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Risk Assessment of Automated technologies for LNG bunkering

Extended Abstract (max. 500 words)

Automation technology has gained much traction over the last few years and it applicability to the maritime industry offers opportunities, such as bunkering of Liquefied Natural Gas (LNG). An analysis is conducted in the research and presents the current state of the art, which is then extended to consider future development and implementations of automated solutions for LNG bunkering. It is argued that as automaton technology improves and their progression in being accepted by industry will help attain sustainable growth. In addition, to saving time and improving staff productivity in the terminals there are factors that must be considered. Factors that have been identified that are considered are; fuel transfer flow, which includes the gasification and re-gasification characteristics, ship status, LNG tanks and their capacities, methods of conventional bunkering currently in practice. Reliable measurements are required to ensure trustworthiness for such risk factors involved in LNG bunkering.

Challenges and opportunities that are involved in automated LNG bunkering procedures are analyzed and evaluated, for example as identified between ship-to-ship. The development of automated LNG technology is argued to provide advantages that are influenced by peripheral technologies development, such as; low temperature actuators, sensors, controllers, Programmable Logic Controllers (PLCs), Direct Digital Controllers (DDCs), Emergency Shut-down system (EMS), Human Machine Interface (HMI) control panels, Building Automation System (BAS) and precision of transfer valves and low temperature pneumatic valves. In this paper particular focus is on BAS in order to consider the risks involves in implementing automated LNG bunkering technology. A Monte Carol simulation method is conducted for risk analysis assessment, We analyze and compare various technical

approaches based on automation technology involving LNG bunkering by using Low Temperature Actuator especially from the FESTO model, the Standard Cylinder DSBC ISO 15552 for the fuel transfer set-up for the Ship-to-Shore bunkering of LNG (FESTO http://www.Festo.com).

Objective (max. 200 words)

Bunkering relates to the transfer of LNG from a supply installation to a receiving vessel. The supplied LNG has the sole purpose of being used as a fuel it is important to note that LNG bunker procedures may vary greatly between projects, ships, and bunker facilities. The use of standardized procedures and checklists from existing projects may be helpful as guidance. However, vessel-specific procedures for the bunkering operation should be developed to include any characteristics or features that are unique to the particular bunkering facility and receiving vessel or location. The following is a simplified bunker operation sequence. Actual sequences will vary depending on the supplier's and receiver's equipment and capabilities.

In this paper, we adopt a Monte Carlo simulation model to evaluate factors that may influence the system. Monte Carlo recreation, or likelihood reproduction, is a strategy used to comprehend the effect of danger and instability in money related, venture administration, cost, and other anticipating models.

Data/Methodology (max. 200 words)

A qualitative approach was conducted by eliciting the use of the literature survey technique in which reviewed scientific articles were studied in order to ascertain if any gaps existed in the research area. In addition, interviews with domain experts assisted in removing any ambiguities that were confronted after the literature review. A quantitative aspect of the research is the use of the Monte Carlo simulation method. Using a Monte Carlo simulation model can be viewed as a good tool when conducting a study on the risks. This model especially shows that evaluating for the safety in efficient bunkering without any sort of dangerous risks is similar to gambling at the casinos in Monte Carlo, Monaco, for which the simulation tool acquired its name. These games at the casino are "games of chance," such as dice, slot machines, roulette wheels, etc.

Results/Findings (max. 200 words)

This paper focuses on the risk analysis of LNG-fueled vessel leakage, during the shipping voyage, neglecting loading and unloading processes, focus is also on the LNG bunkering. The consideration is for the risks to crew and third party onboard, whereas property loss or environmental damage caused by LNG leakage is out of consideration. A risk analysis

model is provided below that indicates the potential of risks, which can be later used for arguing the case for implementing LNG automation technologies in order to mitigate.

Using the Monte Carlo simulation model to determine whether the process for the automated bunkering is possible or impossible results that automation is comparatively possible to implement and there has been the use of BAS i.e., Building Automation System. It is suggested that with customized automation and Human Machine Inter-face they will play a vital role for an effective development of Automation LNG bunkering. This is valid in the process of Ship-to-Ship bunkering and possible to improve an automated bunkering between Ship to Shore with the help of fixed and flexible actuators and sensor components

Implications for Research/Policy (max. 200 words)

In future, most vessels will be propelled by using LNG as fuel, which leads to solutions that consider employing automated bunkering in attaining sustainable growth in LNG bunkering. A few recommendations are suggested to facilitate the use of automated LNG bunkering solutions:

a) Invest in automated LNG bunkering systems as they can lead to efficient bunkering of the LNG thus increasing the use in the LNG market.
b) Eventually, future vessels will adopt automated bunkering of LNG.
c) The risk factors have been seen to be comparably being less when compared to the conventional methods, which are in practice today.
d) Automated bunkering of LNG fuel will save on time, cost and reduce errors.
e) Furthermore, apart from Ship-to-Ship bunkering it is highly possible to improve automated bunkering between the Bunkering Unit in the Terminals of the Port and the LNG vessel.
f) To reliability for automation, it is necessary to estimate the risk factors involved.
g) Qualitative and quantitative analysis of such system ensure high-level sustainable operation of the systems.

In respective to the risk analysis it is possible to conduct an analysis of the LNG tank and its heat exchange rate per second and also per day with respect to boil-off gas rate. Furthermore, in detail, it's necessary to explain the component of failure and repair events takes place in the LNG bunkering sector to analytical prove the risk assessments. Henceforth, evolution of LNG automated bunkering will give new scope to the LNG market.

Keywords *LNG bunkering, Risk factors, Automation Technology, Building Automation System, Marine Industry*