2015 RMMS – DETERMINING LOST AND UNACCOUNTED FOR PRODUCT LOSS

Rocky Mountain Measurement Society

Advancing Hydrocarbon Measurement through cooperative learning.

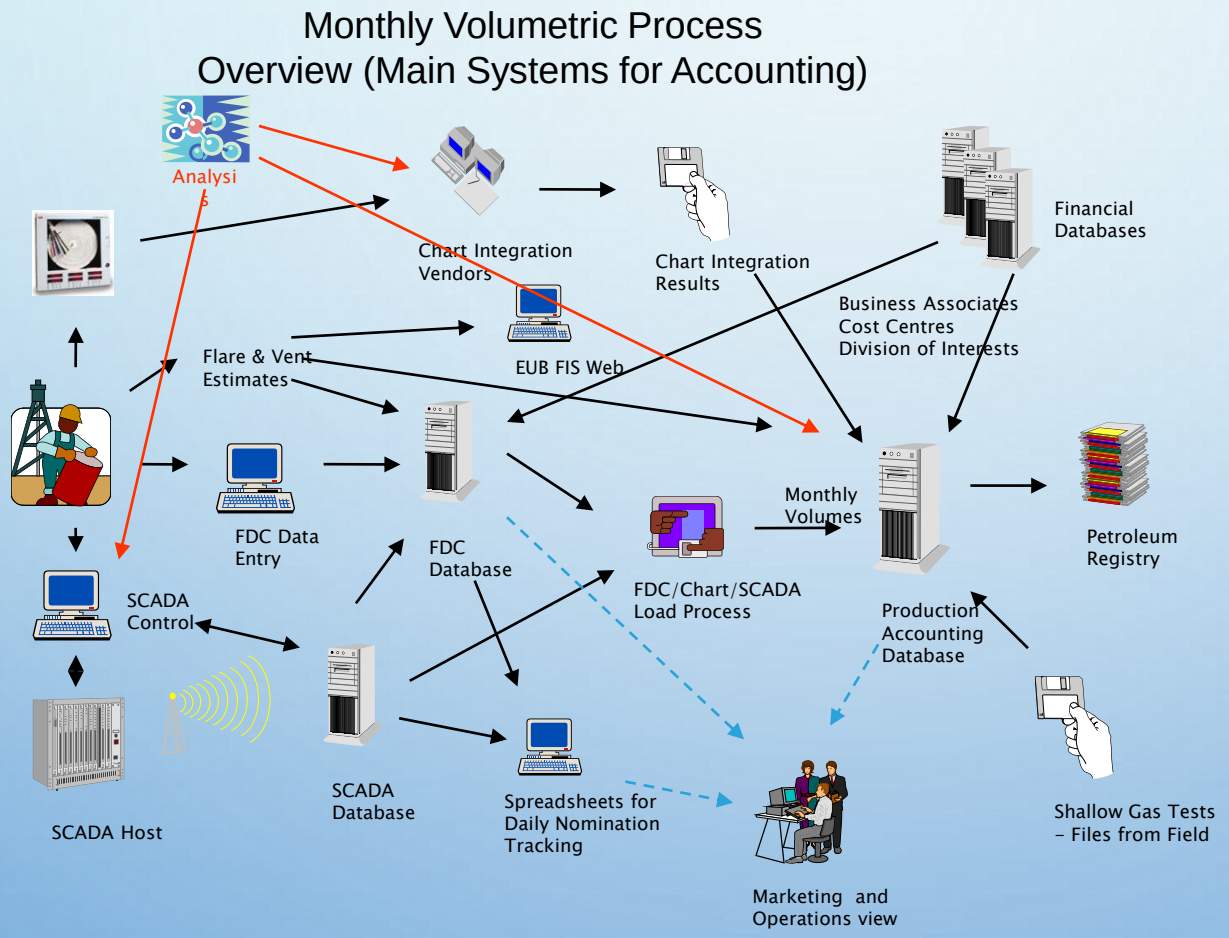
AGENDA

- OVERVIEW OF THE MEASUREMENT PROCESS
- DOLLAR IMPACT
- DEFINITION OF UNACCOUNTED FOR GAS LOSS
- CAUSES OF UAF
- UAF REDUCTION PROCESS
- RESOLVING SYSTEM BALANCING ISSUES
- IMPROVING MEASUREMENT INTEGRITY
- CONCLUSION

OVERVIEW OF THE MEASUREMENT PROCESS

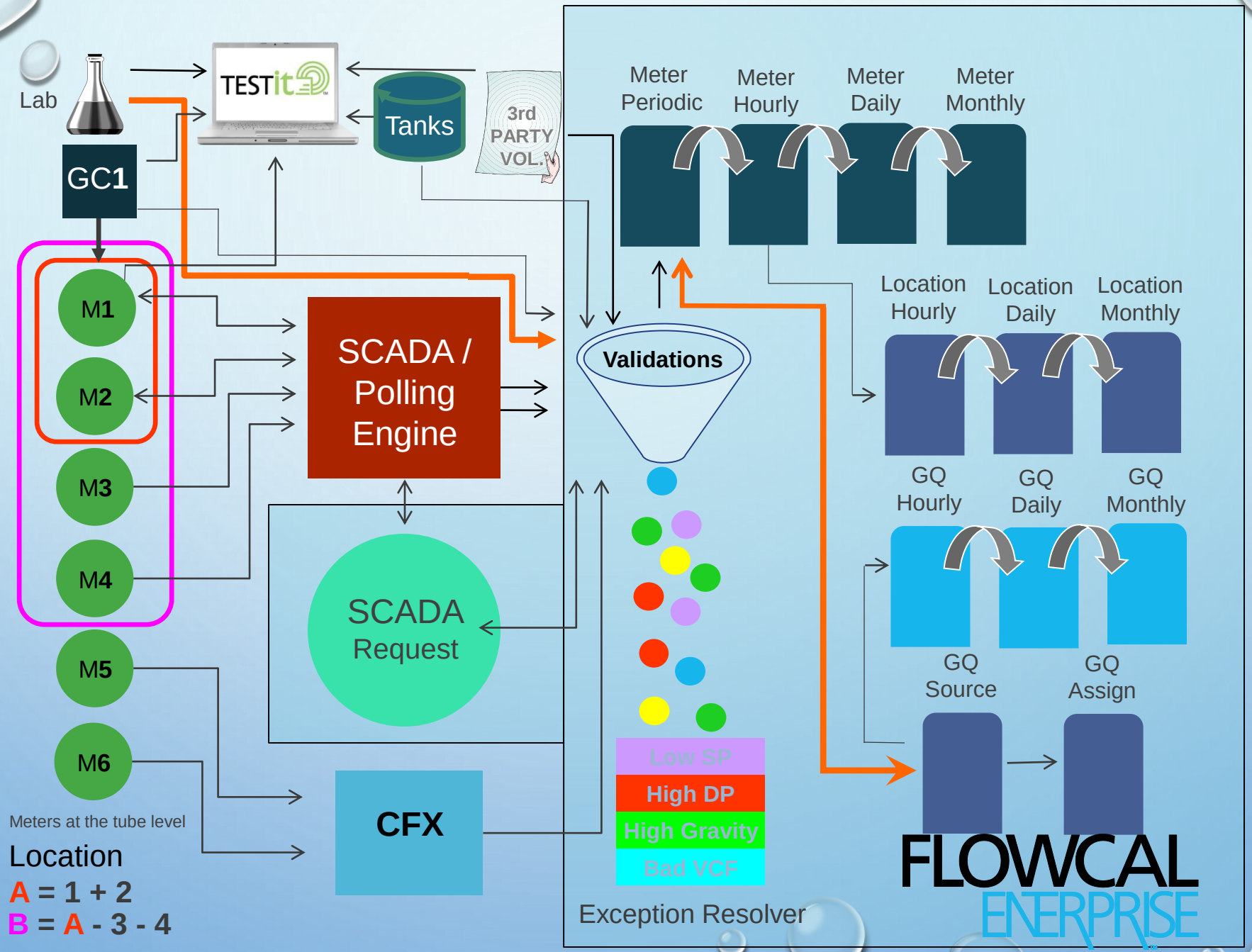
CYLINDER STATUS
EMPTY
IN USE

MEASUREMENT ECO-SYSTEMS ARE TYPICALLY UN-INTEGRATED



CHARACTERISTICS

- UN-INTEGRATED
- ONE-WAY
- NO HISTORY
- REAL TIME /OPERATIONAL
- DATA ISLANDS
- COMPLEX
- SLOW/MONTHLY


Lab
TESTit
Tanks
3rd PARTY VOL.
GC1
M1
M2
M3
M4
M5
M6
Meters at the tube level
Location
A = 1 + 2
B = A - 3 - 4
SCADA / Polling Engine
SCADA Request
CFX
Validations
Low SP
High DP
High Gravity
Bad VCF
Exception Resolver
Meter Periodic
Meter Hourly
Meter Daily
Meter Monthly
Location Hourly
Location Daily
Location Monthly
GQ Hourly
GQ Daily
GQ Monthly
GQ Source
GQ Assign
FLOWCAL ENERPRISE

DOLLAR IMPACT

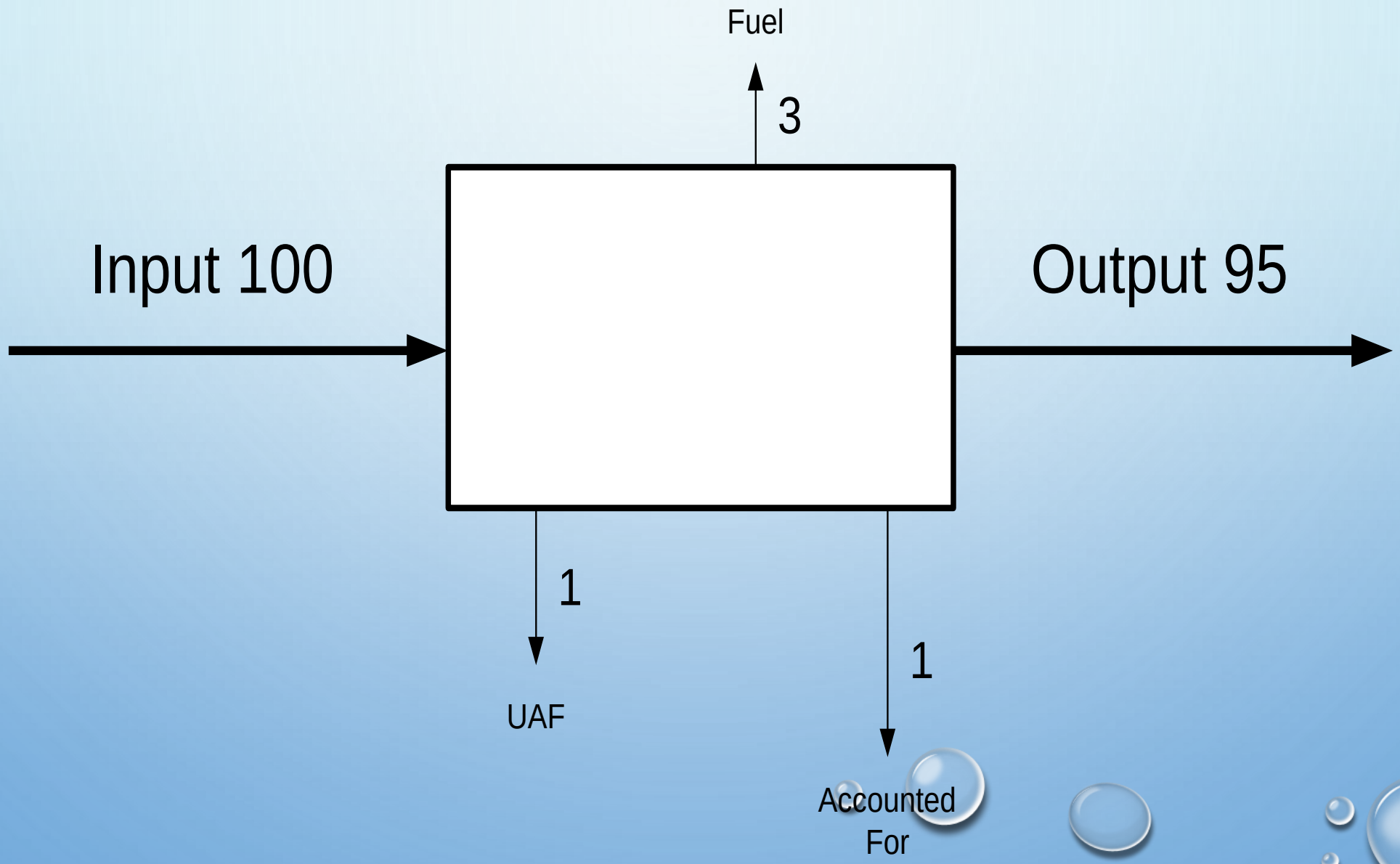
$3.00 Per Dekatherm						
Annual Dekatherm Throughput	Loss Using .25% UAF	Annual UAF Loss				
		0.40%	0.60%	0.80%	1%	2%
100,000,000	$750,000	$1,200,000	$1,800,000	$2,400,000	$3,000,000	$6,000,000
250,000,000	$1,875,000	$3,000,000	$4,500,000	$6,000,000	$7,500,000	$15,000,000
500,000,000	$3,750,000	$6,000,000	$9,000,000	$12,000,000	$15,000,000	$30,000,000
1,000,000,000	$7,500,000	$12,000,000	$18,000,000	$24,000,000	$30,000,000	$60,000,000
2,500,000,000	$18,750,000	$30,000,000	$45,000,000	$60,000,000	$75,000,000	$150,000,000
5,000,000,000	$37,500,000	$60,000,000	$90,000,000	$120,000,000	$150,000,000	$300,000,000

$5.00 Per Dekatherm						
Annual Dekatherm Throughput	Loss Using .25% UAF	Annual UAF Loss				
		0.40%	0.60%	0.80%	1%	2%
100,000,000	$1,250,000	$2,000,000	$3,000,000	$4,000,000	$5,000,000	$10,000,000
250,000,000	$3,125,000	$5,000,000	$7,500,000	$10,000,000	$12,500,000	$25,000,000
500,000,000	$6,250,000	$10,000,000	$15,000,000	$20,000,000	$25,000,000	$50,000,000
1,000,000,000	$12,500,000	$20,000,000	$30,000,000	$40,000,000	$50,000,000	$100,000,000
2,500,000,000	$31,250,000	$50,000,000	$75,000,000	$100,000,000	$125,000,000	$250,000,000
5,000,000,000	$62,500,000	$100,000,000	$150,000,000	$200,000,000	$250,000,000	$500,000,000

DEFINITION - UNACCOUNTED FOR GAS LOSS

- THE UNACCOUNTED FOR GAS LOSS IS SIMPLY THE DIFFERENCE OF THE PHYSICAL INPUTS MINUS THE PHYSICAL OUTPUTS OF THE PIPELINE SYSTEM.
- A “LOSS” OCCURS WHENEVER THE PHYSICAL INPUTS ARE GREATER THAN OUTPUTS OF THE PIPELINE SYSTEM
- A “GAIN” OCCURS WHENEVER THE PHYSICAL OUTPUTS ARE GREATER THAN INPUTS OF THE PIPELINE SYSTEM.

In - Out = UAF



PHYSICAL BALANCE REPORT - UAF

- RECEIPTS _____

- LESS:
- DELIVERIES _____
- FUEL USED _____
- GAS TO ATMOSPHERE _____
- LIQUIDS REMOVED _____
- LINEPACK CHANGE +/- _____

- LOSS / GAIN _____
- PERCENTAGE _____

CAUSES OF UAF

- LEAKAGE
  - REGULATORS / CONTROLLERS
  - DEHYDRATORS
  - HEATERS
  - COUPLINGS
- METER INACCURACIES
  - INCORRECT PLATE SIZE, DIRTY PLATE OR PLATE INSTALLED INCORRECT
  - TRANSMITTER RANGES
  - GAUGE LINES
  - BETA RATIOS
  - DIRTY OR DAMAGED METER TUBES

CAUSES OF UAF (CONTINUED)

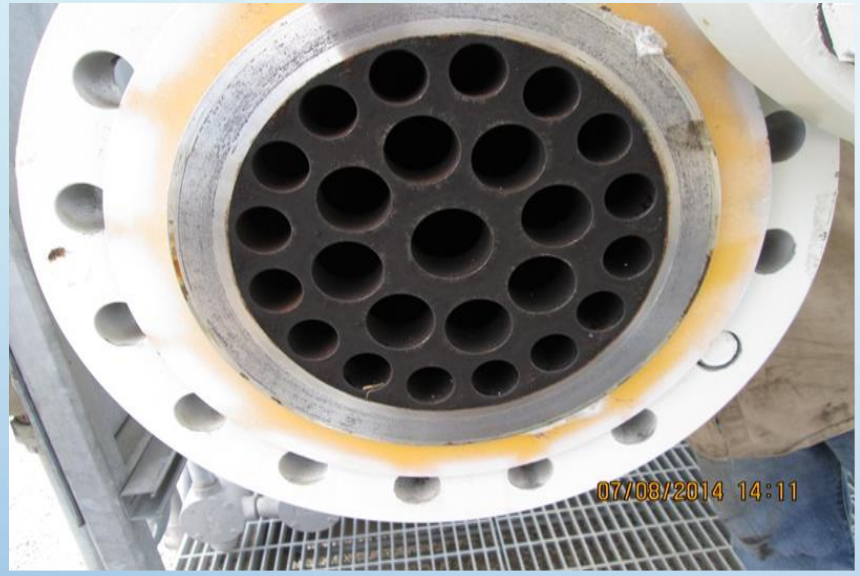
- METER INACCURACIES
  - DOCUMENTATION AND PROCESSING OF METER TEST AND CALIBRATION
  - PULSATION
- PRESSURE REGULATION
  - CRITICAL FOR LDCS
- UNREPORTED GAS LOSS
  - UNMEASURED FUEL
  - COMPANY USE
  - CONSTRUCTION ACTIVITY
- INCORRECT INPUT / OUTPUT CODING

CAUSES OF UAF (CONTINUED)

- THEFT
- LINE PACK
- GAS QUALITY RELATIONSHIPS
  - ONLINE CHROMATOGRAPH / DAILY CHROMATOGRAPH / MONTHLY SAMPLE / ANNUAL SAMPLE / ??
  - SPOT / CONTINUOUS
- 3RD PARTY MEASUREMENT
- TIMING OF UAF TYPE EVENTS
- KEYPUNCH ERRORS

RARELY IS A SYSTEM GAS LOSS DUE TO A SINGLE ISSUE. TYPICALLY, IT IS THE SUM OF NUMEROUS ISSUES.

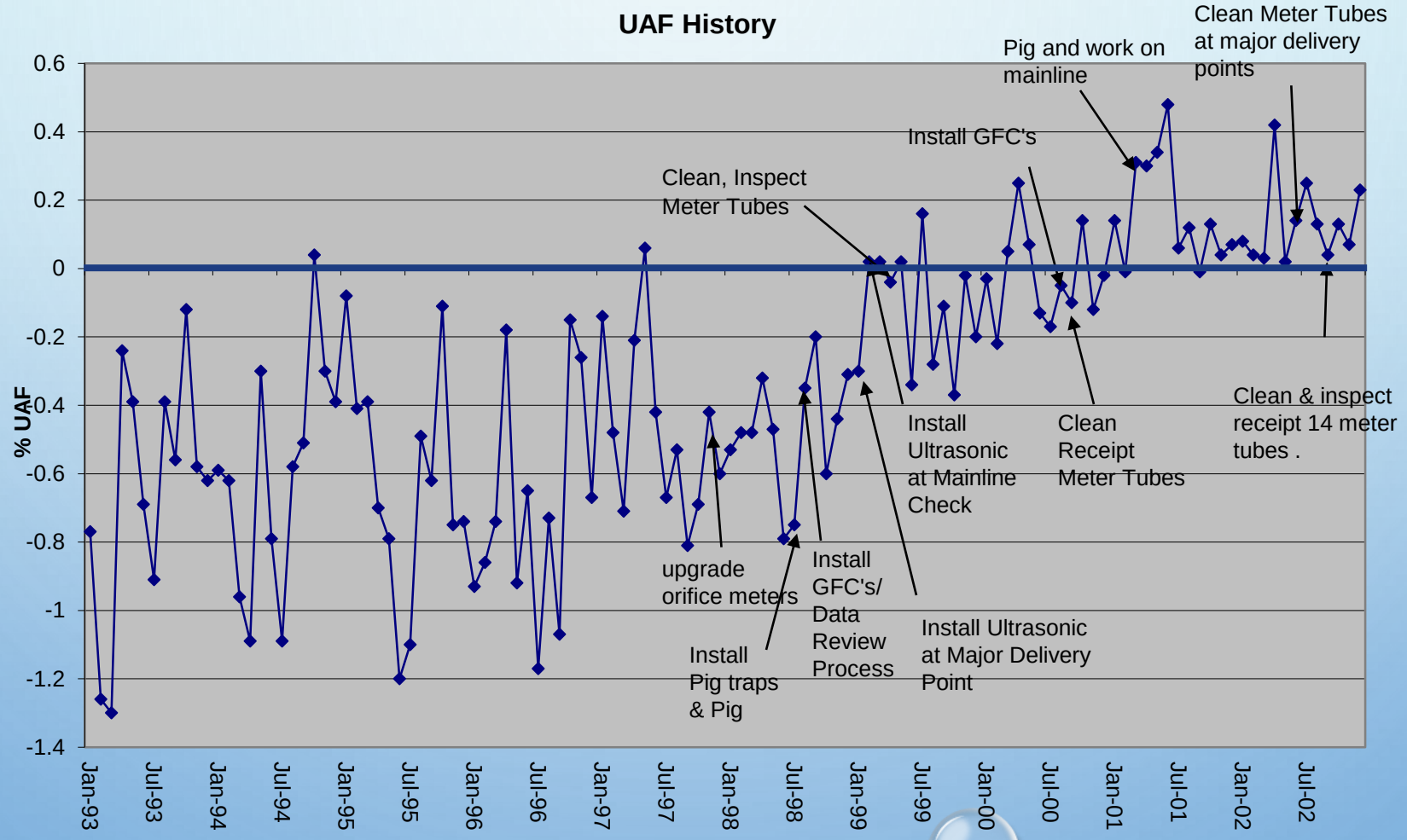
A CLEAN METER IS IMPORTANT



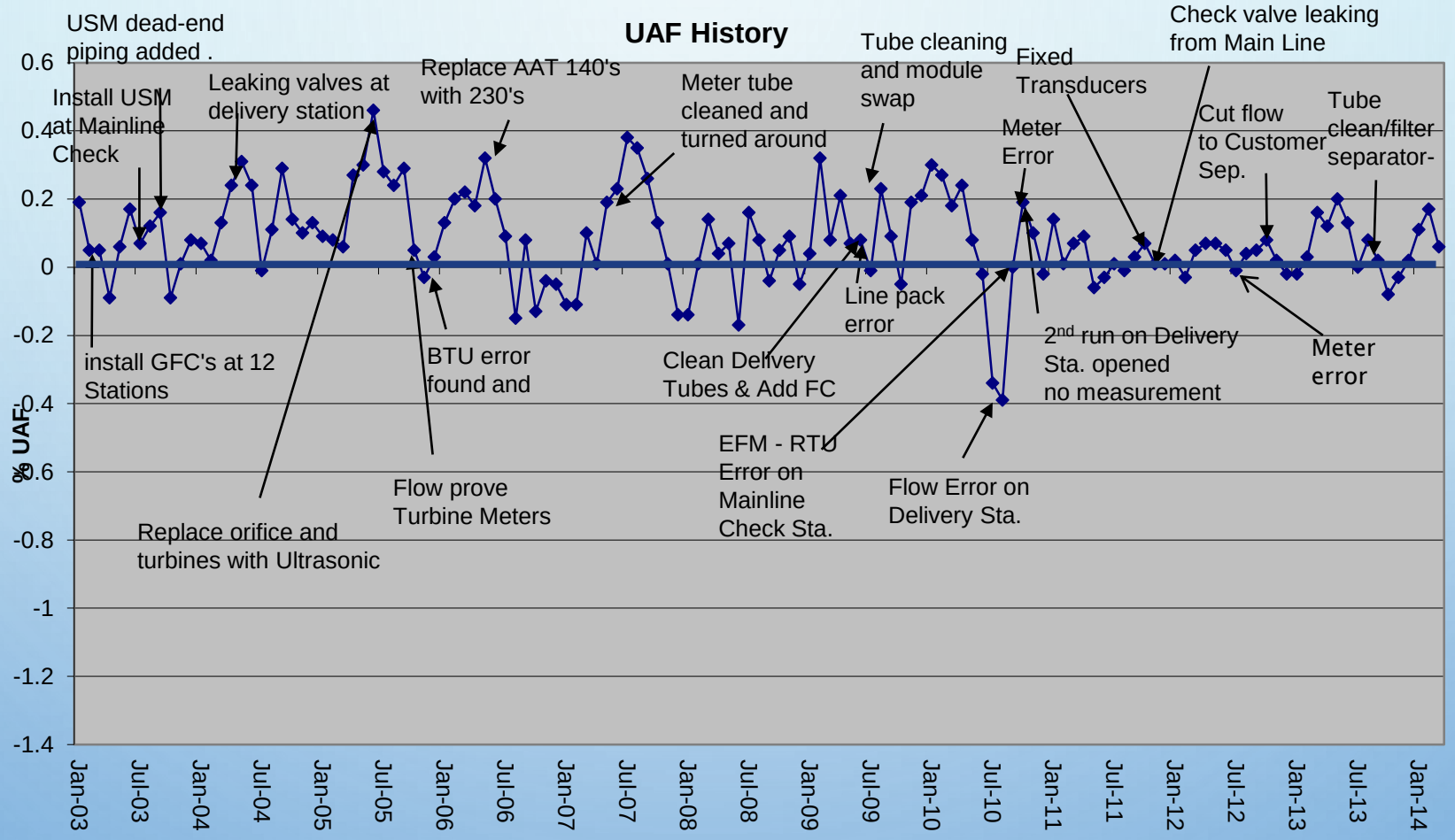
- (0.5%) DIFFERENCE BETWEEN METER AND DOWNSTREAM CHECK METER BEFORE METER WAS CLEANED.
- 0.03% DIFFERENCE AFTER METER WAS CLEANED.

UAF REDUCTION PROCESS

TYPICAL UAF PROJECT



UAF – CONTINUING EFFORT



UAF REDUCTION PROCESS

- SEGMENTATION LEVEL
  - METER
  - STATION
  - SEGMENT
  - BALANCE
- SEGMENTATION BOUNDARIES
  - AREA / REGION
  - PROVINCE / STATE
  - COUNTRY
  - CHECK METER

WHY USE SYSTEM SEGMENTATION

- HELPS ISOLATE THE UAF ISSUE.
- REDUCES THE NUMBER OF METERS THAT NEED TO BE INSPECTED WHEN A LOSS IS DETECTED.
- HELPS WITH THE DETECTION OF SMALLER VOLUME ISSUES AFFECTING THE BALANCE.
- SEGMENTATION ONLY HELPS IF DONE RIGHT!
  - SEGMENTATION METERING SHOULD BE INSTALLED AND MAINTAINED AS CUSTODY QUALITY METERING.
  - TESTING AND SAMPLING SHOULD FOLLOW THE SAME PROCEDURES AS CUSTODY METERING.

HOURLY, DAILY, MONTHLY LEVEL STATION, SEGMENT, AND BALANCE LEVEL VALIDATION

- VALIDATE TOTALS FOR AN HOUR RELATING TO SPLIT RECORDS OR QUARTER HOUR DATA
- DAILY AND MONTHLY LEVEL VALIDATION
  - CONTRACT QUANTITIES
  - REASONABLE DAILY AND MONTHLY QUANTITIES
  - PLUNGER LIFT WELLS
  - BATCHED TOTALS
- STATION, SEGMENT, AND BALANCE SUMMARY LEVEL VALIDATION

SYSTEM_UAF [SYSTEM_UAF]

Type Filter
List Location Meter
Number: SYSTEM_UAF
Name: SYSTEM_UAF

By Location By Meter

Resolution
Hourly
Daily
Monthly

Date Range
Contract Month
Contract Days
Date Time
From: December 2009
To: February 2010

Revision
Current Original

Number of decimals for volume and energy: 0

Measured | Standard | PPA - Meas | PPA - Std | Analysis | Balance - Meas | Balance - Std | Custom

Effective Date	Volume	Energy	Flow Time	Pressure	Temperature	Liquefiable	Completion	GMS Date
12/01/2009 09:00:00	0	0	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 10:00:00	2	2	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 11:00:00	4	4	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 12:00:00	6	6	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 13:00:00	8	8	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 14:00:00	10	10	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 15:00:00	12	12	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 16:00:00	14	14	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 17:00:00	16	16	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 18:00:00	18	18	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 19:00:00	10	10	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 20:00:00	1	1	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 21:00:00	3	3	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49
12/01/2009 22:00:00	5	5	1:00:00	650.00	65.00	0	Complete	02/08/2010 11:28:49

PPA Closed Show Open Unrolled Data Refresh Exit Print Help

Current Daily Data for Location Number SYSTEM_1

File View Type Traces Scaling Help

Date: November 18, 2009

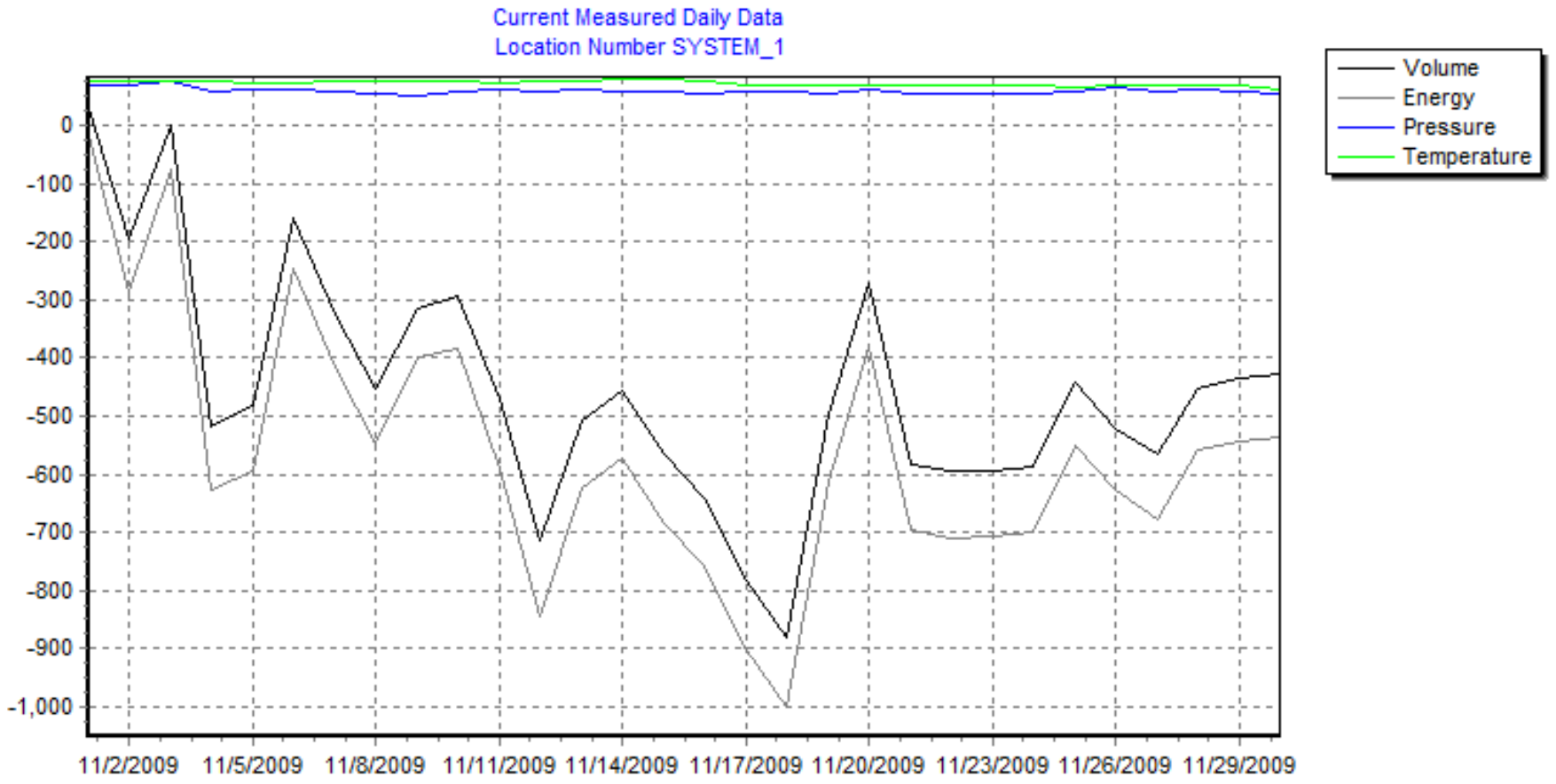
Volume: -883

Energy: -1002

Pressure: 58.670

Temperature: 71.440

Measured | Standard | PPA | Analysis | Balance - Meas | Balance - Stand.



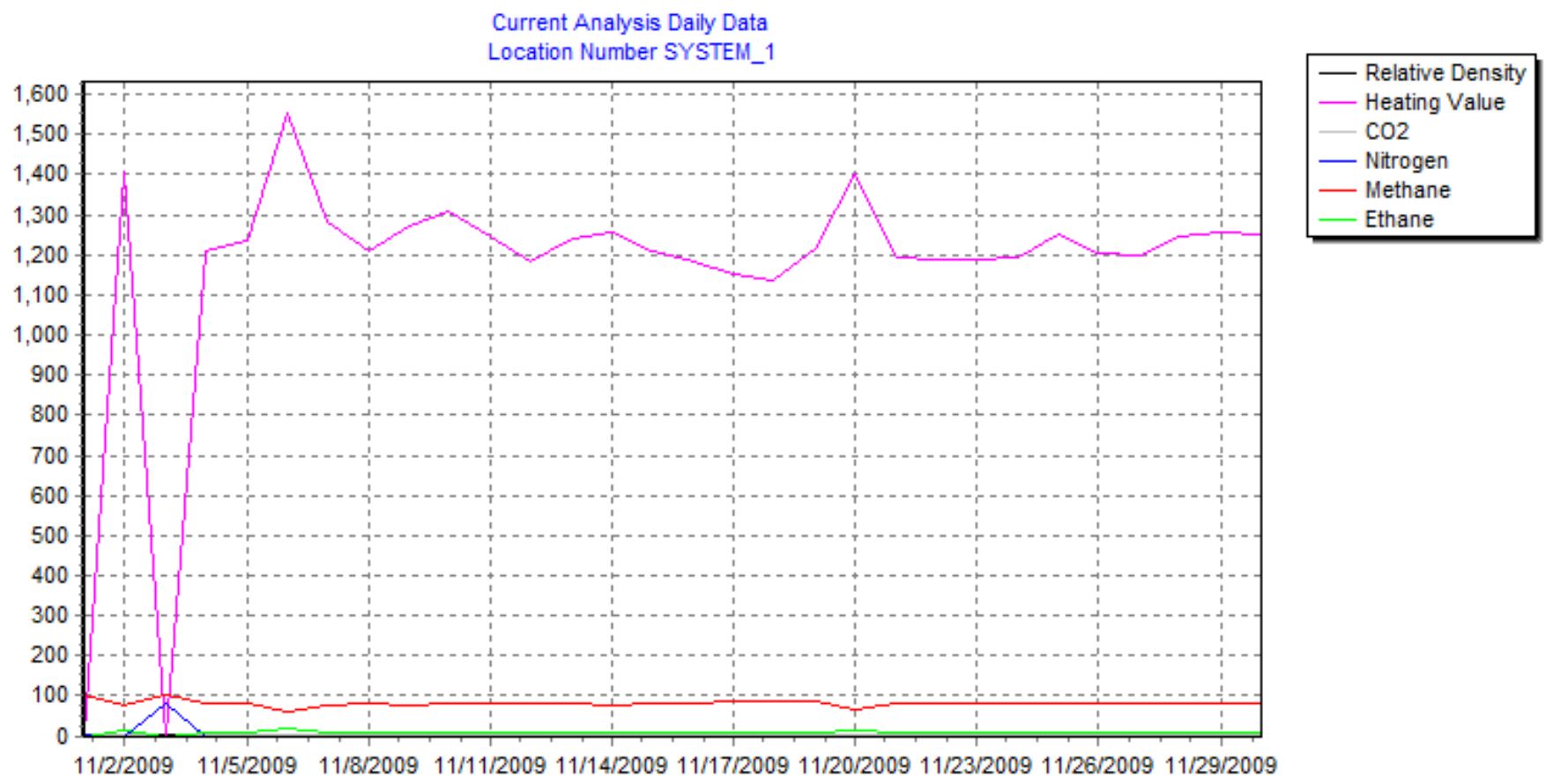
Exit Print Help

Current Daily Data for Location Number SYSTEM_1

File View Type Traces Scaling Help

Date: November 1, 2009	Rel. Density:	0.100	CO2:	0.000	Methane: 100.000
	Heating Value:	0.000	N2:	2.371	Ethane: 0.000

Measured | Standard | PPA | Analysis | Balance - Meas | Balance - Stand.



Exit Print Help

Daily Rollup Viewer

File Options View Type Scaling Show

Date Selections

First April 2010

Conditions

Measured Standard

Data Columns

Volume

Refresh

Graph

View

Location Class Hierarchy

Number

- OVERALL : [OVERALL]
  - SW-02 : Southwes...
  - NE-02 : Northeast ...
  - SW-01 : Southwes...
  - GOM-01 : Gulf of M...

Number	Name	Direction	1	2	3	4	5	6	7	8	9	10	11
L&U Vol			6	80	-81	-121	-256	-524	-671	-791	-856	-835	-963
L&U Ene			6	83	-84	-126	-266	-544	-696	-820	-888	-866	-999
L&U Vol %			2.28	1.26	-1.25	-1.85	-3.91	-7.85	-9.90	-11.53	-12.35	-12.03	-13.81
L&U Ene %			2.20	1.26	-1.25	-1.86	-3.91	-7.86	-9.90	-11.53	-12.35	-12.03	-13.82
SW-01	Southwest Gatheri...		6	80	-81	-121	-256	-524	-671	-791	-856	-835	-963
TGP-01	Western Welhead ...	Receipt	89	2150	2172	2185	2194	2231	2271	2254	2274	2277	2251
TGP-02	Western Wellhead...	Receipt	88	2104	2169	2208	2193	2234	2269	2331	2344	2343	2369
TGP-03	Western Wellhead...	Receipt	86	2101	2114	2136	2168	2207	2240	2274	2314	2321	2351
TGP-15	Western Check TG...	Outlet	269	6435	6374	6408	6299	6148	6109	6068	6076	6106	6008

Ready

duaneh @ DUANE-LT DUANEH @ fc83 NUM Release 8.3.1 5/25/2011 22:46

Monthly Rollup Viewer

File Options View Type Scaling Show

Date Selections

First April 2010

Last May 2010

Conditions

Measured Standard

Data Columns

Volume Heating Value Energy

Refresh

Graph

View

Location Class Hierarchy

Number

- OVERALL : [OVERALL]
  - SW-02 : Southwes...
  - NE-02 : Northeast ...
  - SW-01 : Southwes...
  - GOM-01 : Gulf of M...

Number	Name	Direction	04/2010			05/2010		
			Volume	Heating Value	Energy	Volume	Heating Value	Energy
L&U			-16056		-16660	7720		8000
L&U %			-8.24		-8.24	3.80		3.80
SW-01	Southwest Gatheri...		-16056	1037.00	-16660	7720	1037.00	8000
TGP-01	Western Welhead ...	Receipt	63452	1037.00	65802	64896	1037.00	67299
TGP-02	Western Wellhead...	Receipt	67171	1037.00	69660	72092	1037.00	74762
TGP-03	Western Wellhead...	Receipt	64318	1037.00	66698	66104	1037.00	68552
TGP-15	Western Check TG...	Outlet	178885	1037.00	185500	210812	1037.00	218613

Ready

duaneh @ DUANE-LT DUANEH @ fc83 NUM Release 8.3.1 5/25/2011 22:47

Graph Tool

File Edit View Type Scaling Traces Gradient

Graph options

Date Selections

First April 2010

Last May 2010

Resolution

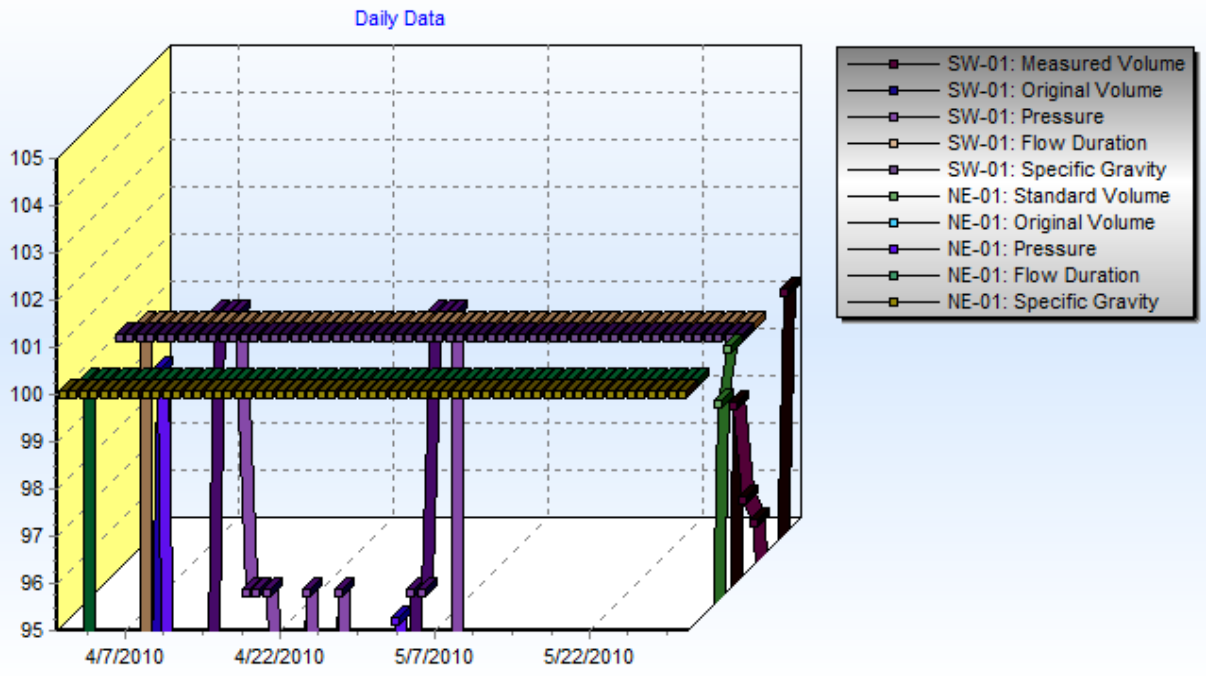
- Hourly
- Daily
- Monthly

Select Parameters

	Name	Variable	Trace
	SW-01	Measured	☑
	SW-01	Original Volume	☑
	SW-01	Pressure	☑
	SW-01	Flow Duration	☑
	SW-01	Specific Gravity	☑
	NE-01	Standard Volume	☐
	NE-01	Original Volume	☑
	NE-01	Pressure	☑
	NE-01	Flow Duration	☑
	NE-01	Specific Gravity	☑

Clear All

Plot



	04/01/2010	04/02/2010	04/03/2010	04/04/2010	04/05/2010	04/06/2010	04/07/201
SW-01: Measured Volume	6	80	-81	-121	-256	-524	-671
SW-01: Original Volume	--	--	--	--	--	--	--
SW-01: Pressure	213	214	216	218	217	218	221
SW-01: Flow Duration	3600	86400	86400	86400	86400	86400	86400
SW-01: Specific Gravity	0	0	0	0	0	0	0
NE-01: Standard Volume	9	118	174	177	133	135	155
NE-01: Original Volume	--	--	--	--	--	--	--
NE-01: Pressure	212	212	215	217	215	217	218
NE-01: Flow Duration	3600	86400	86400	86400	86400	86400	86400
NE-01: Specific Gravity	0	0	0	0	0	0	0

duaneh @ DUANE-LT DUANEH @ fc83 Release 8.3.1 5/25/2011 22:57

NGL BALANCE VIEWER

NGL Balance Viewer

File Options View Type Scaling Show

Date Selections
Daily Monthly
First January 2011

Conditions
Measured Standard

View
Location Class Hierarchy

Refresh

Number
DCP : DCP
METER_6X : Meter Six X
SE-1 : SE-1

Number	Name	01/2011										
		C2	C3	IC4	NC4	IC5	NC5	C6	C7	C8	C9	C10
L&U		-128050.84	-131223.85	-60454.36	-8556.13	-19765.47	-32625.67	-31948.72	-35963.33	-1089584.91	-43890.29	-47812.04
L&U %												
METER2	METER2	1.93	0.34	0.02	0.02							
METER3	METER3	5630.34	5548.22	2547.47	361.92	832.76	1373.88	1345.77	1514.43	46850.05	1848.23	2013.38
METER5	METER5	777.23	135.30	6.66	6.48							
METER4	METER4	136643.24	137370.46	63073.83	8960.83	20618.62	34016.37	33320.39	37496.31	1137008.71	45761.16	49850.08
NWPL1	NWPL METER1	1.53	0.31	0.04	0.04	0.02		0.01				

Ready

duaneh @ DUANE-LT DUANE @ fc8 NUM Release 8.8.0.1 3/27/2012 23:31

UAF REDUCTION PROCESS

- LEAKAGE
  - LEAK REPORT SURVEY
  - GAS CONTROL LOG NOTES
  - SOAP TEST EQUIPMENT
  - IDENTIFY ALL UNMEASURED VENTING OF GAS
- METER INACCURACIES
  - VERIFY ORIFICE PLATES SIZES AND CONDITION
  - REMOVE GAUGE LINES
  - MAINTAIN BETA RATIOS
  - INSPECTION OF METER TUBE

UAF REDUCTION PROCESS

- METER INACCURACIES CONT.
  - VALIDATE CERTIFICATION OF CALIBRATION EQUIPMENT
  - ENSURE FIELD UNDERSTANDING OF TEST AND CALIBRATION STANDARD OPERATING PROCEDURES
  - REVIEW ALL TEST AND CALIBRATION REPORTS FOR ACCURACY AND PROCESS REQUIRED PPAS
- PRESSURE REGULATION
  - VERIFY REGULATORS USE FOR FIXED FACTOR BILLING
  - MAINTAIN THE LOWEST LINE PRESSURE POSSIBLE
- UNREPORTED GAS LOSS
  - IDENTIFY ALL UNMEASURED FUEL
  - IDENTIFY ALL COMPANY USE GAS LOSS

UAF REDUCTION PROCESS

- UNREPORTED GAS LOSS CONT.
  - IDENTIFY ALL COMPANY USE GAS LOSS
  - QUANTIFY AND REPORT CONSTRUCTION ACTIVITY TIMELY
- INCORRECT INPUT / OUTPUT CODING
  - DEVELOP COMMUNICATION FRAMEWORK TO VERIFY METER CODING
  - INLET / OUTLET / METER BEHIND METER / PROPER SEGMENT
- THEFT
  - KEEP YOUR EYES OPEN
  - PERFORM ANNUAL METER USAGE COMPARISONS

UAF REDUCTION PROCESS

- LINE PACK
  - QUANTIFY LINE PACK IN SEGMENTS
  - CALIBRATE PRESSURE TRANSMITTERS
- GAS QUALITY RELATIONSHIPS
  - ENSURE TIMELY GAS QUALITY DATA - ONLINE CHROMATOGRAPH / DAILY CHROMATOGRAPH / MONTHLY SAMPLE / ANNUAL SAMPLE
  - VERIFY CONTINUOUS SAMPLERS ARE FUNCTIONING PROPERLY
- 3RD PARTY MEASUREMENT
  - WITNESS TESTS

SHALE GAS CHALLENGES

- MEASURING AND SAMPLING GAS THAT IS AT HYDROCARBON DEW POINT TEMPERATURE AND PRESSURE.
- MEASURING AND SAMPLING NON-STABILIZED LIQUIDS THAT ARE AT FLASH POINT.
- MEASURING GAS THAT IS OUTSIDE THE AGA-8 LIMITS.
- OXYGEN IN THE GAS STREAM FROM PRODUCERS VAPOR RECOVERY SYSTEMS

UAF REDUCTION PROCESS

- TIMING OF UAF TYPE EVENTS
  - TRY TO COORDINATE GAS LOS EVENTS TO THE CORRECT GAS DAY AND TIME IF POSSIBLE
  - COORDINATE WITH GAS CONTROL AND/OR FIELD OPERATIONS TO ENSURE ALL GAS LOSS EVENTS ARE RECORDED.
- KEYPUNCH ERRORS
  - UTILIZE VALIDATION AND EXCEPTION REPORTING TO IDENTIFY ERRORS
  - UTILIZE MASTER CHARACTERISTICS TO IDENTIFY FIELD KEY PUNCH ERRORS

UAF REDUCTION PROCESS

- CORPORATE OFFICE VERIFICATIONS
  - MEASUREMENT SYSTEM DATA
  - THIRD PARTY REPORTED VOLUMES
  - PROCESSING PLANTS
  - SYSTEM GAS LOSS EVENTS
  - METER STATION OPERATIONS
  - UNACCOUNTED FOR GAS REPORTS
- FIELD VERIFICATION OF METER STATION DATA

IMPROVING MEASUREMENT INTEGRITY

IMPROVING MEASUREMENT INTEGRITY

- EASILY IDENTIFY CRITICAL METER, STATION, SEGMENT, AND BALANCE ISSUES IN YOUR ORGANIZATION
- RESOLVE MEASUREMENT ISSUES PRIOR TO CLOSING – REDUCED PPA'S (PRIOR PERIOD ADJUSTMENTS)
- IDENTIFY TRENDS IN TRANSMITTER, FLOW COMPUTER, PRIMARY DEVICE, AND RELATED EQUIPMENT FAILURES
- REDUCE LOST AND UNACCOUNTED FOR GAS LOSS
- CONSISTENT VALIDATION APPROACH THROUGHOUT YOUR ORGANIZATION

IMPROVING MEASUREMENT INTEGRITY

- IMPROVED COMMUNICATION AND RESOLUTION MANAGEMENT FROM THE FIELD AND OFFICE STAFF.
- ENHANCED IDENTIFICATION UNDERSTANDING FOR FIELD AND OFFICE STAFF.
- PROVIDE TIMELY ACCURATE DATA TO YOUR CUSTOMERS ALMOST REAL TIME BASED ON COMMUNICATION BAND WIDTH AND ISSUE RESOLUTION.
- IMPROVED CUSTOMER SERVICE.

CONCLUSION

- IMPROVED MEASUREMENT PROCESS
- IMPROVED SYSTEM BALANCE
- IMPROVED MEASUREMENT INTEGRITY

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Rocky Mountain Measurement Society

Advancing Hydrocarbon Measurement through cooperative learning.