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Integrity, Reliability and Security: The Role of Technology

Introduction

Integrity, reliability, and security encompass all the attributes we want—indeed, need—from our natural gas industry. We need integrity in physical transportation and storage systems, reliability in operating systems, and security in supplies and delivery systems. This conference is the most comprehensive forum for addressing new and evolving technologies impacting all these needs. The conference scope runs the gamut: from finding and producing to storing, delivering, and utilizing natural gas.

From a government perspective, technology is just one tool for enabling desired outcomes. But it can be a powerful tool, for it creates options for policymakers, mediates opposing factions, and makes possible things not possible before.

Twenty-two centuries ago, the Chinese were developing wells for salt brine in Sichuan Province, some as deep as 300 feet. Occasionally, mysterious invisible devils overtook work crews and caused fires and explosions. By 68 A.D., the Chinese learned to ignite the escaping natural gas and used it to heat brine for making salt. Before long, saltworkers were using bamboo pipes to bring both both brine and gas to salt factories, where the brine was reduced to salt. Thus we have the first known gas wells, the first local distribution systems, and the first commercial use of natural gas, according to Mark Kurlansky in his book “Salt, A World History.”

The rest of the world spent the 19th and 20th centuries catching up to evolving Chinese science and technology. We have witnessed the rapid advances in natural gas technologies over the last few decades. And this conference documents still newer technologies. But the challenges we face today in **ever** rapidly depleting reserves, **ever** increasing demand, an **ever** aging and vulnerable infrastructure, and an **ever** sharpened environmental awareness are unprecedented. So it follows that we look to **ever** more advanced technology for some important solutions to the **ever** more complex world of natural gas. The price and supply volatilities we see today are symptomatic of these challenges.

Addressing the supply volatilities is the first step toward dealing with the kind of price volatilities that have made gas industry planning such a daunting task in recent years.

On the upstream side of the supply issues, technology is the key to tapping the enormous remaining potential natural gas resource in the U.S.: 1,400 tcf that can be produced with the right technology according to the USGS, and 2,000 tcf according to the National Petroleum Council. That target incorporates nonconventional gas, identified gas stranded by its location or geology, and bypassed gas in the reservoir. And it doesn't count the estimated 200,000 tcf of domestic gas entrained in methane hydrate formations—a mammoth target unattainable without the key of technological progress.

The integrity, reliability, and security of America's gas supply also hinges on resolving infrastructure issues. Beyond addressing concerns over pipeline capacity and integrity and storage adequacy, gas infrastructure concerns must include the rapidly growing interest in technologies to utilize stranded gas, such as Liquefied Natural Gas, Compressed Natural Gas, and gas-to-liquids products.

Although utilization is thought of more as a demand concern, it should also be considered in the context of supply. Gas not used is gas made available for supply. We may preserve as much gas through utilization efficiency as we can generate with the drill bit, and the higher prices that spawn demand destruction also enhance the appeal of technology-driven efficiency initiatives.

I will address each of these areas in turn in focusing on the role of technology in the integrity, reliability, and security of America's natural gas supply.

Exploration and Production

In the exploration and production arena, many new technologies are on the cusp of commercialization.

Composite drill pipe, Intellipipe (a drill pipe with a high rate of data transmission capability), and new measurement-while- drilling systems that are high-temperature/high-pressure capable and acid resistant all are enabling smart access to even deep, hostile reservoirs; reducing the risk in deviated drilling; and hitting the sweet spots more often.

Meanwhile, the upstream industry continues to advance technologies that help it reduce the footprint and environmental impact of its operations. Deviated drilling and multiborehole well designs have enabled the growing adoption of pad drilling, which shrinks industry's footprint.

Small borehole technologies being developed today, such as those under DOE's Microhole Technology Initiative, will further reduce drilling wastes and industry's footprint. These systems promise to drill faster and cheaper to their targets. Cheap microbore drilling also holds the promise of more affordably deploying Vertical Seismic Profiling for better exploration imaging and even reduced-cost exploratory and production drilling.

For a “star wars” approach, I remember in the 1970’s Zane Shuck and some others were investigating laser drilling. Most people dismissed his efforts as a fool’s dream. Forty years later the Gas Technology Institute and its partners have advanced this concept to the point that it may have some commercial application for auxiliary drilling. Perhaps with new materials, technology, or some other yet unrealized innovation, laser drilling could become a critical tool in the E&P industry.

And these are just drilling related technologies.

The largest payoff possibility in natural gas supply is technology to produce natural gas hydrates. The outcome is uncertain, the risk is high, but the target is so immense—the largest total accumulation of hydrocarbons in any form on earth—that we can not ignore it. And the United States has significant accumulations of gas hydrates in the Alaskan Arctic and in our offshore areas. Some project that we will see first domestic commercial production of natural gas hydrates by 2015, just a decade away.

Thirty years ago coalbed natural gas was also just a dream. But a DOE program in combination with the then Gas Research Institute—now the Gas Technology Institute—and augmented by significant industry efforts has unlocked a resource in this country that today accounts for nearly 10% of domestic gas production. And coalbed natural gas production is poised to grow. Our efforts now are directed to addressing the issues surrounding water produced from the coal beds, hopefully turning a sometime waste product into usable water in a thirsty West. Perhaps hydrates are tomorrow's coalbed natural gas.

Just as technological solutions are being sought to resolve environmental concerns associated with coalbed natural gas production, technology could be the key to resolving other environmental issues impacting the future assurance of US gas supply.

Federal lands access, from ANWR to the Rocky Mountains to offshore moratoria, has been an impasse involving producers, land management agencies, non-governmental organizations, and the public. Imagine an affordable, roadless, small-footprint, zero-waste exploration suite of technologies that could assess the targets in the Rocky Mountain frontier areas. It would not resolve all the issues, but it would reduce the points of contention so that a reasonable compromise might be more readily achieved.

Such a system is not so far-fetched as it might seem. Some of the technology exists today; some of it is under active pursuit; some of it is still just a dream. DOE's microhole systems concept and GTI's laser drilling efforts might someday underpin radically new technological approaches to accessing the vast natural gas resources that today are just out of reach.

Infrastructure

Supply assurance is also dependent on the integrity of the infrastructure needed to transport, store, and distribute those future gas supplies.

The Nation is faced with an aging pipeline infrastructure. Over a quarter million miles of transmission lines and nearly a million miles of distribution lines serve us today. But much of that pipeline capacity is more than 50 years old. It is generally acknowledged that significant investment in new pipeline capacity must occur to serve our growing demand—which DOE estimates will rise to 30 tcf by 2020 from 22 tcf in 2002.

An equally daunting investment is the one required to refurbish or replace older lines. DOE, GTI, and others have invested in technologies to assess the condition of existing lines, repair pipelines remotely or with less cost, to improve the efficiency and reduce the emissions of compressors, to develop novel leak detection approaches, and to monitor the integrity of gas pipeline systems on a real-time basis. Many of these innovations will be discussed at this meeting. But what comes next? Can we develop new concepts to maintain or increase the pressure ratings and lives of existing pipes? Will new materials or manufacturing technology lead us to more affordable expansions of our pipeline system?

Equally critical to a sustainable supply infrastructure is storage, which has become an increasingly important factor in balancing US gas markets and ensuring gas supply reliability. The nation's 410 storage reservoirs accommodate almost 4 tcf of capacity, a volume equivalent to 20% of annual US gas consumption. But storage faces its own unique challenges, from shifting consumption patterns—like the predicted tripling of electricity demand for gas—to the $100 million operators spend each year to rehabilitate or replace storage wells.

Current storage technology development efforts backed by DOE include R&D to enhance storage efficiency and deliverability, to improve gas metering accuracy and efficiency, and to develop storage capacity in areas without the geology amenable to storage—such as gas storage as hydrates and cavernous storage in carbonate rocks using a new acid dissolution process.

LNG, a technology that arrives at the intersection of transportation and storage, offers great hope for expanding our Nation's gas supply options and thus bolstering its energy security. DOE estimates that LNG will account for 14-17% of US natural gas supply in 2025, up from about 2% today.

LNG also offers some new challenges. Siting of regasification plants in this country is becoming a heated public debate in some areas. But industry has offered up some novel concepts to site regas facilities offshore when it makes sense. Some studies have touted the prospects of floating LNG technology that spans the LNG value chain, from drilling and production to liquefaction to regas to offshore LNG transfer systems.

As the fungibility of LNG as a tradeable commodity has grown, LNG imports also now offer interchangeability challenges for some customers. Unlike the tailored-spec, long-term contracts that have long dominated LNG trade, the proliferation of LNG projects, growth of spot markets, and differences in quality specs beg the need to develop new protocols, strategies, and technologies for accommodating customer requirements.

End Use

Having found, produced, and delivered tomorrow’s gas supplies, the next technology step-change to dramatically affect the future integrity, reliability, and security of America’s gas industry could occur among end users. If gas is a valuable commodity, then we should improve utilization efficiency wherever we can.

In the industrial user segment alone, there is significant potential for efficiency improvements. While the best current gas-fired industrial steam boilers are 83-85% thermally efficient, achieving a targeted 95% or better thermal efficiency will require new technologies for heat recovery and transfer, as well as new sensors and controls that ensure real-time optimization of boiler performance. And all this while we minimize emissions.

Other R&D priorities in gas utilization include high-efficiency direct-drive natural gas engines, cost-effective and highly efficient fuel cell systems, integrated onsite power generation and heat recovery systems, and a significant gain in process heat recovery.

Conclusion

All of these R&D efforts represent an attempt to use technology to enhance the Nation's future gas supply. They represent big targets, in equivalent-gas-resource terms, if we have that technology. Accordingly, with U.S. gas demand projected to jump 40% in the next 2 decades, we have to anticipate our technology needs 20 years out and more. We can also use technology to help ensure that future gas is made available at a cost acceptable to the consumer in both dollar and environmental terms.

And it is not just about having the technology, it is about getting technology accepted and deployed so that we can enjoy the benefits that ensue. The significant role of independent producers domestically and the fragmentation and dislocation among oil and gas operating companies have made R&D progress a tougher hurdle than ever before. And with the responsibility for funding and deploying new technology shifting from the major oil companies to the major service companies, the struggle to reconcile pressure for short-term profits with the need for long-term, high-risk R&D is being waged by a dwindling group of players.

How do we resolve this problem so critical to the integrity, reliability, and security of the Nation's gas future? Some talk of new modes of cooperation among producers and service companies and of new fiscal mechanisms to mitigate R&D risk.

DOE conducts a broad array of programs that, if leveraged properly, can be seen as one template for this kind of R&D cooperation and risk mitigation. GTI offers another template. And there are others.

In the final analysis, however, to supply the Nation's gas demands, new technologies are essential. But it will take all stakeholders—government, industry, academia, and the public—to answer the key questions:

Where will the gas technology R&D priorities be?
Where will tomorrow's R&D come from?
Who will pay for it?
How will those investments pay off?

Just remember: These are not rhetorical questions.

Ladies and gentlemen, I encourage you to take full advantage of the conference. Thank you for your kind attention.