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Benefits of hydrotest exemption and tank settlement assessments

Advanced integrity assessments based on inspection results can demonstrate tanks and their components are fit for continued service, allowing tank operators to often postpone repairs until the next shutdown, eliminate the need for repairs or be exempt from hydrostatic testing.

Improvements in inspection and computing technologies, coupled with the emergence of fitness-for-service standards, have advanced tank integrity assessments. Advanced inspection technologies including ultrasonic testing (UT) and laser scanning provide detailed mappings of corrosion, settlement and cracking of tank shells and floors. This article presents two examples to demonstrate the benefits of advanced structural integrity assessments: hydrostatic test exemption and tank floor settlement.

The purpose of a hydrostatic test exemption analysis is to establish the repaired tank is fit for continued service, without the need for a hydrostatic test, by applying detailed stress analysis and fracture mechanics technology per API 653. Quest Integrity Group routinely performs hydrostatic test exemptions for floor replacement, shell repairs for removing nozzles and new nozzle installations.

A hydrostatic test exemption analysis has many benefits. It eliminates the cost and time of the hydrostatic test itself, as well as treatment and disposal costs of the water used for the test. The exemption is particularly well suited for tanks repaired during the winter, when cold temperatures make hydrostatic testing extremely difficult. Furthermore, eliminating a hydrostatic test allows an operator to return the tank to service earlier.

The tank is considered safe if all flaws are reliably detected and eliminated before the flaws grow to critical size. However, inspection technologies are limited in that flaws below a certain size cannot be detected (the detectability limit). For conservatism, the repaired region is always assumed to contain flaws sized at the detectability limit and these flaws must be smaller than the critical size for the tank to be considered safe. A fracture mechanics analysis is performed to establish the critical sizes of surface connected defects located in the repaired regions. Critical defect sizes are calculated using the Signal™ Fitness-for-Service software package developed by Quest Integrity Group, which is a Windows®-based program implementing methodologies described in API 579/ASME FFS-1 Part 9 Level 3.

Most repairs contain no detectable flaws, therefore the repair is assumed to contain flaws sized at the detectability limit. In this case, the tank is considered fit for service as long as the critical sizes are larger than the detectability limit. A hydrostatic test exemption does not waive inspections (such as radiography) to ensure welds show penetration and fusion.

The fitness-for-service assessments for tank settlement follow procedures nearly identical to the procedures previously described for the hydrostatic test exemptions. Tank bottoms and shells can settle for various reasons. API 653-2009 suggests periodically measuring settlement. For edge settlement exceeding permissible values, API 653-2009 stipulates " … all shell-to-bottom welds and bottom welds should be inspected visually and with magnetic particle examination or liquid penetrant examination. All indications should be repaired or evaluated for risk of brittle fracture and/or fatigue failure prior to returning the tank to service." Often, assessments demonstrate the repairs are unnecessary, allowing the operator to return the tank to service sooner.

In conclusion, advanced integrity assessments based on inspection results can demonstrate tanks and their components are fit for continued service, allowing tank operators to often postpone repairs until the next shutdown, eliminate the need for repairs or be exempt from hydrostatic testing. The advanced integrity assessments described here are not limited to tanks only; assessments are often used to demonstrate fitness-for-service of other structures such as pressure vessels, piping, furnaces, heat exchangers, coke drums and rotating equipment.

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