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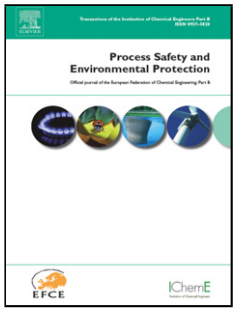

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A comprehensive method for safety management of a complex pump injection system used for shale-gas well fracturing

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Abstract: A pump injection system used in the shale-gas well fracturing process is subjected to various adverse factors during its service, such as high pressures of up to 105 MPa and a large displacement, leading to a high failure rate and a rapid degradation in system performance. To ensure the safety and reliability of such a system, a comprehensive safety management method based on a dynamic object-oriented Bayesian network (DOOBN) is proposed in this article. The approach provides a framework that integrates a system function model, causal model, system behaviour model, and online fault diagnosis model with a remaining life prediction model, to characterise the behaviours in a complex system, such as fault propagation and system degradation. This method could achieve fault diagnosis and also predict the degradation trend of critical components and system performance in the long term, starting from the current system state. The application of the integrated safety management approach to the specific example of the pump injection system demonstrates how each phase of the presented method contributes to the achievement of fault diagnosis and residual life prediction in a systematic and holistic way. It is shown that the proposed model is a reasonable starting point for forecasting the remaining life of pump injection systems. This approach could be integrated into a real-time safety warning device for field application.