37j Prosec: a Process Security Analysis Tool for Chemical Engineering Education

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Security as a whole is an extremely complex subject due to its unpredictable and non-probable nature and as such, traditional process safety measures alone are no longer sufficient for total plant security[1]. Typical scientific tools for safety assessment are based on probabilistic analysis, whereby security incidents are intentional, rather than accidental. Process security is an extended concept and practice of process safety. In the chemical process security arena, the major concern is the potential for an event resulting in a catastrophic outcome, such as explosions, toxic release, and loss of life[2]. If such an event is possible, even with a low probability, it has to be addressed and solutions must be found. Therefore, process security cannot take probability into account, as the adverse events by terrorists or saboteurs do not follow likelihood; they are completely unexpected. In this context, the attacks are harmful manipulations by saboteurs who have sufficient technical knowledge, rather than to brute force attacks that are in the scope of traditional security methods. Development of better-designed processes can reduce the inherent vulnerability of a process. Traditional process safety techniques that rely on steady-state information, likelihood, and preset alarm systems may not be sufficient for addressing process security problems.

Today, process security education becomes more important than ever, especially due to the need of homeland security assurance. The nature of chemical industries, whether due to the hazards and toxicity of ingredients used, the highly exothermic nature of many reactions involved, or simply because of their importance as an essential component of the infrastructure, presents a possible security target. Chemical engineers, due to having insight into the process, have the main responsibility of handling these issues, therefore making the concept of Process Security a critical element in chemical engineering education. Chemical engineers must be made aware of their responsibilities and roles with regard to process safety and security, and be educated about the existence of process security analysis methods and tools.

Here, we introduce a process security educational demonstration software, namely ProSec (Process Security), for studying the dynamics of the occurrence of a runaway reaction under various “security threat” scenarios, and was introduced for classroom demonstration earlier[3]. The software enables application of the Process Security Assessment Theory introduced by Uygun et al.[4] to a simple exothermic CSTR with a graphical interface and various reporting tools; which enables focusing on the conceptual security problem rather than the rigors of the modeling. Another important feature is that the software performs an optimization procedure, which is necessary in the specific method employed, “behind the scenes”, such that a knowledge of optimization is not necessary for security analysis.

For educational use, the software is envisioned as a small-scale demonstration tool that can perform the security analysis for some typical example cases, where the system parameters can be customized so that different problems (i.e. different reactions) can be accommodated. The software can be used for either simple demonstrations of security vulnerabilities in an existing process or an in-depth process security analysis project that students are asked to analyze a process, and create retrofit solutions to reduce or remove vulnerabilities. This introduced software may be implemented in undergraduate process design and/or process safety courses to aid in the incorporation of simple but illustrative examples of the essential nature of process security in a chemical engineering curriculum. The software is free, and can be obtained upon request from Prof. Yinlun Huang (yhuang@wayne.edu).

1. Lou, H. H., R. Muthusamy, and Y. L. Huang, “Process Security Assessment: Operational Space Classification and Process Security Index,” Trans. IChemE. Part B. Process Safety and Environmental Protection, 81(6), 418 (2003).

2. Center for Chemical Process Safety, Guidelines for Analyzing and Managing the Security Vulnerabilities of Fixed Chemical Sites, AIChE, New York, NY (2002).

3. Piluso, C., K. Uygun, Y. L. Huang, and H. H. Lou, “Process Security in Chemical Engineering Education,” Chem. Eng. Ed. 39(1), 48-55 (2005).

4. Uygun, K., Y. L. Huang, and H. H. Lou, “Fast Process Security Assessment Theory,” AIChE J., 50(9), 2187 (2004).