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## Abstract

Industries of all kinds are trying to adapt best possible maintenance strategies for sustainable business and process industry is not an exception. Recently, Reliability Centred Maintenance has been evolved as a popular maintenance strategy in process industry too. Within the RCM framework, Predictive Maintenance (PDM) plays a vital role. The data generated by Condition Monitoring instruments has been mostly used for fault diagnosis and have seldom been used for reliability assessment. Besides, the qualitative data in the form of expert knowledge remains obscured in the quantitative analysis. It is rare to find practical models or approaches that deal with both quantitative and qualitative information to support maintenance manager's decision, which can be made possible through a comprehensive '*Equipment Health Monitoring*' (EHM). In view of the above, the chain '*Stressor-Degradation-PDM-Failure-Maintenance-Reliability*' needs to be focused upon. Therefore, the present research work focuses on the following objectives, *i.e.*, 1) Equipment Health Assessment through Equipment Health Index using PDM data integration, 2) Fuzzy Estimation of True Degradation of Process Equipment, 3) Maintenance Resource Planning through Failure Probability and Fuzzy Fault Tree Analysis, 4) Prioritization of Maintenance Tasks using Possibility of Failure Detection, 5) Equipment Renewal Decision Support System with PDM data.

The research presents models, approaches and frameworks for using PDM inputs such as, condition monitoring data from sensors, inspection data both qualitative and quantitative information along with expert domain knowledge. Fuzzy sets with approximate reasoning have been used to resolve issues related to failure uncertainty, randomness, partial truth and qualitative domain knowledge. The case studies are presented to validate the proposed models with practical scenarios and found to be better for practical maintenance engineering. Throughout the research, thrust has been given to make the research more meaningful in real life situation and easily adoptable to process industry to achieve 'Reliability Assurance'.

*Key words: Degradation, Failure, Fuzzy, Health, Process Plant, Predictive Maintenance, and Reliability*