Natural Gas Systems: Reliable & Resilient

NATURAL GAS COUNCIL

July 2017

TABLE OF CONTENTS

Preamble

Our trade associations, who together comprise the Natural Gas Council and represent the natural gas delivery system from production to consumption, originally researched and developed this white paper to inform a North American Electric Reliability Corporation (NERC) special assessment on any potential risks to bulk power system reliability from a single point of disruption on major natural gas infrastructure facilities (e.g., storage facilities, key pipeline segments, LNG terminals). The facts and data we gathered in the process of preparing information for NERC underscored the exceptional reliability of the natural gas system. It also revealed the need for a comprehensive resource that explains the underpinnings of natural gas reliability, both physical and contractual. The white paper that follows is the result of our joint effort.

The Natural Gas Council
Members:

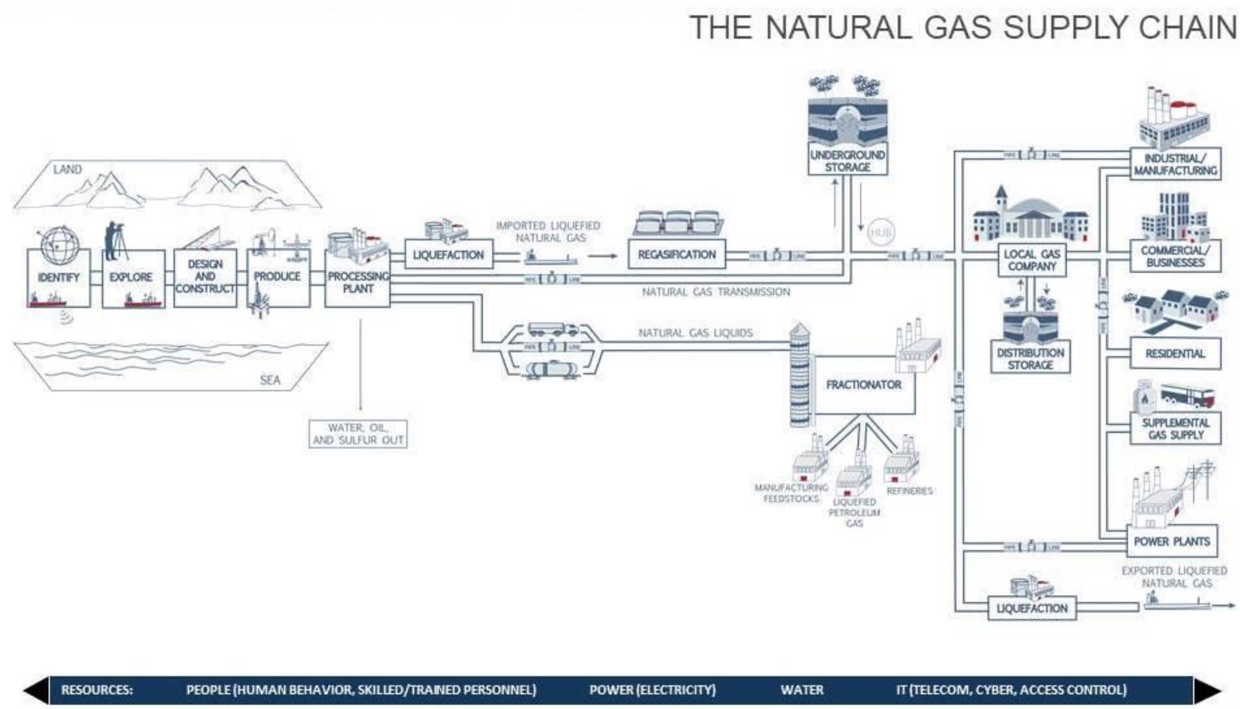
- American Gas Association
- American Petroleum Institute
- Interstate Natural Gas Association of America
- Independent Petroleum Association of America
- Natural Gas Supply Association

July 2017

1. Introduction

The United States has abundant natural gas resources that enable our industry to satisfy customer demand fully. In only a few years' time, the U.S. has become the largest producer of natural gas in the world. Estimates of the gas resource base have more than doubled in the past decade.[1] Since 2010, production has grown almost 30 percent, with government forecasts calling for production to once again reach the record of near 75 billion cubic feet per day this year.[2] The natural gas supply chain is extensive and spans from the production well-head to the consumer burner-tip (see illustration).

Critical Elements of the Natural Gas Supply Chain



Source: The American Petroleum Industry, Oil and Natural Gas Industry Preparedness Handbook, 2016.

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[1] *See* Potential Gas Committee *Biennial Report of Potential Supply of Natural Gas in the United States*, (December 31, 2014), 2015, available here.

[2] See EIA *Short Term Energy Outlook*, May 2017 available here and EIA Natural Gas Summary │Custom Table Builder, available here.

Consumer natural gas demand has grown steadily since 2009 for a variety of reasons: it is abundant, domestic, burns clean and is affordable. Access to abundant, domestic natural gas has given U.S. industrial companies a competitive advantage over their global competition, leading to the resurgence of gas-intensive manufacturing in the U.S. and the creation of more jobs to construct and fill the resulting new and expanded industrial facilities.

At the same time, demand from the power sector has also increased, driven by natural gas's low-carbon emissions, retirements of older coal-fired plants, and the comparatively low cost and small footprint of natural gas-fired power plants.[3] In recent years, greater use of natural gas has produced significant reductions in U.S. carbon emissions because, over its lifecycle, natural gas emits only about half the carbon of other fossil fuels when combusted.[4] Because of these advantages, natural gas is poised to become an even more important part of states' energy portfolios as they seek to meet state clean energy objectives.

Yet, with the forecasted growth in power demand, some – particularly those unfamiliar with natural gas operations and contractual practices – question the ability of natural gas to continue to reliably serve this market. In this paper, we explain how the physical characteristics of natural gas, as well as operational industry practices, provide an extremely high level of reliability and resiliency for gas customers. This paper also explains that while the natural gas industry is physically reliable, if large-volume customers require undisrupted service, they must choose to enter into advance contractual arrangements for "firm transportation" services that ensure pipeline capacity is available when needed to allow the customer to benefit from this

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[3] See Leidos (formerly SAIC), *Comparison of Fuels for Power Generation*, 2016, available here.

[4] See National Renewable Energy Laboratory, "*Harmonization of Initial Estimates of Shale Gas Lifecycle Greenhouse Gas Emissions for Electric Power Generation,"* Proceedings of National Academy of Sciences, July 2014, available here.

reliability. This is how a gas-fired generator (or any pipeline system customer) can achieve continuity of service if that is required.

2. Historic Reliability of Natural Gas Network – Due to Operational Characteristics

The physical operations of natural gas production, transmission and distribution make the system inherently reliable and resilient. Disruptions to natural gas service are rare. When they do happen, a disruption of the system does not necessarily result in an interruption of scheduled deliveries of natural gas supply because the natural gas system has many ways of offsetting the impact of disruptions. As noted in a report from MIT: [5]

> The natural gas network has few single points of failure that can lead to a system-wide propagating failure. There are a large number of wells, storage is relatively widespread, the transmission system can continue to operate at high pressure even with the failure of half of the compressors, and the distribution network can run unattended and without power. This is in contrast to the electricity grid, which has, by comparison, few generating points, requires oversight to balance load and demand on a tight timescale, and has a transmission and distribution network that is vulnerable to single point, cascading failures.

The inherent characteristics of natural gas are an important factor that cannot be overlooked. Unlike electricity that travels at the speed of light and flows along a path of least resistance, natural gas moves by pressure. The gas moves through a transportation system with the use of compressors that pressurize the gas to move it over distance. For long distances, compressors are placed at regular intervals to continue the forward movement. In sharp contrast to electricity, natural gas physically moves slowly through a pipeline at an average speed of 15-20 miles per hour, and its flow can be controlled. This allows time for pipeline operators to

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[5] Massachusetts Institute of Technology, Lincoln Laboratory, "Interdependence of the Electricity Generation System and the Natural Gas System and Implications for Energy Security," May 15, 2013.

manage the flow of natural gas and to adjust their operations in the unlikely event of a disruption. Because of the pipeline operators' ability to manage natural gas on their transportation systems, a failure at a single point on the system typically has only a localized effect.[6]

In addition, natural gas production comes from diverse geographic supply areas spread across many U.S. states and Canada. This abundant and stable supply is coupled with a vast number of production wells dispersed over a wide geographic area that contributes to ensuring that overall natural gas production is rarely impacted by isolated local or regional events. In the U.S. today, there are more than a half million producing gas wells[7] spread across 30 states.[8] There are hundreds of natural gas producers, and even the largest U.S. producer contributes less than 5 percent to total domestic supply.[9] In addition, this diversified supply is connected to an extensive pipeline network.

Another valuable and somewhat unique characteristic of natural gas is its ability to be stored after production. Natural gas is most commonly stored underground in depleted aquifers and oil and gas fields, as well as in salt caverns. It can also be stored above ground in storage tanks as liquefied natural gas ("LNG") for use at import and export facilities and at peak shaving plants, or as compressed natural gas ("CNG") for industrial and commercial uses. In addition to the importance of storage as a supply cushion, it provides vital operational flexibility in the event of constraints in the pipeline and distribution network, as storage facilities are widely dispersed on those networks.

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6 More detail about the physical, operational characteristics of the natural industry segments can be found in the Appendices to the 2011 Southwest Cold Weather Event report prepared by the staffs of FERC and NERC. Report on Outages and Curtailments During Southwest Cold Weather Event of February 1-5, 2011 (August 2011), Appendices 8-10 ("Southwest Cold Weather Report").

7 https://www.eia.gov/dnav/ng/ng_prod_wells_s1_a.htm.

8 https://www.eia.gov/tools/faqs/faq.php?id=46&t=8.

9 http://www.ngsa.org/wp-content/uploads/2017/03/Top-40-2016-4th-quarter.pdf.

The natural gas system[10] is not particularly vulnerable to weather-related events. Natural gas pipelines are predominantly underground and protected from the elements. Therefore, natural gas systems are far more resilient in the face of extreme weather events than electric systems. For example, in 2016, fewer than 100,000 natural gas customers nationally experienced disruptions,[11] while 8.1 million Americans experienced power outages.[12] According to an April 2017 INGAA survey of 51 interstate pipelines, over the ten-year period 2006-2016, pipelines delivered 99.79 percent of "firm" contractual commitments to firm transportation customers at primary delivery points (i.e., the points specified in their contract). As attested to by INGAA's survey data, firm pipeline transportation service historically is extremely reliable.

The wide geographic dispersion of production areas further reduces the vulnerability of the supply to localized weather events. Additionally, most natural gas production now occurs onshore, with offshore production making up only 5 percent of total natural gas production compared with 20 percent in 2004.[13] As a result, the potential for hurricane impact on natural gas production has dramatically diminished.

The operation of the entire natural gas system – production, transmission, distribution and storage – is highly flexible with strong elasticity characteristics. The inherent design of high-pressure and low-pressure gas delivery systems is mechanical by nature. Modern infrastructure has control systems to help monitor, and in some cases operate the pipelines and its components to move the product in a reliable, efficient and effective manner. Operators manage the internal

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[10] A detailed diagram of the natural gas industry segments appears at the end of these comments.

[11] Source: American Gas Association survey.

[12] EIA, Electric Monthly Table B.2 Major Disturbances and Unusual Occurrences, available at https://search.usa.gov/search?utf8=%E2%9C%93&affiliate=eia.doe.gov&query=Electric+Emergency+and+Disturbance+2016

[13] EIA – Natural Gas Monthly December 2007 and Natural Gas Monthly April 2017: https://www.eia.gov/naturalgas/monthly/pdf/table_07.pdf.

pressure of the delivery system by controlling the amount of natural gas entering and leaving the system. The process of increasing or decreasing pressure happens relatively slowly in a natural gas system because of the compressible nature of the gas. This compressibility lessens the immediacy of impact and increases the probability of detection. Layered onto this control system architecture are overpressure protection devices, which kick-in should the unlikely need arise to prevent the internal gas pressure from threatening the pipeline's integrity. This was demonstrated on January 7, 2014 during a "polar vortex" weather event that stretched across large parts of the United States and caused total delivered gas nationwide to reach an all-time record of 137.0 Bcf in a single day.[14] Despite the unprecedented performance levels required, the industry honored all firm fuel supply and transportation contracts.[15]

The joint Federal Energy Regulatory Commission ("FERC")-NERC *Southwest Cold Weather Report* made similar findings about the reliability of the natural gas system during another weather-related event. In the first week of February 2011, the southwest region of the United States experienced historically cold weather that resulted in significant impacts on the electric system in Texas, New Mexico and Arizona, and natural gas service disruptions in those states as well. During the 2011 Southwest outages, 50,000 retail gas customers experienced curtailments when gas pressure declined on interstate and intrastate pipelines and local distribution systems due to the loss of some production to well freezing at a time of increased gas

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[14] EIA, Market Digest: Natural Gas (2013-2014), https://www.eia.gov/naturalgas/review/winterlookback/2013/#tabs_Consumption-4

[15] See https://www.ferc.gov/media/news-releases/2014/2014-4/10-16-14-A-4-presentation.pdf and "During each of these cold events, customers who had firm transportation capacity on natural gas pipelines generally managed to secure natural gas deliveries." Also see https://www.ferc.gov/legal/staff-reports/2014/04-01-14.pdf at Slide 4.

system demand.[16] In contrast, 4.4 million electric customers were affected over the course of the same event.[17] Nonetheless, the *Southwest Cold Weather Report* found that only 10 percent of the electric generation failures were due to fuel supply problems,[18] and that "[f]uel supply problems did not significantly contribute to the amount of unavailable generating capacity in ERCOT."[19] Further, as noted in the *Southwest Cold Weather Report*, "[n]o evidence was found that interstate or intrastate pipeline design constraints, system limitations, or equipment failures contributed significantly to the gas outages. The pipeline network, both interstate and intrastate, showed good flexibility in adjusting flows to meet demand and compensate for supply shortfalls."[20]

Other characteristics of the natural gas system contribute to its historical operational reliability and system resilience. The natural gas transportation network is composed of an extensive network of interconnected pipelines that offer multiple pathways for rerouting deliveries in the unlikely event of a physical disruption. In addition, pipeline capacity is often increased by installing two or more parallel pipelines in the same right-of-way (called pipeline loops), making it possible to shut off one loop while keeping the other in service. In the event of one or more compressor failures, natural gas pipelines can usually continue to operate at pressures necessary to maintain deliveries to pipeline customers, at least outside the affected segment. "Line pack"[21] in the pipelines can be used, if necessary, to provide operational

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16 Southwest Cold Weather Report at 2.
17 Id. at 1.
18 *Id.* at 140-142
19 *Id.* at 153.
20 *Id.* p. 212
21 Line pack is the volume of natural gas contained within the pipeline network at any given time. It allows gas received in one area of a pipeline system to be delivered simultaneously elsewhere on the system. It can facilitate non-ratable flows and support pipeline reliability as a temporary buffer for imbalances. However, line pack must be kept reasonably stable throughout the system to preserve delivery pressure and system capacity. Thus, line pack neither creates incremental capacity, nor is it a substitute for appropriate transportation contracts.

flexibility, as noted in the *Southwest Cold Weather Report*.[22] As noted above, because of the inherent characteristics of natural gas and the interconnected pipeline system, operators can control and redirect the flow around an outage in one segment. The existence of geographically dispersed production and storage, and its location on different parts of the pipeline and distribution system, also provides flexibility for operators to maintain service in the event of a disruption on parts of the transportation and distribution system.

Similarly, producers use various methods to help ensure operational continuity. Because producers have an economic incentive to continue to flow gas out of the producing field at a constant rate, many techniques are in place to help ensure that operations continue or that any disruption is minimized when a problem arises. While not always possible, producers often rely on more than one processing plant or pipeline rerouting options in a production area, especially when handling a significant level of production. In the unlikely event of an unavoidable disruption of supply at a well or in a field, producers have many other options to balance their supply commitments, including increasing production in other areas or using natural gas they have in storage.

3. The Natural Gas Industry – Focused on Cyber & Physical Security Risks

Cyber and physical security are integral to the natural gas industry. Natural gas pipelines, which move over one-third of the energy consumed daily in the United States, are considered critical infrastructure. All along the natural gas supply chain, from production to delivery, the

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22 Southwest Cold Weather Report at 68-70.

industry employs a portfolio of tools to help ensure protection of its facilities from both physical and cybersecurity threats.

On the physical security side, fences, routine patrols and continuous monitoring, as appropriate, help protect above-ground facilities such as compressors, well sites, processing plants and meter stations. The natural gas industry routinely holds briefings and workshops to discuss security concerns, and it has developed industry guidelines and identified leading practices to protect facilities and data. Natural gas trade associations and their members regularly run simulated exercises in response/recovery efforts to help prepare in the event of natural or man-made disasters and work closely with government agencies to share threat information and practices.

On the cybersecurity front, the federal government partners with the natural gas industry on cybersecurity frameworks and initiatives to promote situational awareness, mitigating measures and response/recovery. Critical infrastructure sectors, including natural gas, electric, nuclear, financial, telecommunications, information technology and water, use Information Sharing and Analysis Centers (ISACs) as an adaptive tool to share comprehensive analysis of changing threats within the sector, other sectors and federal and state governments. The Energy Sector is represented by the Downstream Natural Gas ISAC, the Oil & Natural Gas ISAC, and the Electricity ISAC. These ISACs work closely with one another and with other critical infrastructure sector ISACs. The federal government promotes ISACs and Information Sharing and Analysis Organizations (ISAOs) as a best security practice.

As discussed at length in the beginning of this document, there is low risk of single point of disruption (regardless of cause) resulting in uncontrollable, cascading effects. Generally, supply and transportation disruptions can be managed through substitution, transportation rerouting and storage services. Recognizing the pipeline system resilience and redundancy, the federal government continues to partner with industry on cyber as well as physical security matters. This partnership is best experienced through the TSA Pipeline Security Guidelines and various completed and ongoing security initiatives that strengthen the industry's security posture.

One of the most important aspects of cybersecurity in the pipeline space is ensuring the integrity and operability of the Supervisory Control and Data Acquisition (SCADA) system of each pipeline against cyber compromise. From a cybersecurity perspective, natural gas functions are divided across an enterprise network and an operations network (which includes control system, SCADA, and pipeline monitoring). These two networks are generally isolated from each other, and a portfolio of tools and mechanisms is used to improve the prevention, detection and mitigation of cyber penetration. Pipeline safety regulations and standards state that back-up systems cannot be affected by the same incident that compromises the primary control system; thus fail-safes and redundancies must be independent of the cause of the primary mechanism's failure.

In addition, partnership between the private sector and the federal and state governments is a key part of addressing physical and cybersecurity threats to the nation's critical infrastructure. Industry members routinely participate in internal and industrywide security situation simulation exercises – training exercises that present real-world challenges – with government officials and others to ensure that the industry is better prepared for a cyber or a physical emergency.

Just as with pipeline safety, natural gas utilities apply layers of resilience for cybersecurity by employing firewalls and other tools to improve the prevention, detection and mitigation of cyber penetration. Further, natural gas delivery systems are mechanical by nature and can still be run manually if necessary. Natural gas is moved by using pressure to control the amount entering and leaving the system. Layered onto this control system architecture are devices that detect changes in pressure, which serve as a safeguard to prevent internal gas pressure from threatening pipeline integrity.

Cybersecurity is also a priority in other areas of supply chain, such as production. Many companies orient their overall cybersecurity programs around the NIST Cybersecurity Framework for Improving Critical Infrastructure Cybersecurity. Using this framework and other consensus standards can equip upstream operators with the process and tools they need to prevent cyberattacks.

Cyber risk management at any company is tailored to that company's assets and potential risks and must also be flexible to respond to ever-changing external threats and internal deployment of digital assets. Although one size does not fit all, there are some common features of cyber risk management programs for industrial control systems (ICS) employed by many offshore and onshore oil and natural gas industry companies, including: training and security awareness, segregating process control networks, restricting access to computer hardware used to manage software and industrial control programs, restricting and monitoring vendor access to equipment and systems, and on-site inspections and cyber-related drills.

4. Firm Contractual Arrangements Assure Reliability of Service

Above, we discussed the high level of reliability provided by the natural gas industry in terms of its physical operations and ability to deliver to its customers. Yet, in order to benefit from this reliability, large-volume customers, such as industrial users, electric generators, commercial customers and LDCs, must do their part to ensure continuity of service by contracting for firm transportation services to meet their own or their customers' obligations. Absent customers' purchasing pipeline capacity on a firm basis, pipelines may not have spare transportation capacity available on their systems, or a higher priority firm transportation customer may bump the non-firm customers' service for reasons unrelated to physical gas or transportation disruptions. On the coldest days (known as "peak days"), when weather-sensitive firm transportation customers are using their full contractual entitlements, there may be little or no interruptible transportation capacity left over for interruptible customers.

In many circumstances, large-volume customers make arrangements to move natural gas from the wellhead to their burner-tip – that is, through the entire supply chain. In 1992, FERC, which regulates interstate natural gas pipelines, required interstate pipelines to unbundle (i.e., separate) their sales and transportation services, and to provide unbundled transportation service on an open access, not unduly discriminatory basis.[23] As a result of this restructuring, interstate pipelines exited the merchant sales function, meaning that they no longer sell the natural gas that they transport through their pipelines, and the rates they charge are only for the movement of gas through their systems. While FERC's restructuring of the natural gas industry created an additional level of responsibility on the pipeline customer to separately contract for supply and pipeline transportation, it has been beneficial in creating competition by giving gas customers a choice of commodity suppliers and pipeline capacity.

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23 The FERC's unbundling of the interstate natural gas pipeline industry was undertaken to improve the competitive structure of the industry to maximize the benefits of the Wellhead Decontrol Act adopted by Congress in 1989. Pipeline Service Obligations and Revisions to Regulations Governing Self-Implementing Transportation Under Part 284 of the Commission's Regulations; and Regulation of Natural Gas Pipelines After Partial Wellhead Decontrol, Order No. 636, 57 FR 13267 (April 16, 1992), III FERC Stats & Regs. ¶ 30,939 (1992) at p.4.

4.1. Understanding Contract Options – Firm vs. Interruptible

The interstate pipeline industry today is contract-based. As such, pipeline customers select the type of service (firm or interruptible) for their transportation and storage service based on their desired level of certainty and reliability. Pipeline customers ensure their gas supply reliability by taking responsibility for choosing the portfolio of natural gas transportation and storage services that meets their needs adequately, not unlike what is necessary with other fuels, such as coal and fuel oil. Pipelines schedule their capacity based on a system of nominations, and, when necessary, restrict service based upon the type of service contracted. Broadly speaking, there are two main types of service that pipeline and storage operators offer to customers: (1) firm service, whereby a shipper chooses to pay a monthly reservation charge to the pipeline that entitles it to transport or store a certain quantity of gas each day, assuming the shipper nominates the quantity and delivers to the pipeline the equivalent amount of natural gas at the receipt points specified in the contract; and (2) interruptible service, which is a lower-quality pipeline service provided by the pipeline when it has spare capacity that is either not under firm contracts or not being used that day by firm transportation customers. Within firm service, many pipelines and storage facilities provide "no-notice" service. No-notice service is the highest level of firm service that a customer can contract. It allows for the reservation of pipeline capacity throughout the 24-hour gas day. This reservation of capacity allows the customer to nominate its firm service on a primary basis throughout the day, offering the highest level of flexibility available on a pipeline.

Under the FERC regulations,[24] a firm-service shipper is entitled to "segment" its capacity daily and utilize other delivery points within the path to its delivery point if capacity is available. These delivery points along the route are called "secondary firm points." Once scheduled by the pipeline, the transportation capacity to secondary receipt and delivery points is as firm as primary firm delivery. Primary firm-service shippers receive the most reliable service, because they have the highest priority when scheduling and are the last to be curtailed in *force majeure* (or unexpected emergency) situations. Secondary firm-service shippers are next in priority for scheduling, but once scheduled, they are curtailed *pro rata* with other primary-firm service. Interruptible shippers, if scheduled, can be bumped by higher priority firm shippers until the Intra-day 2 (ID2) scheduling deadline, and interruptible shippers are curtailed before any firm pipeline customers – regardless of whether the interruptible transportation was scheduled. Subject to capacity availability on the pipeline, the option to contract for firm or interruptible service is the decision of the pipeline customer based on the level of service that it requires. If capacity is not available, a pipeline may decide to expand its system to accommodate customers' requirements if firm commitments are made.

"Interruptible" transportation contracts ("interruptible") can be interrupted by a higher priority firm transportation shipper for any reason until 5:30 pm, which is the ID2 scheduling deadline.[25] A pipeline customer chooses the contract that best suits its needs and capability to be

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[24] 18 C.F.R. § 284.7(d).

[25] If existing capacity is fully committed under firm contracts, interstate pipelines are not required to expand their facilities to provide transportation service. See 18 CFR 284.7(f) ("A person providing service under Subpart B, C or G of this part is not required to provide any requested transportation service for which capacity is not available or that would require the construction or acquisition of any new facilities."). This contrasts with the Federal Power Act provisions that impose obligations on electric transmission owners to expand capacity to provide interconnection and transmission services. Federal Power Act section 210 and 211, 16 U.S.C. §§ 824i and 824j. Of

at risk of disrupted service. During a *force majeure* (or unexpected emergency) event applicable to firm pipeline customers, curtailment by interstate pipelines is based on the transportation contract in place, in which case, interruptible transportation contracts that were already confirmed are curtailed first. Interruptible transportation that was not available and never confirmed is not a curtailment of service. **Interstate pipelines do not curtail based on the end-use of the gas: FERC's nondiscriminatory open access regulations preclude this. In fact, an interstate pipeline cannot provide transportation service preferences based on customer classification.**[26]

4.2. Portfolio of Choice

Interstate pipeline customers can decide to secure their fuel supply through a variety of options. For example, they can purchase firm transportation directly from the pipeline, obtain firm capacity rights through capacity release (reassignment) from another firm shipper, or enter into firm bundled transportation/supply contracts with marketers. Natural gas marketers are entities that can aggregate natural gas into quantities that fit the needs of different types of buyers and then can arrange transportation of that gas to their buyers. A marketer coordinates, through various contractual arrangements, all the necessary steps to transport the gas from the wellhead to the customer. Natural gas marketers also offer natural gas supply delivered on a firm basis, which includes both the commodity and the transmission capacity needed for delivery of the gas. By holding a portfolio of physical capacity assets (pipeline transportation and storage) and supply contracts, a marketer can provide flexible and responsive service to customers.

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course, interstate pipelines have an incentive to expand capacity for shippers that commit to firm contracts for the expansion capacity.

[26] 18 C.F.R. §§ 284.7(a)(3) and 284.7(b)(1).

Therefore, a marketer's services can be a reliable alternative source of supply for customers during peak periods, if the marketer holds primary firm transportation capacity to the relevant delivery points.

4.3. LDCs as Pipeline Customers

As part of FERC's natural gas industry restructuring in 1992, LDCs converted their bundled firm pipeline sales entitlements to unbundled firm pipeline transportation rights to meet their state regulatory obligations to serve their firm "core" customers. (This is similar to the post-Order No. 888 conversions made by franchised public utilities to network integration service.) LDCs now purchase their natural gas commodity supply and arrange for the transportation of those commodity supplies on interstate pipelines to their systems. LDCs engage in long-range resource planning to ensure their access to supply and the continuous operations of their systems to ensure reliable service to these firm core customers. The delivery of natural gas to core retail customers is of primary importance to LDCs, and their planning involves assessment of potential supply chain disruptions, including commodity supply and interstate transportation disruptions, as well as disruptions that may impact their own local distribution systems.

4.4. Natural Gas-Fired Power Generation

Similar to LDCs, electric generators and other industrial and large commercial gas users must also arrange fuel supply to meet their respective requirements. These customers typically do not purchase their gas supplies from LDCs under their state-regulated tariffs -- unless they are located on an LDC's distribution system, in which case they may contract to use that system for transportation of their own gas supplies purchased in the wholesale market. More typically, many large commercial gas users are connected directly to an interstate or intrastate pipeline that transports the gas supplies they have purchased separately. Again, these large gas users are responsible for arranging their own fuel supply and must consider the entire fuel supply chain, from production to their plant.[27] In practical terms, this means taking into consideration congested transportation paths and pipeline scheduling and curtailment priorities when contracting for delivery of their gas supply. Location alone does not guarantee a large-volume customer security of its gas supply. Location is just one part of a bigger picture that includes the contract-based interstate transportation and storage system, and the utility obligations applicable to LDC systems.

5. Regulatory Requirements Are Relevant to Supply Chain Delivery Options

Historically, the natural gas industry has not been vertically integrated; instead each distinct industry segment's price structure is subject to a different regulatory regime. Broadly speaking, the industry consists of three segments: (1) upstream natural gas production, gathering and processing; (2) pipeline transportation and storage; and (3) local distribution.[28] Congress removed all price regulation for natural gas sold by producers in the Wellhead Decontrol Act of 1989, which was followed a few years later by FERC's removal of all price regulation for the sale of natural gas in the wholesale market. Gathering and processing are also not subject to price regulation by the federal government. However, the price, terms and conditions of the interstate transportation and storage of natural gas remain regulated by FERC. Pure intrastate transportation and storage of natural gas is subject to state regulation. The distribution of natural

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27 *See* Frank Brock and Michael Sloan, ICF, "An Electric Gas Market Calls for Flexibility," 2017, (available at https://www.icf.com/perspectives/white-papers/2017/an-electric-gas-market-calls-for-flexibility?_cldee=cGphZ3RpYW5pQG5nc2Eub3Jn&recipientid=lead-94bc42ae6f47e5118109c4346bb59848-27daa500e3404b359d638cd87a34be6b&utm_source=ClickDimensions&utm_medium=email&utm_campaign=may11-2017-com-ene-energy-digest-newsletter&esid=f789549b-b935-e711-80fd-5065f38a19e1).

28 A more detailed diagram of the natural gas industry segments appears at the end of these comments.

gas by LDCs is also subject to state regulation. All pipelines are subject to safety regulation by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration ("PHMSA") or state agencies. Numerous other federal and state agencies regulate various environmental and safety aspects of the natural gas system.

5.1. FERC Regulation of Interstate Transportation and Storage

As noted earlier, FERC's regulation of interstate transportation and storage is contract-based. A pipeline or a storage company's contract is with its pipeline customer. How that pipeline customer chooses to contract for service determines the scheduling of service on the pipeline as well as the firm service curtailment priorities in the event of a pipeline restriction or *force majeure* event. FERC regulations preclude interstate pipelines from undue discrimination in providing service based on the classification of customers. This means that the identity of the customer, whether it is an LDC, electric generator, or a producer, cannot have any bearing on priority of service. In addition, the pipeline is required to honor all firm service contracts.[29] Therefore, level of service that a customer has contracted for is of paramount importance.

5.2. State Regulation of Local Distribution – High Priority Customers.

LDCs are regulated by most states as local gas utilities that have an obligation to serve their firm core customers – the customers for which the system is built to serve reliably. LDC systems are built to serve these firm core customers and others on a "design day" (a forecasted peak-load day based on historical weather conditions). While gas utilities may offer an

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[29] FERC gas regulations define "service on a firm basis" as a service that is "not subject to a prior claim by another customer or another class of service and receives the same priority as any other class of firm services." 18 C.F.R. § 284.7(a)(3).

interruptible "bundled" sales service (which includes commodity supply and the transportation of the supply on the local distribution system) and/or a stand-alone interruptible transportation service for the transportation of customer-owned gas on the local distribution system, the LDC may not be able to maintain interruptible transportation service at all times. During periods of high usage and system constraints, often prevalent on the coldest winter days, LDCs may call on interruptible customers to cease gas usage temporarily, upon which these customers generally switch to a back-up fuel, such as fuel oil.[30]

In the event of extreme situations that require action to be taken for reasons that include the need to maintain the operational integrity of the system and/or maintain natural gas service to designated high priority customers, including "essential human need" customers, state statutes and public utility regulations may allow an LDC to curtail services to some customers. Historically, these regulatory requirements give the highest priority to residential and commercial customers without short-term alternatives. As a result, a natural gas-fired power generator relying on an LDC distribution system, particularly on an interruptible basis, needs to consider these regulatory obligations of the LDC and, for example, plan for the use of alternate fuels, maintain on-site fuel storage (such as LNG or CNG), or contract for a higher level of service from the LDC (such as firm transportation or emergency service).

[30] The tradeoff for these customers is a discounted rate for the interruptible natural gas delivery service, compared with firm service rates, and the customers enter into these interruptible contractual arrangements with that prior knowledge.

6. Storage's Dual Role in the Gas Supply Chain

Underground natural gas storage is an integral component of the natural gas supply chain, with a function different than the other components of that supply chain. Storage serves to augment natural gas production, and the location of a storage facility can also provide operational flexibility for the natural gas delivery infrastructure. There are 385 underground storage facilities in the lower-48 states with a total of 4,688 Bcf of working gas design capacity.[31] Natural gas storage enables LDCs and interstate pipeline companies to adjust for daily and seasonal fluctuations in demand, in contrast to natural gas production, which remains relatively constant year-round. Storage helps ensure that customers have reliable service and can provide increased price stability. Natural gas storage operators have consistently provided safe and reliable natural gas storage. Because of the critical importance storage plays in the nation's energy portfolio, natural gas storage operators are continually working to help improve safety and reliability through innovations in equipment, processes and methodologies.

6.1. New storage rules will have minimal impact on deliverability

PHMSA's December 2016 interim final rule promulgating safety regulations for underground storage facilities ("Storage IFR")[32] will have minimal impact on deliverability. In fact, the Storage IFR is intended to reduce the likelihood of future storage incidents and ultimately improve underground storage safety and reliability. The Storage IFR, like natural gas pipeline safety regulations that preceded it, takes a functional integrity management approach to storage safety and standardizes the methodology by which operators will analyze risk at storage

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31 https://www.eia.gov/naturalgas/storagecapacity/.

32 See 81 Fed. Reg. 91,860 (2016).

facilities. The Storage IFR requires operators to develop rigorous risk-assessment programs that will be used to determine which preventative and mitigating measures are appropriate for the specific conditions at any given storage facility.

6.2. Underground Storage Facilities Are Not Identical

The gas pipeline and associated storage network is different in different regions of the United States. How an underground natural gas storage facility is configured and serves its market also differs across the country. Much attention has been focused on the Aliso Canyon underground natural gas storage facility. This particular facility is a prime example of how one facility's operational configuration and the way in which it serves its market differs from others.

PHMSA's underground storage rule was prompted by an October 23, 2015 leak at a SoCal Gas natural gas storage well at the Aliso Canyon storage field in California. Aliso Canyon is an integrated gas utility-owned storage facility tied directly to intrastate pipelines that serve market load. As a result, the gas delivery system in the area is dependent upon storage withdrawals to meet market demand. However, the gas pipeline and storage network is different in other regions of the United States, where storage operators instead interconnect with multiple pipelines and storage facilities from which they can access supply and transport gas.

Based on the event data reported since 1990, including the Aliso Canyon incident, the likelihood of an unplanned release from an underground gas storage well, calculated using the

Center for Chemical Process Safety 5 ("CCPS") American calculation for hazardous process facilities, results in a "very unlikely" to "extremely unlikely" or "remote" classification.[33]

One well failed at the SoCalGas facility at Aliso Canyon and, in an abundance of caution, California State Regulators ordered the other 113 wells to be temporarily sealed until they could be tested to ensure their integrity and safety or plugged and abandoned. To date, 49 storage wells at the Aliso Canyon Storage facility have passed all the tests required under the Division of Oil, Gas and Geothermal Resources' ("DOGGR").

There was no mechanical failure of the other 113 storage wells at Aliso Canyon; the regulator's decision to shut down the entire facility is an example of regulatory action taken to help mitigate risk. Nevertheless, the consequences of such actions to gas and electric reliability need to be clearly understood when gas flows are restricted.

7. Conclusion

The natural gas industry is not susceptible to wide-spread failure from a single point of disruption in the same manner as the electric system because of the dispersion of production and storage, its redundant characteristics from the extensive integrated pipeline and distribution network, and its low vulnerability to weather-related events. The natural gas industry also has in place robust cyber and physical security protocols to minimize disruptions from manmade or computer threats, and has a resilient, interconnected system that allows it to come back on line quickly in the rare case of a disruption.

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33 American Petroleum Institute, American Gas Association, and Interstate Natural Gas Association of America "Underground Natural Gas Storage: Integrity and Safe Operations," (July 6, 2016) at 10, available at https://primis.phmsa.dot.gov/UNG/docs/AGA%20White%20Paper%20-%20UNGS%20Integrity%20and%20Safe%20Ops%2020160706.pdf.

While the natural gas industry is committed to continuing its high level of reliability, there is an equally important component of assuring continuity of service that remains the responsibility of large-volume customers. These customers should contract for the appropriate level of firm transportation service they require to ensure reliable service. Together, these two components – operational reliability and contractual continuity of service –make natural gas a secure, reliable and resilient choice for customers.