Energy to do more®

UGI Relief Capacity Spreadsheet

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About UGI

- UGI is dedicated to the safe and reliable delivery of energy to our customers and to the many communities we serve. We strive to deliver this fundamental need through best-in-class safety, operations, products and services.
- UGI provides natural gas service to some 700,000 customers in 45 counties in Pennsylvania and one county in Maryland.
- UGI operates approximately 12,000 miles of Distribution and 300 miles of Transmission pipeline.

UGI Brief History

- In the 2000's, UGI nearly doubled in size through the acquisition of two companies.
- Each of these acquisitions had unique and distinct processes and methods.
  - Stations located in major cities as well as remote locations
- Since acquiring these additional companies, UGI has worked on standardizing processes and practices.
- Case in point: UGI's management of Regulator Stations.

Regulator Stations

- UGI operates approximately 1100 Regulator Stations that require annual Relief Capacity verifications.
- Wide variety of station design, component specifications, and vintage.
- Processes must be in place to capture, retain, and review Regulator Station components.

Applicable Federal Codes

- 192.199 – **Requirements for design of pressure relief and limiting devices.**
  - Pertains to the design of a pressure Relief Valve.
- 192.201 - **Required capacity of pressure relieving and limiting stations.**
  - *Each Pressure Relief Valve installed to protect a pipeline must have enough capacity and be set to operate…*
- 192.743 - **Pressure limiting and regulating stations: Capacity of relief devices.**
  - Perform a capacity check at intervals not exceeding 15 months. Can use initial calculations if station piping has not been altered.

Path to Standardization

- Beginning:
  - Decentralized
  - Relief Capacity calculations performed uniquely based on location
  - Various methods utilized, assumptions being made
  - Retention process was unique to each localized area

Path to Standardization – Regulator Catalog

- Catalog (database) created and used by technicians to perform annual regulator inspections.
- UGI developed this catalog for each Regulator being used in our system to include.
  - Manufacturer
  - Size
  - Style
  - Orifice Size
  - Flow Coefficient Values

Path to Standardization – Regulator Catalog

- Catalog was the basis for the spreadsheet
  - All data used to calculate relief capacity found in the catalog
- All Regulator updates or additions are funneled through one central contact.
  - Verifies literature and updates the catalog accordingly

Cv	C1	Cg
7	35	250
24	35	840
44	35	1540
53	35	1860
89	35	3130
180	33	6000
295	36	10670
364	33	1200
593	36	21340

Path to Standardization – Canvas Reg. Stations

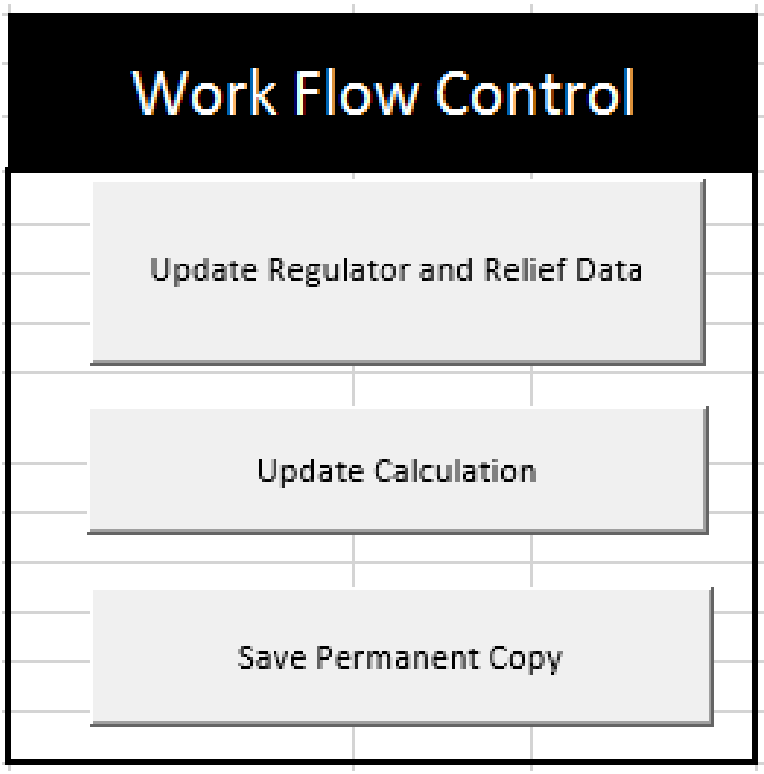
- In 2015 UGI performed a canvas of all Regulator Stations which had a Relief Valve installed.
- Performed Field Review - Physically went to each station:
  - Took pictures of components
    - Valves, Regulators, Station Piping
  - Drew a sketch that included exact measurements of all piping dimensions
    - Diameter, Length, Flanges, Valves, Tees, etc

Path to Standardization – R.V. Spreadsheet

- Several Iterations of a Relief Valve Capacity Spreadsheet were created.
- In 2016 UGI Engineering team began to zero in on the final product.
  - User Inputs kept to a minimum
    - Allows for standardization of calculations
  - All Calculations performed “behind the scenes”
    - Formulas are locked for all users
  - Regulator Catalog was Linked to Spreadsheet
    - Allows for refreshing of data whenever a new Regulator was added

Relief Valve Spreadsheet

- Simple push buttons to control spreadsheet
- Contain dialogue boxes to guide user
- Has ability to identify error in user input, and then provides basic troubleshooting



Relief Valve Spreadsheet

Relief Capacity Calculation GOM 70.70.10-3

Station Information									
Area:		Station ID:		Name:					
Pressure & Flow Data									
Minimum Inlet	psig	Outlet MAOP		psig	Temperature	°F	Required Load		Mscfh
Inlet MAOP	psig	Allowable Build up		psig	Gas Gravity, SG		Max Upstream Flow		Mscfh

Regulator Information				Relief Valve Information				
	Run 1	Run 2	Run 3		Relief Valve 1	Relief Valve 2	Relief Valve 3	Relief Valve 4
Manufacturer	Fisher			Manufacturer				
Model	627			Model				
Size	2			Size				
Reg Catalog Nam	2_627_3/8"			Relief Catalog Name				
Inlet ID				Inlet ID				
Outlet ID				Outlet ID				
Orifice Size				Orifice Size				
Spring Color				Spring Color				
Pressure Class				Pressure Class				
Cg				Build Up (psig)				
C1(Xt)				C1 / Xt				
Cg Wide Open								
C1 Relief Sizing				Cg / Area				
Fp				Fp				
Set PSIG				Set PSIG				
Flow Regime @ Outlet MAOP				Flow Regime				
Capacity @ Min. Inlet (Mscfh)				Set Pressure + Build Up				
Capacity@ MAOP				Capacity (Mscfh)				

Relief Valve Spreadsheet

Relief Capacity Calculation GOM 70.70.10-3

Station Information									
Area:			Station ID:			Name:			
Pressure & Flow Data									
Minimum Inlet	180	psig	Outlet MAOP	60	psig	Temperature	40 °F	Required Load	2 Mscfh
Inlet MAOP	345	psig	Allowable Build up	66	psig	Gas Gravity, SG	0.6	Max Upstream Flow	Mscfh

Regulator Information			
	Run 1	Run 2	Run 3
Manufacturer	Fisher	Fisher	
Model	627	627	
Size	2	2	
Reg Catalog Name	2_627_1/4	2_627_1/4	
Inlet ID	2.067	2.067	
Outlet ID	2.067	2.067	
Orifice Size	1/4	1/4	
Spring Color	Blue 35 - 80	Blue 35 - 80	
Pressure Class	1000	1000	
Cg	46.8	46.8	
C1(Xt)	31.3	31.3	
Cg Wide Open	52	52	
C1 Relief Sizing	31.3	31.3	
Fp	1.00	1.00	
Set PSIG	56.00	54.00	
Flow Regime @ Outlet MAOP	Critical	Critical	
Capacity @ Min. Inlet (Mscfh)	12.1	12.1	
Failed Capacity@ MAOP (Mscfh)	25.1	25.1	

Relief Valve Information				
	Relief Valve 1	Relief Valve 2	Relief Valve 3	Relief Valve 4
Manufacturer	Fisher			
Model	289P_1:1			
Size	1			
Relief Catalog Name	1_289P_1:1_Fixed Orifice			
Inlet ID	1.049			
Outlet ID	1.049			
Orifice Size	Fixed Orifice			
Spring Color	Red 30 - 100			
Pressure Class	110			
Build Up (psig)	3.00			
C1 / Xt	32			
Cg / Area	740			
Fp	1.00			
Set PSIG	58.00			
Flow Regime	Critical			
Set Pressure + Build Up	61.0			
Capacity (Mscfh)	74.3			

Relief Valve Spreadsheet

- Spreadsheet considers pressure drop through station piping, up to the inlet of Relief Valve.
- Ensures piping back to Regulator does not exceed emergency pressures.

Piping Pressure Drop entering Relief Valves												
Run/Branch	Item #	Downstream Item #	Fitting Type	Length (in.) /Quantitiy	Inlet Size (in.)	Outlet Size (in.)	Max Flow RV 1	Max Flow RV 2	Max Flow RV3	Max Flow RV 4	Total Flow	dP (psig)	Inlet Pressure (PSIG)
RV1	11		Relief Valve	1	1.049	1.049	25.10						61.9
RV2													
RV3													
RV4													
Branch 1	10	11	Elbow Screwed 90	1	1.049	1.049	25.10				25.1	0.88	62.8
Branch 1	9	10	Straight Pipe	4	1.049	1.049	25.10				25.1	0.11	62.9
Branch 1	8	9	Reducer	1	2.067	1.049	25.10				25.1	0.00	62.9
Branch 1	7	8	Ball Valve	1	2.067	2.067	25.10				25.1	0.00	62.9
Branch 1	5a	7	Tee Straight Through	1	2.067	2.067	25.10				25.1	0.03	62.9
Branch 1	6	5a	Straight Pipe	12	2.067	2.067	25.10				25.1	0.01	62.9
Branch 1	5b	6	Tee Through Branch	1	2.067	2.067	25.10				25.1	0.10	63.0
Run 1	4	5b	Ball Valve	1	2.067	2.067	25.10				25.1	0.00	63.0
Run 1	3	4	Straight Pipe	7	2.067	2.067	25.10				25.1	0.01	63.0

Relief Valve Spreadsheet

- Relief valve vent stack
  - Piping downstream of relief valve taken into consideration
  - Vent stack back pressure
  - Determines flow characteristics

Relief Valve 1 Outlet (Vent Stack)

RV	Item	Dwst. Item	Max. Flow RV1	Fitting Type	Length (in) /	Inlet Size (in)	Outlet Size (in)	dP (psig)	PSIG (inlet)
RV1	1	Atmosphere	24.30	Straight Pipe	24	4.026	4.026	0.00	0.0
	2	1	24.30	Elbow Weld Long (1.5D)	1	4.026	4.026	0.01	0.0
	3	2	24.30	WNF	1	4.026	4.026	0.00	0.0
			24.30						
			24.30						
			24.30						
			24.30						
			24.30						
			24.30						
			24.30						
			24.30						
			24.30						

Relief Valve Spreadsheet

- Summary of calculations
  - Maximum Pressure Buildup
  - Adequate Relief Capacity
  - Date of Calculation, Electronic Signature

Build Up Summary						
Relief Valve Set Pressure		60.0	psig	**Briefly explain how build up was determined; Specify any literature used in your determination.**		
Build Up to Full Open		1.9	psig			
Pressure Build Up to Branch		1.1	psig			
Pressure Build Up to Regulator		0.0	psig			
Calculated Maximum Pressure		63.0	psig	Relief buildup was found in Fisher Product Manual		
Results Summary						
Maximum Pressure Build Up		63.0	psig		in. WC	**Provide any additional comments:**
Vent Stack Backpressure			psig	0.00	in. WC	
Relief Capacity Adequate?	Relief capacity is adequate.		Within Allowable Buildup?	Yes, pressure does not exceed allowable		
Pressure Drop %		1.9	%			
Engineer:	**ssnyder**		**Date Data Refreshed:**	7/14/2016 11:15		
			Date Calculated:	7/14/2016 11:56		

Roll Out Process

- Spreadsheet was extensively tested
  - Compared to Manufacturer Literature, Hand Calculations, etc
- Held Training Sessions for all Engineering Groups
  - Fielded Questions/Concerns
  - Showcased the spreadsheet
  - Provided example calculations
  - Reinforced supplementary documents Engineers have when performing the calculations

Standardized Method

- Spreadsheet was initially used to verify all Regulator Stations that utilize a R.V. as primary OPP.
  - A very thorough way to “Vet” spreadsheet
- Regulator Catalog was extensively updated once all Engineers were utilizing one central database
- Utilized for all Regulatory Audits
  - Helps auditors when they can refer to 1 document used throughout the company.

Current State of Affairs

- Approximately 9200 regulator catalog entries to date.
- Standardized across all UGI territories.
- All calculations are centrally and locally stored.
- Regulator Catalog updated regularly.
- Continuing to provide ongoing support to Engineers

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Questions