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Brazilian regulation on oil spill: The need of review

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Abstract

The Brazilian oil spill response main regulation has been under a major review for the last couple of years. The origins of this regulation date back to the year 2000, when two accidents of great relevance happened: the Guanabara Bay and the Iguaçu River oil spills. These two accidents quickened the promulgation of the first version of this regulation, an adaptation of the USA framework for facilities transferring oil or hazardous material in bulk (33 CFR part 154). The major changes made during this adaptation to the Brazilian laws were: 01) The scope has been expanded to cover not only transferring coastal facilities, like ports and

oil terminals, but also oil rigs, offshore oil production units, pipelines and refineries. In a later revision other facilities were included: marinas, onshore oil rigs, shipyards and nautical clubs; 02) The response resources could only be provided by the owner of the facility, which has restrained the potential benefits of a shared capability approach like, for example, a specialized response company or association that could support several facilities in a region;

In practice, the application of the same ground rule for inland, coastal and offshore facilities resulted in several distortions, like a dominance of the mechanical removal technique over other response techniques. This also resulted in the application of response time requirements designed for oil terminals to offshore facilities, resulting in an oversized dedicated oil spill response fleet. In addition, this rule is inadequate to linear spill sources, like marine pipelines, and inland facilities, like refineries.

Finally, because of the aforementioned distortions and also some lack of technical guidance for relevant topics, like coastal protection, oil trajectory forecasting modelling, wildlife response planning, among others, several different interpretations of the national regulation have arrived from different levels of governmental agencies. This not only allowed for distinct requirements over time from a same agency but also created confusion when comparing the response capabilities of similar installations from different regions of Brazil.

Thus, the purpose of this article is to describe the improvements proposed by the Oil and Gas producers to review the Brazilian regulation. It aims at presenting the key elements and references used in the review process and the predicted response structure that could arise in order to improve Brazil's environmental safety after the new regulation is in force.

INTRODUCTION - REGULATORY FRAMEWORK BACKGROUND

On October 2019, at Campos Basin oil province, in an area with the same size as the North American Gulf of Mexico, there are 23 specialized support vessels equipped with oil

recovery systems and booms. Most of these vessels should be in a standby condition, near to the oilrigs and production units. There was also a tier 02 availability of around 900 m^3 of chemical dispersant, 1,300 m of situ burning booms and 06 kits to assemble recovery vessels at onshore stockpiles. At other oil provinces, like the Santos Basin, where the first discover of the pre salt reservoirs happened, the response capability is similar or even bigger.

The main reason for such numbers is due to the Brazilian national regulations, which demands that certain productive activities need an environmental permit issued by a governmental agency. The Brazilian federal act n° 9,966/2000 (Oil Pollution Act) establishes that some facilities, O&G included, should present to the environmental agency an "Individual Emergency Plan" (IEP), that contains the procedures and resources to respond to oil spills, in order to receive its environmental permit (Brasil, 2015).

The parliament enacted this act in April 2000 following the Guanabara Bay oil spill, where a ruptured pipeline spilled 1,300 tonnes of bunker fuel into the bay's waters, at Rio de Janeiro city (Short, 2003). This incident caused a significant widespread pollution damage to an environmentally sensitive area and stimulated a major reform of Brazil's pollution liability regime (Salivaras, 2014).

Hence, this regulation was based on international conventions such as MARPOL 73/78 - International Convention for the Prevention of Pollution from Ships – Annex A; CLC / 69 - International Convention on Civil Liability for Oil Pollution Damage; OPRC 90 - International Convention on Oil Pollution Preparedness, Response and Cooperation. Regarding oil spill response, this law establishes that:

- Every organized port, port facility and offshore oil and gas facility should have the facilities or proper means to respond to pollution events (article 5^{th});
- These resources sizing and selection should consider several facility's features like size, location and the type and amount of oil handled and transferred;

- These facilities should have an IEP to respond to oil spills in order to receive its environmental permit (article 7th);
- The environmental agency should integrate the IEP from several facilities working at a determinate area (article 8th) and with the National Contingency Plan;
- In case of need of complementation of its IEP due to failure or inefficiency, the owner of the facility or the ship responsible for the spill should pay a compensation to the government for the expenses for the response, in spite of any fine due (article 23th).

Coincidentally, only three months after the enactment of the federal law 9,966/2000, on July 16th, 2000, another major oil spill occurred in Brazil: an inland loss of containment in a refinery located at Araucaria city, in Parana state. A total of 4,000 m³ of a light crude oil spilled into the Barigüi River, affecting six kilometers before it reached the Iguaçu River, where the oil spread for another 60 kilometers (Falkiewicz,2003).

As a direct consequence, on September 14th 2000 the CONAMA (National Environmental Council) published the Resolution n° 269/2000. This resolution established the legal requirements to use chemical dispersants in open waters. In December of the next year, the CONAMA published the Resolution n° 293/2001 stablishing the ground rules to write oil spill response plans, the IEP.

This resolution was broadly based on the North American regulation of facilities transferring oil or hazardous material in bulk (33 CFR part 154), but expanded its scope to include organized ports, port facilities, pipelines and offshore O&G facilities. Some of the most important definitions of this regulation could be summarized as:

- The environmental agency could demand additional or specific requirements for installations located near sensitive areas. However, it did not provided any technical guidance on the meaning of sensitive areas or proximity;
- Although the IEP was originally designed to be risk analysis-based, in practice, it only adopted the volume of the worst-case scenario to size the volumetric recovery capacity of mechanical recovery and to model oil trajectory in order to identify vulnerable areas. Due to the more frequent discharges not being well represented, the response capability was often overestimated;
- Determination for the use of Environmental Sensitivity Index (ESI) to locate the sensitive biological and human resources;
- Indication that the response resources could be only directly owned by the facility or provided from a third party contractor, as long as it operates exclusively for the facility;
- The sizing criteria of resources for mechanical recovery is an adapted translation of the North American EDRC (Estimated Daily Recovery Capacity). The regulation also incorporated the time response requirements, the formulation and the volumes thresholds of the USA regulation;
- Provided some sizing criteria for chemical dispersion capability.

In 2003, the Federal Decree 4,871 provided the requirements and guidance for Oil Spill Area Plans (OSAP). Essentially, it established that environmental agencies from Federal and State government levels should coordinate the efforts to develop the OSAP for IEP concentration areas. Moreover, an interesting definition presented was that the OSAP should be entitled of dealing with some specific spill scenarios, like the ones with unknown sources and those caused by ships in specific locations of organized ports.

Eight years later, in 2008, the CONAMA updated the Resolution nº 293, replacing it by the Resolution nº 398/2008, with some important changes, such as:

- Addition of land drilling operations, quays, nautical clubs, shipyards and refineries as facilities that should present an IEP;
- Creation of a simplified IEP for small port facilities and terrestrial drilling operations;
- Determination that ship's spills should be supported by the harbor, terminal or shipyard IEP when the ships are operating inside of the port area;
- Provision that a group of O&G or port facilities owned or operated under a single company in a defined area could share resources and present a unified IEP. However, it did not present an objective meaning for this geographical concept;
- Removal of the sizing criteria for chemical dispersants; and
- Recognition that mechanical recovery is not applicable nor necessary to deal with gas condensate spills.

The CONAMA Resolution n° 398/2008 kept the sizing approach based at the EDRC formulas and application from the North American 33 CFR part 154, resulting in a strong mechanical recovery focused requirement. Consequently, every facility must have an IEP able to attend a minimum and progressive EDRC requirement for 02, 06, 12, 36 and 60 hours. The EDRC requirements are calculated based on the installation's worst-case scenario.

Finally, despite the resolution predicted the need for procedures for source control, monitoring, chemical dispersion, protection of environmental sensitive areas and protection of wildlife, it did not set any sizing metrics for those capabilities.

However, a positive environment for more significant changes in Brazilian oil spill legal framework was created after the Deepwater Horizon oil spill, in Macondo Field, in USA (2010), and when the Frade Field oil spill, a leakage from the Campos Basin sea floor, occurred during a drilling operation, in November 2011. Considering the possibility of a major national significance spill, the technical and political discussions about this topic were resumed. Therefore, in 2013, the Federal Decree 8,127/2013 was enacted, creating the National Contingency Plan (NCP), exclusively focused on oil spills, and defining the roles of several agencies and ministries during a national significance event.

Later, in December 2015, the federal resolution that established requirements for the use of chemical dispersants on open waters went through a major review and was renumbered as the CONAMA Resolution n° 472/2015. In 2017, CONAMA published a completely new resolution (n° 487/2017) in order to regulate in situ burning operations (ISB). Both technical discussions were largely engaged by regulatory agencies, academy and the O&G segment.

In **Error! Reference source not found.** the timeline of the Brazilian Oil Spill Regulatory Framework is summarized with important milestones highlighted.

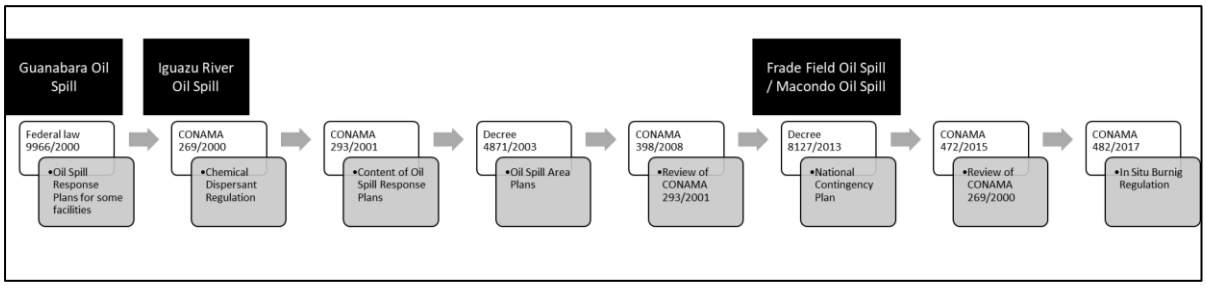

Figure 01: Brazilian oil spill response legal framework chronology

DISCUSSION - IMPROVEMENT OPPORTUNITIES

Although Brazil has a significant response capability as a consequence of its national oil spill legislation, several distortions and blanks still exist, limiting the country's ability to

proper engage some future challenges. The pre salt production rampage, the exploration and production activities in new frontiers and the general process of economical opening, which is bringing several new players for the O&G, ports and several other productive segments will demand a critical redesign of the national response structure.

For example, despite the facts that the legal framework established the role of several agencies and ministries through NCP and that the Brazilian Government is a signatory member of international treaties such the OPRC, the oil spill regulation only demands response capabilities from the productive sector. This results in a lack or deficiency of response structures in areas where there is no presence of port activities, O&G sector and pipelines. In a vast shoreline such as the Brazilian Coast, this vulnerability represents a massive area.

In September 2019, this was fully perceived as the entire Northeast coast of Brazil was oiled from an unknown marine source. This region does not hold intense O&G activity nor an intense port activity along its coast. As a result, there is no availability of routine monitoring resources capable of detecting the oil spill before it reached sensitive environmental areas. In addition, although coastal protection resources were regionally kept by the private sector, especially by PETROBRAS, the Brazilian biggest oil company, there was no state-owned resources and no previously organized emergency management system including different Government levels. This jeopardized the initial response efforts, which could be provided by the municipalities or states governments, demanding several weeks to assemble and organize a rational response structure.

Additionally, another improvement opportunity observed during this event response was the lack of objective criteria to activate the NCP in situations where the source of the oil spill is unknown and there is no OSAP in place: in this event, the NCP was only activated 41 days after the oil started to reach the shoreline (Watanabe & Moreira, 2019). A fast activation of the NCP is considered as paramount to allow the Government to mobilize logistics,

equipment and technical personnel from other regions of the country where there is higher concentrations of these resources due to intense O&G activity and to promote the income of international resources, if necessary.

Another significant opportunity to improvement, as mentioned in the beginning of this paper, consists in the properly establishment of oil spill response planning guidance for the offshore O&G plants. Port activities are normally placed in shallow and closed areas, which allows mechanical recovery to be the main response technique and significant limit the use of chemical dispersion and in situ burning, due to possible negative environmental impacts. While the use of chemical dispersion on shallow waters is not recommended due to water column toxicity issues, the execution of in situ burning close to populated areas can expose communities to health risks caused by the particulate matter and other combustion byproducts (Fingas, 2017). From these facts, it is clear why the North American regulation for port activities prioritizes mechanical recovery.

However, this is not true when responding to an offshore oil spill. For instance, it has no physical boundaries to limit the spreading of the oil, which will potentially cover large areas where the mechanical recovery techniques, no matter how intensive, cannot cope with. For this situation, and considering the goal to optimize the spill impact mitigation, the chemical dispersion may be a more suited approach. As being capable to engage large slicks caused by moderate and big spills through aerial application and not being limited by dilution restrains in open sea, the technique may contribute to a better impact mitigation result, although this needs to be assess in a case-by-case basis, through SIMA (spill impact mitigation assessment) or NEBA (net environmental benefits analysis) processes.

Moreover, even if the containment vessels perform well, because of the deep-water profile of Brazil O&G production, long distances and navigation time result in a very limited operational window due to boat tanks being quickly full. Because oil-water decantation during

a spill is not yet regulated in Brazil, these logistical restrains can severely impair the response efforts. Therefore, the use of in situ burning, once fulfilled the technical and safety requirements stablished by law, has the potential to be more relevant than in the present. Unfortunately, there is still no technical criteria in IEP requirements to allow facilities to proper distribute the required response capability in a true toolbox approach, by choosing the best suitable techniques in order to maximize the reduction of environmental and social impacts caused by a major spill.

Another controversial issue derived from the original North American port regulation is the requirement to fulfill response capabilities in fixed response times, which leads to significant distortions and higher readiness costs that do not provide a reasonable environmental safety improvement. In ports, it is easy to keep the necessary resources for first response near the facility, close to its regular operations, which allows for an initial response in no more than 02 hours. However, it is very unlikely to have the same opportunity, in a reasonable perspective, for offshore facilities and pipelines.

For an offshore plant, the only way to cope with this response time at sea is to keep a dedicated oil spill response vessel (OSRV) close to it. Although operations scale can provide opportunities to mix support logistics and contingency at the same boat, the size of this fleet would be artificially high, once there are limitations derived from the speed that those vessels can travel and the number and the distribution of offshore units supported. Considering that Brazilian oil provinces usually have the size of the entire Gulf of Mexico or the North Sea and that the vessels normally travel at speeds up to 10 knots, it is easy to estimate that, by this approach, each one of these areas should have an exclusive fleet of more than 10 stand-by vessels. In **Error! Reference source not found.** a simulation of the number of OSRV needed to cover the Campos Basin oil fields within 02 hours is presented, where the circles represent

the area covered by the vessels. For this simulation, only to offer the first response, 15 stand-by vessels are necessary.

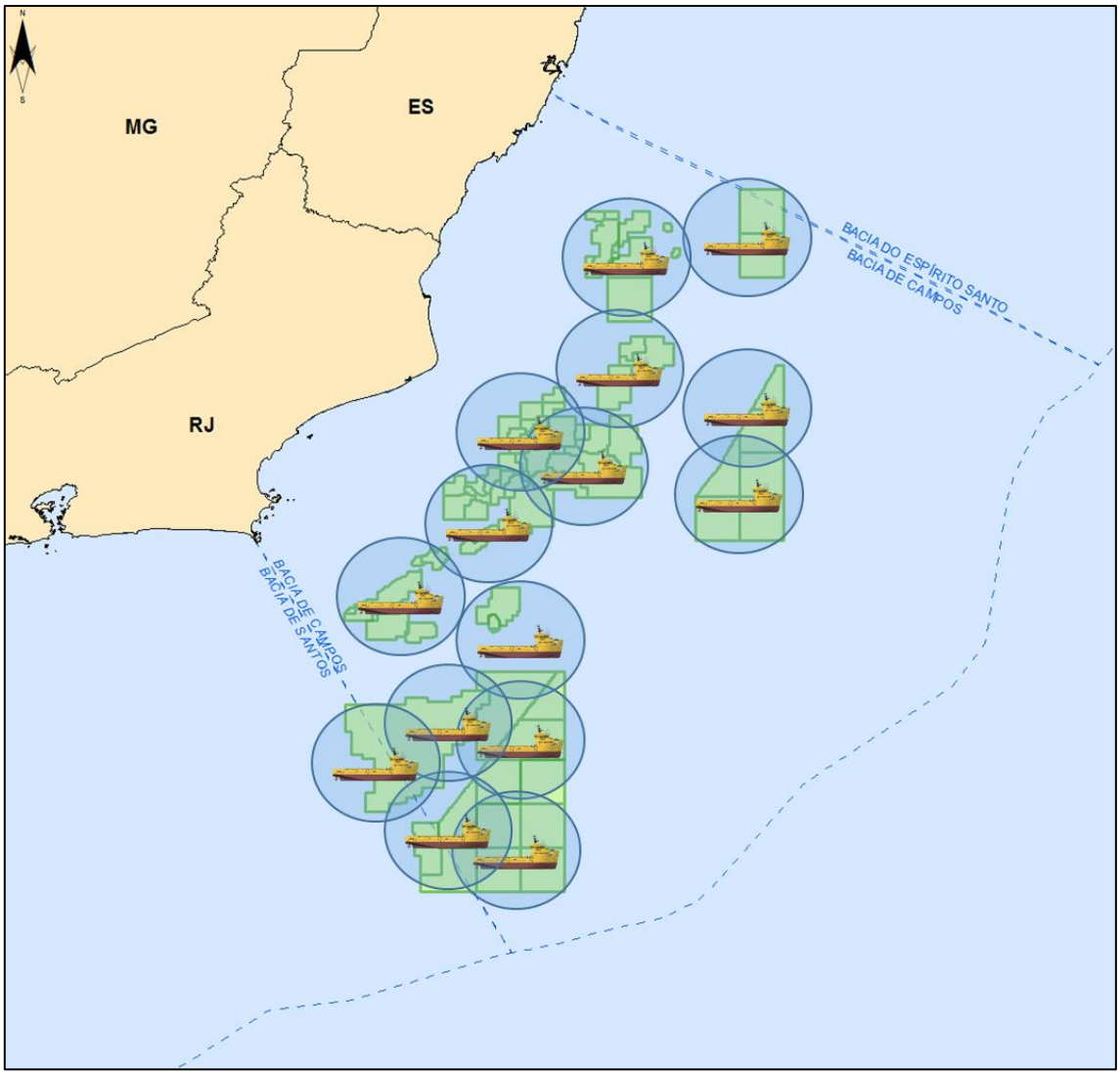

Figure 02: Simulation of the stand-by fleet needed to cope with a 2-hour response requirement at Campus Basin.

Because this approach is not technically reasonable, the federal environmental agency recognized this situation and relaxed the initial response times from 02 to 06 hours for those installations located far from sensitive environmental areas. It is important to highlight that most of these units are located in deep-waters, many located as far as 30 nautical miles from

Brazilian coast. Controversially, Brazil does not have any large-scale aerial chemical dispersion aircraft on ground, being supported by the 727 modified Boeing kept by Oil Spill Response Limited (OSRL) in United Kingdom with a response time of no less than 24 hours for Brazilian territory.

Besides that, in order to calculate the response capability of these vessels and other resources it is usually applied the EDRC concept, as recommended by law. Its formulas can estimate the volume of oil removed by one equipment based on its pump flowrate and its effectivity factor, which combines several operational characteristics, such as daily availability and percentage of recovered oil. This formula is a very pragmatic approach, well suitable for the port's scenarios, where the oil is not expected to reach far distances. However, when applied to the several different facilities indicated by Brazilian regulations, it can easily stimulate a strong drive towards equipment with big pumps, which is not always effective due to operational features and environmental specific conditions.

One possible improvement alternative is to customize and adopt some Response System Planning Calculators, such as those develop by US Bureau of Safety and Environmental Enforcement (BSEE) after Macondo oil spill, which consider several operational and logistical characteristics of the equipment in order to have a more realistic approach and to stimulate the development of newer and more efficient technologies.

However, besides updating these sizing calculation methods, it is also necessary to correct another significant distortion derived from the regulation misinterpretation: the restriction for sharing resources among facilities of distinct owners. When the regulation was adapted for the Brazilian law, somehow the term "Individual Emergency Plan" was understood as "Exclusive Resource Emergency Plan". By this concept, every entrepreneur should have or contract an exclusive response capability that cannot be shared with a facility of another entrepreneur next to his own facilities. It generated some distinct situations such as the need to

duplicate the number of the OSRV in a certain area when a previously operator partially sells some of its FPSO units to another company. In this case, although the overall environmental risk (volume of oil produced, number of offshore wells and units, among others) does not change, the legal required response capability is duplicated, as presented in Figure 01. Controvertibly, coastal vulnerable areas protection and wildlife response capabilities are allowed to be partially shared in a case-by-case basis not only by offshore facilities, but by ports, terminals, pipelines, among others.

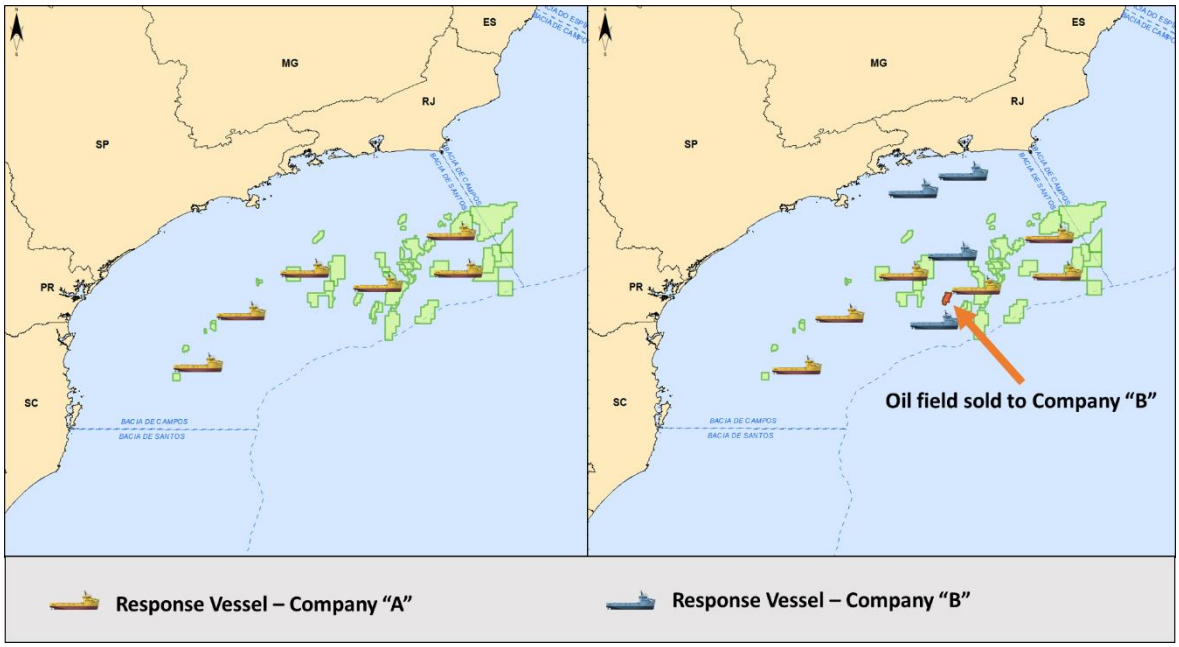

Figure 01 - Schematic representation of response fleet when a field operation is transferred to other company.

Thus, the main undesirable consequence of limiting this response capabilities sharing is the restriction to the development of oil spill response association or enterprise. This kind of arrangement created good examples of response structures such the Norwegian and the North American ones. Specialized monitoring, source control, aerial chemical dispersion, protection of sensitive areas and wildlife protection and rehabilitation are examples of response

capabilities that can be significantly improved by stimulating the incorporation of more advanced and costly equipment if a rational model that allows for an efficient yet environmental responsible sharing of resources exists (Ruopollo et al., 2017). Unfortunately, the Brazilian regulation is quite brief about those response capabilities and very detailed about mechanical removal.

It is also important to take into account that the mechanical removal is a technique with a limited operational environmental condition, such as, small waves, moderate winds and calm currents. It is a well-known fact that when the regulation is focused on a single capability, there is a real chance that no other response can be provided the main one fails. Figure 02 presents a representation of better operational conditions for oil spill response techniques. Because not a single technique is the best choice during all the time, a "toolbox" approach is necessary to offer a proper response considering a changing scenario.

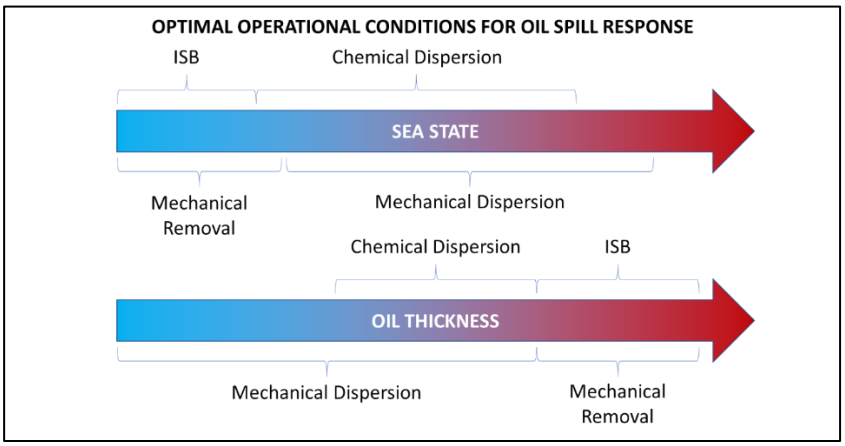

Figure 02 - Best operational conditions for oil spill response techniques.

Another consequence of this "single response capability focus" is the near absence of a tiered response planning. The only tiered response requirement present in the Brazilian regulation is the progressive increase of the volume of EDRC through time, that causes oil spill recovery vessels to arrive on-scene at cascading time intervals (Figure 03). There is no

prevision or stimulus for the IEP to provide resources of other capabilities through time in order to deal with the different aspects of the spill.

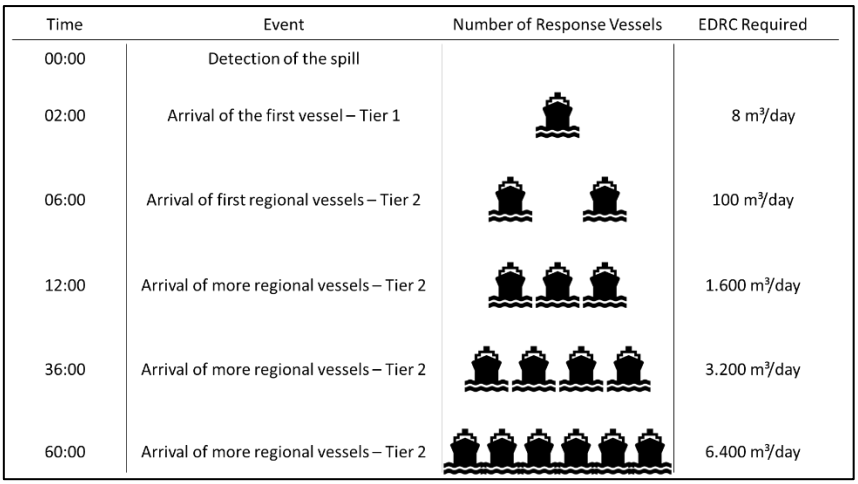

Figure 03 - Schematic increase of response vessels required by the Brazilian Regulation through time for an offshore O&G facility.

This means that the compliance with the regulation does not necessarily equals an appropriated response capability. In other words, the legal compliance may not mean a true risk mitigation as the IEP would be supposed to provide.

About this risk-based approach, the main mechanism present in the regulation to deal with the specific aspects of a facility's environmental risk is the legal prevision for the regulatory agency to establish special requirements, at its own discretionary criteria, to issue the environmental permit, as discussed by Maggi (2011). As it can allow for a better emergency response capability, as long as it is based on a reasonable technical discussion, it can also significantly reduce the capacity of entrepreneurs to preventively plan for operational and financial follow-up of major projects.

Another relevant issue is the fact that the Brazilian environmental permit process can take several months or years, depending of the projects complexity but also of political matters, some of those spent in discussions about IEP content and resources needs. Because there is no

kind of previously approved oil spill response guidance when the oil fields are auctioned by Brazilian Government or any time limit for the aforementioned important technical discussions to comply, this mechanism allows the permit process to last much longer than necessary.

CONCLUSIONS – HOW CAN WE IMPROVE?

THE PREVIOUS SECTION ILLUSTRATED THE MAIN POINTS THAT COULD BE REVIEWED IN ORDER TO PROMOTE A MORE ADEQUATE LEGAL DIRECTIVE FOR OIL SPILL RESPONSE. IN

are presented some possible alternatives for technical and regulatory improvement.

Table 01 – Comparison of the current situation and possible optimizations.

As it is…	**As it should be…**
The oil spill regulation only demands response resources from the private sector and does not provide any guidance on how the Government should act in case of unknown origins events.	The coastal municipalities, state and federal government receive taxes from O&G and port operations. All the oil tankers and general cargo ships that use national waters should also contribute with similar taxes. These resources should be used to create a national fund that covers potential expenses for creating and keeping a response capability alongside the national territory. The national contingency plan should require and provide guidance to organize and build a minimum capability for oil spill response for all coastal states. A national oil spill response training program should be planned to keep technical staffs from different agencies ready and able to respond, if necessary. The military, specially the Navy, should have some response capability in order to complement operations in remote areas, like Amazon and North Equatorial Margin. A periodic NCP exercise should be periodically planned and executed in different country regions.
Absence of objective criteria for a National Contingency Plan activation in case of an oil spill from unknown source (when there is no Area Plan in place)	The federal government should provide a national monitoring system. This system could be based on airborne or satellite platforms, or even on a combination of these platforms. In case of oil slick confirmation with unknown source the government should automatic activate the city / state / federal response and be able to activate the private capability and refund it.

As it is…	**As it should be…**
The regulation focuses on mechanical removal and demands initial response in times like 02 and 06 hours, no matter where the facility is located, whether near the coast or in ocean waters.	The installation characteristics and spill scenarios should be considered to define and distribute the required response capability among the best suitable techniques. The initial response time to deal with the oil (mechanical removal, chemical dispersion or in situ burning) should be set according to the risk of oil spilled from a credible oil spill scenario to reach sensitive areas. Considering the oil spill modeling results for offshore facilities, a practical rule summarizing a risk-based approach derived from oil spill modelling and Brazilian coastal vulnerabilites can be set according to the distance of it to the shore: • From 0 to 12 nautical miles: up to 4h for initial response time; • From 12 to 60 nautical miles: up to 8h for initial response time; • Over than 60 nautical miles: up to 12h for initial response time. The installation owner should be able to distribute the required response capability among the best suitable techniques.
The EDRC (Effective Daily Recovery Capacity) formula mostly based on pump capacity and effectivity factor	The regulation should consider the encounter rate and the efficiency of the response technique and logistic factors in order to allow and encourage technical developments and better arrangements. Besides that, the regulation should consider metrics to other response capabilities, such as in situ burning and chemical dispersant application. After the Macondo Oil Spill, the North American government developed several Response System Planning Calculators for this purpose. A similar approach should be taken.
Response capability can't be shared among facilities of different entrepreneurs ("Exclusive Resource Emergency Plan" concept)	The regulation should allow the resource sharing and create rules to organize this sharing. Should be stimulated the creation of one or more response organizations, funded both from private or government sources.
Absence of a tiered response planning (regardless of the progressive increase of the volume of EDRC through time)	To complement all the others suggestions, the regulation should stimulate creation of resources stockpiles and logistic support plans for all response capacities. This can be done by creating additional response exigencies to those EDRC demanded in the "response times" (2, 6, 12, 36 and 60 hours) presented above. This new requirement, should add EDRC from different response capacities, with no exigence of time but according to a pre-established logistic support plan.

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