Optimal design of flexible and reliable process systems

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SUMMARY

Process plants have to operate under two kinds of uncertainty at once: continuous variation in parameters such as product demand, feedstock quality and reaction kinetics, and discrete changes of state, mainly whether each piece of equipment is working or has failed. The paper sets out a single framework that brings both into the design of process systems.

CONTRIBUTIONS

- **A unified treatment of uncertainty:** stochastic parameter variations and equipment failures are handled together, rather than in separate flexibility and reliability studies.
- **The flexibility-reliability index (FRI):** a combined measure of how well a design copes with both, taking explicit account of the operating interactions and constraints of the process.
- **Design optimisation:** a procedure that selects flexible and reliable designs at minimum investment cost and maximum expected profit.
- **Maintenance:** the paper outlines how maintenance policies can be brought into the same framework.

WHY IT MATTERS

Accounting for operability at the design stage, instead of after commissioning, leads to plants that are inherently more flexible, reliable and economical. This work underpins the **FRAMS** methodology (Flexibility, Reliability, Availability, Maintenance and Safety) and the later criticality analysis tools developed by the authors and PANGAEA R&D.

KEYWORDS

Process systems design · Flexibility · Reliability · Equipment failure · Stochastic parameters · Design optimisation · Maintenance

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