



MARINE & ENGINEERING SOLUTIONS

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## **CAPABILITY STATEMENT**

Structural Integrity Services

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**Introduction**

Aqualis Offshore is a global engineering and marine consulting firm. The company was set up in December 2012 to service the growing demand for quality offshore engineering and marine consultancy.

We provide an experienced multidisciplinary team of engineering and operational resources to support the DP industry, globally covering technical, assurance and project management scopes of work.

Aqualis Offshore has 19 offices in 14 countries, providing support to all regions of the world.

With the demand for many oil and gas facilities to operate beyond their original design life, operators are required to demonstrate these assets can continue to operate without compromising integrity, reliability, productivity and safety. Aqualis Offshore can provide technical support to operators and owners in this regard through a range of studies.

**Life Extension**

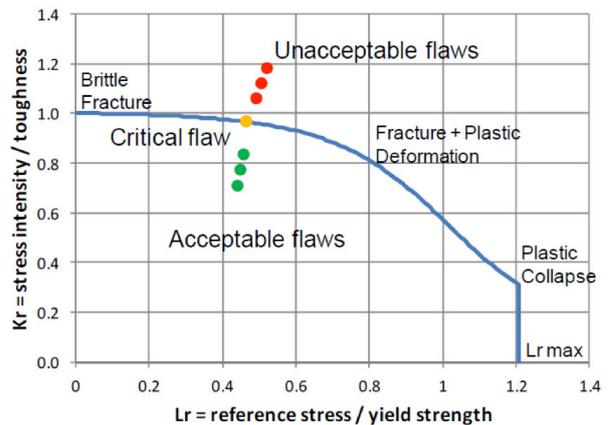
As assets age, operating costs typically increase compromising the economic viability of these assets. Aqualis Offshore have developed a good understanding of the aging process and what typical issues arise. Since the original design date of many of these structures, a significant amount of work has been done on improving structural integrity assessment techniques, through the use of advanced analysis and improved structural inspection methods.

To maintain the viability of an asset a practical approach is often available that rationalizes inspection and maintenance cost and demonstrates continued reliability beyond the original design life. Aqualis Offshore engineers have developed very specific skill sets that assist with this objective such as:

- Review and assessment of in-service inspection records including history of cracking and corrosion
- Review of the original design parameters compared to current design standards and operating requirements and loads
- Re-analysis of the structures to demonstrate compliance with adequate levels of safety
- Projections of corrosion and defect growth to rationalize future inspection scopes
- Recommendation of improvements such as removal of unwanted equipment, weight shedding, weld improvements, additional corrosion protection or structural reinforcement
- Ultimate strength (pushover) studies to establish factors of safety against ultimate collapse

**Structural Reliability Analysis and Risk-Based Inspection Planning**

Reliability/risk analysis aims to establish the probability of failure of offshore structures considering the variability or uncertainty in loading, resistance, tolerances, structural flaws, corrosion, etc. Aqualis Offshore have developed a strong technical and practical base to evaluate both structural strength reliability and structural fatigue reliability. With experience in both S-N curve and fracture mechanics approaches, we provide practical and cost-efficient solutions that minimize structural system failure risks while mitigating loss of production and repair and inspection costs.



We apply our experience in reliability analysis, fatigue and fracture assessments, as well as risk-based inspection planning to the following types of structures:

- FPSOs
- Semi-submersibles
- Jack-up rigs
- Fixed platforms
- Mooring lines and components

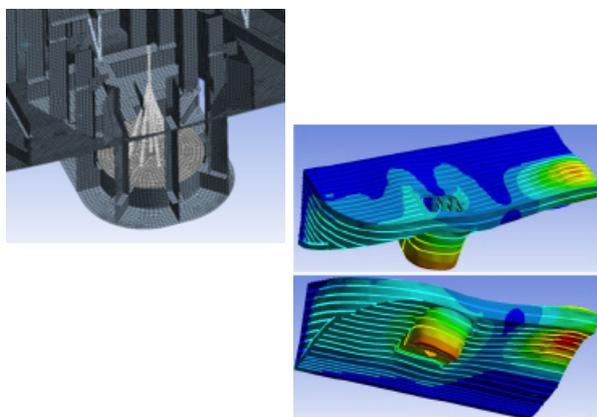
Aqualis Offshore use a variety of commercial software and tools such as SignalFFS, StruRel, iSight, and MATLAB. These are supplemented by in-house programs and tools developed by our engineers. Our experience with industry codes includes BS 7910, API 579, API 580, API RP 2 SIM, NORSOK.

**Vibration Monitoring and Analysis**

Structural vibrations are common in working vessels and fixed or floating offshore platforms. Excessive structural vibrations lead to structural problems such as fatigue and deterioration in the integrity and performance of the structure. In addition, excessive vibration can cause discomfort to personnel onboard and result in lower productivity. Vibration monitoring and remediation are often required to ensure platform structural integrity and productivity of onboard personnel.

With our experienced professionals with in-depth knowledge of vibration engineering, Aqualis Offshore offers a complete set of vibration analysis, monitoring and consulting package to our clients that covers:

- At design stage - Review platform design to identify and alleviate potential problems at design stage
- For existing structures - Prepare structural analysis to identify areas of potential vibrations and to understand the cause of any vibration problems before site visit
- Offshore vibration measuring carried out by our experienced personnel with structural engineering/nondestructive testing (NDT) background
- Repeat structural analysis following the data collection visit to validate the cause and corresponding effective mitigation approaches for any identified problem
- Cost-effective recommendations and designs of remedial measures are provided to our clients

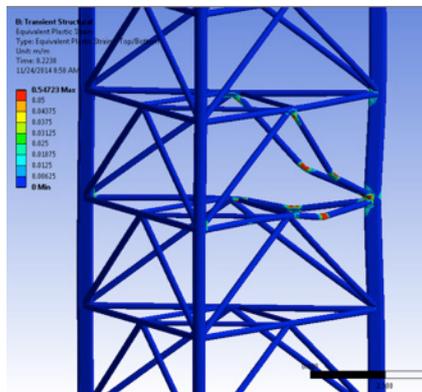


**Seismic Analysis**

Aqualis Offshore has the capability to conduct seismic analyses for a variety of offshore structures including Gravity-Based Structures (GBS), jackets, jack-ups, and various topsides modules such as derrick, flare boom, living quarter, and pipe barn. We can perform either response spectra analyses or time-history analyses using different software and tools such as ABAQUS, ANSYS, and SACS.

**Fire and Blast Analyses**

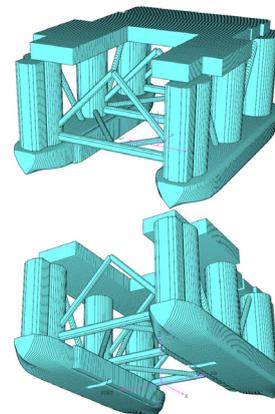
Assessment of the structure’s capacity to resist fire and blast events is often a necessary consideration for new and existing offshore structures.



Aqualis conducts nonlinear finite element structural and thermal analyses for fire and blast evaluations using industry standards or criteria such as API and ASCE, combined with client specifications. We use various finite element software such as ANSYS and ABAQUS. Our experience extends to plastic large strain / large deformation behavior to investigate failure modes such as large deflections, progressive collapse or loss of containment.

**Boat Impact/Collision and Dropped Object Analysis**

Aqualis performs boat impact and collision analysis for both fixed and mobile platforms, such as jack-ups and floaters. Assessment could be based on simplified industry standard approaches or complete dynamic nonlinear finite element analyses are applied to determine the effect of the collision or impact on the local and global performance of assets. Our engineering can be applied to assist with the development of new designs or to determine reinforcement or repair solutions to existing facilities.



We also have experience with dropped object analysis on topside structures.

