Lizárraga-Partida, & Yáñez-Arancibia, 2014).

On the night of March 24, 1989, the Exxon Valdez tanker ran into the submerged rocks of Bligh Reef, causing the rupture of its oil compartments and releasing the approximate amount of **11 million** gallons of crude oil into the Prince William Sound in the Gulf of Alaska. At the time, it was the largest tanker spill in the United States and to the public, one of the major environmental disasters in the American history (Carson, et al., 2003). In the Galician coast (northwestern Spain), another major tanker oil spill occurred on November 13, 2002: the *Prestige* oil tanker leaked 60,000 tons of heavy fuel oil, polluting 500 miles of the Spanish coast and reaching the French coast (Alonso-Gutiérrez, et al., 2009).

Only 31 years after the Ixtoc spill, in April 20, 2010, the *Deepwater Horizon* semi-submersible offshore oil rig working on a Macondo exploration well exploded in the Gulf of Mexico. The largest oil spill disaster in the history of the petroleum industry in the United States resulted in the death of 11 workers and the discharge of **210 million** gallons of oil into the Gulf, fouling beaches and coastal environments from Louisiana to Florida in the United States. Furthermore, it contaminated and killed wildlife, such as marine mammals, birds and fishes, and severely disrupted the Gulf's fishing and tourism industries, as well as caused several other numerous social, environmental and economic impacts (Amadeo, 2019).

These are only some examples of large oil spills with disastrous impacts, whose long-term environmental consequences are still being assessed by the scientific community. But what have we all learned from these disasters? Interest is increasing amongst the petroleum industry to dedicate efforts to implement procedures to prevent oil spills from happening, as well as improve the efficiency of cleanup operations in case an accident occurs (IPIECA; IOGP, 2019).

Furthermore, it became well-known that a developed legal and regulatory framework on contingency planning and response arrangements with establishment of clear responsibilities and coordination between government and industry is one of the success keys for an effective oil spill preparedness and response strategy. Beyond that, international co-operation and mutual assistance in preparing for and responding to major oil pollution incidents have become critical in order to reduce potential impacts to the environment and populations.

As a result of that, following these recent oil spills, interest in oil spill legislation has risen among stakeholders, as regional and national policies in some regions of the globe became stricter, notably on the need of available contingency resources, as well as transboundary and coordinated response. One example is the recent Europewide Safety of Offshore Oil and Gas Operations Directive (2013/30/EU), which introduced new safety requirements for both the offshore industry and European regulators and issued a set of stronger regulations to prevent and mitigate the consequences of incidents on offshore platforms in European waters (Zhovtyak, Besozzi, Tarantola, & Contini, 2018).

In this context, a benchmark and legal framework study on oil spill prompt response and contingency resources for Oil & Gas offshore infrastructures was performed, focusing on six relevant Oil & Gas production areas: the United States of America, Canada, the North Sea, India, Southeast Asia, as well as Australia and New Zealand.

The intent of this paper is to present the results of this work, focusing on the legal requirements and regulatory framework of these six areas of interest, as well as discuss potential legal weaknesses and opportunities for improvements on their regional and national contingency system.

ESTABLISHMENT OF AN OIL & GAS COOPERATION NETWORK

The vast scope of work comprehended the benchmark and legal framework study on oil spill prompt response and contingency resources. It motivated the establishment of a

cooperation network of Oil & Gas consultant experts from the five areas of interest, who worked actively in a continuous process of information gathering, review and consolidation. In case of uncertainties, the experts contacted local regulatory agencies (**Figure 1**).

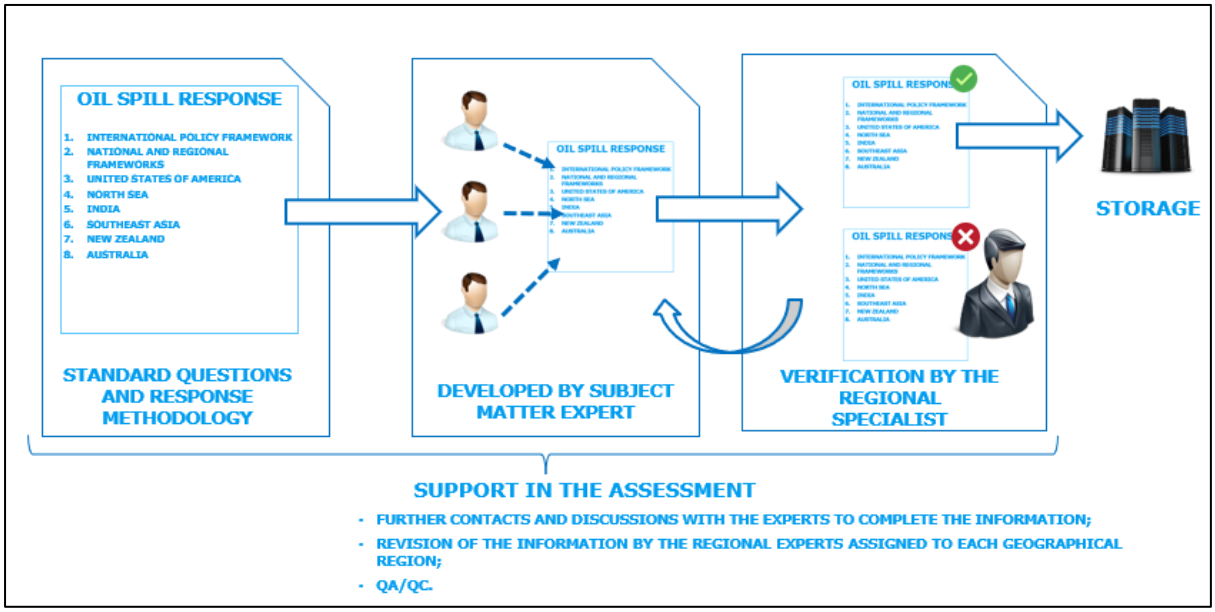

Figure 1 - Establishment of a cooperation network of Oil & Gas experts for the study development.

In order to maximize the process of information complement and gathering, as well as integration between the different teams, technical webinars were conducted, leading to around 60 attendees.

INTERNATIONAL POLICY FRAMEWORK

In terms of oil pollution, preparedness and response, **The International Convention on Oil Pollution Preparedness, Response and Co-operation 1990 (OPRC 90)** is the current most relevant international instrument, which provides a framework designed to facilitate international co-operation and mutual assistance in preparing for and responding to major oil pollution incidents (International Marimite Organization (IMO), 2018). It requires ratifying states to plan and prepare for oil spills by developing national systems for pollution response and by maintaining adequate capacity and resources to address oil pollution emergencies. The Convention also set industry standards, requiring operators under jurisdiction of member states to draft oil pollution emergency plans and coordinate with national systems for responding

timely and effectively to spill events. The OPRC 90 was drafted within the framework of the International Maritime Organization (IMO) in 1990 and entered into force in 1995.

Recognizing the need for increased resources and coordination to facilitate effective response to large marine oil spills, and consistent with the principles of the OPRC 90, industry stablished and funded a network of Tier 3 Centers. These strategically-located oil spill response centers are locations for equipment, expertise, and other resources to be used in coordinated response efforts either regionally or globally (IPIECA; ITOPF, 1999). The resources of each center may be used by member companies and by third parties, such as governments and operators.

After the Macondo incident in Gulf of Mexico in 2010, it became clear that well intervention equipment (i.e., source control) has become an important tool for the industry to demonstrate its ability to contain an incident concerning blowout of subsea wells, which has led to the development of additional global source control equipment, such as subsea capping, containment and dispersant equipment. **Figure 2** presents the location of available capping stacks in 2018 (IPIECA; IOGP, 2019).

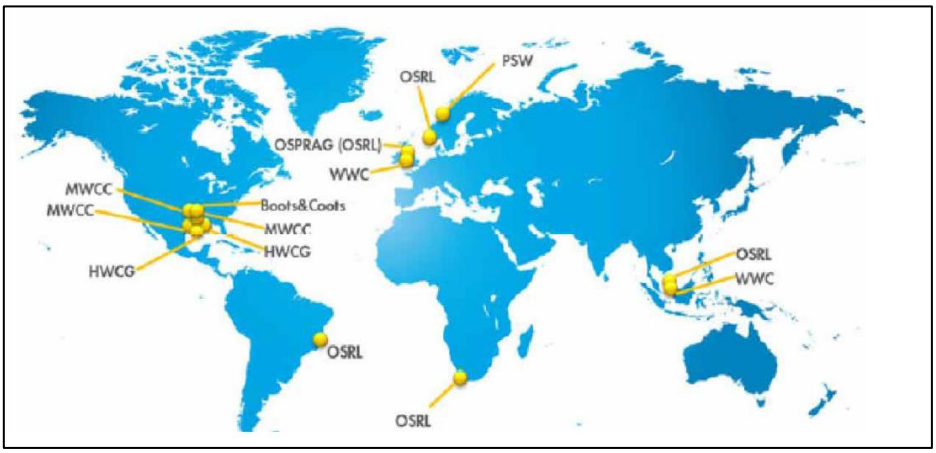

Figure 2 - A snapshot of commercially available capping stacks as at 2018 **(IPIECA; IOGP, 2019)**.

NATIONAL AND REGIONAL POLICY FRAMEWORK

National policies on oil spill coordination and response vary from nation to nation. Governments are encouraged to ratify the OPRC 90 and develop laws and procedures for

preparing for and responding to oil spills. This is often accomplished through the preparation of a national contingency plan under the auspices of an agreed national regulatory authority (IPIECA, 2000). National contingency planning varies from country to country but generally provides the framework for intra-governmental, as well as government-industry coordination that is essential during response to spill events. The following sections provide additional discussion on the legal and regulatory frameworks of the six areas of interest included in the study.

United States of America

Industry standards and spill response arrangements within the US are governed by a combination of the **Oil Pollution Act of 1990 (OPA),** the **Clean Water Act (CWA),** and the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)** in conjunction with the **United States National Response Framework (NRF)**.

Where OPA sets standards for liability and some industry standards during spill events, the Federal **Clean Water Act (CWA)** puts forth requirements for spill prevention, putting certain restrictions on the owners to prevent oil discharges. Under the CWA, owners or operators of offshore facilities prepare and submit Oil Spill Response Plans (OSRPs) or Facility Response Plans (FRPs) to the Bureau of Safety and Environmental Enforcement (BSEE). An OSRP is a planning document prepared and used by industry owners and operators to respond to a worst-case discharge from their offshore facilities, including numerous details, such as the inventory of available resources and precontracted resources sufficient to deal with the worst-case spill scenario (United States Environmental Protection Agency, 2018).

The NCP and NRF together govern the coordination of local, state, and national government response efforts during an oil spill event. Specifically, the NCP defines the US federal government’s responsibilities in responding to a major spill event, including the providing for the first spill reporting framework, setting national priorities during a response,

and establishing the National Response Center and National and Regional Response Teams (NRT and RRTs, respectively). The NRT comprises members of fifteen federal agencies with the Environmental Protection Agency (EPA) and the United States Coast Guard (USCG) serving as chairman and vice-chairman, respectively. Thirteen RRTs have been established for each of the ten federal regions, Alaska, the Caribbean, and the Pacific Basin. NRTs prepare for and practice response efforts at a national level, where RRTs plan, prepare for, and practice response efforts at a regional level. Furthermore, in the event of an oil spill, the Area Contingency Plan (ACP) is also put into motion, which contains details for the use of all agencies engaged in responding to environmental emergencies within a defined geographical area.

The NRF uses the National Incident Management System (NIMS) to provide a consistent nationwide framework (the Incident Command System [ICS]) and approach to coordinate government at all levels (Federal, State, tribal, and local), the private sector, and nongovernmental organizations (NGOs) to prepare for, prevent, respond to, and recover from all emergency response scenarios, regardless of the incident's cause, size, location, or complexity. NIMS is a system of organization and coordination that provides for coordination of preparation, communication, authority, and resource management across sectors and can be applied regardless of size or jurisdiction of a spill incident.

In the US system, the response to a spill is determined by the severity of the incident. However, spill response always begins locally, with the cooperation of local government, industry, and industry contractors, and expands to regional and then national involvement, depending on the size, complexity, or location of the incident. The government agency or entity leading the response is determined by one or more of these factors.

There are several federal agencies that maintain resources and prepare for response events. The US Environmental Protection Agency (EPA), the US National Oceanographic and

Atmospheric Administration (NOAA), and the US Department of the Interior (DOI), the US Federal Emergency Management Agency (FEMA) and the US Coast Guard (USCG) all regularly respond to oil spills and maintain resources to deploy during major events. Response is always cooperatively executed with state environmental agencies, some of which maintain additional resources and expertise for oil spill cleanup, and occasionally local government and industry responders. On-scene response is dictated by NIMS and by the location, severity, and complexity of the spill scenario.

For example, for a marine spill the USCG will designate the Federal On-Scene Coordinator (FOSC), who is responsible for coordinating the levels of response, while the US EPA will designate the FOSC for spills in inland areas (United States Environmental Protection Agency, 2018). For a less severe response in US coastal waters, a unified command comprising a designated (FOSC), State On-Scene Coordinator (SOSC), and the entity responsible for the spill or its representative (Responsible Party or RP) may be established. For a national or more severe oil spill, a National Incident Task Force may be established and commanded by a National Incident Commander designated from the USCG, which will operate with advice from various other organizations through a Multi-Agency Local Response Team, including Scientific Support Coordinator from NOAA and personnel from DOI and the USACE.

Canada

As per the section 161 of the **Atlantic Accord Implementation Act**, oil spill response at an offshore platform within Canadian Waters falls under the jurisdiction of Canada-Newfoundland and Labrador Offshore Petroleum Board (C-NLOPB) (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2014). Thus, C-NLOPB has a Memorandum of Understanding (MOU) with several federal and provincial ministries that may be involved in the response to an offshore oil spill, such as: Canadian Coast Guard, Environment Canada,

Transport Canada, Department of Fisheries and Oceans, provincial government departments, among others.

The main Canadian regulations that specify the oil spill response and preparedness requirements are the Newfoundland Offshore Petroleum Drilling Regulations (C-NAAIA, 1987), Guidelines Respecting Drilling Programs and Safety Planning Guidelines. According to these regulations, all operators have the obligation to develop oil spill response plans to support offshore activities, which must be consistent with the guidelines presented by C-NLOPB for oil spill contingency planning (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2014). The common plan includes comprehensive review of personnel, equipment and vessel resources available to the operator to use in an oil spill response and appropriate to the risk posed by the operator's planned offshore activities and estimated prior to commence of the offshore operation. All offshores facilities operating offshore Canada must have resources to respond to Tier 1 oil spills. In case of Tier 2 or 3 offshore oil spills, operators may use response equipment available from the Norwegian Standard System, ECRC (private management company owned by major Canadian oil companies that provides marine oil spill response services when requested), Canadian Coast Guard or other international response organization though the Global Response Network. Furthermore, all operators have entered into a formal Mutual Emergency Assistance Agreement that establishes that, in the event of an emergency, such as an oil spill, certain types of assistance can be provided to each other, i.e. supplying vessel, surveillance aircraft, among others (Canada-Newfoundland and Labrador Offshore Petroleum Board, 2014).

North Sea

Industry standards, liability, and clean up activity is regulated by European Union (EU) Law. In terms of oil spill response and preparedness, the most relevant is the (EU) Directive on Safety of Offshore Oil and Gas Operations (2013/30/EU), which was published in the

Official Journal of the European Union on June 2013 as a direct response to the 2010 Macondo incident in the Gulf of Mexico. Member states were responsible for adopting the Directive into national legislation within two years (by 19 July 2015).

This directive establishes minimum requirements for preventing major accidents (including oil spills) in offshore and oil and gas operations and limiting the consequences of such accidents. In summary, the Directive establishes requirements for operator/owner licensing and response. According to Directive 2013/30/EU, well operator, non-production installation, or mobile offshore drilling units (MODU) operator must have the financial capability to respond and clean up in case of an oil spill. Assessment of the operator financial capability is performed during an extensive operator licensing process which is completed prior to the start of operations. Directive 2013/30/EU also requires operators/owners of offshore platforms and Member States to develop and maintain Internal Emergency Response Plans and External Emergency Response Plans to improve of cooperation between member states and operators during an oil spill event. Through the creation of Internal Plans, operators and owners seek to limit the consequences of a major accident at and near operation sites. One of the primary requirements of the Internal Emergency Response Plan is an analysis of the effectiveness of the oil spill response strategy (i.e. the proportion of time that oil spill can be effectively responded to).

Through External Emergency Response Plans, EU Member States draft site-specific policies to prevent and minimize the consequences of a major spill event (Nijkamp, Sessions, Kelway, Bunia-Corbetta, & Priebe, 2015). The External Emergency Response Plans shall be made available to the Commission, other Member States, and the public for review.

In responding to a major spill event, cooperation between Member States during and planning for a spill event is of the utmost importance. The EU has developed measures to

prioritize compatibility and interoperability of emergency response equipment, resources, and expertise between Member States' response organizations during an event.

In general, there are three levels of cooperation and agreements within the EU that help facilitate meeting these goals (European Maritime Safety Agency (EMSA), 2018):

- Multi-lateral agreements (sub-regional level): agreements between neighboring Member States, such as **NORBRITPLAN**, and others;
- Regional Agreements (regional level): agreements between Member States adjoining the same sea area, such as the **Bonn Agreement**; and
- European Maritime Safety Agency (EMSA) (Pan-European level): agreements between all European Union Member States and European Neighborhood Policy (ENP) Countries (European Maritime Safety Agency (EMSA), 2018).

India

The Indian Coast Guard is the designated national authority for oil spill response in Indian waters under the National Oil Spill-Disaster Contingency Plan (NOS-DCP) approved in 1993 and last updated in 2015. The Maritime Zones of India Act 1976 enables the Government to take measures for protection of the marine environment. The Coast Guard Act 1978 states that the preservation and protection of marine environment and control of marine pollution is the function of the Indian Coast Guard. The ICG has been accordingly nominated in 1986 as the Central Coordinating Authority for oil-spill response in the Maritime Zones of India and Coast Guard officers have been empowered under the Merchant Shipping Act 1958, for taking necessary actions against polluters (Ministry of Defense, Government of India, 2015).

There are three response centers: in Mumbai, Chennai and Port Blair, each with qualified personnel and a well-stocked inventory of response equipment. Limited capabilities exist with the Coast Guard at Kochi and Vadinar on the west coast (Ministry of Defense, Government of India, 2015).

The NOS-DCP hierarchy, consists of: National Oil Spill Disaster Contingency plan; Regional Oil Spill Disaster Contingency Plans; District Oil Spill Disaster Contingency Plans; State and Union Territory plans, and Port, and industry plans.

Responsibilities for responding to oil spills in Indian waters are shared between the Indian Coast Guard, State Governments, Port Authorities and Corporations, and the oil industry. Liability for clean-up of oil spills remains with the polluter. Occupiers of offshore oil installations are to maintain an oil spill contingency plan meeting specified requirements and maintain appropriate manpower, equipment and resources for oil spill response taking into consideration any guidelines and suggestions that may be issued by the Government of India/ Coast Guard from time to time. Offshore oil installations must provide response equipment, material, trained personnel, and ships when required by the Coast Guard on as available basis and without affecting safety of operations.

Furthermore, oil industry is required to immediately combat oil pollution around its installations up to 500 meters and continue to provide equipment, material, trained manpower, sampling efforts, and vessels as may be required by OSC when such oil spill spreads beyond 500 meters.

Hence, Oil handling facilities and offshore installations would be expected to handle Tier 1 incidents and respond to spills in their designated area. However, the Coast Guard would take over the operation if the spill were beyond the capability of the facility concerned or where the response capability has not been developed. Outside of oil handling facilities and offshore installations, all spills are handled by the Coast Guard. The Coast Guard would coordinate with various resource agencies during a response. The regions have individual contingency plans to deal with spills in their area.

Southeast Asia

Within the region of Southeast Asia, the member of the Association of Southeast Asian Nations (ASEAN) (Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam) identified the need for the development of regional oil spill preparedness and response capabilities in the area as far back as the early 1990s. In this way, the ASEAN OSRAP (Oil Spill Response Action Plan) was born with assistance from the Japanese. In 2009, a Memorandum of Understanding (MOU) was revised and was signed by the ten ASEAN Ministers in November 2014 in Mandalay, Myanmar (Guevarra, 2015).

An integral commitment of the ASEAN member countries in the MOU was the development of a Regional Oil Spill Contingency Plan (ROSCP). The ROSCP was formally adopted by the ASEAN Maritime Transport Working Group in the end of 2018.

There are also a number of sub-regional and bi-lateral agreements in place between the ASEAN member countries, some of which have been in place for a number of years, but rarely updated, and their status many times remain unclear.

New Zealand

The Maritime New Zealand (MNZ) has responsibility for all forms of marine emergency including oil pollution. The Maritime Transport Act 1994 (MTA) places a requirement on MNZ to produce a National Oil Spill Contingency Plan (NOSCP) and develop a Marine Oil Spill Response Strategy that sets out national policy (Maritime New Zealand, 2017).

The NCP describes the national marine response organization and procedures, and provides information on response resources, clean-up techniques, and administrative and operational procedures. The Plan is updated every six months and officially reviewed every three years. MNZ produces special area contingency plans where necessary. These are

developed where an area is of such environmental significance, or has such complex response issues, that it is deemed necessary to address contingency planning as a discrete entity.

New Zealand has adopted a 3-tier approach to marine oil spill preparedness and response. Industry (offshore, oil transfer sites and shipping) is required to plan for their own risk and respond to their own spills (Tier 1). Regional councils (Tier 2) respond to spills beyond the capability of industry within New Zealand's Territorial Sea (22km). MNZ, executed through its Marine Pollution Response Service (MPRS), responds to all spills within the Territorial Sea and EEZ which are beyond the capability of industry and regional councils (Tier 3), including the offshore sub-Antarctic and Kermadec islands.

MNZ maintains a response capability of sufficient size to counter an oil spill of 3,500 tones. If the scale of an incident is beyond the nation's capability, arrangements are in place to secure overseas assistance. Maritime NZ has also developed contracts with external parties for the provision of specialized services such as oiled wildlife response, waste management, trajectory modelling, and aerial capability.

Australia

The Australian Maritime Safety Authority (AMSA), a federal government self-funded maritime safety agency established in 1990, is responsible for providing a national response capability for marine pollution. AMSA administers the "National Plan for Maritime Environmental Emergencies" (Australian Government - Australian Maritime Safety Authority, 2017).

The National Plan gives effect to a number of international conventions and agreements to which Australia is a party. The National Plan utilizes a range of domestic legislation that provides government agencies with response powers and places preparedness and response obligations on various industry sectors. Recovery is a responsibility shared across industry,

maritime agencies, other government entities and the affected communities (Australian Government - Australian Maritime Safety Authority, 2017).

Australia has established a comprehensive regulatory regime for the offshore petroleum industry for environmental management and oil spill response. The regime places the onus on the polluter to manage marine pollution risks and requires that all petroleum activities have an Environment Plan (EP), including an Oil Pollution Emergency Plan (OPEP), accepted by the relevant regulator before that activity can start.

Under the Australian regulations, each titleholder has a duty to establish, maintain and implement marine pollution response capability, which may be in partnership with other parties. This response capability must be commensurate with the risks presented by the activity. Similar legislation and regulations exist for offshore petroleum activities in the different Australian states. Each state/Northern Territory establishes its own regulator and has specific oil spill response arrangements for offshore petroleum activities within its jurisdiction (Australian Government - Australian Maritime Safety Authority, 2017).

In terms of maintaining response equipment and resources, operators are responsible for undertaking prompt and effective action to ensure the safety of their facilities, including the engagement of commercial assets where necessary and available. For incidents that may require a response beyond individual company capabilities, the Australian Institute of Petroleum (AIP) through its Australian Marine Oil Spill Centre (AMOSC) subsidiary has established the AMOSPlan formalizing mutual aid arrangements among member companies. AMOSPlan additionally formalizes integration of industry resources into the National Plan, including AMOSC's Tier Three stockpile held at Geelong.

LEGAL FRAMEWORK COMPARISON, POTENTIAL WEAKNESSES AND OPPORTUNITIES FOR IMPROVEMENTS

This benchmark and legal framework study enabled the identification and comparison of the regulatory requirements regarding the availability of contingency resources for prompt emergency response in six major Oil & Gas Offshore production areas globally (United States, Canada, North Sea, India, Southeast Asia, Australia and New Zealand).

Error! Reference source not found. Figure 3 below presents the comparison of the regulatory framework within these regions of interest considering different topics related to the oil spill contingency and prompt response.

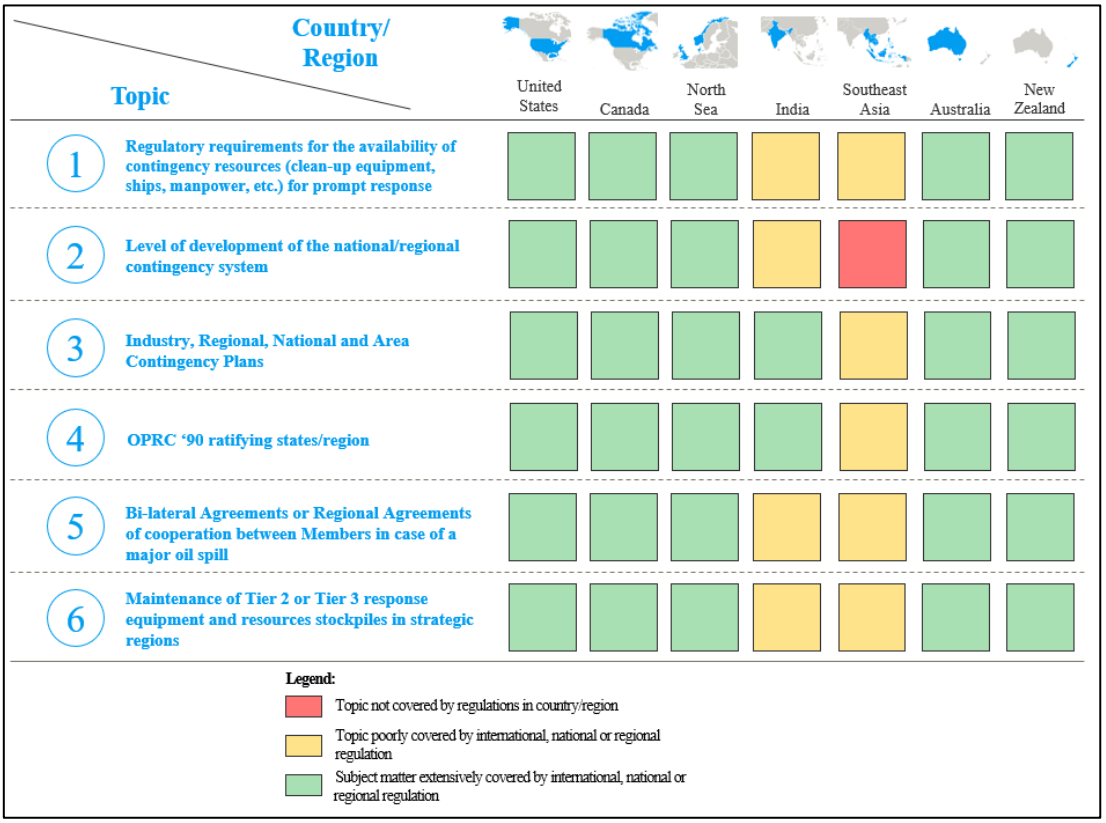

Figure 3 – Comparison of the regulatory framework of the six areas of interest.

Best practices in marine prompt oil spill planning and responding includes coordinating and sharing the existing response resources between the various agencies responsible for responding to major oil spills (i.e. local, national, oil spill cooperatives, industry and international centers). Furthermore, competent and trained personnel should work with a well-developed OSRP that has been adequately resourced and regularly exercised. In the case that an oil spill does happen, the response coordination should be led by National Incident

Management and Command Systems with clear responsibilities amongst the different stakeholders.

Based on the results of this benchmark and legal framework studyError! Reference source not found., it is possible to see that there are opportunities for improvement in sharing oil spill response resources, especially in Southeast Asia and India. In the case of the other assessed regions, it is noticed that there are well-developed oil spill response cooperatives operating in these regions/countries, such as Oil Spill Response Limited (OSRL), AMOSC and Western Canada Marine Response Corporation (WCMRC). However, it is of extreme importance to increase even more research and development to improve spill response, especially for spills of national significance, such as the Deepwater Horizon, as well as complex spills in remote and challenging areas, such as in the Arctic.

Even in the case of existence of well-developed local, national and regional contingency plans and efficient oil spill response systems, 'Orphan' oil spills still may happen, such as the recent Brazilian oil spill crisis, which demanded an unplanned response structure, and whose authorities weren´t able to identify its source and mitigate its impacts and consequences in an efficient and quick manner. This crisis highlighted the importance of having a clear oil spill response strategy included in the national legislation, in case of unknown responsible polluter. From the assessed regions, it was identified that the United States, Canada, North Sea and Australia all have clear response strategies in case of unknown oil source.

Another opportunity for improvement for all the assessed regions involves the assessment of potential environmental and human health impacts of emerging contaminants when using different oil spill clean-up technologies. Emerging contaminants are potentially toxic substances that are not commonly monitored in the environment but have the potential to enter the environment and cause known or suspected adverse ecological and/or human health effects (Rosenfeld & Feng, 2011). Examples are the Per- and Polyfluoroalkyl Substances

(PFASs). According to Kissa (2001), PFAs may be used in chemical barriers injected into the sea to contain and prevent oil from spreading. Furthermore, perlite or vermiculite treated with a cationic PFAS is claimed to be helpful in containing oil spills (Kissa, 2001), and liquid hydrocarbon fires may be extinguished using aqueous film foaming foam (AFFF) containing PFAS chemicals (United States Environmental Protection Agency, 2017).

CONCLUSIONS

This benchmark and legal framework study enabled the identification and comparison of the regulatory requirements regarding the availability of contingency resources for prompt emergency response in six major Oil & Gas Offshore production areas globally (United States, Canada, North Sea, India, Southeast Asia, Australia and New Zealand).

It was possible to conclude that many of the areas of interest, specially the United States, Canada, North Sea, Australia and New Zealand, has strong regulatory framework regarding oil spill contingency and response, with a well-developed national/regional contingency system. However, there are several opportunities for improvement, including:

- Better sharing of oil spill response resources and mutual assistance;
- Conducting more research and development to improve spill response, especially for spills of national significance, as well as complex spills in remote and challenging areas;
- Having clear oil spill response strategy in case of unknown responsible polluter to better address mystery or orphan oil spills (such as the Brazilian Disaster); and
- Assessing potential environmental and human health impacts of emerging contaminants (such as PFASs) before using different oil spill clean-up technologies.

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