

BENEFITS AROUND TIMELY ANALYSIS OF MEASUREMENT DATA

Class # 8240

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Introduction

The need to have timely measurement data has grown considerably over the years due to the age of electronic flow measurement, contracts, and competition. Timely data allows companies to more effectively and efficiently operate their systems, determine shortfalls, and meet the needs of their customers.

Electronic flow measurement reviewed on an hourly granularity has 744 records per month on a 31 day calendar. If you process approximately 10,000 measurement sites, you could potentially review some 7,444,000 records.

We will discuss various processes to identify potentially invalid or incorrect transactional data and push that data to those analyzing and reviewing the information. This will reduce the time it takes to analyze the data, thus enabling internal and external customers downstream of measurement to use the data.

We will also review the benefits in receiving electronic information from field technicians -- such as meter test calibrations, plate changes, and well status changes to name a few.

Who benefits from timely analysis of measurement data.

Depending on how organizations are structured and how systems are interfaced with various software applications the subscription/publishing of data can be instant upon receipt or at an interval determined by the users needing the information.

- Nominations and Accounting Systems
 - Pressure information for any pressure agreements
 - Imbalance management (Well-head production vs. scheduled nominations)
 - Cash outs (contract driven)
 - Capacity allocation on system(s)
- Gas Control-Dispatch-Operations Center
 - Monitoring of system(s)
 - Pipeline pressures
 - Outages - (assisting with maintenance coordination – liaison between operations, downstream pipes and customers)
 - Failures - (assisting with maintenance coordination – liaison between operations, downstream pipes and customers)
 - Communicating between operations and downstream pipes
- Internal Operational Applications
 - Those applications assisting operations in the monitoring of assigned measurement sites to help determine daily work assignments.
- Dashboards – Bulletin Boards – Web Interfaces (internal and external customers)
 - Provides a tool for customers to view and trouble shoot daily production
 - Volume Statements a.k.a. Quantity Statements
 - Gas Analyses
 - Test/Calibration Results
 - Configuration Changes
 - Audit Packages

By using validation on measurement transactional data it can be analyzed faster

Validation is identifying measurement data that falls outside of acceptable variances to an established mean and/or value, thus the term “fails validation”. These validation parameters can and should be updated frequently, depending on operational and environmental conditions. Validation (a.k.a. rules) ran against measurement data points will be prioritized and then reviewed by the analyst or processor. Validation parameters can be systematically or manually updated, depending on the type of processing system used by the company.

The fastest and most efficient way to review measurement data is to push potentially incorrect or questionable data to the analyst or processor. This eliminates the need for those individuals to review all data points, either through hourly or daily granularity.

This data can be viewed in text format or in a graphical view depending on your software.

The text data below shows that the pressure and flow time failed the “Reasonability Limit Check” on meter 01048-30. Also meter 01222-30 has failed for temperature.

Action	Name	Type	Group	Field Date Time	EOP	Timezone	History Type	Problem Class	Problem Type	Problem
No Action	01048-30	Gas Meter	WGP03	Jan 07/13 11:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 08/13 06:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 08/13 07:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 08/13 08:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 08/13 09:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 09/13 08:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	flow time
No Action	01048-30	Gas Meter	WGP03	Jan 09/13 10:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Reasonability Limit Check	pressure
No Action	01048-30	Gas Meter	WGP03	Jan 10/13 02:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	flow time
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 14:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 15:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 16:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 17:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 18:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 09/13 19:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature
No Action	01222-30	Gas Meter	WFS03	Jan 10/13 12:00:00	<input type="checkbox"/>	Mountain Sta...	hourly	Data Validation	Operational Limit Check	temperature

The graphical view below shows the days within the month that have invalid data for each meter. Red=Invalid Data

Close Refresh Meter Data Editor Meter Data Simple Editor Problematic Context Properties Problematic Configuration Historical Timestamp Override

83541 Filter: None Jan 01/13 Invalid Config: Data Estimation: Valid Data: No Data: Events: 2
 Invalid Data: Calculation Error: Processing: Comments: 1 Both: 3

Proble	This mo	Reject	Gas Meter	Description	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
61	61	0	83532-01	CHENEY FEDERAL...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
23	23	0	83533-01	CHENEY FEDERAL...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
50	50	0	83534-01	NEBU 69 A CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
29	29	0	83535-01	NEBU 311 M	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
2	2	0	83536-01	NEBU 307 M CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
47	47	0	83537-01	NEBU 318 M CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
34	34	0	83538-01	ALBINO CANYON 1...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
71	71	0	83539-01	SJ 27-5 UNIT 108 N...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
23	23	0	83540-01	SJ 27-5 UNIT 70 Y C...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
7	7	0	83541-01	CAT DRAW 101 S	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
32	32	0	83542-01	ALLISON UNIT 106 S	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
56	56	0	83543-01	SJ 27-5 UNIT 96 N C...	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
29	29	0	83544-01	NEBU 322 M CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
130	130	0	83545-01	NEBU 325 M CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						
1	1	0	83546-01	NEBU 323 M CMG	2	2	2	2	2	2	2	2	2	2	2	2	2	2						

Measurement transactional data points that should be validated

Reasonability Limit Validation –

Depending on what data is most vulnerable within your operation you may choose a variety of the following, or all of the following to validate.

- Differential Pressure
- Static Pressure
- Temperature
- Flow Time
- Pulse Count
- Volume
- Energy

From the transactional data you can also identify the following.

- Splits (hourly or daily)
- Repeating Values - Frozen Values
- Missing Data
- Calculated Energy Check (checking for gas quality discrepancies between the host and the RTU)
- Beta Ratio Check
- Volume Ratio Check

For measurement transactional data the mean value may be the average of valid data for a given historical time period. For example, the average valid pressure (psig) over the past week is 123 lbs, temperature is 86 degrees, and the differential is 11.86". The validation on this data point could look like the following. This is often referred to a "Reasonability Limit Check".

Type of Validation-Rule				<i>Low</i>	<i>High</i>
	Standard Deviation	% +/-	Mean or Value	Allowed Variance	
	Pressure	3.5% +/-	123	118.695	127.305
	Temperature	2.5% +/-	86	83.85	88.15
	Differential	2% +/-	11.86	11.623	12.097

Not all transactional data that fails validation requires the analyst or processor to edit the data. Operating or environmental conditions may have changed enough that the values have been flagged, but are not incorrect.

The frequency of updating the validation parameters can also affect the number of records failing validation. The frequency should be determined depending on operational or environmental changes. You would not want to use validation parameters for winter conditions that have been established from summer conditions. Nor would you want to use validation parameters for a measurement station if a compressor has been removed or added. You want to update the validation parameters often enough to not fail all transactional data, but not so often that the standard deviation tolerance is widened to the point that all data parameters will pass through all validation settings.

A more manual process would be to review transactional data that failed and manually change the lower limit or high limit to the value reviewed in the hourly or daily tables, then accept that data within the tables.

An efficient way to update the reasonability validation parameters would be to have automated software that runs at specified times and days of week. This eliminates human interpretation, as well as keeps the information fresh for the operating and environmental conditions. The reasonability limit values are time/date effective with an audit trail.

Example:

MTR pressure reas chk					
Item Name	Value	Units	Date/Time Effective	Last Mod Time	
Enable	<input checked="" type="checkbox"/>		Y	Nov 09/11 09:40:18	
High threshold	163.926	PSI	Y	Jan 10/13 10:41:33	
Low threshold	135.762	PSI	Y	Jan 10/13 10:41:33	
Pressure type	Absolute		Y	Jun 14/04 08:41:13	
Severity	Flagged		Y	Jun 14/04 08:09:21	

MTR temperature reas chk					
Item Name	Value	Units	Date/Time Effective	Last Mod Time	
Enable	<input checked="" type="checkbox"/>		Y	Nov 09/11 09:44:34	
High threshold	60.66	F	Y	Jan 10/13 10:41:33	
Low threshold	20.68	F	Y	Jan 10/13 10:41:33	
Severity	Flagged		Y	Jun 14/04 08:09:41	

The reasonability pressure range for this meter has been set from 135.762 to 163.926. The temperature range is 20.68 to 60.66. Those ranges are effective until the next update.

Field Date Time	Volume MCF	Energy MMBTU(60)	HV BTU(60)/CF	Flow Time Hour	Press. PSIA	Temp. F	Diff. Press. inches of H2O
Jan 10/13 08:00:00	0.50	0.59	1176.9740	0.036	153.547	50.90	7.94
Jan 10/13 09:00:00	11.71	13.78	1176.9740	0.790	153.253	49.93	8.93
Jan 10/13 10:00:00	2.43	2.86	1176.9740	0.168	159.981	49.84	8.12
Jan 10/13 11:00:00	2.67	3.15	1176.9740	0.237	160.369	51.79	4.93
Jan 10/13 12:00:00	4.62	5.44	1176.9740	0.337	164.721	54.41	7.14
Jan 10/13 13:00:00	0.00	0.00	0.0000	0.000	168.019	69.66	0.00
Jan 10/13 14:00:00	5.36	6.31	1176.9740	0.374	167.194	49.03	7.63

This screenshot shows that the pressure in the hourly flow data has failed validation and has been flagged for the analyst.

Audit History for MTR pressure reas chk High threshold					
Value	Last Mod Time	Last Mod User	Adjustment Reason	Adjustment Description	
164.410	Jan 13/13 12:51:19	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Jan 13/13 08:00:00
163.926	Jan 10/13 10:41:33	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Jan 10/13 08:00:00
156.545	Jan 07/13 15:01:08	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Jan 07/13 08:00:00
156.572	Jan 04/13 12:41:32	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Jan 04/13 08:00:00
155.552	Jan 01/13 10:23:43	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Jan 01/13 08:00:00
155.178	Dec 29/12 08:16:02	svc_msscada_pfcagmas	Bulk Validation	Bulk Validation	Dec 29/12 08:00:00

The audit trail created by the validation limit updates is tracked by effective date and time and the accepted value.

Operational Limit Validation –

Validation can also be established for what we often refer to as “operational validation”. Each meter make has established operational ranges. This can be, but is not limited to, the differential pressure range, static pressure range, and temperature range. When measurement transactional data fails “Operational Validation” it may not be invalid, but may require notification to operations of a potential issue or that a change is needed: such as the orifice plate or temperature setting for the production equipment.

The operational limit values are not time/date effective as they are not updated on a regular basis. They are only updated when the make of the electronic flow meter changes or ranges change.

Operational Validation		
When values exceed	Acceptable Value	Unacceptable Value
Differential range of 250	210	272
Pressure range of 500	380	512
Temperature range of 120	98	138

Item Name	Value	Units	Date/Time Effective	Last Mod Time
Gas Meter Operational Validation	Fisher Operational Limits		N	Mar 03/10 15:25:42

Configuration data -

Each electronic meter has configurable points used to calculate the volumes, including information for the primary device such as plate and tube. Depending on the frequency required for your organization, selected settings should be retrieved from electronic flow meters and compared to the host -- preferably on a daily frequency to catch and resolve any differences. The differences will be pushed to the analyst or processor. Below is a list of the items that can be polled for validating.

<i>Plate Diameter</i>	<i>Low Alarm EU Flow</i>	<i>Viscosity</i>
<i>Tube Diameter</i>	<i>High Alarm EU Flow</i>	<i>Isentropic Exponent</i>
<i>Contract Hour</i>	<i>Heating Capacity Source</i>	<i>Tap Type</i>
<i>Elevation</i>	<i>Heating Value Type</i>	<i>Tap Location</i>
<i>Latitude</i>	<i>Heating Value Basis</i>	<i>Tube Reference Temp</i>
<i>Atmospheric Press</i>	<i>Gas Composition Adjustment</i>	<i>Tube Material</i>
<i>Static Press Setting</i>	<i>Gravity Source</i>	<i>Orifice Material</i>
<i>Base Press</i>	<i>Volumetric Calculation</i>	<i>Orifice Reference Temp</i>
<i>Base Temp</i>	<i>DP Low Flow Cutoff</i>	
<i>Supercompressibility Calculation</i>		

Scripts and/or Queries -

Another avenue to finding problem data without reviewing all transactional data is through custom scripts or queries. These scripts and/or queries are searching for data in a specific state, such as:

- Accepted Estimates (system inserted zeroes)
- Split Hourly or Daily records
- Hourly and Daily records with bad time stamp (record other than top of the hour – 08:00)
- Hourly records exceeding 1.000 hour
- Daily records exceeding 24.00 hours
- Records missing volume or energy that have flow-time and differential
- Records with null values for pressure and temperature
- Records with atmospheric pressure showing volume and energy

These scripts and/or queries are published in an excel format and distributed to the analyst or processor.

Note that none of the validation rules as mentioned above change the actual original transactional data or configuration information received from the electronic flow meters. Only the actions or changes made by the analyst or processor to the actual data will change the results. In all cases an audit trail will exist following data accepted, edits or changes made with time date effectiveness.

Efficiencies realized in capturing field measurement data

The gathering of data electronically from field measurement technicians versus manual data collection has expedited the receipt of the data. These are gained efficiencies in not having to submit paperwork. One is eliminating the paper path and steps between the field, measurement, and the customer.

A version that Williams is using is called EAGLE – Enterprise Application for Gas and Liquid Entry

- A workforce automation tool that eliminates paperwork
- Allows operation technicians to manage measurement work orders
- A tool to collect data electronically

EAGLE enables operation technicians to report electronically

- Meter test-calibrations
- Orifice Plate Inspections
- Plate and tube changes
- Meter status changes (active to a disconnect state and visa versa)
- Equipment Inventory
- Manual Meter Readings
- Gas Use/Loss

- Estimated Fuel Usage

Because EAGLE collects data, not paper, we can.....

- Optimize downstream data processing
- Implement “do-it-yourself” reporting for customers
- Improve metrics and reporting capabilities
- Create opportunities to identify process improvements

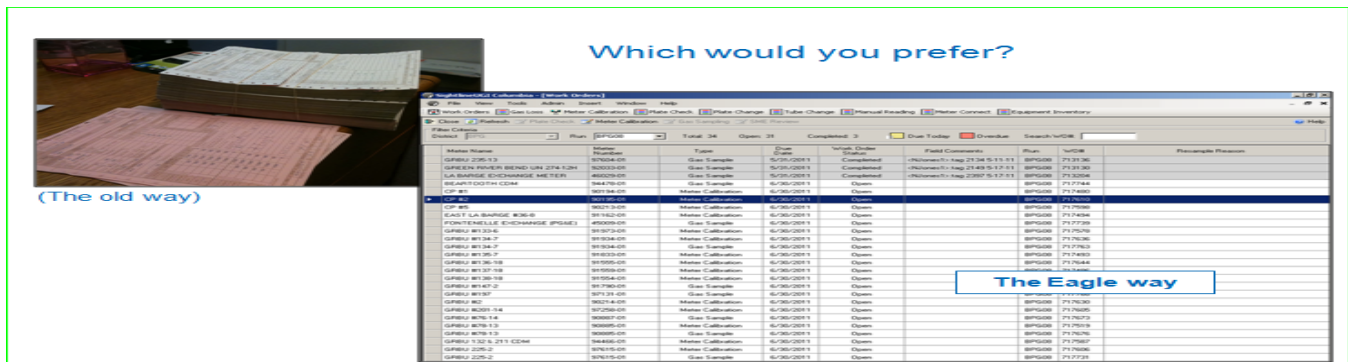
Test and Calibrations –

A predesigned form is auto-populated by the operations technician by an upload or manual input. The calibrations are categorized into the following.

- Rejected – calibrations resulting in a potential adjustment that are <2% or <100Dth, thus rejected
- NA – Tests within tolerance thus no calibration was performed
- Pending – Calibrations resulting in an adjustment that are >2% and >100Dth.
- Accepted – Pending calibrations that have been accepted.

Pending calibrations are the only calibrations viewed on a frequent interval. These are viewed for accuracy and completeness prior to accepting for an adjustment. Some of those that are pending will be rejected.

E 504's	YTD	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Total Received	23807	1892	1601	1771	2326	2368	2155	1989	1586	1649	2275	2338	1857
Calib - Accepted	281	11	21	15	36	26	25	19	12	12	32	33	39
Calib - Rejected	13116	1206	995	1059	1284	1462	1408	1078	731	722	989	1197	985
NA - Test no Calib	10410	675	585	697	1006	880	722	892	843	915	1254	1108	833
		0.58%	1.31%	0.85%	1.55%	1.10%	1.16%	0.96%	0.76%	0.73%	1.41%	1.41%	2.10%



Conclusion: The timely analysis of data is critical to those who use and receive information downstream of measurement. It allows companies and customers to make better informed decisions based on quality measurement. There are several processes you can use to help identify and analyze incorrect or invalid data and electronically gather data, thus reducing time spent reviewing all collected information.