

## Cost-Effective Safety Management with LOPA



### What is the issue?

The safety of employees, contractors and the public are of more than average concern in the (petro-) chemical and process industry. Significant sums of money are spent on safety assurance and many safety studies are done. The studies address technical or organisational aspects of worker's or external safety in a qualitative or quantitative way. These studies are all concerned with safety, but are often performed in iso-

lation of each other. Therefore, it is usually very difficult to assess the beneficial effects on safety of the measures taken. This makes it difficult for companies to select the most cost-effective measures.

TNO, which has a long standing reputation in many aspects of safety, has recognised this problem, and developed a methodology, based on LOPA, to help companies take balanced safety investments.

### What do you do with LOPA?

Layer of Protection Analysis (LOPA) is one of the techniques used for technical safety studies in the chemical industry. Currently LOPA finds its prime use as a tool to assess which Safety Integrity Level (SIL) a Safety Integrated System would need to meet safety requirements. Potential

accident scenarios are considered in a semi-quantitative way by using order of magnitude numbers for parameters like probabilities of events that may initiate an accident and for probabilities of failures of a number of predefined, independent protection layers.

### What more can you do with LOPA?

In the TNO approach a number of extensions and adaptations to LOPA were made that were worked out to various degrees. TNO developed methods so LOPA can be used to combine various safety analyses

and to include financial assessments of measures. Some of the results were presented on conferences<sup>i,ii,iii</sup> and/or externally published<sup>iv</sup>.



## What can TNO do for you?

TNO can perform a number of activities for you. The approach outlined below was followed by TNO on a chemical production site in the Netherlands. The exact

scope of work will of course depend on your needs and also on the information already present on your site or within your company.

### Cost-effective safety management approach

- **LOPA** on an installation or plant. If safety studies are present already (e.g. a HAZOP or fault tree analysis) the effort will be greatly reduced. Part of this study will be the setting of *safety targets* with site (or company) management.
- **Installation integrity** study to be included in the LOPA. The increasing (average) age of process installations requires more attention to integrity. Introduction of dedicated integrity (degradation) scenarios in LOPA allows for this increased attention.
- **Organisational and behavioural safety** study to be included in LOPA. There is a general recognition that organisational and behavioural aspects are more and more determining the actual safety level of a plant. But what is the effect of operational routines and habits on process safety? TNO has developed methods to include these effects in LOPA. This may be important in case of a high turnover of staff, or when outsourcing activities.
- **Safety Rating** (overall safety level) calculation.
- Calculation of **effect of safety measures** on safety level.
- **cost-effectiveness** assessment of safety measures using LOPA.

## Whom to contact?

For more information on these subjects please contact.

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<sup>i</sup> 'LOPA and cost-effectiveness' Presentation (in Dutch) at 'Stichting Industriële Loss Prevention, March 5<sup>th</sup>, 2002.

<sup>ii</sup> 'An Integrated Safety for Business Analysis of Process Plants', Presented at Loss Prevention Symposium (Prague, May 2004), and at ESREL/PSAM conference (Berlin, June 2004)

<sup>iii</sup> 'An Integrated Safety for Business Analyses of Process Plants' Presentation (in Dutch) at workshop 'Industrial Safety' in Rotterdam, August 2003.

<sup>iv</sup> 'Complementing LOPA with Economic Analysis', Workshop at CCPS conference, October 2002.