USE OF TARAWA CLASS AMPHIBIOUS ASSAULT SHIPS: AN OPTION FOR BRAZILIAN OFFSHORE OPERATION LOGISTICS

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ABSTRACT

Oil exploration in the Brazilian pre-salt fields poses a significant challenge for helicopter offshore operation. The distance between the pre-salt fields and the coast is, in average, greater than 280 km. This justifies the acquisition, retrofit and use of decommissioned and demilitarized Tarawa class amphibious assault ships, as support points working not only as passengers' distribution hubs, but also as a maintenance center for all helicopter operators and as a field hospital in case of accidents. In case of bad weather, it could act as a hotel sheltering the passengers until the improvement of the meteorological conditions. Medium and heavy helicopters would bring passengers from the shore and small or medium helicopters would distribute them between the various rigs in order to bring down costs and increase the safety of operations. During the retrofit, modern navigation and air traffic control equipment should be installed, transforming the ship in a modern floating FBO. The advantage of the use of a former amphibious assault ship lies in the fact that it was originally designed to operate with medium and heavy helicopters, having a long and obstacle-free flight deck, with various spots for takeoffs and landings. Beyond that, it has two elevators able to transport helicopters from the flight deck to the hangar deck where they can be parked or necessary maintenance performed. The aft-well deck or docking well could be used for fast boats to transport people to and from the shore. These ships are out of operation and awaiting disposal and could be purchased by a small price.

INTRODUCTION

The search for the "black gold" in Brazil has a long history that goes back to colonial times. Yet, the first oil field in the country was only discovered in 1939, in the Lobato neighborhood on the outskirts of Salvador (state of Bahia). Coincidentally, the site has the same name as one of the icons of the defense of oil exploration in Brazil. The São Paulo writer Monteiro Lobato, who battled tirelessly to show that the country had potential in the sector and that oil could give the Brazilian people a better standard of life. Lobato the writer, is the author of the phrase "The oil is ours!", which became a symbol of the nationalist campaign launched in 1946 in defense of Brazilian sovereignty over natural resource. Seven years later, came Petrobras[1].

With the creation of Petrobras, the search for oil continued, and, in 1968, the first offshore oil discovery was announced. In 1974, oil was found in the Garoupa field, located in the Campos basin in the Rio de Janeiro state coast. Since then, helicopters have been used to support the logistics of oil production ferrying passengers and cargo between the shore and the rigs.

In 1977 the Enchova field inaugurated the offshore oil production at Campos basin.

Though since 2005 the first evidences of the pre-salt oil fields were known, only in 2007their existence was made public. The pre-salt fields are localized between the states of Espírito Santo and Santa Catarina (Figure 1).

In 2008, oil from pre-salt was produced for the first time in the Jubarte field at Campos's basin. [1]

The alternative presented in this paper, aims ensuring increased operational safety, due to the intense flow of transport and long distances to be traveled by helicopter between the coast and the

production systems of the pre-salt, increasing logistics efficiency.

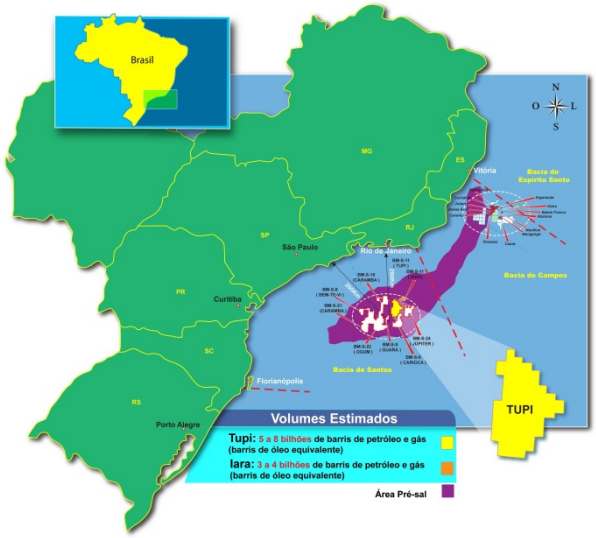

Figure 1 Pre-salt fields location map[3]

DEVELOPMENT

It can be said that there are two strands of technological challenges to explore oil and gas contained in the pre-salt. The first is vertical in nature: drilling the well into the reservoir through the layers of water, sediment and salt, each one having a behavior at temperatures ranging from 80ºC to 150ºC and pressures and corrosive gases. It is necessary to consider yet the way back to the surface, carrying the oil and gas extracted from wells, without clogging the pipes and causing leaks that could cause environmental accidents[2].

The other aspect is the horizontal challenges: transporting oil and gas from the production area to the coast, 300 kilometers away, by means of vessels and pipelines, and load personnel, equipment and supplies for the platforms. One shall remember that, in that region, a single well can cost between USD 120 and 160 million, ten times more than in the Campos basin.[2]

The distance of the future fields and the shore is in some cases three times greater than the distance of the Campos basin fields now in production. It means a huge logistical demand to the supply chain and also significant restrictions to the helicopters carrying personnel to and from the rigs and ships.

To bridge the pre-salt distance – 300 kilometers from the Brazilian coast – and optimize domestic production, Petrobras wants to invest in logistics. The air and maritime transport (support vessels) are in the focus of the question. Currently, the state company uses a fleet of 94 helicopters,most part midsize, to transport 850,000 employees annually between the platforms and the continent. The goal is to transport 1.4 million in 2020 through 120 helicopters. Half of the fleet is composed by large size helicopters[4].

"Every month we transport 75,000 people between the mainland and the platforms and 100% of such transshipment is done by helicopter, which is the most efficient way," said Ricardo Albuquerque, Petrobras general manager of exploration and production logistics. "The demand for freight transportation and support is also great. We have a great challenge ahead," he said[4].

It was also said that in 2016 the company will be transporting 1.3 million employees per year. While acknowledging that the helicopter is a vehicle with limited range, he ensured that it is still the most effective and secure way. "We have studies to develop faster boats than the ones existing today to make this transport. But you must have an equipment able to face the adversities from the sea and at the moment we do not have this technology," he said[4].

Large helicopter, ultra-fast boats and maritime hubs - sort of artificial islands - are being mobilized by Petrobras for the logistical assistance of the new oil frontier. But the structure being built by Petrobras has no precedent in the history of the oil industry. The new demand will mean an increase in the supply of large helicopter contracted by Petrobras. They are aircraft that can carry 18 to 20 people, including the pilot, co-pilot and a flight attendant[5].

At the beginning of the decade, Petrobras mapped the use of helicopters in the offshore world and felt comfortable in the choice of two models: the S92, manufactured by American Sikorsky, and the EC-225 of the French Eurocopter, both civilian versions of military models. Each one costs in-between USD 15 and USD 20 million, depending on the accessory options, reaching speeds of up to 280 kilometers per hour. The great advantage of these large aircraft is their flying range. By Petrobras rules, a helicopter fully loaded must have the ability to land in the pre-salt platform, return to the mainland and still have fuel for half an hour of flight as a safety margin. Since 2008, the company began hiring this type of aircraft from air taxi companies. Currently (2010), there are 15 contracted, 12 of them in operation[5].

However, not everyone will use helicopters on long trips. Petrobras plans to create a maritime

hub, like artificial islands. "The idea is not someone on an island sipping coconut water, sunning," says Albuquerque, kidding. The intention is to transform a platform or a vessel in an intermediate point in the sea[5] (Figure 2).

Figure 2 Airports and maritime hubs[5]

In a study plan, employees will arrive in ultra-fast boats, transfer to the maritime hub and from there, they will take a midsize helicopter that accommodates 12 passengers to go to the platform at the pre-salt area (Figure 3). The boat, a kind of ferryboat, will go at 30 knots - the equivalent of 55 kilometers per hour - and the travel may not last more than five hours, depending on the well-being and passenger comfort. On the journey, time for a nap or watch a movie. The boats may have 400 to 500 passengers accommodated in the same kind of seats used in cinemas. In the case of artificial islands, Petrobras is studying creating accommodations and helidecks. It is still defining the best format of the operation scheduled to begin in 2014[5]

Figure 3 Pre-salt logistics shore to hub[5]

To accommodate the new operations, Petrobras plans to expand its logistics base ashore by 2017. Today, the company operates seven airports and provides three bases for takeoff and landing of helicopters. A new in Campos (RJ), another brand new in Itaguai (RJ) and a third in Santos Air Force Base, which is, ironically, in Guarujá (SP). In the case of ports, the idea is to also build three new bases for the current four port operations: Anchieta (ES), Itaguai (RJ) and Santos (SP)[5].

Currently, the production of pre-salt occurs in eight different platforms, four of them producing only in the pre-salt layer. Between 2014 and 2016 another 11 new platforms will come into operation for the production of the pre-salt oil: Ten in the Santos basin and one in the Campos basin. This will allow production operated by Petrobras in the pre-salt layer, already in 2017, to exceed 1 million barrels per day[6].

It is important to say that this research is based on the previous described scenario and on its associated hypotheses.

Due to economic constraints, the decision to build many of the above proposed equipment and installations have not been made yet.

SAFETY ISSUES

The work in an offshore rig is very risky and, almost daily, air ambulance helicopters are called to transport sick or wounded personnel to hospitals ashore. They are equipped with the necessary medical apparatus, work on a 24/7 basis and, other than the pilot, they are crewed by one Physician and one Nurse. Some are able to carry two patients simultaneously.

According to Carvalho[7], the average periods of time for an air ambulance supporting the oil rigs at Campos basin are as shown in Table 1.

Table 1 – Average period of time in minutes

Actioning and take-off	39
Actioning and landing at oil rig	84
Time at rig	22
Flight time	117
Actioning and return to airport	156

72% of air ambulance mission flights[7] are during the day. In percentage terms, 57% of them involve disease; 43%, accidents.

FACING THE CHALLENGE

From the earliest days of warfare, attacks from the sea usually were limited and generally ineffective due to logistical problems and a lack of equipment suited to the task. Coastlines were accepted as barriers to any attempts to wage war by using the

oceans to stage, assemble, and deploy troops against an enemy[8].

With technological progress and the various conflicts in the last hundred years, conducting amphibious landings has become increasingly important, with the United States being its main performer. This led to the development of a number of specialized vessels (e.g., Figure 4).

With the start of the employment of the helicopter in war operations at the end of World War II, was only a matter of time until it was integrated into the concept of amphibious assault, becoming a major tool for the transport of troops to the disputed areas.

Figure 4 USS Saipan[9]

The LHA (helicopter landing ship, assault), or Tarawa class, was designed in the late 1960s to supplement and ultimately replace the LPH (landing ship, helicopter) and LPD (landing ship, dock) classes that were limited in the amount of vehicles, stores and helicopters they could carry. LHA construction was to have totaled nine, but four were cancelled with only five built. LHA hulls are 833.7ft - 250m long, with a beam of 106ft -31.8m (extreme beam width with side elevator horizontal is 132ft – 39.6m) and a draft of 25.9ft – 7.77m. Tonnage ranges from 27,195t (light) to 39,967t (full load). A hospital facilitiy of 352 beds with four operating rooms and a mortuary were designed into the ships. All interior spaces are air-conditioned. Each can carry enough food, water, fuel and facilities to sustain five thousand people aboard for up to six months, but in an emergency up to eight thousand people can be handled for a short period. Vehicle storage space amounts to 24,416ft^2 – 2,197m^2 (Figure 5). When vehicles are driven into the ship, and secured or positioned for unloading, forced air ventilation systems prevent the buildup of engine exhaust fumes. Palletized cargo spaces total 107,000ft2 – 9,630m2 [8].

Figure 5 – USS Tarawa[8]

Figure 6 - USS Peleiliu[8]

Approximately 1,200t of JP-5 aviation fuel and 50t of fuel for vehicles can be carried. An aft-well dock (Figure 6) or docking well 250ft – 75m in length, 76ft - 22.8m wide, and 26ft – 7.8m high is able to accommodate four LCUs (landing craft, utility) or seven LCMs (landing craft, mechanized) or one LCAC (landing craft, air cushioned). An overhead monorail system allows vertical loading and unloading of vessels in the docking well. Two elevators (one twenty-ton capacity on the port side, 50 by 34ft – 15 by 10.2m folding; the second of forty-ton capacity, aft, 59.75 by 34.75ft – 17.92 by 10.43m) deliver aircraft from the hangar deck to the flight deck[8].

It is suggested the acquisition of the three remaining ships of this class that have been decommissioned, to be retrofitted and adapted to civilian operations, with the removal of all weapons and military equipment in order to allow them to be used as hubs, supporting the distribution of materials and passengers between the coast and platforms. Medium and large size helicopters would transport passengers between the bases on the coast and vessels. There, passengers would be transferred to smaller helicopters, to further transfer to the final destination. This would allow faster distribution of staff. In case of bad weather or helicopter failure, the ships would be equipped to host passengers until the solution of problems that hindered their journey. Another important function would be serving as a base for Search and Rescue teams decreasing the response time in case of accidents. The ship's hospital would also serve to

give a first and faster service to accident victims. Helicopters could be undergoing maintenance inside the ship's hangar that would act as a maintenance service center.

The docking well could be used for the mooring of boats carrying cargo and passengers or even as a basis for fast rescue or medical evacuation (MEDEVAC) boats. These vessels operate large aircraft such as the CH-53 Super Stallion whose MTOW is over 30,000kg being fully capable of operating medium and large size helicopters.

These ships (e.g., USS Belleau Wood, Figure 7) are awaiting disposal and could be bought by a reasonable price.

Figure 7 – USS Belleau Wood[9]

DISCUSSION

Two profiles for passengers' transportation are evaluated in Table 2. The first is the operation as-is today, with direct flights between the airports and the oil rigs situated 340km from the shore. In the second profile, a former amphibious assault ship is used as a hub situated 150km from the shoreline. The costs involved in both kinds of operations with different helicopters are compared. The EC-225 has the lowest variable cost for shore to rig flights. It can be observed that, although heavy helicopters have a lower variable cost per flight hour per passenger carried, the use of a hub allows the employment of smaller helicopters that can simultaneously, transport passengers to the various rigs, gaining time and right sizing the transportation. It is important to take into account, that the helicopters analyzed have different variable costs per flight hour and the tables are for helicopters with all available seats occupied.

Travel from the shore to the hub can be made by boat or by helicopter. Setting aside the boat option, any of the helicopters listed as in-use in Brazilian offshore operations, could reach the hub fully loaded.

This study also considers the option of using heavy helicopters to decrease the number of landings on the hub, while maximizing the number of passengers transported. With the passengers already in the hub, a more adequate helicopter choice could be made in order to speed up the delivery of the passengers to their destination, and also keep the costs the lowest as possible.

Table 3 shows the total cost of transport to a rig 340km from shore and 190km from the hub using two helicopters. A combination of EC-225 for the shore to hub leg only, and all the others for the hub to rig leg. Even another EC-225 could be used to carry passengers to rigs, depending on the demand.

Table 4 shows the total cost of transport to a rig 340km from shore and 190km from the hub using a combination of S-92 for the shore to hub leg, and all the others for the hub to rig leg.

Beyond the transportation aspects, one also has safety issues due to the long time that will take to perform a MEDEVAC of any sick or wounded person. The distances from shore are in average three times greater than the ones at Campos's basin. The use of the ship as a search and rescue base and hospital for emergencies can be a very important advantage. Rescue boats could be placed at the aft-docking well, enabling them to reach any rig in less time than shore based ones. In the same way, a MEDEVAC helicopter could be based on board, reducing dramatically the time from accident to first hospital care.

Inside the ship's hangar a maintenance center could be established and perform scheduled inspections, avoiding the necessity to send the helicopters back to the shore and this way, increasing theirs dispatch reliability.

Table 5 lists the pros and cons for the ship acquisition and operation as a hub for the pre-salt oil rigs support. It must be said that this pros and cons analysis is still in a very early stage. More data regarding the costs of the ship retrofitting and hub operations are needed to promote a more precise, effective evaluation.

CONCLUSIONS

The acquisition of amphibious assault ships of the Tarawa class and its use as a hub strategically

positioned between the pre-salt fields and bases ashore shows itself as a technically interesting option for Brazilian offshore operations.

A bigger and better support in terms of operational safety, logistics, search and rescue, and medical aid in case of accidents, are some of the benefits of using these vessels.

The facilitation of the maintenance of the helicopters enabling an increased availability for the fleet could also be a benefit arising from these hubs.

In summary, it is recommended the acquisition and use of the ships as leverage points to Brazilian oil production operations.

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Table 2 - Costs per helicopter for offshore operations [10], [11](*)

Aircraft	Variable cost/FH (USD)	Pax without hub	Variable cost/Pax without hub (USD)	Pax with hub	Variable cost/Pax with hub (USD)
AW-139	2,167.00	12	180,58	15	144.46
EC-135	1,090.00	0	N/A	6	181.67
EC-155	1,751.00	7	250.14	11	159.18
EC-225	3,205.00	24	133.54	24	133.54
AS-365	1,691.00	2	845.50	8	211.38
S-76	1,989.00	9	221.00	12	165.75
S-76A	1,989.00	9	221.00	12	165.75
S-76C+	1,867.00	9	207.44	12	155.58
S-92	3,312.00	19	174.31	22	150.54

(*) EC-225 and S-92 operating for Petrobras carry a maximum of 19 passengers and a flight attendant

Table 3 - Total cost from shore to rig using EC-225(**)

Aircraft	Cost Shore to Hub EC-225 (USD)	Number of pax	Cost Hub to Rig (USD)	Total Cost (USD)
AW-139	133.54	15	144.46	278.00
EC-135	133.54	6	181.67	315.21
EC-155	133.54	11	159.18	292.72
EC-225	133.54	24	133.54	267.08
AS-365	133.54	8	211.38	344.92
S-76	133.54	12	165.75	299.29
S-76A	133.54	12	165.75	299.29
S-76C+	133.54	12	155.58	289.12
S-92	133.54	22	150.54	284.08

(**) EC-225 and S-92 operating for Petrobras carry a maximum of 19 passengers and a flight attendant

Table 4 Total cost from shore to rig using S-92(***)

Aircraft	Cost Shore to Hub S-92 (USD)	Number of pax	Cost Hub to Rig (USD)	Total Cost (USD)
AW-139	150.54	15	144.46	295.00
EC-135	150.54	6	181.67	332.21
EC-155	150.54	11	159.18	309.72
EC-225	150.54	24	133.54	284.08
AS-365	150.54	8	211.38	361.92
S-76	150.54	12	165.75	316.29
S-76A	150.54	12	165.75	316.29
S-76C+	150.54	12	155.58	306.12
S-92	150.54	22	150.54	301.08

(***) EC-225 and S-92 operating for Petrobras carry a maximum of 19 passengers and a flight attendant

Table 5 – Pros and cons for the ship acquisition and operation as a hub

Pros	Cons
Acquisition cost	Retrofiting cost
Reduction of the distance of flight without support.	
Improvement the safety margins	Operational cost
Ship design especially for multiple helicopter operations.	Maintenance and crew cost
Quick MEDEVAC support	Cost of crew and equipment
Maintenance support	Cost of personnel and equipment
Improvement of logistics	
Lodging	Cost of personnel and equipment
Storage of supplies	
Hospital	Cost of personnel and equipment
Intermodal transportation possibilities	

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