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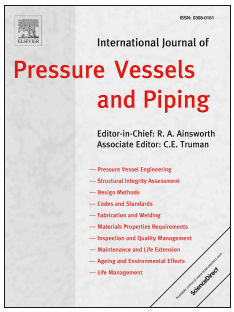

Natural gas distribution system: A statistical analysis of accidents data

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Natural Gas distribution system: a statistical analysis of accidents data

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Abstract

Natural Gas (NG) distribution is obtained by a really complex system that must ensure safe conditions and avoid human or economic losses. This paper analyzes accidents that occurred between 2004 and 2015 in the United States distribution systems and were recorded in the Pipeline and Hazardous Material Safety Administration (PHMSA) database. Statistical trends are studied; number of accidents, injuries and fatalities are shown and risk indexes are proposed for different accident causes. An average value of 2.09 x 10^{-5} accidents/km are found in US distribution systems and it is shown that natural events pose the highest risk to distribution systems. Working conditions, such as pressure, pipe diameter and system age are considered in the study, finding that the low pressure and diameter systems account for the greatest number of injuries and fatalities in the case of failure. On the basis of the results, recommendations are given to sector stakeholders.

Keywords: Natural Gas safety, Natural Gas distribution system, Natural Gas distribution accidents.

1. Introduction

Natural Gas (NG) is a primary energy source although an increase of renewable energy production is necessary to reach the objectives set out in the Paris Agreement in 2015 to reduce the global average temperature to well below 2°C with respect to pre-industrial conditions and to limit the temperature increase to 1.5°C above pre-industrial levels.

Among fossil fuels, the use of NG should be preferred for several reasons. First of all, the reduced environmental impact. In fact, considering the same level of efficiency, chemical energy can be converted into thermal energy by the combustion of NG ensuring the minimization of CO_2 emissions (2.75 kg of CO_2 per kg of fuel) thanks to the highest Lower Heat Value (LHV~50000 kJ/kg) and the lowest carbon-hydrogen ratio (i.e. C/H = 1/4 = 0.25) in the fuel composition as reported by [1].

Moreover, NG can also be transported between very long distances within pipelines or inside vessels in the form of Liquefied Natural Gas (LNG) with a cost that depends mainly on the distance and on the installation environment. A maximum value of 33 \$/(km x Sm^3) has been estimated for offshore transportation, and 11.3 \$/(km x Sm^3) for LNG transportation [2]. Because of the presence of pressure drops, several compressor stations are installed along the entire distance in order to maintain an average pressure between 70 – 100 bar in the onshore environment.

In other words, the importance of NG is evident considering national energy balances despite the declining period due to the financial crisis and the implementation of solutions to improve energy efficiency in industrial and power generation sectors [3]. As reported in [4], NG was the second

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