



A Calculated Risk - BBB (Borrow)

Layer of Protection Analysis: Simplified Process Risk Assessment from CCPS

Reviewed by Nick Sands

One of the most popular risk assessment methodologies today is Layer of Protection Analysis (LOPA). *Layers of Protection Analysis* explains the methodology and its application. The Center for Chemical Process Safety (CCPS), formed by the American Institute of Chemical Engineers (AIChE) in 1985, has published many guidelines to promote safety in the process industries. Art Dowell, of Rohm and Haas, chaired the CCPS committee of experts from several companies that produced the book. A pair of examples, which are not all that different, are introduced early and used in each chapter to clarify the steps of LOPA.

The first chapters provide a very brief history of LOPA, an outline of the book, and an overview of LOPA. LOPA is a semi-quantitative method to assess risk by systemically identifying the causes and consequences of an event and identifying each protection against the event and its probability of success in preventing the consequences of the event. LOPA is more detailed than the qualitative methods developed by many companies and less rigorous than Chemical Process Quantitative Risk Assessment (CPQRA) method documented by CCPS.

The steps of LOPA begin with estimating the consequences of an event and summarizing its severity. Several different approaches to consequence estimation can be used. Once a consequence has been identified, scenarios are developed that could result in the event. The scenarios include an initiating event, and may also include enabling conditions or events. The next step is to quantify the initiating event frequency, the first quantitative step. There are typical frequencies used for common initiating events, such as different types of equipment failures and operator errors.

With the frequency of the unmitigated event determined, the next step is to identify the various protections from the event. To fit the method, there are rules for the selection of protection layers. Primarily each layer must be independent of other layers, which can be quite complicated to determine. This rule enables the math of probability multiplication used to determine the resulting event frequency. Each layer must also be effective and auditable. All layers of protection are audited. Many things can qualify as layers of protection, from design options, to procedures, to alarms, to relief devices, and interlocks.

With all of the layers, and their associated probability of success, or probability of failure, identified, the final event frequency can be determined. This information allows decisions to be made about risk. If the risk is unacceptable, other layers of protection can be added or the risk can be avoided. The final chapters provide a plan to implement LOPA within a company and some advanced topics.

The Center for Chemical Process Safety provides a great service to the process industry, publishing guidelines and books on special topics. Books written by committee seem to address the lowest common denominator. While *Layer of Protection Analysis* does cover the LOPA method, it does so in a minimal way. It is worth borrowing and reading (BBB). It is available at Amazon.com for about \$136.