Data Driven Brewing – Worth Sharing

Presented by Brian Faivre
Tim Alexander

DESCHUTES BREWERY®

Agenda

- Deschutes Brewery
- Data Challenges
- Solution
- A Quick Win
- Results
- Future Plans

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Deschutes Brewery

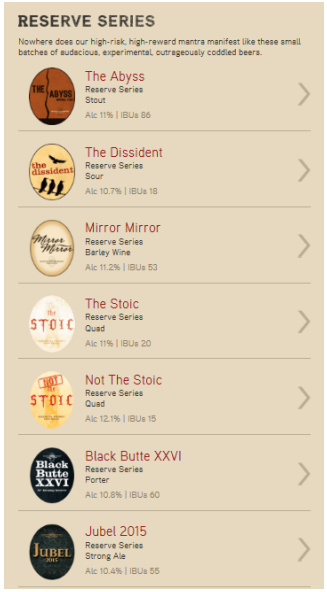
- Located in Bend, OR
- Founded in 1988
- Pub opened in Portland, OR in 2007

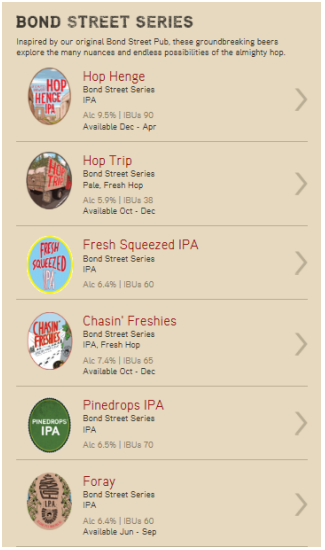
Deschutes Brewery – Production Facility

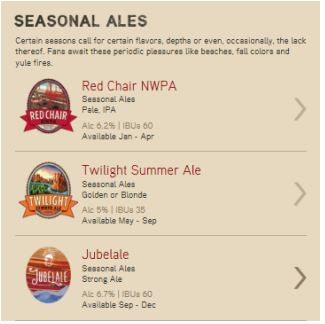
- 2 Brewhouses
- 50+ Vessels
- Bottling and Kegging
- 7th Largest Craft Brewer in the US

Deschutes Brewery – Diverse Brand Mix

- Diverse Brand Mix
- Largest Brand is 22% of Production







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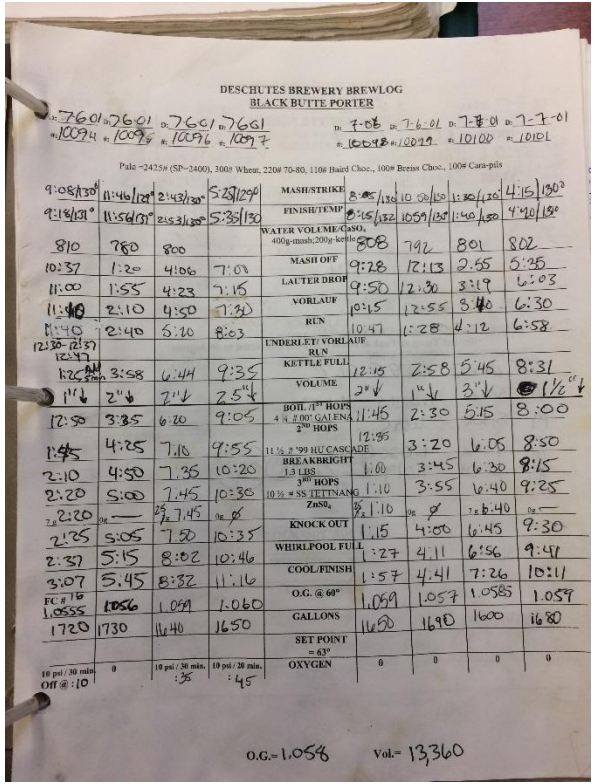
Data Challenges – Paper & Tracking

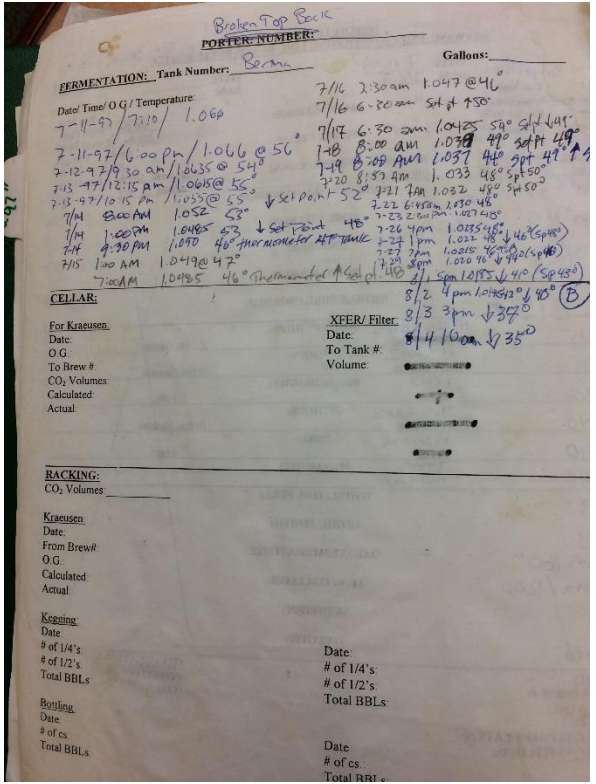


DESCHUTES BREWERY BREWLOG
BLACK BUTTE PORTER

Pale ~2425# (SP–2400), 300# Wheat, 220# 70-80, 110# Baird Choc., 100# Breiss Choc., 100# Cara-pils

MASH/STRIKE	9:08/130°	11:46/128°	2:43/130°	5:25/129°				
FINISH/TEMP	9:18/131°	11:54/135°	2:53/130°	5:35/130				
WATER VOLUME-CaSO4 400g-mash;200g-kettle	810	780	800		808	792	801	802
MASH OFF	10:37	1:20	4:06	7:08	9:28	12:13	2:55	5:35
LAUTER DROP	11:00	1:55	4:23	7:15	9:50	12:30	3:19	6:03
VORLAUF	11:10	2:10	4:50	7:30	10:15	12:55	3:40	6:30
RUN	11:40	2:40	5:10	8:03	10:47	1:28	4:12	6:58
UNDERLET/ VORLAUF	12:30–12:57							
RUN	12:47							
KETTLE FULL	1:25 2nd	3:58	6:44	9:35	12:15	2:58	5:45	8:31
VOLUME	1"↓	2"↓	2"↓	2.5"↓	2"↓	1"↓	3"↓	1½"↓
BOIL /1ST HOPS 4 ¾ # 00' GALENA	12:50	3:35	6:20	9:05	11:45	2:30	5:15	8:00
2ND HOPS 11 ½ # '99 HU CASCADE	1:45	4:25	7:10	9:55	12:05	3:20	6:05	8:50
BREAKBRIGHT 1.3 LBS	2:10	4:50	7:35	10:20	1:00	3:45	6:30	8:15
3RD HOPS 10 ½ # SS TETTNANG	2:20	5:00	7:45	10:30	1:10	3:55	6:40	9:25
ZnSO4	2:20	—	25/8 7.45	Ø	25/8 1:10	Ø	7# 6:40	—
KNOCK OUT	2:25	5:05	7:50	10:35	1:15	4:00	6:45	9:30
WHIRLPOOL FULL	2:37	5:15	8:02	10:46	1:27	4:11	6:56	9:41
COOL/FINISH	3:07	5:45	8:32	11:16	1:57	4:41	7:26	10:11
O.G. @ 60°	FC # 16 1.0555	1.056	1.059	1.060	1.059	1.057	1.0585	1.059
GALLONS	1720	1730	1640	1650	1650	1690	1600	1680
SET POINT = 63°								
OXYGEN	10 psi / 30 min. Off @ :10	0	10 psi / 30 min. :35	10 psi / 26 min. :45	0	0	0	0

O.G.= 1.056 Vol.= 13360



Broken Top Beck

PORTER NUMBER:

Gallons:

FERMENTATION: Tank Number: Berna

Date/ Time/ O.G / Temperature:

7-11-97 / 7:10 / 1.066

7-11-97/6.00 pm/1.066 @ 56°

7-12-97 9:30 am/1.0635 @ 54°

7-13-97/12:15 pm/1.0615 @ 56°

7-14-97/10:15 pm/1.055 @ 55°

7/14 8:00 AM 1.052 52°

7/14 1:00 PM 1.0485 52° ↓ Set Point 48°

7-14 9:30 PM 1.050 48° thermometer 48° tank

7/15 1:00 AM 1.049 @ 47°

7:00 AM 1.0485 46° thermometer 46° tank

7/16 2:30 am 1.047 @ 46°

7/16 6:30 am Set at 45°

7/17 6:30 am 1.0425 50° Set 49°

7/8 8:00 AM 1.039 49° Set 49°

7-19 8:08 AM 1.037 48° Set 49°

7-20 8:57 AM 1.033 48° Set 50°

7-21 7 AM 1.032 48° Set 50°

7-22 6:45 am 1.030 48°

7-23 2:00 pm 1.027 49°

7-24 4 pm 1.0235 48°

7-25 1 pm 1.022 48°

7-26 7 pm 1.0215 46°

7-27 8 pm 1.020 46°

7/28 5 pm 1.0185 46°

8/2 4 pm 1.0142 48°

8/3 3 pm 37°

8/4 10 am 35°

CELLAR:

For Kraeusen:
Date:
O.G.:
To Brew #:
CO_2 Volumes:
Calculated:
Actual:

XFER/ Filter:
Date:
To Tank #:
Volume:

RACKING:
CO_2 Volumes:

Kraeusen
Date:
From Brew#
O.G.:
Calculated:
Actual:

Kegging
Date
# of 1/4's
# of 1/2's
Total BBLs

Date
# of 1/4's
# of 1/2's
Total BBLs:

Bottling
Date
# of cs
Total BBLs

Date
# of cs
Total BBLs

Data Challenges – Integrating Data Systems

Compusense®

Rockwell Automation

Allen-Bradley

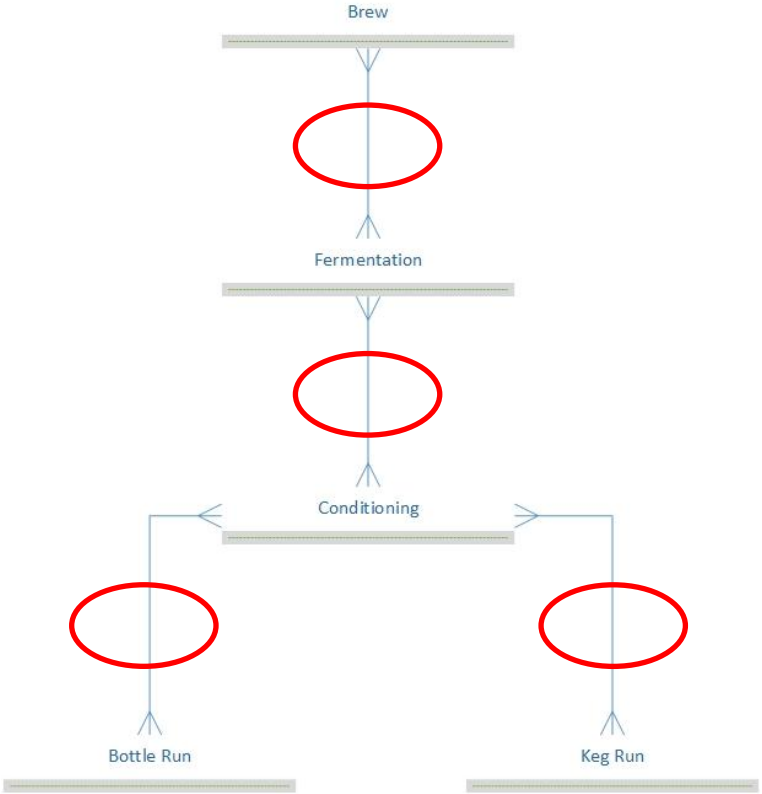
DELTAV™

DESCHUTES BREWERY

Others

Data Challenges – Batch Reporting

- DeltaV / S88
- Many to Many Relations



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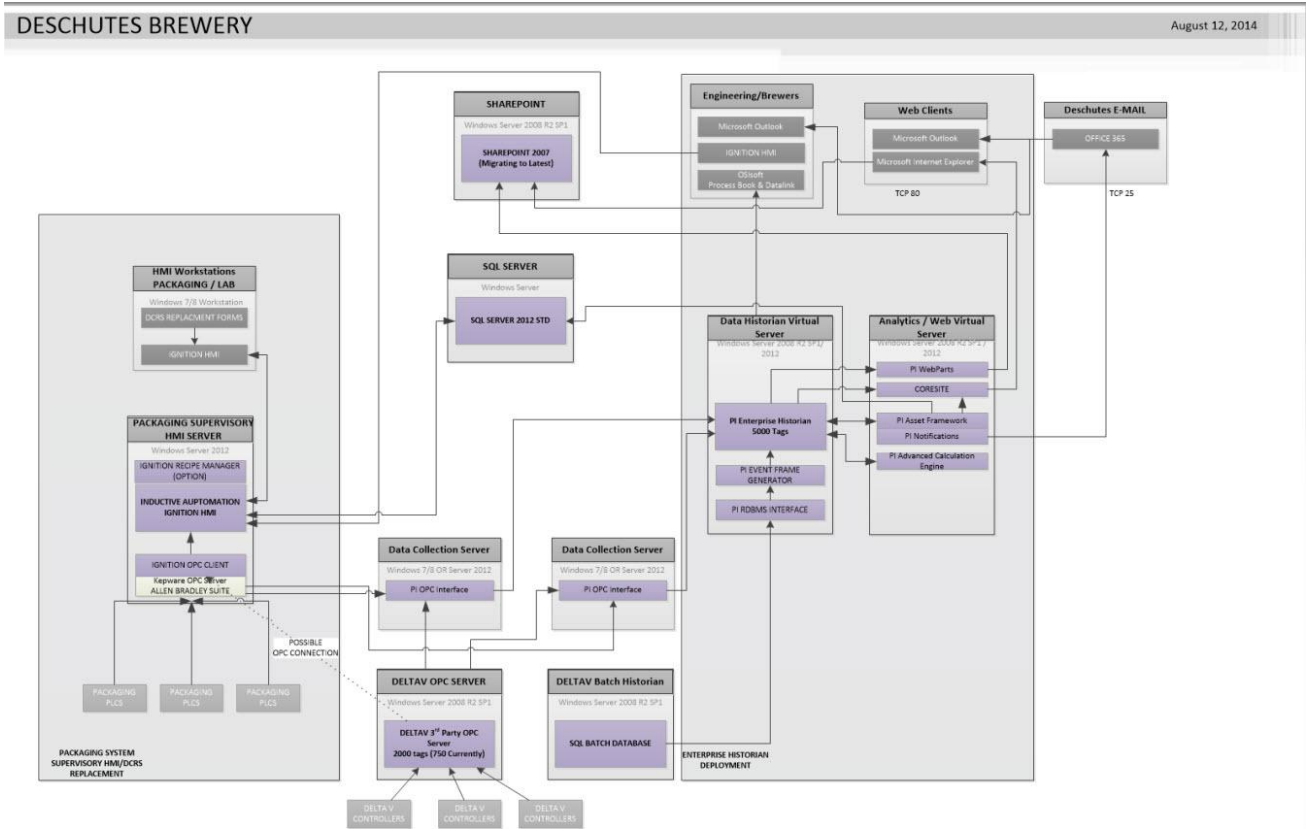
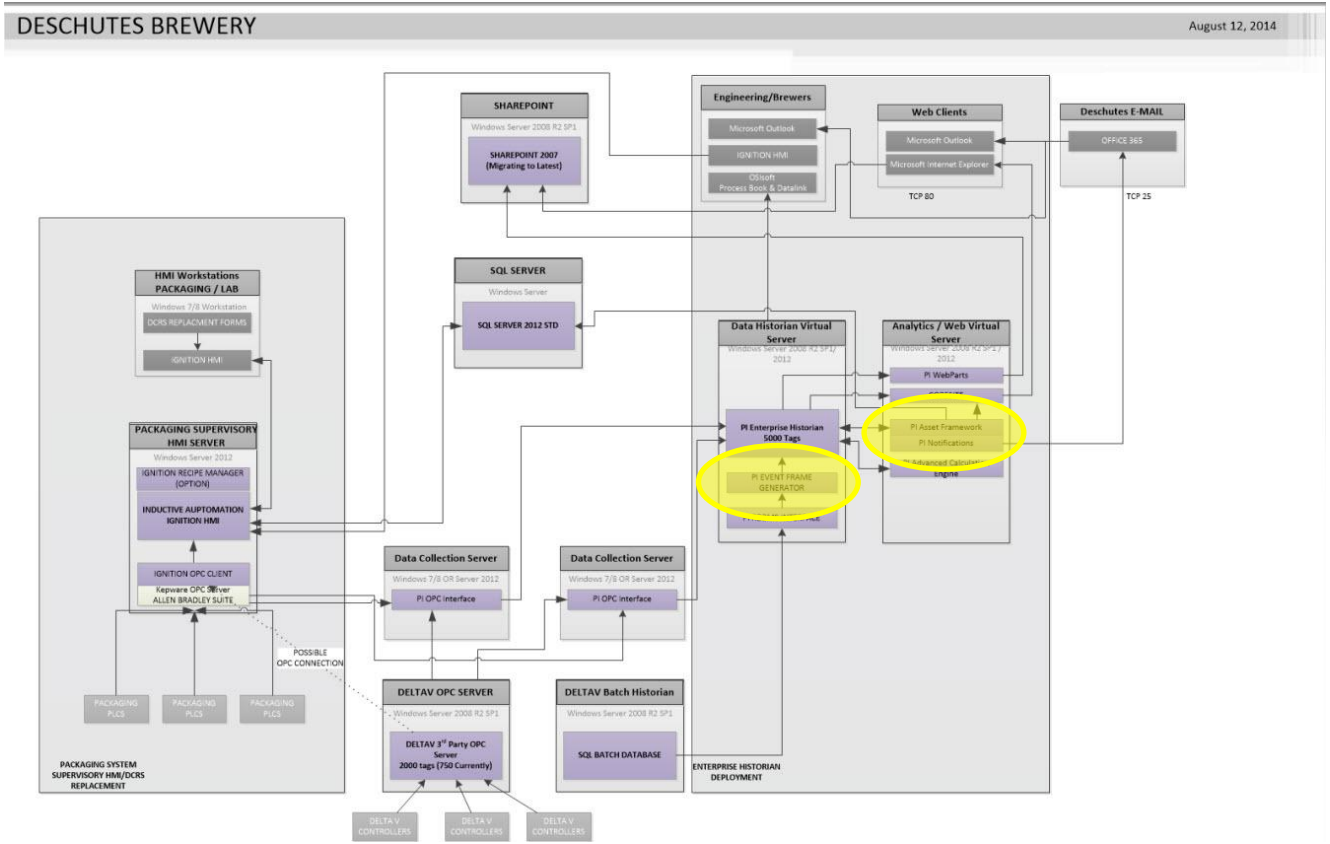
Solution



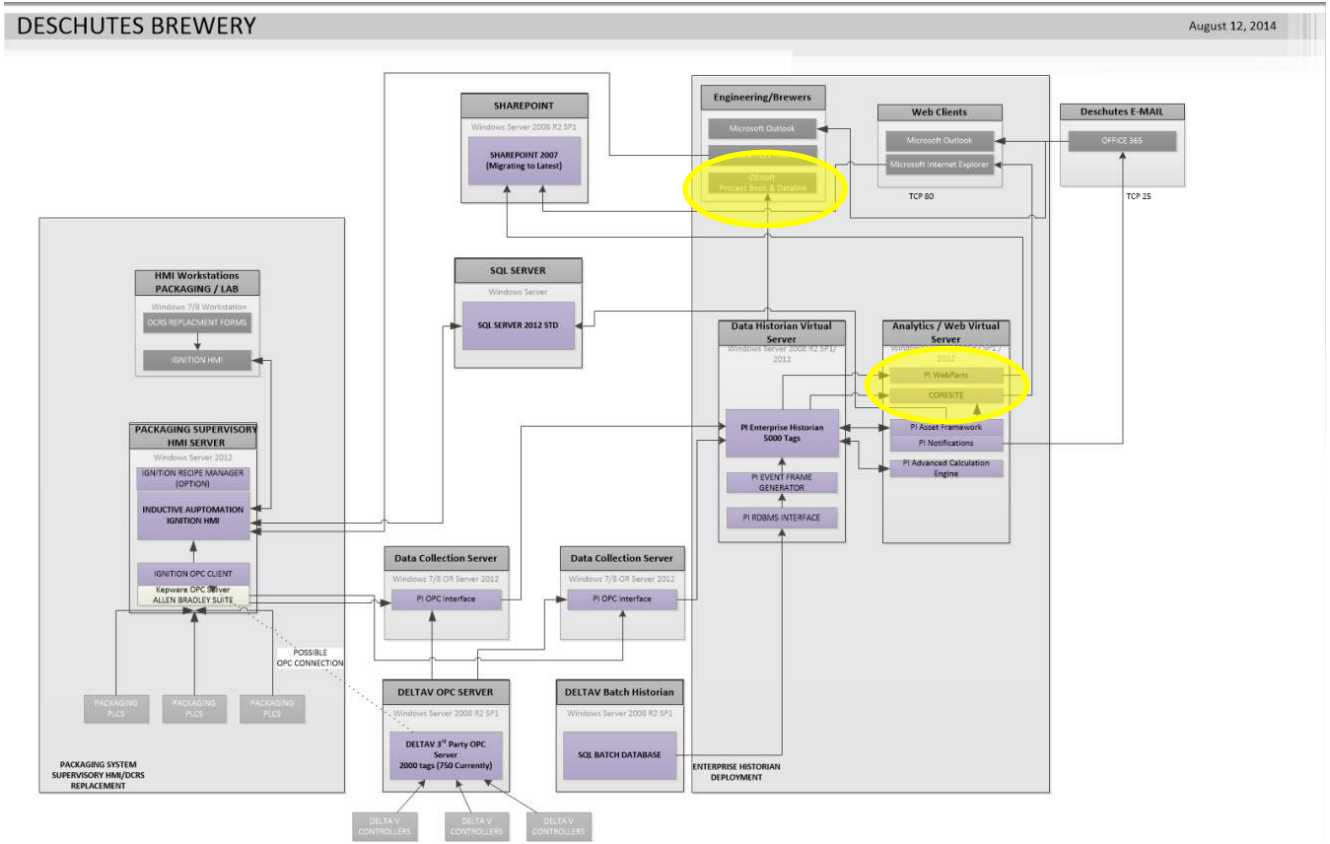
Solution – PI Server

- Asset Framework (AF)
- Event Frames
- Notifications



Solution – Analysis & Visualization

- PI ProcessBook
- PI DataLink
- PI Coresight
- PI WebParts



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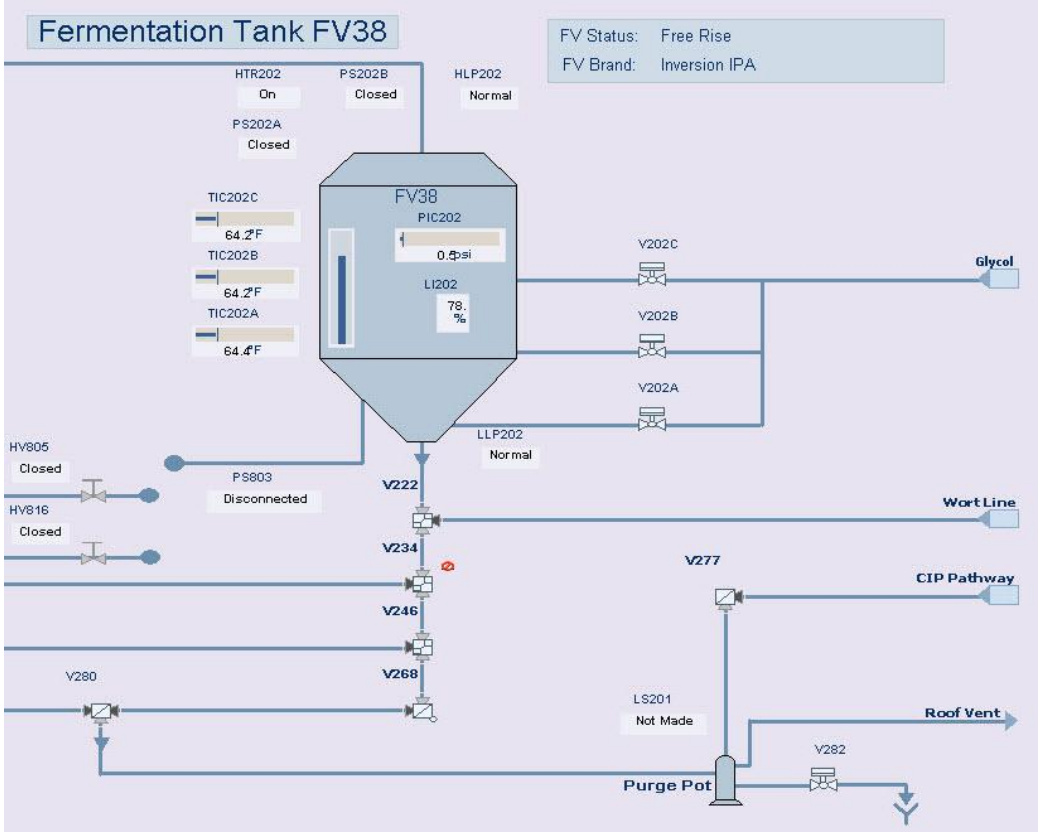
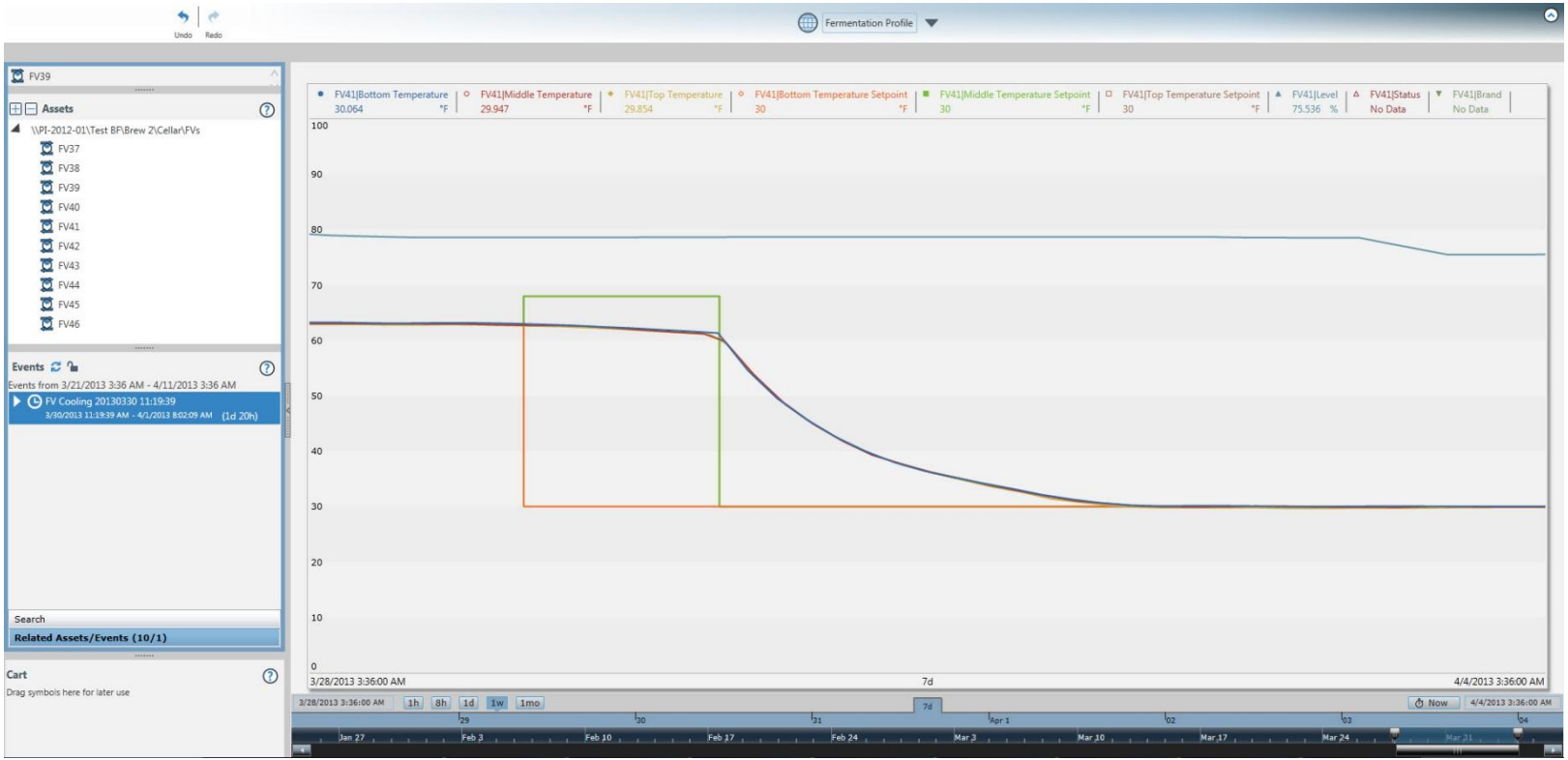
A Quick Win - The Problem

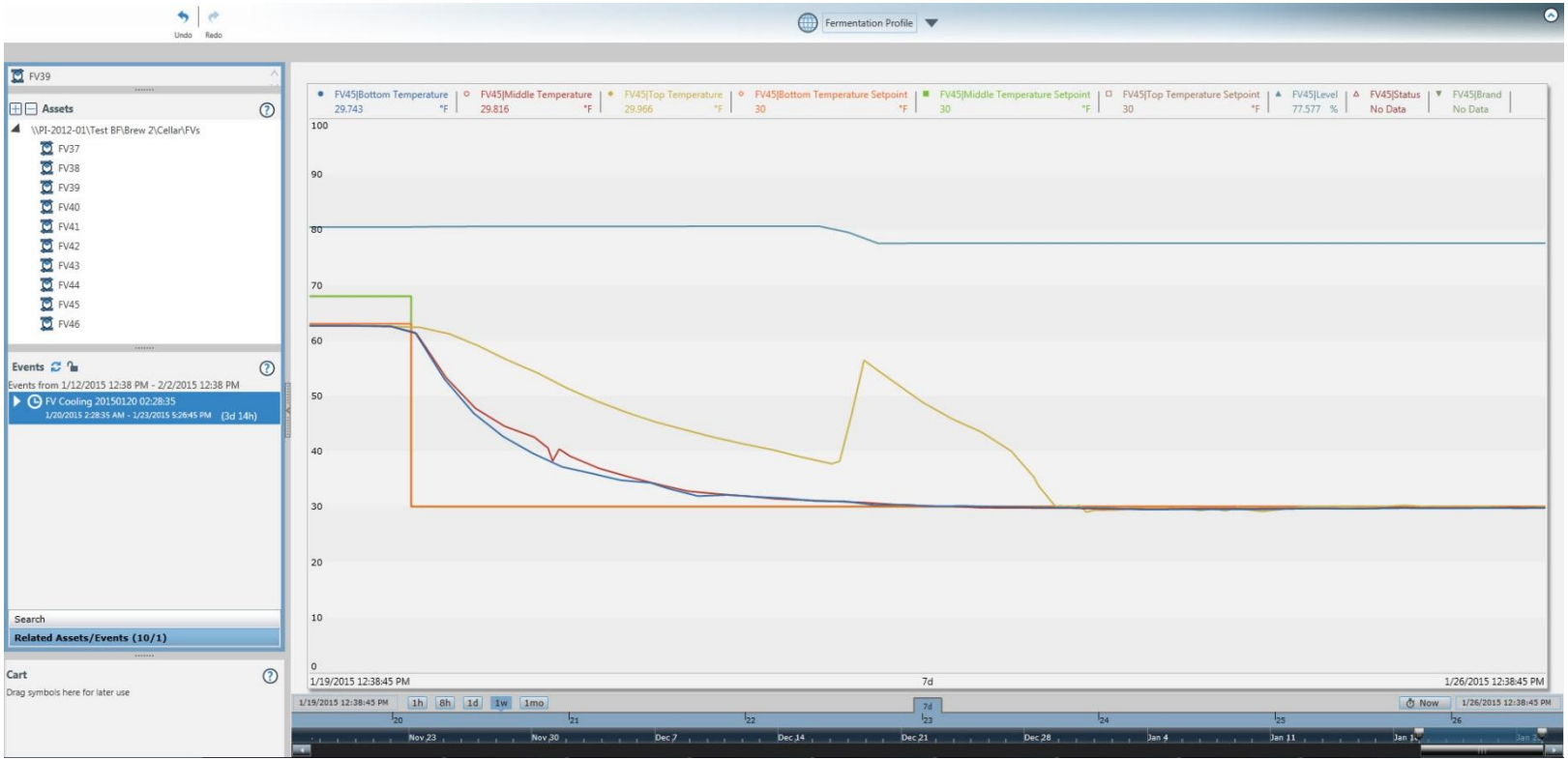
- FV Stratification
- Phased Install of FVs
- Brewing's Theory
- Engineering's Theory



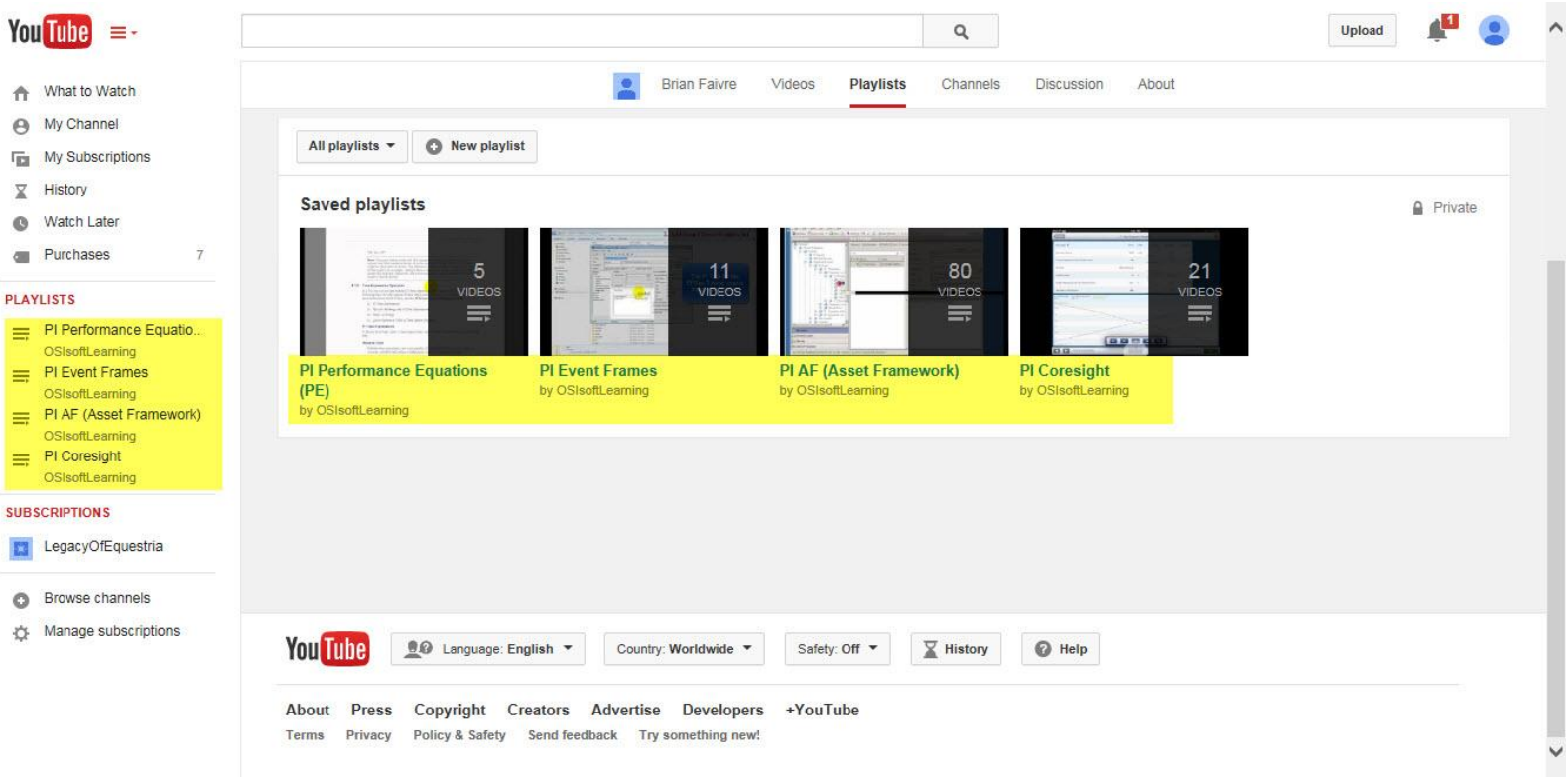
A Quick Win – Ideal Cooling



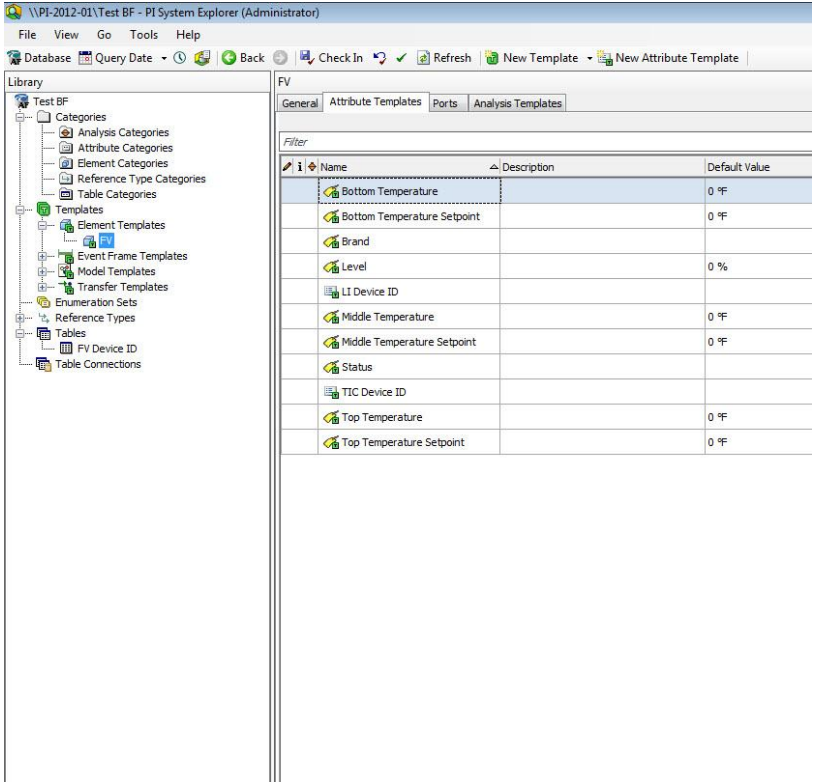
A Quick Win – Stratified Cooling

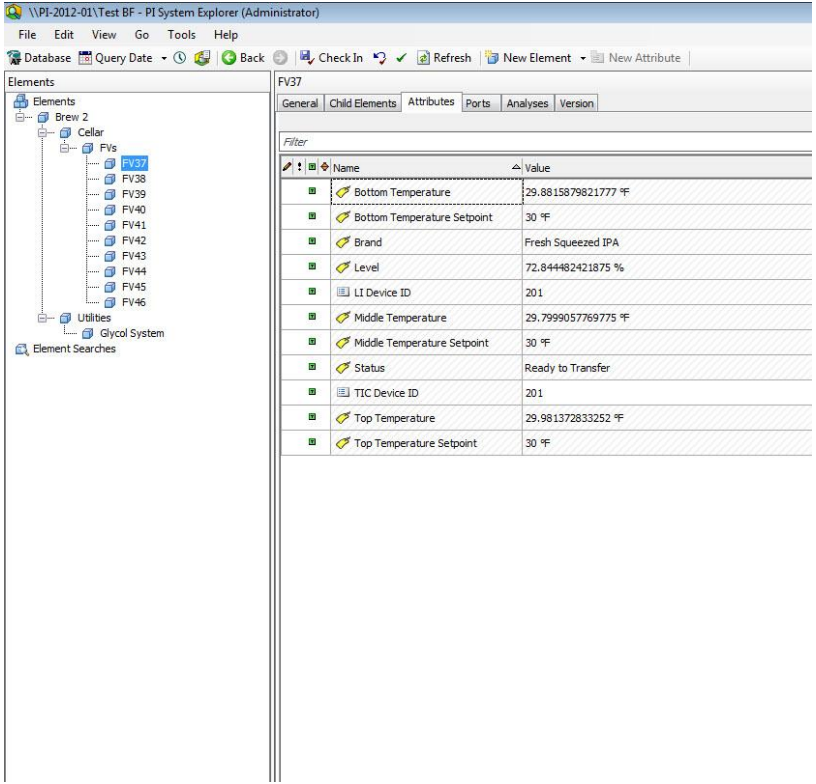


A Quick Win – OSIsoft Learning

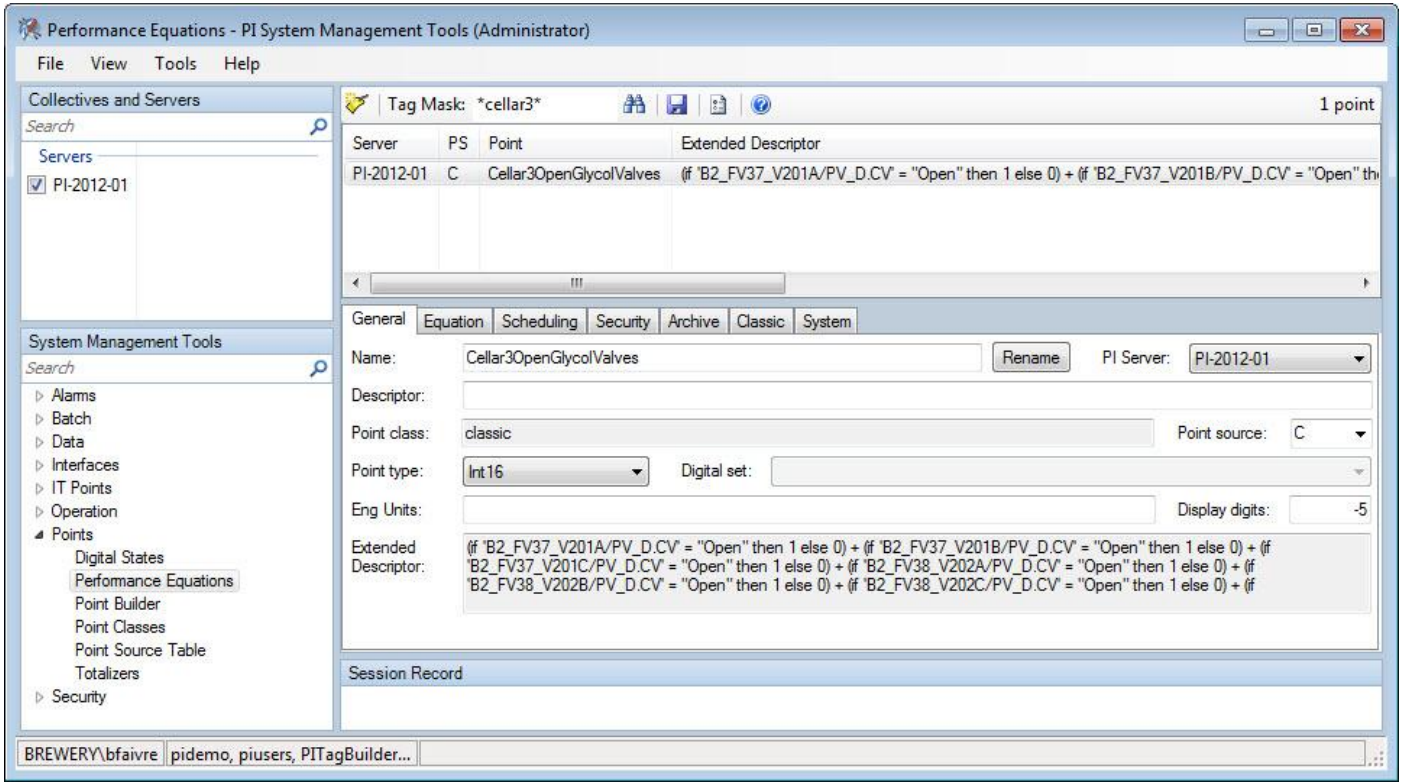


A Quick Win – Asset Framework (AF)

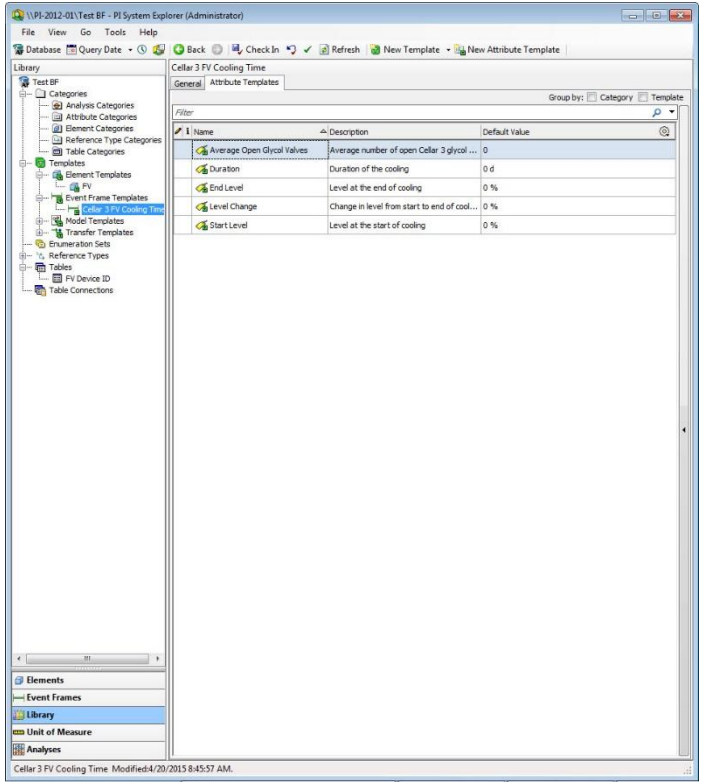


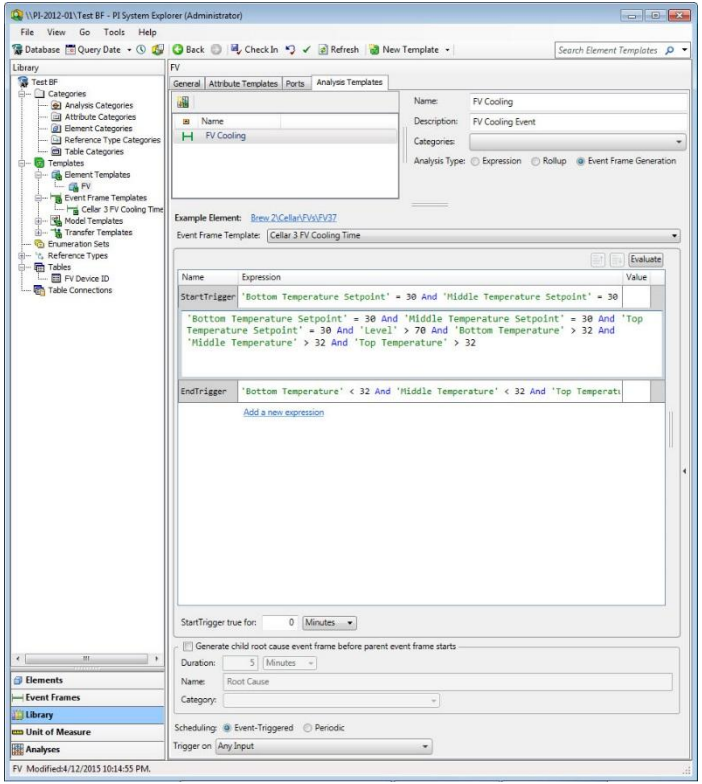


A Quick Win – Performance Equations (PE)



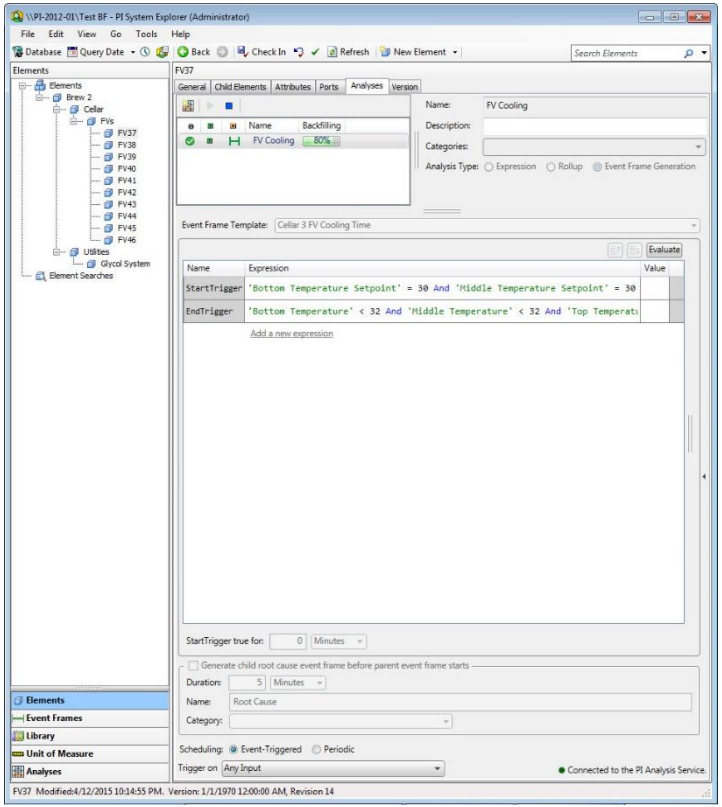
A Quick Win – Event Frames Templates



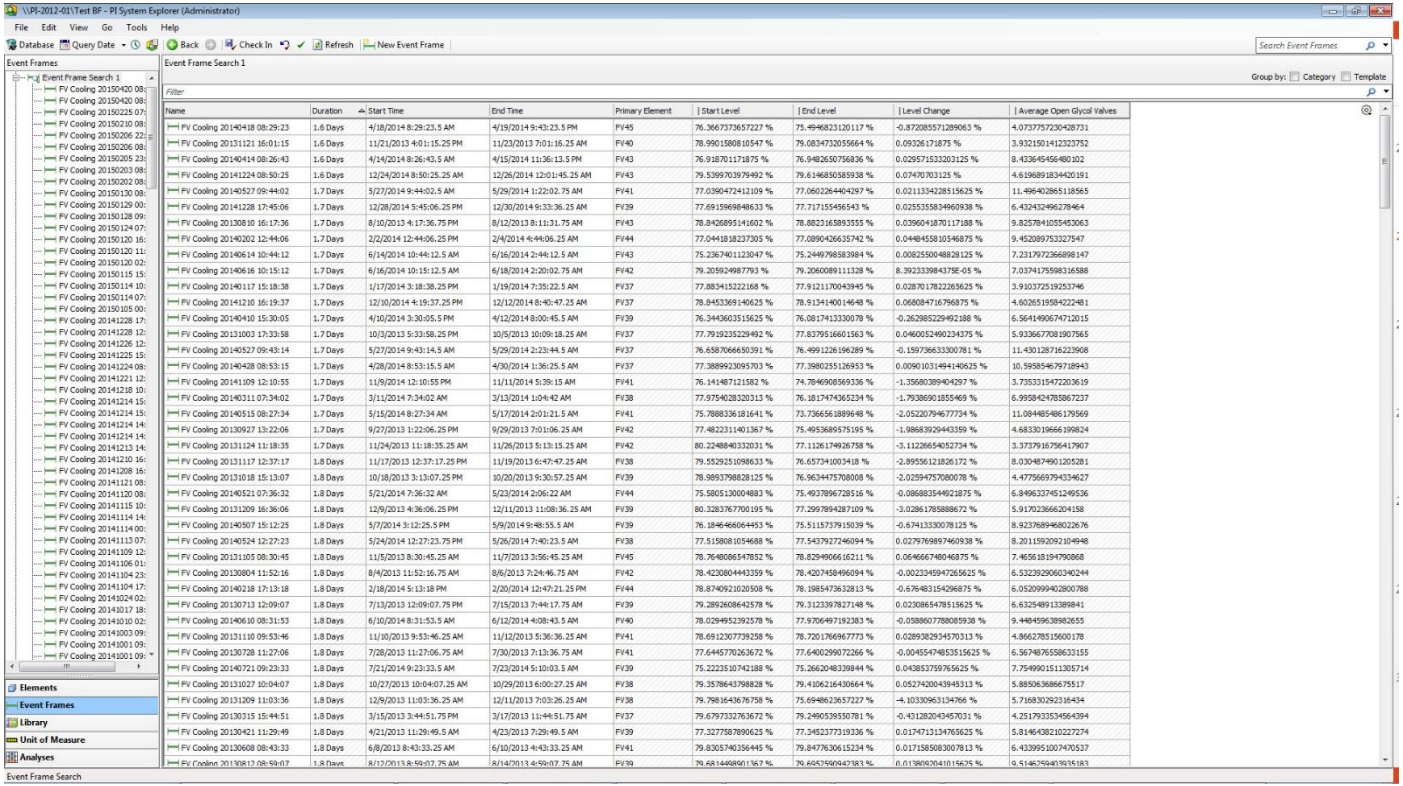


A Quick Win – Event Frames Backfill

- PI Interface for OPC DA
- Performance Equations Recalculator
- Backfill for each FV Cooling Event Frame



A Quick – Event Frames for Asset Analysis



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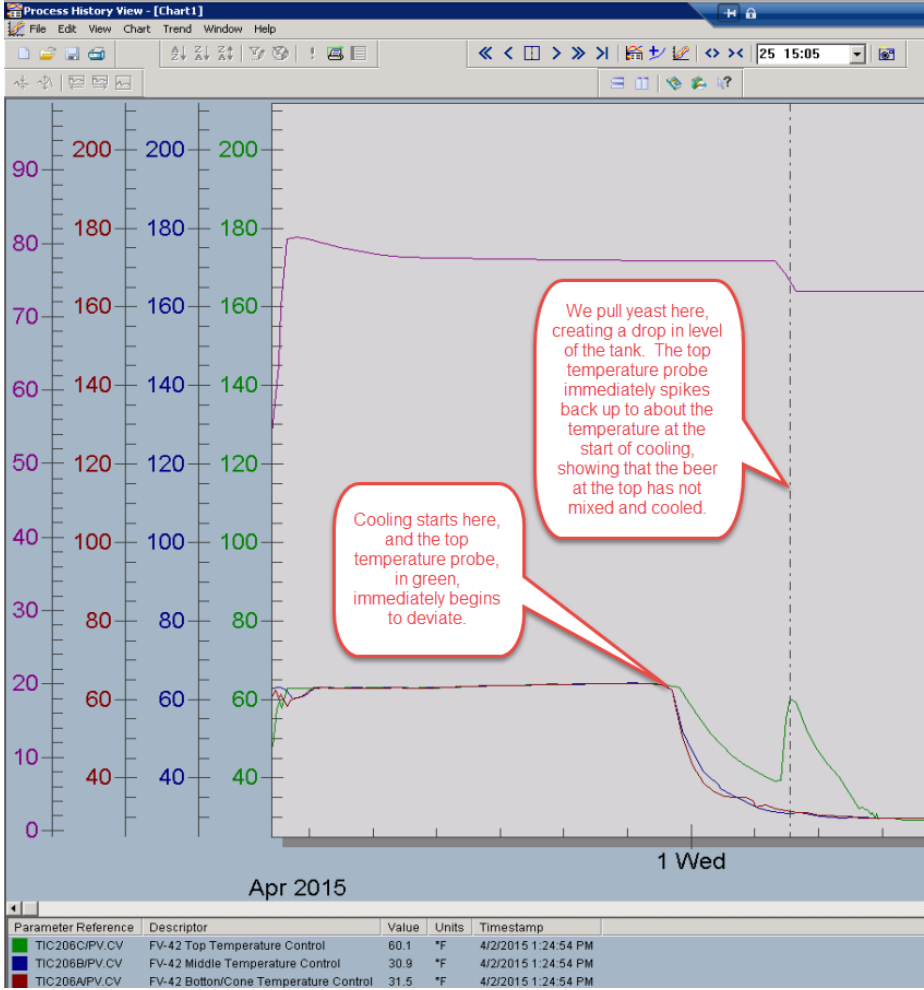
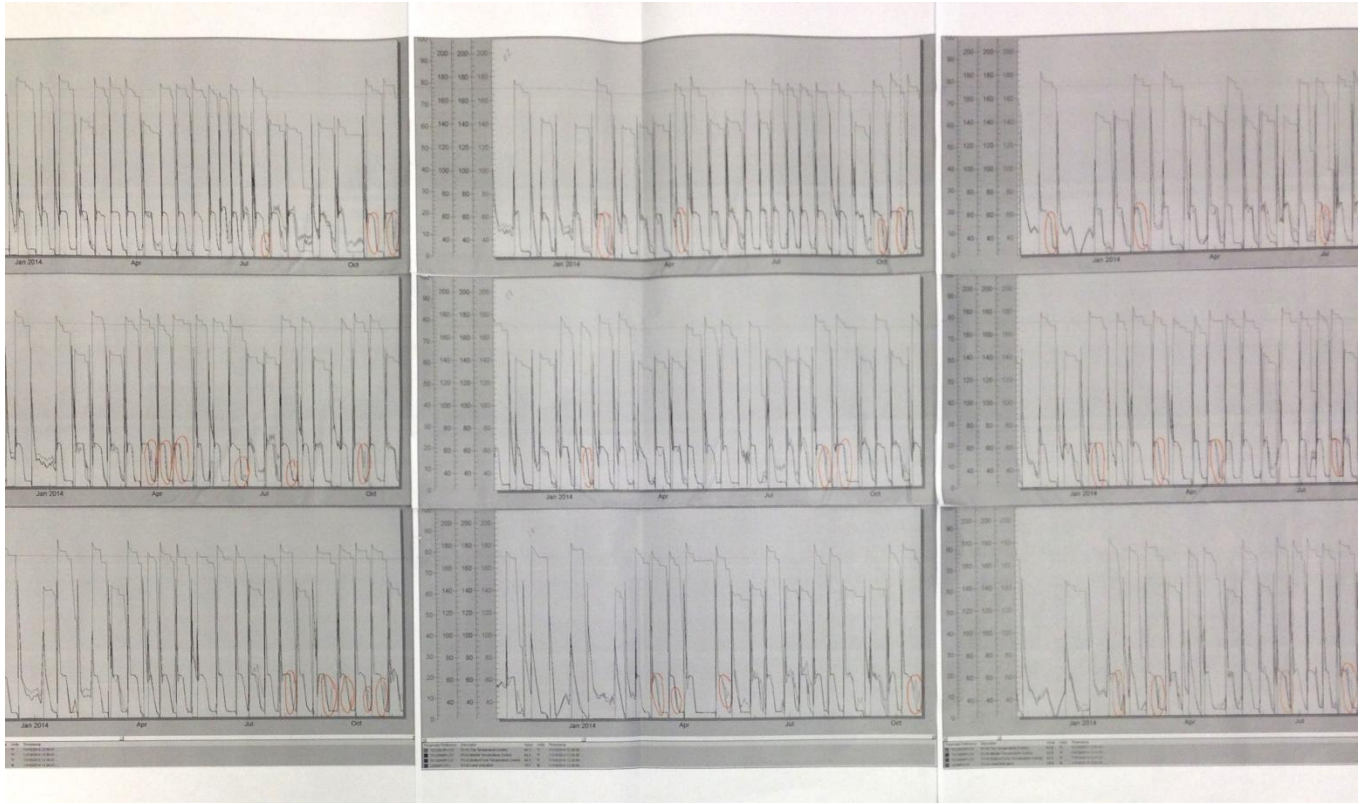
Brewing Analysis Before

- From Delta V Process Historian, we could fairly easily create trends for individual coolings like the one to the right.
- The top of the tank is clearly stratified.
- Our conclusion is that no glycol is getting to the top jacket of the tank, looking at the intensity of the issue.
- When we look at longer periods of time, or multiple tanks, the process historian gets slow, and is time consuming to set up.
- We have trouble tying in and ruling out other possibilities by looking at a larger data set.



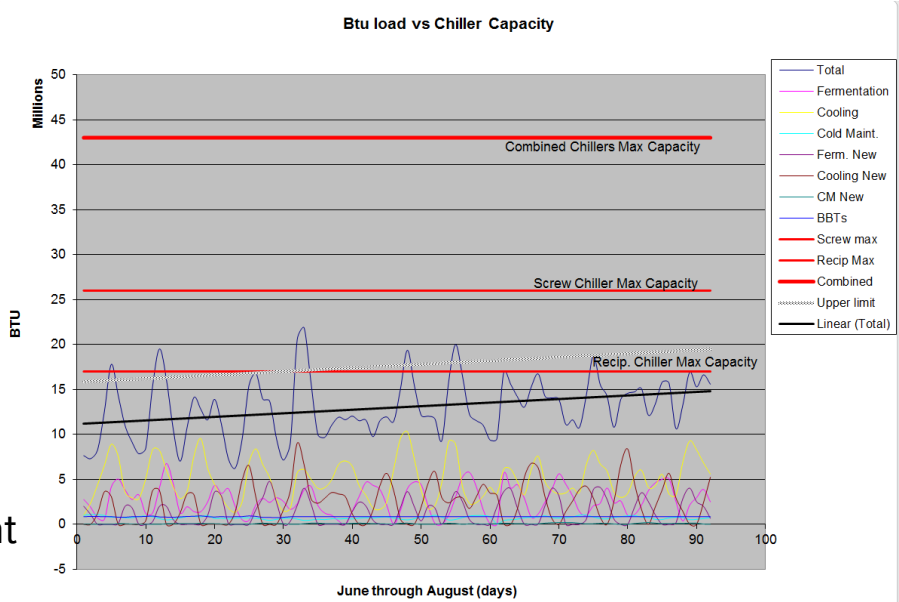
Engineering Analysis Before

- This is a year's worth of data printed out and taped together for nine of our fermenters (10 did not arrange well).
- Deviations are circled in red and appear to be somewhat random.



Engineering Analysis Before

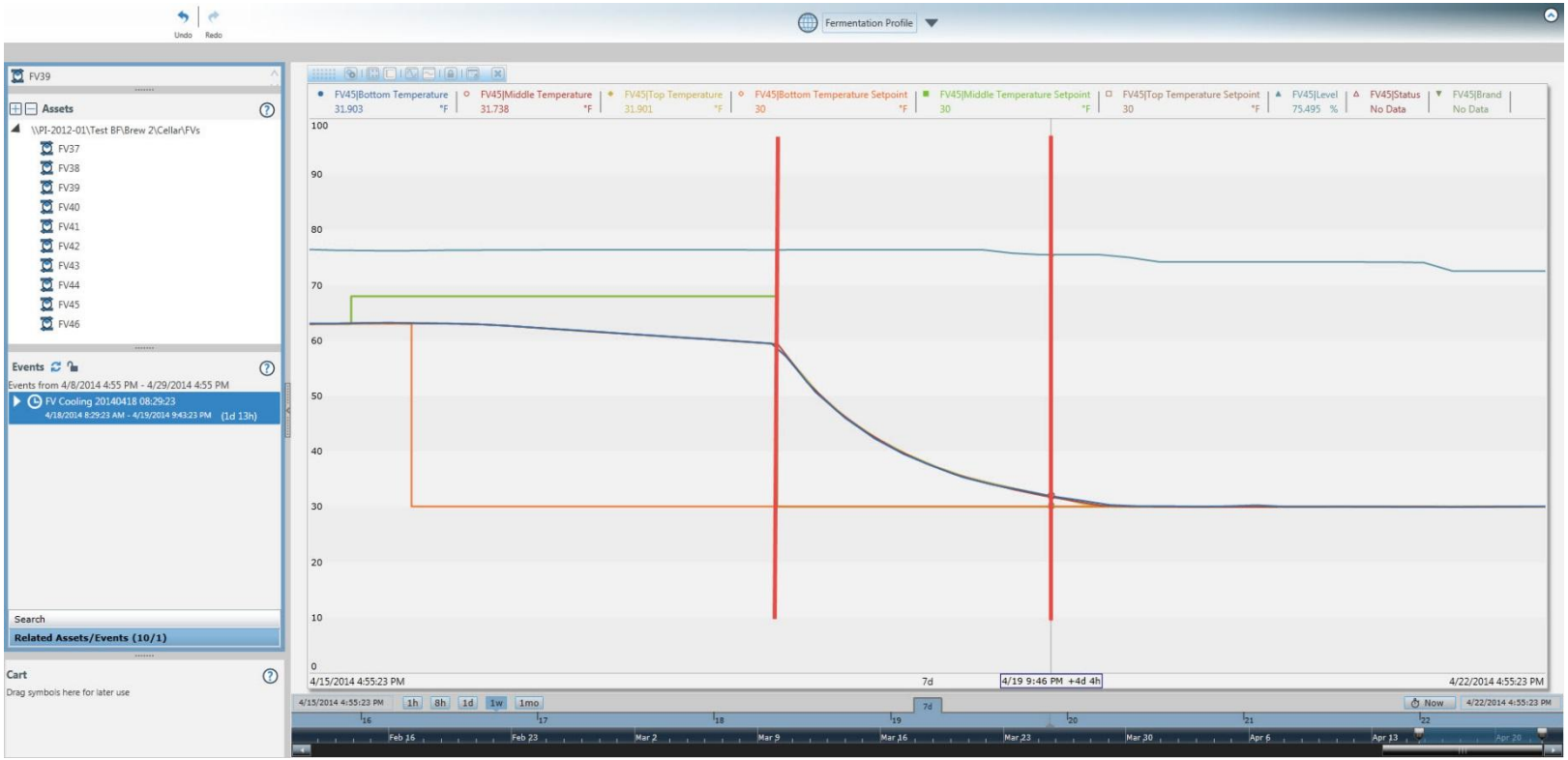
- A spreadsheet is also assembled to try and link glycol capacity to cooling issues.
- With our data tools, this takes literally months to do; it takes a week just to get the data.
- After all the analysis, glycol capacity is deemed to be acceptable.
- Engineering has good reason to believe the glycol system design is sound (they designed it).
- They theorize from a set of the printed charts that the timing of our yeast pulls is causing the issue.
- As this theory is disproved, more are developed.
- We determine we need more instrumentation installed.
- This costs money and time; we are dragging our feet while we lose significant time in fermentation.



Event Frame Analysis – Shortest Durations

Name	Duration	Start Time	End Time	Primary Element	| Start Level	| End Level	| Level Change	| Average Open Glycol Valves
FV Cooling 20140418 08:29:23	1.6 Days	4/18/2014 8:29:23.5 AM	4/19/2014 9:43:23.5 PM	FV45	76.3667373657227 %	75.4946823120117 %	-0.872085571289063 %	4.0737757230428731
FV Cooling 20131121 16:01:15	1.6 Days	11/21/2013 4:01:15.25 PM	11/23/2013 7:01:16.25 AM	FV40	78.9901580810547 %	79.0834732055664 %	0.09326171875 %	3.9321501412323752
FV Cooling 20140414 08:26:43	1.6 Days	4/14/2014 8:26:43.5 AM	4/15/2014 11:36:13.5 PM	FV43	76.918701171875 %	76.9482650756836 %	0.029571533203125 %	8.433645456480102
FV Cooling 20141224 08:50:25	1.6 Days	12/24/2014 8:50:25.25 AM	12/26/2014 12:01:45.25 AM	FV43	79.5399703979492 %	79.6146850585938 %	0.07470703125 %	4.6196891834420191
FV Cooling 20140527 09:44:02	1.7 Days	5/27/2014 9:44:02.5 AM	5/29/2014 1:22:02.75 AM	FV41	77.0390472412109 %	77.0602264404297 %	0.0211334228515625 %	11.496402865118565
FV Cooling 20141228 17:45:06	1.7 Days	12/28/2014 5:45:06.25 PM	12/30/2014 9:33:36.25 AM	FV39	77.6915969848633 %	77.717155456543 %	0.0255355834960938 %	6.432432496278464
FV Cooling 20130810 16:17:36	1.7 Days	8/10/2013 4:17:36.75 PM	8/12/2013 8:11:31.75 AM	FV43	78.8426895141602 %	78.8823165893555 %	0.0396041870117188 %	9.8257841055453063
FV Cooling 20140202 12:44:06	1.7 Days	2/2/2014 12:44:06.25 PM	2/4/2014 4:44:06.25 AM	FV44	77.0441818237305 %	77.0890426635742 %	0.0448455810546875 %	9.452089753327547
FV Cooling 20140614 10:44:12	1.7 Days	6/14/2014 10:44:12.5 AM	6/16/2014 2:44:12.5 AM	FV43	75.2367401123047 %	75.2449798583984 %	0.0082550048828125 %	7.2317972366898147
FV Cooling 20140616 10:15:12	1.7 Days	6/16/2014 10:15:12.5 AM	6/18/2014 2:20:02.75 AM	FV42	79.205924987793 %	79.2060089111328 %	8.392333984375E-05 %	7.0374175598316588
FV Cooling 20140117 15:18:38	1.7 Days	1/17/2014 3:18:38.25 PM	1/19/2014 7:35:22.5 AM	FV37	77.883415222168 %	77.9121170043945 %	0.0287017822265625 %	3.910372519253746
FV Cooling 20141210 16:19:37	1.7 Days	12/10/2014 4:19:37.25 PM	12/12/2014 8:40:47.25 AM	FV37	78.8453369140625 %	78.9134140014648 %	0.068084716796875 %	4.6026519584222481
FV Cooling 20140410 15:30:05	1.7 Days	4/10/2014 3:30:05.5 PM	4/12/2014 8:00:45.5 AM	FV39	76.3443603515625 %	76.0817413330078 %	-0.262985229492188 %	6.5641490674712015
FV Cooling 20131003 17:33:58	1.7 Days	10/3/2013 5:33:58.25 PM	10/5/2013 10:09:18.25 AM	FV37	77.7919235229492 %	77.8379516601563 %	0.0460052490234375 %	5.9336677081907565

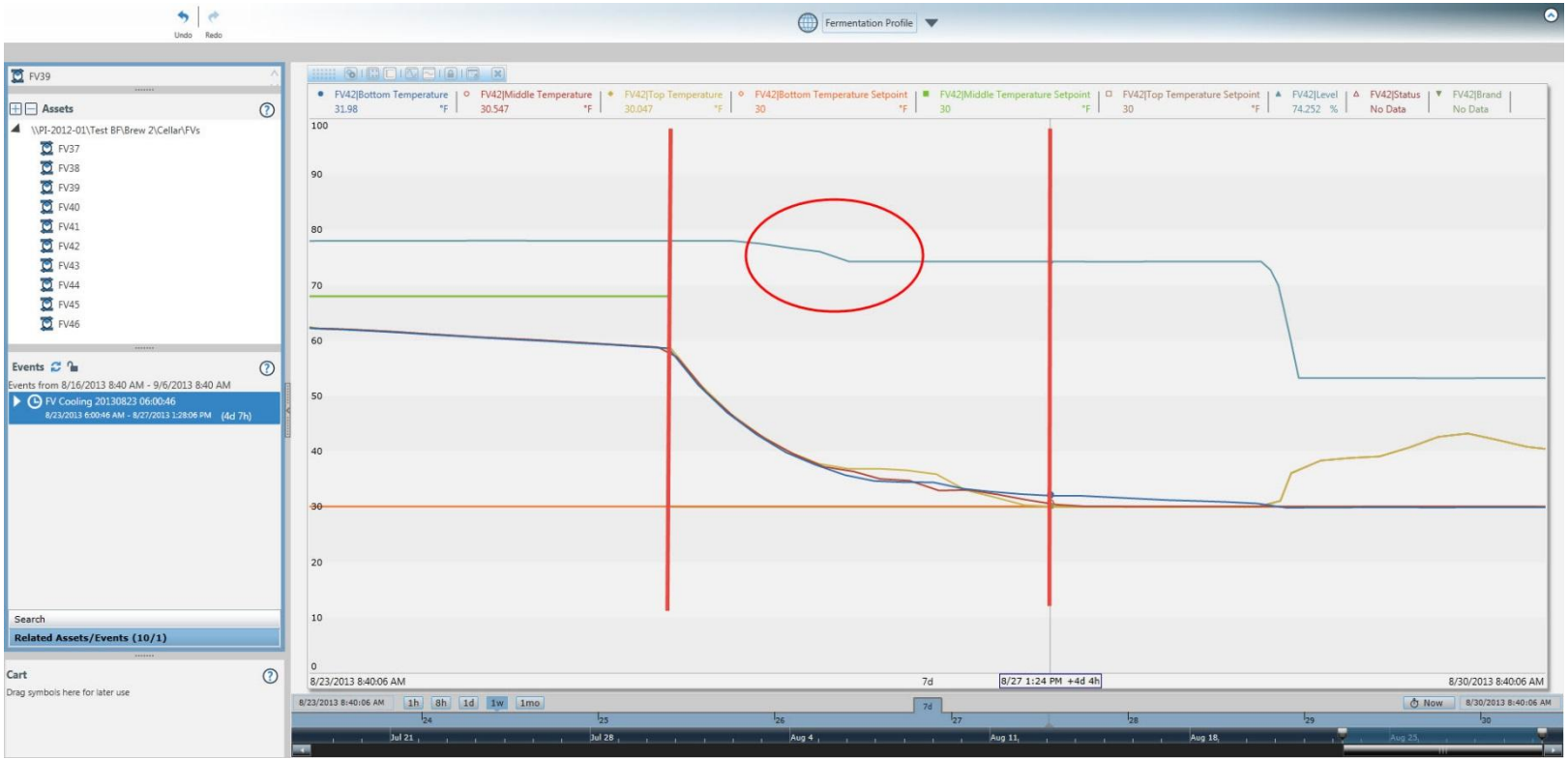
Event Frame Analysis – Shortest Durations



Event Frame Analysis – Longest Durations

Name	Duration	Start Time	End Time	Primary Element	| Start Level	| End Level	| Level Change	| Average Open Glycol Valves
FV Cooling 20141214 14:59:36	4.6 Days	12/14/2014 2:59:36.25 PM	12/19/2014 5:18:36.25 AM	FV38	78.5620880126953 %	74.6569061279297 %	-3.90522766113281 %	10.886848715713182
FV Cooling 20130918 20:41:24	4.4 Days	9/18/2013 8:41:24.25 PM	9/23/2013 6:58:14.25 AM	FV46	77.5207824707031 %	72.6069107055664 %	-4.91395568847656 %	5.5781738571369459
FV Cooling 20141017 18:00:55	4.4 Days	10/17/2014 6:00:55 PM	10/22/2014 3:32:35 AM	FV42	78.4429550170898 %	73.0975341796875 %	-5.34316253662109 %	7.7448796832499784
FV Cooling 20130823 06:00:46	4.3 Days	8/23/2013 6:00:46.5 AM	8/27/2013 1:28:06.5 PM	FV42	77.9475326538086 %	74.2516174316406 %	-3.69590759277344 %	4.2727392331650735
FV Cooling 20130726 10:02:56	4.3 Days	7/26/2013 10:02:56.75 AM	7/30/2013 5:03:35.75 PM	FV43	77.4938735961914 %	73.5756912231445 %	-3.91816711425781 %	7.0702933078775425
FV Cooling 20130625 14:58:59	4.2 Days	6/25/2013 2:58:59.75 PM	6/29/2013 8:50:19.75 PM	FV37	79.4979858398438 %	76.6395721435547 %	-2.85842895507813 %	4.8059684221710119
FV Cooling 20141214 15:00:24	4.2 Days	12/14/2014 3:00:24.25 PM	12/18/2014 7:42:44.25 PM	FV45	78.4905548095703 %	72.6208953857422 %	-5.86973571777344 %	11.355183009978209
FV Cooling 20141104 23:55:07	4 Days	11/4/2014 11:55:07 PM	11/8/2014 11:01:57 PM	FV37	79.0864105224609 %	73.3271560668945 %	-5.75927734375 %	8.9334119671349175
FV Cooling 20141228 12:34:45	4 Days	12/28/2014 12:34:45.25 PM	1/1/2015 11:26:35.25 AM	FV41	79.7449188232422 %	75.4286956787109 %	-4.31625366210938 %	6.0480373927557025
FV Cooling 20140810 11:20:01	3.9 Days	8/10/2014 11:20:01.25 AM	8/14/2014 8:58:41.25 AM	FV45	78.5662307739258 %	74.8937911987305 %	-3.67250823974609 %	11.455427553924913
FV Cooling 20141001 09:19:06	3.9 Days	10/1/2014 9:19:06 AM	10/5/2014 6:00:46 AM	FV40	77.9615249633789 %	73.4658584594727 %	-4.49568176269531 %	10.080265008490661
FV Cooling 20141214 14:59:56	3.8 Days	12/14/2014 2:59:56.25 PM	12/18/2014 11:22:36.25 AM	FV39	79.4332046508789 %	74.5328826904297 %	-4.90036773681641 %	11.74434277367242
FV Cooling 20141113 07:21:34	3.8 Days	11/13/2014 7:21:34 AM	11/17/2014 3:21:34 AM	FV45	76.9297866821289 %	75.199951171875 %	-1.72986602783203 %	9.7123742954911432
FV Cooling 20141001 09:19:14	3.8 Days	10/1/2014 9:19:14 AM	10/5/2014 5:19:14 AM	FV45	77.5227279663086 %	73.3457641601563 %	-4.17699432373047 %	10.113268015297907

Event Frame Analysis – Longest Durations



Agenda

- Deschutes Brewery
- Data Challenges
- Solution
- A Quick Win
- Results
- Future Plans

Future Plans

Short Term

- Minimize manual data entry
- Eliminate duplicated data input
- Use PI Coresight for quick data analysis and problem solving
- Gain process visibility with PI Coresight and PI ProcessBook
- Link process data to accounting data
- Link process data with quality data, including sensory analysis

Longer Term

- Rationalize our alarm system and start to use PI Server Notifications
- Create a scalable system that can seamlessly integrate our second facility
- Use machine learning concepts and quickly accessible data to solve problems more quickly and adjust before large issues arise

Questions

Please wait for the microphone
before asking your questions

Brian Faivre
Tim Alexander
Deschutes Brewery

THANK YOU