

Digital Structural Monitoring Tools @ADaPT for Cracks Initiation and Growth due to Mechanical Damage Mechanism

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Abstract : Conventional structural health monitoring approach for mechanical equipment uses inspection data from Non-Destructive Testing (NDT) during plant shut down window and fitness for service evaluation to estimate the integrity of the equipment that is prone to crack damage. Yet, this forecast is fraught with uncertainty because it is often based on assumptions of future operational parameters, and the prediction is not continuous or online. Advanced Diagnostic and Prognostic Technology (ADaPT) uses Acoustic Emission (AE) technology and a stochastic prognostic model to provide real-time monitoring and prediction of mechanical defects or cracks. The forecast can help the plant authority handle their cracked equipment before it ruptures, causing an unscheduled shutdown of the facility. The ADaPT employs process historical data trending, finite element analysis, fitness for service, and probabilistic statistical analysis to develop a prediction model for crack initiation and growth due to mechanical damage. The prediction model is combined with live equipment operating data for real-time prediction of the remaining life span owing to fracture. ADaPT was devised at a hot combined feed exchanger (HCFE) that had suffered creep crack damage. The ADaPT tool predicts the initiation of a crack at the top weldment area by April 2019. During the shutdown window in April 2019, a crack was discovered and repaired. Furthermore, ADaPT successfully advised the plant owner to run at full capacity and improve output by up to 7% by April 2019. ADaPT was also used on a coke drum that had extensive fatigue cracking. The initial cracks are declared safe with ADaPT, with remaining crack lifetimes extended another five (5) months, just in time for another planned facility downtime to execute repair. The prediction model, when combined with plant information data, allows plant operators to continuously monitor crack propagation caused by mechanical damage for improved maintenance planning and to avoid costly shutdowns to repair immediately.

Keywords : mechanical damage, cracks, continuous monitoring tool, remaining life, acoustic emission, prognostic model

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