The complexity of modern industrial plants poses significant challenges for the design of effective alarm systems. Rigorous alarm management is recommended to ensure that the operators get useful information from the alarm system, rather than being overloaded with irrelevant state information. Alarm management practices have been shown to significantly reduce the frequency of alarms in industrial process plants. These practices help focusing the operators’ attention on actually critical situations. However, they cannot resolve the cascades of critical situations frequently occurring during emergency situations. Multilevel flow modelling (MFM) has been proposed as a way of representing knowledge about the industrial process and infer causes and consequences of deviations throughout the system. The method enables the identification of causes and consequences of alarm situations based on an abstracted model of the mass and energy flows in the system. The application of MFM for root cause analysis based alarm grouping has been demonstrated and can be extended to reason about the direction of causality considering the entirety of the alarms present in the system for more comprehensive decision support. This contribution presents the foundation for combining the cause and consequence propagation of multiple observations from the system based on an MFM model. The proposed logical reasoning matches actually observed alarms to the propagation analysis in MFM to distinguish plausible causes and consequences. This extended analysis results in causal paths from likely root causes to tentative consequences, providing the operator with a comprehensive tool to not only identify but also rank the criticality of a large number of concurrent alarms in the system.

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