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Brazil Case Study - Tactical Response Plans and Voo's Program - A New Approach to Shoreline Protection Preparedness

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ABSTRACT 289860:

In the past, Brazilian Oil Spill Response Plans focused on the definition of response strategies in offshore environments, but were insufficient when it came to shoreline protection.

After the occurrence of major oil spill accidents around the world and events of great repercussion in Brazil and with the intensification of oil and gas E&P activities in locations close to the coast and near environmentally sensitive areas in the country (such as Camamu-Almada and the Jequitinhonha basin), the need for additional nearshore response studies became of the utmost importance.

Recently developed documents address the environmental characterization of the coast and indicate the appropriate response strategies, but a more action-oriented approach is needed.

For that purpose, based on the best practices in shoreline protection worldwide, a methodology is being implemented so as to provide consistent preparedness support for the protection of nearshore resources.

The methodology uses the Brazilian licensing mandatory documents in order to identify the appropriate level of protection preparedness for each of the vulnerable segments of shoreline within the domain of the E&P activity.

Once the proper level of preparedness has been identified, the method indicates how to attain such result by presenting a set of tools, such as: TRP (Tactical Response Plan), VoOs (Vessel of Oportunity) Program, Advances Bases and Full Deployment Exercises.

This paper provides an overview of the methodology, followed by a case study in Brazil which helps illustrate how the level of preparedness is determined and how the proposed tools help achieve such result. Therefore, it allows assessing the effectiveness of this new approach in the country.

Considering Brazil's growing E&P potential, the long extent of its coastline and the abundance of sensitive resources alongshore, the methodology should be applied to other E&P projects developed in the country.

INTRODUCTION:

In the past, Brazilian Oil Spill Response Plans focused on the definition of response strategies in offshore environments, but were insufficient when it came to shoreline protection.

After the occurrence of major oil spill accidents around the world and events of great repercussion in Brazil and with the intensification of oil and gas E&P activities in locations close to the coast and near environmentally sensitive areas in the country (such as Camamu-Almada and the Jequitinhonha basin), the need for additional nearshore response studies became of the utmost importance.

In that sense, the first steps have recently been taken by a group of oil & gas companies that operate in Brazil. Since 2012 they have been conduction a project that seeks to map the entire Brazilian coastline so as to create an integrated GIS (Geographic Information System) environmental database which would support the development of specific shoreline protection procedures for each E&P activity. This project, which will be accomplished by 2015, will provide support to shoreline protection by presenting georeferenced site-specific information, such as: existing environmental physiognomies, ESI (Environmental Sensitivity Index), access conditions, socioeconomic and biological characterization, applicable response strategies, potential areas for equipment and waste storage, among others.

However, even though recent studies address the environmental characterization of the coast and indicate the appropriate response strategies, a more action-oriented approach is still needed.

For that purpose, based on the best practices in shoreline protection worldwide, O'Brien's do Brasil (OdB) - a Brazilian emergency management consulting company - has been implementing a methodology so as to provide consistent preparedness support for the protection of nearshore resources.

This paper provides an overview of the methodology, followed by a case study in which the effectiveness of the new approach in Brazil is assessed.

METHODS:

The new approach to shoreline protection preparedness that OdB has been implementing is based on the assortment of coastal segments according to multi-level criteria, through which differentiated tools are assigned to each location, as seen in **Figure 1**.

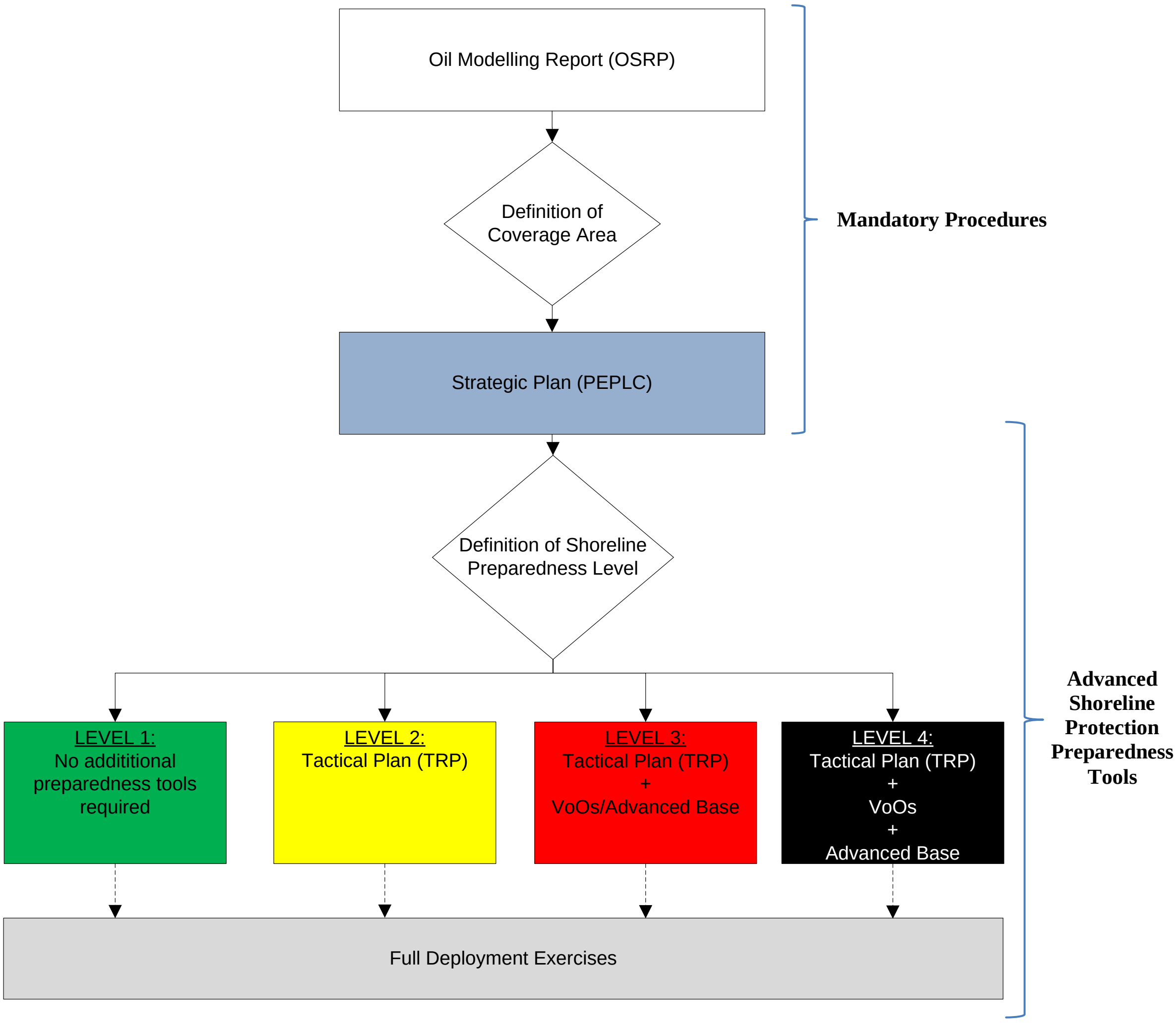

Figure 1 – Shoreline protection preparedness methodology overview.

The methodology uses as its starting point the mandatory documents already developed by the oil & gas companies in response to applicable Brazilian legal requirements for E&P activities.

First of all, for a specific E&P project, the vulnerable shoreline segments are identified through the assessment of the oil modeling results contained in the activity's OSRP (Oil Spill Response Plan, named PEI – *Plano de Emergência Individual* in Brazil).

Based on this information, as required in the Brazilian legislation, companies develop Shoreline Protection Strategic Plans (PEPLC - *Plano Estratégico de Proteção e Limpeza da Costa*, as they are called in Brazil) for the municipalities considered most vulnerable to oil spill.

The PEPLC displays through forms and maps specific information about physical, biotical and socioeconomic aspects, access conditions, local infrastructure (nearby hospitals, ports, airports etc.), recommended protection and cleanup strategies, photographic evidence, among others. Most importantly, it identifies priority areas for protection and potential oil collection areas within the area covered by the plan, according to the assessment of local aspects such as ESI, fauna occurrence, existing protected areas and socioeconomic importance.

Nevertheless, as supporting as the PEPLC might be for planning and operational teams, further studies are still required for some of the most critical areas, where shoreline protection preparedness need to be fully and promptly functional.

In that sense, the list of priority areas of protection identified in the PEPLC is submitted to a sorting criterion that identifies the level of shoreline preparedness recommended for each specific location. To each of these levels, different set of tools are assigned, among those: Tactical Response Plans (TRP), Vessels of Opportunity (VoO) Program and the establishment of Advanced Bases, as described below.

The TRP represents a step further in shoreline protection in operational and managerial level by presenting detailed specifications of the response operations, resources required, structuring of the response organization, among others. Among its components, the TRP presents Tactical Maps (spatial representations of the response recommendations for a specific site), Emergency Management Forms (usually developed using ICS[1] principles) and Pre-Spill SCAT (Shoreline Cleanup Assessment Technique) Forms.

The VoOs Program on the other hand is a tool that ensures the operability of shoreline protection tactics, being especially applicable in remote locations where there is lack of permanent emergency response capability (equipment, personnel and expertise). The program works by registering a list of local fishermen vessels and providing them with theoretical and practical oil spill response training, taking advantage of their local knowledge and proximity to these sites.

Finally, Advanced Bases are facilities established in specific locations in order to store equipment for initial response during oil spill response operations, while awaiting tactical assignment. Analogous to the VoOs Program, Advanced Bases have significant tactical importance when there is lack of emergency capability associated with resource availability.

The procedure for determining the level of shoreline protection preparedness is described in **Figure 2**.

[1] ICS – Incident Command System: ICS is an internationally recognized systematic tool used for the command, control, and coordination of emergency response. It is a subcomponent of the National Incident Management System (NIMS), release by the U.S. Department of Homeland Security in 2004.

T_{RESP}/T_{REACH}		Conditional Probabilities - Worst Case Scenario									
		1-10%	11-20%	21-30%	31-40%	41-50%	51-60%	61-70%	71-80%	81-90%	> 91%
		1	2	3	4	5	6	7	8	9	10
> 0,5	1	1	2	3	4	5	6	7	8	9	10
0,5 - 0,6	2	2	4	6	8	10	12	14	16	18	20
0,6 - 0,7	3	3	6	9	12	15	18	21	24	27	30
0,7 - 0,8	4	4	8	12	16	20	24	28	32	36	40
0,8 - 0,9	5	5	10	15	20	25	30	35	40	45	50
0,9 - 1,0	6	6	12	18	24	30	36	42	48	54	60
1,0 - 1,1	7	7	14	21	28	35	42	49	56	63	70
1,1 - 1,2	8	8	16	24	32	40	48	56	64	72	80
1,2 - 1,3	9	9	18	27	36	45	54	63	72	81	90
> 1,3	10	10	20	30	40	50	60	70	80	90	100

Legend:

Level 1: No additional preparedness tools required (besides the PEI and PEPLC procedures)

Level 2: TRP

Level 3: TRP + VoOs/Advanced Bases

Level 4: TRP + VoOs + Advanced Bases

Figure 2 – Shoreline Protection Preparedness Level Matrix (A. Ranieri, 2013).

The matrix suggested by A. Ranieri (2013) defines the level of shoreline preparedness required, through which different tools are assigned to each location, by crossing 02 (two) information: the probability of the coastal segment being reached by oil in the worst-scenario spill of the specific E&P project (based on the modelling results from the OSRP) and the ratio between the effective response time "T_{RESP}" (time needed for activation, mobilization, displacement and response start – estimated using background knowledge and information from previous experiences) and the time for oil to reach the coastal segment "T_{REACH}" (based on the modelling results).

These parameters help reflect the importance of both vulnerability and operational aspects when determining the appropriate shoreline protection preparedness level.

Therefore, the methodology indicates that for priority protection areas less likely to be reached by oil (small probability) and with lower ratio T_{RESP}/T_{REACH} (**Figure 2** – Level 1: green area), no additional efforts besides the PEPLC are required in terms of shoreline protection preparedness. In such locations, in addition to the low probability of impact, it is expected that the response resources (human and material) would have sufficient time to establish oil spill response capability in order to protect the vulnerable resources.

It should also be noted that as the probability of impact and the ratio T_{RESP}/T_{REACH} increases (**Figure 2** – Level 2, 3 and 4: yellow, red, and black area), other tools are required in order to assure shoreline protection preparedness capability, since it applies to areas most likely to be impacted and where there is relatively less time to set up response capability prior to the impact by oil.

In short, the matrix suggests when an area is classified as Level 2 (yellow area), a TRP should be developed. If it is classified as Level 3 (red area), besides the TRP, the area should be granted with either a VoOs Program or an Advanced Base. Finally, in the most critical cases, if it is classified as Level 4 (black area), all 03 (three) tools must be implemented: TRP, VoOs and Advanced Base.

After the adequate capability has been established, the final step of the methodology consists of coordinating full deployment exercises involving the priority areas of protection, in which shoreline protection procedures are put to the test and improvement opportunities are identified. Therefore, an action plan is generated, providing a continuous improvement cycle.

RESULTS/DISCUSSION:

Following the methodological description presented in the previous topic, this chapter will describe one of the first enterprises in which this new line of work was implemented in Brazil, allowing for the assessment of its consistency and effectiveness.

1.1. Brazil case-study:

The case study was developed in the context of Queiroz Galvão E&P (QGEP) drilling activity in maritime block BM-J-2, in Jequitinhonha's Basin, conducted in 2013. The project was implemented along the coastal region of the state of Bahia, located in the northeastern portion of Brazil, near the municipality of Canavieiras. Its closest distance to the coast valued 13.8 km and water depth varied from 20 to 200 m.

The region's economy is very dependent on the touristic potential associated with its coastline, which is composed mostly of sandy beaches, river mouths and mangroves and its constant warm climate and calm waters attract Brazilian and international visitors all year long.

Taking into consideration that QGEP's activity was located within a small distance to the shoreline, where sensitive socioeconomic and environmental resources are abundant, it came to light to need for proper shoreline protection preparedness capability.

According to the oil modelling results developed as part of the activity's licensing process, 26 municipalities between the state of Bahia and Espírito Santo presented probability of being impacted by oil during good and bad weather conditions, ranging from 1-100% and 3-100% respectively.

Given this information, QGEP decided to cover all of the 26 municipalities on its Strategic Plan (PEPLC), comprising among others the municipality of Ilhéus.

The list of priority areas for protection indicated a list of 212 sites, among which Barra de São Miguel was included.

Barra de São Miguel consists of a low-income community installed along the mouth of Almada River, north of Ilhéus – state of Bahia. The site was selected due to the abundance of environmentally sensitive resources such as mangroves (ESI 10) along the river mouth.

Following the proposed methodology, Barra de São Miguel was submitted to the priority area selection matrix (**Figure 2**) by crossing information regarding the ratio T_{RESP}/T_{REACH} and the probabilistic modelling results.

The variable T_{RESP} was estimated as 57 hours according to the following premises:

- Activation time: 01 (one) hour – based on previous experiences;
- Mobilization time: 06 (six) hours – based on previous experiences;
- Displacement time: 26 hours – considering the use of road transportation by trucks;
- Response start time: 24 hours – based on previous experiences.

The variable T_{REACH} was determined as 44 hours and 29 hours, based on the modelling results for good and bad weather conditions respectively. Therefore, T_{RESP}/T_{REACH} resulted in:

- T_{RESP}/T_{REACH} (good weather): 1.30
- T_{RESP}/T_{REACH} (bad weather): 1.97

Given that probabilistic modelling results indicated a 14% chance of oil reaching the coast during good weather and 100% chance during bad weather, the matrix indicated the following:

- Good weather conditions: Level 1 - No additional shoreline protection preparedness tools required;
- Bad weather conditions: Level 4 - Development of TRP, VoOs Program and Advanced Bases.

Therefore, in a conservative measure, QGEP decided to implement the tools indicated during the bad weather scenario, following with the development of TRP, the conduction of a VoOs Program and with installation of advanced bases that would allow for the protection of the sensitive resources within Barra de São Miguel.

1.2. Development of shoreline protection preparedness capability in Barra de São Miguel - Bahia

After classifying Barra de São Miguel as Level 4 of the Shoreline Protection Preparedness Matrix, QGEP coordinated the development and implementation of the following products.

- **Tactical Response Plan (TRP)**

The first step toward developing a solid TRP consisted of building up a multidisciplinary team able to understand and consolidate emergency response information in both operational and managerial level.

The team was composed of:

- 01 (one) oil spill operator – responsible for determining the appropriate response tactics for the protection of the vulnerable resources;
- 01 (one) SCAT specialist – responsible for identifying the characteristics of different segments of the site's coastline, providing recommendations about appropriate oil clean-up techniques;
- 01 (one) emergency management specialist – responsible for coordinating the development of the TRP and for structuring the response organization based on the tactics prescribed by the operational team.

The first stage of the development for the TRP consisted of a field survey by foot in which the team investigated the site in terms of environmental conditions and dynamics, oil spill response operational restrictions (e.g. equipment/personnel mobilization and demobilization viability), existing local infrastructure (road access, medical and lodging facilities, wharfs and pier structures etc.), existing local fishing communities (as local labor potential for the implementation of the TRP) etc. Meanwhile, the SCAT specialist identified and documented his recommendations for clean-up techniques for each of the different coastal segments.

In order to confirm the information that the oil spill operator had regarding local environmental dynamics, the team approached some of the local inhabitants and verified the existence of hidden sand banks and the occurrence of strong currents within the river mouth. Such aspects were considered by the operator when determining the positioning of containment booms and oil collection areas inside the river mouth, in calmer waters of sufficient water depth.

After sufficient data had been collected on the field, the work proceeded to the office, where the information was compiled and processed in order to generate the 3 (three) products described previously: Tactical Maps (**Figure 3**), Emergency Management Forms and Pre-Spill SCAT Forms.

Figure 3 – Except from Barra de São Miguel's Tactical Map, illustrating prescribed tactics, allocated resources and structuring of emergency response (response operations divided into different teams).

- **Vessels of Opportunity (VoOs) Program**

In addition to the TRP, a VoOs Program was conducted in order to complement the shoreline protection preparedness capability in Barra de São Miguel.

The Program was conducted in 04 (four) strategically locations in order to meet the needs of all the most vulnerable segments of the coastline according to the proposed methodology. The one that contemplated Barra de São Miguel was based in Ilhéus, within a distance of approximately 10 km (by sea) to the site.

In order to initiate the VoOs Program, the coordination team scheduled kick-off meetings in which they provided the fishing community with an overview of the project, after which the vessels/crew interested in participating were submitted to an auditing process.

Audits played the role of verifying pre-established operational, communication, safety and documentation minimum requirements.

Safety and documentation requirements were some of the aspects that narrowed down the list of the fleet fit to work, as a great number of vessels did not have the proper papers or had them out-of date/expired, and/or failed to present life-vests/lifebuoys on board.

This information regarding the fleet (along with contact information, photographic evidence etc.) was compiled in order to develop a VoOs Catalogue. At the end of the VoOs Program, the catalogue, which was also updated with information regarding the amount/type of training provided to each vessel, was sent to QGEP so that, in case of an oil spill incident, it may activate the required resources in accordance with their needs.

Based on the tactics prescribed in the previously developed TRP, coordinators of the Program (mostly composed of oil spill operators) established the number of vessels that would be required for the protection of the area and initiated the conduction of training. In order to account for historically high rates of evasion among fisherman, coordinators considered a surplus ranging from 30% to 50% of the required fleet.

After this first stage, the training program was initiated, being divided into theoretical and practical sessions.

Theoretical sessions were conducted mostly in the begging of the program, when fishermen were presented to the basics of oil spill response. These classes consisted mainly of informal lectures covering subjects such as response equipment/strategies, safety considerations etc., conducted prior to each day of practical training. Coordinators also took advantage of these sessions to contextualize participants of their involvement, describing QGEP’s activity in the region, the OSRP etc.

VoOs practical training sessions were conducted during all of QGEPs activities in Block BM-J-2. During a period of approximately 06 (six) months, over 33 days of training were provided to vessels from Ilhéus - Bahia.

The content of these training sessions comprised the deployment of booms (e.g. absorbent, nearshore, beachboom etc.), deployment of skimmers, boom formation techniques, deployment of oil storage equipment, storage and maintenance techniques, safety considerations, among others (**Figure 4**).

Figure 4 – Equipment deployment during VoOs practical training sessions.

Vessels and crew were sorted according to the assigned response tactics (e.g., oil deflection, oil recovery, protection with sorbent material etc.) and were provided with different types of training.

- **Advanced Base**

Parallel to the development of the VoOs Program, QGEP initiated the establishment of advanced bases along the coast of Bahia.

These bases were equipped with nearshore response equipment such as containment and sorbent booms, skimmers, oil storage tanks, and support equipment (anchors, cables etc.) and had the role of promptly providing resources for initial oil spill operations.

The location of the 04 (four) bases implemented was strategically chosen so as to cover all of the coastal segments identified with high vulnerability, being co-located with the 04 (four) VoOs Programs being implemented. Therefore, they directly provided equipment for the practical training sessions, which would have also been used in the case of a real incident.

The base that covered the area of Barra de São Miguel was located in the vicinities (within less than 1 km) of the river mouth/mangroves identified as priority area in this case-study.

Each of the Advances Bases also had dedicated personnel to perform periodical maintenance on the equipment, through which all the inventory was kept in constant operational conditions.

- **Full Deployment Exercise**

Once QGEP had put in place of the tools required for the protection of the vulnerable segments of the coastline subject to impact by oil during its activities in Block BM-J-2, the company conducted a Full Deployment Exercise in Barra de São Miguel. The exercise had the role of testing the effectiveness of the prescribed shoreline protection procedures in both operational and planning level, and to identify improvement opportunities.

Therefore, in August 5th, following a simulated kick in the well, an oil slick started drifting towards Barra de São Miguel, initiating both offshore and nearshore response procedures.

Upon the activation by the Emergency Management Team (based in the company's Command Center in Rio de Janeiro) the shoreline protection structure that had been built for Barra de São Miguel throughout the development of the TRP, the conduction of the VoOs Program and the implementation of the Advanced Base was promptly activated. Within 03 (three) hours, the VoOs had been mobilized to the location, were equipped with response equipment and were executing response tactics according to the TRP, protecting the vulnerable resources Barra de São Miguel (**Figure 5**).

Figure 5 – Full Deployment Exercise conducted in Barra de São Miguel.

CONCLUSIONS:

The main objective of this paper consisted in assessing the efficiency of a shoreline protection preparedness methodology by analyzing its application to an E&P project in Brazil.

As described throughout the text, the methodology uses the licensing mandatory documents (such as the OSRP and the PEPLC) in order to identify the appropriate level of preparedness for each of the vulnerable segments of shoreline within the domain of the E&P activity. Once the proper level of preparedness has been identified, the method indicates how to attain such result by presenting a set of tools, such as: TRP, VoOs Program, Advances Bases and Full Deployment Exercise.

The case study of QGEP and Barra de São Miguel helped illustrate how this level of preparedness is determined and how the proposed tools help attain such result. Such ascertainment was reinforced by the conduction of the Full Deployment Exercise after all 03 (three) tools had been implemented (TRP, VoOs Program and Advanced Base).

Thus, considering Brazil's growing E&P potential, the extent of its coastline (over 7,400 km) and the abundance of sensitive resources alongshore, the methodology should be applied to other E&P projects developed in the country.

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