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# A Quantitative Risk-Assessment System (QR-AS) Evaluating Operation Safety of Organic Rankine Cycle using Flammable Mixture Working Fluid

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## Highlights:

- A comprehensive Quantitative Risk-Assessment System (QR-AS) evaluating operation safety of Organic Rankine Cycle is proposed.
- The QR-AS covers analysis of concentration distribution, explosion risk assessment and mitigation measures.
- Explosive zone, damage range of explosion and risk prevention measures can be figured out by QR-AS.
- Results of QR-AS can provide valuable guidance for ORC application with safety operation.
- A case of propane-carbon dioxide leaking from ORC is exemplified applying the QR-AS.

## Abstract

Mixture of hydrocarbon and carbon dioxide shows excellent cycle performance in Organic Rankine Cycle (ORC) used for engine waste heat recovery, but the unavoidable leakage in practical application is a threat for safety due to its flammability. In this work, a quantitative risk assessment system (QR-AS) is established aiming at providing a general method of risk assessment for flammable working fluid leakage. The QR-AS covers three main aspects: analysis of concentration distribution based on CFD simulations, explosive risk assessment based on the TNT equivalent method and risk mitigation based on evaluation results. A typical case of propane/carbon dioxide mixture leaking from ORC is investigated to illustrate the application of QR-AS. According to the assessment results, proper ventilation speed, safe mixture ratio and location of gas-detecting devices have been

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