A Study on the NDE Reliability Matrix for LNG Plant System

Woong-Ji Kim[1], Song-Chun Choi[1], Chul-hee Yu[1]

Institute of Gas Safety R&D, Korea Gas Safety Corporation[1],
Shiheung, Gyeonggi-do, Korea[1]

ABSTRACT

Liquefied natural gas has the unique distinction of being the only flammable or hazardous material. Inspection effectiveness may be introduced into the probability of failure calculation by using Bayesian analysis or more directly by modifying the model for the independent variables, the distribution function and parameters, such as mean and coefficient of variation, changed based on the NDE method and coverage used during an inspection. Available failure data from the LNG industry are often statistically unreliable. Therefore, we need to improve more accurate information data. NDE reliability matrix is to apply optimization method of the NDE method. Reliability matrix is composed with combinations of environment reliability and inspection reliability. Environment parameters consist of inspector qualification and experience, test condition and inspection reliability parameters are composed of the inspection method and process method, such as UT, ET, RT and s/n ratio, signal processing method, etc. Finally, this paper purposes that the Reliability matrix is a powerful tool for risk assessment of not only the LNG industry but also in other industry.

KEY WORDS: NDE(Non-destructive evaluation), NDERM(NDE Reliability Matrix), RBI(Risk Based Inspection), POD(probability Of Detection), IHMS(Inspection History Management System)

INTRODUCTION

Liquefied natural gas is simply a convenient form of natural gas, a cryogenic liquid condensed in volume to make storage economically feasible. LNG is made at a liquefaction plant is restored to a gas at a regasification plant. In a liquefaction plant, there are several steps. The main steps, starting at the natural gas feed, include CO_2 removal, dehydration and mercury removal, initial chilling, liquefaction, nitrogen rejection, finally, product LNG storage.

LNG is a liquid mixture of light hydrocarbons. The main component is methane C1. And there have a other minority components such as nitrogen N2, ethane C2, propane C3, and traces of i-butane iC4, n-butane nC4, i-pentane iC5, n-pentane nC5(Mario and Rafael, 2010). The largest amount of LNG imported in 2005 was 58.6million tons to Japan, or 30% of the world trade in LNG. A large portion of imports to

Japan, as well as to South Korea and Taiwan, have been from Indonesia and the Middle East. If current natural gas trends continue, industry analysts predict that LNG imports to the US could increase 20% of total US gas supply by 2020(Yergin and Stoppard, 2003).

According to increase of LNG amount used must strengthen safety management. January 19, 2004. Skikda, Algeria, at the Sonatrach LNG liquefaction plant. A refrigerant line leaked and vapors were drawn into the combustion air intake for a high-pressure steam boiler. The boiler fire box exploded and damaged other lines that precipitated a larger explosion outside the boiler and caused extensive damage to the facility. There were 27 workers killed, 80 injured; three LNG trains were destroyed, bringing production for 2004 down to 76% of normal for the year(NASFM, 2005). This is an interesting case where risk management is an important in both health and properties.

RBI technology prioritizes inspection planning by calculating the risk value, and then the technology effectively implements an inspection programs(Tien et al, 2007). RBI is beneficial for increasing the operating time of a plant or, at the very least, keeping risks at the existing or acceptable levels(Khan, Haddara, 2004). However, little attention has been given to the inspection history database of nondestructive testing. Consider industrial site of gas pipelines for example. When conducted risk assessment, diagnosis with a history of NDE were not systematically recorded.

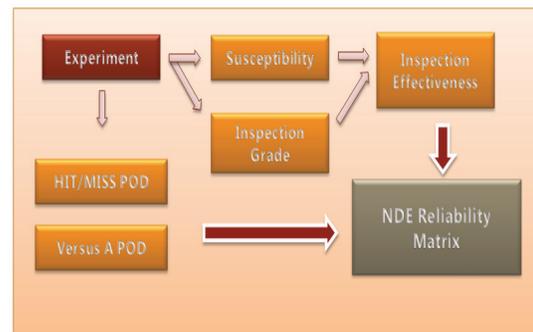Thus, NDE reliability inspection history database management system(IHMS) were developed in this study. The scheme of reliability evaluation was appeared in Figure 1.

Fig. 1 The Scheme of Reliability Evaluation