OPERATIONS AT THE GAS COMPANY OF THE FUTURE

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ABSTRACT

Over the last few years gas companies around the world have undergone tremendous changes in an effort to remain competitive, while providing a safe, reliable product for their customers. The demands for additional changes are continuous, but the options are becoming limited. One option that remains in the forefront is the development of new paradigms, and the deployment of new technologies to support them. The use of new technologies holds the promise of more efficient and productive operating methods, with associated cost reduction. This paper presents a futuristic view of what a gas company of the future might look like with the incorporation of new strategies and technology innovations.
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2. INTRODUCTION

Gas companies throughout the world are increasingly looking to technology developments as a primary means to further reduce costs in a highly competitive marketplace. While short-term technology enhancements are preferable, longer term, higher risk concepts are also being considered. The potential impacts and benefits of rapidly evolving technologies are finding their way into an increasing number of operations and processes in the energy field. As the state-of-the-art in gas operations-relevant technology moves well beyond using PowerPoint presentations in the office and guided drilling tools in the field, issues involving everything from the development of new paradigms to address daily operations issues, to the billing of customers and receiving bills from vendors. For a gas company to prosper in the future, it must seek out, quickly adjust to, and embrace technological changes.

We would like to offer here a few observations to stimulate thinking about how gas operations may evolve in coming years under the influence of rapidly changing technology. We aim to raise possibilities, some of which may materialize and some not, in order to encourage discussion and speculative planning for and about change. We believe that technological change will be the benchmark of how well gas companies perform, not simply which new technology works best in what isolated function.

We do not claim a crystal ball permitting us to predict the future with great precision. Rather, we attempt to imagine specific gas operations technological products and processes likely to be possible with today’s technology progress.

We pose the following question:

What will be the technological “IQ” of gas company operations fifteen to twenty-five years from now?

As a way of placing this question in perspective, recall that ten years ago the commercial World Wide Web did not exist, and twenty years ago personal computers were a rarity. While it is impossible to know what new technologies will emerge in the next decades, it is reasonable to assume that technological growth will produce changes greater in magnitude than developments that have occurred since the introduction of the personal computer and commercialization of the Internet.

Our expected dominant strategy for as company operations in the future is “automation”.

We expect that four areas of gas operations might be affected:

- Gas Transmission
- Distribution Infrastructure: new construction
- Distribution Infrastructure: Maintenance and repair
- Other Gas Company functions

Within this, the functions likely to be impacted are:

- Human Ergonomic Activities
- Equipment
- Data Gathering and processing
- Customer billing and gas accounting
3. TECHNOLOGY DRIVERS

3.1 Transmission

In 25 years, existing transmission pipelines will still be with us. Innovative materials for the newly constructed and rehabilitated pipelines will have been developed. Both steel and composite pipelines will be installed. New technologies to rehabilitate existing infrastructure will be widely used, because of the ongoing high costs of replacing existing infrastructure.

The technologies that may emerge in this area are:

- Composite pipelines: new “engineered” materials that have high strength, are lightweight, can be joined by a fusion method (laser welding), and can be tapped for outlets with relative ease.

- Nano-materials will be developed that can be borne by the natural gas stream. These materials would be “programmed” to transmit information about the gas system, including the location of third parties right-of-way encroachments, the location of third party contact with the pipe, the effectiveness of cathodic protection on steel pipe, and the condition of the pipe and pipe coating. The nano-materials would also assist in SCADA control by transmitting information about pressure, flow, and volumes within defined parameters. In this way constant, real-time monitoring can be achieved. These functions are generational evolution from today’s nano materials and micro electro-mechanical (MEMS) machines. We expect that great emphasis will be placed on the ability to alert the operator for preventative maintenance before a problem occurs, so that the combined attributes of low cost and high sensitivities will drive these technology implementations.

- MEMS will be used to provide real-time information about gas composition and characteristics. This analysis will be particularly important because there will be gas coming from many sources, including LNG and synthetic (SNG) production. An outgrowth of this development will be real-time billing by producers, transmission companies, and local distribution companies. End-use customers will use real-time billing information to better understand the efficiencies of their appliances.

- Because gas will come from a multitude of sources, localized gas processing will be required, as needed, to assure uniform gas quality. The ability to gather real-time intelligence from the gas will determine when, and where localized gas processing is needed. The local processing will be accomplished with compact, mobile equipment that uses the information gathered from the gas to automate processing capabilities.

- Compressors will function at higher outlet pressures, due both to system demands, and higher operating pressures. Compressors will be high efficiency turbines, powered by electricity that was generated at the site from the natural gas stream.

3.2 Distribution Infrastructure: New Construction

Not withstanding the nano technology that will be embedded in the gas stream, as described above, there will be many new approaches to gas pipe installation.

- It is expected that a move to non metallic materials, including materials that will span pressure ranges up to 14 Bar (203 psig) will lead to new paradigms in gas operations.

- The installation of pipe that has an outer, flowable layer with characteristics to enable “self healing” in the event of a small leak.

- New gas mains and services will be made of material that will have the ability to self restrict or stop itself, in the event of a large change in gas flows caused by a third party damage to the pipe. Once the leak is repaired, the restriction would revert to full diameter, with no damage to the pipe.

- This pipe would be manufactured from base material and installed from compact, vehicle-mounted production machinery at the job site. This method would lower the pipe material cost, eradicate pipe inventory and facilitate easy material transportation to the job.
finished pipe would be one continuous piece, minimizing the need for pipe joining. Any required fittings would similarly be produced.

- The pipe will be automatically installed by a self-operated drilling system with built-in obstacle detection. The pipe installation path will be preset to avoid other known substructures.

### 3.3 Distribution Infrastructure: Maintenance and Repair

New technologies (vehicles, tools, equipment, materials and procedures) for maintenance and repair activities will allow for the work to be completed by a one-person crew.

- The vehicle will have real-time connectivity to all relevant mapping, customer records, materials availability, standards, and engineering drawing information at the gas company.
- The worker will operate independently, being able to receive work, access data, record results, replenish materials and (where appropriate) initiate an invoice for a third party, and complete work documents that update maps, records, time systems, materials management.
- Ergonomically designed equipment will make the worker’s job safer. This will include:
  - Small hole (less than 50mm (2 inches)) excavation and restoration tools, based upon silent ultrasonic cutting techniques and core replacement.

Other capabilities that the worker will have at the jobsite include the ability to:

- Show accurate, three-dimensional maps of the underground utility network from all types of facilities at any location within the gas company service area. The maps will also show special, area-specific conditions, such as habitats, known buried hazardous waste sites, and protected historical areas.
- View an image of gas leaks to enable rapid leak pinpointing.
- Launch a multi-function sensor into a small (less than 25mm (1 inch)) hole that will find the pipe and transmit back information on pipe condition, seal leaks, repair coatings, and mark pipe location by GPS.
- The ability to position a composite flexible material “bubble” to cover a problem blowing gas situation. The bubble will resist a specific pressure and then deploy a rollout vent from a suitable location to blow gas until the problem is corrected.
- The ability to access information both from the nano materials in the gas, and roaming micro robots that reside in the piping system. These micro robots will assess and repair older pipe during automated permanent activity. They will also automatically move towards significant blowing gas, inside the pipe, to assist in repairing the condition.

### 3.4 Other Gas Company Functions

As a result of all the information being received from these sources we have mentioned, it will be possible for the gas company to undergo some radical process changes.

- Orders and information from customers or clients can go directly to the relevant field person from the source. Work schedules will automate so no office personnel are necessary to place work or requests into the appropriate work queue.
- Billing to customers can be real-time, and time of day based. Sectional calorific (heating) value of the gas, and other gas parameters, can be matched with customer use, as it occurs.
- Customer information would be transmitted back through the gas stream to the central data source for required billing.
- Customer metering and pressure regulation would be accomplished by MEMS machines at the customer premises.
- The gas delivery piping system would accrue data to calculate and enable “just in time” preventative maintenance to components such as pressure regulators (small MEMS based machines) valves and cathodic protection of older steel systems.

### 3.5 Support

An increased reliance on advanced technologies will require a significant increase in the amount, and sophistication of support services required. The amount of support staff needed may increase, depending on the amount of technological automation.
3.6 Security Matters (Cyber Security)

With the increased amount of “through the air” transmission of information, described above, gas companies will have a high level of cyber security in place, both in its operations communications, and in its centralized gas control SCADA systems. In 2006, in the United States, a person has a 0.000001667 (1 in 600,000)\(^1\) chance of being struck by lightning\(^2\). By comparison, a corporation has a 6 in 10 chance of becoming the victim of a corporate computer security breach.\(^3\) Security problems are increasingly exploited by people with bad intentions. PSINet Europe purposely built an unprotected server and connected it to the Internet to determine how quickly it would be compromised. Their findings were astonishing. Its server was maliciously attacked 467 times in the first 24 hours of operation.\(^4\) All of this means that with the information gathering that we have described, the development and maintenance of computer counter security and equipment with high cyber attack protection will be inherent in how we operate. This is particularly important for the gas industry, where a recreational hacker, or a committed terrorist, could intercept and alter the information being received, which has dire consequences for an industry whose business is the sale of a flammable substance.

4. CONCLUSIONS

No one has a crystal ball to evaluate what new technologies might be used in gas operations in the future. Through this paper, we have attempted to stimulate the consideration of different ways of performance, based on what could occur in the gas industry. We have also attempted to describe a company’s daily operation in the example that follows.

We did not try to evaluate scenarios from a micro situation basis (what clothes does the person wear, will they drive a fuel cell-based vehicle, etc, etc.), rather look at specific aspects of the company.

An unspoken part of the technology chain is equally important—the education and training of future gas engineering and operations personnel. Our society is growing ever more dependent on the creation and flow of information and these thoughts documented here show how that will become more significant.

The gas industry needs to explore how to ensure an efficiently run system through the continuing development of new technologies. The success of this effort will help ensure the future of natural gas as a safe, clean, competitive energy source.