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Asia Pacific Technical Center

FOREWORD

BY YEH-SHENG KUAN

Regional Manager Offshore Business
South East Asia/Australia Region



While low oil prices have crushed new investment in offshore oil, gas projects are still going ahead.

The increased demand for clean fuel and shorter time to first gas will ensure that demand for offshore gas projects continues. Floating solutions are attractive both for exploiting and exporting the gas and for reception at the import terminal. They are proven, flexible and safe. FSRUs, with their fast track capacity, are by far the most appealing.

Bureau Veritas brings its deep knowledge of marine structures, its long experience with LNG handling and its readiness to innovate to a wide range of gas projects of all types. Verification is a key means of ensuring that new gas projects are safe and efficient.

The expertise of Bureau Veritas in verification is unrivalled. Come and talk to us at LNG18 and learn how we can help you move your gas project forward with confidence.*

yeh-sheng.kuan@au.bureauveritas.com

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ICHTHYS VALIDATION NEARS COMPLETION

Bureau Veritas is currently completing the validation of Ichthys offshore facilities including Central Processing Facility, FPSO, URF and Gas Export Pipeline on behalf of INPEX Operations Australia Pty Ltd. Located about 220 km offshore Western Australia, Ichthys represents the largest discovery of hydrocarbon liquids in Australia in forty years. The Ichthys LNG Project is ranked among the most significant oil and gas projects in the world. It is effectively three mega-projects rolled into one, involving some of the largest offshore facilities in the industry, a state-of-the-art onshore processing facility and an 890 km pipeline uniting them for an operational life of at least forty years.

Specific to the Australian regulations, validation is the process required in order for an operator to obtain Safety Case acceptance. The operator will produce a Scope of Validation to be agreed by NOPSEMA, including definition of the codes and standards to be applied to the facility. A validator will perform a validation in accordance with this scope and issue a Validation Statement. This will allow NOPSEMA to be assured that design, construction and installation of safety critical systems will incorporate measures that protect

health and safety of persons to the extent required by the scope of Validation.

The activities have been performed mostly by Kuala Lumpur and Singapore teams, where Bureau Veritas has engineering departments specialized in oil and gas processes and marine engineering.

"It has been a very interesting exercise to manage such a project". The overall activity required deep understanding by Bureau Veritas engineers of the nearly 200 Codes and Standards selected by INPEX and covered sixty-four Safety Critical Elements.

A challenging aspect of such a large validation project lies in the thin line between validation and verification. As validator, Bureau Veritas advises on the pertinence of the code selection for the sake of the contemplated performance criteria. It is the verification scope of work to check that the code compliance is properly implemented. It requires constant attention and close communication with the client's safety lead to ensure that the validation work does not overlap with the verification, allowing a close control on the project timelines and overall costs, both aspects being critical".

jerome.floury@bureauveritas.com



STICKING TO YOUR IDEAS

Jean-Philippe Court knows he has a big job to do. "We have to convince the offshore industry that they can use adhesive instead of welding," he says. "It is a change of mentality that will not come easily, but there are already many who are convinced and when the others see the advantages they will change their minds, I hope."

He is not daunted by the prospect of going on the road and talking to FPSO operators and oil majors. He has been sticking with his idea of using composite repairs for FPSO hulls and other offshore steel structures for a long time now. "I worked for many years as a structural engineer with offshore responsibility," explains Jean-Philippe. "I was thinking all the time of ways to repair and maintain a steel hull in a marine environment without using hot work. I knew that composite technology, using carbon fibre bonded to the steel, would be the way forward but I had to find a way in which that could be done to offshore industry standards."

In 2011 Jean-Philippe started his own company, Cold Pad, to develop and commercialise the technology. That was done working with Total and the IFP-EN and

Cold Pad has now launched its first product, Coldshield. "This is a hybrid reinforcement made of super duplex alloy and composite materials and we have been able to show that it meets the criteria of installation, strength and durability that the offshore industry demands. We have achieved what we set out to do, which is marine composite reinforcement for offshore steel structures."

Jean-Philippe is passionate that the new product is both safer to use in live hull maintenance and also cuts out downtime as no hot work is required.

But making technology work and developing it with a potential first client is only one step. To achieve wider acceptance any new product or process must have class approval. "I went to Bureau Veritas first because I was working with Total FPSOs which are BV-class," he says. "They have a rigorous process for type approval and we have now passed the first stage. It has been an eye-opener for us, Bureau Veritas were meticulous in their approach, diving into every detail and checking everything. They asked us very good questions which have helped us refine the product and process."

www.cold-pad.com



Mr Jean-Philippe Court
CEO of Cold Pad

RAM STUDIES FOR FSRUs

Bureau Veritas' advisory arm, Tecnicas has constructed a RAM model to check the availability and constraints on maintainability during operations of a large FSRU. The FSRU is based on a QMax LNG carrier design and will be equipped with a regasification plant which will enable the vessel to execute permanent gas transfer operations.

The vessel is designed to increase the availability of continuous regasification at nominal sendout rates, enable regasification with simultaneous loading, facilitate concurrent maintenance and repair activities on installed components and operate for an initial period of twenty years without dry-docking.

Tecnicas' RAM Analysis is a highly interactive process involving the participation of a number of engineering disciplines at every stage of the model development. Process, maintenance, operations and project management are all involved to build confidence in using the RAM model to explore various scenarios. When a base case model has been well established using the Tecnicas Monte Carlo RAM Simulator Optimise[®], sensitivity cases can be used to really add value and do so cost effectively in a controlled manner without costly changes to design.



For this FSRU, Tecnicas ran a Reliability Workshop to understand the critical equipment in the FSRU Regasification Installation, the associated failure modes, their impact on the system and necessary repair times to carry out maintenance in the event of equipment failure. The workshop served as an opportunity to both verify assumptions and generate ideas in terms of sensitivities to be explored. Using the outputs from the workshop, assessment of the availability of the Regasification Installation can be demonstrated through RAM modelling to meet a high target availability.

diane.ruf@tecnicas.com

FUGITIVE EMISSION MONITORING

Bureau Veritas has recently provided Fugitive Emission Monitoring for seven gas production platforms using infrared cameras for rapid detection of volatile organic compounds leaking from process equipment. Once a leak was detected, more precise quantification was performed using a flame ionisation detector.

Daily reporting of the leaks enabled the client's maintenance crew to reduce or even repair the cause of the leaks. Leaks which could not be repaired on line triggered the creation of work orders for the next shutdown. At the end of the project, more than seventy leaks had been detected representing a total amount of forty tonnes of gas released to the atmosphere.

Bureau Veritas regularly delivers Fugitive Emission Monitoring projects to offshore operators, reducing the risks of fire and explosion, improving personnel protection and reducing environmental impacts while reducing loss of production.



Fugitive emissions of volatile organic compounds result from the loss of tightness of equipment initially tight due to pressure, temperature, ageing, vibrations and maintenance. These hydrocarbon vapours create risks to safety and employees' health. Bureau Veritas has been pioneering the monitoring of fugitive emissions while participating in the European Technical Committee in charge of the development of a standard for measuring and quantifying fugitive emissions (EN 15446) and associated software. Bureau Veritas is also participating in several technical committees comparing the performance of monitoring using the sniffing method and Optical Gas Imaging.

bernard.valette@bureauveritas.com

FSRU AND SMALL SCALE FLNG PROJECTS



Despite the low oil price, several FLNG and FSRU units have recently been given a positive Final Investment Decision and are moving forward. An increasing proportion of new floating gas projects are small scale units, often moored to jetties and there is more uncertainty about large offshore units with high CAPEX. Currently ten FSRU projects, new-built or conversions, are on order or being built in shipyards.

A desire to reduce CAPEX means that many of these projects are being re-engineered to reduce costs. Some large FLNG units were first planned to produce and export gas directly at the point of extraction, but these projects may move towards a totally different solution based on minimum subsea equipment for the extraction of the gas, which will then be piped to smaller scaled FLNGs, moored at a jetty along the shore.

Bureau Veritas is continuously developing new classification notations to meet the market needs and will shortly release a new classification notation for offshore units that are permanently moored to jetties.

Bureau Veritas is deeply involved in many of these offshore gas projects, supporting rapid changes being made across the industry as it adjusts to the new financial environment. Guidelines and rules developed for the classification of the first FSRU, a conversion of the Excelerate's LNG-RV Excellence and the classification of the first newbuild FLNG, Exmar's Caribbean FLNG have now been published to help the industry move forward.

jonathan.boutrot@bureauveritas.com

NEWS IN BRIEF...

■ **BUREAU VERITAS AND APSYS HAVE PRESENTED A PAPER** at the Subsea Valley Conference 2016 on the application of the system engineering approach established in aerospace to subsea development.

■ **BONDED STRUCTURAL REPAIRS APPROVED.** Bureau Veritas has approved in principle the repair of offshore structures using the bonded composite product Coldshield, developed by Paris-based start-up Cold Pad. Coldshield is a composite structural reinforcement specifically developed for the harsh environments of offshore units. Marine offshore structures are subject to a harsh environment

combining high loads, fatigue and potential heavy corrosion. The classical method of repair by welding is not always possible, or needs long downtime. The idea of bonded structural composite repair has been under development for many years but bonding and composite repairs usually require a controlled environment, making them unsuitable for offshore structures. Approval in Principle by Bureau Veritas confirms that the design is feasible, achievable, and that the research and development campaign is relevant to demonstrate the ability of the product to behave in accordance with its specifications. Coldshield becomes the first non-welded structural repair available for an FPSO hull.



OPTIMISING MAINTENANCE

Optimising maintenance strategies and reducing related Operation & Maintenance (O&M) costs is a significant challenge for the Marine Renewable Energy (MRE) sector. Selecting an appropriate maintenance approach can be particularly difficult for multiple devices at sea, such as MRE arrays or MRE platforms combining distinct devices. Bureau Veritas has developed a methodology in the EU FP7 project - MARINA Platform-, combining an economic and a Reliability, Availability and Maintainability (RAM) assessment.

In the methodology, all the costs involved over the lifespan of the platform including manufacturing, installation, operation, maintenance and decommissioning, are evaluated in the economic model. In addition, an optional O&M module has been integrated into the economic model to enable a detailed assessment of O&M costs. This O&M module is based on outputs of the RAM assessment, such as the number of spare parts purchased, frequency of maintenance vessels or crew mobilization. This is a new development as O&M costs of MRE projects are usually simplified as a percentage of CAPEX costs.

For developing the methodology Bureau Veritas' case study was a platform combining one wind turbine and twenty wave energy converters, developed within the MARINA Platform project. Through the combined economic/reliability assessment, a comparison between several preventive maintenance strategies and spare parts management policies was made with respect to availability and revenue. Benefits of independence and modularity of MRE devices during preventive maintenance and impact of spare parts policies were investigated. The model can be used in the future to investigate other maintenance assumptions, such as the impact of the mean time to repair or the maintenance vessel fleet size and type.

It should be noted that the combined reliability/economic model is not limited to MRE combined concepts. MRE arrays of offshore wind turbines, tidal turbines or wave energy converters can also be addressed.

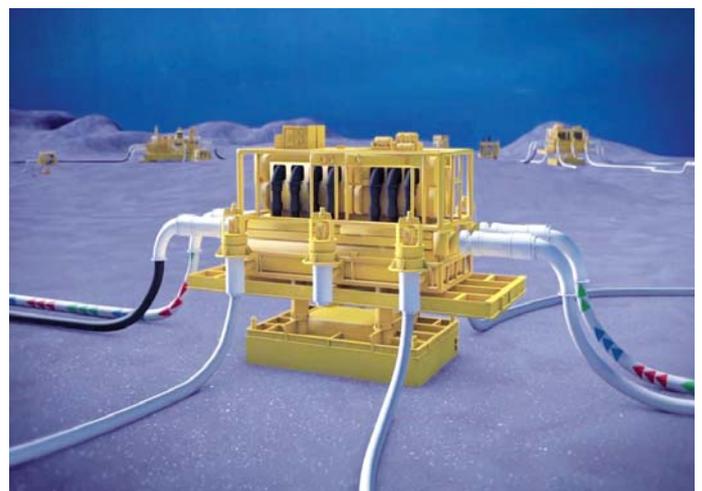
laura-mae.macadre@bureauveritas.com

ASIA PACIFIC TECHNICAL CENTRE DELIVERS REGIONAL SUPPORT

Bureau Veritas' Technical Centre in Kuala Lumpur is providing increased support across the South East Asia and Pacific region. In Australia it has supported validation of several surface and subsea systems projects. Subsea flexible risers life extension and surface and subsea equipment were also certified to various specifications. Certification of fixed offshore platforms in Malaysia, Thailand and Myanmar, together with topsides of FPSOs in Malaysia, Vietnam and Brunei is a part of the workload.

The Kuala Lumpur-based Technical Centre is one of ten Bureau Veritas Regional Technical Centres in the world. Teams of engineers provide Third Party Independent Validation and/or Verification of asset designs, carrying out independent analyses when required with various computer tools, and also providing consulting services such as Asset Integrity Management, Risk and Safety studies, Fitness-for-Service and Life extension assessments and HSE audits.

christian.bucherie@bureauveritas.com



CONTACT FOR VERISTAR NEWS OFFSHORE

Marie-Françoise Renard: 33 (0) 1 55 24 72 36

Charlotte de Roberty: 33 (0) 1 55 24 77 08
offshoreservices@bureauveritas.com

Bureau Veritas,
67/71 Boulevard du Château, 92571 Neuilly-sur-Seine Cedex, France - www.bureauveritas.com - <http://www.veristarnews.com/en/offshore>