EMERSON EXCHANGE 2025

ACCELERATING INNOVATION

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Sizzling Control: How implementing a MPC Upgrade Delivered Big Wins

Session ID: 3-1258

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Lou Heavner

Principal Consultant / Emerson

Agenda

Marcelo Leiva	Viscofan Overview
Marcelo Leiva	Context
Lou Heavner	Problem Statement
Lou Heavner	Proposed Solution
Both	Execution
Marcelo Leiva	Results
Lou Heavner	Conclusion

Viscofan– Global Leader in Casing Solutions

Viscofan is the **world's leading producer and distributor of artificial casings for the meat industry.**

- Leads the industry as the only company with all major casing technologies (cellulose, collagen, fibrous and plastic).
- Ensures global reach with 20 manufacturing sites, 15 of which produce casings, across 12 countries.
- Serves a diverse customer base by expanding its commercial network to more than 100 countries.

OUR SITE


EUROPE
Sites: 7
NORTH AMERICA
Sites: 6
DANVILLE, IL
ASIA PACIFIC
Sites: 3
SOUTH AMERICA
Sites: 4

Danville Site

- This is the largest Viscofan facility in the United States for which it plays a pivotal role in the organization.
- Its origins trace back to 1957, when it was built by Teepak.
- The site was acquired by Viscofan in 2006.
- Specializes in cellulose casings, primarily used for hot dogs and frankfurters, designed for easy peeling after cooking.
- Produces fibrous casings, essential for larger processed meats like salami and deli hams, offering strength and controlled expansion.
- Alongside production and manufacturing systems, Viscofan inherited OT/IT technologies for process control.

Context: Digital Transformation in an older plant

Brief History

- Since 1957, the factory has undergone several transformations
- It was owned by multiple corporations before Viscofan acquired it in 2006.
- With the different stakeholders, machines, processes and knowledge has suffered radical changes.
- Control systems were no exception; before the implementation of DeltaV the factory relied on a PIMS computer program from Biles & Associates named AIM. It was originally connected to PROVOX, a legacy Emerson product.

Legacy Control

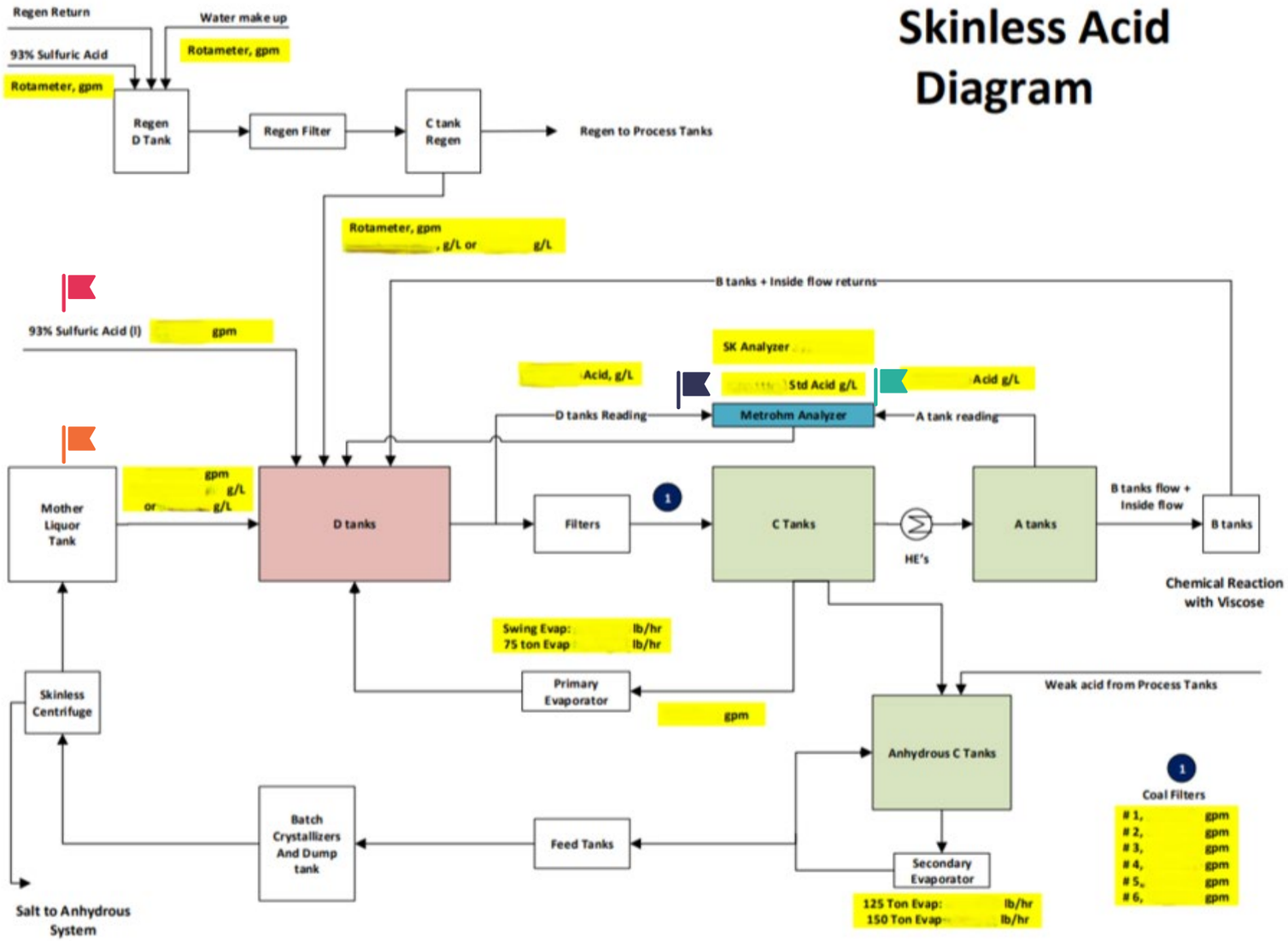
- AIM was critical for the plant as it helped automate process control in different production areas.
- The previous generation of control included the PROVOX DCS connected to the Biles & Assoc. AIM PIMS system. Both are obsolete.
- AIM controls could be categorized as expert systems, that highly specialized chemical and process engineers used to program and maintain.
- However, due to the many transformations the factory underwent, a lot of knowledge was lost.

Contemporaneous Control

- DeltaV was implemented in Danville, 18 years ago and Viscofan has migrated most of the legacy controls.
- DeltaV is the main DCS in the plant.
- Alongside it, other systems, such as AVEVA PI were implemented.
  - The obsolete Biles & Assoc AIM package remained, providing crucial control functionality
    - The sole support engineer retired
- The advanced process control capabilities available within the DeltaV system, enabled Viscofan to migrate 100% from AIM.

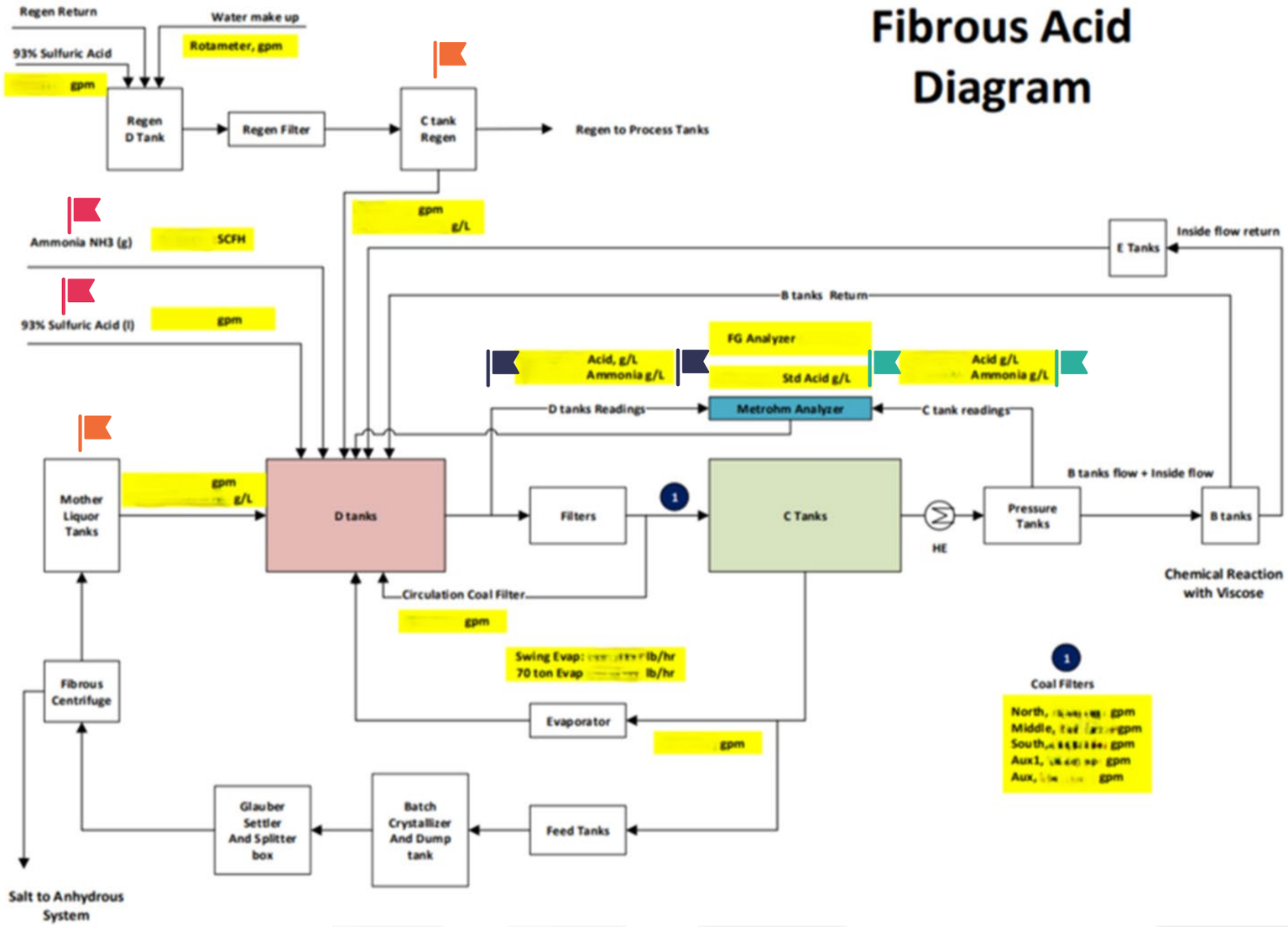
Context: The Skinless Curing Process

- 1 MV: Acid Flow
- 1 DV: Mother Liquor Flow
- 1 CV: Acid Concentration in A tank
- 1 LV: Acid Concentration in D tank

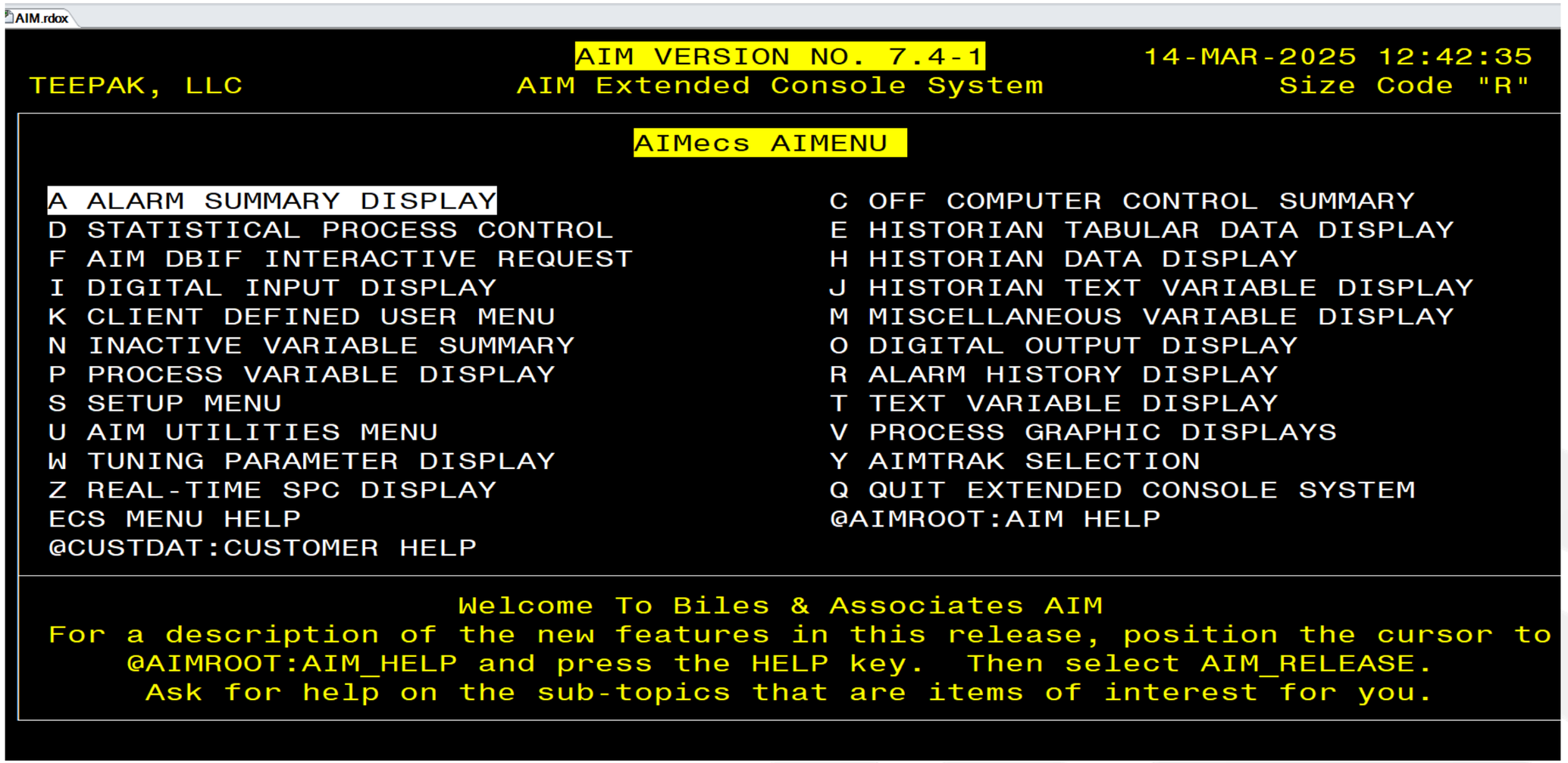


Context: The Fibrous Curing Process

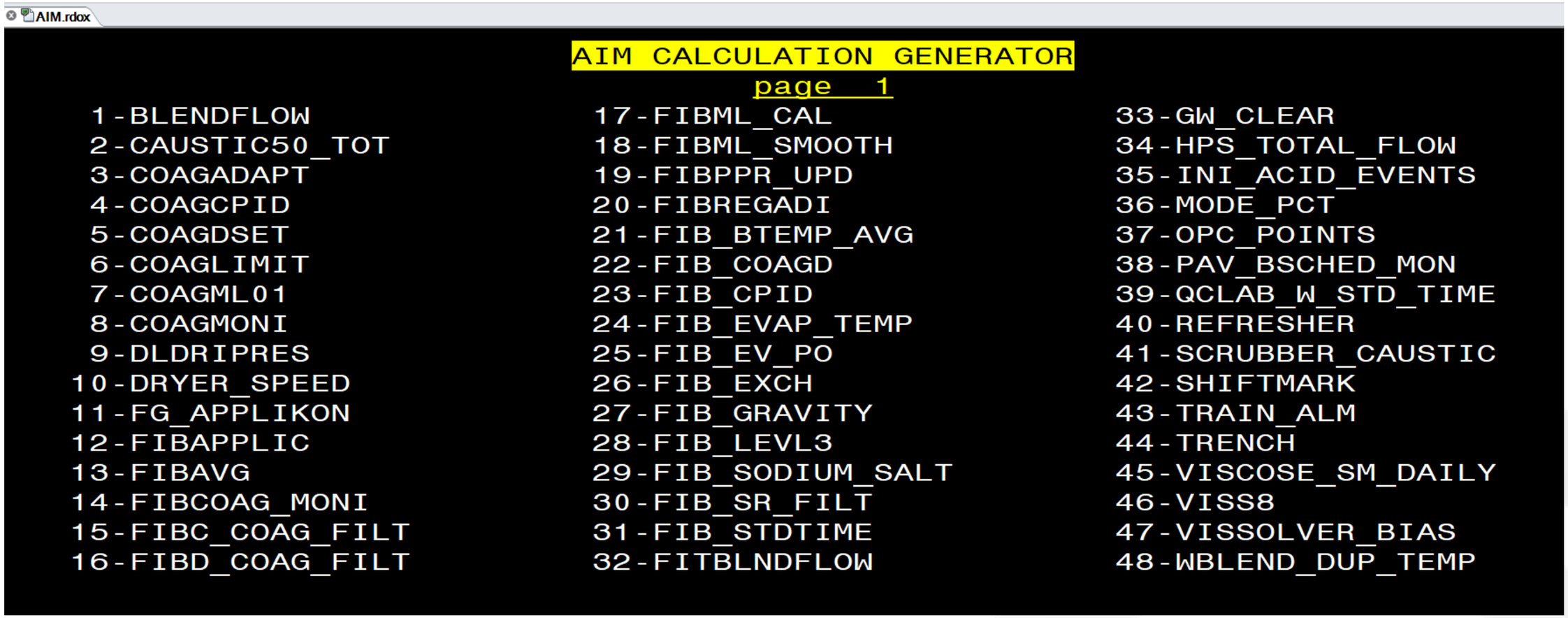
- 2 MV: Acid & Ammonia Flows
- 2 DV: Mother Liquor & Regen Flows
- 2 CV: Acid & Ammonium Sulfate Concentrations in A tank
- 2 LV: Acid & Ammonium Sulfate Concentrations in D tank



Context: AIM System Usability



Context: AIM System Usability



Context: AIM System Usability

- Over 20 pages of code in a script
- Multiple Scripts per control strategy
- No GUI
- No mouse
- Hard to keep versions
- Diffused documentation (Only printed copies and notebooks)
- Limited memory
- A lot of comments with unorganized dates and variables.

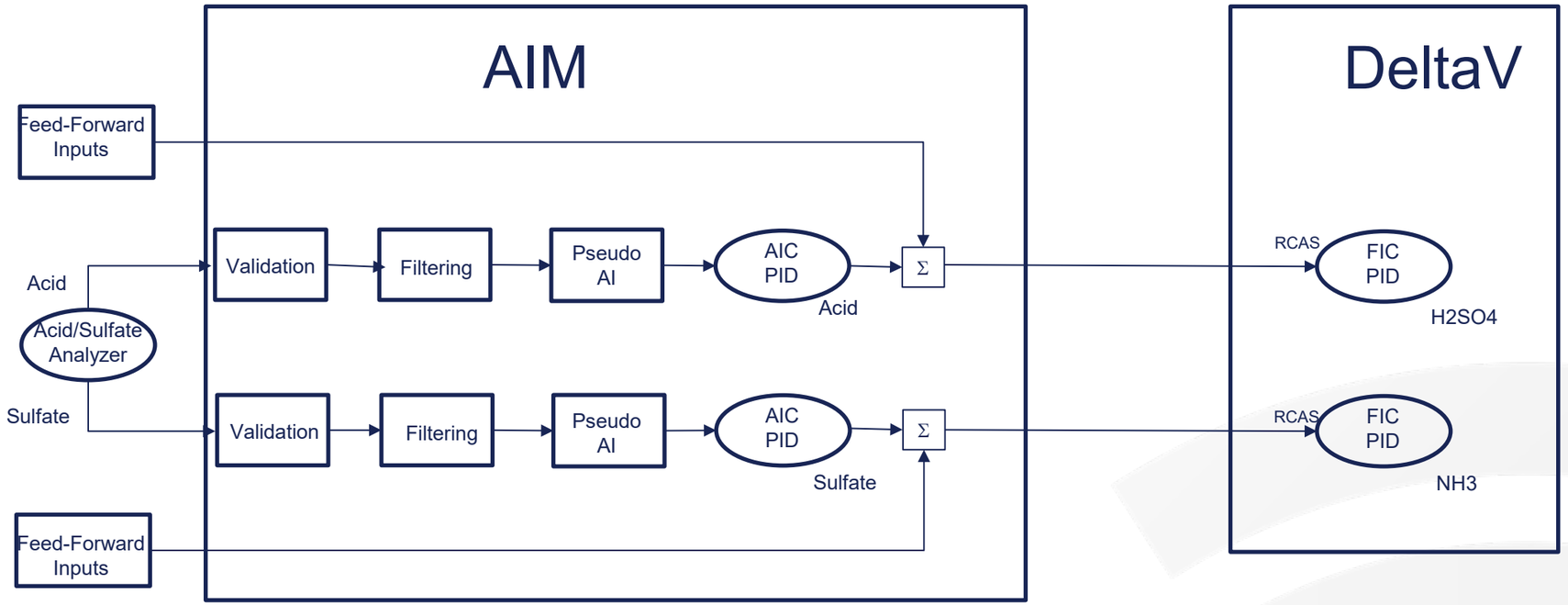
AIM.rdox

```
% Long before 12/22/2016: Adjust value of "wp_std_del", the devi
% target, if one value of wp_std_del has high absolute value.  I
% adjust the filtered values based on the previous standard devi
% target, when the previous value is within +-0.882 (3 sigma lim
% If both the current and previous value are outside of 3 sigma
% this is considered validation of the extreme deviation, and th
% deviation is applied.  (CJR 10/11/2000)
  holdstd=laststd  !for troubleshooting purposes only, in adump
if(abs("wp_std_del$amvcur")>0.882)then  !a
  t1=abs(laststd-"ac10-628s$apvtar")
if(t1<0.882)then !b
  std_del=laststd-"ac10-628s$apvtar"  !only 1 bad standard
else !b
  teststd=laststd-"ac10-628s$apvtar"
if((teststd<0.and."wp_std_del$amvcur"<0)
#.or.(teststd>0.and."wp_std_del$amvcur">0))then !c
  std_del="wp_std_del$amvcur"  !2 or more standards outside 3 si
endif !c
endif !b
else !a
  std_del="wp_std_del$amvcur"   !normal standards, withing 3 sig
```

Problem Statement

- Replacement of obsolete optimization package
  - Must be Integrated with DeltaV
    - User Interface requirements
  - Must be Integrated with online sampling analyzers
    - Asynchronous Inputs
    - Input Validation Required
  - Must be Easy for non-programmer
    - Supported by plant staff
    - Viscofan to self-perform project with limited Emerson consultation
  - Must faithfully reproduce AIM functionality
    - Closed Loop Supervisory Control
    - Analyzer validation & filtering
- Scope
  - Skinless Line curing (1 MV – acid flow)
  - Fibrous Line curing (2 MVs – acid flow & ammonia flow)

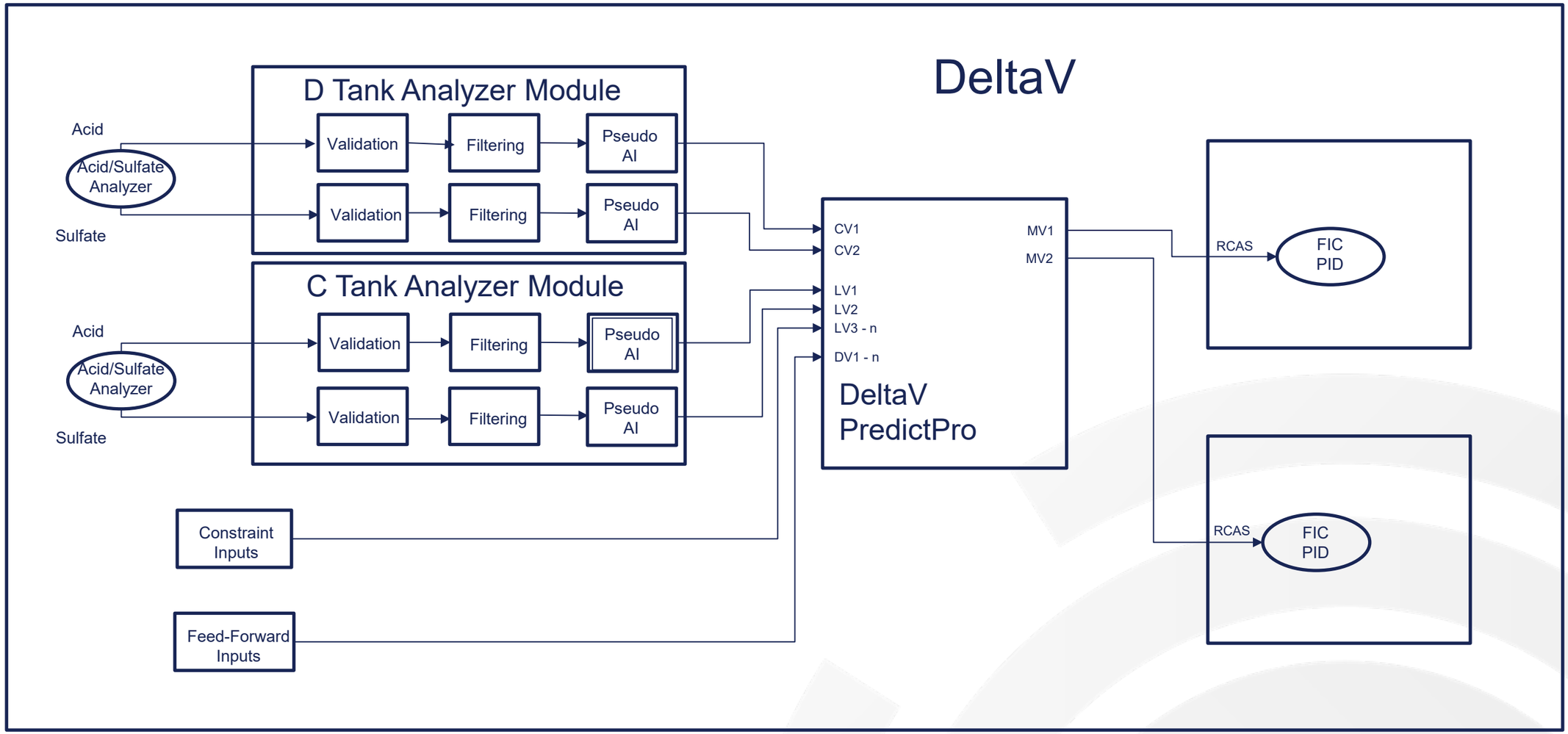
Original Control Structure



Proposed Solution

- DeltaV PredictPro replaces the AIM Control functionality
  - MPCPlus Block
    - Embedded in DeltaV
  - Ideal for slow deadtime dominant process
  - No license required for 1 MV configuration (prototype/proof of concept)
- Analyzer Input Block and Module replaces AIM analyzer validation functionality
  - Embedded in DeltaV (Composite Block)
  - Performs Validation Checks (Bad Input, Calibration, etc.)
  - Designed to work with PredictPro
- Design
  - Skinless - 1 MV, 1 CV, 1 LV, 2 DVs
  - Fibrous - 2 MV, 2 CV, 2 LV, 2 DVs

Proposed Structure



Project Execution

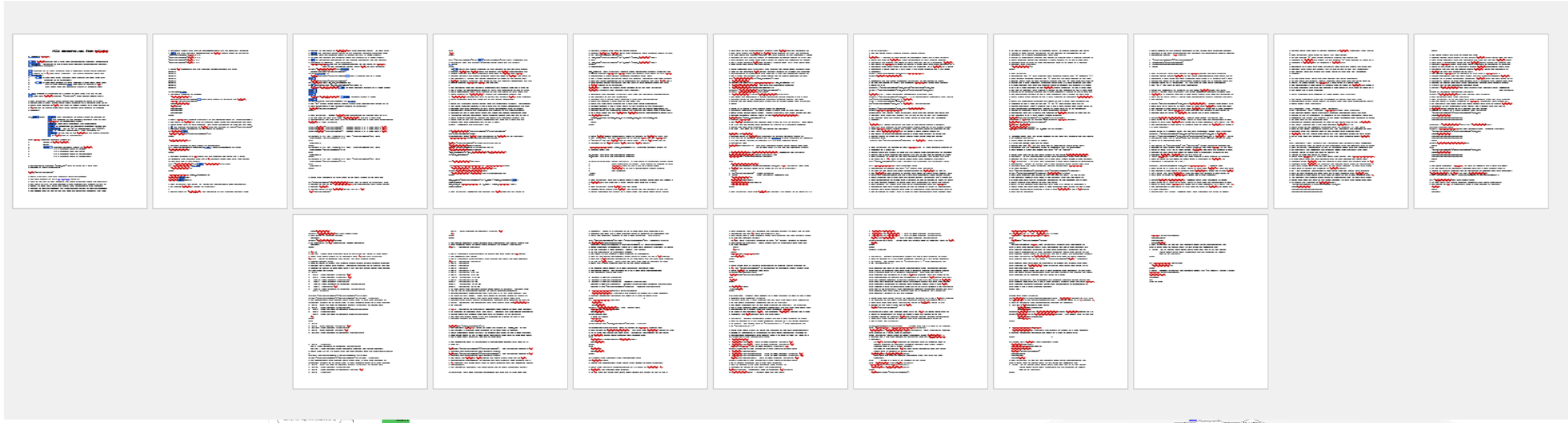
- Define Scope
- Decode AIM package
- Design
- Configure & Test
- Step Test
- Model Identification and Verification
- Commissioning
- Continuous Improvement

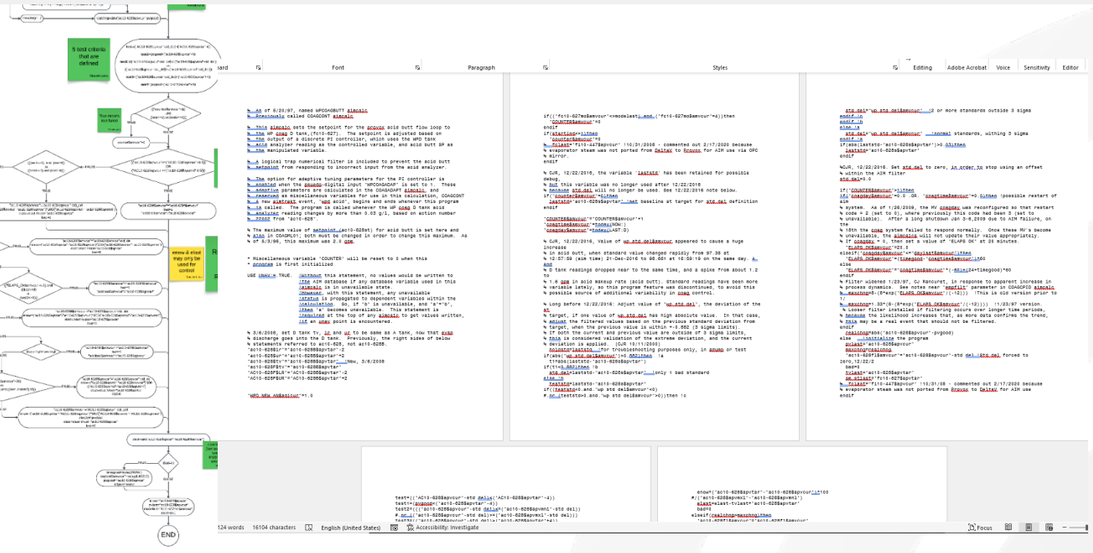
Decoding AIM package

AIM.rdox

```
% Long before 12/22/2016: Adjust value of "wp_std_del", the deviation of the st♦
% target, if one value of wp_std_del has high absolute value.  In that case,
% adjust the filtered values based on the previous standard deviation from
% target, when the previous value is within +-0.882 (3 sigma limits).
% If both the current and previous value are outside of 3 sigma limits,
% this is considered validation of the extreme deviation, and the current
% deviation is applied.  (CJR 10/11/2000)
  holdstd=laststd  !for troubleshooting purposes only, in adump or test
if(abs("wp_std_del$amvcur")>0.882)then  !a
  t1=abs(laststd-"ac10-628s$apvtar")
if(t1<0.882)then !b
  std_del=laststd-"ac10-628s$apvtar"  !only 1 bad standard
else !b
  teststd=laststd-"ac10-628s$apvtar"
if((teststd<0.and."wp_std_del$amvcur"<0)
#.or.(teststd>0.and."wp_std_del$amvcur">0))then !c
  std_del="wp_std_del$amvcur"  !2 or more standards outside 3 sigma
endif !c
endif !b
else !a
  std_del="wp_std_del$amvcur"   !normal standards, withing 3 sigma
```

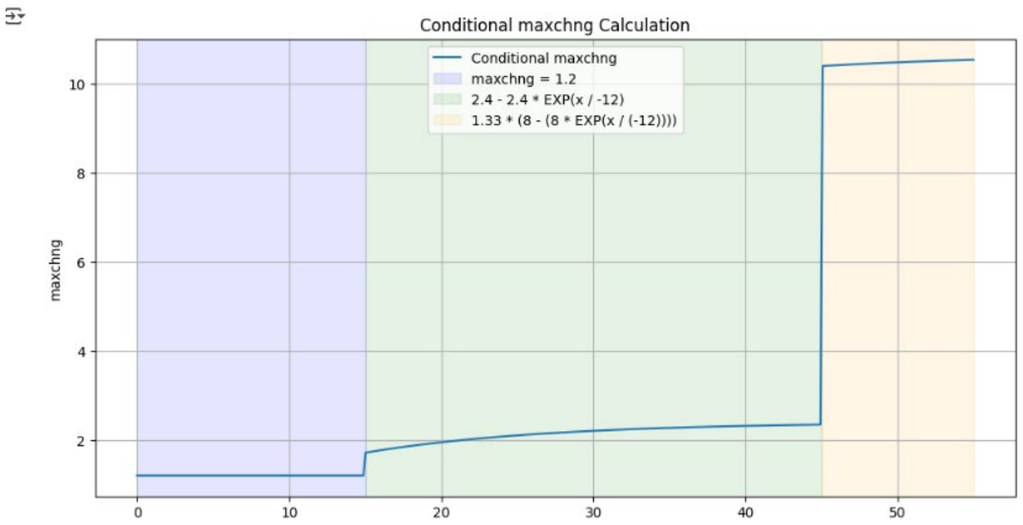
Decoding AIM package

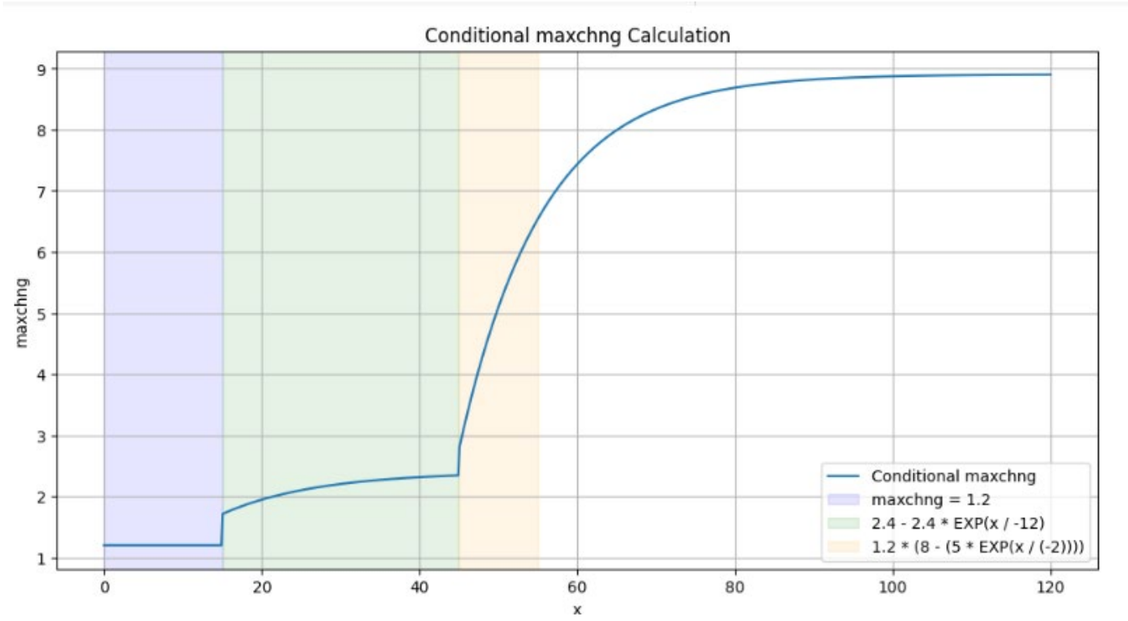




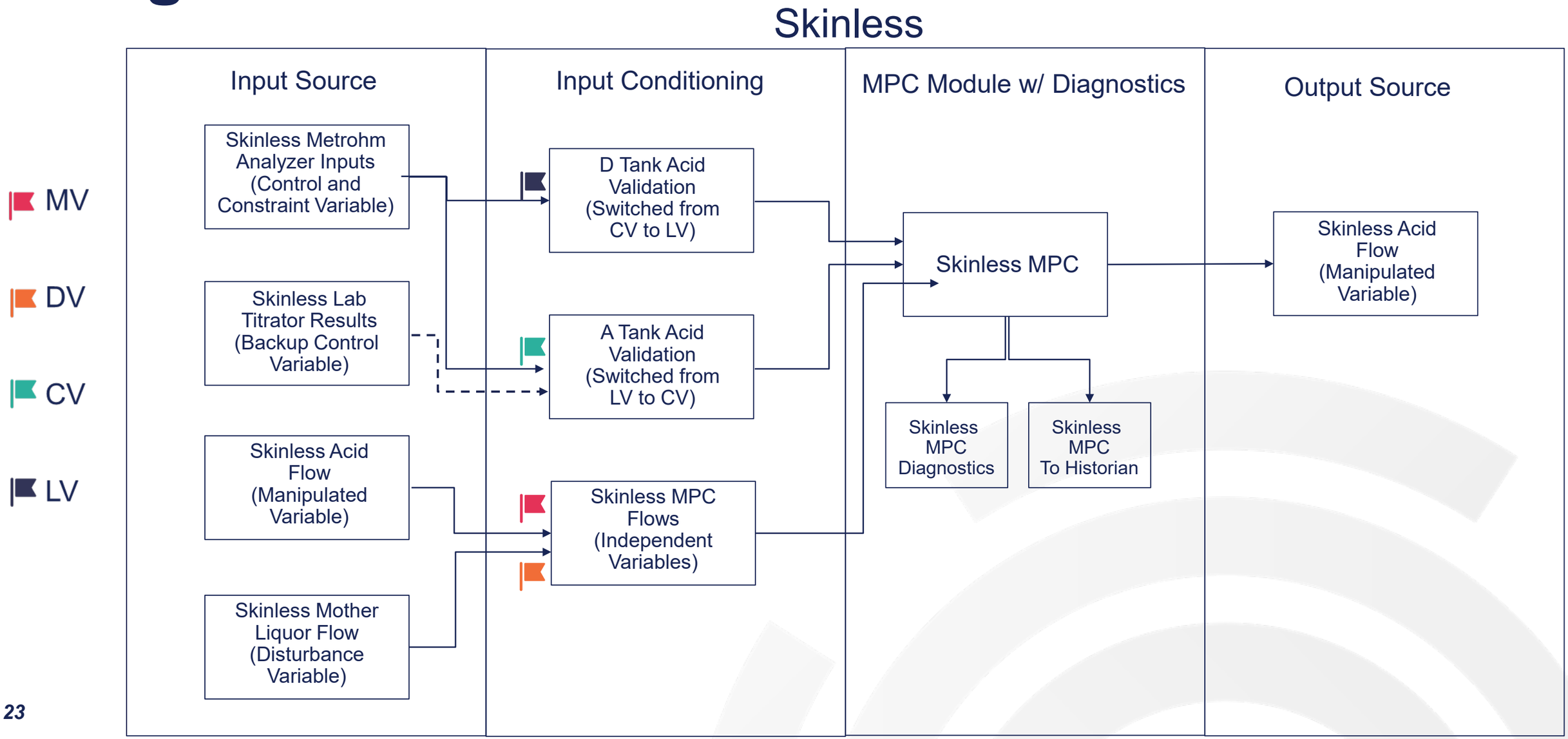
Analyzer Conditioning Requirement

- Minimum change to be new result
- Maximum change to be a valid result
  - Maximum change limit is dependent on time since last result.
  - AIM used step limits. DeltaV used filtered limits.

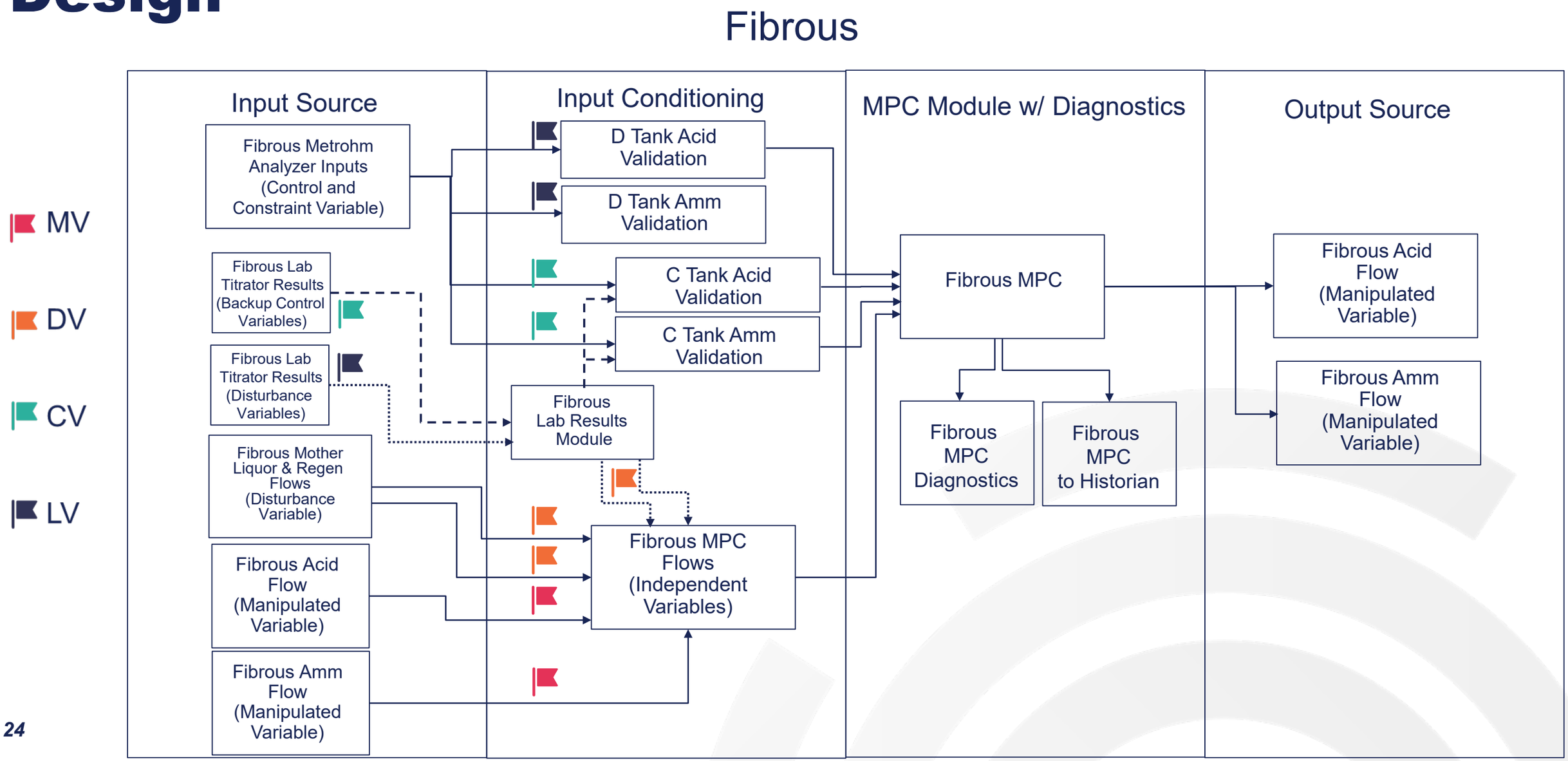




Design


Skinless
MV
DV
CV
LV
Input Source
Input Conditioning
MPC Module w/ Diagnostics
Output Source
Skinless Metrohm Analyzer Inputs (Control and Constraint Variable)
Skinless Lab Titrator Results (Backup Control Variable)
Skinless Acid Flow (Manipulated Variable)
Skinless Mother Liquor Flow (Disturbance Variable)
D Tank Acid Validation (Switched from CV to LV)
A Tank Acid Validation (Switched from LV to CV)
Skinless MPC Flows (Independent Variables)
Skinless MPC
Skinless MPC Diagnostics
Skinless MPC To Historian
Skinless Acid Flow (Manipulated Variable)

Design


Fibrous
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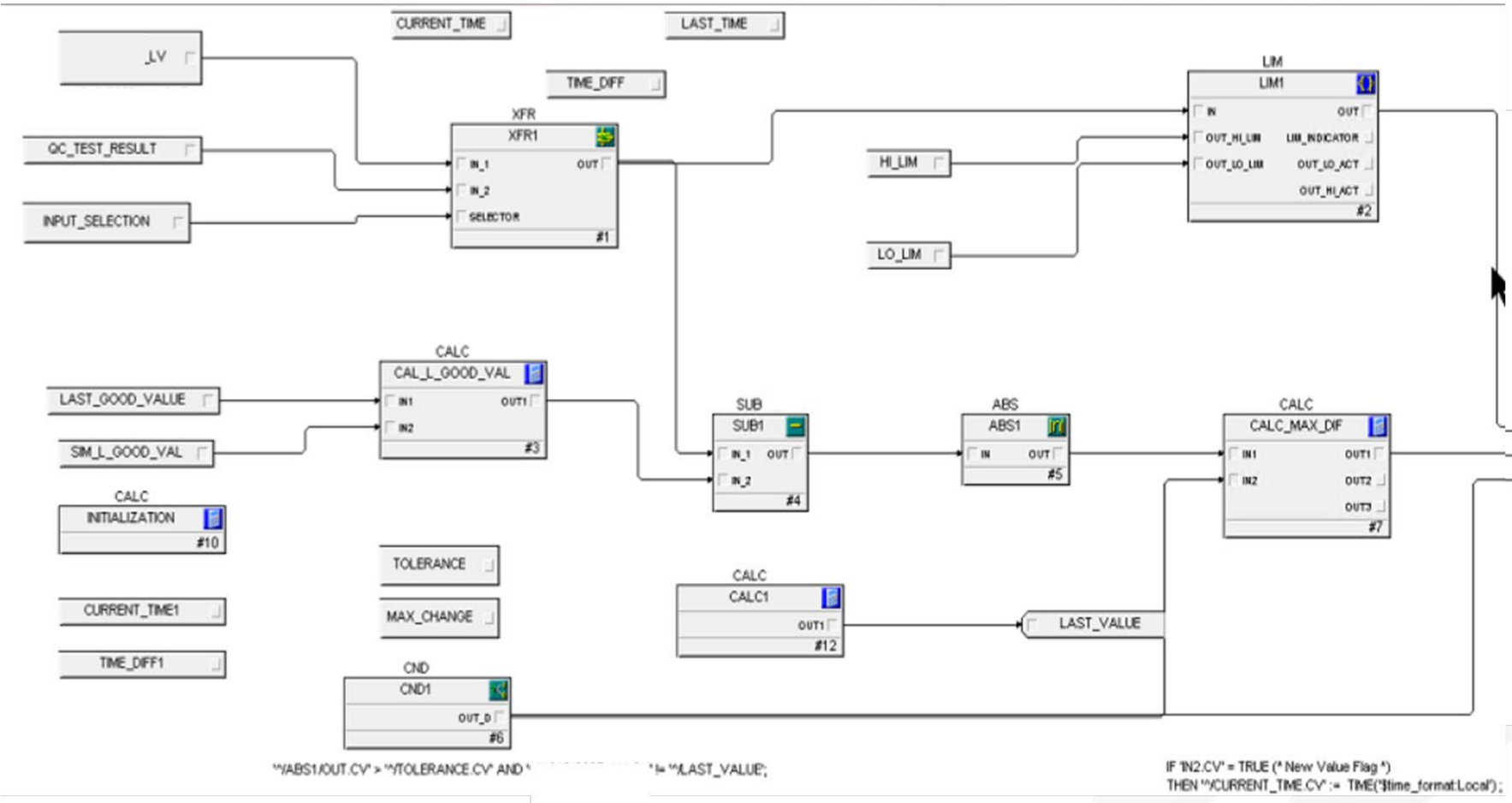
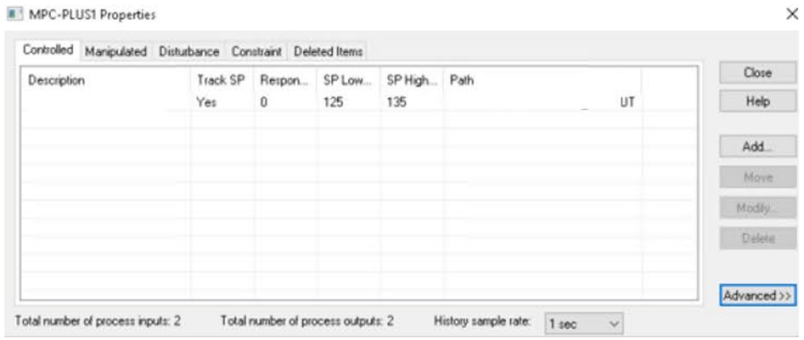
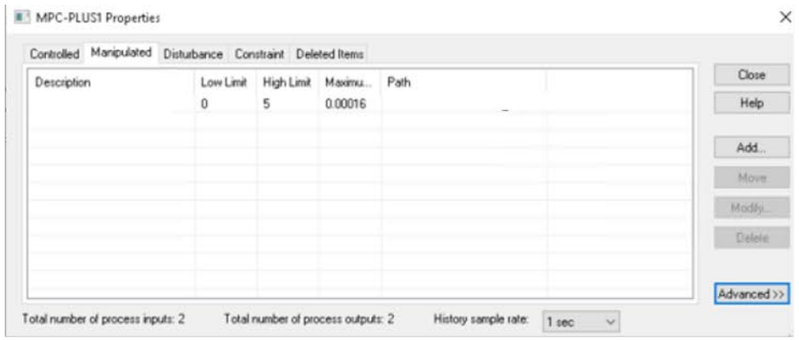
Fibrous Mother Liquor & Regen Flows (Disturbance Variable)
Fibrous Acid Flow (Manipulated Variable)
Fibrous Amm Flow (Manipulated Variable)
D Tank Acid Validation
D Tank Amm Validation
C Tank Acid Validation
C Tank Amm Validation
Fibrous Lab Results Module
Fibrous MPC Flows (Independent Variables)
Fibrous MPC
Fibrous MPC Diagnostics
Fibrous MPC to Historian
Fibrous Acid Flow (Manipulated Variable)
Fibrous Amm Flow (Manipulated Variable)

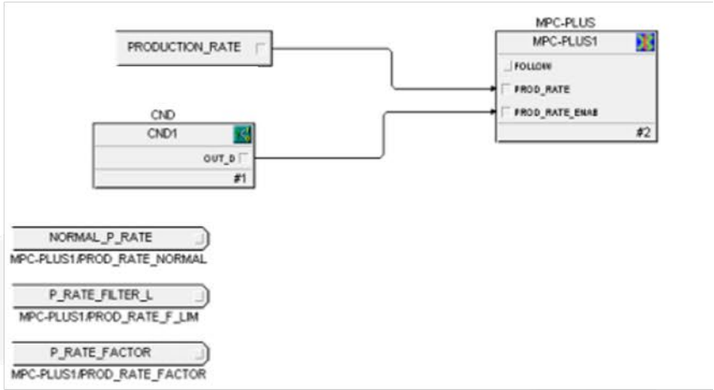
Analyzer Input Configuration

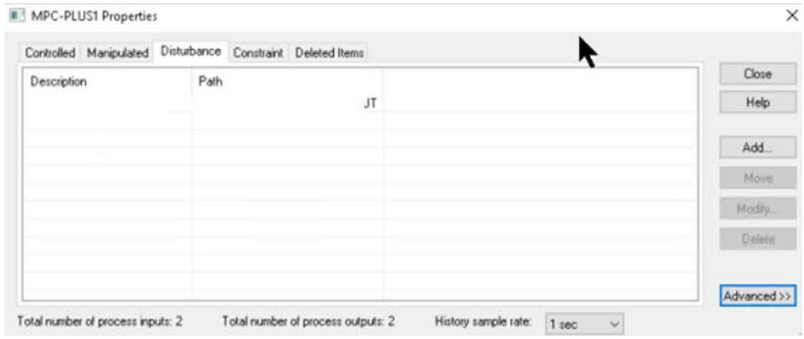


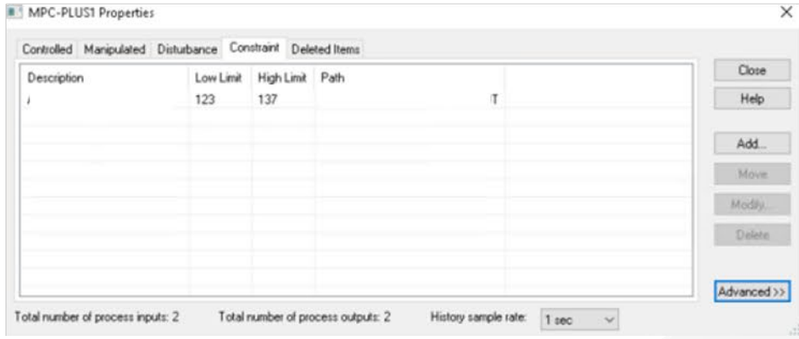
PredictPro Configuration



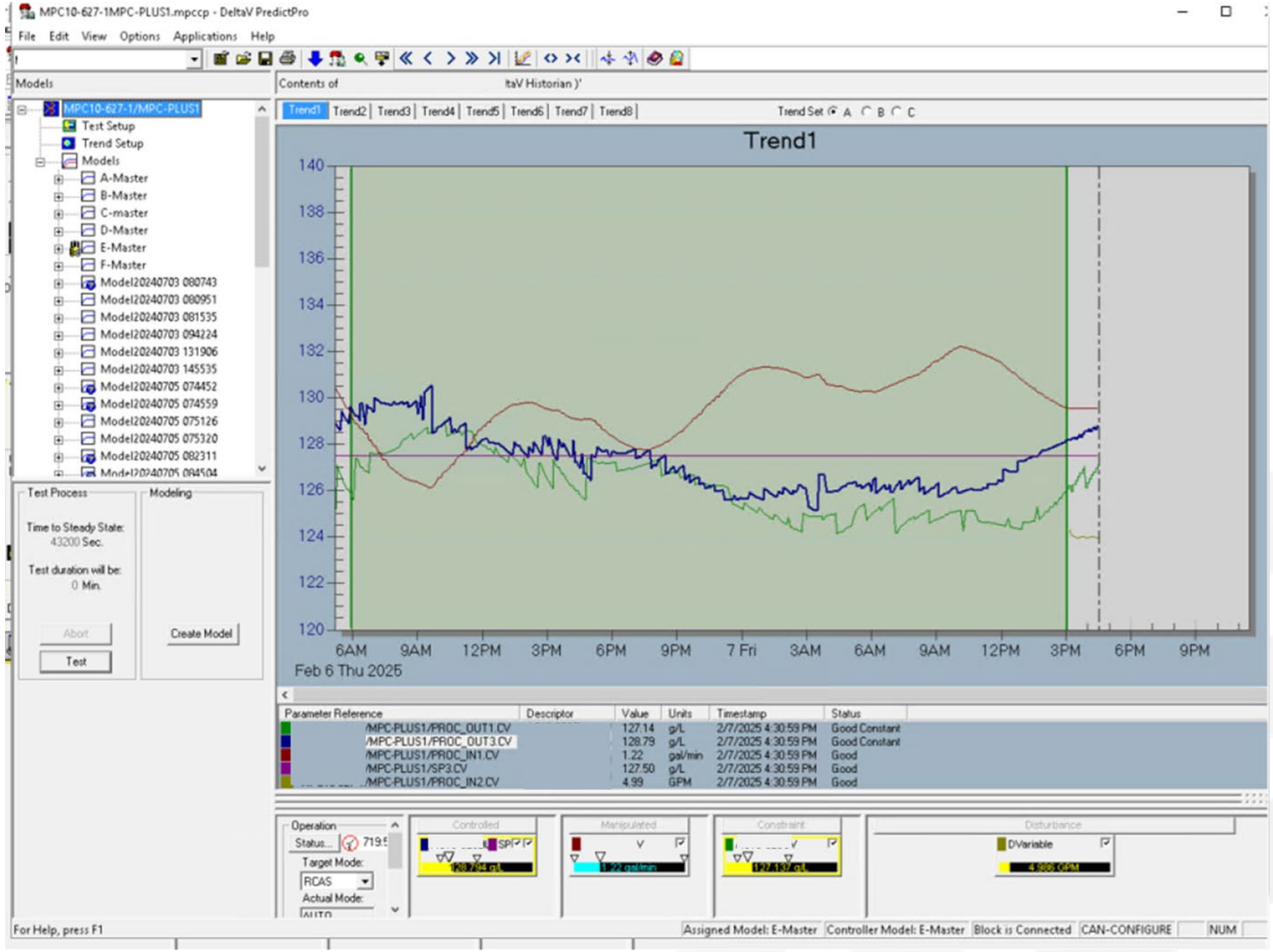




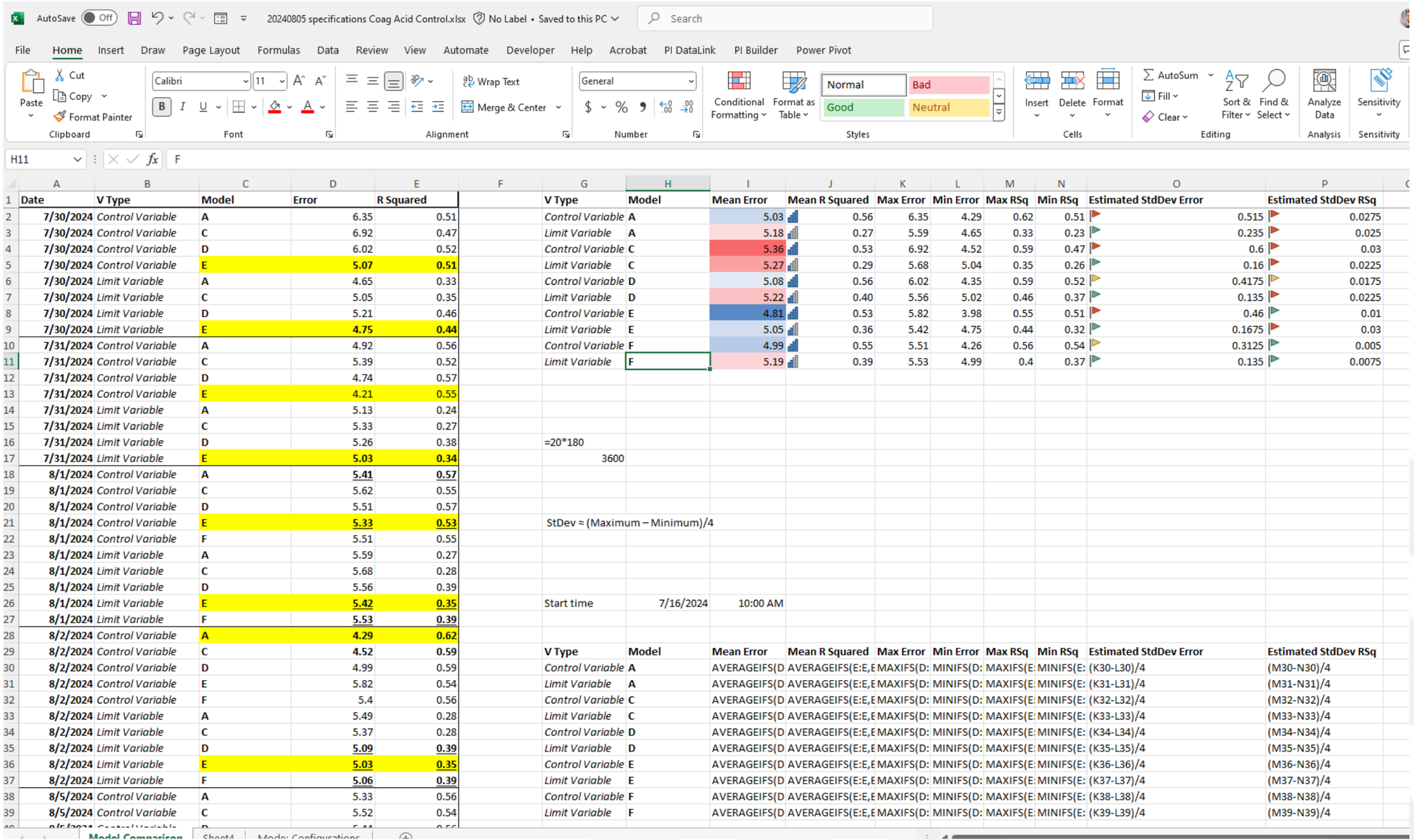




Model Identification

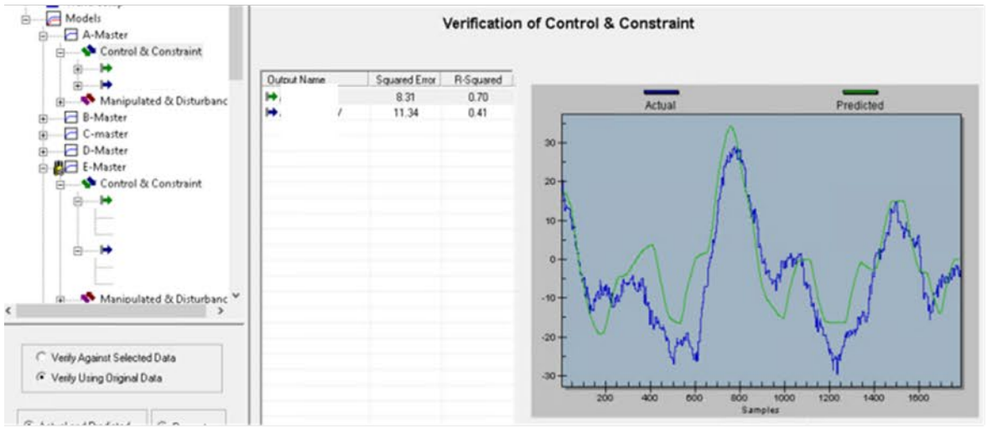


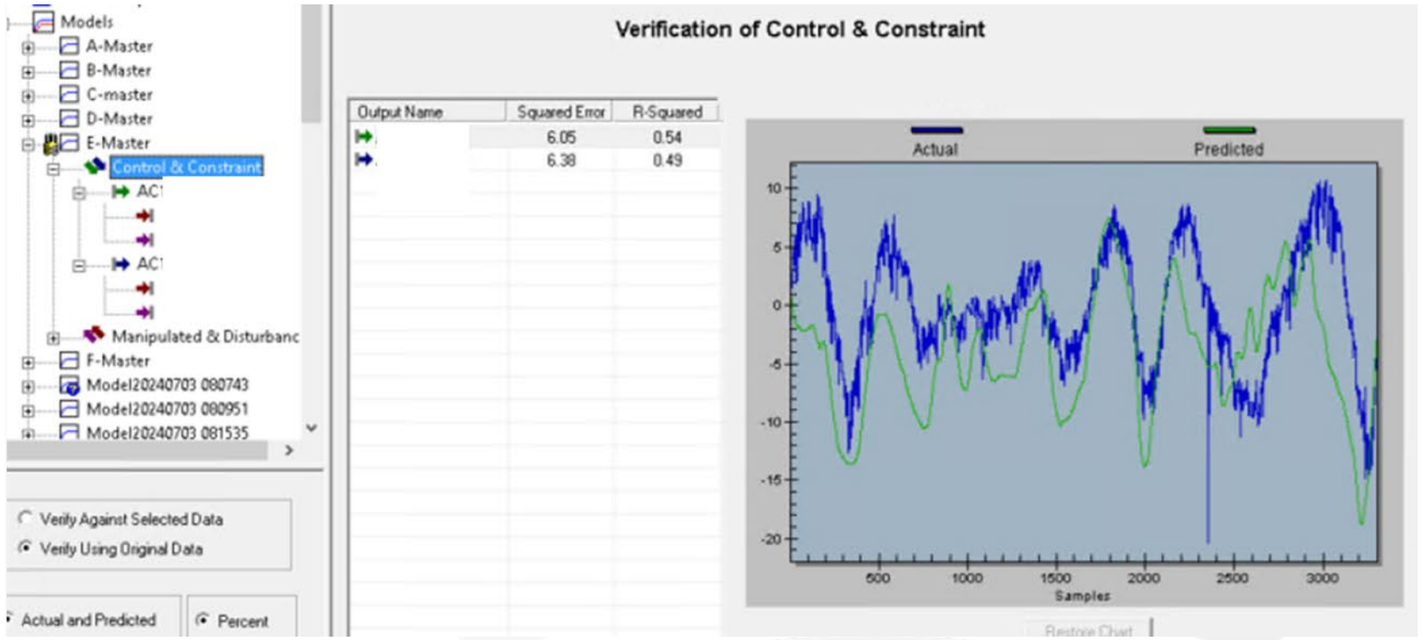
Model Identification



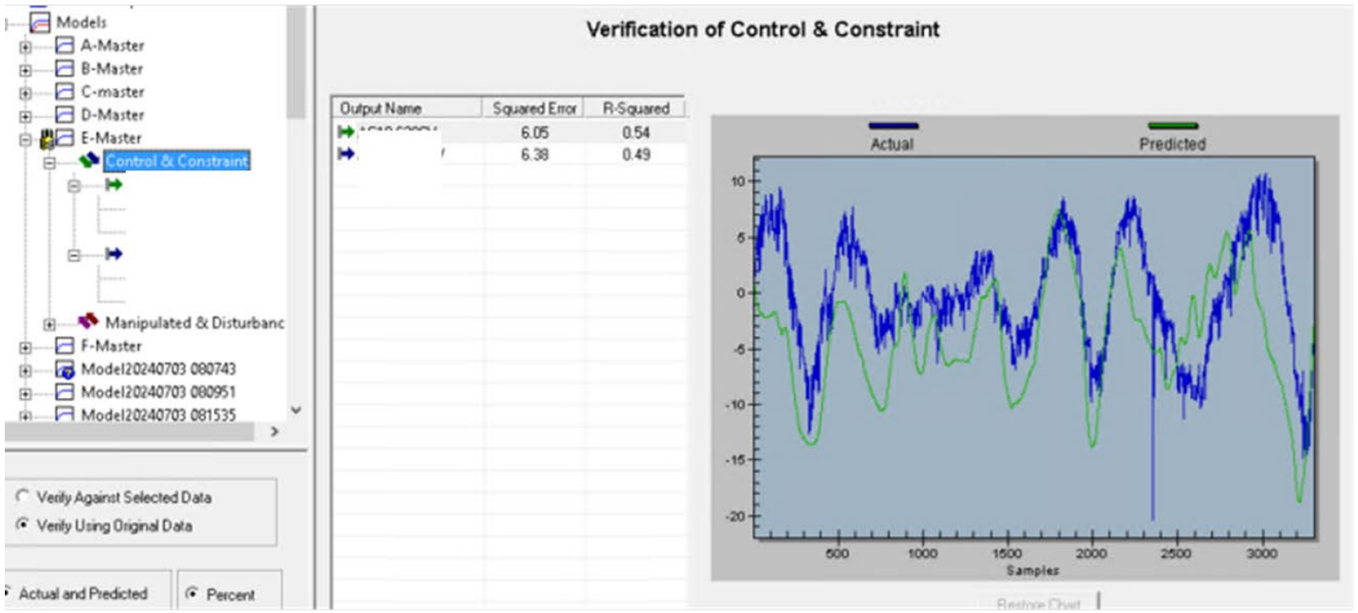
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Date	V Type	Model	Error	R Squared		V Type	Model	Mean Error	Mean R Squared	Max Error	Min Error	Max RSq	Min RSq	Estimated StdDev Error	Estimated StdDev RSq
2	7/30/2024	Control Variable	A	6.35	0.51		Control Variable	A	5.03	0.56	6.35	4.29	0.62	0.51	0.515	0.0275
3	7/30/2024	Control Variable	C	6.92	0.47		Limit Variable	A	5.18	0.27	5.59	4.65	0.33	0.23	0.235	0.025
4	7/30/2024	Control Variable	D	6.02	0.52		Control Variable	C	5.36	0.53	6.92	4.52	0.59	0.47	0.6	0.03
5	7/30/2024	Control Variable	E	5.07	0.51		Limit Variable	C	5.27	0.29	5.68	5.04	0.35	0.26	0.16	0.0225
6	7/30/2024	Limit Variable	A	4.65	0.33		Control Variable	D	5.08	0.56	6.02	4.35	0.59	0.52	0.4175	0.0175
7	7/30/2024	Limit Variable	C	5.05	0.35		Limit Variable	D	5.22	0.40	5.56	5.02	0.46	0.37	0.135	0.0225
8	7/30/2024	Limit Variable	D	5.21	0.46		Control Variable	E	4.81	0.53	5.82	3.98	0.55	0.51	0.46	0.01
9	7/30/2024	Limit Variable	E	4.75	0.44		Limit Variable	E	5.05	0.36	5.42	4.75	0.44	0.32	0.1675	0.03
10	7/31/2024	Control Variable	A	4.92	0.56		Control Variable	F	4.99	0.55	5.51	4.26	0.56	0.54	0.3125	0.005
11	7/31/2024	Control Variable	C	5.39	0.52		Limit Variable	F	5.19	0.39	5.53	4.99	0.4	0.37	0.135	0.0075
12	7/31/2024	Control Variable	D	4.74	0.57											
13	7/31/2024	Control Variable	E	4.21	0.55											
14	7/31/2024	Limit Variable	A	5.13	0.24											
15	7/31/2024	Limit Variable	C	5.33	0.27											
16	7/31/2024	Limit Variable	D	5.26	0.38		=20*180									
17	7/31/2024	Limit Variable	E	5.03	0.34		3600									
18	8/1/2024	Control Variable	A	5.41	0.57											
19	8/1/2024	Control Variable	C	5.62	0.55											
20	8/1/2024	Control Variable	D	5.51	0.57											
21	8/1/2024	Control Variable	E	5.33	0.53		StDev ≈ (Maximum – Minimum)/4									
22	8/1/2024	Control Variable	F	5.51	0.55											
23	8/1/2024	Limit Variable	A	5.59	0.27											
24	8/1/2024	Limit Variable	C	5.68	0.28											
25	8/1/2024	Limit Variable	D	5.56	0.39											
26	8/1/2024	Limit Variable	E	5.42	0.35		Start time	7/16/2024	10:00 AM							
27	8/1/2024	Limit Variable	F	5.53	0.39											
28	8/2/2024	Control Variable	A	4.29	0.62											
29	8/2/2024	Control Variable	C	4.52	0.59		V Type	Model	Mean Error	Mean R Squared	Max Error	Min Error	Max RSq	Min RSq	Estimated StdDev Error	Estimated StdDev RSq
30	8/2/2024	Control Variable	D	4.99	0.59		Control Variable	A	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K30-L30)/4	(M30-N30)/4
31	8/2/2024	Control Variable	E	5.82	0.54		Limit Variable	A	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K31-L31)/4	(M31-N31)/4
32	8/2/2024	Control Variable	F	5.4	0.56		Control Variable	C	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K32-L32)/4	(M32-N32)/4
33	8/2/2024	Limit Variable	A	5.49	0.28		Limit Variable	C	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K33-L33)/4	(M33-N33)/4
34	8/2/2024	Limit Variable	C	5.37	0.28		Control Variable	D	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K34-L34)/4	(M34-N34)/4
35	8/2/2024	Limit Variable	D	5.09	0.39		Limit Variable	D	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K35-L35)/4	(M35-N35)/4
36	8/2/2024	Limit Variable	E	5.03	0.35		Control Variable	E	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K36-L36)/4	(M36-N36)/4
37	8/2/2024	Limit Variable	F	5.06	0.39		Limit Variable	E	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K37-L37)/4	(M37-N37)/4
38	8/5/2024	Control Variable	A	5.33	0.56		Control Variable	F	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K38-L38)/4	(M38-N38)/4
39	8/5/2024	Control Variable	C	5.52	0.54		Limit Variable	F	AVERAGEIFS(D	AVERAGEIFS(E:E,E	MAXIFS(D:	MINIFS(D:	MAXIFS(E	MINIFS(E:	(K39-L39)/4	(M39-N39)/4

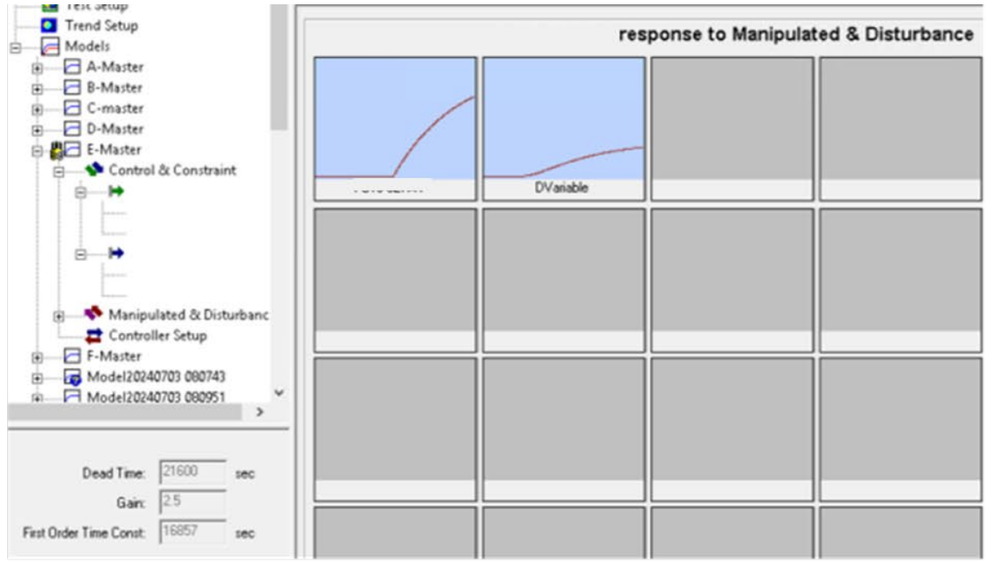
Model Comparison

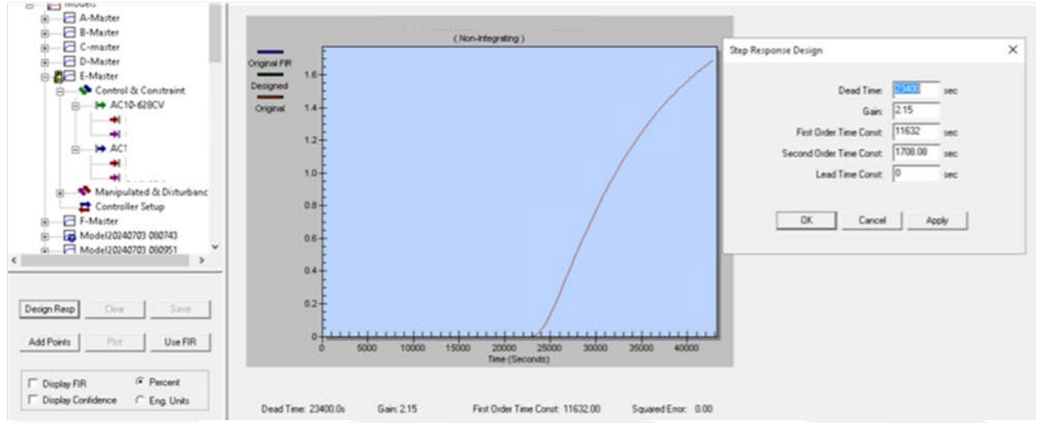




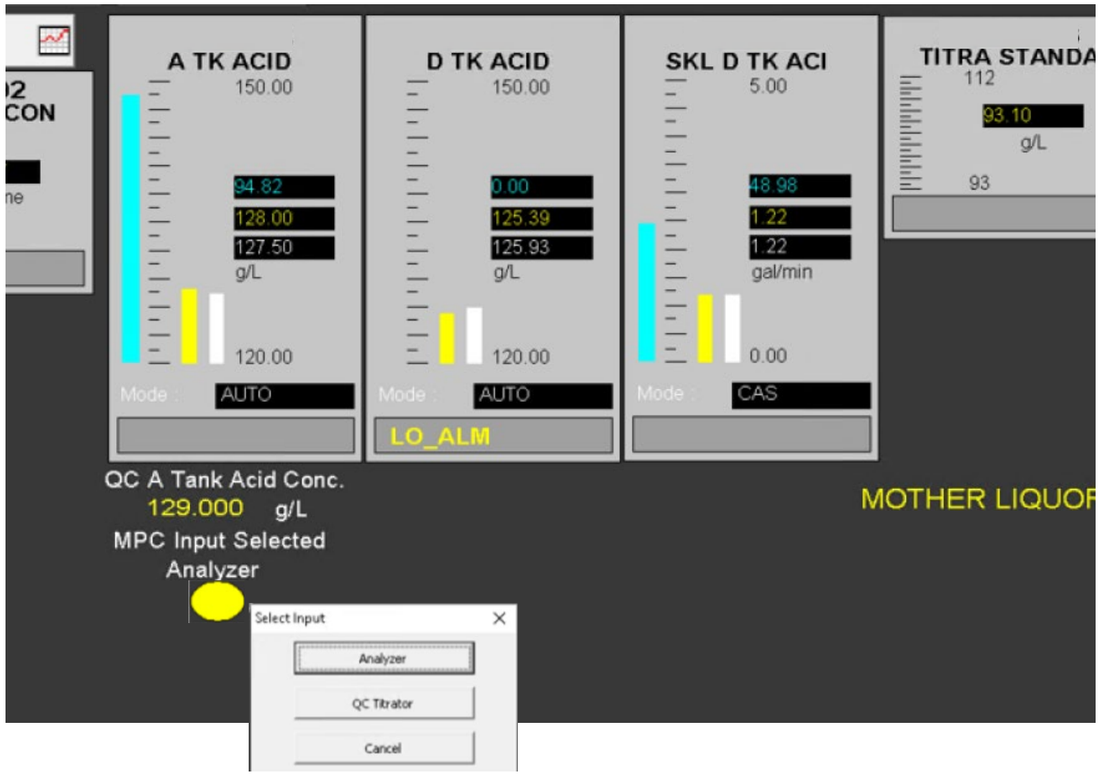
Model Verification & Editing

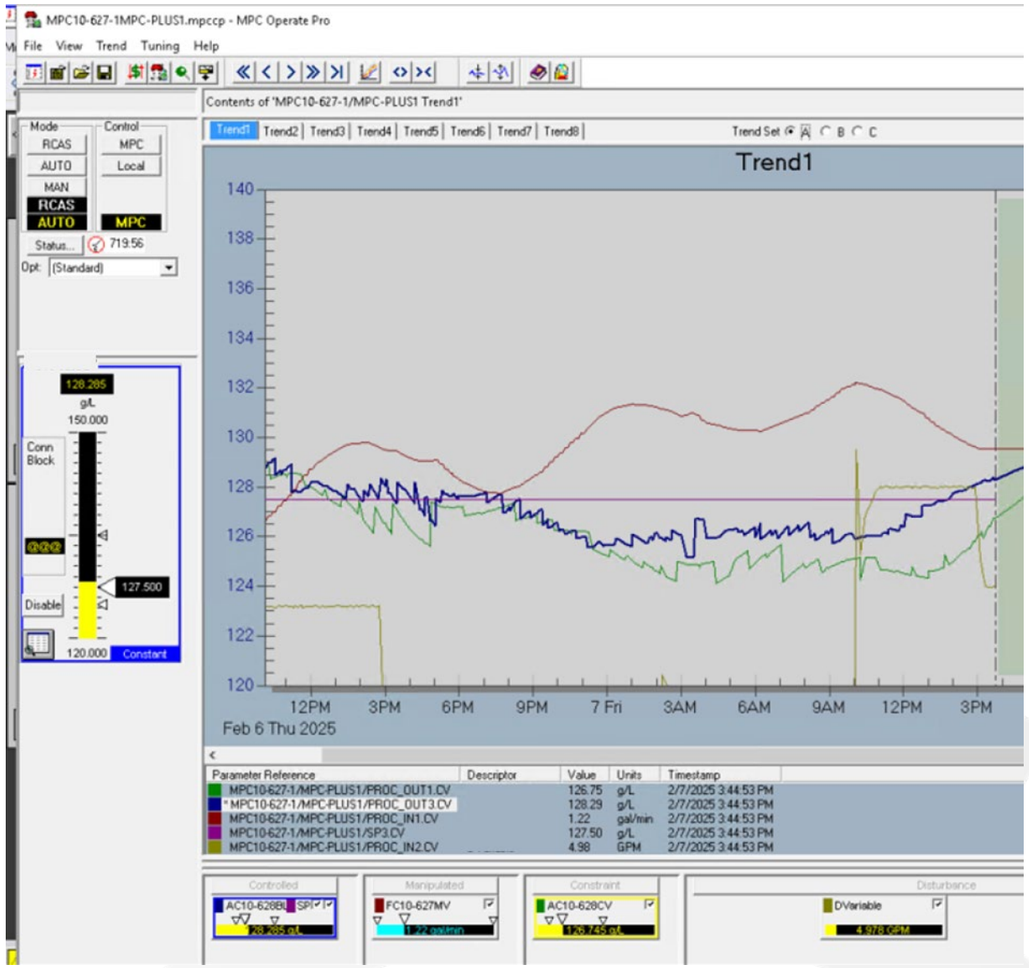






Continuous Improvement

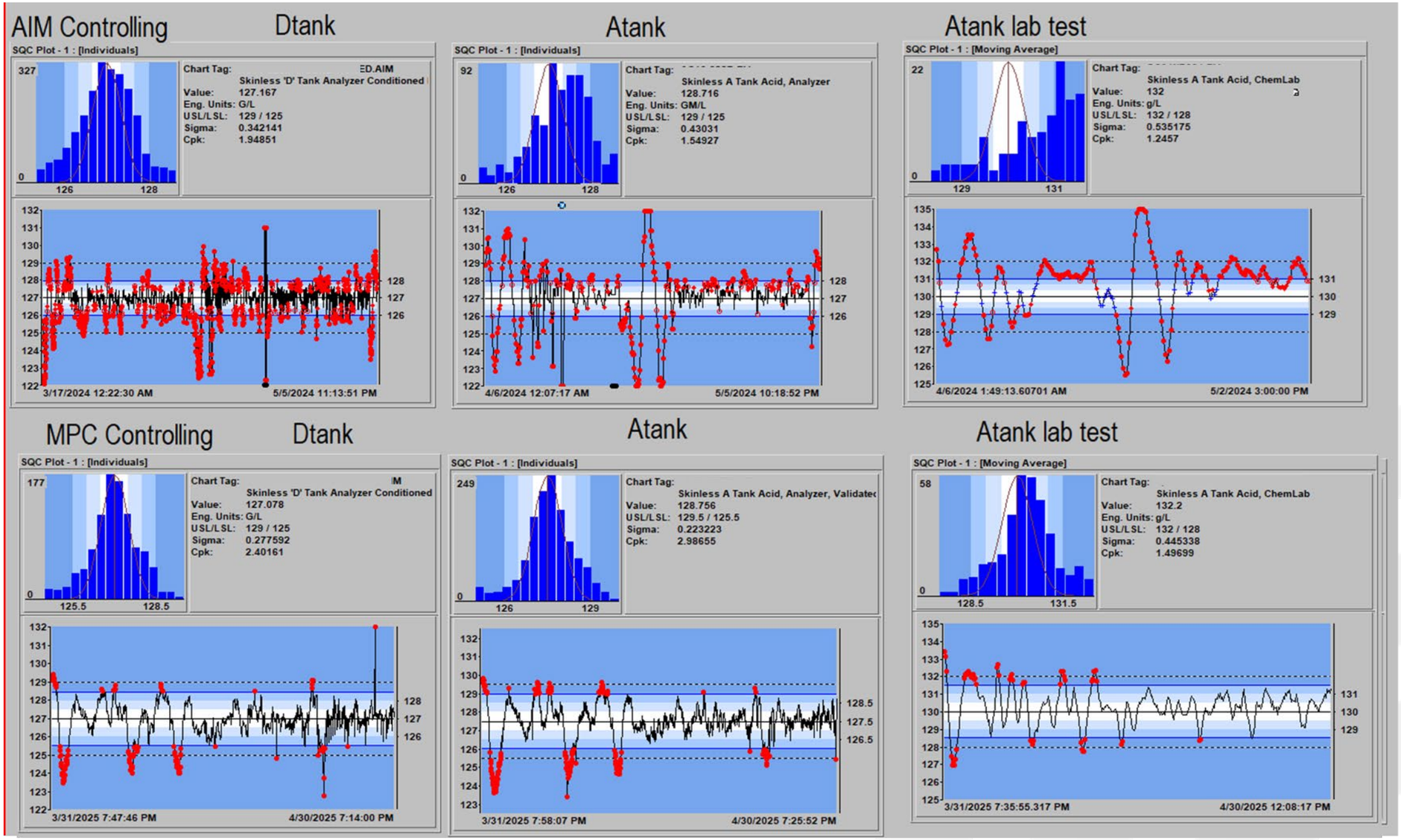




Results

- Even if the AIM control was controlling at acceptable conditions when compared to manual control, it was hard to maintain and was a “black box” for the process engineers; resulting in OPEX and working hours cost.
- MPC achieved a higher CPk than both manual control and control with AIM. PredictPro increases process stability effectively reducing costs.
- Instability in this part of the process can surmount to $45,000 scrap and waste costs per month in Skinless alone. In Fibrous it can surmount to $15,000.
- Viscofan can save up to $60,000 in monthly costs by using the MPC under current production rates.
- Additionally, the control is now democratized and is accessible for a wider audience to maintain, update and scale up.

Results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Eng. Units: G/L
USL/LSL: 129 / 125
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Cpk: 1.94851
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Atank
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Atank lab test
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MPC Controlling
Dtank
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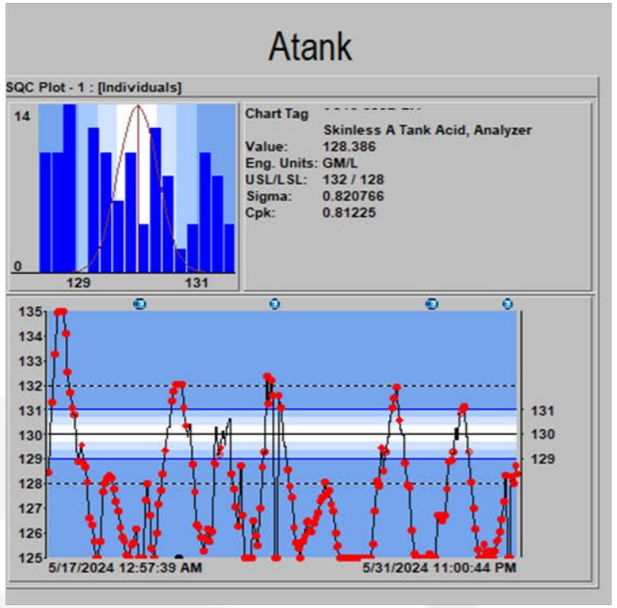
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Conclusions

It’s that Easy

- Marcelo started the project having NO experience with DeltaV, MPC, and obvious lack of experience in the legacy AIM and PROVOX systems.
- The project transformed complex control logic into a graphical and user-friendly interface, removing the need for advanced programming skills.
- The project proved a dynamic and flexible approach like the MPC can have better results than an expert system.
- This project challenged the adage that you can only choose two out of speed, cost-efficiency, and quality—because it successfully delivered all three.

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Questions?

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Thank You