Chapter 7
Safety and Efficiency Enhancement in LNG Terminals

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ABSTRACT

Liquefaction of natural gas helps in transporting it over long distances by sea vessels. It is then regasified and transported through pipelines to the consumer. Due to large energy density of Liquefied Natural Gas (LNG), and associated flammability issues, the LNG terminal involves high risk. Consequently, safety is an important factor in the operation of LNG terminals. Although a substantial amount of time money and effort has been put in this area, there is always some possibility of improving the process so that less risk is involved. Rapid advancement in process simulation software like Aspen Plus and Aspen HYSYS, has led to the convenience of experimenting the various control methodologies on the computer offline from the actual plant operation, before they are implemented in real time. In this chapter, main hazards associated with LNG terminal operation will be highlighted. Further, recent advancements in research for safety enhancement and efficiency enhancement in the liquefaction and regasification processes will also be included.

INTRODUCTION

Natural gas is widely used as gaseous fuel in heating, transportation and power generation. Due to recent advancements in the fracking technology, it is now possible to economically produce natural gas from large shale formations (U.S Energy Information Administration, 2014). It is liquefied at the Liquefied Natural Gas (LNG) shipping terminals which are usually located along the coast and transported by LNG tankers over the sea. It is stored and regasified at the LNG receiving terminal and is transported through a network of pipelines to the end consumer.

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Natural Gas Imports and Exports in US

In the regional U.S markets, natural gas imports play an important role. In 2012, 4 percent of natural gas consumed in US was imported. Ninety eight percent of imported natural gas came from Canada through integrated pipe line network, while 2 percent was imported as LNG. However, imports from Canada are declining since the increase in U.S shale production. Net U.S imports fell from 3,785 Bcf in 2007 to 1,181 Bcf in 2014. As the shale gas production increased further, it is estimated the imports will continue to decrease. LNG imports accounted for 1-3 percent of total natural gas demand between 2003 and 2008 according to EIA. In summer 2007, LNG imports reached maximum at about 100 BcF per month (Federal Energy Regulatory Commission, 2015).

United States exports natural gas to Mexico, Canada and Japan. Growth in shale gas production in U.S between 2011 and 2014 led to proposals to export large volumes of LNG. Consequently, many LNG export facilities have been approved, as of January 2015, but none have begun operations (Federal Energy Regulatory Commission, 2015).

Safety in LNG Terminals

Due to the hazardous nature of LNG, it is important to reduce the risk it poses to the plant personnel and the community. Risk in the process is defined as a product of probability that an undesired event will occur and the consequences that occur as a result of the undesired event. (Cramer, 1991)

i.e. Risk = Probability * Consequences

The calculation and mitigation of risk is governed by a Risk Management Plan (RMP), which a facility must maintain as a management tool in order to comply with Section 112(r) of the Clean Air Act of the Environment Protection Agency (EPA). A typical RMP includes

- Hazard identification,
- Consequence analysis,
- Hazard control and mitigation,
- Procedures for:
  - Operation of the plant,
  - Maintenance,
  - Testing and inspection
  - Management of change.
- Training,
- Emergency planning,
- Accident investigation,
- Audits.

Effciency in LNG Terminals

Operating the terminal in safe and efficient manner is a challenging task. Process simulation is an important tool in the hands of process engineers because they can experiment with various production routes on a computer before actually implementing their ideas in the plant. The process under obser-