



Uncertainty Techniques in Liquefied Natural Gas (LNG) Dispersion Calculations

Dorota Siuta^{a,b}, Adam S. Markowski^a, M. Sam Mannan^b

^aSafety Engineering Department, Faculty of Process and Environmental Engineering Technical University of Lodz, 90-924 Lodz, ul. Wolczanska 213, Poland

^bMary Kay O'Connor Process Safety Center, Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, Texas 77843-3122, USA

Abstract

The dynamic development of the LNG sector increases the risk of major accidents. Uncontrolled releases of LNG during the processes of manufacturing, distribution, storage, and regasification can pose a serious threat to people, facilities, and the environment. Therefore, an important goal is to determine hazard zones and the extent of potential consequences associated with a release of LNG. The key issue is to estimate these with the least level of uncertainty. The largest part of uncertainty comes from the modeling of LNG release sources and performing dispersion calculations. It is connected with the application of different mathematical models, the adoption of a number of simplifying assumptions, approximations, empirical relations, constants, and a lack of knowledge.

This paper proposes a general procedure for calculating the release rate and duration time of the LNG release, pool spreading, vaporization, as well as dispersion, taking into consideration the uncertainty. The procedure consists of two parts. The first part concerns the sensitivity analysis to identify the most uncertain parameters of the LNG source term and dispersion models. The second part applies to two techniques used to include the uncertainty aspects of fuzzy sets and the Monte Carlo method for calculating hazard zones. In order to provide a basis for comparison between these two approaches, the shape of the membership functions used in the fuzzy methods are the same as the shape of the probability density function used in the Monte Carlo simulation. The case study, concerning an LNG release, illustrates the application of the proposed techniques.