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APPARENT CAUSE ANALYSIS
Low Pressure System Outage
Chicopee, Massachusetts

Incident Date: March 31, 2020

Full Report Publication Date: 4/17/20

Revision 1 Publication Date: 4/20/20

Full Report

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DEFINITION

- **Apparent Cause Analysis (ACA)**

“The ACA process is designed to identify the dominant reasonable cause of an incident that management has the control to fix through effective corrective actions. An ACA should aim to identify the apparent cause of the incident, as well as any contributing factors. Cause is a condition that produces an effect; eliminating a cause(s) will eliminate the risk of an incident.”

- Source: *NiSource SMS Process - Incident Investigation and Lessons Learned v28 draft*

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EXECUTIVE SUMMARY

Purpose Statement

Purpose Statement**:** To identify the apparent cause of the low pressure system outage resulting from the shut in of the regulator station at Olivine St. @ Chicopee St., Chicopee MA on March 31, 2020.

Key Data & Facts

- M&R technicians were performing annual compliance work on the control regulator at the Olivine & Chicopee regulator station.
- Control regulator was on bypass and system pressure was maintained correctly. The pressure was lost during the process of re-activating the control regulator.
- During the course of restoring the station to normal operations, the pressure of the low pressure system downstream of the regulator station dropped to approximately .5'' water column.
- Upon learning of the loss of system pressure, CMA management directed the station to be "shut in" in the interest of safety.
- Station shut in resulted in a 227 customer outage.

Cause Map Results

Apparent Cause Themes
Inadequate Process / Procedure – No detailed checklist for performing this maintenance activity
Operator Error - Failure to properly bring the control regulator back into operation

Possible Preventive Solutions Identified by ACA Team

- **Checklist**
  - Create step by step list of items to be completed (and consider requiring signoff on each step) for this type of maintenance activity
  - Create a rigorous field culture of following step by step procedures when executing routine maintenance activities

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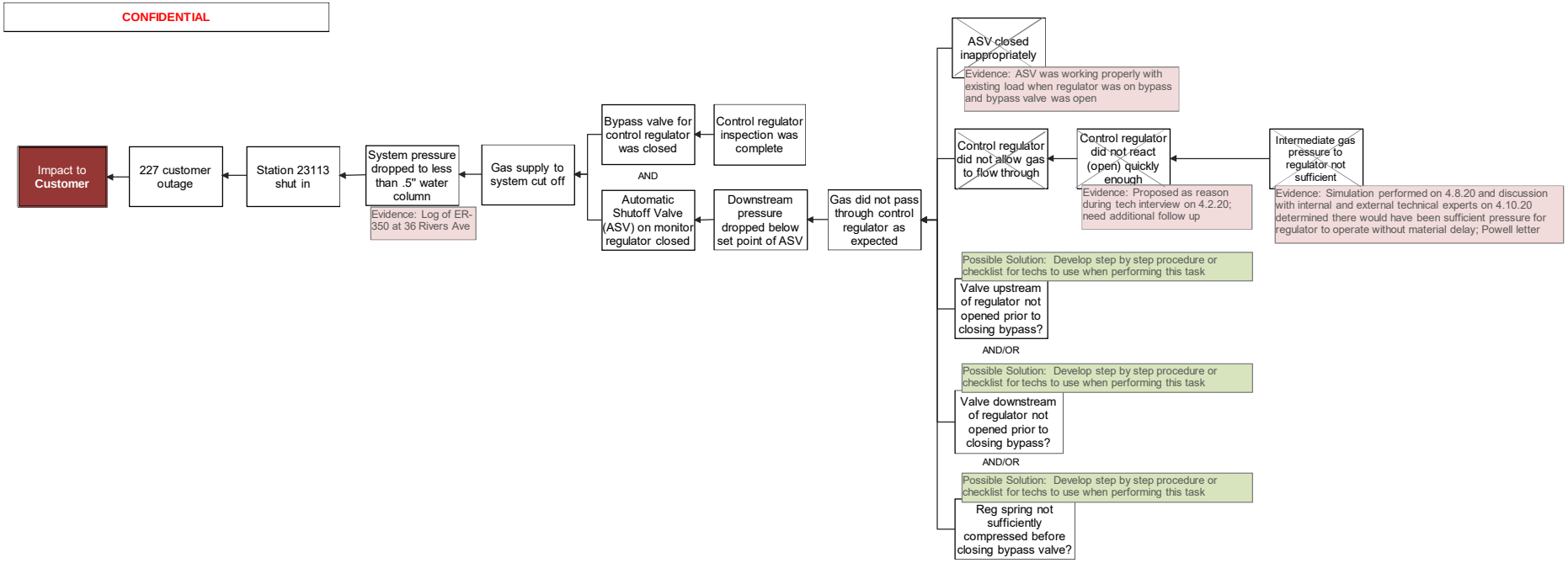

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March 31, 2020 Chicopee Outage
Apparent Cause Analysis Cause Map Narrative

On March 31, 2020 Measurement and Regulation (M&R) technicians were performing annual compliance work (performing a regulator lock-up test) on the control regulator at the Olivine St. @ Chicopee St. Regulator station, which feeds a low pressure system. In order to perform maintenance on the control regulator (Grove), the technician placed the regulator on bypass. At this time, the bypass valve was open and system pressure was maintained adequately with the pressure being controlled by the monitor regulator (Pietro Fiorentini) approximately 15 to 20 feet upstream. During the course of restoring the station to normal operations, the pressure of the low pressure system downstream of the station dropped to approximately 0.5'' water column. This indicated that gas supply to the downstream system was cut off - a result of the bypass valve being closed and then the automatic shutoff valve (ASV) on the monitor regulator closing due to the downstream pressure dropping below the minimum set point of the ASV. It is important to note that the ASV was working properly with existing system load when the regulator was on bypass and the bypass valve was open. The ASV closed after the bypass valve was closed, which indicates that gas did not pass through the control regulator as expected.

In an effort to understand why gas did not flow through the control regulator as expected, the Company interviewed the technicians who performed the work. The technicians indicated that the control regulator did not allow gas to flow through because it did not react (open) quickly enough. The technicians believed that the cause was insufficient intermediate gas pressure to allow the control regulator to function properly.

In an effort to rule out equipment issues that would need to be remediated at this and other similarly configured and equipped regulator stations, the Company performed a simulation of the event at it's training center in Shrewsbury, MA. To execute the simulation, the Company utilized the same kinds of equipment and same configuration as the Olivine @ Chicopee station. During the simulations, performed by a number of Company M&R experts, the Company was unable to replicate a failure of the control regulator to open quickly enough. For a more comprehensive analysis, the Company consulted with Powell Controls, Inc. (Bob Powell, President). Powell Controls, Inc. sells and maintains the type of regulator in question across the US Northeast region. Powell Controls, Inc. provided a letter, which states in part:

> *The opening of the monitor as the bypass valve is closed should be instantaneous. With the 893 tube material in the worker a 5psi minimum is required to begin flow. The monitor will keep opening as the bypass is further closed. Once the bypass is fully closed, the pressure into the worker is dictated by whatever differential pressure is required to keep it open enough to satisfy the load. It will definitely be above 5psi and could be as high as 23psi as the rollup curve shows at 23psi the worker is wide open.*

Therefore based on this expert analysis, the Grove working (control) regulator would have had more than enough pressure available (e.g., 5 psi or greater) as the by-pass valve was closed, to immediately open following the closure of the by-pass.

Thus the conclusions of the simulation and the consultation with internal and external experts led the Company to determine that there were no equipment issues contributing to this event.

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The Company, therefore, has determined that there are three remaining possible reasons to explain why gas did not flow through the control regulator. 1) The valve upstream of the control regulator was not opened prior to closing the bypass; 2) the valve downstream of the control regulator was not opened prior to closing the bypass; or 3) the control regulator spring was not sufficiently compressed prior to closing the bypass valve. *It is important to note that while there is a gas standard covering this maintenance activity and CMA's employee was trained on this gas standard, there was no step by step checklist for this type of maintenance activity.*

As a result of the findings of this Apparent Cause Analysis, the following apparent causes are identified:

1) Inadequate process / procedure - *No detailed checklist for performing this regulator maintenance activity.*
2) Operator Error – *Failure to properly bring the control regulator back into normal operation.*

Further, the following possible mitigating actions are being presented to Company management to evaluate for implementation, in order to prevent a similar outage from occurring in the future:

1) Create a step-by-step checklist of items to be completed (and consider requiring signoff on each step) for this type of maintenance activity.
2) Create a rigorous field culture of following step by step procedures when executing routine maintenance activities.

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APPENDIX

-Maps/Diagrams

-Letter From Powell Controls Inc.

-Revision Log

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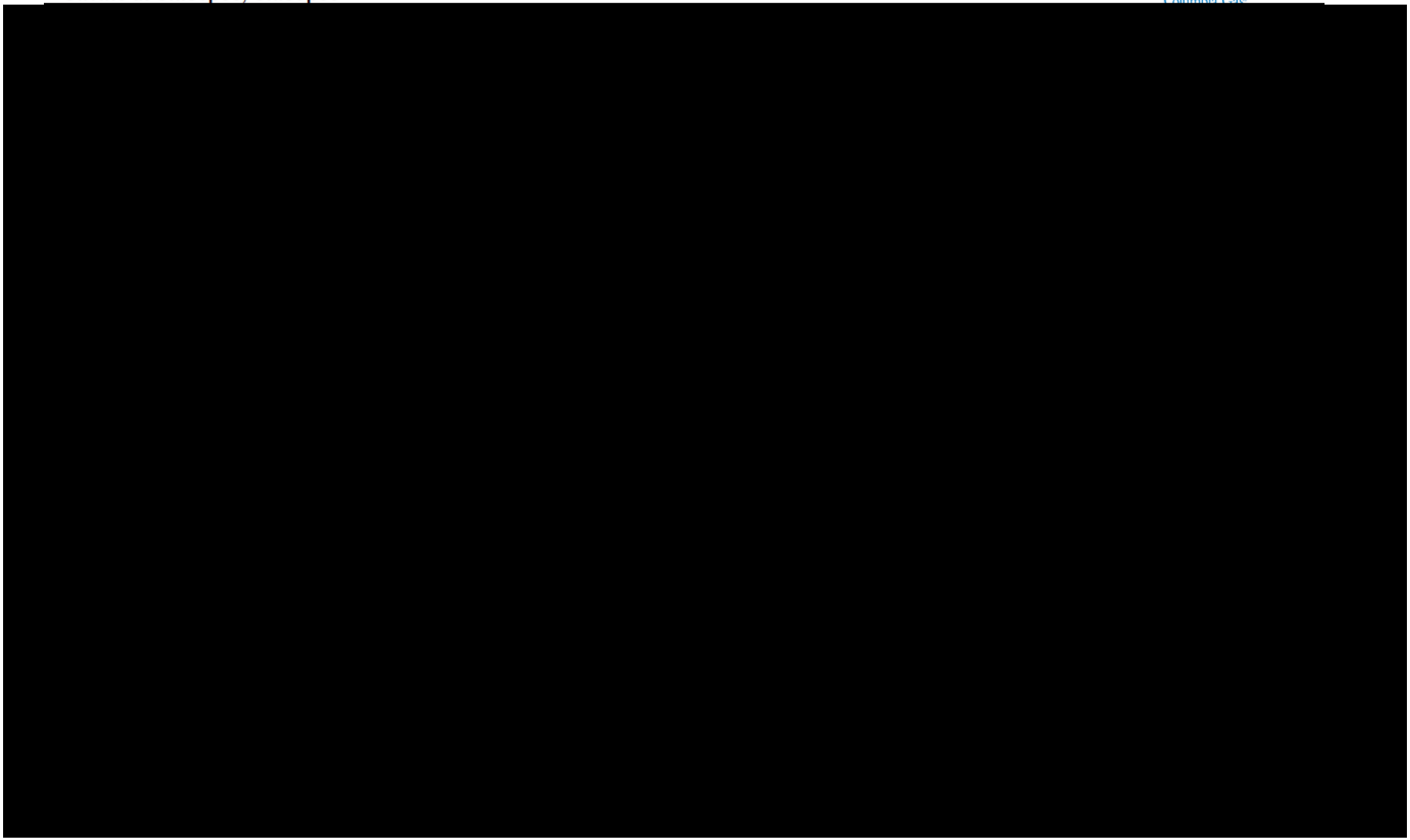
MAPS / DIAGRAMS
GIS map of affected area

Olivine at Chicopee, Chicopee



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MAPS / DIAGRAMS
Olivine at Chicopee Station Isometric Drawing

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LETTER FROM POWELL CONTROLS INC.

- Place holder for letter from Powell

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powell controls, inc.

April 14, 2020

Dana Argo
Columbia Gas of Massachusetts
55 Foundation Ave.
Haverhill, MA 01835

Dear Dana,
As you know, Powell Controls is the factory representative for Grove, Mooney, and Becker pressure regulators. I started my career in 1989 and immediately attended factory training sessions at each manufacturer. I continue to attend these sessions as do all our outside sales people. Our corporate philosophy simply "if you buy it we will come". We do not charge for training, troubleshooting, nor commissioning assistance and we would rather be there than have you looking for us. This philosophy has exposed us to mostly every situation possible. Coupling this experience with the factory training gives us a certain level of expertise. That being said, please see the following procedure:

Procedure for turning on a working regulator after maintenance has been performed and it is by-passed. Slowly refers to an action taken while watching the manometer.

Assumptions:
1. Working regulator inlet and downstream block valves are closed.
2. Monitor regulator is in service controlling the downstream pressure.

Procedure:
1. Back out working regulator pilot so there is no spring compression.
2. Slowly open working regulator inlet valve.
3. Open a blow off valve between the outlet of the working regulator and the downstream block valve to verify lock-up.
4. Close the blow off.
5. Slowly open the downstream block valve.
6. Slowly turn the pilot adjusting screw clockwise to begin compressing the spring. Wind in all the way.
7. Slowly close the bypass valve.
8. Back out working regulator pilot to desired set pressure.

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powell controls, inc.

This procedure is used by all gas utilities in New England. I personally do the regulator inspections in Wakefield, MA (WMGLD) and this is the procedure I use.

A recent event in Chicopee, MA has directed new focus onto this procedure. I will try to fill in some numbers to help clarify. Please remember I am the representative for Grove, Becker, and Mooney. This is how things work with these 3 brands. The monitor at the station in question is a brand I am not familiar with so I really cannot comment on its performance.

The station was flowing fine with the monitor regulator in control and the worker by-passed. The outlet pressure was approximately 14" water column. When the inlet to the working regulator was opened, the pressure going into the working regulator was 14" as well. This is not enough pressure to open the working regulator. As the by-pass valve is closed, the monitor will sense a drop in outlet pressure and open more and build pressure into the worker causing it to open. Remember the monitor sense line is downstream of the worker and that is the point where the 14" is being maintained. The opening of the monitor as the bypass valve is closed should be instantaneous. With the 893 tube material in the worker a 5psi minimum is required to begin flow. The monitor will keep opening as the by-pass is further closed. Once the bypass is fully closed, the pressure into the worker is dictated by whatever differential pressure is required to keep it open enough to satisfy the load. It will definitely be above 5psi and could be as high as 23psi as the rollup curve shows at 23psid the worker is wide open.

Please call should there be any questions.

Robert Powell
President

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Revision Log

Revision	Revision Date	Description
1	4/20/20	Clarified that the work being performed on regulator was annual compliance work. Update on Executive Summary slide and on Cause Map Narrative