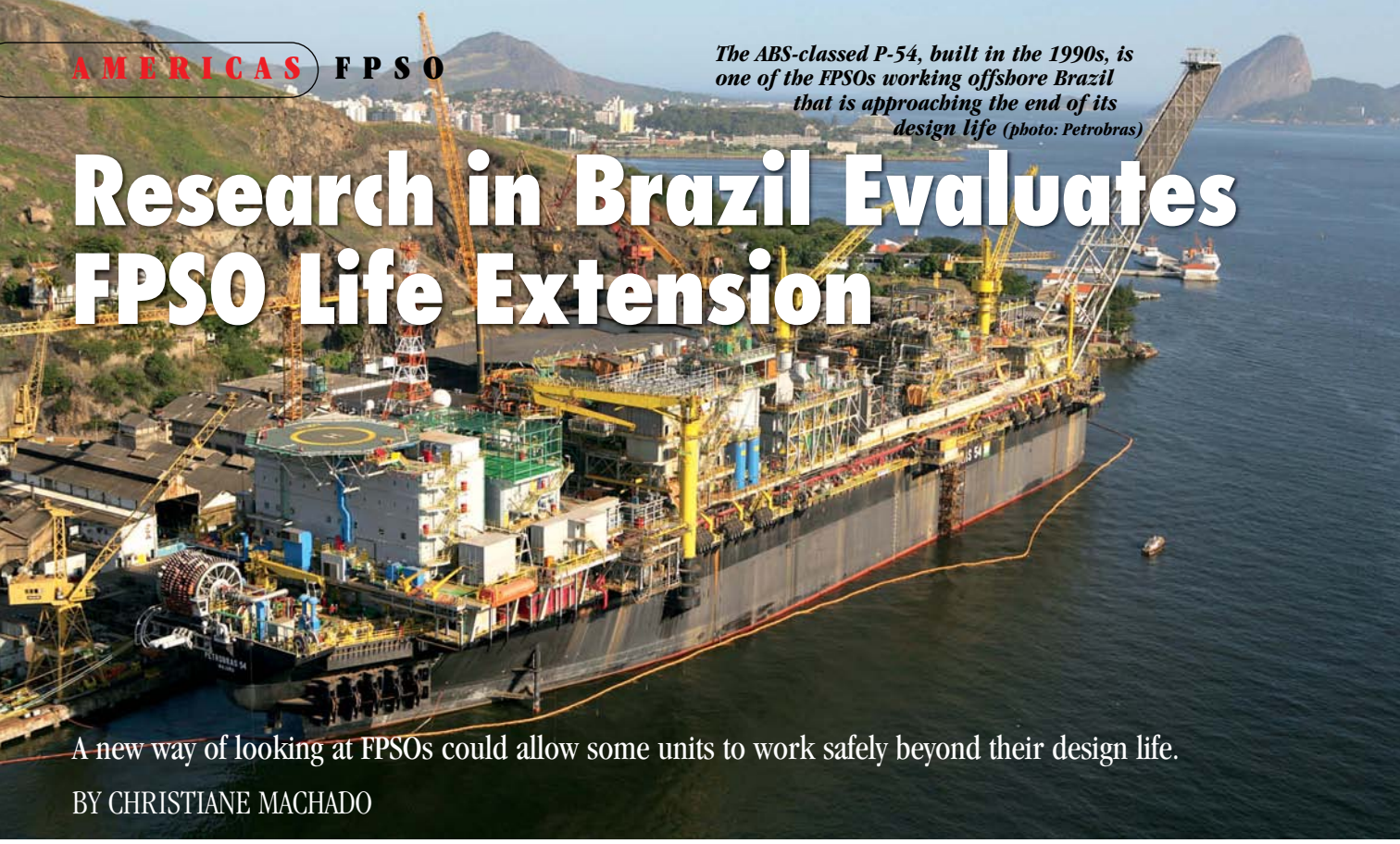


The ABS-classed P-54, built in the 1990s, is one of the FPSOs working offshore Brazil that is approaching the end of its design life (photo: Petrobras)

Research in Brazil Evaluates FPSO Life Extension

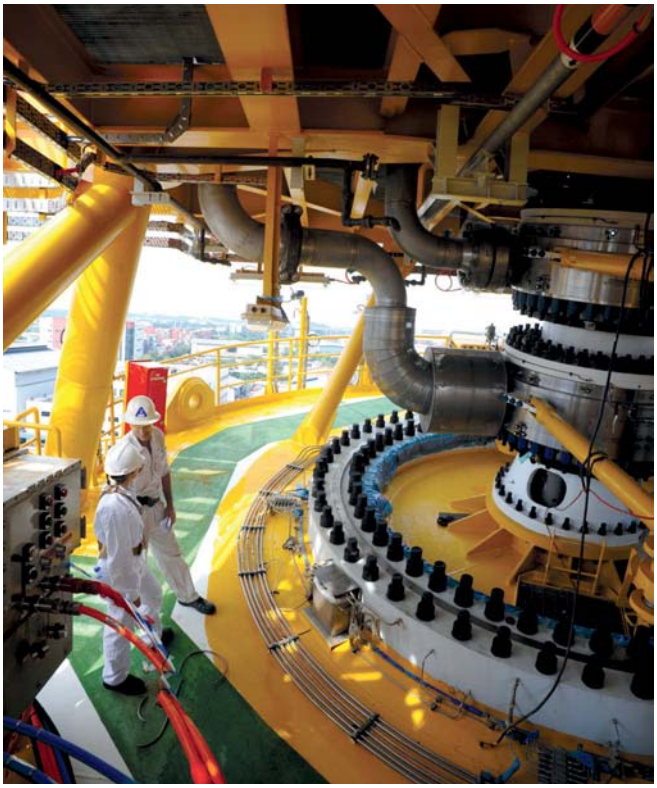
A new way of looking at FPSOs could allow some units to work safely beyond their design life.

BY CHRISTIANE MACHADO

Floating Production, Storage, and Offloading (FPSO) units have been used in the offshore industry for decades. They have become the production unit of choice in a number of regions, including Brazil. And if analyst predictions are correct, that picture is not likely to change in the near term.

The "Floating Production Market Report to 2017", published by Infield Systems, forecasts a boom over the next few years, with the number of installations in 2017 expected to be 95% higher than in 2008. While this growth in capex and the number of installations is largely driven by the increase in the number of developments to monetise gas in remote locations, an increasing focus on optimising production from ultra-deepwater developments is another significant driver. Africa, Latin America and Australasia are expected to account for the most significant levels of growth in terms of capex relating to floating production system developments.

Already, there is a significant newbuild program under way in Brazil, where Petrobras anticipates the need for a sizable fleet of deepwater production units. While the country gears up for new field development, however, there has been recognition that there are producing units working offshore Brazil that have been in the field for almost two decades.



***Mooring systems are among the critical components that must be evaluated carefully when considering FPSO life extension** (photo: Andre Eichman)*

A number of the country's offshore post-salt fields are reaching maturity, and the FPSOs that have been on station since first oil are rapidly approaching their design life expectancy. While it makes good sense to build or convert units to tackle the fields that will soon be in development, it is not economically feasible to move newbuilds to mature fields to replace aging units. With new reservoirs coming onstream through tiebacks to these older FPSOs, it is quite possible that the production vessels now onsite in the Santos and Campos basins could be needed in those same locations for another 20 years.

The big question operators are facing is a simple one: "Will these units be able to work safely for another two decades?"

Petrobras, the largest offshore operator, has tackled this question head on. The operator wants to find a way to safely extend the life of FPSOs in the field and is working with the ABS Brazil Offshore Technology Center (BOTC) to meet that objective, carrying out

research on corrosion rates in operating conditions specific to local conditions.

Workshop Assesses Life Extension

There are many factors that affect the survivability and longevity of a floating production unit, including its design, structural integrity, and maintenance. Additional factors include fatigue life and environmental load changes. There are major challenges related to the hull structure of a production unit over time, and in the case of FPSOs, these issues can be even more challenging because of the large number of onboard cargo tanks that must be inspected and maintained.

To discuss these and other key aspects of FPSO life extension, ABS joined other offshore industry players and regulatory agencies in an FPSO workshop supported by IBP (Instituto Brasileiro de Petróleo, Gás e Biocombustíveis) and the Society of Petroleum Engineers following the OTC Brasil 2013 conference and exhibition, in Rio de Janeiro, Brazil.

The event, "How to Extend Operating Life", provided a forum where approximately 200 attendees from the offshore industry gathered to hear regulatory insights provided by Brazil's National Petroleum Agency (ANP) and ABS and technical presentations from Brazil's primary FPSO operators – SBM and MODEC – and multinational energy majors Chevron, Total and Statoil, along with Brazil's state-run Petrobras.

***ABS is studying the impact modifying structural design parameters will have on an existing FPSO** (photo: Petrobras)*

The primary objective of the workshop was to facilitate discussion about upcoming frontiers in technology development and how new technologies might be applied to extend the service lives of FPSOs working offshore Brazil.

Class Requirements

One of the significant questions considered at the workshop was the role of classification in the process of FPSO life extension. Class societies provide operators with critical information, for example, the steps taken in hull reassessment based on a review of the original design calculation results and the relationship between these results and in-service inspection plans for life extension. Class societies also track results trends during a unit's service life as well as modifications on the design hull parameters.

Research under way at ABS BOTC encompasses local studies on FPSOs in an effort to determine the integrity of operating units, information that will be used when outlining the critical aspects of life extension and the expected scope of work to be developed, which includes structures, mooring systems, machinery, and stability. Another significant consideration is maintenance challenges that will arise due to the large number of surveys that are required and the impact these surveys have on engineering documentation.

A wise approach to extending FPSO life is to map the unit's structural behavior according to class rule requirements and to develop trend curves for each finding by accumulating the design and operations modifications and their consequences on structural behavior and global performance. This process involves reviewing the original and updated design basis and existing analyses (strength, fatigue, and stability) as well as existing in-service inspection plans (ISIPs) and inspection reports from the class society and the owner as well as modification and repair records, metocean history, and measured load history.

This way, designers, operators and the class society can understand how each specific critical point of the hull structure develops over the years. Having this data would allow engineers to better predict the future behavior of the unit and then to better specify safety factors, reducing the number of additional complex numerical simulations and close-up surveys required.

The next steps would be a reassessment of the unit based on a review of collected data, a baseline survey according to the survey plan,

Local R&D Delivers Site-Specific Results

ABS opened the doors of its BOTC in Rio de Janeiro, Brazil, in 2010 with the goal of partnering with local industry and universities in R&D efforts that have immediate application to challenges encountered in oil and gas operations offshore Brazil.

BOTC is one of five international technology centres that co-locate ABS engineers with customers. In addition to the centre in Brazil, ABS has had a Harsh Environment Technology Center on the campus of Memorial University in St. John's, Newfoundland and Labrador since 2009; the ABS China Offshore Technology Center, which was established in partnership with Shanghai's Jiaotong University in 2011; the Korea Energy Technology Center in Busan, South Korea, founded in 2012; and the ABS Singapore Offshore Technology Center, which opened eight years ago and has become a key research and development facility supporting developments in Southeast Asia.

Supported by the extensive resources of the ABS global technology centre in Houston, all of the technology centres work through partnerships with local industry, government, and academia to address the industry's most pressing technology challenges.

Mapping a unit's structural behaviour and understanding how each specific critical point of the hull structure develops over time can help engineers better predict future behaviour of the unit and specify safety factors

engineering analyses, and a modified survey scope based on the findings. This would be followed by the development of a revised ISIP and finally, a decision on the part of the classification society about life extension.

In one FPSO life extension R&D project under way at BOTC, ABS is studying the impact modifying structural design parameters will have on an existing FPSO. These findings are being catalogued so they can be incorporated into a new Guide on life extension based on ABS' existing Floating Production Installation (FPI) Rules to better define the current critical points of the structure according to Surveys and Rule Requirements.

BOTC already has presented some of the preliminary results of the prescriptive Rule Requirements of that particular unit, and the results are positive, indicating that it is both possible and productive to reassess mature FPSOs for the current FPI Rules while taking advantage of more sophisticated design review tools and criteria.

The Next Challenge

The next steps in the BOTC project for 2014 and 2015 are to develop methodologies for considering the non-linear behavior of FPSO structures in their current condition (including wastage and coating conditions), the typical fracture mechanics modeling that can be used as part of this structural investigation, and recent real-time hull monitoring as an alternative to close-up surveys and its consequences for engineering considerations.

Meanwhile, it is important for industry to collect more data and periodically to reevaluate global performance of FPSO units so operators and class societies alike can have a clear understanding of and develop best practices for service life monitoring and maintenance.

Toward that end, ABS through BOTC and ABS Group are working together to deliver a pilot program for Brazilian operators. ■

The Author:

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