

Consequence Analysis of Major Hazards for Concept Design of LNG-FSRU

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ABSTRACT

Risk assessment is a relatively new technical field and dissimilar from traditional divisions of engineering such as civil, mechanical, chemical, and aeronautical. It applies to all of them and belongs to none. Nowadays, in offshore area, risk assessment became an important item (tool) to check the rule & regulation and to verify a new design, construction way and operation activity, etc.

This paper presents the severity of major hazards at initial design stage of LNG-FSRU. First of all, we did HAZID study to get every possible hazardous event that we can imagine from structural lay-out and operational activity of LNG-FSRU. Second, we tried to find major accidents and its scenarios which can cover serious or typical events (accidents) identified from HAZID study and offshore accident records. Third, a numerical analysis (consequence analysis) was carried out to evaluate the severity of each scenario including major accidents. Finally, we suggested several prevention and mitigation methods to decrease the present risk.

KEY WORDS: Risk analysis; consequence analysis; HAZID; LNG-FSRU; fire; explosion; gas dispersion.

INTRODUCTION

LNG-FSRU (Floating Storage and Re-gasification Unit) is a new concept to supply a natural gas from offshore re-gasification plant to onshore consumer. It has been proposed as alternatives to traditional onshore re-gasification plants.

The concept of LNG-FSRU has been studied and developed as a new LNG supply facility for a long time, caused by the FSRU concept having several benefits over the land based re-gasification facility. One great advantage is the flexibility for location with minimum or no construction at onshore. It means that the obstacles in public acceptance are less than the onshore re-gasification plant. Another advantage is the easiness of LNG-FSRU construction in the modern major shipyards, covering all key functions such as procurement, material supply, construction, mechanical completion and testing. Also the LNG-FSRU

will have the benefit of being able to move other places.

Main challenge for the LNG-FSRU design lies in the integration of a large number of functions on a facility with limited space. LNG storage tanks, re-gasification facility, power production, accommodation, and gas offloading system must be designed so as to fit on a very compact area compared to a land based re-gasification plant. So there are limited possibilities of designed according to the "safe by distance" principle.

This paper shows the results of quantitative risk analysis at initial design stage of LNG-FSRU. First of all, LNG-FSRU concept and lay-out are introduced. Second, HAZID activity using top-side lay-out is explained. Third, a numerical analysis (or consequence analysis) results of main events such as fire, gas dispersion, explosion are showed. Finally, the prevention and mitigation methods are suggested to decrease the present risk.

CONCEPT OF LNG-FSRU

Main Facilities and Process

LNG handling facilities of LNG-FSRU generally comprise the following main systems and equipments.

1. LNG Storage Tanks
2. Cargo Handling Equipments
 - High and low duty compressors
 - High and low duty heaters and LNG vaporizers
3. LNG Pumps in Storage Tanks
4. Re-gasification Plant
 - Booster pump suction drum
 - LNG booster pumps
 - LNG vaporizers
5. Gas Export Metering
6. Submerged Turret Loading System
7. Knock-out Drum and Flare Tower or Cold Vent Stack
8. Offloading Arms

The LNG pumps inside of tanks discharge to the re-gasification plant (or skid). The high pressure pumps on the re-gasification plant increase