

Columbia Gas of Ohio - Zanesville Regulator Failure

Low Pressure MAOP Excursion – May 9, 2019

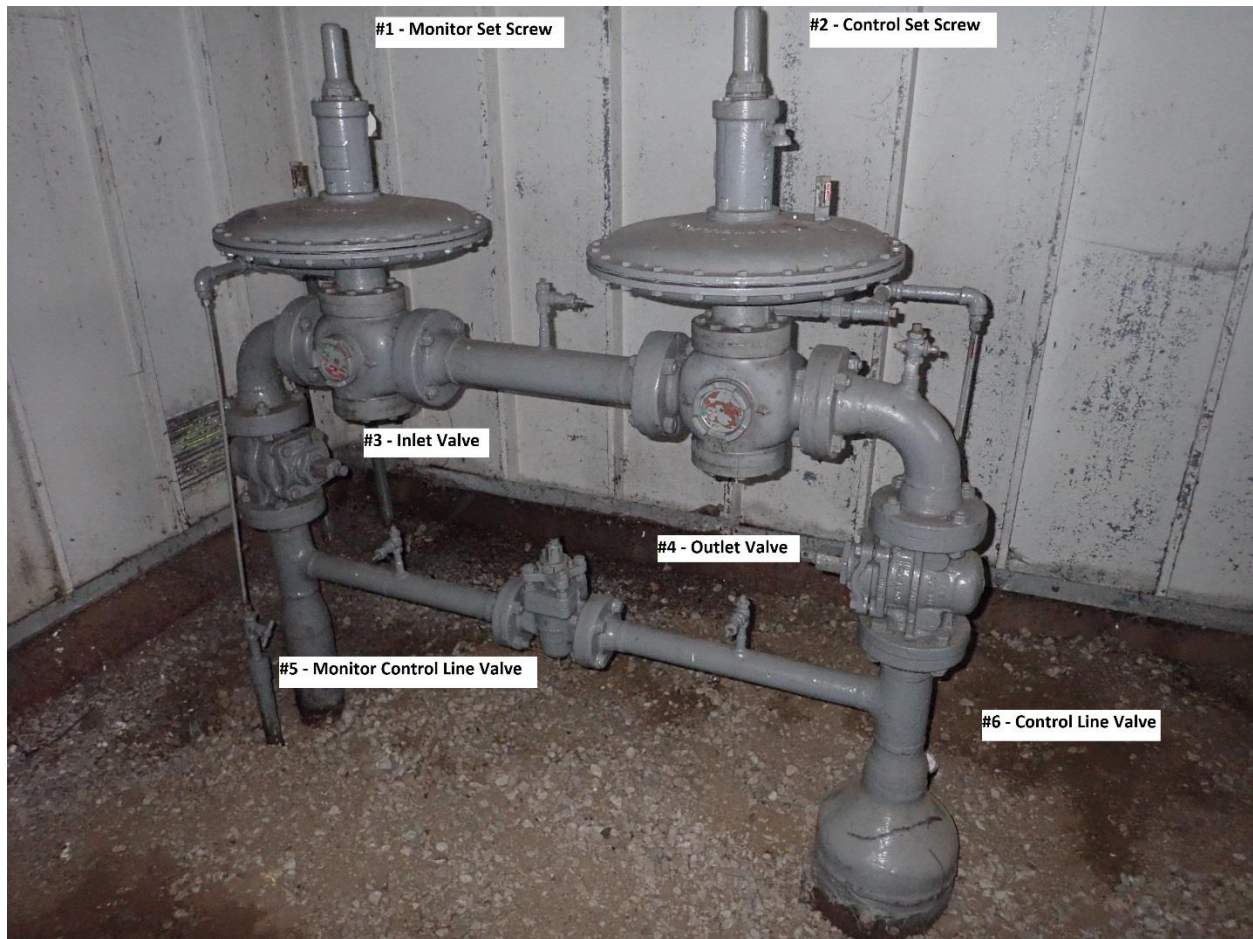
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I. Background

Columbia Gas of Ohio, Inc. ("COH") provides natural gas service to more than 1.38 million customers through 20,011 miles of pipeline. Columbia Gas is a natural gas company subject to the jurisdiction of the Public Utilities Commission of Ohio ("PUCO") under Title 49 of the Ohio Revised Code and rules adopted by the PUCO in the Ohio Administrative Code.

COH has approximately 823 low pressure regulator stations feeding into 378 low pressure systems.

II. Summary Events Caused Low Pressure MAOP Excursion



This low pressure regulator is located in Zanesville, Ohio and is one of the two regulator stations feeding into the system, where the operator had a maximum allowable operating pressure ("MAOP") excursion. This station is called the Muskingum Station (DR-14/Premise #401708). The Indiana Station (DR-35/Premise #401715) was operated and the location where the control line valves were shut, but this Muskingum Station photo is a clone to the Indiana Station. The parts of the regulator station are numbered to help explain what actions the Measurement and Regulations ("M&R Tech") performed to cause the MAOP excursion.

On Thursday, May 9th, I performed the verbal interview with the M&R Tech and he stated, he did not turn valves #5 or #6. On Saturday, May 11th, he retracted his original statement to Columbia personnel and said he did operate and shut valves #5 and #6 (Control line valves to monitor and control regulators).

Per conversation with Columbia personnel and written statement by the M&R Tech, the M&R Tech operated the set screw (#2) and ran it up to stop the flow of gas; he then proceeded to operate set screw (#1) on the monitor and ran it up. This would take the force off of the spring, which removes the force from the top of the diaphragm. The control line pressure which is downstream of the regulator, applies pressure to the bottom of the diaphragm. The pressure would push the diaphragm up and close the seat to the orifice, which stops the flow of gas. The tech. then shut the inlet valve (#3) and then shut the outlet valve (#4). The tech. then blew down the top works of the regulator station. This station was shut off for around 30 to 40 minutes. The tech. then shut the control line valve (#6) and then shut the monitor control line valve (#5). When the Indiana station was shut down, this made the Muskingum Station supply gas feed to the entire low pressure system. This was part of a monitor regulator replacement from the results of the Massachusetts over-pressurization. If the Muskingum Station could supply the feed, then the M&R tech did not have to put the Indiana Station on by-pass during the monitor rebuild.

Once the 30 to 40 minutes passed, the tech. was convinced the Muskingum Station could feed the low pressure system without putting the Indiana Station on by-pass. The M&R tech started introducing natural gas back into the Indiana Station, he had a gauge downstream to observe the pressure. The tech slowly opened the inlet valve (#3) and then slowly opened the outlet valve (#4), then adjusted the set screws on the top of the monitor (#1) and control (#2) regulators and observed the downstream pressure.

The M&R tech then went to lunch and received a call about an hour into this lunch, there was a possible over-pressurization on the low pressure system.

The M&R tech forgot to open the monitor control line valve (#5) and the control line valve (#6), which trapped the natural gas between the closed control line valves and the bottom part of the diaphragm of the regulators. This trapped downstream pressure is what causes the diaphragm not to move from the existing spring tension and applied a constant gas flow and pressure. This created a false sensing pressure for the monitor and control regulators, which caused the MAOP Excursion (refer to VIII – Written Statements).

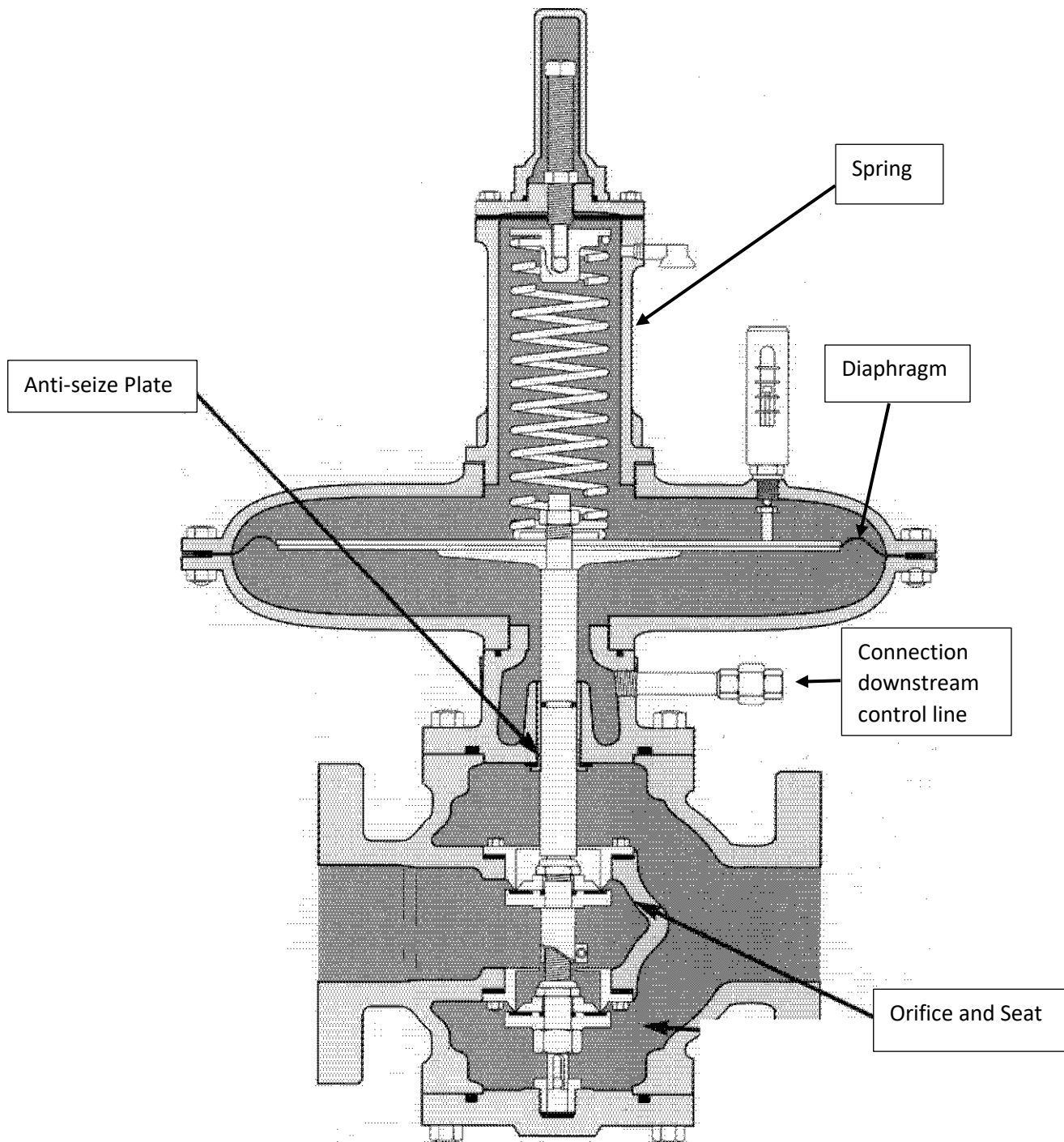
III. Regulator Characteristics

The Indiana Station and the Muskingum Station had monitor and control regulators called Rockwell 441-S. These self operated regulators have 3 key elements:

1. **Restricting Element (Valve)** – The restricting element is always some type of valve that can be opened and closed to increase or decrease flow. The valve will typically consist of an orifice and a valve seat. Most regulators have soft-seated valves to give 100% shut-off when it is required.
2. **Measuring Element (Diaphragm)** – The measuring element measures the outlet or downstream pressure and compares it with the desired pressure to determine if a change in flow is necessary. The measuring element may be a manometer, bourdon tube, bellows, or a diaphragm. All of these measuring elements respond to a pressure change to give an indication of some kind. In gas regulation work, the diaphragm is by far the most common. The downstream pressure is what causes the diaphragm to move up against the spring tension closing the valve or down with the spring tension opening the valve, adjusting gas flow and pressure.
3. **Loading Element (Spring)** – The loading element must be able to exert a force like a weight acting downward, a spring under compression, or a diaphragm with pressure on it. The loading element will be a weight, spring, or pressure. Today, springs are used instead of weights. It is recommended that a spring be used in the upper 50% of its range. This allows for spring compression even at high flow which translates into lower droop or proportional band.

Additional Information of Self Operated Regulator – The spring compression works to push down and open the valve; the primary valve opening force in a spring regulator comes from the spring. The diaphragm works to close the valve; the primary valve closing force in a spring regulator comes from the outlet pressure acting against the effective area of the diaphragm. An increase in outlet pressure greater than the spring, causes the valve to close. Conversely, a decrease in the outlet pressure less than the spring, causes the spring force to open the valve. The set-point (the outlet pressure a regulator is adjusted to deliver) is adjusted by the spring compression. Turning the set-point adjustment clockwise increases the spring compression, which in turn increases the set-point pressure, and vice versa. The **control lines** provide the regulator measuring device with a more accurate indication of the downstream system pressure. Any external control or sensing line should originate at a location on the station piping downstream of all regulators and the station setting outlet valve. The location should be in an area of low turbulence and the tubing should include a valve for ease of shut-off and maintenance. All regulators that require an external control line connection must have a separate tap on the downstream piping. The control lines should never be placed or tapped on the bypass piping.

Below is a side view diagram of a Rockwell 441S Regulator:



IV. Timeline – Public Utilities Commission of Ohio – Lead Gas Pipeline Safety Investigator

On Thursday, May 9, 2019 I was dispatched to Zanesville, Ohio at 3:30pm EST for an over-pressurization on a low pressure (“LP”) system. The operator was Columbia Gas of Ohio (“COH”). The low pressure station names were Indiana Street LP Station and Muskingum Street LP Station. The two LP stations were operating at a downstream pressure of 12.5 inches of water column (“wc”). The upstream pressure feeding the LP stations were 35 pounds per square inch gauge (“psig”). I called Columbia Gas and asked the operator to not tear down the regulators until I was on site, because I wanted to see a bubble-tight lock-up from each regulator station.

I arrived on the scene around 4:30pm EST and received an update of the events that took place. Prior to my edict to stand-down, the Measurement and Regulation (“M&R”) group had worked on modifying low pressure stations and performed some operational work to the Indiana LP Station at 11:30am EST. The reason for the operational check on the Indiana Station, the operator was planning on installing new monitor regulators (Pietro Fiorentini Regulators) with slam shuts to help prevent over-pressuring. When the operational work was finished the M&R group at 12:00pm EST went to lunch. Around 30 minutes later at 12:30pm EST, a service technician (“tech”) was dispatched to 622 Munson Avenue (residential customer) about no gas to the appliances. The service tech arrived at the house and verified the cooking range was not working, then went to the hot water tank (“hwt”) and turned the temperature control to a higher temperature setting to see if the hwt would turn the burner on to increase the temperature. The service tech said the burner did turn on and he noticed improper flame characteristics. The service tech then went to the meter set and put his Kuhlman gauge (water manometer used to testing and checking pressures) on the inlet meter tail and had all 3 valves open (which means it was set for inches of water column) and the Kuhlman gauge blew out the fluid. The tech called a Field Operations Leader (“FOL”) and informed him on the situation. The tech went to 767 Pine Street, which was near the low pressure regulator station and checked the pressure at the inlet meter tail with his Kuhlman gauge set to psig. The Kuhlman gauge registered to 4.5 psig. The service tech called the FOL at 1:16pm EST and they advised the service tech to shut off the inlet valves to the LP stations at the Indiana Station and the Muskingum Station (refer to VIII – Written Statement).

I asked the M&R group if they operated the control line valves and they said, “No”. I then witnessed the bubble-tight lockup (the tension is off of the spring to the regulator; false pressure is applied to bottom of diaphragm; an outlet port opening is unplugged; outlet downstream block valve is closed; and inlet pressure is applied to regulator) for both the monitor and control regulators for both stations. The regulators all passed and stroked up and down (operational check) without any sticking or delay. When the M&R tech started performing the tear-down, I noticed an oil similar to production fluid inside of the Indiana Station regulators. I also noticed oil inside of the control line near the snubber (1/16” orifice in control line that helps remove turbulent gas streams and connects to the bottom of the regulator diaphragm pan). The tear down of the Muskingum Station monitor regulator had oil in the bottom of the diaphragm pan and both of the regulators had some plug valve grease. Both low pressure regulator stations had a chart recorder with an element range from 0 – 25” wc and both stations exceeded the limits of the chart recorder (refer to VII – Photo Documentation).

I also asked if any construction had taken place in the area and I was advised by Don Ayers (Director of Construction) there had not been any work in the area.

The area manager for COH Three Rivers was on scene and mentioned this system did receive production gas at one time and was known to have water and fluids in the system from time to time.

On Monday, May 13, 2019 I performed a follow-up in Zanesville to check the progress on the relights and see if the operator identified any new information. I found out the M&R tech admitted fault in the low pressure MAOP excursion in Zanesville, Ohio. This individual is currently being interviewed by Columbia company officials and they will give me a written statement. It was mentioned this individual did turn the control line valves to the off position and did not return the control line valves back to the open position after the operational exercise and then went to lunch.

I also observed the turn-on process to one residential customer at 313 Abington Ave in Zanesville, Ohio. The operator established a process to validate each appliance control to ensure it is safe and works properly. The operator performs a pressure testing on the houseline piping, repairs leaks if found; then have a HVAC tech perform a pressure safety check on each appliance control (appliance controls must meet the ANSI Z21 standard (referenced below), which the maximum safe pressure is 2.5 psig); if the appliance control passes, then the HVAC tech ignites the burners and then pressure checks the appliance controls again to make sure it is in the correct range (usually a 4 count with the pressure holding and not fluctuating or by performing a gas meter appliance clocking test); the operator also reviews all inside piping and appliance information to make sure everything follows in the National Fuel Gas Code and International Fuel Gas Code.

ANSI Z21 Standard – House Appliance Controls

In addition, T_s shall not be greater than $T_y + 1$ minute. After 1 second of gas flow, the differential outlet pressure shall not exceed 120 percent of P_{y-SS} .

Only the values determined from curves developed under similar test conditions (i.e., without a vent limiter or with the same vent limiter) shall be compared.

Figure 12, Integrity of Operation Curve, is an example of this curve when $P_{y-SS} = P_{y-SS}$ and $T_y = T_s$.

2.11 Resistance To Permanent Damage At Excessive Supply Pressure

A control shall operate as intended at normal inlet test pressure after each function has been subjected to an excessive inlet pressure of $2\frac{1}{2}$ psi (17.2 kPa). If necessary, the control may be reset to restore operation after exposure to the $2\frac{1}{2}$ psi (17.2 kPa) test pressure.

a. A separate sample shall be used for this test. If the control incorporates a pressure regulator or an automatic gas valve which fully opens in one second or greater, a base curve showing control opening characteristics shall be developed by recording outlet pressure versus time. If the control includes a pressure regulator, it shall be set at the minimum specified outlet pressure at a flow rate equivalent to the midpoint of the specified range of regulation capacity and with an inlet pressure 2.0 in wc (498 Pa) above the minimum specified outlet pressure. If the control does not include a pressure regulator, the flow rate shall be 10 percent of the 1 in pressure drop capacity.

This curve shall be developed with the control at room temperature and mounted in the manufacturer's upright position.

The following points shall then be determined by examination of the curve:

- | | | |
|------------|---|---|
| P_{y-1} | = | Outlet pressure at 1 second of gas flow. |
| P_{y-2} | = | Outlet pressure at 2 seconds of gas flow. |
| P_{y-3} | = | Outlet pressure at 3 seconds of gas flow. |
| P_{y-4} | = | Outlet pressure at 4 seconds of gas flow. |
| P_{y-SS} | = | Steady state outlet pressure. |
| T_s | = | Time at which the curve crosses either 90 percent of P_{y-SS} or 110 percent of P_{y-SS} and remains within these limits. |

If the control incorporates an integral gas valve thermostat function, it shall be tested for Accuracy of Temperature Set Point, at the calibration reference point only, as specified in 2.13.1 prior to the conduct of this test.

b. The control shall then be subjected to the manufacturer's minimum specified ambient temperature. An inlet pressure of $2\frac{1}{2}$ psi (17.2 kPa) shall be instantaneously applied to the control with all functions closed and held for one minute. The inlet test pressure shall then be lowered to zero psi. Each function shall be opened separately and subjected instantaneously to the inlet test pressure of $2\frac{1}{2}$ psi (17.2 kPa). This pressure shall be held for 1 minute and then returned to zero psi before opening the next function. The sequence of separately testing each function shall be in accordance with the control's normal operating mode until all functions have been opened.

V. Timeline Columbia Gas of Ohio

Time Line of events: Zanesville service failure/OP

5/9/2019 Thursday

Time	Description
10:45	Arrived Onsite at DR 35 @ Indiana/Pine Streets in Zanesville. PPE - fire bottle/hardhat/sensit/bag/o2monitor/bypass wrench/prejob form/CGI'd then Const Coord SC and M&R Tech BH went into station; identified size and space for reg. M&R Tech BH shutoff wall chart and installed LP spring gauge. Backed off control regulator (left nut location) (pressure dropped from 12.5 to 12.3) Waited another 10 minutes - no change.
11:00	M&R Tech KS called to discuss an inspection and new job.
11:30	(time is approximate) Const Coord SC said the crew was on the way. M&R Tech BH shut off inlet block/outlet block, broke & failed the control lines then tightened the control lines. Waited another 10 minutes - no change.
11:45	Const Coord SC said the guys were going to lunch. M&R Tech BH did not want to leave the station off while gone so he turned the inlet/outlet block back on (no flow). M&R Tech BH ran the jackbolt back down to original set point 12.5" locked the nut and waited approx. 10 minutes.
12:00	M&R tech BH got off the phone, checked the chart one more time, locked the door and got in Const. Coord SC truck to go to lunch.
12:07	M&R tech BH texted M&R Tech MG to confirm the station at Indiana/Pine (DR35) is M&R Tech JN's station and M&R tech BH and Const Coord SC were working at the Indiana Station, but had left for lunch.
12:30	El order is taken
	Service Tech SW onsite at 622 Munson Ave. Upon arrival, verified range not working. When downstairs checked water tank, noticed improper flame characteristics. Went to van to get Kuhlman gauge, turned off meter valve, dropped meter, hooked up test fitting to inlet of setting. Blew fluid out of gauge on inches of water column. Turn meter valve off, secured setting, advised customer will return and went to reg building on
12:44	Indiana/Munson/Pine (DR35)
13:05	Service Tech SW called Field Operations Leader (FOL) SS, informed him and requested instruction on what to turn off.
13:12	Service Tech SW found the chart was pegged at DR 35. Called FOL SS and went back to 767 Pine St. and dropped meter and verified 4.5 pounds on
13:16	Kuhlman gauge that was later determined to be 3.8 pounds when compared to the Heise gauge. FOL SS informed me of inlet valve at DR 35 reg building and 2nd LP inlet valve at DR 14 reg building.
13:16	Service Tech SW turned DR 35 station off and went to DR 14 station and turned off LP inlet and installed stand to blow down LP system.
13:25	
13:18	M&R Tech BH received a call from M&R Tech MH at that Zanesville LP system had gone up to 4# so Const. Coord SC and M&R Tech BH immediately left to investigate.
13:28	Service Tech SW started blowing the DR 14 station down. It took approximately 10 minutes for the station to blow down. Building and setting secured.

5/9/2019 Thursday

Time	Description
13:29	M&R Tech BH called M&R Tech JN and advised the LP system had gone up and asked him and M&R Tech MG to assist.
13:35	M&R Tech BH arrived onsite at DR 35, unlocked the door and immediately checked the gauge - it was off the chart. Noticed the station was quiet and inlet block was off - shut off outlet block, grabbed Heise and verified pressure (0.6# and falling). Removed the LP spring gauge and installed MP spring gauge to verify I had the correct reading. Chart came down to 13" and stopped. Continued to watch the Heise gauge fall when Service Tech SW got onsite and talked to Const. Coord SC. I then double checked all the valve positions and noticed that I had left the sense lines off and realized what had happened. I turned the control lines back on and walked out of the station to talk to Service Tech SW. I ask the service tech what had happened, what he saw, where he went, who he contacted and what pressure he saw. I was aware Service Tech SW shut off the inlet block valve. Service Tech SW said the pressure went up to 4.5# on his Kuhlman gauge. He went in and shut off the inlet block and went to the other station (per engineering request) and shut in the Musky station. We went back into the station to verify that the pressure in the system was down to 0#. My reading of the chart showed the pressure went up around noon and spiked off the chart. My reading of the timeline looks like it took maybe 10-15 minutes. I do not know the duration of time the pressure exceeded 1#.
13:35	CB (Manager M&R, System Ops) advises FD (Front Line Leader, M&R) of 4# in LP system.
13:38	FLL M&R FD called MF (M&R Tech) and LS (M&R Tech)
13:38	Service Tech SW texted FOL SS and advised going to DR 35 Station to verify pressure. Then went to 767 Pine, dropped meter and verified no pressure.
13:40	then went back to DR 35 station and verified pressure was down to zero w/Heise gauge supplied by BH M&R Tech.
13:43	FLL M&R FD texts SH (M&R Tech)
13:51	Service Tech SW advised FOL SS of gas off and started verifying no CGI readings in customers home and securing meter settings.
13:55	FLL M&R FD headed to Zanesville
13:58	M&R Tech MH called M&R Tech BH so I advised him what had happened. M&R Tech BH advised COH Project Mgr. HH to advise.
14:05	M&R Tech JN and MG onsite at DR35 station.
14:20	M&R team call, facilitated by M&R Mgr. CB, with M&R leadership advising of the over pressure event.
14:30	M&R FLL RO & FD arrive onsite. M&R Tech BH advises M&R FLL RO & FD that he had backed the jackbolt off to see if the station would hold up then ran it back to the set point and heard the station flowing at 12.5" and left for lunch. M&R Tech JN went to the DR 14 station to confirm/verify everything was off.
14:43	Mgr. Ops Compliance RS called ODNR to report service failure of over 99 customers.
14:54	Mgr. Ops Compliance RS called Mgr. Gas Pipeline Safety Section PUCO to advise on service failure of over 99 customers.
15:50	FLL M&R FD arrives at station.
16:00	Pre job briefing at DR 35 with M&R Techs on site
16:05	Mgr. M&R CB advised all onsite to wait on PUCO rep, GR (Construction FLL), Ops Mgr. JH.

5/9/2019 Thursday

Time	Description
16:20	M&R Tech JN went to make sure DR 14 station is off by service dept. M&R Tech JN verified inlet was off by service tech.
16:25	M&R Tech JN turned off outlet at DR 14 station.
16:30	PUCO & Construction FLL GR both arrived onsite.
16:55	PUCO wanted lock on station DR35
16:56	Mgr Ops Compliance RS on site
	M&R Tech JN & MG PUCO conducted operational checks, at the direction of the PUCO, of the regulators. Also did tear down to look for debris. No
17:00	operational issues identified.
17:15	M&R Tech BH and PUCO looked at SW (Service Tech) Kuhlman gauges
	Gauge 1 was blown
	Gauge 2 was pumped up to 4.5 psig w/air (difference between gauges 4.5 psig on Kuhlman, 3.8 on Heise)
	Gauge 2 was approx. 1/4 # differential between the Kuhlman/Heise.
18:35	M&R Tech AK & ML conducted operational checks, at the direction of the PUCO, of the regulators DR 14. Also did a tear down to look for debris. No
	operational issues identified.
22:30	PF regs installed at the DR 35 by M&R Tech JN, MG, and MH as well as help from an InfraSource crew.

5/10/2019 Friday

Time	Description
13:00	Cut in three main line valves to segment the system in to two zones to expedite restoration efforts.
14:30	Electric restored service to those affected by the outage.
16:00	Completed the installation PF regs at DR 35 station by M&R Tech JN, MG as well as an InfraSource crew.
17:30	Zone 1 gassed up, purged and leak surveyed. Various M&R Tech's monitored pressure during the relight process.

5/11/2019 Saturday

Time	Description
14:40	Zone 2 was gassed up, purged and leak surveyed. Various M&R Tech's monitored pressure during the relight process.
22:00	First pass relights complete for all accessible buildings.

5/12/2019 Sunday

Time	Description
All day	Continued working on gaining access to homes.

VI. Affected Outage Area / Leaks Identified / Status

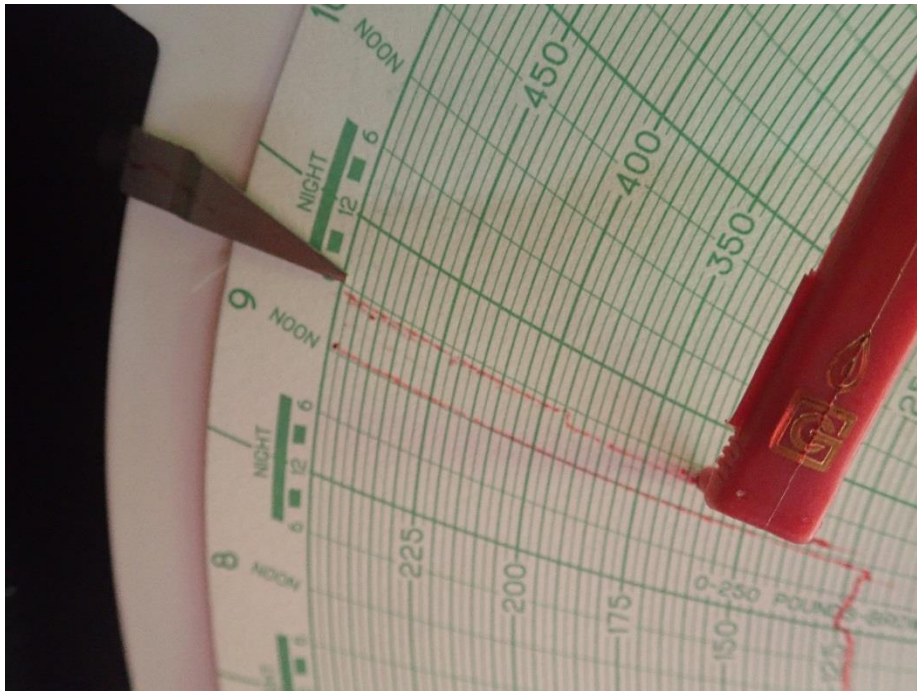
The outside customer service lines and mainlines have been leakage surveyed twice. The system affected by the LP excursion was around 40,000' of mainline and 562 customers.

During the first leakage survey the operator found: 5 – Grade 1 leaks; 10 – Grade 2 leaks; and 10 – Grade 3 leaks; these were all corrosion leaks. As of Monday, May 13, 2019 the operator has restored service to 452 customers; 102 – Nobody home; and 26 – Inside houseline piping leaks.

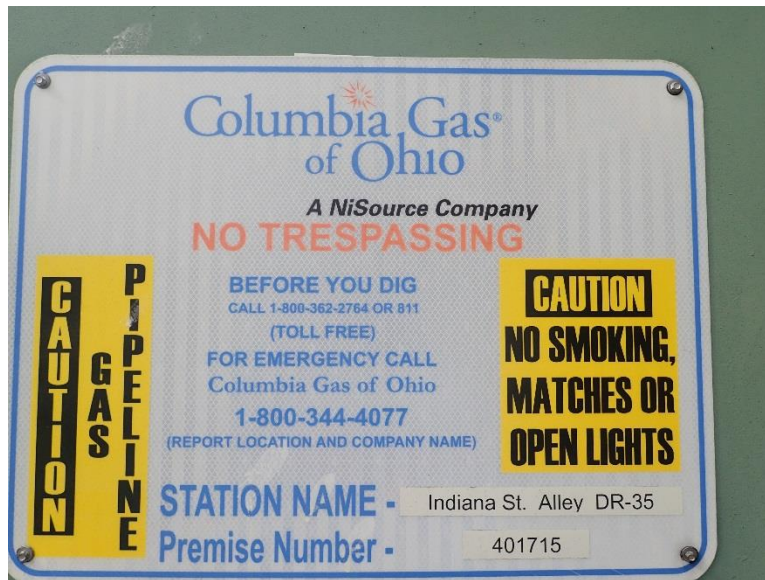
The operator installed at drip near the piping at the Indiana Low Pressure Regulator Station and found 14 gallons of production fluid. The operator also has producers feeding into the Zanesville systems.

VII. Photo Documentation:

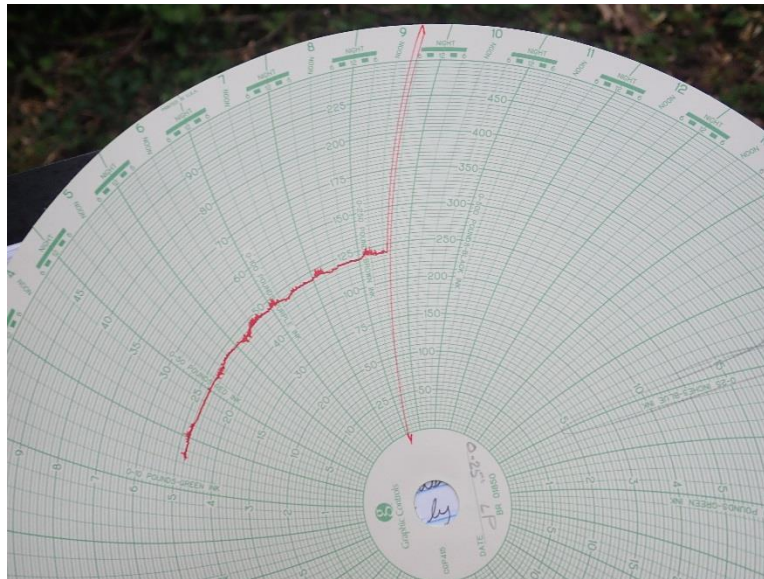
May 9, 2019



Pressure exceeded chart recorder element pressure (0-25"wc) at Indiana Station



Building Sign – Indiana Station



Pressure exceeded chart recorder element at Muskingum station



Station Sign – Muskingum Station



Production Oil – Bottom of Inspection Plate at Indiana Station



Indiana Station Prior to Lock-up and Tear Down



Complete Tear-down Indiana Monitor Regulator



Performing Complete Tear Down of Control Regulator at Indiana Station



Regulator Station Prior to Lock-up / Tear Down at Muskingum Station

May 13, 2019



Modified Indiana Station – New PF Monitor Regulator and Token RV



Modified Muskingum Regulator Station – New Monitor PF regulator and Token RV

VIII. Written Statements (Columbia Employees)

Columbia Gas of Ohio – Service Technician Written Statement

Personal Statement of: SW, Service Tech

12:30 PM - EI (emergency investigation) order taken for 622 Munson Ave.

12:44 PM - Service Tech onsite at 622 Munson Ave.

Upon arrival, verified range not working. Went downstairs checked hot water tank, noticed improper flame characteristics.

Went to van to get Kuhlman gauge, turned off meter valve, dropped meter, hooked up test fitting to inlet of setting. Blew fluid out of gauge on inches of water column. Turned meter valve off, secured setting, advised customer will return and went to reg building on Indiana/Munson/Pine.

1:05 PM - Called FOL SS informed him and requested instruction on what to turn off.

1:12 PM - 1:16 PM - Chart was pegged at Munson Station. Called FOL SS and went to 767 Pine St. and dropped meter and verified 4.5 pounds on Kuhlman gauge that was later determined to be 3.8 pounds when compared to the Heise gauge.

FOL SS informed me of inlet at Munson St. reg building and 2nd LP inlet at Muskingum Ave. reg building.

1:16 PM - 1:25 PM - Turned Munson reg building off and went to Muskingum Ave. reg building and turned off LP inlet and installed purge stand to blow down LP system.

1:28 PM - Started blowing the Muskingum Ave. reg down. It took approximately 10 minutes for the station to blow down. Secured building and setting.

1:38 PM - 1:40 PM - Texted FOL SS and advised going to Munson Station to verify pressure.

Went to 767 Pine, dropped meter, and verified no pressure. (Pine is across the street from the Munson station)

Went back to Munson reg station and verified pressure was down to zero w/ Heise gauge supplied by M&R tech.

1:51 PM - Advised FOL SS of gas off and started verifying no CGI readings in customers home and securing mtr settings.

Columbia Gas of Ohio – Measurement and Regulation Technician Written Statement:

Personal Statement of: BH, M&R Tech

Incident Description -----

10:50 – Onsite – (Verify time with Greenroads) – Me and [REDACTED] (S.C., a Columbia Construction Coordinator)

Prejob discussion with [REDACTED] (S.C., a Columbia Construction Coordinator) in Crooksville

Arrived onsite

PPE – fire bottle/hardhat/senit/bag/o2 monitor/bypass wrench/prejob form/

CGI'd – [REDACTED] (S.C., a Columbia Construction Coordinator) and I went into station (identified size and space for reg)

Shutoff wall chart and installed LP spring gauge

Backed off control regulator (left nut location) (pressure dropped from 12.5 to 12.3)

Waited approx. 30 minutes for crew to show up

11:00 – [REDACTED] (K.S., a Columbia M&R Technician) called to discuss an inspection and new job

Around 11:30 [REDACTED] (S.C., a Columbia Construction Coordinator) said the crew was on the way so I shut off the inlet block/outlet block, broke & failed the control lines then tightened the control lines.

Waited another 10 minutes – no change

11:45 [REDACTED] (S.C., a Columbia Construction Coordinator) said the guys were going to lunch

I did not want to leave the station off while I was gone so I turned on the inlet/outlet block back on (no flow)

I ran the jackbolt back down to original setpoint at 12.5" locked the nut and waited approx. 10 minutes

12:00 – Got off the phone, checked the chart one more time, locked the door and left [REDACTED]'s (S.C., a Columbia Construction Coordinator) truck to go to lunch.

12:07 – [REDACTED] (M.G., a Columbia M&R Technician) texted to confirm it is [REDACTED]'s (J.N., a Columbia M&R Technician) station and we were working at the Indiana Station, but had left for lunch.

1:18 – Received a call from [REDACTED] (M.H., a Columbia M&R Technician) that the Zanesville LP system had gone up to 4# so [REDACTED] (S.C., a Columbia Construction Coordinator) and I immediately left to investigate.

1:29 – Called [REDACTED] (J.N., a Columbia M&R Technician) and advised the system had gone up and asked him and [REDACTED] (M.G., a Columbia M&R Technician) to assist.

1:35 – Onsite – unlocked the door and immediately checked the gauge – it was off the chart

Noticed the station was quiet and inlet block was off – I shut off the outlet block

Grabbed my heis gauge and verified pressure (0.6# and falling)

Removed the LP spring gauge and installed MP spring gauge to verify I had the correct reading

Chart came down to 13" and stopped

I continued to watch the heis gauge fall when the service tech got onsite and talked with [REDACTED] (S.C., a Columbia Construction Coordinator).

I then double checked all the valve positions and noticed that I had left the sense lines off and realized what had happened. I turned the control lines back and walked out of the station to talk to the service tech.

I asked the service tech what had happened, what he saw, where he went, who he contacted and what pressure he saw. I am aware that the service tech shut off the inlet block valve.

He said the pressure went up to 4.5# on his Kuhlman gauge. He went in and shut off the inlet block and went to the other station (per engineering request) and shut in the musky station.

We all went back into the station to verify that the pressure in the system was down to 0#.

My reading of the chart showed pressure went up around noon and spiked off the chart. My reading of the timeline looks like it took maybe took 10 – 15 minutes.

I do not know the duration of time the pressure exceeded 1#.

1:58 – [REDACTED] (M.H., a Columbia M&R Technician) called me so I advised him what had happened

2:05 – Advised [REDACTED] (H.H., a Columbia Project Manager)

[REDACTED] (J.N., a Columbia M&R Technician) and [REDACTED] (M.G., a Columbia M&R Technician) got onsite

2:30 – Advised [REDACTED] (R.O., a Columbia M&R Leader) and [REDACTED] (F.D., a Columbia M&R Leader) that I had backed the jackbolt off to see if the station would hold up then I ran it back to the setpoint and heard the station flowing at 12.5" and left for lunch.

[REDACTED] (R.O., and F.D., two Columbia M&R Leaders) got onsite

[REDACTED] (J.N., a Columbia M&R Technician) went to the other station to confirm/verify everything was off.

Post Incident

5.9.19 (Thursday) -----

I made a statement with [REDACTED] (R.O., Columbia M&R Leader) and Mike Percel of the PUCO.

21:00 – Left Zanesville to take a drug test.

5.10.19 (Friday) -----

The next day I went back to Zanesville and spent another 15 hours supporting the restoration effort.

9:45 – [REDACTED] (R.O., a Columbia M&R Leader) called to take another drug test.

21:00 – I left Zanesville to go home.

On that drive home I had time to think about what had happened and had a moment of clarity about the situation and I knew what I needed to do. I finally got the courage to call [REDACTED] (R.O., a Columbia M&R Leader) around 11:00 Friday night.

Full disclosure: I told him that after I had gotten back to the station I was investigating and I realized that I had left off the control lines and I had turned them back on. I believe this may have been the cause of the over pressurization. It was an accident, a mistake and that I had simply did not recognize that the needle valves where still off. It wasn't until I got back to the station that I had realized this.

IX. Recommendations

The operator should consider the following for all regulator station in Ohio:

- Installing filter/separator on the control lines or upstream of the pressure regulator stations where they have know fluid in the system. Due to the fact regulators do not work properly when any type of fluid is introduced into the system.
- Installing a token relief valve or full capacity relief valve downstream of the low pressure regulator station, to prevent a reoccurrence.

X. Probable Non-Compliance(s)

192.623 *Maximum and minimum allowable operating pressure: Low-pressure distribution systems.*

(a) No person may operate a low pressure distribution system at a pressure high enough to make unsafe the operation of any connected and properly adjusted low pressure gas burning equipment.

Columbia Gas of Ohio over-pressured a low pressure system in Zanesville, Ohio. The pressure exceeded the maximum safe operating pressure to 562 customers with natural gas burning appliance(s).

192.803 *Definitions.*

Abnormal operating conditions means a condition identified by the operator that may indicate a malfunction or a component or deviation from normal operations that may:

(a) Indicate a condition exceeding design limits; or

(b) Result in a hazard(s) to persons, property, or the environment.

A Columbia Gas of Ohio employee did not recognize an abnormal operating condition ("AOC") when performing covered tasks on a low pressure regulator station in Zanesville, Ohio. The employee performed work on a low pressure regulator station and failed to recognize the AOC, closed control line valves. Failure to recognize the AOC caused a maximum allowable operating pressure excursion on a low pressure system.

Lead Investigator: Michael F. Purcell II

Date: May 17, 2019

This foregoing document was electronically filed with the Public Utilities

Commission of Ohio Docketing Information System on

12/3/2020 3:44:02 PM

in

Case No(s). 20-1759-GA-GPS

Summary: Staff Report of Investigation Exhibit 4 electronically filed by Mr. Thomas E Stikeleather on behalf of PUCO Staff.