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Natural Gas Energy for Maine's Future?!

I appreciate the invitation to join you today. As you all know the advent of shale gas extraction in the United States is changing the energy landscape in North America. Marcellus shale gas is pushing back supplies from many other producing regions leading to flow reversals on many pipelines and a new way of viewing our energy future. This resource, and what it represents an abundant, clean, cheap energy supply is driving capital investment decisions regarding energy intensive businesses and providing regions that have access to the supply a competitive energy advantage.

Here in Maine we have seen significant build-out by the State's local distribution companies (LDCs) to bring the natural gas option to large industrial clients and residential homes along the route to these anchor customers. These developments are extremely positive for Maine consumers and Maine jobs, and many of the discussions that will occur throughout the day will undoubtedly address the ways that we might continue our progress in this area.

However, it is at the very moment when, as now, we are in a build-out atmosphere that it is most important for all of us to pause and recognize that the future and success of natural gas in Maine depends, first and foremost, on the public's trust and confidence in the safety of the natural gas transportation system. In a sense it is public perception which grants utilities a social license to operate in the state. The Commission's very authorizing statute places safety first . Section 101 states "The basic purpose of the regulatory system is to ensure safe, reasonable, and adequate service…at just and reasonable rates." If we treat safety as either a foregone conclusion, or an afterthought, we will have failed to satisfy our core responsibilities and will have violated the social contract by which we license natural gas transportation systems to deploy capital for a public purpose. Let me be perfectly blunt: more than capital, price, and the promise of economic development opportunities, it is the guarantee of a safe

pipeline system that is a prerequisite for the continuation of any license to operate. The entirety of my remarks today are intended to elaborate on my firmly held views on what a culture of safety must mean for our natural gas utilities in Maine.

My formative years as an engineer were spent in the Navy's nuclear propulsion program NR (Naval Reactors). If there is an organization that epitomizes what it means to mainstream safety it is the NR program. What do I mean by "mainstreamed safety"? "Mainstreamed Safety" is what the former director of Naval Reactors (NR) Admiral Bowman described in his testimony to Congress following the Space Shuttle Columbia tragedy[1]. Mainstreamed Safety means that the role of safety must be part and parcel of everyone's job – extending from deckplates to Head Quarters (in our case from the trenches to the boardroom). So understood, Safety as a primary mission doesn't reside simply in some particular working group displayed on some organizational chart whose raison d'etre is stated in terms such as "the promotion of safety in our organization." Instead, safety must be mainstreamed – it must be a critical component of every daily function performed by every worker and manager at every level of the organization and beyond the bounds of the organization described by the typical org chart. This means that safety is equally part of the responsibility of every supplier, and contractor and that it extends to areas such as training, construction planning, hiring decisions, engineering and design considerations, and how quality assurance is approached in all of these activities and by all of these actors.

The necessary approach to Gas safety is, to my mind. more similar than it is different from nuclear safety. The fundament goal of each is to eliminate low probability of failure occurrences. Why do I say "eliminate" rather than "reduce the likelihood of" failures. It is because the result of a failure could be catastrophic…Low likelihood of failure, high impact. This is not portfolio theory – we are not applying a beta "risk factor" to maximize likely returns at some predetermined level of acceptable risk. This is about ensuring the safety and preservation of more than investment capital – it is about the protection of human life and of

[1] See testimony, http://www.navy.mil/navydata/testimony/safety/bowman031029.txt

property. Avoidable risk due to not meeting the minimum federal safety standards is unacceptable.

In the navy nuclear world, decisions are made based on a cradle to grave view of the technology used to build a project. All decisions are made for the long haul. A given class of ships may, and likely will, be in service for 50 years. The same long-term view applies to natural gas infrastructure, for reasons far more important than depreciation rates and rate base. Pipe that is put in the ground today is likely to be in service 50 years from now. And if we are investing in and building new infrastructure that is going to be around for the long-haul, we must ask: what is it that, at a minimum, we should know about that infrastructure today, as it is being placed in the ground? At the very least we should know the precise physical location of the infrastructure that we are installing and we should document those locations. GPS is not a new tool, and we must use it. For each piece of pipe laid in the ground, we must also document the type of pipe installed and the fittings and joining methods used to connect each piece of pipe. And again, we should document the location of each of those fittings, before the trench is closed. Why is this important? Because we will inevitably learn, over the course of the coming decades, about a class of pipe, or a class of fittings, or a joining method which is starting to experience problems in the field. In the 70s and the early 80s, safety bulletins started coming forward on stress cracking of plastic pipe at joints and other points of stress. Plastic pipe companies responded with new resins and improved resistance. LDCs responded with replacement programs. We are all familiar with the ongoing issues around the country associated with cast iron pipe . Cast iron pipe was the state-of-the-art material, at the time of its installation (over 100 years ago to as recent as 50 or 60 years ago). It's now leak prone due to its bell joints, small diameter pipes are susceptible to brittle cracking, and graphitization of the cast iron occurs in certain soil conditions. More recently issues with mechanical couplings like the Dresser fittings in the 80s-90s that did not have adequate restraint on plastic pipe and led to catastrophic failures[2]. What might we read about 10 years from now concerning our current practices? Maybe nothing, but more likely, weaknesses will be found out and new

[2] PHMSA-RPSA-2004-19856 Pipeline Safety: Issues related to Mechanical Couplings Used in Natural Gas Distribution Systems, See NTSB Pipeline Accident Report National Fuel Gas Company Natural Gas Explosion and Fire Sharpsville, Pennsylvania Feb 22, 1985

materials and techniques will be developed and adopted to ensure safety. Based upon these past experiences of which a prudent manager of a natural gas transportation system must undeniably be aware, and the all but inevitable fact that weaknesses in current materials and practices will be discovered over time, a prudent manager of a natural gas utility installing long-lived infrastructure must anticipate the future by conducting current build-out in a way that facilitates future necessary remediation requirements even while the contours and particulars of such remediation is presently unknown. To act prudently today, a gas utility needs to know, today, and with a specificity focused on current and future safety, what it is installing, where it is being installed, and how it is being installed. That such safety-oriented actions are necessary seems, to me, to be self-evident and unremarkable. But to make my views especially clear – and the lawyers among us should take note, I attach to these actions the word prudent on purpose and with reference to the particular meaning that the word prudence holds in the context of utility regulation.

When we do encounter technical problems – as history proves that we inevitably will -- how do we seek to address them? Having been on the operations side of the nuclear navy I can tell you how Naval Reactors personnel approached seemingly small problems. They asked all of the hard and difficult questions on every issue…including the seemingly mundane ones. What actually happened; ie. what are the facts? How do you know this is what happened ? (was it a visual inspection/NDT/instrument readings/etc)? Who is the responsible party ? Is it a vendor/a contractor/our inspectors/our technicians? What could be be affected? Not "what will likely be affected," but what *could* be affected. Do we have other instances of this particular event, or other analogous events? Is this a condition that is outside of our design expectations? What is the worst possible outcome/failure modes? Now why is it important to ask the hard questions on the small and mundane issues? It is important because solving technical issues related to small problems prevents them from growing into bigger problems. It trains your organization not to accept and live with small problems. How many times do your technicians walk by small problems? Is their reaction, "Oh, it has always been this way?", or "that valve has never operated correctly and we'll will get to it sometime….that pressure relief usually needs to manually reseated" ….and the list goes on. It is attention to detail in the small

things that is a barometer of the overall health and efficacy of an organization as a whole and of its management. As Admiral Rickover so aptly pointed out:

> "Any one detail, followed through to its source, will usually reveal the general state of readiness of the whole organization".

As the regulator charged with overseeing gas safety for the state of Maine I have a limited staff, a gas safety manager, and two inspectors. They are a great team, to their credit they received a perfect score on their latest PHMSA audit (not something I have seen since coming to the commission). Our inspectors are in the field almost every day. They see a very small percentage of your organizations and their operations. They look for details and follow them through and I believe this gives us a pretty good idea of the general state of readiness of your organizations.

Safety, in my mind, boils down to a sense of ownership and responsibility. The ownership and responsibility in each LDC organization must extend to contractors and suppliers. How do you push a sense of ownership and responsibility down the chain ? You do it by holding individuals accountable to high standards. There is no secret here as with most things in life it comes down to people.

(Adm Rickover, the father of the nuclear navy, in building the program understood that to develop the workforce culture that was necessary he needed to diligently screen those he brought in…and he sought to bring in young talent that he could mold…he wasn't interested in transfers. So he personally interviewed everyone. NR has continued that policey everyone does a face to face with the Admiral, quite a day when lowly Midshipman Vannoy went to his interview at NR HQ in Crystal City with Adm DeMars something you never forget…this is a 4 star admiral…a midshipman thinks a Lieutenant is lofty. As the interview started I saw the Admiral scanning what looked like my transcript…my heart took a bit of a lurch because I knew there was an outlier on that sheet of paper…his eyes stopped moving down the sheet and I new he had found it….at that point he looked up and asked "why should I let you in the program how do you explain the D you received during your first semester of electrical engineering?" I knew at that point that the 4 basic responses you are taught during plebe summer were not going to

cut it. “Yes sir, No sir, I will find out sir., and No excuse sir”. Although in answering I do think I led with no excuse sir….the rest was a blur but in the end he did let me in the program and 5 years later after completing a sea tour operating a nuclear reactor I was back at headquarters in crystal city for two days of nuclear engineer exams which I passed and was certified as a Naval Nuclear Engineer.) The point in this aside is: are you doing the due diligence on the people you allow to construct and operate your system? You must because they are integral to the quality of the system.

By way of example – admittedly one that is unfortunately not entirely hypothetical, let’s think for a minute about the process of joining together two pieces of plastic pipe. As with most welding or fusion procedures one of the keys to successful joining will be cleanliness. Equipment used on the pipe must be clean. The surfaces that will be joined must be clean. Verbatim compliance with the joining procedure, established by rule and/or by the manufacturer, must be strictly adhered too. In order to establish the working conditions on the job site that ensure a successful joint the pipe crew must take ownership and responsibility for ensuring that they manage their worksite in a way that clean preparation of pipe and fittings is possible, and that the joining process adheres to the required procedures. When an inspector walks on a site it is readily apparent in the small things/the details which crews are taking ownership and responsibility of their worksite and which ones are not. Quality Assurance associated with a joint depends on a series of steps demonstrating compliance, and uniform and unambiguous documentation demonstrating that compliance.

In order to qualify to join plastic pipe a person must:

1. Receive training and experience in the use of a specific procedure (documented)
2. Make a specimen joint according to the joining procedure. The specimen joint must pass both visual inspection and either an ultrasonic inspection and contain no flaws, or be destructively tested and exceed the strength of the pipe. (documented)
3. Finally a person must be re-qualified in a specific joining procedure if over a 12 month period they have done no joining or if 3 joints or 3 % of joints made under the procedure are found to be unacceptable. (49 CFR Part 192.285) (documented)

From a quality assurance perspective what the minimum federal safety standard does is require a joiner to demonstrate competency in the joining method….it then assumes that competency in the method assures future quality (when coupled with inspections) unless a joiner demonstrates otherwise by failing to pass inspection on future joints.

In this construct, Quality Assurance begins with the joiner and the joiner's attention to detail in strictly following the joining procedure. If the joining procedure is not followed the integrity of the distribution system is necessarily called into question. The next step in the federal safety standards is the requirement that only qualified personnel carry out joint inspections. Further, pursuant to 192.273c each joint must be inspected to insure compliance with this subpart. The inspections stand as check on the joiner's application of the approved joining procedure. A joint that passes inspection is another step in the Quality Assurance process. It allows the engineer of record to have confidence that the joints actually installed will withstand the stresses for which they were designed (this takes us to 192.273 (a)). The minimum federal safety standards indicate that a pipeline must be designed and installed so that each joint will sustain the longitudinal pullout or thrust forces caused by contraction or expansion of the piping or by anticipated external or internal loading.

One of the key design loads for plastic pipe installations in Maine results from the thermal expansion and contraction of plastic pipe under temperature changes. Often times plastic pipe is installed in a shallow trench about three feet deep during the heat of a summer day. The sticks or coil have been sitting in the sun on a truck or beside the road. Temperatures can easily be in excess of 90F. The pipe is installed, and welded to adjoining sticks or coils of pipe. Once backfilled and eventually subject to winter conditions (design frost penetration in southern Maine extends to 4 feet) temperatures in the ground in the vicinity of the pipe drop below freezing…this gives a delta T in likely field conditions of 60-70 F. One manufacturer, Performance Pipe, adopts a rule of thumb that the thermal expansion and contraction of Polyethlene Pipe is 1 inch for each 10F change in temperature for each 100 ft of pipe. In our example of a 60-70F temperature change we can expect 6-7 inches of contraction in 100 ft of pipe. This unique characteristic (the high level of thermal expansion and contraction of this

material) means that joints in plastic pipe are potentially subject to significant loads due solely to the physical properties of the material from which the pipe is manufactured. Given these immutable physical properties of the pipe, and the immutability of the environmental conditions we experience in Maine, it is self-evident that quality joints are mission-critical.

Quality Assurance in new construction begins with training and is ensured through a series of individuals who take responsibility and ownership of their respective parts of the process. Verbatim compliance to the fusion procedure, coupled with rigorous inspections of each finished fusion joint play a critical role in quality, and therefore safety outcome. A signature on the joint by the qualified joiner and a signature next to the joint by the qualified inspector demonstrate ownership/responsibility. If each and every chair manufactured by the Thos. Moser Company bears the signature of its particular craftsman as a point of pride, why would we expect any less of those who should be in a position of owner, and be held accountable, for the quality of the joint connecting two pieces of pipe the failure of which can lead to a catastrophic event ?

While I do not possess empirical data to prove the point, my strong suspicion is that that any study of the matter would quickly demonstrate that a crew that attends to the outwardly visible details of cleanliness is most like to also have attended, in strict and verbatim compliance, to the required fusion process even where evidence that they have done so may not so easily be outwardly visible by looking at the pipe. I challenge the LDCs and their management team to hold their employees and contractors accountable in the details. This brings us to the concept of responsibility. Who is ultimately responsible and what does responsibility look like? It is worth thinking about…

Responsibility:

Admiral Rickover, the father of the nuclear navy, in establishing the construct of the NR program, realized the importance of putting total responsibility in one place. I quote: “Responsibility is a unique concept: it can only reside in a single individual. You may share it with others, but your portion is not diminished. You may delegate it, but it is still with you. You may disclaim it, but you cannot divest yourself of it. Even if you do not recognize it or admit its

presence, you cannot escape it. If responsibility is rightfully yours, no evasion, or ignorance, or passing the blame can shift the burden to someone else. Unless you can point your finger at the person who is responsible when something goes wrong, then you have never had anyone really responsible. "

Each of you in your various organizations is responsible for the safe and reliable operation of your gas transportation systems. As the Chair of the regulatory organization entrusted with the oversight responsibility for ensuring that your licensed organizations are operating your infrastructure safely ….I will endeavor to hold you accountable in a fair, impartial way, to the minimum safety standards outlined in both rule and statute. Ultimately though the responsibility and ownership associated with providing safe and reliable service lies with the regulated community. This is a serious responsibility. It is the very essence of what it means to be a Public Utility -- to be granted the authorization by the State to place infrastructure into the service of the public. Shouldering this responsibility and discharging it faithfully each day ensures the social license necessary to continue bringing the benefits of natural gas distribution to the people and economy of Maine.

Thank-you for the opportunity to speak today and for your kind attention.

End here some additional quotes:

Galileo 1615 (letter to the Grand Duchess Christian of Tuscany) Tuffte Visual Explanations page 53)

"It is not within the power of practioners of demonstrative sciences to change opinion at will, choosing now this and now that one; there is a great diffence between giving orders to a mathematician or a philosopher and giving them to a merchant or a lawyer; and demonstrated conclusions about natural and celestial phenomena cannot be changed with the same ease as opinions about what is or is not legitimate in a contract, in a rental, or in commerce."

Physics (demonstrative sciences) govern operations….nature will find any weaknesses. The physical realities of the system remain true no matter the veneer/gloss that legal pleadings and opinions might put forth. As Richard Feynman testified before congress following the shuttle explosion

“For a successful technology, reality must take precedence over public relations, for Nature can not be fooled.”