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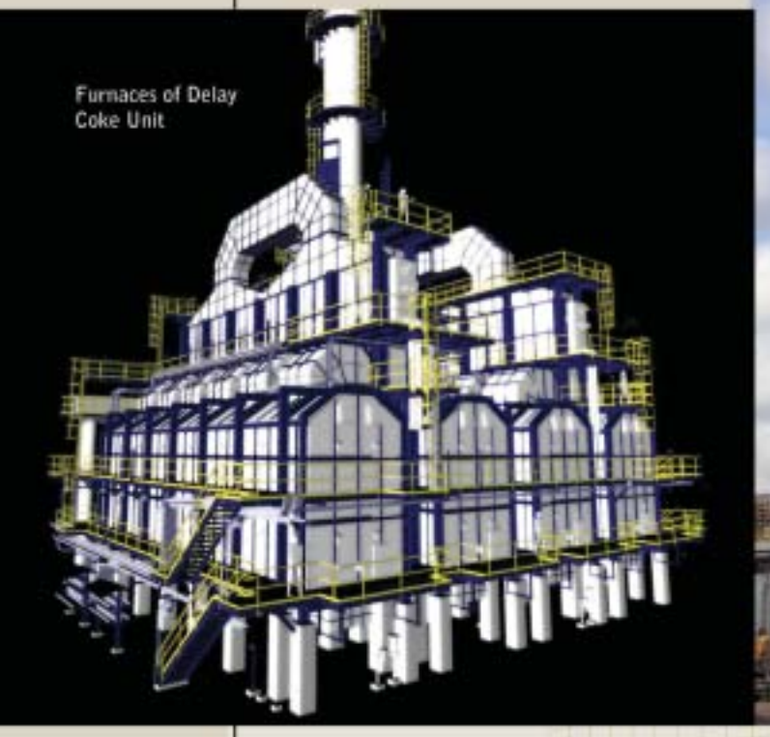
Formigli Interview


Costa Fraga Interview

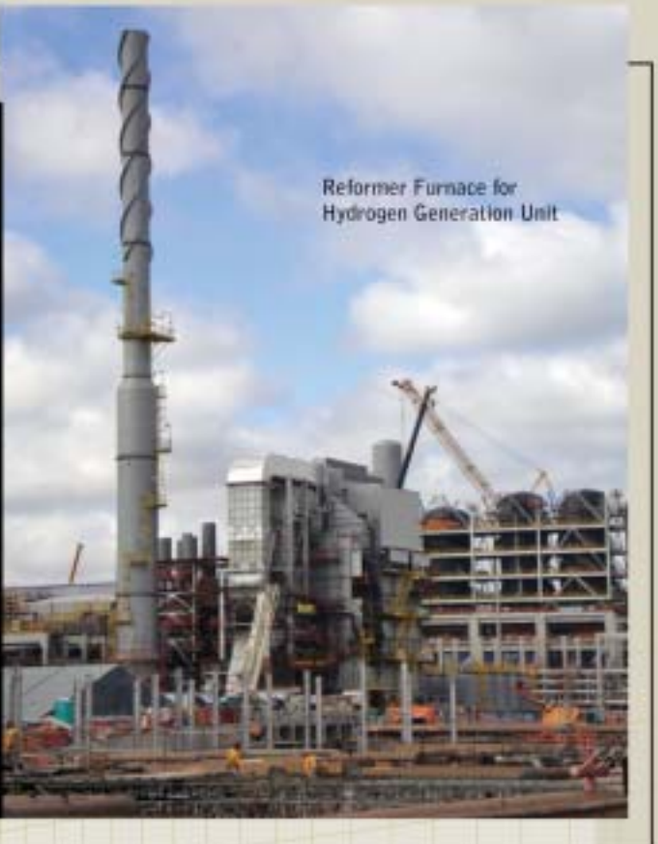

Azevedo Interview

RIO OIL & GAS 2010 SPECIAL ISSUE


Petrobras Image of Pre-Salt.



Furnaces of Delay
Coke Unit



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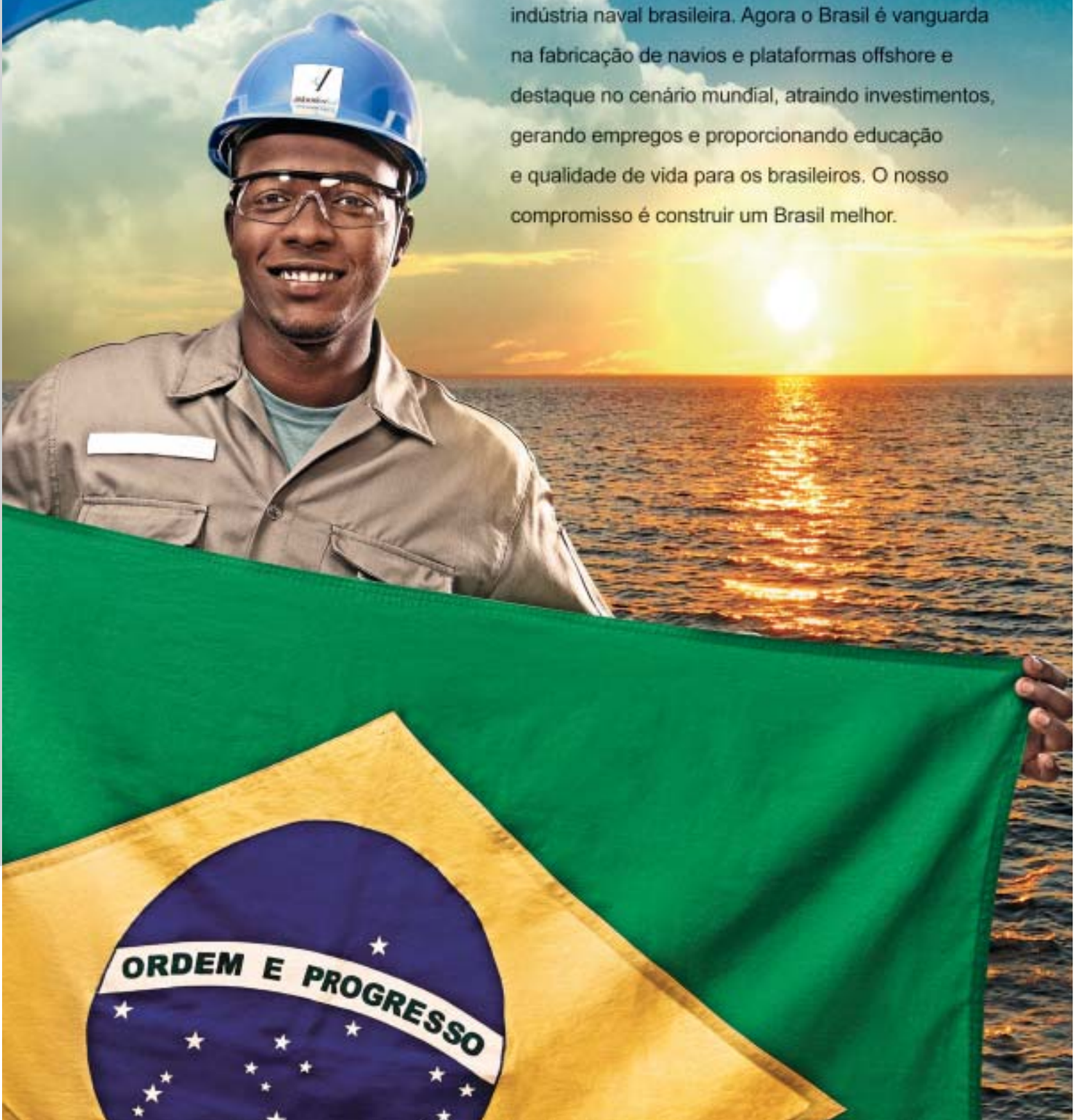

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Petrobras and the Tupi Extended Well Test

By Petrobras News Agency.

Q: Brazil Oil and Gas – What knowledge has been gained from the Tupi Extended Well Test?

A: Formigli – In early May, we completed a year of production in the Extended Well Test. The well is called RJS-646 and is in the Tupi block, in B-MS-11. The results have been extremely consistent with what the reservoir staff had anticipated and with the expected flow assurance. In other words, the reservoir's behavior in terms of oil and gas flow through the reservoir rock, in this case a microbiolite, which is the carbonate we produce in at the site, has behaved exactly as the simulations had predicted. This is very important because it causes a large decrease in the natural uncertainty that surrounds developing a field of such proportions, in a sort of reservoir that is unusual as a hydrocarbon producer in the world. We also had the effects of the EWT production on the drilling of some wells that are already in a definitive system, which is important because it ensures good continuity to the flow through the porous medium, in other words, good communication in the reservoir, which, in turn, has positive effects when we undertake water and alternated water and gas injection because it allows us to foresee the efficiency of this secondary recovery will be good. It is important because it will have a good increase in the recovery factor and, hence, in the future, a larger volume of reserves that we will be able to produce from in the block.

Q: Brazil Oil and Gas – Doesn't this production in testing conditions use water and gas injection yet?

A: Formigli – No. The well the EWT is being done through is a single producing well. The pilot, which will come into production perhaps next November, will have flow wells and water and alternated water and gas injectors, in addition to CO_2 injectors. The CO_2 is that which is produced through the well's gas flow. The CO_2 content in Tupi is around 12%. This cannot be done in the EWT because we do not have more than one well in order to produce from one and inject in the other.

Q: Brazil Oil and Gas – How long is the Pilot Project expected to last?

A: Formigli – It was designed, in terms of the useful life of the platforms and equipment, for the entire concession time, but the pilot phase will last the first two years. If all goes well, it will then become a definitive system and we will increase the number of flow and injector wells. At a first moment, there will be eight wells, of which five flow wells and three injectors. We will call it definitive in the future, but for now we call it a pilot on account of the need to eliminate uncertainty, which is natural in all Petrobras projects in major fields, which always begin with EWTs, go on to the Pilot Project phase, and then to the Definitive System.

Q: Brazil Oil and Gas – In this transition from the Pilot Project to the Definitive System, will the FPSOs be substituted for other types or will they remain the same?

A: Formigli – For this phase we're talking about, they will remain FPSOs. We have divided the development of the Santos Basin pre-salt into three phases. The first is Phase 0, which includes the EWTs, with the Tupi pilot plus the exploratory wells that are still being drilled in the blocks as they have not been declared commercial yet. The first to take place is that of Tupi, late this year. Then there is phase 1A, which consists of 10 units: two pilots, one in Guará and one in Tupi Northeast, which have similar characteristics but are larger than Tupi. We were more daring because we noticed that the reservoir behaved very well, so we decided to increase production from 100,000 barrels of oil per day to 120,000 bpd, in addition to 5 million cubic meters of gas. Furthermore, we have eight replicant FPSOs, which are new units, focusing on definitive units from the start and will be installed in blocks B-MS-9 and B-MS-11. The current phase is that of design for the surface production facilities and early bidding for a few critical devices. There was a tender for eight hulls and we are currently discussing with our partners the final allocation and hiring of eight hulls from the company which was the winner.

Q: Brazil Oil and Gas – Is the planned production for the Tupi pilot actually 100,000 barrels per day?

A: Formigli – Production will increase as the five wells are interconnected. The average production per well will be some 20,000 barrels. We will have about 4 million cubic meters of gas, of which 3 million will be exported or reinjected. The rest will be consumed as fuel in the platform and another part is CO_2, which will be reinjected.

Q: Brazil Oil and Gas – Is there a forecast regarding when the 100,000 barrels will actually start being produced?

A: Formigli – Yes. By the end of the second half of 2011. We have to continue drilling the flow and injector wells and, fortunately, we have several other projects.

Q: Brazil Oil and Gas – And what can we expect from the EWT for Guará?

A: Formigli – The first oil is foreseen for the second half of 2010 and will be produced by an FPSO. However, it is unlike the FPSO for the Tupi EWT, since the BW Cidade de São Vicente platform is an anchored unit that produces from a satellite well that is interconnected with the wet Christmas tree installed in the well on the seabed and to the FPSO, through a flexible line. In fact, Petrobras had already contracted these vessels before the significant discoveries that were made in the pre-salt because we needed them for other applications. With the discoveries in the pre-salt, we diverted the program in order to allocate this unit to the Guará EWT. The unit is called a Dynamic Producer and belongs to a Brazilian company called Petroserv. It is in its final conversion stage in Singapore and is slated to arrive in Brazil in late June or early July to begin production in August or September this year. It is a dynamic positioning unit that remains over the well. The wet Christmas tree is connected to the platform by means of a rigid completion riser, not a flexible one. On top of the unit, there is a small probe that allows these risers to be handled and, also, a plant that can process up to 20,000 barrels of oil per day, consumes the gas for energy and burns the remaining gas. In this respect, it is similar to the Cidade de São Vicente.

Q: Brazil Oil and Gas – Why the choice for using different platforms?

A: Formigli – If we had to label one as being different, it would be the FPSO Cidade de São Vicente because when we hired the Dynamic Producer vessel, it was based on the model of a vessel that has been in operation with us for many years and has a successful design. When we discovered the pre-salt, we decided to anticipate the EWT. The vessels that were available in the world were of the anchored, not of the dynamic positioning type. There are not many of such units ready. The one we hired went through a conversion period. The two concepts are entirely viable. The dynamic positioning one can be positioned over the well, allowing for the use of a shorter line (completion riser) between the well and the unit, affording flow advantages. Transferring the tenancy for this type of unit is also quicker. On the other hand, the anchored type has a less expensive area rate because it has fewer resources on board. There is this compromise solution that is being balanced. Solutions often vary according to the market. We will use these two types of units with all of the EWTs we carry out.

Q: Brazil Oil and Gas – What challenges have been overcome, since the first well to date, in the pre-salt?

A: Formigli – Petrobras' efforts to identify the potential of this area got underway in the 1990s, when our geologists and geophysicists started assessing what might be hidden under the massive layers of salt present in the Santos Basin. The existence of a hydrocarbon accumulation there was perceived as fairly possible by the geologists because salt is an excellent waterproof barrier. They worked hard to create a geological model, which is how

these professionals imagine that nature acted over the million years leading up to today. In the model that was conceived, it made sense to have oil accumulated in the region. This allowed Petrobras to be quite aggressive, in 2000 and 2001, in bidding for the acreage that the ANP tendered in the two bidding rounds. We were successful and won the status of operator for six of the seven blocks. And we partnered with Esso in the seventh. With this amount of areas, in 2001 and 2002 we undertook the biggest deepwater seismic acquisition of the time aiming to cover several million square kilometers of area. Later, the same geophysicists and geologists worked on developing algorithms that would allow the processing of the physical lines in such a manner as to make what might be nestled underneath the 2km of salt more visible. This is fundamental in order to approve leases, which are huge investments made in drilling wildcat wells.

The first wildcat started being drilled in the area in 2005. To achieve this, Exploration & Production and CENPES (Petrobras' Research and Development Center) made large investments in well-drilling technology to determine the best way to cut through the 2 km of salt. The salt is very fluid and, although in that state it is a rock, it can swell when the well is drilled, which, in turn, may cause well walls to collapse. Furthermore, we must scale the casings in such a fashion as to withstand the forces present in the salt that induce shear stress that can cause the disruption and loss of well casings. With this in mind, we started drilling the first wildcat in the Parati area. This drilling took a long time to be completed and cost $230 million. The investment focused on two aspects: the first was to prove that geologic model, in other words, to discover hydrocarbons under the salt; the second was that the well would serve as an excellent school to practise the theories that were developed to drill in the pre-salt.

In 2006, we got proof of the fact that there were hydrocarbons in the Parati area. Thus, we started drilling other wells which led to other discoveries such as Tupi, Tupi Nordeste, Júpiter, Guará, Iracema, Carioca, etc. The techniques have evolved and we now have much lower well-drilling costs, something around $70 to $80 million. We started making discoveries that required care in meeting these challenges. I would like to state, however, that we are talking about design optimization challenges. Putting the EWT into production proved there is no such thing as an insurmountable obstacle. Among the challenges, I would highlight the presence of CO_2, which is a contaminant. The CO_2 is usually removed from the gas that is produced, which is vented to the atmosphere. We believe that over time there will be restrictions on such emissions. Thus, Petrobras is designing projects in order to reinject the CO_2 into the formation. To do so, it is necessary to compress the CO2 under high pressures, something that requires the preparation and installation of CO_2 compressors. In fact, the level of compression applied to the CO_2 is so high that it is more than a compressor, it is a pump, because the gas is in the liquid form. The CO_2, when in contact with water – and every oil well after some time in production starts to produce water – produces carbonic acid. And if you do not prepare the inside of the plant, corrosion will set in. It is therefore necessary to prepare the path for the oil, from the reservoir to the plant, with coatings or special alloys capable of coexisting with the carbonic acid. This is not an obstacle: what we have to do is work with the least expensive alloy or coating as possible, one that will ensure the field's productive range.

Another challenge is reservoir characterization, which requires having good knowledge of the properties of the fluids held in the reservoirs. We got this knowledge with tests such as the EWT, during which you fine-tune the simulators with production results, both in terms of flow and pressure; with work that is done in other appraisal wells, including the collection of witnesses, which are intact cylinders collected from the reservoir rock or from the salt in order to study, in the laboratory, the characteristics of the different formations and their impermeability. We call this reservoir characterization. With it, we have better production forecasting conditions and optimize the geometry of the wells, which helps us not only try to decrease the number of wells needed to make a greater recovery of the hydrocarbons from the reservoirs, but also couple this with greater productivity. When you have that and a smaller number of wells, there is a investment needs decrease.

Another challenge we can highlight is the fact that the pre-salt is about two times further away from the coast than the Campos Basin. This brings about oil and gas transfer challenges, causing us to often analyze not only traditional relief vessel solutions – which in the pre-salt case will be dynamic positioning ships as already used in the Campos Basin – but also intermediate stations that allow the transfer of oil from these vessels, which have a higher area rate, to conventional vessels when the oil is transported over long distances. These issues are important to our partners, for example, when they decide to export the oil. To Petrobras, it is also important because refineries are being built in the northeast and there will

This vision is the next step in managing operations in all of the expertise we developed in the Campos Basin and also in Santos Basin, so that we can use our experience in the pre-salt, but not replicate exactly what we have already done.

be a greater distance to take the oil to Pernambuco, Ceará, Maranhão, etc.

Q: Brazil Oil and Gas – Apart from the oil, how will the gas be transported?

A: Formigli – Regarding gas, we are launching a gas pipeline that will link the Tupi area to the Mexilhão platform, which is already installed. The gas pipeline will be interconnected between the platform and a terminal in Caraguatatuba. At first, the Tupi, Guará and Tupi-Nordeste gas will flow through this pipeline, which is capable of transporting 10 million cubic meters of gas. We are working on alternatives that might allow for bigger flows, whether associated to another gas pipeline and/or to what we call onboard liquefied natural gas (LNG). The difficulty is that when in a gaseous state, it is necessary to give a destination to the molecule when it is produced. When in liquid form, as is the case with oil, you can always store it and decide what to do with it at a later time. The gas pipeline is a form of transportation in which the gas must have a pre-defined destination, and this can cause trade complications. Therefore, the solution to liquefy the gas is an excellent business strategy tool.

Q: Brazil Oil and Gas – Are there other logistical challenges?

A: Formigli – The distance brings about the need to optimize life support and the offshore operations. The transportation of people, of cargo, ranging from piping, bulk materials, chemicals, food and even diesel to the drilling rigs. This leads to a very large flow of goods from land to sea and from sea to land. Knowing how to properly position the locations on the coast from which we will provide this support to the platforms is critical. So is deciding on the best mode to do this over. The E&P Services management is working on identifying the best areas on the coast to install ports and airports - places from where the helicopters will take off – and intermediary diesel, drilling fluid and even people hubs, because there may be a large transport capacity to an intermediate hub and then the staff can be distributed to the platforms on smaller helicopters. Another issue that concerns us is communications. In the second half of the 1990s, we installed a fiber optic ring in the Campos Basin that is now the mainstay of voice and data transmission between sea and land. In the Santos Basin case, we realized that the sooner we can launch the fiber optic ring, the better. This vision is the next step in

managing operations in all of the expertise we developed in the Campos Basin and also in Santos Basin, so that we can use our experience in the pre-salt, but not replicate exactly what we have already done.

Q: Brazil Oil and Gas – How does CO_2 reinjection work?

A: Formigli – In the case of the pre-salt, along with the gas that is produced, there is a contaminant, which is CO_2. On the surface, it is necessary to separate the CO_2 from the hydrocarbon, since there is no commercial interest in CO_2. Furthermore, there are standards set by the ANP regarding the maximum amount of CO_2 that can be delivered to the customer. Thus, we use special equipment to retain CO_2. There is a simple way to deal with the CO_2 that has been retained, which is to blow it into the atmosphere. We believe that the volume that we will produce, in the medium and long terms, would represent a very large amount, so we decided to reinject it into the reservoir. To achieve this, it is necessary to drill wells which, instead of producing oil, will be used mainly to inject CO_2 back into the reservoir. This CO_2, at the plant, is separated from the gas and there are compressors that increase its pressure to more than 500,550 bar, which is a unit of pressure, and under such pressures it returns to its liquid state. This mass of fluids is injected back into the reservoir. And, by means of a process that resembles production very much, the flexible line, wet Christmas trees, well, and reservoir path is recreated and the CO_2 is injected. It is also important to monitor where that CO_2 is moving to in the reservoir. To achieve this, we will use simulators that can predict where it will go, in addition to certain pressure, flow and CO_2 content parameters in the other wells in order to know how that CO_2 front is stretching, spreading into the reservoir.

Q: Brazil Oil and Gas – What about oil transportation that can be done closer to the platform and by other vessels?

A: Formigli – We have an intermediary hub we call the Offshore Transfer and Export Unit (UOTE). This will be a unit consisting of one tanker, which is called FSO, since it does not have a plant; it is only a Floating Storage and Offloading unit and only has tanking. With this system, the relief vessels can go up to it and transfer oil from the dynamic positioning (DP) vessel to a conventional one. Other modes that we are investigating this year include a pipeline, in other words, in addition to the transfer done via vessels, we are considering a pipeline to go onshore and, when coming ashore, distributing the products to the refineries in the São Paulo – Rio de Janeiro area. Furthermore, we can also imagine that instead of having the DP vessel we can undertake the operation at the FSO. This concern is because the DP vessel is more expensive than a conventional ship. All these concepts are being evaluated. In concrete terms, what we have are the dynamic positioning vessels and this intermediate unit that I called UOTE, which has already been approved and which we are already deploying. We are working on the pipeline, both technically and economically, and on these other concepts of monopoly in deep waters and deep water docking to see how competitive these concepts are and what other solutions we may have.

Q: Brazil Oil and Gas – Is there anything you would like to add?

A: Formigli – The amount of effort the pre-salt demands affects all company areas. An example is this project's fundability, which is extremely critical. So the financial area is present in this master plan. We provide them with our investment and revenue need forecasts so they may seek funding solutions. The legal department is also important because it gives us all the support we need for the business strategies prepared to approach the market. Petrobras' legal department is present, ensuring this alignment of the goals and the feasibility for these market strategies. All Petrobras areas are involved because of the magnitude of the investment and of the volume of oil and gas to be produced, something that will certainly change the current production and marketing logic, in other words, involve refining and distributing all of these products we will have in coming years.

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Petrobras: Research and Development in the Pre-Salt

By Petrobras News Agency.

The Executive Manager for Petrobras' Research and Development Center (Cenpes), Carlos Tadeu Costa Fraga, speaks about the company's investments in research and development in Brazil, and talks about the challenges brought about by the pre-salt.

Q: Brazil Oil and Gas – How has Petrobras' investment in research and development (R&D) transformed the Brazilian technological park in the energy area?

A: Carlos Tadeu – For five years in a row, Petrobras has been among the eight biggest investors in research and development in the oil and gas industry worldwide, including oil and service companies. Our investments added up to approximately $900 million in 2008 and 2009 alone. This level of investment was a significant part of the development of research projects in cooperation with Brazilian universities. This research, in particular, the partnership with Brazilian universities, has given us a chance to build, together, and using part of these resources, experimental infrastructure that did not previously exist in Brazil. Petrobras is fully aware of the most important offshore exploration and production laboratories in the world, and we, through the investments we have made over the past few years, are reproducing the labs we used to use the most abroad in Brazil. The investments made in universities, together with the investments we are making in the expansion of the Cenpes, are turning the domestic technological park in the oil and gas area into one of the best equipped in the world.

An important effect of this movement is the perception, by our major international suppliers, of the existence of this technology park in Brazil. Considering the interest among these suppliers to establish even more intense commercial ties with Petrobras in response to orders coming from the pre-salt, we are also taking advantage of this to develop deeper intellectual relationships with these suppliers. In other words, undertaking research with these suppliers in Brazil. So, in sum, international suppliers are building research centers in Brazil. This is a move the press has dubbed "the creation of the pre-salt's Silicon Valley". Of course, the pre-salt is not the only thing that stands to benefit from this. Discussions have already been surfacing about collaboration in the refining, natural gas, biofuels, and environment areas. This is certainly a movement that is starting to afford benefits to Petrobras and is becoming known by the international industry.

Q: Brazil Oil and Gas – How many networks, research centers, and universities are involved in this process?

A: Carlos Tadeu – We currently have 50 networks, which work in total alignment with our technological challenges. We singled out 50 topics that are of technological interest to Petrobras with those Brazilian universities which have the most training in each of the themes worked on under each of the networks. Across the networks, we have about 80 universities and research institutes participating in the effort in Brazil. This is a nationwide movement. There are many universities in Rio de Janeiro and São Paulo, obviously, but several of them are in Northeastern, Southern, Northern, and Midwestern Brazil too. The constructed area of the new or refurbished laboratories at these universities adds up to four times the area of the Cenpes. It is as if we had multiplied our experimental capacity fourfold with the construction of these networks and their associated infrastructure.

We are increasing our international cooperation – we are bringing foreign universities into the loop to participate in these networks. Today, we are able to attract foreign researchers to Brazil because we have more appropriate laboratory facilities here, and they can impart knowl-

edge, build critical mass, and help us increase the amount and the quality of the research human resources in Brazil. Companies are coming to the technological park at the University City located on the Ilha do Fundão (RJ). Four companies have already stated their intention to settle here. Schlumberger, a leading global provider of specialist exploration and production services, Baker Hughes, which is a major Schlumberger competitor and also a Petrobras partner of many years – both companies with very high investment capacities in technology – and FMC Technologies, the world's largest manufacturer of marine oil production equipment. These three have made their investment decisions, as has Usiminas, which is important because it is the first Brazilian company to make this move, as it is interested in undertaking research in materials for the pre-salt with Petrobras. Usiminas has also stated its intention to install facilities here, and we are only waiting for the university's approval, something I believe will soon happen. And, following the lead of these four companies, we have information that several others have similar plans. Some will settle in Rio de Janeiro, others in other states, and our aim is that they install themselves in Brazil with research activities so that they not only have manufacturing plants here, but also do research in the country in partnership with Petrobras and Brazilian universities. In practice, Petrobras has built a joint research project portfolio with each of these companies, in which we invest money and human resources.

Q: Brazil Oil and Gas – Based on this scenario, what are the next steps Petrobras will take in R&D in the upcoming decades?

A: Carlos Tadeu – The establishment of this technology park will certainly afford a major leap forward in the possibility of carrying research out in Brazil. But we will not put our international involvement on the back burner. In a globalized world such as the one we live in,

knowledge can be present in other centers of excellence, and we must pursue it, but we increased Brazil's coordination capacity with other important centers around the world. Petrobras has three major R&D lines: the first line seeks to expand the current boundaries of the oil and natural gas exploration, production, and refining businesses. Petrobras has given more emphasis to the second line each year, because it is the one that seeks to increase the range of energy products the Company provides to society. This second line includes renewable energy, and major emphasis is placed on biofuel. Petrobras, via Cenpes, is studying and implementing, together with the Company's Gas & Energy area, wind energy, solar energy, and sea energy projects. And the third major axis of the future is the sustainability line. Our operations are carried out with all necessary care regarding environmental protection and social inclusion. In this axis, there are important issues such as reducing water consumption in our operations, since water is an increasingly scarce, valuable resource, and this is a very important matter. Emission reduction is another very important topic. Finally, the topic of energy efficiency, consuming less energy in our processes and ensuring ever better use of the energy that is present in our products so that more people on the globe can benefit from that energy and as a carrier of well-being for the society. Today, a third of the world's population is unfamiliar with modern energy sources. This is amazing in a society that has a great degree of technological advancement that brings us new discoveries each day. Those who produce energy have to do so consuming less and less energy in internal processes, and must provide more energy to society.

Q: Brazil Oil and Gas – And what about the pre-salt?

A: Carlos Tadeu – Yes, the challenge of overcoming technological barriers to ensure access by a growing number of people to modern forms of energy, and doing this sustainably, is happening at a very opportune moment for the Company. Petrobras recently discovered very important oil and gas deposits off the Brazilian coast, in the so-called pre-salt layer, under the salt layer. These fields have the potential, in terms of short-term oil production, that might catapult Petrobras to another level. Petrobras, which had been growing steadily and gradually over its history, can make a great leap in a very short period of time. Obviously, all of the experience Petrobras had previously accumulated on account of its innovations applied to deep waters represents an excellent starting point for us to overcome any challenges we may have to confront in the pre-salt, and places us in a privileged position, not only for having discovered these reserves, but also for having a lot of experience in deep-water operations. The volumes that have been foreseen are enormous, affording a scale that will help us develop the domestic industry, turning it into an even more competitive industry, on an international scale. Human resources will be increasingly necessary for Petrobras, its suppliers, universities, and for the academic world.

All of this introduces a new drive, a new vector of social and economic development in Brazil. The pre-salt is attractive from the technological point of view, presenting issues that Petrobras can work on and improve the methods and processes that we already apply to wells already in production in extended well testing systems, and, more so than for Petrobras, the pre-salt is a great development platform for the country. As it has already done in the past, Petrobras will continue working in coordination with our main goods and services providers, and with universities, and research institutes to seize this opportunity even better. So, the pre-salt is one of the big attractions of the oil and gas industry in the world.

Q: Brazil Oil and Gas – Because it is a new technological frontier?

A: Carlos Tadeu – In some respects. The pre-salt is a new frontier, but the experience of Petrobras in deep waters guarantees us a privileged position. We have an excellent starting point as our experience is recognized internationally and also because it is a new technological frontier. It is interesting because with all this excitement over the pre-salt, Petrobras is also in the U.S., in the Gulf of Mexico. In the Cascade and Chinook fields, it is implementing systems which are innovative to the region, such as the use of FPSO (floating production, storage and offloading) type platform vessels, based on all of the experience we developed in Brazil. When we operate in the Gulf we also incorporate the experiences of other operators, and, certainly, some solutions that are being used, such as, for example, the tension-leg well platforms (TLWP), which we will be able to apply in Brazil, perhaps in the pre-salt, and certainly in other situations, such as in the Papa-Terra field. Petrobras' international presence introduces another benefit, the possibility of using technologies we have developed and implemented in Brazil all over the world, affording Petrobras the opportunity to be in touch with what is being done in another parts of the globe.

Petrobras' Offshore Oil and Gas Exploration in the US

By Petrobras News Agency.

Petrobras is increasingly under the spotlight in the offshore oil and gas exploration and production industry in the United States. Orlando Azevedo, the CEO of Petrobras America, speaks about the expectations for first oil in Cascade and Chinook, and discusses the Company's operations in the Gulf of Mexico.

Q: Brazil Oil and Gas – For those who experience the daily activities in the American oil industry, why is it important to participate in the OTC?

A: Orlando Azevedo – The OTC is one of the most important oil and gas industry fairs. It is a showcase for those who want to put their technology on display or get information to share experiences. That is why it is important to participate in the OTC. And it has become a tradition for Petrobras to have a strong participation in it. In fact, the Company has already won three OTC awards. Therefore, to Petrobras America, it is extremely important to take part in the fair.

Q: Brazil Oil and Gas – What does Petrobras' presence in the US, via Petrobras America, represent?

A: Orlando Azevedo – Through Petrobras America, Petrobras can assess and review its procedures and its performance in a highly competitive market such as the American one. The truth is that it is the world's most competitive market and is a way for the company to show its feasibility, efficiency, and its use of new and complex technologies in such a highly competitive market. That is why it is so important to have a footprint in the US. In a few months, Petrobras will kick production off in the Cascade and Chinook fields, in the Gulf of Mexico.

Q: Brazil Oil and Gas – Is this likely to be a major theme during the OTC?

A: Orlando Azevedo – Yes. Indeed, since Cascade and Chinook will go into production in the second half of the year, it will likely be an even stronger subject in the next edition of the OTC. Of course, a lot will be discussed on this issue during this conference, as it is our main project. With Cascade and Chinook, we are bringing new technologies into the Gulf of Mexico. This is really a project that is in the showcase, and it is sure to get a lot of attention.

Q: Brazil Oil and Gas – Petrobras was the first company to be authorized to use an FPSO (floating production, storage, and offloading) type platform in the Gulf of Mexico. Did the fact the company is the world leader in deep water exploration and production play a role in this?

A: Orlando Azevedo – Absolutely. Bringing this technology to the United States required monitoring by US government regulators, and it was only possible on account of Petrobras great experience using these types of rigs. In fact, Petrobras owns nearly 50 per cent of all floating units in the world. The runner-up has a mere 15 per cent of them. In other words, we are well ahead and hold a very strong leadership in this area. That is why we have earned the trust of the American agencies, of the Coast Guard, and of the MMS (Minerals Management Service), the agency which, together with Petrobras, created new regulations on the use of FPSOs in the Gulf of Mexico.

Q: Brazil Oil and Gas – Besides the innovation of introducing an FPSO platform there, what other innovations is Petrobras implementing in the region?

A: Orlando Azevedo – In addition to the FPSO, which in and of itself is a novelty in the Gulf of Mexico, the use

Today, the big operators in the industry invite us to participate in farm outs and farm ins, so Petrobras, with its technology and knowledge, can add value to these consortia and joint ventures that are formed here in the United States.

of hybrid risers, rigid risers, is also a new technology that is being deployed in the Gulf of Mexico, and we already use them in Brazil, on P-52. The way it is being submerged is also a new technology. There is also the fact the FPSO can be disconnected, an unprecedented feature in the Gulf of Mexico. So, there are several novelties, all of which are field proved and with low use risk.

Q: Brazil Oil and Gas – Are the Cascade and Chinook fields also a new frontier for Petrobras?

A: Orlando Azevedo – Exactly. It is a new frontier for Petrobras, especially in terms of depth. The FPSO will be submerged at a depth of 2,500 meters. In other words, it will be the deepest FPSO the Petrobras System has ever installed. The reservoir and the well drilling and completion process are also highly complex and sophisticated. The depth of the wells is slightly greater than those in the pre-salt. This all brings new frontiers to Petrobras' operations. And this is only made possible because of our experience, with the help we get from Brazil based on the experience the company has accumulated over its 50 years of existence. And this gives us the ability to operate more boldly on the world's biggest market.

Q: Brazil Oil and Gas – What other production and exploitation activities does Petrobras America have?

A: Orlando Azevedo – We have a rather solid portfolio in the US. In addition to Cascade and Chinook, we hold stakes in the Stones (25 per cent) and Saint Malo (25 per cent) fields, and now in Tiber, which was last year's great discovery and was made together with British Petroleum and ConocoPhillips. British Petroleum currently considers it as the second biggest discovery made in the Gulf of Mexico. Near that great discovery, we have a very interesting prospect for the future of exploration.

Q: Brazil Oil and Gas – What investments can be expected in the coming years?

A: Orlando Azevedo – The investments are connected to Petrobras' business plan. We are making the best use of the investment defined by our parent company in Brazil so that we reach the goals that have been laid out to achieve a production of about 45,000 barrels of oil by 2015, and 110,000 barrels in 2020.

Q: Brazil Oil and Gas – Something else to add?

A: Orlando Azevedo – I find it very important to emphasize that it is feasible for Petrobras to operate in the US market. Today, the big operators in the industry invite us to participate in farm outs and farm ins, so Petrobras, with its technology and knowledge, can add value to these consortia and joint ventures that are formed here in the United States. As regards our history, it is important to stress that our experience over these 50 years is not Petrobras' work, rather the work for Petrobras. All of the support we get from Brazil is fundamental to Petrobras' success and for the company to remain here in the United States.

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Pre-salt: the Technology Challenges Facing the Pipelines Sector

By CTDUT Staff.

In the pipelines segment, the technology challenges facing oil and gas companies producing from pre-salt reservoirs are directly related to the conditions found in water depths exceeding 2000 meters. For instance, such challenging environments require high thermal insulation coatings capable of lowering the temperature of produced oil without significantly increasing the weight and costs of risers. Another challenge is the presence of aggressive fluids, sulphur dioxide, CO_2, high salinity water, which, in combination with oil and gas, causes severe wear and corrosion in currently available risers and pipelines.

Moreover, the flow from the production platform to land, whenever the option is through pipeline, brings the challenge of constructing pipelines which will have to be set down at water depths exceeding 2000 meters and across distances over 200 km.

"In a segment that requires production units to have a working life exceeding 20 years, the use of new materials or innovating known products such as the use of carbon fibre in risers with internal diameter above 8 inches is fundamental for the integrity and long life of the installations. This allows the safe production and the injection of CO2 or other fluids at a reasonable cost," explains Raimar van den Bylaardt, President of the Executive Board of the Pipeline Technology Center – CTDUT.

A technology center dedicated to the development of the pipeline sector, CTDUT has participated in research related to the thermal insulation of risers, in a partnership with PUC – Rio, and, at the moment is considering the construction of new laboratories and the upgrade of some of its facilities for attending the demands of the pipeline community faced to the pre-salt challenges.

"We are prepared for future opportunities, which will come up with the pre-salt," he says. "We have technology, expertise, teaching and research entities, and companies supplying goods and services which have the conditions to meet this challenge," he concludes.

Production increase will require greater transportation and distribution systems

Brazil is experiencing an important moment, of great expectations. With the pre-salt, the country is no more a spectator in the global oil industry scenario. "This is a moment of changes and big challenges. The increase of the production of oil and gas will require greater transportation and distribution systems. Presently, with the inauguration of the Rio de Janeiro-Belo Horizonte gas pipeline, Gasbell II, we depend on a network with 22 thousand kilometres of pipelines in operation. This number may grow, taking into account that we will reach the level of approximately 3.9 million barrels per day in 2020," says Raimar.

According to the executive, despite the fact that Brazil is 16th in the world ranking of pipeline networks, the extension of the national pipeline network is still small if we take into account the massive production of the oil and mining sectors, which are the main drivers for this kind of transportation. The European Union, which has a territorial extension smaller than that of Brazil, operates with 800 thousand kilometres of pipelines.

"The pipeline is a products transportation system which is economic, safe and low pollution. The growth of the network will require more and more complex technologies for an efficient and risk free operation, broadening the opportunities and stimulating the companies in the segment," he states.

CTDUT is to start up, in 2011, a pilot unit for cathodic protection tests

CTDUT will start up, by the first half of 2011, a pilot unit for Cathodic Protection Tests, Research and Evaluation of Anticorrosion Coatings for Pipelines in the country.

The Pilot Unit is being constructed in an approximately 1000 m^2 area and will allow the conduction of tests and simulations of field conditions, through the installation of buried pipelines, lined with different types of anticorrosive coatings, protected by a cathodic protection system made out of rectifiers, anode beds and test points.

Budgeted at R$3,5 million, the facility became viable upon the signing, in October 2009, of a cooperation agreement with Petrobras, that will assume the costs of the unit by using the budget of the R&D (Research and Development) Investments Clause provided at the concession contracts.

External corrosion is one of the causes of leakages in buried or submersed pipelines. The protection of the structures against the corrosive process is presently made by the combination of the uses of Mechanical Coatings and Cathodic Protection Systems.

"With this structure we will be able to simulate technical conditions pretty close to those in the field, making it possible to test new technologies and new practices, besides the study of existing technology in order to better understand potential problems and their solutions," explains Mauro Barreto, vice-President of CTDUT and member of the Brazilian Corrosion Association (ABRACO).

The main objective of the facility is to give support to R&D projects of companies, universities and technology centers. "The field of application of this technology is very wide, comprising from transportation companies and distributors to companies which have buried or maritime pipelines, besides the ones that offer services and equipment for cathodic protection," considers Barreto.

On top of that, the facility will fully comply with the requirements of NBR 43:000.03-001Standard (Criteria for the qualification and certification of cathodic protection professionals) from ABNT/CB-43 – Brazilian Corrosion Committee, being, therefore, fundamental for the adequate training of people to work in this area.

Another initiative involving the pre salt was the creation, in August 2010, of the Valves Competence Network.

The Network goal is to allow the valve manufacture to conform to the Technical Standard NBR 15827:2007 – Regulations for the Evaluation of Conformity of Industrial Valves for Installations for Exploring, Production, Refining and Transportation of Oil Products. "The idea is that the network becomes a space

for the discussion of a laboratory infrastructure for the pre salt," says Raimar van den Bylaardt.

Participants in the Network, besides CTDUT, are the Federal University of Paraná (UFPR), the Federal University of Alagoas (UFAL), the Brazilian Association of the Machinery and Equipment Industry (ABIMAQ), the Research and Technology Development Institute of the Machinery and Equipment Industry (IPDMAQ), the Technology Research Institute (IPT), the Brazilian Oil, Gas and Biofuels Institute (IBP), National Institute of Technology (INT) and COPPE/UFRJ.

About CTDUT

A technology center oriented to the development of the pipelines segment, CTDUT has real scale installations and research laboratories for testing products, equipment and systems used at the pipelines network. The infrastructure offers technical and economic advantages both for the suppliers and the operators, which can, for instance, test new technologies without risks to their operations.

Among the products and services offered are pig tests, pipeline integrity, flow meters and leakage detector tests, coatings, pumps and valves tests, which make CTDUT a valuable facility also for demonstrations, training and professional qualification.

Inaugurated in May 2006, CTDUT was born through the initiative of Petrobras, Transpetro and Pontifical Catholic University of Rio de Janeiro (PUC-Rio). The Center counts on an impressive number of members, including companies, entities, universities and teaching and research institutions. Its facilities were built with resources from the Oil and Gas Sector Fund (CTPetro), allied to the Ministry of Science and Technology (MCT) through the Study and Projects Financer (FINEP).

For more information, contact Helena de Aguilar, Pipeline Technology Center – CTDUT,
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PRICEWATERHOUSECOOPERS

Offshore Pipeline Technology for Deep Water and Rugged Seabed Applications

By Marcelo Caire, Research Scientist, Marintek do Brasil; Egil Giertsen, Research Director, Marintek, Norway.

Pipelines are one of the solutions for gas transportation from the remote and deepwater pre-salt provinces. A 250 km pipeline which connects the Tupi Pilot System to the Mexilhao pipeline is already in place, and several other pipeline networks are under evaluation offshore Brazil. Considering the very deep water and the rugged and irregular seabed, advanced design and installation technology is required in order to make pipelines competitive to LNG, Compressed Gas and Gas to Liquid solutions, both with regard to cost and flexibility.

This advanced technology is now available in a software package called SIMLA. Driven by similar seafloor challenges encountered in the North and Norwegian Seas, the research institute MARINTEK (www.marintek.sintef.no) has developed the SIMLA software – a special purpose computer tool for engineering analysis of offshore pipelines during design, installation and operation.

SIMLA allows 3D visualization of the pipeline on the seabed, also including the results from structural response analyses. It features various models for pipe/seabed interaction, control algorithms for feeding of pipe joints, 3D load model for current and nonlinear material model for the pipe in cases with significant plastic strain.

The SIMLA computer tool was first made available on desktop computers, and was shown to be a robust and efficient design tool. It has then been integrated onboard pipe-laying vessels for analysis and visualization during the lay operation. This provides valuable additional information such as catenary shape including

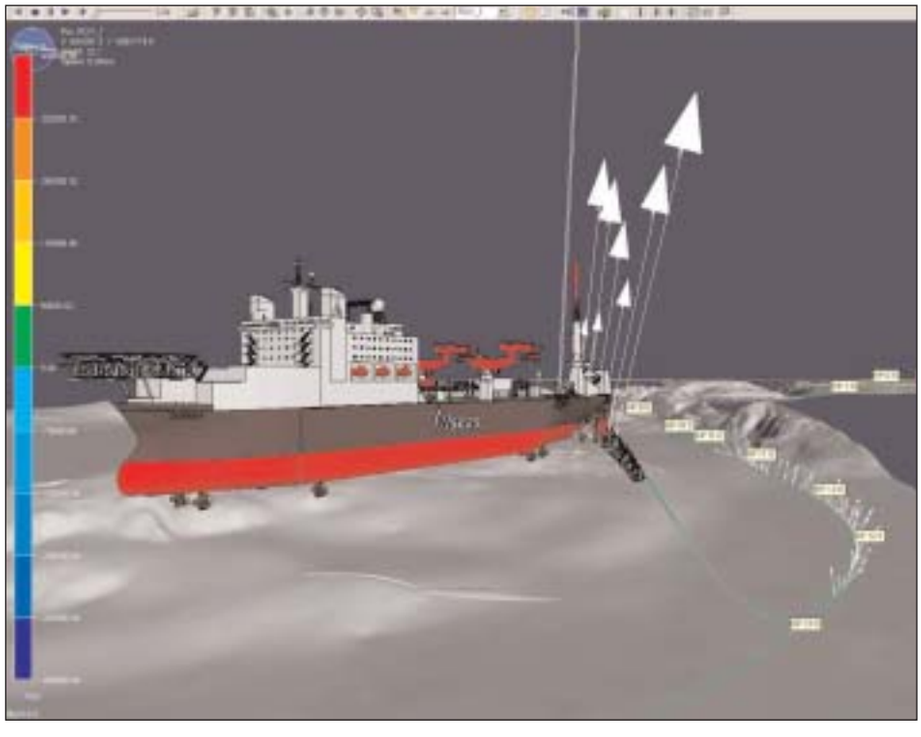


Figure 1: Overview of a pipe-lay operation.

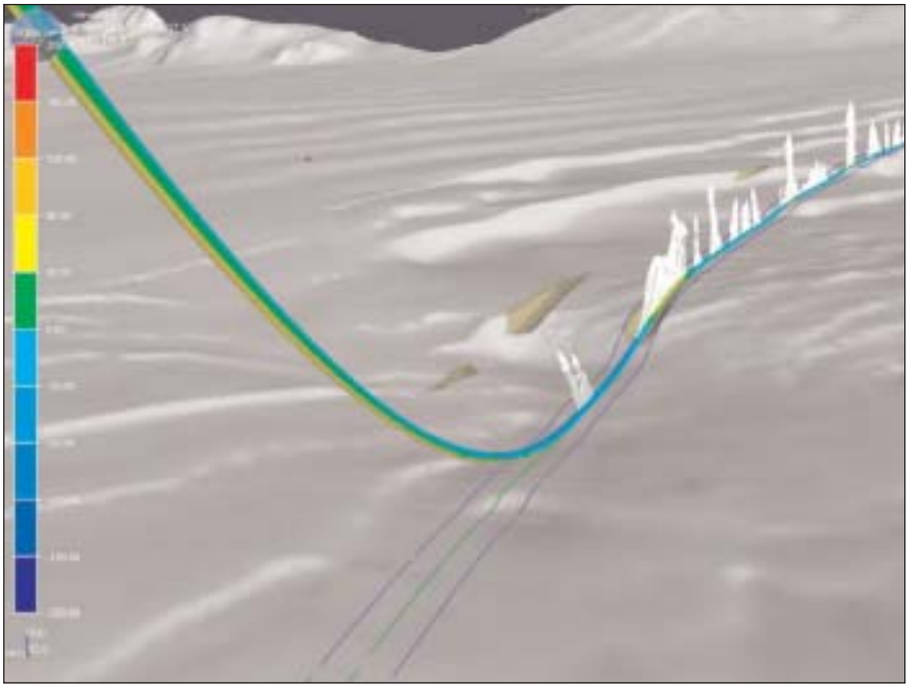


Figure 2: Zoomed view of the touchdown area. Contact forces are represented by white arrows. Stresses on the pipe cross section are mapped on the 3D model of the pipe.

stresses in the pipe, lay tension, sagbed utilization, pipe tension and VIV at free spans and lateral stability. The first version of this 'online' system was successfully field tested during summer 2009 by Acergy at the Ormen Lange field in Norway.

The main "online" output from the tool is a visualization of:

- the seabed with possible intervention work (dredging, rock supports, gravel carpets etc.), including the target route corridor for the pipe,
- the measured position of the lay vessel, and corresponding computed configuration of the catenary,
- the calculated contact forces acting on the pipe from seabed, rollers on the stinger, counteracts or other objects,
- a set of online key parameters as curve plots (top- and lay-tension, lay-back, maximum curvature for the pipe, predicted deviation from target route, and utilized lateral capacity).

It is believed that this technology will help to secure safe and cost effective deepwater pipe lay installation operations also in Brazil. Not only because of the onboard system itself, but also because this technology allows for high quality training and familiarization prior to offshore installation.

For more information contact our local office in Brazil (http://www.marintek.com.br<http://www.marintek.com.br/> MARINTEK do Brasil, Rio de Janeiro, or Egil.Giertsen@marintek.sintef.no at our main office in Norway.

MARINTEK will be present at the Rio Oil&Gas 2010 exhibition, pavillon 4, 'Pavilhão Noruega'.

Petrobras Refineries

Alberto Pasqualini Refinery (Refap)

Established in 1968, in Canoas, state of Rio Grande do Sul.

Area: 5.7 km²

Main products: Diesel fuel, petrochemical naphtha, gasoline LPG, aviation kerosene, fuel oils, bunker for vessels, kerosene, asphalts and solvents.

Background: The youngest of the Petrobras System companies, Alberto Pasqualini - Refap S/A was built in January 2001 as part of an asset exchange between Petrobras and Repsol-YPF. It operates the refinery, which started producing on September 16 1968 and the name of which is a tribute to Rio Grande do Sul senator Alberto Pasqualini (1901-1960), the speaker for the project that created Petrobras in 1953. The refinery is installed on the land that belonged to the old Brigadeira Farm and still preserves the old main house, a construction of the early 20th century.

Henrique Lage Refinery (Revap)

Established in 1980, in São José dos Campos, state of São Paulo.

Area: 10.3 km²

Main products: Gasoline, diesel fuel, aviation kerosene, LPG, asphalt, and sulfur.

Background: Planned in the late 1970s to make the goals of the II National Development Plan feasible, Revap was the fourth and last refinery to go on stream in the State of São Paulo – and the last to be built in Brazil. Inaugurated in 1980, the unit pays tribute to naval engineer Henrique Lage, who died in 1941. He was a great encourager of important sectors of the domestic industry such as mining. Lage pioneered salt extraction in Northeastern Brazil and, in the 1920s, he ordered drilling to be made in search of oil in the Campos municipality (state of Rio de Janeiro).

Presidente Vargas Refinery (Repar)

Established in 1977, in Araucária, state of Paraná

Area: 10 km²

Main products: LPG, gasoline, diesel fuel, fuel oils, aviation kerosene, asphalts and naphtha.

Background: The refinery started being built in 1973 and went on stream on May 27 1977. In the late 1970s, the unit processed 24,000 cubic meters of oil per day. In the 1980s, the refinery enhanced its green areas and installed the air quality measurement stations, marking the environmental awareness that yet today guides its actions. Accounting for about 12 per cent of the national production of oil derivatives, Repar destines 85 per cent of its products to the states of Paraná, Santa Catarina, and Mato Grosso do Sul, in addition to the southern region of the state of São Paulo. The remaining 15 per cent supply other regions or are exported.

The Diesel Fuel Desulpherization Unit (HDS) went online in 2004, processing 5,000 cubic meters per day of diesel fuel, reducing the sulfur content from 2,000 parts per million to only 500 ppm, with expressive environmental improvements. In 2005, Repar set historical noble derivatives production records. They went there to perform the symbolic HBIO production test, officially

Presidente Vargas Refinery (Repar).

placing the Unit as one of the first refiners of a new diesel fuel, which will have vegetable oil in its production process. When the second phase was completed, in 2008, the program was expected to reduce Brazil's diesel imports by 25 per cent.

Paulínia Refinery (Replan)

Established in 1972, in Paulínia, state of São Paulo.

Area: 9.1 km²

Main products: Diesel, gasoline, LPG, naphtha, kerosene, coke, and asphalt.

Background: The refinery started processing oil in February 1972, three months ahead of schedule. To date, the thousand days Replan was built in are a reference for the oil industry. While the technologies have evolved and allowed for faster construction work to be done, the environmental legislation has become more stringent and requires lengthier analyses. For example, it took 412 days just to get the environmental permits for the units that were inaugurated in late 2004. Today, the pen that was used to sign the inauguration minutes by the then presidents of Petrobras, general Ernesto Geisel, and of Brazil, general Emilio Garrastazul Médici, are part of the unit's collection. Initially called the Planalto Refinery, the refinery's name was later changed to Paulínia Refinery – Replan, on the date of its inauguration, on 05/12/72.

Duque de Caxias Refinery (Reduc)

Established in 1961, in Duque de Caxias, state of Rio de Janeiro.

Area: 13km²

Main products: lubricants, gasoline, diesel fuel, aviation kerosene, LPG, bunker and petrochemical naphtha.

Background: The most complete refinery in the Petrobras System, it was inaugurated in 1961 with only six units, in addition to its power plant. In the early 1970's, it received its first lubricant plant. In 1979, the second lubricant and paraffin assembly was already in operation with six new units. The 1980's marked the arrival of natural gas. Meanwhile, in the last decade of the past century, units focusing on product quality and diversification and on environmental protection, such as the QAV and diesel hydrotreatment unit and another unit designed to recover sulfur, were installed. The ongoing modernization process is what allowed Reduc to currently market a line of 52 products.

Landulpho Alves Refinery - Mataripe (RLAM)

Established in 1950, in São Francisco do Conde, state of Bahia.

Area: 6,4 km²

Main products: propane, propene, isobutane, cooking gas, gasoline, petrochemical naphtha, kerosene, aviation kerosene, paraffins, fuel oils and asphalts.

Background: The Mataripe Refinery started being built in 1949, and is directly connected to the discovery of the first oil wells in Brazil, more precisely in the Recôncavo Baiano region. Its construction formed a worker's class egress from fishing and agricultural communities, and inaugurated a new economic cycle, with the industrial refining activity turning the page on the until then reigning sugarcane agribusiness. With the creation of Petrobras, in 1953, the refinery was incorporated to the company's assets, and it was renamed Landulpho Alves-Mataripe in tribute to the Bahia engineer and politician who struggled for the oil cause in Brazil. As the inventor of the New State of Bahia, since 1938 Landulpho Alves had been calling for the construction of a refinery on Bahia territory, something that the federal government only authorized in 1946.

Capuava Refinery (Recap)

Established in 1954, in Mauá, state of São Paulo.

Area: 3,7 km²

Main products: propene, LPG, gasoline, metropolitan diesel fuel (with low sulfur content), and special solvents.

Background: Currently the smallest refinery in São Paulo, in the past Recap had Brazil's biggest production volume. When inaugurated, in December 1954, and back then called Refinaria e Exploração de Petróleo

União S/A, it processed 3,180 m^3 of oil per day, then the biggest refining capacity in Brazil. Recap was incorporated by Petrobras on June 3 1974. Since it was one of the oldest refineries, it had many of its instruments activated by pneumatic pumps until the 1990s. Today, it has a high level of automation and its Digital Distributed Control System is one of Petrobras' most modern.

Presidente Bernardes Refinery (RPBC)

Established in 1955, in Cubatão, state of São Paulo.

Area: 7 km^2

Main products: Automotive fuel, ecological diesel fuel, Podium gasoline, Formula 1 gasoline components, coke for exports.

Background: The first major refinery built by the then newly incorporated Petrobras, RPBC was designed in 1952. In the post-war efforts, RPBC initially supplied 80 per cent of the incipient internal market's demand. When inaugurated, in 1955, it supplied 50 per cent of the Country, which took huge development steps. It currently accounts for 11 per cent of the production of derivatives in Brazil. Installed on the foothills of the 'Serra do Mar' mountain range, RPBC is crossed by the Cubatão River and by the mythical Santos old road, the first road in Brazil to be paved and made immortal by a Roberto Carlos song.

Isaac Sabbá Refinery (Reman)

Established in 1956, in Manaus, state of Amazonas.

Area: 9.8 km^2

Main products: LPG, petrochemical naphtha, gasoline, aviation kerosene, diesel fuel, fuel oils, light oil for electrical turbines, oil to generate energy, asphalt.

Background: Called Companhia de Petróleo da Amazônia, the refinery was installed on the margin of the Negro River, in Manaus, by businessman Isaac Benaion Sabbá and went on stream on September 6 1956 – a period in which the entire region was being impacted by a dwindling rubber industry. The official inauguration was on January 3 1957, and was attended by the then president of Brazil, Juscelino Kubitschek. Already back then, its three units (Atmospheric Distillation, Vacuum Distillation, and Catalytic Cracking, the latter the first in Latin America) allowed for the refining of 5,000 barrels per day. In 1971, Petrobras took the company over and renamed it the Manaus Refinery (Reman). In tribute to the pioneering spirit of its founder, in 1997 Petrobras renamed it again, this time as the Isaac Sabbá Refinery - UN-Reman.

Pasadena Refinery System Inc. (PRSI)

Location: Pasadena, Texas

Area: 1.31 km^2

Main products: Gasoline, Heating Oil, LPG, Coke and Sulfur

Background: Inaugurated as Crown Refinery in 1920 to manufacture lubricants, in 1925 it started producing fuels. As of 2001 it cut back on a major part of its activities due to economic restrictions. The refinery was taken over in 2005 by Astra Oil Co. and renamed as Pasadena Refinery System Inc. (PRSI). Then, in 2006, Petrobras acquired 50 per cent of the Company's equity stakes and investments were made in the purchase of an additional area adjacent to the refinery for the planned investments. The refinery is expected to receive investments to adjust its facilities to process heavy oils.

Ricardo Eliçabe Refinery

Location: Bahia Blanca – Buenos Aires – Argentina

Background: The Eliçabe refinery is located in Bahia Blanca (Buenos Aires), a vital place to receive oil coming from the Neuquina basin. The refinery's location is excellent for the maritime supply of oil coming from the country's southern region or from the international market.

This is one of Argentina's most modern refineries. In 1997, it inaugurated new naphtha reforming, isomerization and hydrotreatment units, completing a successful facility enhancement process.

The refinery's oil processing capacity is 30,500 barrels per day, and it has an extensive product range, such as: super naphtha, regular naphtha, super 97 SP naphtha, raw materials to produce solvents and petrochemical products, kerosene, diesel fuel, fuel oils, asphalt, propane, propylene and butane, among others.

The refinery counts on its own power generation, on modern control systems and environmental monitoring processes, and it complies with the highest safety, environmental preservation, and quality standards.

Most of its processes are certified by the ISO 9002 norms, and they are in the process of adapting to the new ISO 9000 / 200 norms, something that will ratify its products' quality.

Okinawa Refinery

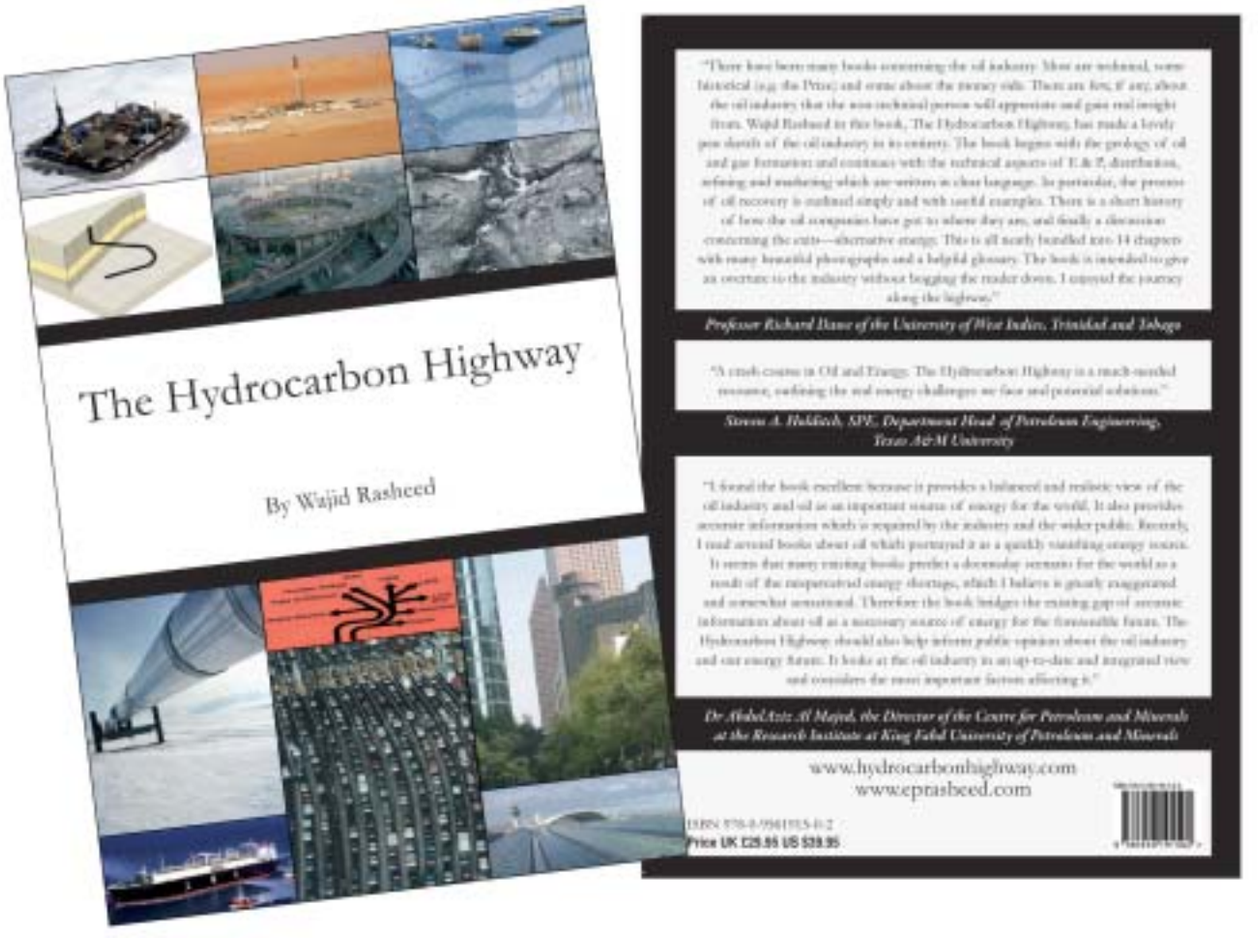
Location: Okinawa Island, Japan

Background: Petrobras holds 87.5 per cent of the stakes in the Nansei Sekiyu refinery, in Okinawa, which is capable of processing 100,000 barrels of light oil per day on the Okinawa island, Southeastern Japan. The refinery is capable of processing 100,000 barrels of light oil per day and of producing high-quality derivatives within the Japanese market's standards.. It also has an oil and derivatives terminal to store 9.6 million barrels, three piers with potential to receive product vessels of up to 97,000 deadweight tonnage (DWT) and a monobuoy for Very Large Crude Carrier (VLCC) vessels of up to 280,000 DWT.

Refineries Under Construction

REFINERIES	OPERATIONS TO BEGIN	CAPACITY IN BARRELS/DAY
Abreu e Lima Refinery (state of Pernambuco)	2011	230,000
Rio de Janeiro Petrochemical Complex - Comperj (state of Rio de Janeiro)	2012	165,000
Premium I Refinery (state of Maranhão)	2013/2015	600,000
Premium II Refinery (state of Ceará)	2013/2015	300,000
Clara Camarão Refinery (state of Rio Grande do Norte)	2010	30,000

Properties, Players and Processes



Clearly, the most prized possessions in the industry are the leases allowing access to giant oil and gas fields; however, these fields must be found and this entails risk. This chapter looks at the background of how oil companies come to possess oil and gas 'properties' and the processes and players involved in their development.

Bids and Blocks

Acreage, blocks and concessions all refer to a legally recognised interest in an oil and gas property. This is surrendered by a land owner in exchange for royalties and other considerations. Despite the fact that most oil and gas deals are confidential business transactions, almost all are bid for openly. The final contract and choice of the oil company will depend on the nature of the land owner and development complexity[1].

Land Owners

Governments have different obligations from institutions, which in turn have different needs to those of pri-

FPSO Platforms - *Floating, Production, Storage and Offloading vessels (FPSOs) can process and store crude oil, and offload the oil and/or natural gas. A process plant is installed on the ship's deck to separate and treat the fluids from the wells. After the crude is separated from the water and gas, it is stored in tanks on the actual vessel and then offloaded to a relief ship every so often.*

The relief vessel is an oil tanker that moors on the FPSO stern to receive the crude stored in its tanks and then transport it onshore. Compressed gas is sent onshore through gas pipelines and/or injected back into the reservoir. The larger FPSOs have a daily processing capacity of some 200,000 barrels of oil, with an associated gas production of approximately two million m^3 a day.

Round-Hull FPSO - *This is a pioneering FPSO platform due to its round-hull shape, and the first to produce, store and offload oil. The platform produces in deep waters, ranging from 1,000 to 1,500 metres. The round shape increases stability in the sea, since the waves circle the vessel. Its hull, made out of two layers of steel plates, is more versatile and stable, allowing operation under much more severe environmental conditions and affording the vessel more safety with regard to oil leakage into the sea.*

Fixed Platforms - *These were the first units to be used. Preference has been given to them in fields located in water depths to 200 m. Fixed platforms generally consist of modular steel structures installed at the operation site with piles driven into the seabed. Fixed platforms are designed to receive all drilling equipment, material storage, and staff accommodation, plus all well-production facilities.*

Jack-Up Platforms - *These consist basically of a barge fitted with a support structure, or legs that when activated mechanically or hydraulically, are lowered until they reach the seabed. The platform is then raised above the water level to a safe height, away from the action of the waves. These platforms are mobile and are pulled by tugboats or are self-propelled. They are designed to drill exploratory wells on the continental shelf in depths varying from 5 to 130 m.*

Semi-Submersible Platforms - *Semi-submersible platforms consist of a structure of one or more decks supported by submerged pontoons. A pontoon moves in accordance with the action of waves, currents and winds, and this may damage the equipment that is to be lowered into the well. That is why it must be set in position on the surface of the sea, within a tolerance radius dictated by the sub-surface equipment. Two kinds of system are responsible for positioning the pontoon: the anchoring system and dynamic positioning system.*

The anchoring system consists of 8 to 12 anchors and cables and/or chains, like springs that produce efforts that can put the pontoon back in position when it is moved by the action of the waves, winds and currents.

In the dynamic positioning system, there is no physical connection between the platform and the seabed, except in relation to the drilling equipment. Acoustic sensors determine the driftage, while the computer-controlled propellers in the hull bring the platform back into position.

Semi-submersibles may or may not be self-propelled. In any event, they are more mobile and are preferred for drilling wildcat wells.

Drill Ships - *A drill ship is a vessel designed to drill subsea wells. Its drilling tower is located midship, where an opening in the hull allows the drill string to pass through. The drill ship positioning system, consisting of acoustic sensors, propellers and computers, cancels out the effects of the wind, waves and currents that tend to move the ship from its position.*

Figure 1 - Types of Platforms (Courtesy of Petrobras)

vate individuals. Governments are driven by a much wider agenda ranging from economic sustainability, obligations to future generations and social responsibility. Institutional and private individuals are generally more concerned with a Return on Investment (ROI) within a given time period[2].

Development Complexity

The cost and complexity of a particular development depends on its location, size and the extent of geological knowledge. If the lease is offshore, greater complexity and cost will be added. This is because offshore fields require more capital, technical expertise and logistical planning than onshore fields. The rule of thumb is the greater the water depth, the greater the complexity and cost, as higher specification rigs are required.

Developments that are located in shallow waters (defined as up to 1,500 ft or 500 m water depth to the seabed) may use fixed platforms. Greater complexity is associated with developments located in deep seas (up to

Where previous wells have been drilled, reservoirs and conditions have been characterised and this acts as a guide to future drilling; however, in wildcat or exploratory wells where reservoir characterisation is not present, complexity, cost and risk are increased.

6,560 ft or 2000 m of water) as they require tension leg platforms or semi-submersible rigs. The greatest technical and financial challenges are linked with ultra-deepwater developments located in water depths of 8,200 ft (2500 m) or more. In these water depths, semi-submersible facilities or Floating Production, Storage, and Offloading (FPSO) vessels are required[3].

Block size will also add complexity and cost. Typically, offshore Gulf of Mexico (GOM) blocks are nine square miles in size. Offshore North Sea block sizes vary between 230 and 460 square miles. Blocks in new exploratory frontiers can be much larger. Exemplifying this are Brazilian exploratory blocks such as those in the Foz de Amazonas which can be 2000 square miles in area. Locating reserves in such a large area is no mean feat.

Where geological knowledge exists, exploration risk is reduced. Where previous wells have been drilled, reservoirs and conditions have been characterised and this acts as a guide to future drilling; however, in wildcat or exploratory wells where reservoir characterisation is not present, complexity, cost and risk are increased.

Royalties

A 'royalty' is an interest in an oil and gas lease that gives the owner of the land the right to receive a portion of the production from the leased acreage or proceeds from the sale of production. This generally does not require the owner to pay any portion of the costs of drilling or operating the wells on the leased acreage. Royalties may be either land-owners' royalties or overriding royalties. Land-owners' royalties are reserved by the owner of the leased acreage at the time the lease is granted. Overriding royalties are usually reserved by an owner of the leasehold in connection with a transfer to a subsequent owner. Royalties can vary from 100% in the case of national companies, to 50% in joint ventures and to as little as 10% in mature assets. The level of royalty depends on the complexity of the development and investment required. Royalties are not necessarily the most important aspect of an oil and gas deal as creating local content and infrastructure maybe equally important[4].

Producers seek exploration and development assets in order to maintain a return to shareholders. Market watchers apply considerable weight to proved reserves and production when analysing share values. They are the long-term measure of an oil company's health, while daily production represents short-term cash flow.

Portfolios Balance Risk

How do oil companies routinely back some of the most expensive and risky ventures on earth (i.e. deepwater exploration drilling) and still make profits? Oil companies can sustain the heavy losses of a wildcat (drilling for

unproven reserves with limited geological knowledge) because they have a portfolio of assets generating cash. This is usually managed on the basis of markets, geography and economics. Oil companies employ geological modelling, offset data and exploratory wells to pinpoint reserves. Both oil companies and concession holders use due diligence systems to appraise certain blocks (a lease area inland or offshore) according to historic finds to date or the likelihood of finding oil and gas. Where no wells have been previously drilled, the oil company will drill a wildcat. This represents the highest degree of risk, but can be balanced with finds and production from other mature assets generating cash. The portfolio is usually split along regions, countries and assets. It is here that market conditions prevail. Oil companies will use financial models that take into account the future value of hydrocarbon reserves at different barrel price scenarios and demand. Oil companies will apply financial models assessing economic and production variables such as the '3 Ps' and the present value of reserves[5].

Gaining a Concession

Land owners attract attention to prospective offerings or licensing rounds by informing industry analysts and firms specialising in oil and gas leases. They may also conduct 'road-shows' where key members of the land owners management will present 'upstream opportunities' at industry events such as the International Petroleum Conference, the World Petroleum Conference and at financial centres around the world.

Subsequently, and without exception, all land owners will pre-qualify companies with an invitation to tender. Strict technical and financial criteria are applied before this initial application for a concession is accepted. In this way, concession holders (governments, institutions or private individuals) can screen prospective oil companies or 'operators' to see that they are actually capable of meeting the challenges associated with the exploration and production of hydrocarbons and pay the all important royalties.

Once a prospective operator has been qualified, they can then proceed to the next stage. Qualification leads to bidding or negotiating the contract for lease acquisition.

Further steps will be seismic permitting, lease option negotiations, and preparing pooling and unitisation agreements. It should be noted that unitisation agreements are usually only entered into after discovery and some production has taken place. This usually occurs when the collective area operators realise that their field can produce more oil as a single unit rather than several sub-units. Negotiating a unitisation agreement is incredibly complex, particularly in the case of land leases where a large number of land owners are involved. Typically, this is an open auction, sealed bid or a negotiated deal. Open auctions are competitive bids for leases, sealed bids are posted and closed negotiations are held between parties. Each has its merits and downfalls; sometimes more can be negotiated off the bidding table rather than on the table[6].

'Producers-88' Lease Form

Although there is no standard form of oil and gas lease, a common form for US oil and gas leases is known as the 'Producers 88'. The name arises from an oilman or 'producer' who was seeking to purchase a lease. This producer had a certain deal in mind, but had no printed contract outlining the terms and conditions. The oilman sought a printer's shop to get the form printed. The printer's foreman needed to give the printing job a name and pencilled in 'Producers-88' to the job referring to its sequence in the press. Due to an oversight, the pencilled reference was printed on the upper left-hand corner and the name stuck, 'Producers-88' lease form.

Not every producing company used the same printer, but anecdotes show that many farmers (land owners holding the title deeds) would only sign a 'Producers-88' form of lease. Consequently, majors, independents and 'land-men' had their own forms of leases printed, many of which were similar in content, but all of which had 'Producers-88' printed in the upper left-hand corner.

The pre-printed form of lease typically presented to a mineral owner has basic terms and provisions such as the name of the land owner and oil company, the description of the land, the duration of the lease, the amount (fraction or percentage) of royalty, the name of the depository bank for the payment of rentals, and the amount of rentals (if it is not a paid-up lease)[7].

'Paperweights'

There is no single form of lease that meets all land owners' specific needs. Each lease is a bulky set of documents prepared on an individual basis. Usually, the oil company will have to accept the bid lease conditions offered, but in certain cases (i.e. for a multi-billion dollar invest-

ment) negotiating leeway exists. Conditions will cover the granting of a lease, royalty, shut-in well, pooling and unitisation, delay rental and partial release, operations and offsetting production, assignment, warranty, and force majeure clauses.

On entering an oil concession, the land owner and oil company have different interests. The land owner is interested in gaining as much bonus, royalty and terms such as local capability as possible. The oil company is interested in limiting its obligations to the land owner and wants the lease to contain terms that are as broad as possible. In most instances, the parties will compromise to reach a mutually acceptable middle ground and a contract will be signed[8].

Bargaining Power

As in all business transactions, the party with the greater bargaining power and knowledge sets the terms. It has been said that governments, at times, can be at a negotiating disadvantage when dealing with International Oil Companies (IOCs). At any given time, IOCs can draw on a much wider knowledge base of global trading conditions. In contrast, a national government is limited to national conditions. This was part of the rationale for the nationalisation of petroleum in many countries and the formation of the Organisation of the Petroleum Exporting Countries (OPEC). Nonetheless, land owners will always hold the upper hand because they 'own' the oil and gas reserves. Oil companies need reserves to keep trading so they are willing to 'buy' the technical and financial risks associated with exploration and pay royalties; however, neither can profit without the other as there is a mutual need.

Today, gas exporting countries have formed alliances to share information on global gas trends. This experience shows that granting access to oil and gas rights are strong bargaining tools which can help obtain benefits beyond royalties[9].

The Oil Is Ours... But You May Develop the Gas

Some twenty-five years ago, the Saudi royal family finished the process of re-nationalisation of the country's oil and gas reserves. This allowed Aramco, the national oil company, to join a growing group of oil companies and countries that re-nationalised their hydrocarbons; for example, countries such as Mexico, Venezuela and Iran. By some accounts, between 1970 and 1976, nearly 20 countries asserted their national sovereignty over their operations. Driven by the need to develop gas reserves (to meet the growing demand for gas and to keep oil for exports), many countries have slowly relaxed their national controls. This has been accomplished through joint ventures, contracts with service companies and ownership licences which allow larger oil companies to return to previously nationalised oil markets[10].

Many types of oil and gas contracts exist. In this section, we consider the process of selecting and contracting oilfield service companies. It is worth distinguishing oil and gas operating contracts from service and supply contracts. We have already seen how operating contracts provide a framework for paying hydrocarbon production royalties (bids and blocks). Now, we can consider how service contracts enable the supply of equipment and technical services that are necessary for hydrocarbon production.

Outsourcing

Traditionally, oil companies whether IOCs, NOCs or independents have always outsourced certain oilfield activities, such as rig supply or facilities engineering. As the industry consolidated in the 80s and 90s, the volume of outsourcing increased as new definitions of non-core activities were applied to a greater number of activities and disciplines. Nowadays, non-core activities are defined differently according to the discipline and oil-company in question; however, the common thread that emerges is that all disciplines will have at least some outsourced elements. This means that any given oil company will have service providers in many different areas of activity. The extent of actual outsourcing depends very much on the culture of the oil company, the degree to which a task is defined as core and its accompanying level of commercial sensitivity.

Core Activities

Facilities engineering, for example, is an area that is traditionally outsourced. Certain oil companies, however, may consider production or drilling and completions as non-core. In this case, an oil company representative will act as a project manager, but the actual engineering is conducted by a lead service company and a number of sub-contractors. Other oil companies may consider disciplines such as reservoir management as core areas, or as sensitive functions, and therefore not wish to outsource the service. Almost all operators consider exploration and reservoir management as core to their opera-

Rank	Company	500 Rank	Revenues ($ millions)
1	ExxonMobil	2	347,254.0
2	Royal Dutch Shell	3	318,845.0
3	BP	4	274,316.0
4	Chevron	7	200,567.0
5	ConocoPhillips	9	172,451.0
6	Total	10	168,356.7
7	Sinopec	17	131,636.0
8	China National Petroleum	24	110,520.2
9	ENI	26	109,014.2
10	Pemex	34	97,469.3
11	Valero Energy	43	91,051.0
12	Petrobras	65	72,347.0
13	Statoil	78	66,280.3
14	Repsol YPF	90	60,920.9
15	Marathon Oil	92	60,643.0

Table 1 - The 15 Top Oil Companies as Listed by the Forbes Fortune 500 Group

tions because these two activities can make or break a company[11].

Major oil and gas disciplines are classed as:
- Facilities (platforms)
- Drilling and completions
- Production
- Reservoir engineering
- Health, Safety and Environment (HSE)
- Management systems (IT and Accounting)
- Project management, and
- Project economics/financing.

Oil Service and Supply Companies

Fortune 500 Top 15 Oil Companies

Table 1 shows the top 15 oil companies that are listed by the Forbes Fortune 500 group and floated on the New York Stock Exchange (NYSE) or other American stock markets as of 2007. With the fall of the Oil Curtain, we can expect more NOCs such as Sinopec, CNPC, Petrobras, Pemex and StatoilHydro to move higher up the table.

Many of the large service companies are floated on the Philadelphia Stock Exchange; however, some companies such as Schlumberger, Halliburton, Baker Hughes and Weatherford are also listed on the NYSE. The Philadelphia exchange runs an Oil Services Index (OSXSM) which is price-weighted and comprise companies that provide oil drilling and production services, oil field equipment, support services and geophysical/reservoir services. The OSX commenced trading on February 24, 1997.

Some OSX companies are:
1) Baker Hughes Inc. (BHI)
2) R&B Falcon Drilling Company, Inc. (FLC)
3) Global Industries Ltd. (GLBL)
4) Halliburton Co. (HAL)
5) Nabors Industries Inc (NBR)
6) Noble Drilling Corporation (NBL)
7) Rowan Companies, Inc. (RDC)
8) TransoceanSedcoForex (RIG)
9) Smith International Inc. (SII)
10) Schlumberger Ltd. (SLB)
11) Tidewater, Inc. (TDW), and
12) Weatherford (WFT).

National Factors

Many service companies can trace their origins to as far back as 50 years ago, and in some cases, as much as a century. These companies will have built up strong positions in technological niches and markets through organic growth as well as acquisitions. Their positions will be based on local applications, relationships, investment and management philosophy.

Variations in market presence occur due to political situations, governmental policy and the trading regulations between countries; therefore, certain service companies will be stronger in certain markets and enjoy a leadership position, while in other geographic areas they will have only a skeletal presence. In this way, the service sector tends to balance itself out globally with the larger companies tending to consolidate their market share in certain areas while being weaker in others. This occurs with giant service companies such as Baker Hughes, Schlumberger and Halliburton. One or more of these service companies may have a large market share in Latin America and the North Sea, while having a reduced presence in the Middle East. By the same token, the other service company's operations will reflect the opposite; it will have a stronger presence in the Middle East and a lower presence in other areas[12].

Operator Type

Large IOCs such as Shell and BP will always tend to favour centralised service agreements due to the high number of operating assets these companies hold. A central procurement contract offers global supply and pricing advantages which will have been negotiated by a head or regional office with bulk volumes in mind. Many such contracts exist and are aptly named such as the 'Big Lever', 'Preferred Contractor' or the most popular term these days, Master Service Agreement (MSA). The oil companies will also appoint local focal points which enable the contracts and services to be managed more effectively and in accordance with local needs.

For certain products that can be bought in bulk such as casing, bits and drilling fluids, this provides certainty of business on both sides. Independents may also develop global preferred service agreements but, due to a much smaller number of operating assets, their contracts will be less centralised and will tend toward establishing contact with major service companies on location[13]. Sometimes smaller oil companies may form 'co-ops' to purchase commonly-used items in bulk to get a low price. They usually do this thorough the auspices of an area supply store.

Process of Selection

Despite the oil and gas industry being highly globalised, most of the factors that influence the selection of contractors are locally based. These include variations from nation to nation, operator type, the extent of goodwill between companies, technical innovation and price. The actual selection of contractors is a complex process that requires oil companies to appoint a project manager or other executives to act as a tender board in order to prepare a contracting strategy.

This document will cover: the prequalification of tenderers; a finalised bidders' list; finalised technical and commercial specifications; the preparation and issuing of a tender document; bid clarification; issuing of clarifications and addendum to tenderers; prepation of company estimates; the evaluation of technical and commercial bids; presentations to the project manager or tender board; presentations to the Ministry that deals with oil and gas leases; the awarding of contracts; start up (mobilisation); and budget calculations among other things. Corporate governance, ethical standards and local content targets are also often included[14].

Typically, IOCs will employ a global focal point or a project or technology leader with responsibility for the contracting strategy and direction. Each region or major asset will also have a local specialist or focal point. This local specialist will have a local service company counterpart. Other staff will include service personnel seconded to the oil company's local offices[15].

National Oil Companies

NOCs are more likely to contract long-term services and develop partnerships with service companies. NOCs, despite the perception to the contrary, provide many of the most lucrative service contracts. The predominant philosophy or perception is that 'the lowest price wins'. This may be applicable in some cases, but in general, the NOCs often offer long-term fixed revenue contracts, something that IOCs rarely offer.

Some NOCs are obliged under the laws of their country to accept the low bid. This can cause problems as many

Operators develop technology in-house through JIPs and with best-in-class companies; for example, Shell and Petrobras respectively are involved in the monobore and the Procap 3000 initiatives which are two examples of technology cascading downward.

fly-by-night companies deliberately lower a bid to get the work or concession and try to figure out later how they are going to fulfill its terms.

Goodwill

This concept covers global relationships that permit the exchange of technology, knowledge and operational know-how. These relationships exist at many levels. Some oil companies use bulk-buying contracts to supply international operations, while others use Joint Industry Projects or JIPs. Other oil companies rely on technology cooperation agreements and personal relationships with their service company counterparts and small specialised companies.

Small companies may not achieve large economies of scale, but at the same time they do not have large overheads. Because they can act rapidly, they can often beat the giants when it comes to developing new technology. Operators develop technology in-house through JIPs and with best-in-class companies; for example, Shell and Petrobras respectively are involved in the monobore and the Procap 3000 initiatives which are two examples of technology cascading downward.

Underlying the monobore (a vision of drilling and casing a single-diameter well from top to bottom) was the creation of two businesses to develop the downhole tools, tubes and markets for expandables. Procap 3000, a range of exploration and production technologies, is paving the way in ultra-deepwater development. Drilling contractors have introduced simultaneous drilling and completion of two wells by way of the dual-activity derrick system. Additionally, the billion-dollar think tanks and research and development facilities that major service companies own are continually creating new technologies.

So how do small companies compete against this backdrop? How do they succeed without the benefit of marketing channels or the influence of larger service companies?

Small companies can distinguish themselves by providing a service that includes applications analysis, technical recommendations and rig-site support through end-of-well reporting[16].

If they can maintain market leadership, they will attract the attention of operators interested in new technology. Certain oil companies select market leaders in what they deem essential technology and work with those leaders

to develop new technologies (tough luck if you're not No. 1) .

Tangled Thicket

Traditionally, the oil company appoints a lead service contractor who may or may not be responsible for naming a drilling unit provider. The complexity of the drilling unit required will also affect whether this decision is made by the lead contractor or oil company. Drilling units (e.g. drillships, jack-ups, semi-submersibles or land rigs) will vary according to offshore and onshore needs. Subsequently, specialist contractors in each activity of each discipline are selected. As very few companies can provide all the required services, the concept of integrated contracting becomes commonplace. An integrated contractor or contracting alliance allows for each party to calculate their share of the development cost and price. These calculations are then used as performance targets, with the gain or pain of reaching or not reaching the target being shared. For operators fed up with the tangled thicket of contracts and contractors, the easiest course may lie in integrating outsourced services. This certainly reduces some of the complexity and numbers of service providers by providing a single point of contact. The appropriateness of integration, however, is very much dependent on the location and nature of the project; for example, the right approach for a development in China is probably inappropriate for Brazil. Other examples include the US GOM and the UK North Sea where contracting differs from practices.

Critics would argue that integration tends to discourage small-company services, as the main service provider will fulfil most technology requirements in-house. Only where technology is unavailable can a small company enter the project, filling a gap that no other business can.

Integrated services often mean small companies are required to meet wide-ranging legal or other tender requirements, many of which are applicable only to the major service provider. While safety is non-negotiable, it seems unfair to insist on the same levels of insurance liability for two different scopes of services. This asks small companies to bear more project risk without an accompanying increase in the reward[17].

Recently, IOCs have recognised the benefits of 'chain-of-accountability' and weigh this highly in contractor selection. Instead of dealing with a myriad of small providers, they limit their contracts to a few large, integrated service providers. If anything goes wrong, there is no finger-pointing. The contractor takes responsibility and fixes the problem.

Price – Market Cycles

Market cycles affect pricing more than any other aspect. In terms of tender strategy, an operator may use price competition as a way of controlling costs. In a down market, demand falls while the need to maintain utilisation remains. Here price-beating, where the lowest price wins, may be adopted by the service company to retain work. In an up-market, demand is increased and there are greater demands on utilisation; therefore, price competition is counter-productive as companies will tend not to provide services or equipment as they are diverted to the highest-paying markets.

Performance Pricing

How does one reward so many different service companies? Perhaps this is where value or performance pricing can help. The operator and small company set a performance target and price the work accordingly. If the contractor overachieves, they receive a proportion of the gain.

Conversely, if the contractor underachieves, they invoice less than the original price. It is self-evident that operators and small companies need to work more closely in developing cost-lowering technology. Increasingly, drilling engineers are becoming project managers rather than specialised engineers. Essentially, it lies with the service provider to effectively market service benefits to the operator.

This is where small companies trip up. Without established marketing channels, small companies regularly miss out on opportunities. Operators can help by focusing a small company's resources on specific projects where applications are plentiful. Cynics would argue operators are not in the business of making small companies richer, but this misses the point.

Sign-posting a project helps accelerate product development and operator savings. To that end, small companies must improve their marketing to demonstrate service benefits.

They must also develop partnerships with operators and be service-oriented rather than supply-oriented.

Today's IOC must look outwards for technology and this is where the service companies fit in perfectly. The service company's concern – read gripe, if you are an operator – is that although they solve an increasing number of operator 'owned' problems, and run R & D facilities previously only undertaken by operators, rewards have remained constant over the years.

Operators need to keep on the lookout for small companies, invest in their technology and encourage integrated service providers to use their services. Last, but not least, everyone must reassess how the reward is spread across the hydrocarbon machine[18].

Bundled or Bungled Services

It's easy to see the attractions of 'bundling' services. By integrating contracts for equipment and services, you can reduce suppliers and paperwork. In this way, fewer demands are made on your time, there is less paperwork, and there is less debating over which tool caused the trip.

Bundled contracts, however, can quickly become 'bungled' if individual Bottomhole Assembly (BHA) components and their risks are not isolated. Everything hinges on achieving a balance between risk and reward.[19]

Service companies have been saying for years that the scales have tipped the wrong way. As in the past, oil companies still own acreage and all the geological or other problems it may have. Whether the reservoirs are hard-to-access, hard-to-locate or bounded by hard-to-drill formations, the challenges are inherited by the oil company. Yesterday's IOCs, that mainly kept their full internal Research and Development (R & D) facilities, could grapple with the difficulties by using in-house R & D 'greenhouses'. Shareholders didn't mind this. In fact, it was universally agreed that R & D investment was a way of maintaining a competitive edge; however, many modern oil companies do not necessarily have this resource any longer.[20]

Consolidation in the oil industry drove this change. Profits could be handsomely boosted by reducing expenditure in various things, not least in-house R & D. Today's IOC must look outwards for technology and this is where the service companies fit in perfectly. The service company's concern – read gripe, if you are an operator – is that although they solve an increasing number of operator 'owned' problems, and run R & D facilities previously only undertaken by operators, rewards have remained constant over the years. Sure, rental or operating rates for equipment increase annually or have a premium according to location, but these are localised factors rather than a redistribution of reward based on risk acceptance and investment in research.

Everybody agrees that maximising oil production is the

Everybody agrees that maximising oil production is the most important and valuable activity for the operator; however, nobody agrees about how to define and apply the true value of a particular activity.

most important and valuable activity for the operator; however, nobody agrees about how to define and apply the true value of a particular activity. Mostly, the industry does simple maths: costs plus margin equals price. This, however, omits the true value delivered – or not – to the operator[21].

If you don't deliver, you get hit with the penalty, a lower value invoice. While this sounds good in theory, there are drawbacks. Standard drilling service contracts allow for separated BHA component risks. That's a grand way of saying if you're a drill bit (or other) company and some other downhole tool screws up, your final bit invoice won't be affected. And quite rightly – why should it? If the bit is performing fine, but a trip is caused by another element in the BHA, the bit company won't lose out.

In an integrated contract, this type of situation causes losses at an operating/meterage and at an overall performance level. Let's continue the example. Not only does the bit company suffer a loss in revenue due to another BHA component's failure, but there is also a lower overall performance for section drilled time. This invokes a penalty clause and it is not so easy to claim extenuating circumstances if all the equipment is supplied under a single company's service contract.

Things get even more complicated with the contracting of third party niche suppliers. If the equipment doesn't work properly, who bears responsibility? Worse still, what happens if this malfunctioning leads to a stuck fish or Loss-in-Hole (LIH)? On the note of LIH, it's worth straying a bit. It can be said that LIH prices are high. Certainly, a tool that is new and has only seen a few hours downhole will always have a high LIH price because this is a function of future revenue loss. Conversely, you must account for depreciation. If the tool had many hours utilisation, it should have a much lower value.

Let's get back to our stuck fish. It causes a sidetrack and a heavier than expected LIH invoice. Bang goes any incentive for the bit's good performance. Who bears the responsibility? If the Authority for Expenditure (AFE) is exceeded, who pays the difference?[22]

These are tough questions and some might say somewhat extreme; however, they are based in reality. Although using a main contractor approach where a single company drills and completes the entire well is not yet commonplace, this is a growing trend. The remaining dilemma is as follows: how can risk and reward be shared between the many different service components?

Perhaps performance pricing can help. The operator and main contractor set a performance target and price the work accordingly. If there is overachievement, all receive a proportion of the gain. Conversely, if a component company underachieves, it invoices less than the original price and takes a proportion of the loss. Performance

pricing would reflect costs (e.g. R & D manufacturing, tool wear and tear, etc.) and some part of the value delivered to the client[23].

An appreciation for the dilemma faced by operators has been a long time coming. For many years, oil company departments were semi-autonomous and had little regard for the other departments in the company. The drilling department was responsible for drilling a hole in the ground and casing it. The hole (one could hardly call it a well at this point) was then turned over to the completions department. The drilling department started to drill the next well, leaving the completions department to remedy such problems as form-ation damage caused by poor drilling fluid selection, bad cement jobs, damaged casing or wellhead problems.

The formation of asset teams alleviated these problems. By holding every member of the asset team responsible for the asset and rewarded solely based on the asset's performance on production, people such as drillers suddenly got a stake in the end result, and their sloppy performance came back to bite them in cost overruns or curtailed production performance; a lower asset profitability meant a lower bonus for them. The same fate awaited the geology department whose sloppy work caused a well to be drilled in the wrong place.

We know who the major players are in the oil industry and how they came to acquire their 'properties'. Now we need to know how do asset teams strike oil?

References

1. Land and Leasing ISBN: 0-88698-094-1 PETEX 1984.
2. Well Planned Brazil Oil and Gas Issue 5 Wajid Rasheed.
3. These are generic rules for ease of classification.
4. This will depend on the land owner's priorities.
5. The API Specification Database The American Petroleum Institute Specification Database
Software™ provides a knowledge-management toolset for the project engineering team. Facilitates
the entire equipment specification process including the entry of process data and design to the final
entry of mechanical data sheets and development of the technical bid specification package.
6. Dependent on the oil company and land-owner involved.
7. May vary from lease to lease.
8. Negotiation plays as important a role as the bid.
9. Such as building local content.
10. Such as Brazil, Mexico and Saudi Arabia which all had monopolies.
11. Fundamental to asset management.
12. From the 30 countries I have worked in this is very much the case.
13. Idem.
14. Corporate governance requirements are often stipulated as contractual terms.
15. Also known as in-house engineers.
16. Harts E & P Mar 2002 Drilling Column Wajid Rasheed. 'Small companies and tangled thickets'.
17. Idem.
18. The reassessment of risk and reward seems to have stopped at percentage of value delivered or percentage operational cost.
19. Harts E & P Mar 2002 Drilling Column Wajid Rasheed 'Small companies and tangled thickets'.
20. Although this may change as IOCs seek to differentiate themselves. Shell selects certain start-ups through its technology ventures (STV).
21. Harts E & P Mar 2002 Drilling Column Wajid Rasheed 'Small companies and tangled thickets'.
22. Harts E & P Jun 2004 Drilling Column 'Bundled or bungled services?'. Advocates balanced integrated services contracts.
23. In a low oil price some service companies may prefer to take greater risk. Others would shun this as unthinkable.

PETROBRAS

STATE AND REGION	OIL barrels/day			NATURAL GAS thousand cubic meters/day			OIL & GAS barrel equiv./day (boe)
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	TOTAL – BOE/DAY
Rio de Janeiro	---	1,569,341	1,569,341	---	25,587	25,587	1,730,279
Espírito Santo	12,995	148,877	161,872	126	5,317	5,443	196,105
Amazonas	55,253	---	55,253	10,237	---	10,237	119,640
Bahia	45,607	368	45,975	2,741	2,205	4,946	77,083
R.G.Norte	52,278	10,213	62,491	735	796	1,531	72,122
Sergipe	35,809	8,865	44,673	249	2,838	3,087	64,090
São Paulo	---	18,170	18,170	---	740	740	22,823
Alagoas	6,678	241	6,918	1,498	301	1,799	18,236
Ceará	1,759	7,700	9,459	1	140	142	10,349
Paraná (schist)	3,640	---	3,640	119	---	119	4,391
Total Brazil	214,017	1.763775	1,977,793	15,706	37,924	53,630	2,315,117
Africa	---	63,630	63,630	---	---	---	63,630
North America	---	1,368	1,368	---	288	288	3,063
South America * (consolidated)	82,495	---	82,495	15,471	---	15,471	173,557
South America** (non-consolidated)	7,127	---	7,127	119	---	119	7,827
Total abroad	89,622	64,998	154,620	15,590	288	15,878	248,076
Petrobras Total	303,639	1,828,773	2,132,413	31,296	38,212	69,508	2,563,193

Notes:

* Consolidated Production is the production coming from companies controlled by Petrobras.

** Non-Consolidated production is the production coming from companies Petrobras holds stakes in, but does not control.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