ASPE American Society of Plumbing Engineers™

BALTIMORE

Monthly Newsletter **OCTOBER 2019**

Upcoming Meeting

Date: **October 23, 2019**

Time: **6:00pm to 8:00pm**

Place: Olive Grove Restaurant

Topic: Natural Gas Sizing For Emergency Generators

Speaker: Mike Hainzl - Generac

Meeting Format
6-6:30 Social
6:30-6:45 Announcements and Table Tops
6:45 Dinner Served
7:00-8:00 Speaker

ASPE CHAPTER AWARD OF MERIT Recipient 2017-2018

In This Issue

MEETING LOCATION

Olive Grove Restaurant & Lounge

705 North Hammonds Ferry Road
Linthicum, Maryland 21090
Phone: 410.636.1385

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Please Contact Jason Eagles or Jeff Edwards

Make checks payable to Baltimore Chapter of ASPE. Please contact the chapter Treasurer with any questions.

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Jeffrey W. Edwards, CPD ,GPD
President

President's Report

Our opening monthly meeting for this year had approximately 40 attendees with three tabletop presenters. Along with the great technical presentation from Chip Matthews and Tom Buckley from WSSC, I was very pleased with how our ASPE season kicked-off.

Thanks to all who spent their own time attending the meeting.

ASPE's Technical Symposium this year is being held in Pittsburgh on October 24th thru 27th. There will be 2 and ½ days of technical seminars on some great topics. This is a great way to accumulate CEU's/ PDH's. For more information, go to www.aspe.org. I plan on attending so I hope to see some of you there.

If you are a member of ASPE, I'm sure you get emails from ASPE Connect, ASPE's open forum service that allows designers/engineers to ask questions regarding just about everything relating to a plumbing design system. I open the email every day, I read most of the questions and have only got involved in a topic once. I have mixed thoughts on this forum, on one hand, I think it's a great way for people to ask questions on a design system, yet if you wanted to get involved in multiple questions, your work day/ projects, etc. could suffer, time wise. Feel free to email me your thoughts on this forum, I'm curious what other people think.

Please know if there is anything you want to discuss about our chapter, please feel free to reach out to me.

Best Regards,
Jeff Edwards, CPD, GPD
President-ASPE Baltimore Chapter

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- Product Show registration: includes attendance to the Product Show on October 24

aspe.org/2019tech

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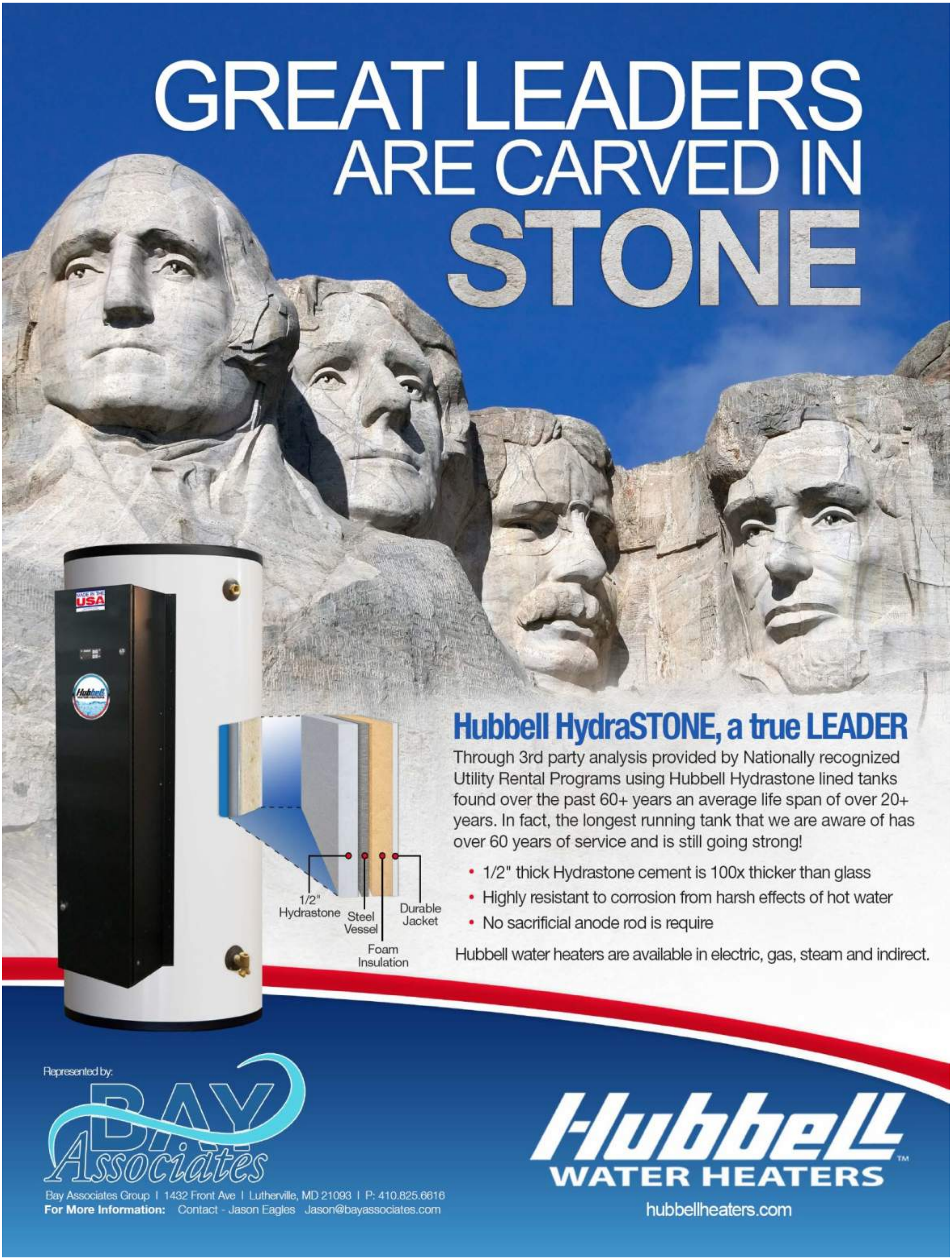
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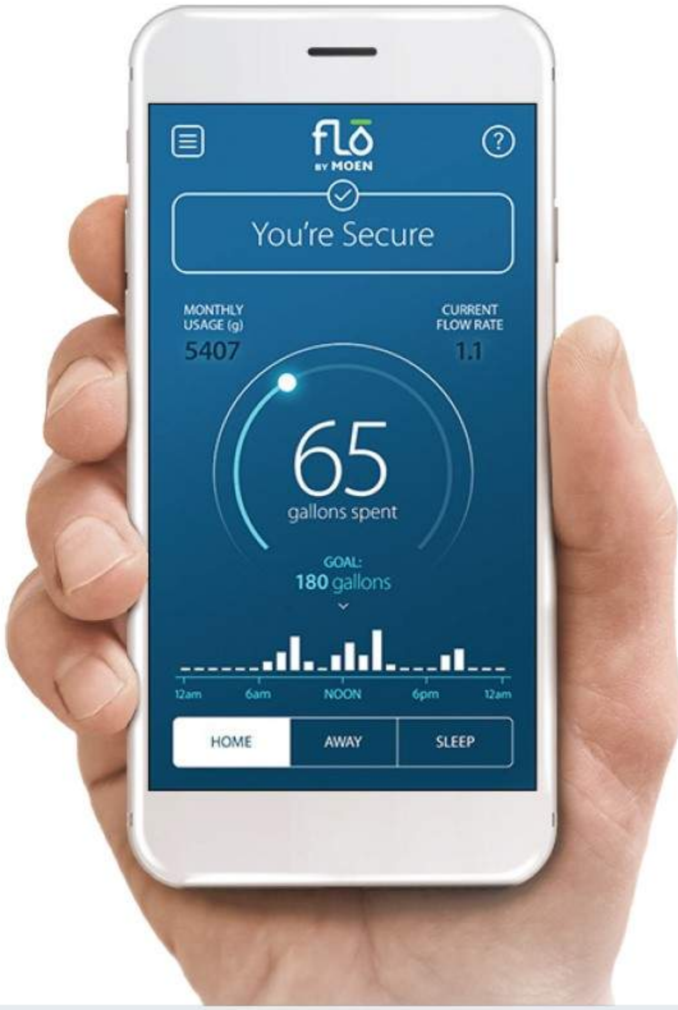

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Chuck Swope, PE, CPD, LEED AP BD+C
Vice President—Technical

Technical Report

This season of the Baltimore Chapter is shaping up to be another great one. We had excellent turnout for another informative presentation from our friends at WSSC. Chip Matthews and Tom Buckley are an excellent resource for not only Cross connection control, but the plumbing industry as a whole.

There are a lot of hot topics that are in our industry, like cross connection control, roof drainage systems, and legionella and pathogen control. One of the more discussed topics is providing natural gas service to generators. It seems that there are a lot of opinions on how best to accomplish this, however we thought that it would be best to bring a generator manufacturer in to let us know what their expectations are. Mike Hainzl is the Northeast Power Solutions Manager for Generac Power Systems and will be presenting on the topic of Understanding Natural Gas Supply Dynamics. He will cover topics like applications for natural gas generators over diesel generators, pipe sizing guidelines to maximize the volume of gas, and regulator characteristics and requirements.

Prior to joining Generac in 2015, Mike spent 23 years in the telecom industry holding positions in RF and Facilities Engineering, Field Operations, and Business Continuity Management. This includes hands-on experience managing fixed and mobile generator fleets for national telecom providers, as well as coordinating emergency power restoration after major storm events like Hurricanes Katrina, Irene, and Sandy. He specializes in risk analysis and mitigation planning with a focus on operational readiness that begins with system design and continues with a robust preventative maintenance policy.

Mike earned his BSEE, MS in Engineering Management, and MS in Emergency Management & Business Continuity from New Jersey Institute of Technology. He is also a Certified Business Continuity Professional (CBCP) and has been a volunteer firefighter for over 30 years. Mike is married with two sons in high school and lives in Vernon, NJ.

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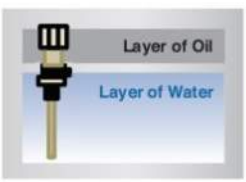

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Christopher Imhof, PE, CPD
Education Committee Chair

The Potential Risks of Oversizing Piping

By Chris Imhof, PE, CPD

For decades plumbing design manuals, standard codes, and plumbing designers have propagated conservative methods of pipe sizing. The primary concern for sizing is that the piping would be too small. There is good reason for this concern, smaller piping can result in greater high velocity and greater pressure drop in water and gas piping and there is a perception that smaller sewer piping is more likely to clog. Problems associated with undersized piping can link directly back to the plumbing designer and can have substantial additional costs. The simple solution to avoid these potential problems is to oversize the piping. Larger piping has less pressure loss, lower velocity, and is perceived to be less likely to clog. Rarely is the design checked for oversized piping and the relatively small additional costs go unnoticed.

Over time plumbing fixtures and their usage changes, investigation of known issues continues and new problems emerge. The EPAct of 1992, the development of LEED, and the demand for low flow fixtures has drastically reduced the load on domestic water and waste systems. The number of reported cases of Legionella have grown exponentially since 2000. Fatbergs and grease clogs have made international news, flushable wipes (that you shouldn't flush) have become common in all types of buildings, not just residential. Science classrooms and labs have changed practices and use natural gas less often. Natural gas has become more abundant and gas fired equipment is more frequently being chosen over electrical.

Domestic Water

The Centers for Disease Control (CDC) lists biofilm, water temperature fluctuations, inadequate levels of disinfectant, and water stagnation as some of the factors that lead to legionella growth. Low flow and stagnation can encourage biofilm growth, reduce levels of disinfectant, and cause hot and cold water to change temperature to ranges where legionella can grow. Larger pipe sizes create a larger surface area for biofilm and legionella. Increasing flow and reducing system water volume can lower the risk of Legionella. Despite significant reductions in water usage by the most common required plumbing fixtures, codes and standards have not revised Water Supply Fixture Units (WSFUs) that are used for pipe sizing.

Fixture Type	Prior to EPAct of 1992	Per EPAct of 1992	WaterSense (2006)	LEED Influenced (2009)
Bathroom sink (lavatory) faucet	Up to 2.5 gpm	2.2 gpm	1.5 gpm	0.35 gpm
Showerhead	3.0 to 5.0 gpm	2.5 gpm	2.0 gpm	1.5 gpm
Tank-type toilet	3.5 to 5.0 gpf	1.6 gpm	1.28 gpf	0.92 gpf

Maximum Allowable Flow Rate and Flush Volume per Standard Requirements

Domestic Water Sizing Example

Compare traditional water pipe sizing and engineered pipe sizing.

Traditional water pipe sizing: Size cold water branch for gang of 8 public lavatories with Type L copper piping using methods found in appendix E of the 2018 International Plumbing Code (IPC).

2018 IPC Table E103.3(2) assigns 1.5 WSFUs for the cold water supply for a public lavatory.

8 public lavatories would have a combined 12.0 WSFUs for cold water supply.

2018 IPC Table E103.3(3) (supply system predominately for flush tanks) converts 12.0 WSFUs to 16.0 GPM.

Using IPC Figure E103.3(3) and assuming a maximum allowable velocity of 8 fps, the minimum required pipe size is 1" (pressure drop is 6 psi/100 ft and velocity 6.2 fps)

Engineered pipe sizing: Size cold water branch for gang of 6 public lavatories with Type L copper piping using maximum possible flowrate.

The typical flowrate for modern public lavatories is 0.5 GPM.

8 public lavatories would have a combined flowrate of 4.0 GPM.

Using IPC Figure E103.3(3) and assuming a maximum allowable velocity of 8 fps, the minimum required pipe size is 1/2" (pressure drop is 10 psi/100 ft and velocity 5.5 fps)

For Type L copper pipe, the volume of 1" pipe is 3.5 times greater than the volume of a 1/2" pipe. The surface area of a 1" pipe is 1.9 times greater than the surface area of a 1/2" pipe.

If the pipe is installed at 1" and only has a maximum flowrate of 4.0 gpm, the velocity would only be 1.6 fps.

Sewer

Reduced flow rates and flush volumes also have the potential to affect on how sewer piping is sized. Traditionally sewer pipe size and slope are determined using tables that assume a uniform flow and a minimum velocity of 2 fps. A minimum velocity of 2 fps is required to scour the pipe and keep solids in suspension instead of settling and potentially forming a blockage in pipe. Although there have not been any recent changes to the standard pipe sizing methods per lower flow rates, there is interest in studying the affects of low flow fixtures on sewer system design.

In January 2009 the Plumbing Efficiency Research Coalition (PERC) was formed. The objectives of PERC include studying the sanitary flow and addressing any consequences of reduced water usage from water conservation measures and the reduction in water usage by plumbing fixtures. The Coalition is composed of the following organizations, the Alliance for Water Efficiency (AWE), the International Association of Plumbing and Mechanical Officials (IAPMO), the International Code Council (ICC), the Plumbing Heating Cooling Contractors (PHCC), the Plumbing Manufacturers Institute (PMI), and the American Society of Plumbing Engineers (ASPE). The coalition has conducted a series of experiments and released reports of their findings. The report "The Drainline Transport of Solid Waste in Buildings – Phase 2.0" concluded "reducing Pipe Diameter from 4-inch to 3-inch did not consistently result in improved drainline transport". However, the report also emphasizes "The Importance of Toilet Paper Selection" and says "the wet tensile strength of the toilet paper used appears to have profound implications for drainline carry. It appears that more study is required. To read the studies, visit the coalition website,

http://www.plumbingefficiencyresearchcoalition.org,

Fatberg. What is a fatberg? Wikipedia says, “a fatberg is a congealed mass in a sewer system formed by the combination of non-biodegradable solid matter, such as wet wipes, and congealed grease or cooking fat”. In September 2017, A fatberg of congealed fat, wet wipes, and waste was discovered under the streets of Baltimore, Maryland that caused the spillage of 1.2 million US gallons. In February 2019, a Fatberg weighing over 440 tons was discovered in Liverpool, England. The frequency of grease clogs can be lowered with proper grease abatement and by systems users not flushing wipes. Perhaps a study like those conducted by PERC will be done to examine how wipes, like toilet paper, affect the performance of sewer piping. Although oversized sewer piping doesn’t carry the same potential health risks as oversized water piping, it is something that continues to be investigated as more low flow fixtures are introduced into market, FOG programs are developed, and users continue to find new ways to abuse sewer system.

Natural Gas

Natural gas stinks, right? Not really. Natural gas in its native state is colorless and almost odorless. So why does it smell so bad even when there is a tiny gas leak? To protect customers, chemicals with a scent like rotten eggs is added to the natural gas by the utility provider. The most common chemical compound added is tert-butyl mercaptan, commonly referred to as just mercaptan. There are some conditions and situations that may cause the added odor to fade. Odor fade, also known as lack or loss of odorant, occurs due to physical or chemical processes. Adsorption is when the odorant attaches to the surface of a pipe wall. The largest the surface area the more likely odor fade will occur. New pipes are more susceptible to odor fade and utility contractors may precondition or “pickle” piping by saturating lines with odorant. Rust, moisture, and other substances in the pipe and as may also cause odor fade. Leaks in pipes, even those underground, can allow oxygen to enter system and the mercaptan to be oxidized. Low or intermittent use can also contribute to odor fade.

To prevent odor fade the plumbing designer should avoid oversizing piping and lengths of piping with low or intermittent use. A great example of oversized pipes along low and intermittent use is middle and high school science classrooms. Unlike college science labs that are shared by multiple classes and used frequently, middle school and high school classrooms act as the labs. It’s not uncommon for every science classroom to have a gas turret for each individual student. Despite all these gas outlets, students appear to spend most of their time in lecture, and when they use gas for labs they often do so in groups and do not use all the outlets. These labs typically aren’t used at all during seasonal breaks. Most schools are designed with gas service located near the majority of gas fired equipment. The meter is located outside a mechanical room, with boilers and water heaters inside, the kitchen is adjacent to mechanical room, and a gas generator is located nearby with other outdoor mechanical equipment. However, the science classrooms may be located at the opposite end of the school. This distance can be far as schools tend to build horizontally as opposed to vertically. Further adding to the problem is the requirement from some schools to only distribute low pressure gas (less than 14” water column). Lower pressure gas requires increasing pipe size to decrease pressure loss. The situation describes creates a perfect storm of long lengths of large diameter gas piping that is has low or intermittent use that may result in odor fade. To avoid danger the plumbing designer should go over risks with architect and owner. Solutions include changing locations of gas equipment, decreasing the number of gas connections, and using medium pressure gas (2 psi). Another solution may be to increase flow of gas by connecting a frequently used piece of gas equipment, such as a water heater, downstream of lesser used equipment. As the domestic production of natural gas continues to rise, designers can expect to see gas fired equipment being chosen over the electrical equivalent more often.

Conclusions

Oversized piping may contribute to health risks such as Legionella, sewage clogs, and odor fade. As time moves forward, plumbing fixtures and the use of plumbing systems changes, and new risks are discovered and studied. It is the plumbing designer's responsibility to respond appropriately to potential health risks and to not only design properly functioning systems but to protect the health of users.

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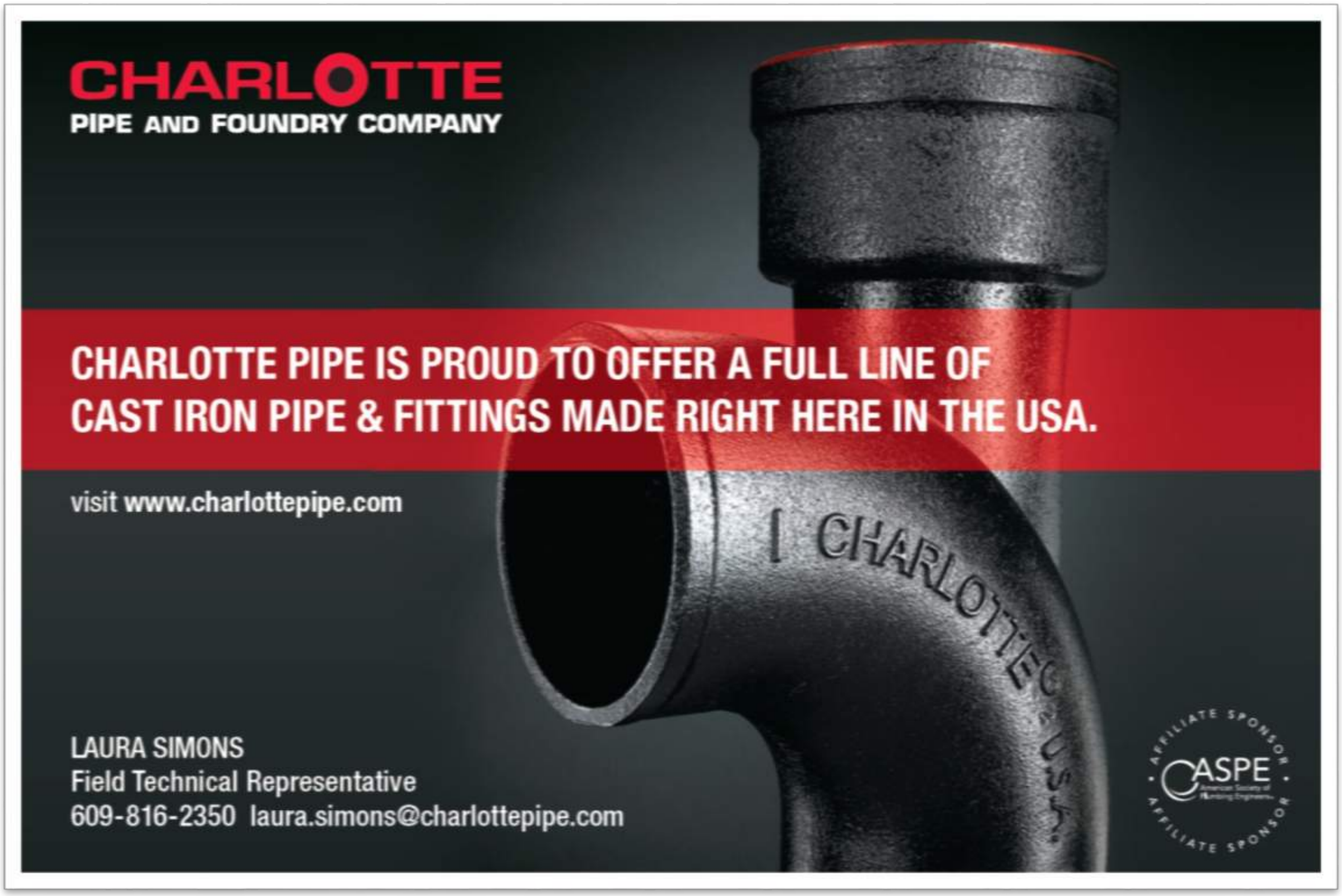
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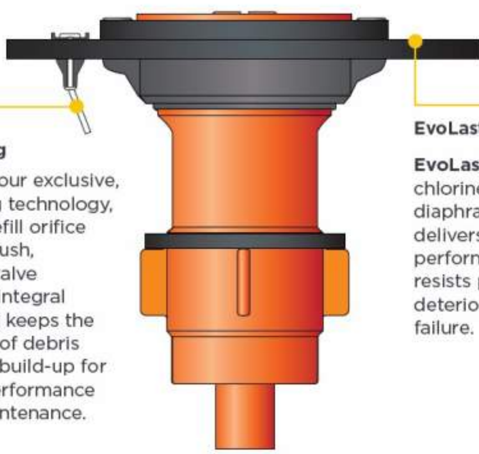

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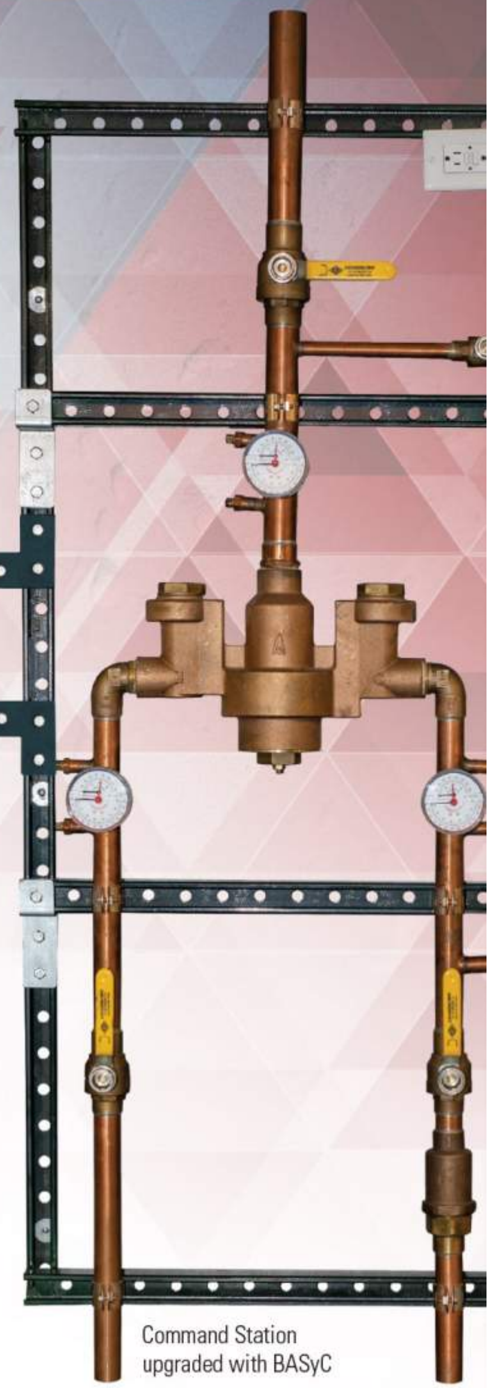

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GENERAC INDUSTRIAL POWER

Understanding the Dynamic Characteristics of Natural Gas Supply Systems for Emergency Standby Generator Sets; Why Pipe Volume Matters!

Engineers and Mechanical Contractors sometimes question why Generac's Installation Best Practices recommend at least 10 feet of gas pipe between the secondary (service) regulator and the generator gas inlet fitting. Natural gas regulators are feedback control systems and like all control loops, they have a characteristic response profile and time constant. Gas regulators are designed to be stable under a wide range of conditions, but instability can result when installation best practices are not followed.

One of the more difficult failure modes to understand and explain is the pressure instability that can occur when a gas service regulator is placed immediately outside the generator frame rail with limited pipe volume between the two. To help visualize the underlying system behavior, a physical model was constructed using MATLAB Simscape[i] to demonstrate the installation conditions that can lead to regulator instability.

The model in ***Figure 1*** (following page) has four main components, from left to right they are:

1. An infinite reservoir of natural gas at 2 PSI. This represents the natural gas supply from the utility.
2. The gas travels at 2 PSI through 50 feet of 2-inch supply main to the regulator serving the generator set. The regulator response characteristics are represented by a PID loop with a feedback delay. The delay represents the finite amount of time it takes the regulator valve to move from one operating point to another given changing flow conditions. The process variable for this control loop is the natural gas pressure on the low-pressure side of the regulator. While there has been extensive research done to model gas regulator behavior[ii], model parameters for commercially available gas regulators are not easily obtained. The model here represents just one of many possible regulator response characteristics and makes simplifications for the sake of computational efficiency.
3. A variable length of 4-inch diameter pipe connects the service regulator to the generator set. By adjusting this length of pipe, and consequently the gas volume between the regulator and generator set; it is possible to demonstrate how instability can be created in the system.
4. The generator fuel supply and throttle control system are represented as another PID loop with a feedback delay. In this case, the feedback delay represents the collective response time of the throttle control and the gas regulator onboard the generator set. The process variable for this control loop is the mass flow rate of natural gas into the generator set's engine.

The simulation occurs over a period of 15 seconds after the natural gas supply system is initialized at 15 inches of water column (w.c.).

At 0.5 seconds, the gas system initializes at 15" w.c., followed by the engine crank cycle at 3.0 seconds. The gas solenoid valve inside the generator set opens at 3.0 seconds and in a little over one second gas flow changes from 0 to 100%. Gas flows at 100% until 11 seconds, then idles for two seconds before shutting down. Remember, we're simulating the response of the gas system only; it is possible to adequately observe gas system behavior over a shorter time span than if we were actually starting and running the engine.

Figure 1: MATLAB Simscape Model, natural gas regulator and piping to generator set.

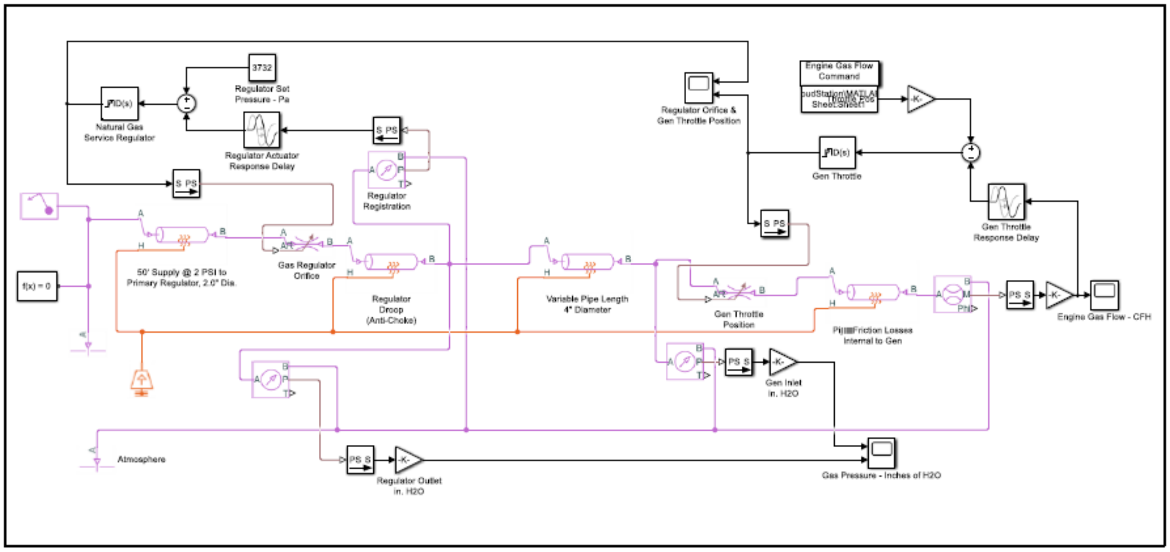
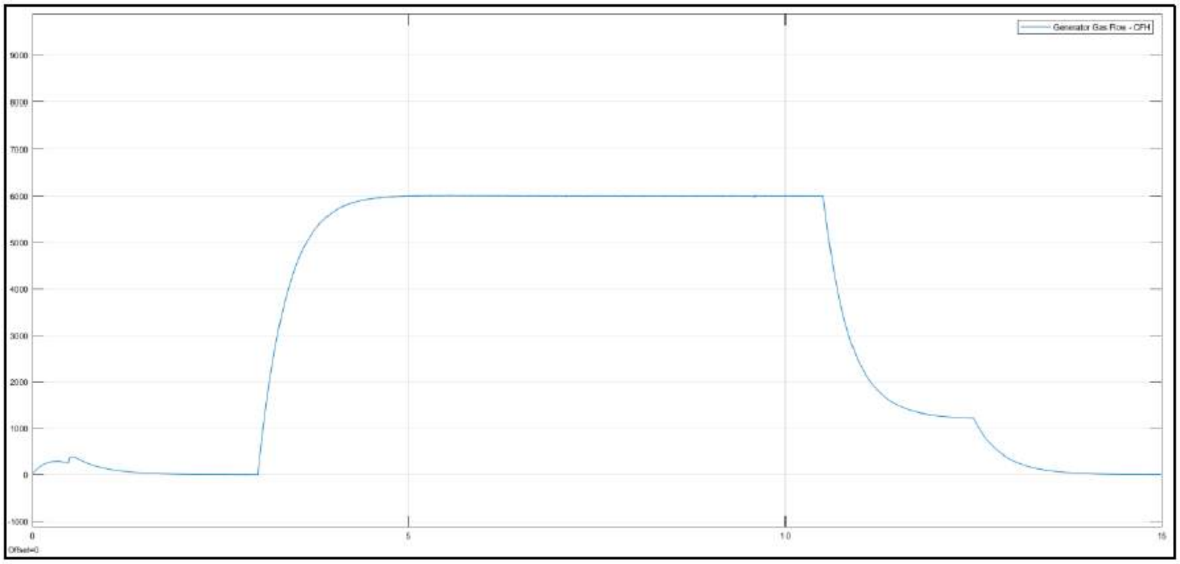


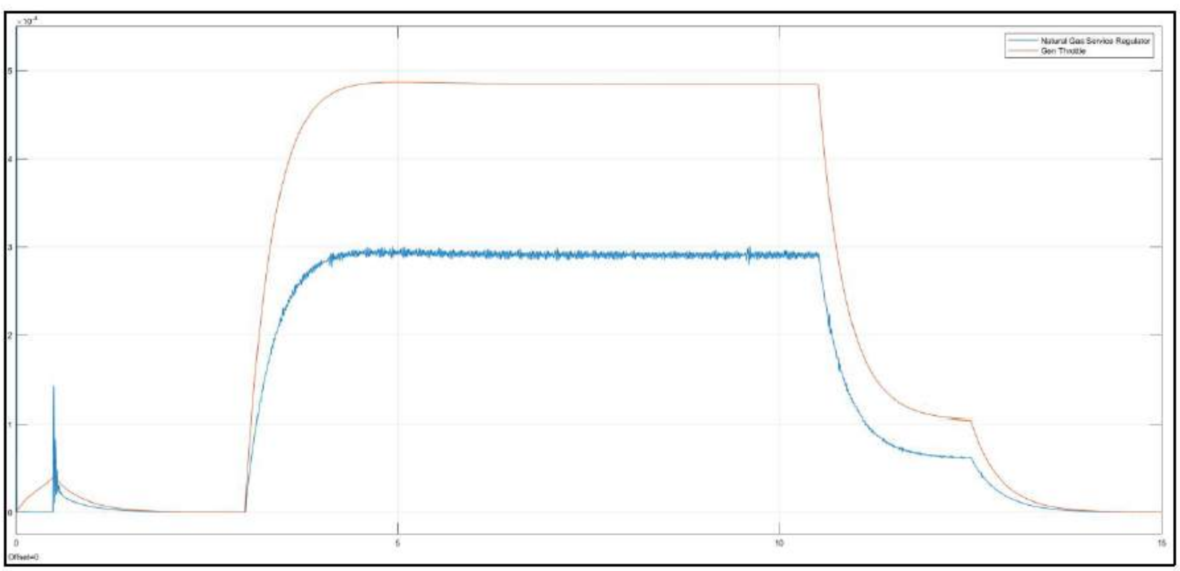
Figure 2 shows stable gas flow into the generator. The model is set up to control for mass flow rate, it's not looking to regulate pressure into the generator; that's the job of the upstream service regulator.

Figure 2: Gas flow into engine, cubic feet per hour (CFH).



With 10 feet of 4" diameter pipe, the system is stable. ***Figure 3*** shows the orifice valve position for the gas regulator (blue) and the generator throttle position (orange). In control system terminology, the curves below are the outputs of the respective PID controllers; the manipulated variables. The generator "throttle position" approximates the combined response of the internal gas pressure regulator and the throttle body actuator.

Figure 3: Gas regulator and generator throttle position PID control outputs.



While they are too small to be visible as pressure variations on a gas manometer, the natural gas regulator valve is always moving in small increments in response to changes in the system. The blue trace above shows the very small variations in the valve position on the natural gas service regulator. The orange trace is the generator throttle position, or more formally, the natural gas mass flow rate demanded by the engine.

Natural gas flow into the generator set is controlled by the generator fuel system and demand can change very quickly in response to load step changes on the generator. The stability of gas flow into the generator depends in turn on the stability of the gas supply pressure which is controlled by the service regulator; a separate control loop itself. Without sufficient damping between the two control loops, unstable conditions can result. *The pipe run between the regulator and the generator is the damper.*

At this point we can see why having a sufficient pipe volume between the service regulator and the generator set is critical. On the initial model run, 10-feet of 4-inch diameter pipe connects the service regulator to the generator set. ***Figure 4*** shows the initial pressure dip when the gas solenoid valve opens on the generator set followed by the pressure recovery, slight overshoot, and then very small pressure variances during steady state operation at 100% gas flow. The orange trace shows the gas pressure at the downstream side of the service regulator. The blue trace shows the gas pressure at the frame rail of the generator set. The pressure difference between the two represents the friction loss of the pipe run.

Figure 4: Gas pressure at regulator outlet and generator inlet, inches water column.

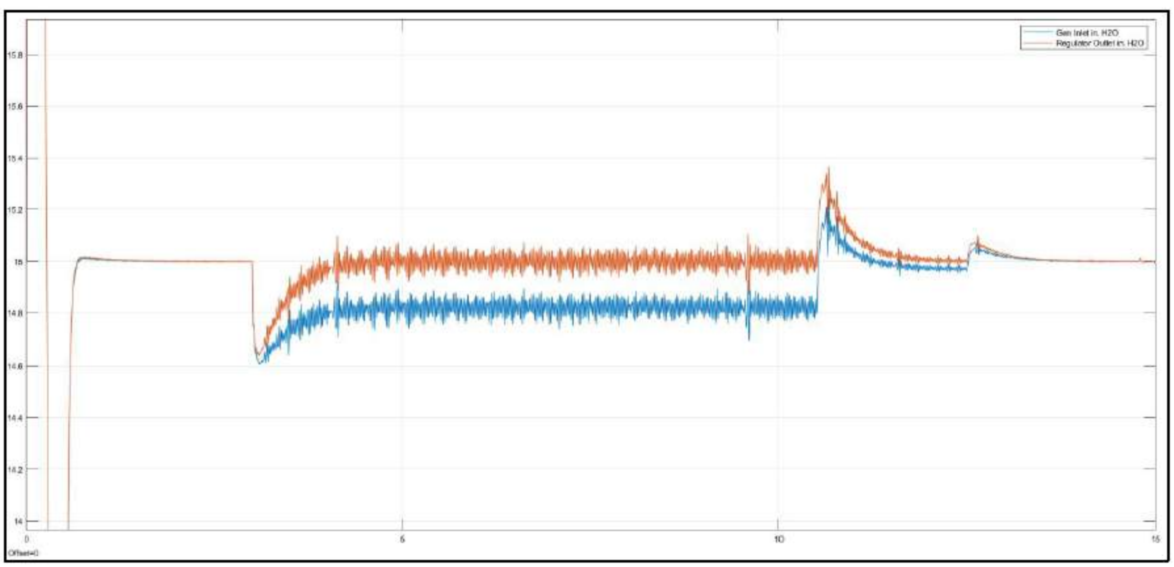


Figure 4 would be characterized as stable operation. The system is delivering the maximum gas flow to the generator set with minimal pressure drop while maintaining a stable operating pressure. The small pressure variations visible on the graph are on the order of +/- 0.1 inch w.c. and would not present a problem for proper operation of the engine nor would they be detectable on a handheld manometer.

Figure 5: Losing control, gas pressure variation with reduced gas pipe volume (6.3 feet).

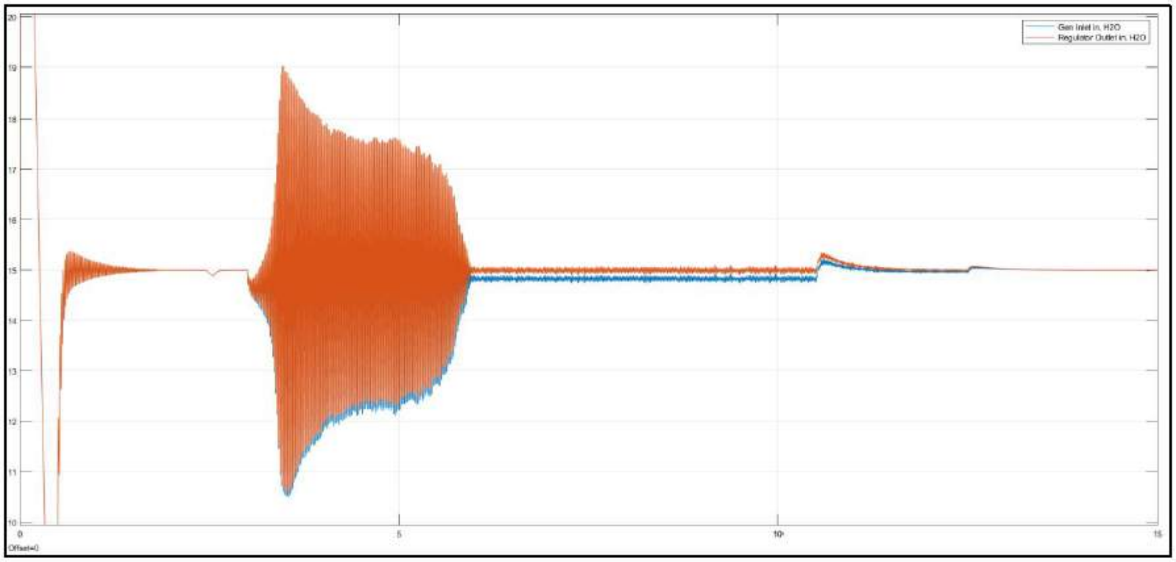
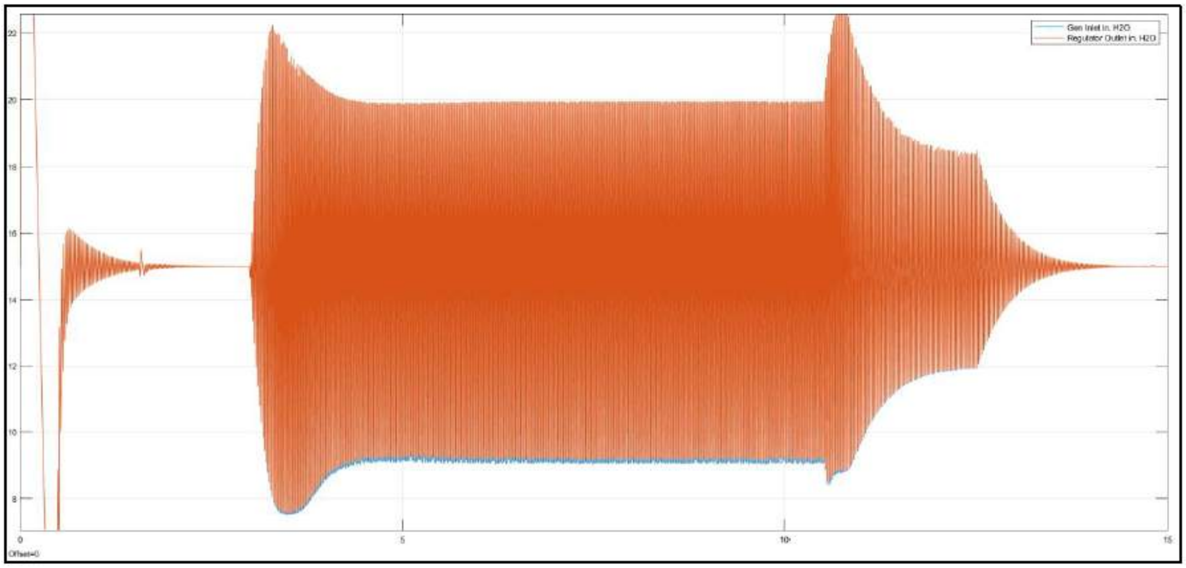


Figure 5 illustrates instability that can occur when the pipe volume between the service regulator and the generator is reduced, resulting in a tighter (and difficult to predict) coupling between the two control loops. For this particular regulator, the system is on the edge of stability when the pipe connecting the service regulator to the generator set is reduced in length to 6.3 feet. Gas pressure swings from 10.5" – 19" w.c. from the time the engine first begins cranking until about the six second mark. The engine may start under this borderline unstable condition, but it would be characterized by an extended crank cycle, and at least several seconds of engine speed variation, assuming the oscillations settled out. Even though the system regains stability in this simulation, it is likely that subsequent changes in gas demand would cause further instability and erratic engine operation. A system in this condition would not be considered stable.

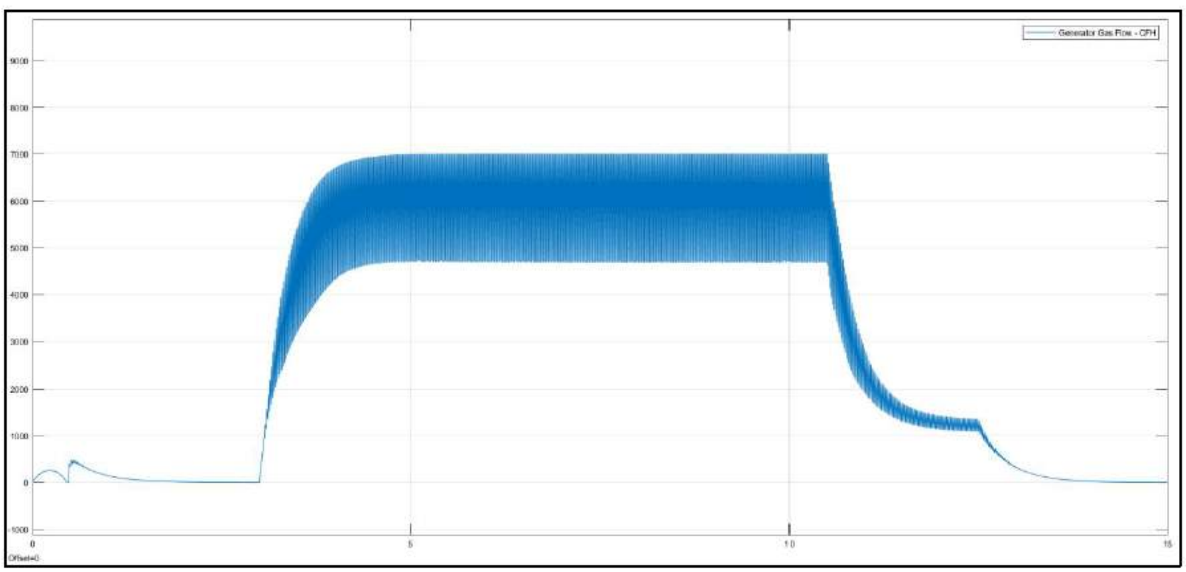
Reducing the pipe volume further, in this case to 4 feet in length, results in consistently unstable conditions that do not settle out. ***Figure 6*** shows pressure variations between 7.5" – 22" w.c. The service regulator and generator throttle control systems are too tightly coupled and have become completely unstable. Both control loops are trying to achieve a stable operating point. However, since there is insufficient damping between the two (too little pipe volume), they end up working against each other resulting in instability. In the field, this situation would be characterized by multiple generator crank cycle failures and over-crank lockout. If the engine was able to start, it would operate erratically and most likely would not be able to deliver rated output power.

Figure 6: Gas pressure instability created by further reducing pipe volume (4 feet).



The gas pressure instability at the inlet of the generator set makes it impossible for the generator set's throttle control system to provide a consistent natural gas mass flow rate into the engine. Recall the Generac SG500 requires approximately 6,000 CFH of natural gas at full load. ***Figure 7*** shows the unstable mass flow rate varying between 4,500 – 7,000 CFH. Again, if the engine were able to start, it would be unstable and may shut down automatically due to an over/under speed condition or low gas pressure.

Figure 7: Unstable gas flow into engine, CFH.



Summary:

Natural gas generator sets are highly reliable and easier to maintain then their diesel counterparts. Challenges remain in characterizing the dynamic behavior of the natural gas supply systems. The variable performance of regulator models from many different manufacturers, the often-unpredictable installation conditions that can depart from what the design engineer or mechanical contractor had in mind, and the difficulty of validating system performance through simulation prior to construction are obstacles the industry is still working to overcome. However, once a system is proven stable, it almost never experiences another gas stability problem in the future.
Following industry and manufacturer best practices can avoid many problems in the field:

- Consult natural gas regulator manufacturer representatives for recommendations on a model that is appropriate for the application. Emergency generators require a gas regulator with fast response, low pressure droop, and dead-end lockup to prevent pressure creep when the generator set is not running.
- Size piping appropriately to obtain no more than 1" – 2" w.c. pressure drop at the generator set gas pressure test port while operating at 100% load. Remember, with a generator set it's about maintaining pressure while flowing the maximum volume of gas! Use vendor provided design tools such as Generac's Power Design Pro[iii], which includes a gas pipe sizing module, to assist with your design.
- Ensure there is sufficient pipe volume between the service regulator and the generator frame rail. Sources vary on the recommended minimum pipe volume; some suggest a length of "at least 10 pipe diameters." For example, on a regulator with a 3" diameter pipe flange, at least 30 inches of pipe is recommended to minimize the probability of unstable system operation. Generac recommends at least 10 feet of pipe run to account for the widest possible range of regulator characteristics and operating conditions.
- Avoid pipe swages and elbows immediately before or after an external pressure registration line. If an external registration line is used on a regulator, it should be installed at the midpoint of the longest straight run of the largest diameter pipe.
- Avoid elbows immediately before and after a regulator. Ideally, there should be at least 10 pipe diameters of straight pipe run before and after a regulator. If field conditions prohibit meeting both objectives, put the elbow on the upstream (high pressure) side of the regulator. The straight run on the low-pressure side is especially important for accurate pressure control.

About the author:

Mike Hainzl joined Generac Power Systems in 2015 as a Power Solutions Manager supporting the Northeast US and Atlantic Canada.

Hainzl brings over 23 years of experience from the telecom industry where he held positions in RF and Facilities Engineering, Field Operations, and Business Continuity Management. He has managed fixed and mobile generator fleets for national telecom providers and coordinated emergency power restoration following major events like Hurricanes Katrina, Irene, and Sandy.

Hainzl developed techniques to improve operational readiness of telecom emergency generator assets through remote monitoring, automated reporting and triage. Failure mode and risk analysis provided quantitative data for capital and maintenance budgeting.

Hainzl holds a BS in Electrical Engineering, MS in Engineering Management, and MS in Emergency Management and Business Continuity; all from New Jersey Institute of Technology. He earned the Certified Business Continuity Professional (CBCP) designation from DRII in 2009.

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[i] https://www.mathworks.com/

[ii] Stability Study and Modelling of a Pilot Controlled Regulator; doi:10.4236/msa.2011.27116 Published Online July 2011; http://www.SciRP.org/journal/msa

Dynamic Modeling and Analysis of a High Pressure Regulator; http://dx.doi.org/10.1155/2016/1307181

Stability of Gas Pressure Regulators, doi:10.1016/j.apm.2006.11.003

Causes and Cures of Regulator Instability; William Earney, Fisher Controls International.

Stability Evaluation of Gas Pressure Regulator by Frequency Response Test; Takeuchi, Toriumi, Kagawa. http://docplayer.net/35139392-Stability-evaluation-of-gas-pressure-regulator-by-frequency-response-test.html

Development of a pressure pulsation damper for gas pressure regulators with account of operation parameters; doi: 10.1016/j.proeng.2015.06.036

[iii] https://www.generac.com/industrial/engineer-resources/power-design-pro


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Brian Crisp, CPD
Vice President - Membership

Membership Report

Another meeting in the books! I'd like to thank all the guys from WSSC for joining us last month. It's always good to "tap" into their "well" of knowledge *wink wink*. Good job to our new board lineup, I thought our first meeting of the year went swimmingly.

We also have a couple new members for the month of October, as Baltimore remains a growing chapter:

Richard Lee - Kibart
David Becker – Chesapeake Systems

Please join me in welcoming them to our chapter, I think an adult beverage and a chat at the September meeting would be a good start.

This month I'd like to highlight some of the benefits of membership:

- ASPE Pipeline: The Society's biweekly e-newsletter contains news and views about the events, activities, and issues impacting the plumbing engineering profession and the industry.
  - For me, this is a one-stop shop to staying connected with what's going on in the plumbing industry.
- ASPE Connect: This is a great new resource that every member can take advantage of. If you're working on something that's new to you or want another opinion you can simply ask the community for their thoughts on the topic and you will get instant feedback.

If you or anyone you know is interested in joining, or at least hearing about the benefits of membership, please don't hesitate to reach out to me. You can also join directly at https://www.aspe.org/join.

Thanks, and see you at the meetings!

Brian Crisp, CPD
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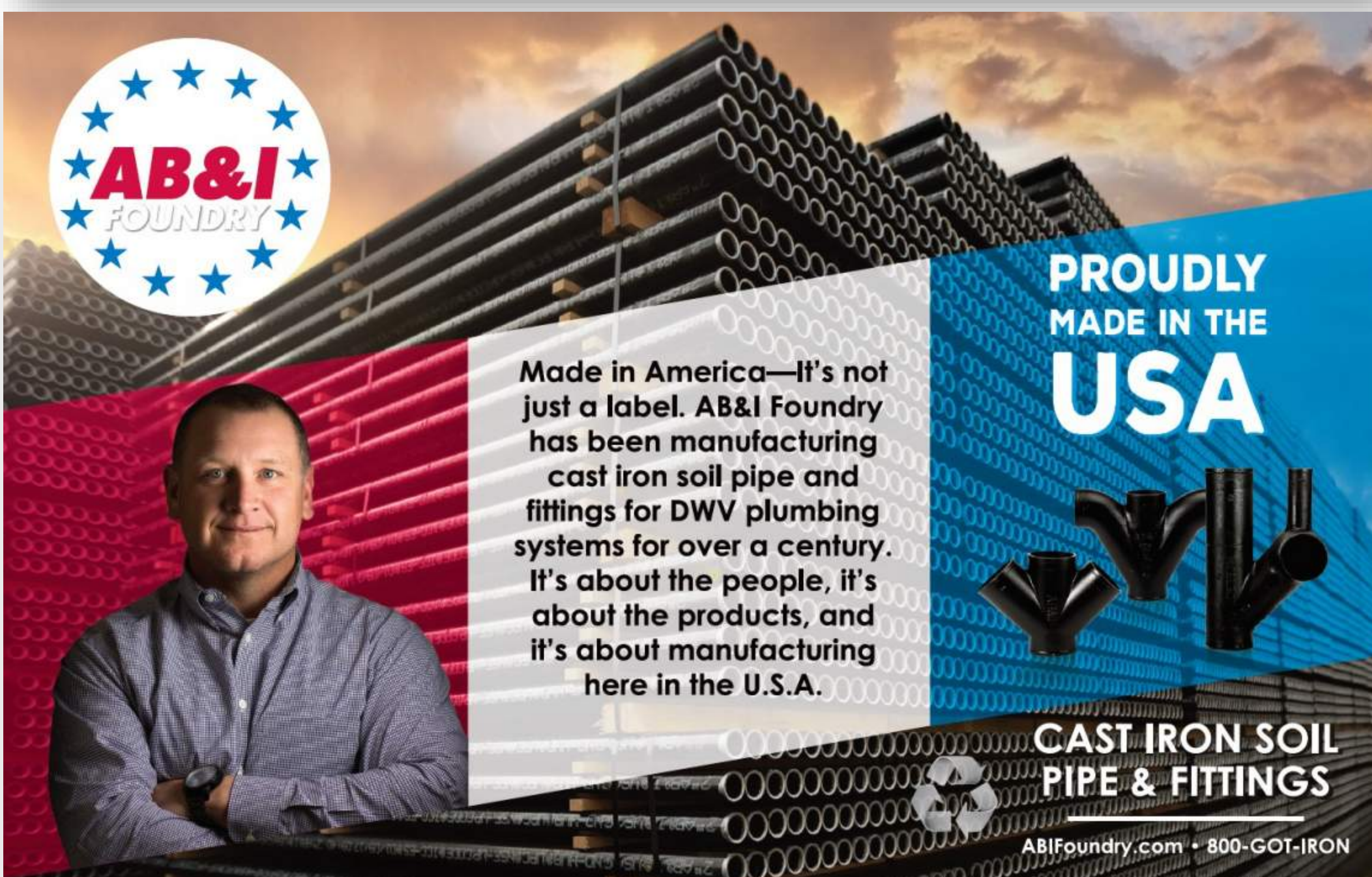
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2019-2020 ASPE Baltimore Chapter Meeting Schedule

Date: **September 25, 2019**
Speaker: WSSC
Topic: Cross Contamination Control

Date: **October 23, 2019**
Speaker: Generac
Topic: Natural Gas Sizing for Emergency Generators

Date: **November 20, 2019**
Speaker: Viega
Topic: Opportunistic Pathogens 101

Date: **December 13, 2019**
Event: Holiday Party
Location: Mustang Alley's

Date: **January 22, 2020**
Speaker: McShane PC
Topic: Professional Ethics in Engineering

Date: **February 26, 2020**
Speaker: Professor Kenneth Isman—UMCP
Topic: Importance of Fire Protection Hydraulic Calcs

Date: **March 25, 2020**
Speaker: PVI
Topic: Water Heater Sizing, Construction, and Efficiency

Date: **April 22, 2020**
Speaker: Charlotte Pipe
Topic: Cast Iron Pipe

Date: **April 24, 2020**
Event: Golf Outing
Location: The Timbers at Troy

Date: **May 27, 2020**
Speaker: Watts
Topic: Automatic Control and Pressure Reducing Valves

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Monthly Sponsorship Opportunities

The Baltimore Chapter of ASPE continues to have successful meetings and is looking to continue improving throughout the year.

The Chapter has the following sponsorship opportunities for each month:

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