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NEW YORK STATE LNG DEMONSTRATION PROGRAM

Submitted by:
NEW YORK STATE ELECTRIC & GAS CORPORATION
Binghamton, NY

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NEW YORK STATE LNG DEMONSTRATION PROGRAM
Draft Final Report

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Robert Vagnetti, Project Manager
and Bonnie Dowdell, Project Coordinator

Prepared by
NEW YORK STATE ELECTRIC & GAS CORPORATION
Binghamton, NY

Prepared by:
Lisa R. Hoffman
Project Coordinator
And
Bruce Roloson, Project Manager

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SUMMARY

One of the major obstacles to widespread use of LNG as a fuel is its cost and availability. Expensive front-end gas clean up needed to remove potential solids that would damage refrigeration equipment, and substantial over-the-road fuel delivery costs make it difficult for LNG to be cost competitive with #2 fuel oil and diesel. The concept for lowering the production and delivery costs of LNG is to develop a mass-producible, small-scale natural gas liquefier, with a low-cost gas clean-up process, that can be installed on pipelines and wellheads with new sources of natural gas.

In October 2003, the U.S. Department of Energy obligated \$600,000 of its funds to NYSEG to complete a small-scale liquefaction facility demonstration in New York State with the purpose of illustrating the capability and efficiency of storage and peak shaving of natural gas sources through the process of liquefaction. To this end, NYSEG researched various available and emerging processes capable of small-scale liquefaction of natural gas at wellheads and pipelines. NYSEG selected the letdown technology created by the Idaho National Laboratory (“INL”) in Idaho Falls to be the primary technology for the field demonstration. NYSEG selected a project site in the Southern Tier area of New York. The Southern Tier is experiencing a rapidly-escalating gas production industry as it overlays the Trenton—Black River natural gas find. At this location, the project would require 5,630Mcf per day natural gas flow to liquefy a portion, about 80 percent, into liquefied natural gas. The design at this site would render about 30,000 gallons per day of LNG, store a total of 200,000 gallons on site, and include a dispensing terminal that would allow loading of LNG into 10,000-gallon tankers to be hauled to a peak shaving/vaporization facility to be built in upstate New York.

Concurrently, NYSEG acted as the lead in a project funded by the New York State Energy Research and Development Authority (“NYSERDA”) which had the twin goals of building a consensus around the recommendations of the NYSERDA LNG Steering Committee with regard to the safe handling of LNG at points of manufacture and storage and along transport routes, and developing the site control and technical design of a specific LNG network that complies with the adopted protocols. At the outset, a 40-year old moratorium on licensing LNG facilities was in effect. The Steering Committee was integral in convincing the legislators to allow the moratorium to lapse with the promise of drafting legislative and regulatory protocols relative to LNG. Despite the work over the past 5 years toward this end, there persists safety concerns and political opposition that has effectively stalled adoption of any rules in New York.

To date, NYSEG has spent none of the USDOE funds, which was earmarked to purchase equipment for the facility. The purpose of this report, then, is to document the work completed under the cost share portion of the project and increase the body of knowledge around small-scale natural gas liquefaction technology and permitting issues.

PURPOSE OF THIS REPORT

This report documents the processes followed from conceptualization to the present as the NYSEG Project Team, working together with the NYSERDA Steering Committee, has

- focused its efforts on assisting the New York State Department of Environmental Conservation (“NY DEC”) in its efforts to draft LNG protocols;
- worked with the NYS Legislature to pass legislation allowing for the safe production, storage, and transport of LNG within the State (excluding the New York City area);
- selected a preferred liquefaction technology following exploration of alternatives and discussions with appropriate vendors;
- selected sites for a demonstration project which would include the design for at least one LNG liquefaction plant, and its on-site storage tank(s), at least one LNG peak shaving storage tank and vaporization facility at a local gas distribution network, and several L/CNG dispensing sites;
- developed a preliminary marketing plan;
- coordinated the preparation of safety training materials;
- coordinated the preparation of public outreach materials; and
- initiated the establishment of a dedicated website.

MARKET ASSESSMENT

Since September 11, pipeline security issues have emerged as major areas of concern. In addition, the United States, particularly the Northeast, is dependent on foreign supplies of LNG and oil. It might be best to layer or overlap markets wherever possible. The following opportunities were seen as possibilities in the New York area:

- Micro Peaking
- Interruptible supplies for industry
- Remote gas systems
- Mobile source L/CNG (heavy-duty)
- Special industries that require significant quantities or specific quality of natural gas
- Use of NYS natural gas resources via LNG.

An analysis of the market opportunities was seen as essential. The focus of the market assessment would allow for the following:

- An understanding of which markets could and should be targeted for initial development efforts by the Project Team
- What are the economic push points in those markets?
- What changes the markets might demand in an optimized technology in terms of size, construction, mobile, skid, etc.

Initially, NYSEG held several internal discussions on marketing methodology for customer identification and strategies to identify and contact communities targeted as potential sites for LNG liquefaction and/or storage and distribution centers. Over the

course of several months, a number of sites were identified within the NYSEG/RG&E service territory, which could serve as the distribution points from which LNG would be transported to various market points (storage) throughout the State. A marketing map for LNG was drafted, indicating potential delivery routes, distribution systems, liquefier site(s), and customer sites.

Preliminary marketing rollout efforts for the production/storage/transportation of LNG in New York State (NYS) began early in the project. Initial contacts fell into three (3) categories:

- Industrial Customers
- Communities which may serve as distribution centers
- General potential sites for liquefaction

NYSEG has subsequently compiled information in order to begin its preliminary economic analysis of the LNG plant and appropriate sub-systems including the costs and availability of various sized storage tanks. A preliminary cost estimate was completed for the metering and regulating equipment and pipeline infrastructure necessary for interconnection to the gas source.

Utilizing the expertise of our team members, we ran economic models to determine the optimum size of the LNG plant(s) (gallons per day output) and the relative size of the storage tanks on-site and at the end-users' sites. The parameters that influence the size of the plant and storage tanks include the load forecasts of firm customers, seasonality of the demands, trucking distances, and, among other things, costs and availability of storage tanks. A judgment must be made about how many days of available storage should be on-site at the liquefaction plant and at the end-users' sites. The factors that influence this judgment are the output of the plant, the likelihood of weather-related delays, availability of backup sources of LNG, and the reliability of the selected trucking company.

NYSEG has assessed the market for LNG and has determined its initial target customers. Forecasts of the customers' loads were completed. The initial market would include:

- Peak shaving facilities on NYSEG/RGE's gas distribution system
- NYS Department of Transportation ("NYS DOT") alternative fuel vehicles
- Supplies for load growth occurring in southeast counties not currently near gas supplies
- Distributed generation in Adirondack and Catskill Mountain communities
- Other utility companies that could use LNG for an alternative gas supply.

The initial peak shaving opportunity to be pursued is on NYSEG/RG&E's gas system in its east-central service territory. Approximately 46,000 gallons of LNG will be needed in each of the two coldest months to keep a NYSEG gas pipeline, which serves two sizeable communities from having low-pressure problems. The company is in the process of modeling the annual demand curve to determine the size of the storage tanks it will need at the facility. A site for a vaporization and injection facility has been identified at the outskirts of one community, and a network analysis shows that the facility would

alleviate the peak pressure problems as well as allow for future load growth in these communities and all along the areas served by the NYSEG pipeline. Real estate and environmental permitting related to the site would be investigated under a later phase of the project. Other peak shaving opportunities will be considered following successful implementation on the initial pipeline.

A load forecast is underway for the Catskill Mountain market area where significant new development projects, including three casinos, were announced. Other new loads would include several villages and towns, large institutional customers, manufacturing facilities and three NY prisons. Additionally, there is a potential for serving alternative fuel vehicles at a large NYS DOT yard in Sullivan County.

The NYS DOT has required that half of its heavy-duty fleet be converted to an alternative fuel by 2005. The DOT has a preference for converting many of its vehicles to LNG, and provided a seasonal estimate for an initial DOT fleet load. NYSEG planned to site LNG facilities to serve the DOT fleet at both DOT truck yards and private truck stops. Conversations were held with the owners of a private travel center adjacent to the NYS Thruway, and the owners agreed to host the first private LNG vehicle fueling station.

NYSEG/RGE assessed the potential of using LNG to power a combustion or engine-driven generator to alleviate power shortages experienced on peak days in several small communities in the Adirondack and Catskill Mountains. If LNG is made available in such locations, conversion of residences, as well as commercial and industrial customers, is a possibility. The demand at one such location has been calculated, and presents a significant potential load.

As the loads for the above were forecast, they were worked into the preliminary economic analysis model to determine the optimum supply of LNG to be created at the selected liquefier sites.

OUTREACH/GUIDELINES/REGULATIONS/LEGISLATION

One of the most critical steps in this process was to formulate a Legislative/Regulatory Strategy as it pertained to the development of new LNG projects in NYS. Toward this end, two committees were formed under the auspices of the NYSERDA-sponsored NYS LNG Steering Committee; the Regulatory Guidelines Committee, and the Legislative Guidelines Committee.

Regulatory Process

Title 17, Article 23 of the Environmental Conservation Law requires that the NY DEC set up permitting requirements for the siting of LNG facilities in NYS. This regulatory role was assigned to NY DEC, but due to a lack of resources, both in terms of available personnel and funds, regulations were never developed. Representatives of the NY DEC attended meetings of the Regulatory Guidelines Committee over the course of several months to discuss their role in the regulatory promulgation process and a regulatory

framework. Throughout this process, the NY DEC pointed to the length of time that would elapse before the development of new regulations, including the lengthy approval period, thereby potentially impairing the successful completion of this project. They agreed that it made sense to pursue a parallel legislative course of action.

It was deemed appropriate to make NY DEC's permitting and enforcement responsibilities equivalent to their responsibility for other liquid fuels. Two levels of existing NY DEC permitting/regulation responsibility were considered; storage tank permitting and certification (related to environmental/groundwater contamination and public health/welfare/safety), and environmental impact assessment related to large-scale sites. A two tiered system or "Thresholds" could be established for certain volumes of LNG storage. If the proposed storage quantities were below the threshold, the permitting process would be more perfunctory and require less involvement from the State while proposals with quantities above the threshold would trigger NYS Environmental Quality Review Act ("SEQR") laws requiring a more comprehensive environmental impact statement or assessment.

The Regulatory Guidelines Committee proposed a regulatory construct that would contain the following principles:

- Include national standards for LNG facilities (by reference), such as NFPA and Federal pipeline safety standards.
- Establish "Home rule" for cities of more than 1,000,000 (allowing NYC to adopt its own LNG standards).
- Assign ministerial responsibilities to specific NYS agencies, including the following:
 - Department of Transportation (DOT) for transport issues, and reporting to NY DEC and NY Department of State ("DOS") on any transport-related LNG "incidents" (spills, uncontrolled venting, fires, and damage to vehicles, property, and/or people...)
 - DEC for SEQR environmental assessments (when they are triggered only for projects over 70,000 gallons LNG storage), for issuing permits when required, maintaining a database of LNG facilities per the permits issued; and for collecting reasonable fees to cover the cost of issuing permits and the maintenance of the database.
 - DOS for the training of local fire departments, and preparation of an annual report to the Legislature (based on its own data, and data for NY DEC and DOT), listing the total number of LNG facilities, the extent and severity of "incidents," the extent of any need for a local fire department to respond to any LNG-related incidents, the number of person hours of LNG related training offered during the reporting period...and recommendations for legislative and/or regulatory change.
 - NYS Department of Public Service (PSC) for pipeline-based LNG production facilities owned by "gas companies."
 - NYS Department of Weights and Measures for establishing uniform dispensing measurement criteria.

- o Department of Taxation for establishing and monitoring appropriate methods for collecting taxes on LNG (and vaporized gas from LNG) depending on its use.

In January of 2003, several members of the Project Team met with the NYS PSC to discuss the legal conflicts that currently exist in relation to the regulation and oversight of LNG facilities in NYS, and to review options for an integrated rational approach to LNG use and development in NYS for both utility and non-utility providers and users. No action resulted from this meeting, as the Committee decided to continue the parallel efforts with the NY DEC and the NYS Legislature.

In April 2003, the regulatory track took somewhat of a back seat to the legislative process, due mainly to the invitation put forth by the Assembly Staff for the LNG Project Team to submit amendments to Title 17, Article 23 in a very short timeframe. It was understood that much of the research put forth in the Team's legislative efforts would be applicable to the regulatory efforts as well.

In May of 2003, a staff member in the Governor's Office (who had previously been with the NY DEC), reported that the Rule Initiation Memo (RIM) had been drafted and circulated within the State. After the RIM is signed, regulations will be developed and reviewed internally. There is no deadline for this process, and it could take a minimum of 12 months.

For several months, the regulatory efforts were sidelined while energies were concentrated on the legislative changes. When the legislature recessed in the summer of 2003, attentions were turned once more to the regulatory requirements.

Meetings were again initiated with the NY DEC to review the regulatory process. NY DEC assigned a new staff person to work on this project, and he reviewed the existing state codes and definitions for overlap with the proposed regulations. They have indicated that a new regulation would be placed under NYS Environmental Conservation Law Part 560.

The NY DEC opened up a discussion about what may be exempted from the most rigorous state regulations. Current standards differentiate by the volume of LNG stored, i.e., less than 10,000 gallons, between 10,000 and 70,000 gallons, and over 70,000 gallons.

They have also opened up discussions on the concept of time; i.e., is it a "facility" if it dispenses LNG for 72 hours or less, such as a LNG truck to pipeline vaporization. These emergency or temporary facilities may qualify for an exemption under the proposed regulations.

Current Status

Draft rules have been developed by a member of the Project Team, working with senior DEC staff and with the participation of the NYSERDA Project Manager. The status of the rule-making process is outlined below, and it is estimated that the process can be completed within 18 to 24 months.

Regulatory Agenda filed with the Department of State and published in the State Register.	Published 3/17/04
Rule-making Initiation Memorandum written and approved up through the Commissioner.	Approved 4/9/04
Scoping meeting held with DEC staff and other key participants to discuss the SEQR aspects of the rulemaking process, time frames and what documents are required by the State Administrative Procedure Act.	Latest held in August 2008, at which rulemaking process suspended to allow time for DOS to conduct independent safety studies.
Program staff solicits input from businesses, local governments, rural publics and other citizens on the effect of the proposed regulation on regulated parties.	
Program staff prepares required documents: draft express terms (and summary), SEQR documents, Regulatory Impact Statement, Regulatory Flexibility Analysis, Rural Area Flexibility Analysis, Job Impact Statement, Notice of Proposed Rulemaking.	
Above documents approved by DEC Executive Office and sent to GORR for pre-proposal review.	
Proposed regulation approved by DEC Executive Office, filed with Department of State and published in the NYS Register.	
Public hearings held as required by law.	
If an DEIS was written, a Final EIS is completed.	
Program staff make any necessary changes, add Assessment of Public Comment, and Notice of Adoption to package.	
Presented to Environmental Board for approval.	
If an EIS was written, a Finding Statement is written by Staff, signed by Commissioner and placed on file.	
Adoption package approved by Executive Office of DEC and filed with the Department of State. Regulation becomes effective 30 days after filing or 60 days after filing with the DOS.	

Legislative Process

In the fall of 2002, NYSEG received specific comments from Assembly and Senate staff regarding the failure of Title 17, Article 23 to be repealed during the last legislative session. Comments were also received from the NY DEC, NYSERDA, NYS DOT, and the NYS PSC. The Project Team, working with Assembly staff and other relevant state agencies, made a concerted effort to develop amendments to Title 17, Article 23, which would address the main concerns. The three issues of greatest concern were: strict liability, role of different state agencies in permitting, and LNG safety.

Meeting with Assembly Staff in late February 2003, the Project Team agreed to present a draft set of amendments rather than seek outright repeal of Title 17, Article 23. It was

suggested that in considering the language of the amendments, the following should be kept in mind:

- An examination of the “navigation law” to identify “touchstones” that might be included in the revised legislation.
- Generic references to NFPA rather than listing a particular “dated” set of rules, thus not requiring periodic amendment of the law.
- Clarification as to how the State would have oversight of LNG facilities and transport.
- Allow the NYC LNG moratorium to have a life of its own, but don’t include wording that specifically designates cities of over 1,000,000 with special LNG-related “home rule” provisions.
- Inclusion in the amendment, language that covers the essential “siting criteria,” so that the legislators can feel assured that all issues are covered.

Keeping in mind the decision to run a dual regulatory/legislative track, the legislative track took a short-term precedence at this point due to the limited window of opportunity relative to the then current session of the legislature. The Project Team addressed the concerns that were voiced by various legislators, staff persons, and other groups that opposed repeal in previous legislative sessions.

When the LNG Assembly Bill was reported to the Environmental Conservation Committee, contacts were made with several organizations, which had expressed an interest in the process, among them, The Business Council of New York State, The Energy Association of New York, and the National Resources Defense Council (NRDC), to advise them of the state of the legislative efforts. As a result of these contacts, several letters were issued in support of the legislation.

After multiple refinements to accommodate concerns and inquiries, a final version of the language was introduced. Shortly thereafter, the Senate sponsor of the original LNG bill recalled the Senate’s previously passed version and amended it to contain the same language as the Assembly Bill.

Throughout this process, Project Team members and representatives of KeySpan (now known as National Grid) continued to meet with legislators representing key areas such as Staten Island and Queens to address their concerns, and assure them that the proposed amendments to Title 17, Article 23 would in no way impact the current LNG moratorium in NYC. The Project Team also provided draft copies of the LNG Fact Sheet and the LNG Safety Guide to the Office of Paul Tonko, NYS Assembly.

Current Status

An amended bill was advanced in both houses in July 2004. Keyspan worked with Consolidated Edison on amendments that clarified the status of “grandfathered” facilities. That clarification, along with previously-agreed to items regarding the NYC moratorium and preemption, were added to the existing Senate and Assembly bills (which will

become “B” versions). However, the Legislature did not consider the bill in July 2004, and its introduction has again been postponed.

At this point, draft amendments to Title 17, Article 23 were fine-tuned, and are ready for introduction by the Senate and Assembly sponsors during subsequent sessions of the legislature. Additional minor modifications may be required if specific (local) opposition develops.

Public Outreach

The Project Team, with the Support of the Legislative and Regulatory Guidelines Committees, drafted an LNG Informational Guide/LNG Fact Sheet, to be used as a tool to familiarize local/state officials and legislators as well as the general public on LNG. The initial purpose of the Guide is to assist municipal and state officials entrusted with fire protection and the safety of those within their jurisdictions to understand the basic facts and rules surrounding the use of liquefied natural gas as a transportation fuel.

The LNG Guide is composed of four sections. First is an informational section that explains the general properties and uses of LNG. This section reviewed the uses, safety concerns, and advantages of LNG. Second is a checklist of the recommended permitting requirements for new LNG vehicle refueling stations. The latest edition of NFPA 57 serves as the foundation for the checklist. Third is a checklist for safety personnel and first responders. This section outlines the recommended steps that safety and fire prevention officials need to know in the event of an incident involving LNG. The final section is a compilation of outreach tools designed for specific targeted audiences.

Throughout the process of compiling this Guide, drafts were distributed to the Guidelines Committee members, and their suggestions/recommendations were incorporated into subsequent drafts. All final comments have been received and integrated into the Guide, a copy of which may be obtained upon request.

AET Energy Solutions was retained to assist in the development of LNG related training materials. The goal for AET was to develop a Guidelines Manual that could be utilized by emergency first responder teams. This manual was to provide the necessary outlines to allow emergency teams to better prepare for any situation that might occur at these facilities.

AET has developed a “Guidelines for Emergency First Responders at LNG Facility Incidents,” a copy of which is available upon request. The guideline manual is still in a “draft” mode pending passage of LNG legislation by the NYS Legislature, to ensure that all potential safety requirements that may be adopted by the Legislature have been incorporated in the final document. AET is currently working with a Binghamton, NY, vendor to develop a full-scale “virtual reality” training program to be used at the NYS Fire Academy. This state-of-the-art training will allow firefighters to be trained in a classroom setting utilizing video of actual facilities. This type of training will allow the

Academy to program a variety of emergency scenarios with which an emergency responder may be faced. It is AET's goal to provide emergency training not only to firefighters, but emergency medical personnel, law enforcement, and private or utility plant operators. NFPA 59A requires periodic refresher training, and this approach will enhance this process. AET is also working with the State Fire Marshall's office, and with the Director of the Fire Academy in Montour Falls.

Savvy Sites DeSigns (SSD) was engaged to design and bring online an informational website dedicated to LNG in the Northeast. During the course of several presentations, the principal of SSD brought the Committee up-to-date on the ongoing activities, and invited input from the Committee members.

The site will contain pictures and descriptions of LNG facilities, and information on LNG in general as well as status updates relative to this demonstration program. Once the layout has been finalized, printable versions of the pages on the website will be available. A link was sent out to all participants in the Steering Committee in April 2004. All preliminary work on the website has been completed and is currently awaiting Committee approval to take the website live. SSD plans to have a mechanism in place that will allow the site to be maintained and updated as required by new technology, regulations, or changing industry needs.

PRELIMINARY DESIGN/TECHNOLOGY SELECTION

Meetings began in January 2003 between the Project Team, an interested vendor, and representatives from Idaho National Laboratory (INL) from Idaho Falls, Idaho to determine the following regarding the rapid commercialization of the small-scale natural gas liquefier being developed by the INL:

- Was there sufficient interest and willingness among the parties to initiate a project, and what exactly were they getting?
- What was the timetable for the project based on the needs of customers, the reality of the remaining technological issues to be resolved, marketing considerations, fabrication and commercialization requirements, and the legal/administrative work that must be completed?
- What were the financial and intellectual resources necessary to complete the project, and were they available?
- What was the structure and basic terms of any licensing agreement?
- What were the "patents" or "intellectual property" concepts that had to be protected for the parties to move forward?

At that time, the parties agreed that the focus of the effort was on the development of an INL technology that could produce between 10,000 and 30,000 gallons of LNG per day utilizing a small-scale letdown pressure technology. All agreed that design of the gas liquefier was important, but that the real innovation of the technology was in the "gas cleanup" system included in the technology.

The Project Team identified three basic activity areas for completion during Phases I and II.

Technology development, proof of concept of commercialization unit

- INL's letdown technology has been used in PG&E's Sacramento, CA small-scale liquefaction plant. At a meeting held during July 2003, attended by several Project Team members and representatives of a qualified vendor, INL, and PG&E, a technical review of the Sacramento liquefier status was held and the following issues were addressed. Contrary to expectations, the turbo expander was not working properly in this context. It is an off-the-shelf unit and currently problematic. However, the expected capacity had been thought to be 10,000 to 15,000 gallons per day (gpd). Once the problems are resolved, it is expected that the capacity may, in fact, be 20,000 to 25,000 gpd. There was a high level of confidence that the hydrocyclone (CO₂ separation) would work as expected.
- As of Late July 2004, the Sacramento liquefier experienced problems with bearings and had to be redesigned. The bearings were replaced and optimization/validation testing conducted in August 2004 revealed that the problem has been resolved and the bearings were operating properly.
- The testing of the Sacramento facility was watched carefully by INL, NYSEG's Project Manager, and a commercial partner who has acquired an option to purchase a license to develop the INL technology for the NYS Development Project. After a validation test was performed, analysis of the plant operation data provided NYSEG and the commercial partner the information on costs and operating efficiency it needed to make further project commitments and progress.

Fabrication/Sublicensing

- An additional objective of the design effort was to make sure the technology could be reproduced at costs that accomplished the economic objectives established above. The fabrication work was not scheduled to begin until technology optimization was begun. This effort would also give the parties an opportunity to review how the fabrication and installation process could be organized to keep costs down.

Siting Study

Criteria for the LNG site(s) have been developed, and a siting study was begun, not only for the LNG facility, but also for potential market areas for the product. NYSEG staff met with a well-drilling company that is developing natural gas wells in the Southern Tier of New York to review potential sites for the LNG liquefaction facility. Engineering requirements have been developed, and preliminary design concepts were evaluated for site-specific applications. Discussions with potential engineering partners and assessments of potential markets for the use of the 30,000 gallons per day of LNG were completed.

To create 30,000 gallons of liquid natural gas per day at the facility, the flow of gas is a factor. If 100% of the natural gas could be converted to liquid, a flow rate of 2500 Mcf per day is needed. However, a 100% conversion rate is unlikely and each technology has its own efficiency. For site selection, the absolute minimum flow rate was established at 2500 Mcf per day but will be dependent on the technology contemplated at the site. The ideal drop in pressure required for using a letdown technology is approximately 4:1. The gas should be of high quality with low water content and low levels of carbon monoxide, carbon dioxide, hexanes, and other components. A site approximately four acres in size in an area of compatible land uses is desirable, as is proximity to a State highway for hauling purposes.

Preliminary evaluations have been performed at locations within the NYSEG/RG&E service territory of New York where there are high-pressure pipelines for the feed gas. The Plattsburgh and Lowville areas have been examined and are still potential sites for future examination, but the Company's attention turned to the Chemung and Schuyler Counties in New York because of the recent natural gas drilling activities in these counties, which are not as remote as Plattsburgh and Lowville.

Three sites were examined further. At the first site, several wells are connected via gas gathering lines to a metering and regulating station tap at a NYSEG gas transmission line. The quantity of gas flowing at the site is adequate to sustain long-term production of LNG. This site is being considered for INL's letdown technology since the existing NYSEG pipeline presents a suitable sink for the process gas and it is likely that additional wells may be added to this pod of gathering lines and wells. Additionally, it is a large site with compatible land use, and a State highway is approximately two miles away.

The second site is at a stranded well that is capped, and has never been tapped for use. The well has good pressure, flow and quality. There is adequate land surrounding the well and the distance to a State highway is not great (approximately one-quarter mile). However, the nearest sink for any unconverted, process gas is several miles away. This would be an excellent site to demonstrate a 100% liquefaction technology that does not require a sink for process gas. NYSEG is contemplating issuing a request for proposals for development of a 100% liquefaction facility at this and potentially other stranded wells.

The site of prime consideration for the first demonstration project has a large quantity of available gas and is located adjacent to a State highway in an area of other utility uses. The site is in proximity to a gas storage facility staffed 24 hours a day, year round. The LNG facility would take advantage of a high-pressure gas transmission line coming into the storage facility, which is mainly fed from local wells. The nominal pressure range of the pipeline gas is 750-900 psig. A large manufacturing facility that operates year round is located approximately one mile from the storage facility. An existing 60 psig distribution line to the manufacturing facility would be the outlet for the low-pressure process gas. The technology application suited for this site is the same Letdown Technology, with modifications, that is being used in Sacramento, CA to make 10,000

gallons per day. It is estimated that approximately 30% of the gas flow would be liquefied to create 30,000 gallons per day of LNG at this site. Approximately 5,630 Mcf per day of natural gas flow is required. The manufacturing facility and a nearby village would use all of the process gas.

Hanover Company (now known as Exterran) met with NYSEG many times to develop a working partnership and necessary agreements to pursue construction of the first site. They assisted in preliminary design and when a site was selected for a first demonstration project, they purchased the development rights for INL's letdown technology and cleanup process. Exterran continues to be a willing partner for the demonstration project in New York when LNG storage protocols are finalized.

Technology Evaluations

In addition to the letdown technology, other technologies have been researched, including those suitable for a stranded well location. A mixed refrigerant method and a liquid nitrogen method would use various coolants in a heat exchanger to liquefy natural gas. Virtually all the flow of gas through the facility is converted to LNG due to repeated cycling through the heat exchangers. The drawback to these technologies is the need for storage of a chemical on site that may require additional containment, licensing, and emergency protocols.

A liquid nitrogen liquefaction technology may be combined with an on-site generator. One-third of the gas flow could be liquefied, and two-thirds would be used to generate electric power. This could be a very attractive option at the right location – one where there is a need for the 23kV power output. The liquefier flow through gas is at an ideal pressure to run a 3-5 MW turbine. The concerns that this technology presents are that a steady pressure of 1000 psi at the inlet is needed, a portion of either the electricity or the gas is used to power the generator, and it requires a step-up transformer or a substation, which adds cost, noise and potentially licensing issues.

A thermo-acoustic technology uses pressurized helium moved by sound waves to cool the natural gas to a liquid state. This technology has successfully been proven at the rate of 500 gallons per day, so it would likely not be the sole methodology employed in the demonstration program but it could be very appropriate at an end-user site. It results in 70% gas to liquid efficiency. The remaining 30% of the gas is used to create sound waves. It requires no outlet or sink for the pass-through gas; the machine has few moving parts to maintain; and it is a good, closed system appropriate for use at a stranded well.

CONCLUSION

NYSEG anticipated the passage of the legislation and/or regulations that would allow the creation of the LNG facilities in New York prior to this date. However, it has used this time to further explore the available technologies, markets, and potential business

partners. The delay has actually allowed additional testing and refinement of the letdown technology design prior to any capital investment, which has been an unexpected benefit. Despite the delay, we remain optimistic concerning the overall benefits this new energy commodity would bring to upstate New York, especially considering the potential LNG provides as a way to get local New York gas to market. NYSEG, its cost-sharing partners, and the LNG Steering Committee remain committed to establishing the program and look forward to beginning the final phases, including site design, permitting, safety training, outreach and finally, construction and operation. Contact will be initiated again with the DOE Project Management team if and when legislation and/or regulations are adopted in New York to determine the DOE's interest in participation.

National Energy Technology Laboratory

626 Cochrans Mill Road
P.O. Box 10940
Pittsburgh, PA 15236-0940

3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

One West Third Street, Suite 1400
Tulsa, OK 74103-3519

1450 Queen Avenue SW
Albany, OR 97321-2198

2175 University Ave. South
Suite 201
Fairbanks, AK 99709

Visit the NETL website at:
www.netl.doe.gov

Customer Service:
1-800-553-7681

