

A [White Paper](#), "LNG: A Viable Technology for Improving Gas Supplies", has been developed based on the conference presentations and discussions. The paper has been approved by AIChE's Government Relations Committee and released to the Canadian Society for Chemical Engineering for its use. The paper's principal author is Peter B. Lederman, Ph.D., P.E.

# LNG: A VIABLE TECHNOLOGY FOR IMPROVING GAS SUPPLIES

## **An AIChE Position Statement**

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### **Chemical Engineers Represent a Key Resource to Provide Technology**

AIChE, founded in 1908, is a professional association of more than 50,000 chemical engineers worldwide. AIChE fosters and disseminates chemical engineering knowledge, supports the professional and personal growth of its members, and applies the expertise of its members to address societal needs and improve the quality of life.

Chemical engineers are creative problem solvers who perform research and develop processes and products utilizing the principles of engineering, physics, chemistry, biology, and mathematics. They play key roles in such diverse industries as energy, chemicals, biotechnology, food, electronics, and pharmaceuticals. Chemical engineers are also leaders in environmental health, safety, and sustainability. They endeavor to improve the quality of life for people the world over.

*Approved by AIChE's Government Relations Committee, December 2005*

### **HIGHLIGHTS**

- LNG could play an important role in filling the gap between energy supply and demand in North America.
- Safe LNG system designs exist.
- Full and early communication with affected communities could facilitate the overall licensing and permitting processes.
- Emergency plans could be improved by application of risk-based criteria.
- Industry should further improve data, analysis, and validation of safety models.
- Generally speaking, regulations protective of people and the environment are in place throughout North America.
- Harmonizing industry standards and regulations throughout North America would enhance clarity and understanding for all stakeholders.
- Sound land-use planning principles should be applied to the evolution of all proposed facilities.

## **INTRODUCTION**

The Canadian Society for Chemical Engineering and the American Institute of Chemical Engineers convened a technical conference to explore the critical technical, regulatory and institutional issues that impact the expansion of LNG facilities in North America. The conference brought together technical experts, regulators, citizens, non-governmental organizations (NGOs) and industry representatives to discuss key issues and make recommendations for a path or paths forward. This paper provides an overview of the conference findings and makes some recommendations for members of our profession and the industries we serve.

It is obvious that there are a number of stakeholder groups that have very strong interest in the development of LNG facilities. We, as technologists, must address the many concerns and interests of these diverse individuals and interest groups. LNG has been in the energy mix for more than four decades, but it has only recently come into the national and international spotlight. With increasing demand for LNG, there are a growing number of potential projects in North America. There are over 40 proposed projects in some stage of development compared to today's five major operating, storage and regasification facilities (excluding "peak shaving" facilities, which store surplus natural gas to be used to meet requirements at times of peak demand).

The economics of LNG are closely tied to power production. It is expected that North American demand for natural gas will outstrip conventional supplies within the next few years for a variety of reasons, but primarily because of increased demand for power generation and decreased domestic natural gas reserves. LNG can be a very competitive option for future supplies given the enormous foreign reserves.

The discussions and observations of the conference can be analyzed through four primary stakeholder communities. The four—the regulatory, industrial, citizen, and environmental NGO communities—are all concerned with the same issues. That is, how to ensure that the industry develops in a safe, economically sound manner that incorporates the concerns of local citizens and environmental groups into the growth model. The four groups approach these needs from differing perspectives, but do appear to be more than willing to listen to and work with each other.

It is important to continue to emphasize the proper management of safety to maintain the safety record the industry has achieved. This is important for all stakeholders. Many factors drive safety at an LNG terminal including siting, design, construction, and operation. Innovative approaches to all these phases, especially in offshore and "cold climate" facilities, need to be pursued.

## **THE STAKEHOLDER COMMUNITIES**

Understanding the views of the four stakeholder communities represented at the conference will be key to successful LNG development. Some of the key issues and concerns of each group are described briefly below. Because there was only limited representation from some groups and because local issues are often as important as broader concerns, these brief summaries should be considered one, of many, approaches to the challenges ahead.

### **REGULATORY COMMUNITY**

The regulatory community believes that regulations are in place, but that, in some cases, regulation should be harmonized to make the planning and permitting process more efficient, while fully protecting the public. In the United States, there is a well-developed regulatory environment that has been in place for the last three decades, subject to periodic reviews and revision. In Canada, regulations are also in place, but are currently being modified by some of the affected provinces. In Mexico, regulations are in place. However, technical regulations and standards specific to LNG are, in many cases in all three countries, under review or being updated. And, they are, to some degree, location dependent. Outside the U.S., they often incorporate different primary and secondary standards depending on the jurisdiction, so the regulatory framework that has been established may still be subject to modification. This can add to confusion and uncertainty.

Siting an LNG terminal is a costly and lengthy process regardless of the location in North America. Depending on the country, it may require application to two or three jurisdictions and several agencies. The process can easily take up to four years. This is the formal application process. In addition, and at least equally lengthy, is the time to work with the nearby community. Ideally this should start early in the process and recognize that multiple levels of the community need to be approached and their interests must be addressed. This needs to be done on an individual basis as early as possible in the process.

In the regulatory permitting process it is important that the proposer of the facility take into account local land-use patterns, the movement of LNG into the facility, as well as the expectations of the local communities that could be affected by the facility. The public needs to have confidence in the regulatory process and would probably be better served with a uniform set standards and, where politically feasible, uniform regulations. The public is concerned about risk to their communities. Regulations should address this by incorporating risk-based analysis as part of the permitting process where it is not already required. This would also assist industry in that it would provide one set of standards and regulations for planning purposes.

## **THE ENVIRONMENTAL NGO COMMUNITY**

The environmental community believes that LNG should be considered part of an overall sustainable energy policy. As such, it feels that it is important to carefully examine the environmental affects of loading, unloading, liquefaction, and regasification in terms of total energy consumption and ecological impact. This conference did not address this totality except in passing. However, it did note that LNG is only a part of the total energy picture and should be examined on a sustainable and total environmental impact basis as part of the overall energy policy discussion.

## **THE LOCAL CITIZEN COMMUNITY**

Local citizens in LNG sending and receiving communities need to be heard and their concerns taken into careful consideration. The conference heard only from receiving citizen groups. It was obvious that local conditions created a wide variation in concerns. These concerns were based on local conditions, the degree to which local groups were involved at an early stage and on a continuing basis, and the degree of technical sophistication. Potentially impacted citizens are, first and foremost, concerned for their safety and quality of life issues. It is critical to the progress of any of these projects that all affected parties are brought into the process at the early planning stages. They need to have available an independent, credible source of information. Citizen groups feel that, at the moment, there is much conflicting information from a variety of sources. This is not good for any of the stakeholders. Facts and dialog, we believe, are among the keys to a successful project.

## **THE INDUSTRIAL COMMUNITY**

The industrial community would like more assurance, at an earlier stage, that if done correctly, the proposed project can be built. At the moment, some believe that too much money and time is at risk before a project can even enter the permitting stage(s). We believe that early, and frequent communication with local stakeholders is one step to providing greater certainty at an early stage. The LNG industry speaks to the excellent safety record of the past 40 years. It is important to continue that safety record because one major accident could severely impact one community and the entire industry. In that light, risk-based decisions founded on sound science are important. Continuous implementation and updating and drills on Process Safety Management procedures (including Incident Response Command Plans that involve the public) should be required.

## **KEY FINDINGS AND RECOMMENDATIONS**

The major findings of the workshop, together with some major recommendations, are:

### **Role of LNG in Energy Policy**

- North America will be experiencing an increasing gap between natural gas supply and demand.
- LNG will play an increasingly important role in filling the gap.

### **Regulations / Standards / Guidelines / Permitting**

- Regulations that are protective of people and the environment are in place in the US, Canada, and Mexico.
- These require the development of Emergency Plans – prevention, preparedness, response and recovery
- There is a need to harmonize industry standards and, where possible, regulations over North America, for clarity and understanding by all affected parties.
- Process Safety Guidelines from the Center for Chemical Process Safety (CCPS) of the American Institute of Chemical Engineers (AIChE) should be applied to all facilities.
- There needs to be agreement, with leadership from a standards setting body, on risk tolerance or consequence criteria.
- There is a need to incorporate sound land-use planning. It should be the responsibility of the proposer to provide for and incorporate appropriate land use planning and buffer zones, based on sound science.
- Bring in local communities at the earliest possible time.
- Involving the public early and on a continuing basis is essential to success and acceptance.

### **Emergency Preparedness and Response**

- Plans could be improved by requiring the use of risk-based criteria.
- LNG facilities are similar to chemical and petroleum facilities in terms of catastrophic incident planning.
- Sound Emergency Response Plans based on the Incident Command System Approach should be available for all facilities.

## **Communication of Technology and Risk**

- We need honest, full communication that is understood by non-technical people.
- We need to communicate risk and potential consequences more fully.
- We need credible, independent sources of information

## **Risk Analysis and Decision Making**

- We need to develop and apply the best science to decision making.
- There is a need to improve the technical basis of consequence analysis.
  - Models currently used have been validated only with relatively small-scale events, and are believed to be overly conservative in significant ways.
  - We require large-scale LNG test data to confirm predictive models.
  - There is little practical experience with the consequences of large LNG releases on water due to a good safety record and limited testing.
- Reliability data for LNG facilities and equipment should be updated by industry.
- Different societal values placed on preventing air pollution versus water pollution drive different design approaches to vaporizing LNG.

## **Design Considerations**

- Safe LNG system design approaches exist, and new approaches that incorporate inherently safe design continue to be developed.
- Specific storage tank designs depend in part on local conditions, but should provide for full containment to provide a high degree of protection.
- As in any industry, operator (human factor) issues are important.

## **TECHNICAL NEEDS**

The technical and scientific basis for success is mostly in place. The technology is improving as advances are made. For example, much more attention is being paid to security related scenarios and risk assessments. Regulatory requirements and sound operating procedures have led to safe facilities. However, additional work will always be necessary and desirable to ensure that facilities are as up-to-date and safe as possible. In that regard, a number of areas deserve additional attention. These include the more thorough use of human factors engineering in the design of plants and better verification of models through large-scale tests. In the transportation area, a better analysis of onboard ship leaks would provide important added information. Safe LNG system design approaches are in use, but new approaches are being developed and they should be tested and implemented when available.

## **SUMMARY**

It is the opinion of the Conference that there are no insurmountable impediments to the growth of the number of facilities if they are carefully planned, designed, and operated. The industry has had a good safety record over the past 40 years. However, the industry, like all industrial ventures today, still has room for improvement in a number of areas, including communication with citizens of nearby communities. Additional effort should be placed on validating current and improved models with large-scale release test data. More realistic data on emptying of tanks is also desirable. These issues and the development of better risk tolerance and consequence criteria continue to warrant attention in spite of the efforts of industry in these areas.