LNG Terminal Engineering and Maintenance Standards (LNGTEMS)

Gayle S. Johnson, P.E.
Halcrow HPA

Abstract

The California State Lands Commission (CSLC) has recently begun development of LNG Terminal Engineering and Maintenance Standards (LNGTEMS) that will be applicable to the design of all new LNG terminals within the jurisdiction of the State of California. This paper describes this new project and several of the key issues that will be addressed.

Introduction

The Lempert-Keene-Seastrand oil spill prevention and response act of 1990 authorized the CSLC to regulate marine facilities in order to minimize the possibility of discharge of oil, and to protect public health, safety, and the environment. The authority for this regulation is contained in Sections 8755 and 8756 of the California Public Resources Code. This act defines "oil" as any kind of petroleum, liquid hydrocarbons, or petroleum products or any fraction or residues thereof, including but not limited to, crude oil, bunker fuel, gasoline, diesel fuel, aviation fuel, oil sludge, oil refuse, oil mixed with waste, and liquid distillates from unprocessed natural gas. The State has determined that this act also provides for the regulation of marine facilities that are used for the offloading, storage, or processing of Liquefied Natural Gas (LNG).

In June 2006, the Marine Facilities Division of the CSLC awarded a contract to a group of consultants led by HPA, Inc. to develop the LNGTEMS document. Other major team members include Aker Kvaerner, Energo Engineering, Earth Mechanics, and Fugro. The project is expected to take up to two years to complete.

Project Scope

CSLC has previously developed the Marine Oil Terminal Engineering and Maintenance Standards (MOTEMS) to regulate marine oil terminals in California waters. Where MOTEMS is primarily used for existing marine oil terminals, LNGTEMS is intended for the design of new LNG terminals. This fundamentally dictated the scope of the new standards. However, these new standards should reasonably parallel those already developed for oil terminals.

The new LNG standards will apply to the four primary LNG terminal configurations that were expected to be proposed for use in California.

- Pier/Wharf type with LNG pipeline/trestle to shore (Figure 1)

- Deep Water Port (DWP), including floating processing units or energy bridge concepts, in water depths from 150 to 3000 feet (Figures 2 and 3)

- LNG vessel mooring adjacent to an existing oil platform (Figure 4)

- Gravity Based Structure (GBS), in water depths from roughly 75 to 125 feet (Figure 5).

Not covered in these standards are all components or issues related to vessels, such as Floating Storage Regassification Units (FSRUs), LNG tank vessels, tugs, etc. Vessel requirements are subject to US Coast Guard regulations and are not covered by LNGTEMS.

The main topics addressed in LNGTEMS are similar to those covered by MOTEMS:

- Structural Loading, Analysis, and Performance
- Mooring and Berthing Analysis and Design
- Geotechnical Hazards
- Component Structural Analysis and Design
- Fire Prevention, Detection, and Suppression
- Piping and Pipelines
- Mechanical Systems
- Electrical Systems
- Audits and Inspections

In addition to these, an emphasis is placed on Hazards and Risk Analyses, with an entire section devoted to this topic. As the CSLC has already learned from one proposed project, the level of risk and methodology to determine the risk is a salient requirement of LNG receiving terminals in California.

Key References

Although much of the technology and resources are available for this project, putting it all together, in a coherent set of standards that resolves questions of which standards trump others, is no small task. Some of the primary resources are:

API RP 2A
NFPA 59A
MOTEMS
Mexican LNG Code
Sandia Guidance Document
DnV
ABS

Key Issues

There are several issues that CSLC must address for each of these concepts. Some are common to all concepts, while others are specific to individual concepts. Examples are presented below.

Varying Concepts:

This project poses a unique challenge to CSLC to provide a means to evaluate a wide variety of different concepts on a consistent basis, and to clearly define and address the parameters that could impact the environment or pose a safety issue for the public. It is an ambitious project for CSLC to develop standards considering the wide range of configurations, new technological advances, environmental differences as well as various levels of risk to the general public. Although the overall goal is the protection of the public health, safety and the environment, a key question arises as to whether these various configurations should be treated differently depending on where they are located (e.g. distance from population centers) or what type of facility is being proposed.

Varying Levels of CSLC Jurisdiction

The lead agency and authority of the State varies for each concept, depending on a number of factors. For deepwater ports, outside of the three nautical mile state limit, state agencies have input into the findings provided to the governor, who can make a decision about the future of the project. It is anticipated that “conditions” will be placed on any deep water port offshore California. For the case of a GBS or wharf/pier structure, it would be located within state waters, and the Lempert-Keene-Seastrand oil spill prevention and response act would have jurisdiction. For the deep water port cases, the CSLC has been the lead agency for the development of EIRs.

Nearshore vs. Offshore Design:

Offshore and onshore / nearshore have their own typical design and construction practices that have evolved over a period of many years. The order of magnitude difference in the footprint of an offshore facility compared to a conventional onshore or near shore facility necessarily leads to significantly different design considerations.

LNG vs. Oil:

Many of the oil and gas facilities, such as offshore platforms, were designed to environmental standards that have evolved over years of experience, and with the understanding of the risks of oil exploration and production. With the addition of LNG, the question is whether the criteria/risk should remain the same. MOTEMS was designed for oil terminals, and its applicability to LNG receiving terminals may not be universal or adequate. There will be conflicting codes/regulations, such as API RP 2A for offshore platforms and NFPA 59A for LNG receiving terminals.

Seismic Design Standards:

Except for deep water port configurations, any marine structure built in California has a primary design issue of seismic demand. The offshore industry has a long history of design for two levels of earthquakes, with different performance criteria, while onshore design has been for a single level event. The different approaches, and their corresponding analysis techniques, must be reconciled. In addition, many other design standards have been developed for locations of low seismicity, and long return periods of 5,000 to 10,000 years are common for LNG terminals. This level of conservatism may not be feasible in California.

On seismic design, there is also a special concern for topsides and interfaces between different design approaches. If the structure is designed to be damaged or experience significant deformation in a severe earthquake, the affected facilities, piping, equipment, and appurtenances must be designed for the global structural behavior, and remain within the parameters described by the new LNG standards.

New Technologies:

The LNG industry continues to develop innovative technologies. The criteria must balance the ability to introduce these changes, but to do so without compromising safety and the environment. One of the challenges will be to determine what constitutes an acceptable level of testing and verification of a new technology, prior to it being approved for a specific LNG project.

This project also proposes to incorporate a new methodology to determine the structural performance of wharves/piers. This will be an extension of the procedure described in the MOTEMS, using a strain-based performance for the two levels of earthquakes. The new methodology, being developed by Professor R. Goel, California State Polytechnic University, will employ a “drift criteria”, and expected to be significantly easier to understand and implement.

Path Forward

Many new and varied challenges lie ahead, in the development of this set of regulations for LNG terminals offshore/nearshore California. As an initial draft is developed over the next 12 months, the next step will be to have an engineering workshop in Houston, to give technical experts a chance to review and to comment on the draft. This workshop will provide important feedback and guidance as the initial draft is modified. Completion of the document is expected in 2008. The regulatory process must keep up with the proposals, EIRs and future design criteria, analyses and ultimately the design of the facilities.

Conclusions

The task of developing comprehensive standards for various offshore and near shore configurations of LNG receiving terminals for California is a vital and challenging project. And because of the various configurations being proposed offshore California, some sort of universal standards must be developed. This project seeks to bring together the very best expertise and technology in the United States, to develop a set of standards for LNG terminals. A workshop is planned in late 2007 in Houston to have the initial draft peer reviewed by engineers and other LNG specialists, to make certain that this proposed set of standards is logical, consistent and serves the needs of the CSLC.

Figure 1: Typical nearshore facility. This one is being constructed at Costa Azul, Mexico.

Figure 2: FSRU and tanker at BHP Billiton's deepwater port, Cabrillo Port.

Figure 3: Floating Storage and Regasification Unit (FSRU) for Cabrillo Port

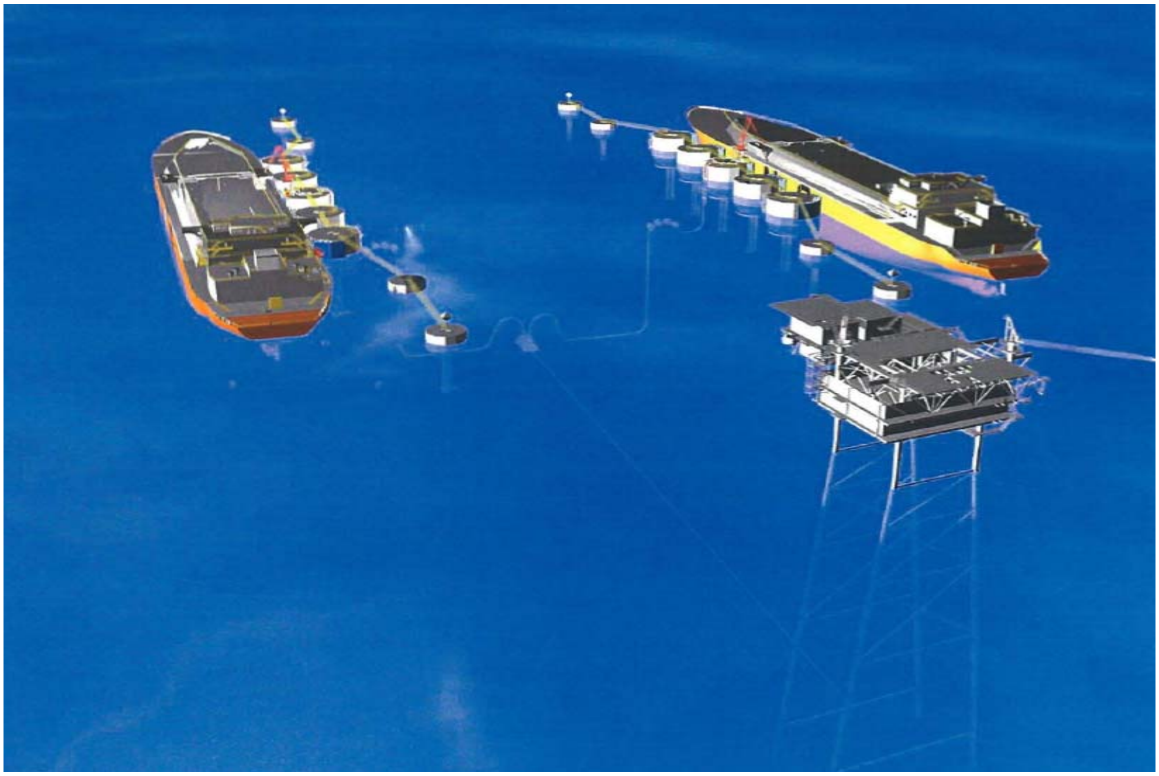

Figure 4: Proposed Concept of Reuse of Existing Platform – Clearwater Port

Figure 5: Example of Gravity Based Structure (GBS) with tanker moored next to it.