

# AHMS has an important role in shedding light on FPSO design assumptions versus operating reality

The relationship between Didier L'Hostis, a naval architect from TOTAL, and MARIN goes back a long way – probably getting on for nearly 20 years. Didier explains why TOTAL decided to support the Monitas Joint Industry Project and he outlines the steps TOTAL takes to ensure the long-term structural integrity of its FPSOs.



Didier L'Hostis

**D**idier was involved in many JIPs and used results from MARIN's deep-water basin on many projects, even before the start of the FPSO JIP Week, he emphasises. For the last seven years, Didier is well known in his role as chairman of the steering committee for Monitas 1 & 2.

"Naturally we do inspection and maintenance on a continuous basis to prevent corrosion and keep the FPSO classification up-to-date. We carry out regular inspections to see if any degradation is occurring." Typically, water ballast tanks are inspected annually and cargo tanks are inspected once every five years but when an FPSO gets older than 15 years, the frequency increases to once every 2.5 years. "We also have an annual underwater inspection by divers."

But obviously as Didier points out, an FPSO is an extremely complex structure to design and to fabricate with numerous details so it is not possible to monitor and check every single detail during the design phase. "Therefore we have to work using assumptions and then take any necessary repairs or action."

This is really where the Monitas JIP comes in, he says. "When we are in the design phase, there are a number of criteria we take into account and we make several assumptions including how we are going to operate the facility." "But as we all know," he quips, "there are always surprises when any facility starts operating!" TOTAL and MARIN started the original Monitas JIP in 2006 and it was eventually supported by more than 15 companies. Essentially, the project was aiming to develop an Advisory Hull Monitoring System (AHMS) for FPSOs. The original Monitas idea came when TOTAL commissioned MARIN to generate a specification for a monitoring system on the basis of various sensors for stress monitoring on the hull, he adds, incorporating

wave measurement and motion recording data. "The idea then came that makes Monitas unique in the industry to date!"

**Real value** "Once we have crunched the numbers from the measurements, we could then compare the results with the design values. But the real value is that this can be done on the spot. If all the number crunching has taken place and then been pre-programmed so the software tools can be available on board, this is very interesting. It is possible to look at regular intervals on line and view exactly what is happening with your installation. We now know what to measure, how to measure and crucially, how to extract the real essence from these measurements."

The aim in the next few years is that TOTAL has AHMS on all of its new FPSOs. Currently, it has installed AHMS on board the USAN and CLOV FPSO. Further systems are currently being prepared for the INPEX Ichthys FPSO and Total E&P Congo Moho Nord FPU. The pilot AHMS following on from Monitas was installed on the USAN in Nigeria but this FPSO has recently left the TOTAL operation group. The company has around 2.5 years of data however. The second AHMS is installed on the CLOV FPSO that is due start operations this summer.

Didier is looking forward to the time when TOTAL's facilities all have an AHMS on board. "We will try to take all the information available on the loading side of the equation into account when doing our fatigue analysis: metocean (mainly wave and swells), FPSO draughts, tank contents etc. and use it in our analysis. We use it to compare with the original loading distributions that were assumed during the design phase. We can assess consequences in terms of accumulated fatigue damage and therefore, expected residual fatigue life for the unit. And if it has significantly deviated from predictions, we need to understand why and make an informed decision with this data in hand.

It will be great to have real data in a consistent format. This allows me to rerun it and compare it directly with the design assumptions. The AHMS system processes the measurements and calculates the lifetime consumption on board the FPSO."

However to make these calculations, the design tools are brought on board the FPSO, which is rather unique in the industry. An alternative is to send the data onshore and do the calculations in the office. Didier points out that this on board system is not without its challenges.

**Software preparation** "Feedback from the industry is that a monitoring system is difficult to run and maintain." He stresses that in his view to use it efficiently, all the number crunching should be done up front. "When we do data analysis and send everything to shore the engineering company will always get back to you and say what about this missing data/information and so forth. And then if one item was overlooked in the early stages in the monitoring system's development the results are not matching reality. So everything has to be properly prepared on the software side upfront.

"It should be possible to compare with the design calculations from day 1! The software

should be ready, installed on board and then you can make sure you get consistent results straight away. Because it takes more or less five years from specification to first oil for an FPSO facility, and then you get the first results only two years later, there is always a mismatch and of course, as technology runs very fast, it is almost impossible to predict five years ahead what will be the missing information for the new models."

Once Moho Nord and Ichthys are equipped with the AHMS – expected to 2016 and 2017 respectively – it will be possible to have comparison sets of data. "We will be able to use Monitas for comparing actual hull fatigue levels to the predicted ones." But of course, each facility has its own life, he stresses. "If it is located in the Gulf of Mexico, Nigeria, Angola or Western Australia, each facility will be operating in different weather conditions, the tools used for the design will be different, different contractors... Therefore, it is vital to have actual information for the actual conditions! Each unit should have its own records."

In his opinion, the downside of sending everything ashore is partly that the amount of information going from site to shore is increasing every day so can become overwhelming. Additionally, he says: "I think if we are gathering information and sending



Photograph: Igor Sachs – TOTAL E&P Angola

it to shore for the number crunching often people on site will lose interest. It is preferable to have a fully developed software system, fully tested through the entire chain before the unit is on site. It should be operating and working when delivered, and should be able to run calculations, otherwise it will become a secondary issue for the site personnel."

And because the AHMS compares the lifetime consumption predicted during design with the measured lifetime consumption, data has to be provided by/to the operator. Again, obtaining the design data can be challenging, he says.

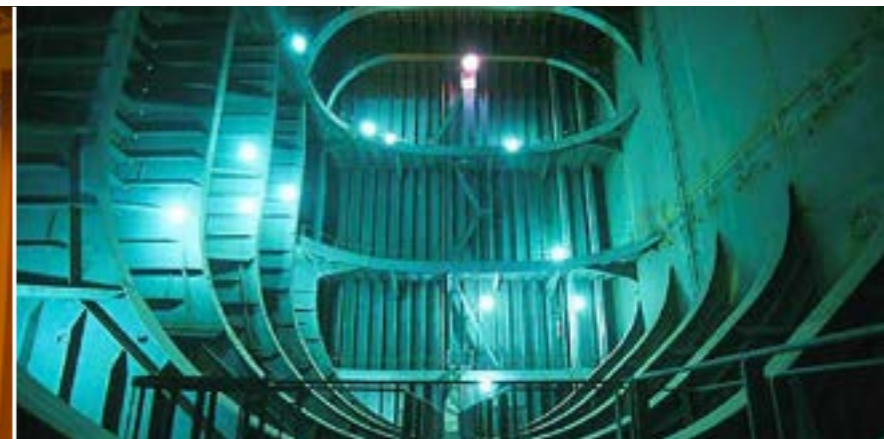
**Big step forward** "It is a very difficult exercise to prepare the tools if AHMS is not fully embedded into the design loop of the project. But this is not that easy for many



Directional wave rider buoy



Long base strain gauge



Cargo oil tank



Installation of LBSG on deck

reasons. For example, the yards that build the hulls are reluctant to give detailed information about their design tools. All the assumptions by the yard should ideally be transferred during the design phase, otherwise different assumptions may be introduced unwillingly.

“When considering that we are doing an analysis five years after the newbuilding or conversion stage, there has to be consistency because technology evolves so quickly.

Given the different sets of rules and regulations, guidelines, software etc. during this period, we have to be able to understand the mindset of the original engineer. For this reason, I think it is important to work more closely with the yards to look at the assumptions they made during the hull design.”

Although there are still several challenges to overcome, Didier concludes that AHMS is set to play an even more important role in

examining the lifetime of an FPSO and it can even contribute to extending their lifetime through actual measurements instead of prediction using a crystal ball! Overall, AHMS has certainly enabled the industry to take a big step forward in comparing design assumptions with operating reality. ▢



AHMS: measurements results are compared with the design values, on the spot.

