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# NEW APPROACH TO DEFINE SHORELINE PROTECTION PREPAREDNESS IN BRAZIL

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**Abstract:** 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 with great repercussion in Brazil as well as the intensification of oil and gas E&P activities in locations close to the coast in the country, the need for additional nearshore response studies became of the utmost importance. For that purpose, based on the best practices in shoreline protection worldwide, a methodology was elaborate 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, indicating how to attain such result by presenting a set of tools, such as: TRP (Tactical Response Plan), VoO (Vessel of Opportunity) Program, Advances Bases and Full Deployment Exercises. As the first approach did not consider that each tool would have a different result on the organization preparedness to respond at shoreline, the aim of this paper is to present our revision on the methodology allowing us to assess its effectiveness in the Brazilian coast.

## 1. 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 Jequitinhonha basins, as well as the next O&G frontier in Brazil - the Equatorial Margin basins), 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 conducting a project named Shoreline Protection and Cleanup Plan (*Plano de Proteção e Limpeza da Costa* – PPLC, as it is called in Brazil[1]) that seeks to map the entire Brazilian coastline (including coastal islands) 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 valuable georeferenced site-specific information, such as: existing environmental physiognomies, ESI (Environmental Sensitivity Index), access conditions, socioeconomic and biological

[1] For additional information about the PPLC (including preliminary data), refer to: www.pplc.com.br

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, Witt|O'Brien's Brasil (WOB) - a Brazilian emergency management consulting company - has been implementing a methodology so as to provide consistent preparedness support for the protection of nearshore resources.

The methodology, which was first presented during 2014's International Oil Spill Conference (IOSC), did not consider an interactive perspective of its results, indicating an area of improvement for future studies.

Therefore, this paper presents the revision of the initial methodology based on the recent lessons learnt, illustrated by examples/discussions regarding its application.

## 2. Shoreline Protection Preparedness Methodology

The new approach to shoreline protection preparedness that WOB 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**.

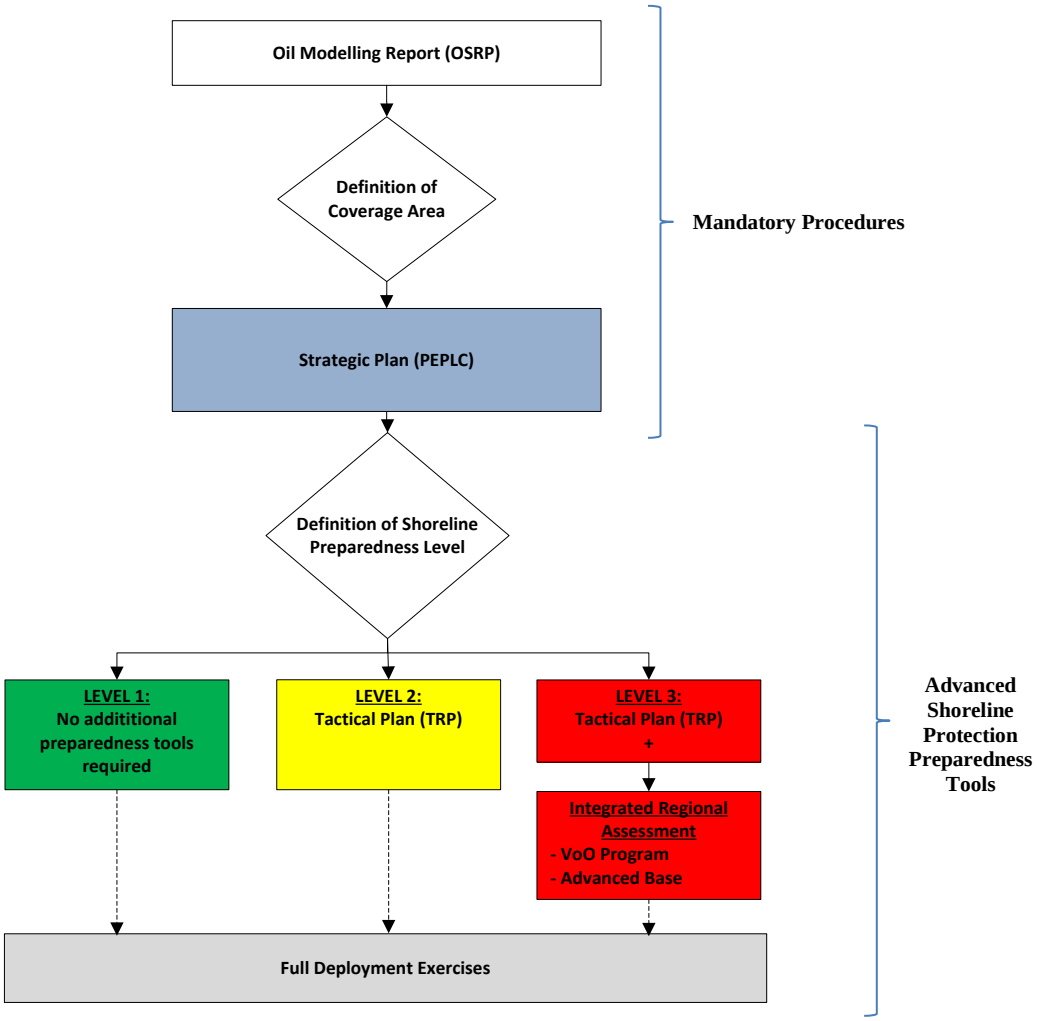


**Figure 1 – Shoreline protection preparedness methodology overview**

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. This information is usually presented through Tactical Maps (spatial representations of the response recommendations for a specific site) and Emergency Management Forms (usually developed using ICS[2] principles).

The VoO 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 VoO 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.**

[2] 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 OSRP and PEPLC procedures)**

**Level 2: TRP**

**Level 3: TRP + Integrated Regional Assessment (VoO Program and/or Advanced Base)**

**Figure 2 – Shoreline Protection Preparedness Level Matrix (adapted from: RANIERI, 2013).**

The matrix suggested by 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 and 3: yellow and red 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.

For areas classified as Level 2 (yellow area), the matrix suggests that 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 VoO Program or an Advanced Base, or both. However, as VoO Program and Advanced Bases may have a spatial comprehensiveness greater than that of the area under analysis, in order to properly assign these tools (without prescribing redundant measures – e.g. two neighboring areas assigned with two individual VoO Program), all areas classified as Level 3 must undergo an **Integrated Regional Assessment**[3].

In order to allow for an integrated holistic approach, besides the geographical distribution of such areas, the assessment must be performed considering several criteria, among them:

**VoO Program**

- Distance from covered areas (considering navigation from vessel concentration areas)
- Local VoO fleet (and crew)
    - Availability
    - Profile (e.g. (size of vessels, crew size, engine power, type of activity (e.g. tourism, fishing))
    - Preexistent oil spill response capability
    - Safety equipment availability (e.g. life jackets)
    - Communication equipment availability
    - Documentation availability
    - Regular income (for estimating payment rates)

**Advanced Bases**

- Distance from covered areas (land and water)
- Local labor force (for operation and maintenance of the base)
    - Availability
    - Profile (e.g. fishermen, port crew, industrial crew)
- Local infrastructure
    - Accessibility
        - Land (e.g. road and traffic conditions)
        - Water (e.g. existence of harbors/wharfs, maximum draft, tidal/seasonal restrictions)
    - Local facilities (for potentially hosting bases)

[3] The implementation of an Integrated Regional Assessment within the methodology is a result of an improvement opportunity identified after the first presentation of the methodology in 2014's IOSC, held in Savannah – Georgia.

- Availability
- Type
- Dimensions
- Cost per m²
- Security considerations

- Equipment suppliers (e.g. provision of replacement parts)
- Utilities (e.g. lodging, restaurants, police/fire department)
- Telecommunication infrastructure

In addition to the criteria presented above, the analysis should also consider the influence of external factors that may apply, such as the contracting company's/governmental preferred alternative (Advances Bases *versus* VoO Program) or even socioeconomic aspects (e.g. local development due to investment associated with shoreline protection).

Finally, encompassing all this aspects into one single assessment would allow for a better understanding of the spatial comprehensiveness of these enterprises (VoO Program and Advanced Base), supporting the provision of integrated holistic guidance in terms of shoreline protection preparedness capability.

After the adequate capability has been identified through the tools assigned by the matrix above, 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.

## 3. Conclusions

The main objective of this paper consisted in presenting a revised version of a recently developed shoreline protection preparedness methodology.

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 and after conducting an integrated regional assessment, the method indicates how to establish an optimized shoreline response capability by implementing a set of tools, such as: TRP, VoO Program, Advances Bases and Full Deployment Exercises.

This methodological approach may be used to support E&P projects in Brazil, considering the industry's growing potential, the extent of its coastline (over 7,400 km) and the abundance of sensitive resources alongshore.

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## 6. Presenter's Professional Biography

Adriano Ranieri has 15 years of professional experience related to HSE, emergency preparedness, crisis management, disaster response and the regulatory aspects of the Brazilian Oil & Gas industry. Among his many consulting projects, he has worked in some of the most environmentally sensitive areas in Brazil. Adriano currently serves as the Chief Operating Officer for Witt O'Brien's Brasil (formerly O'Brien's do Brasil).