Impact of LOPA Uncertainty on Safety Instrumented System Design

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Abstract

Layer of Protection Analysis (LOPA) is a semi-quantitative risk evaluation tool. The methodology is widely used in setting Safety Integrity Level (SIL) targets for Safety Instrumented Systems (SIS). LOPA is often used to evaluate the adequacy of existing protective systems against corporate risk targets. The LOPA method is based on the use of conservative estimates of the initiating events and failure probability on demand of protective systems.

Previously, Freeman presented a method for the quantification of uncertainty in a LOPA study based on the application of variance contribution analysis (VCA) techniques. This paper explores the impact of the uncertainty in the LOPA estimated frequency of a scenario in setting target Risk Reduction Factors (RRFs) for SIS design. Design questions such the following are addressed in the paper:

• Is there really a difference in risk between using a SIL-1 system with a RRF=90 or a SIL-2 system with an RRF=110?
• How large must the difference be in target RRF values for the difference to have a significant impact on risk?
• Can a fixed, predefined RRF for a given SIL class be used without impacting the resulting process safety risk? For example, use of an RRF of 50 to represent all SIL-1 designs is tested to see if the resulting reduction in incident frequency is sensitive to the use of a fixed RRF or one computed using the LOPA technique.

Recommendations are given on the applicability of the use of the ISA Technical Report (TR84 series) calculation methods for reducing the risk of facility operations.