FLARE STACK STRUCTURAL INTEGRITY ASSESSMENT

When undertaking the design or assessment of a piece of equipment, it is essential to accurately identify the most important structural features and the governing load cases in order to reach reliable conclusions. For simple items this is usually a straightforward exercise, but for more complex structures it can prove much more difficult. Aided by the presence of staff with significant experience in the field of structural analysis, FCL pride themselves on their ability to 'zero-in' on the key aspects of any given design and to then develop an appropriate and efficient methodology to adopt in progressing with the required scope of work.

An example of this involved the structural integrity assessment of the upper water seal section of an integrated knock-out (KO) drum and flare stack located at a refinery in South Wales. The work was commissioned to identify minimum acceptable metal thicknesses in areas believed susceptible to internal corrosion, for subsequent comparison with measured thicknesses. The KO drum itself was a relatively straightforward vertical pressure vessel, but in order to accurately predict stress levels it quickly became apparent that it would be essential to also include consideration of the 40m tall stack, which was stayed by three guy ropes to provide additional support against wind loading. Furthermore, initial scoping work indicated that the support offered by these guy ropes was of fundamental importance to the overall structural behaviour. After a series of development studies, it was determined that the guys could best be represented using spring elements with appropriate tensile stiffness, which were only included in the model at locations where the guys were expected to be placed in tension by the applied loading. Appropriate consideration of self weight and pre-loading was then made by the separate application of forces to the guy rope attachment points.

Linear elastic stress analyses were carried out using Pro/MECHANICA (now CREO/Simulate) finite element software, using a carefully constructed model that comprised a mixture of solid, shell, beam and spring elements. Solid elements were used in areas of particular interest where the greatest accuracy was required, while shell, beam and spring elements were used elsewhere to reduce model complexity and make more efficient use of computing resources. The increased understanding of the structural behaviour provided by the work and the conclusions reached regarding minimum acceptable metal thicknesses enabled FCL's client to confidently make informed decisions regarding the necessary actions to take to ensure the continued safe operation of this important piece of plant.

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