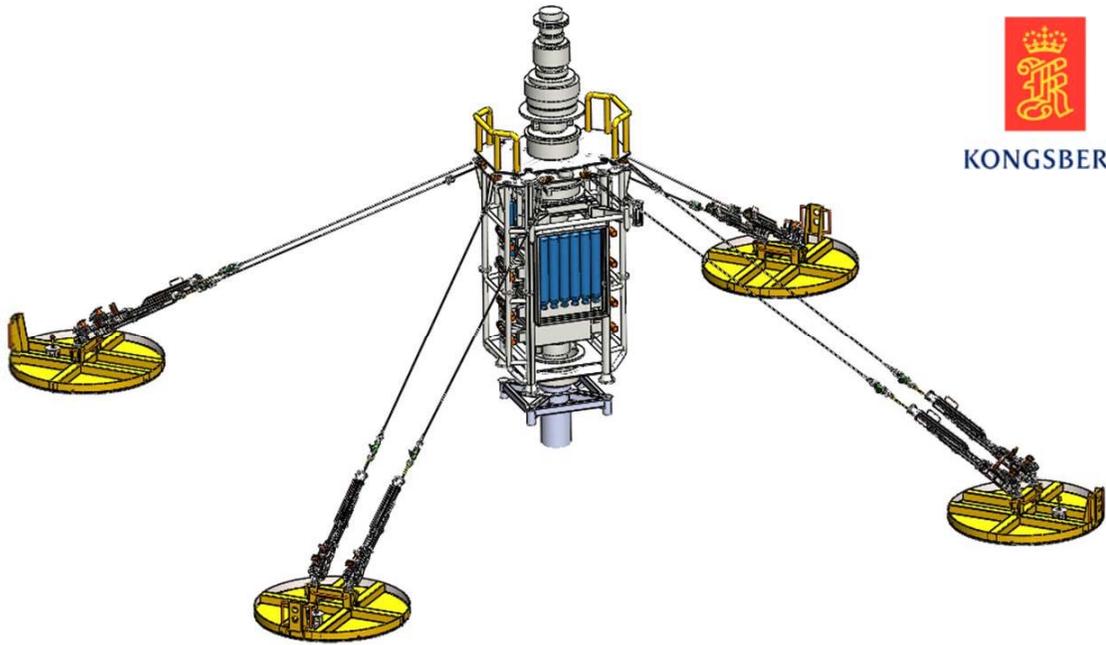


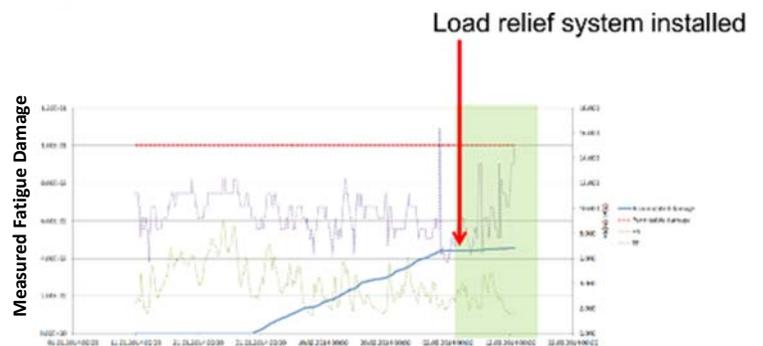
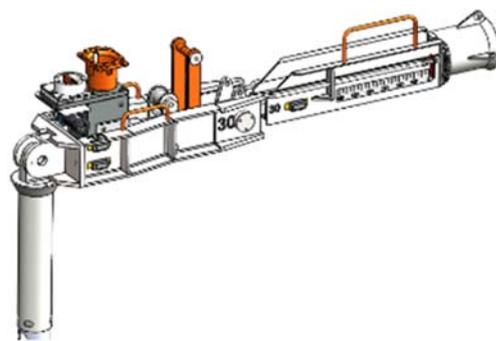
PRODUCT SHEET



INSTRUMENTED WELLHEAD LOAD RELIEF SYSTEM

FIELD PROVEN SYSTEM TO PREVENT FATIGUE DAMAGE OF SUBSEA WELL SYSTEMS FROM DRILLING OPERATIONS

KONGSBERG in partnership with SubseaDesign offer field proven systems for wellhead load relief (WLR) integrated with instrumentation systems for wellhead integrity and fatigue monitoring. Built on world leading technology and competence, KONGSBERG offers a range of options for Wellhead Integrity Systems, now including WLR systems together with SubseaDesign. KONGSBERG has a long record of accomplishments from installation and operation of instrumentation systems in various subsea applications. For drilling vessels already equipped with other KONGSBERG solutions, utilizing existing infrastructure will ease and facilitate the installation of a Wellhead Load Relief and Integrity Monitoring system. This will provide options for seamless integration to document effectiveness of the WLR system, and allow distributing selected data, results and enabling correlation with the Wellhead Integrity Monitoring system. SubseaDesign is an engineering, design and fabrication company providing equipment and services for the oil and gas industry. SubseaDesign represents a high level of competence and experience gathered by the senior employees from many years in central positions in the oil and gas industry. The SubseaDesign WLR system is field proven, and has been successfully been applied on seven wells through 2014 – 2015. The system is adaptable to different BOP designs and well layouts. It provides highly efficient load relief, it is easy to install, retrieve and re-deploy for single and multiple well projects.



Wellhead Fatigue

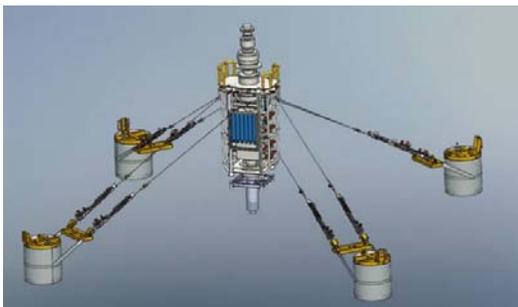
Static and dynamic loads from the drilling vessel and riser system are transferred through the BOP stack (BOP + LMRP) to the wellhead resulting in fatigue damage to the wellhead, conductors and casings. This may lead to failure of barriers and uncontrolled release of formation fluid. The risk for this type of failure must be managed to avoid catastrophic consequences. The WLR system is designed to increase the fatigue life of the subsea well system by reducing the dynamic bending moment imposed by the BOP stack.

How the Instrumented WLR System Works

The basic principle is to restrict motions of the BOP stack by connecting a number of tension lines from attachment points with load cells on the BOP to anchoring structures located in near proximity of the well. Once the lines are suitably pre-tensioned, the horizontal component of the line tension will support the BOP stack, significantly reduce motions and consequently wellhead moments and fatigue. The WLR system consists of several Mechanical Rope Tensioners (MRT) used to provide pretension of the tension wires and rigging between the BOP and the support structure. The anchoring points can be the template structure, protection structure or separate mudmats/clump-weights depending on the type of well and existing infrastructure.

What We Provide

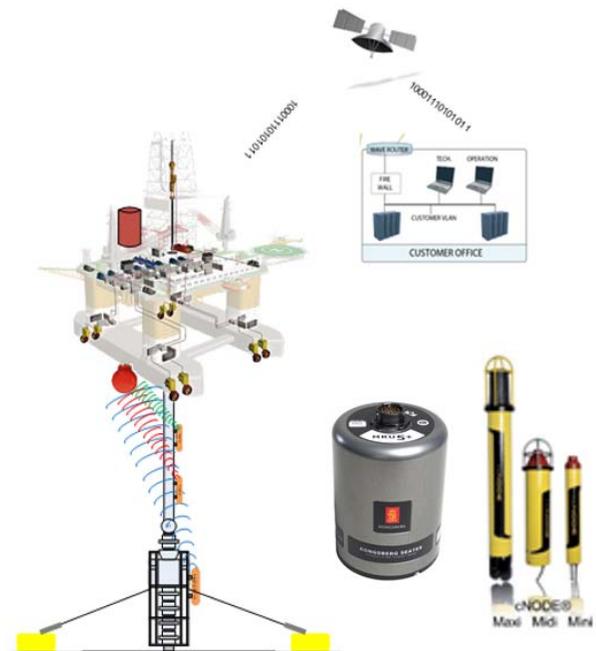
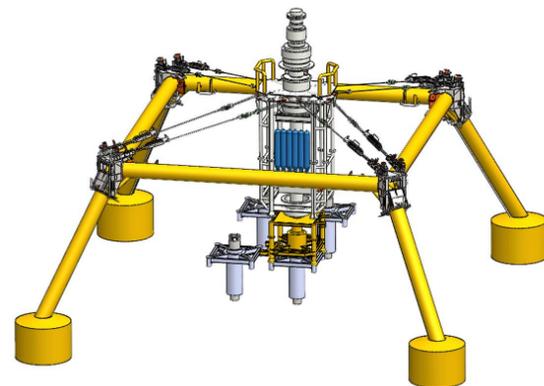
- Complete riser and wellhead analysis for strength and fatigue
- Design of the WRL system including number of tension lines, tension lines configuration and lengths
- Design of attachment points on the BOP including verification of the BOP structural integrity
- Design of attachment points to the anchoring structure including verification of the protection structure foundation and structural integrity
- Analyses of required pretension and calculation of WLR efficiency
- Monitoring system for documenting WLR efficiency and resulting wellhead loads and fatigue accumulation
- Specification of the WLR system with monitoring systems including all required components
- Delivery of all required hardware and software
- Installation and offshore support as needed
- Data processing and analysis after operation to document status and integrity of well system.



The monitoring system serves two main purposes.

- During installation and pre-tension of the tension wires, load cells on the BOP attachment points will be monitored and provided to the ROV operator to ensure proper pre-tensioning by the ROV torque tool.
- During operations, document the effectiveness of the WRL system by monitoring:
 - Tension in the lines will be monitored to ensure that the required pretension is maintained. Adjustments will be made by the ROV if required.
 - BOP dynamic motions and/or strain/LVDTs, at suitable locations, to calculate wellhead moment to be used in fatigue calculations for critical well locations.

The WLR monitoring system utilizes proven KONGSBERG sensors and will be selected based on accuracy requirements for the project. The WLR monitoring system will be interfaced to existing KONGSBERG systems on the rigs for online data processing and data replication to shore.



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