Our speakers

WEBINAR SERIES FOR MENA, PART 2

Featured speakers

Sam van der Zwan, *expert pipeline hydraulics*

Mina Ibrahim, *hydraulic surge protection lead engineer*

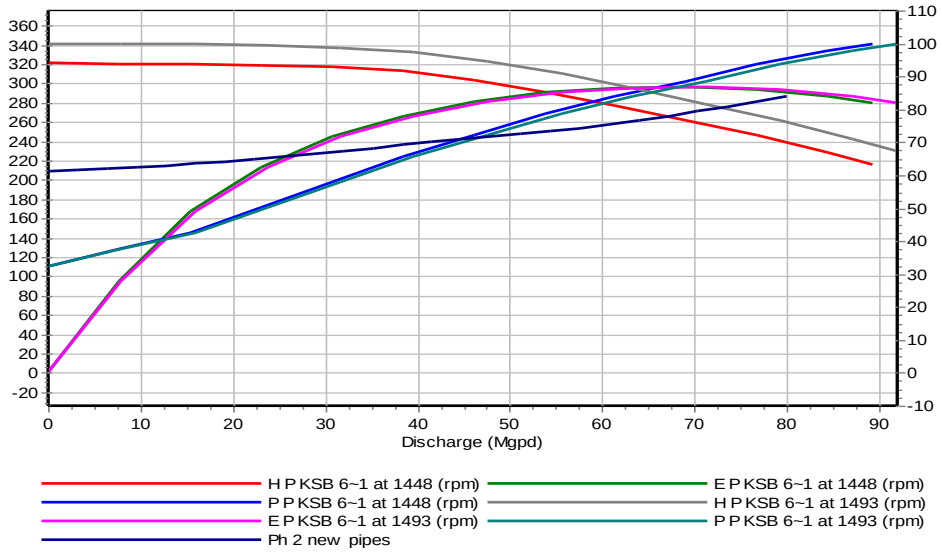
Digital twins for pipeline systems

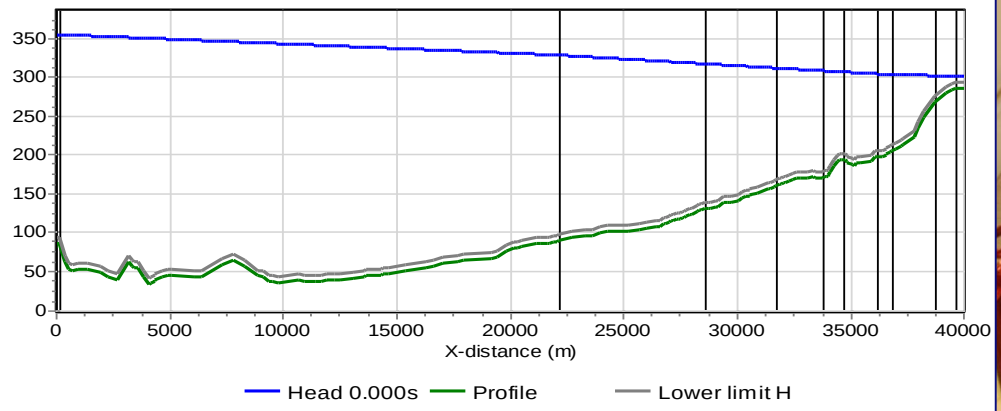
December 16 – 1:00 pm UAE, 10:00 am Delft

Webinar topics

1. Big corporation pipelines Hydraulics
2. The Imitations of existing Monitoring system
3. Automated Expert Monitoring (Digital Twin)
4. Example of AEM

Big corporation pipelines Hydraulics





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The Imitations of existing Monitoring system

Each organization has big collected data via SCADA system

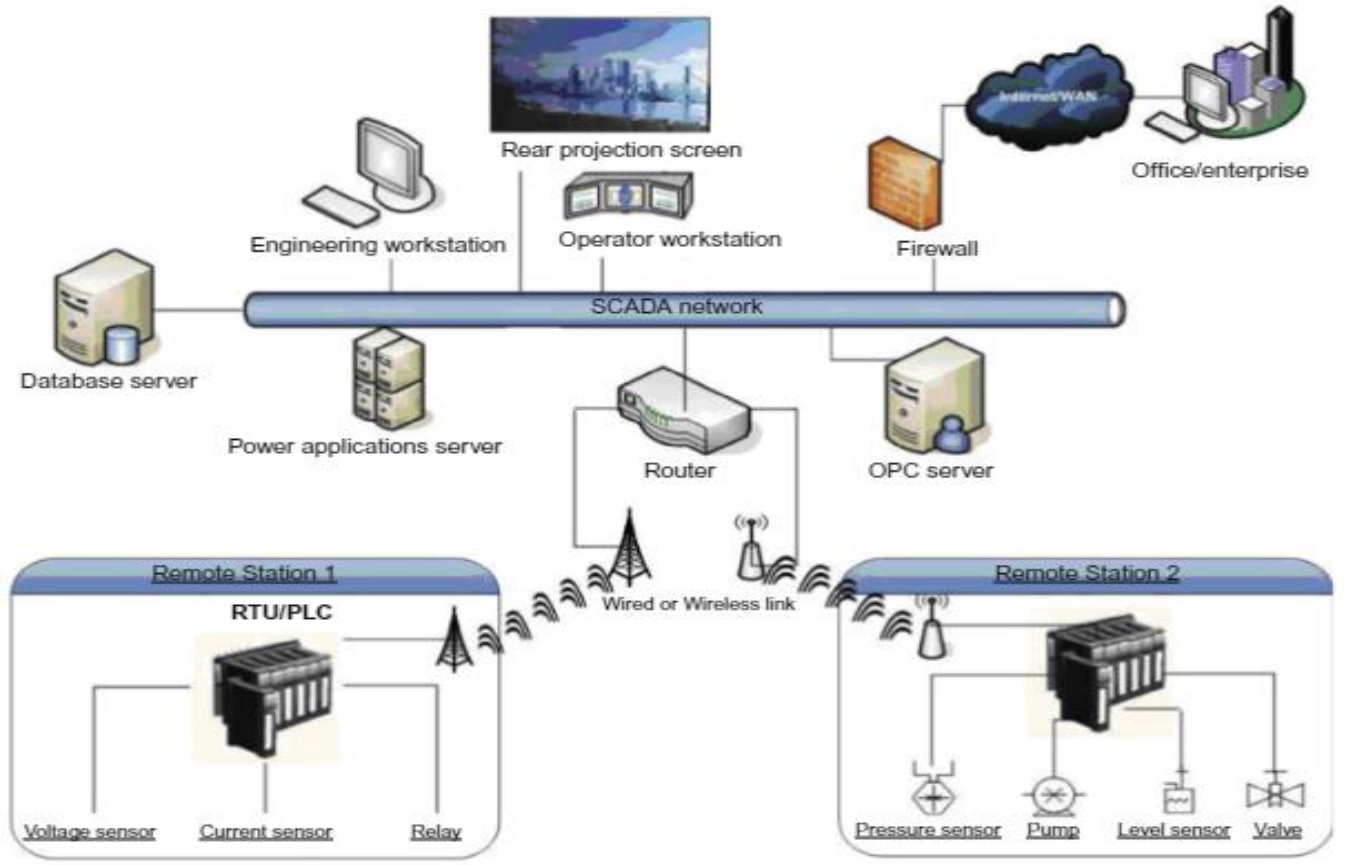

FIG. 1

SCADA system network.

Smart Energy Grid Engineering. http://dx.doi.org/10.1016/B978-0-12-805343-0.00018-8

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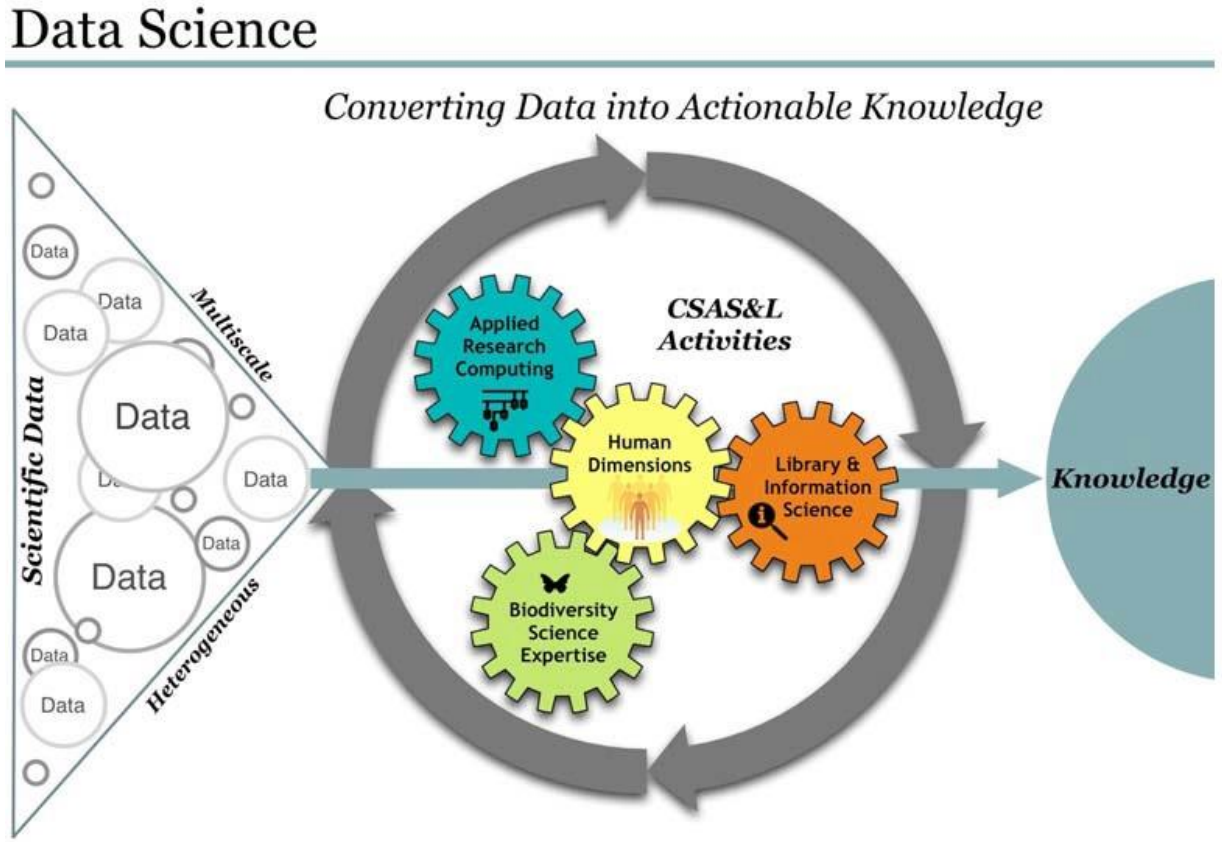
The Imitations of existing Monitoring system



Experts are needed to analyze the data interpreting it into useful information

For big organization It is a costly and time-consuming

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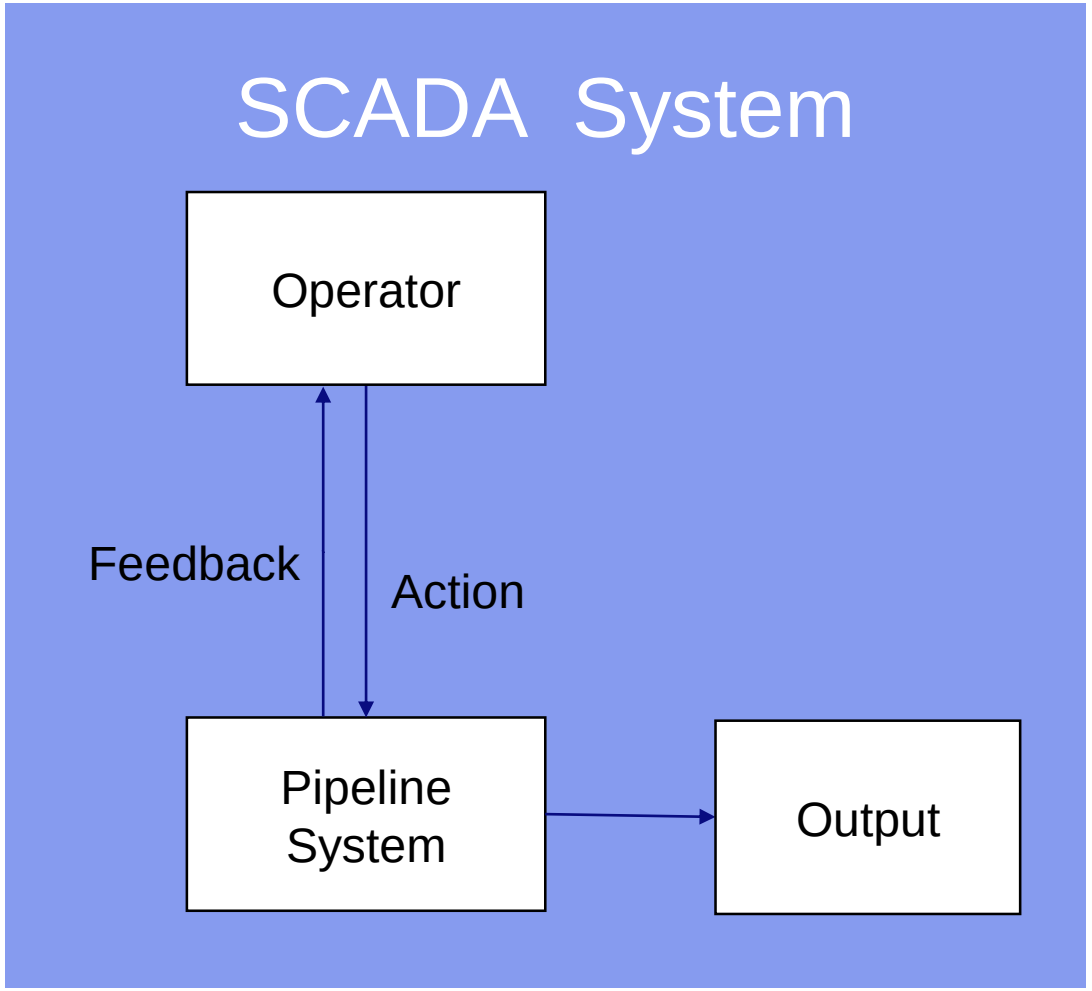
The Imitations of existing Monitoring system

The Automation is the best solution when we have big scale of work and limited resources such as the experts

The Imitations of existing Monitoring system

Existing Monitoring system



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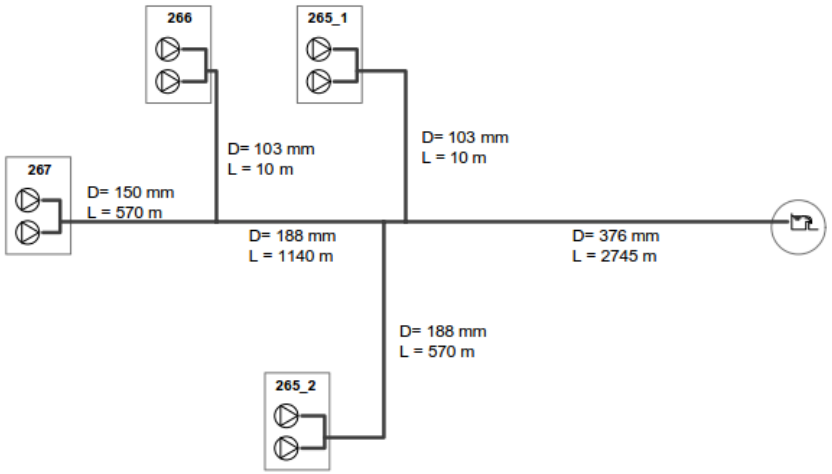
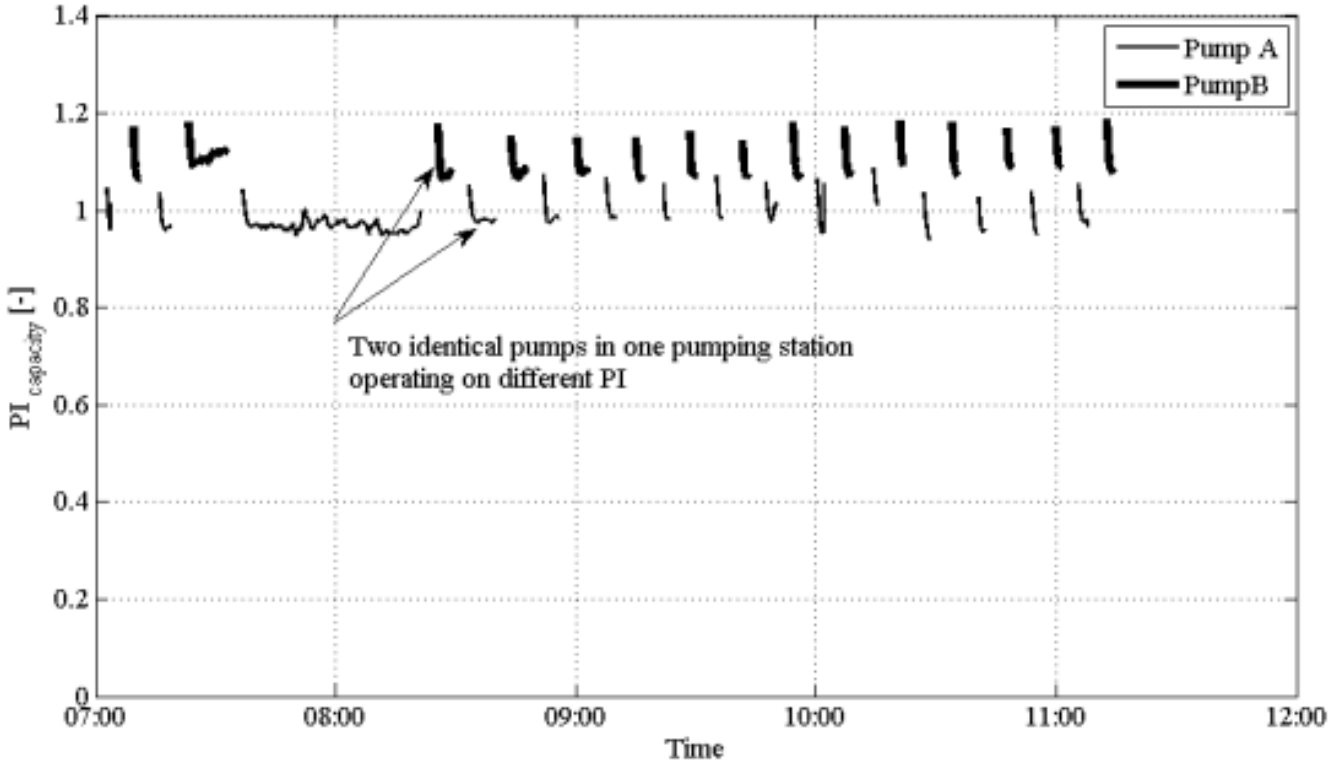
Why Benchmark!

1. Pumps performance compare operation of different pumps

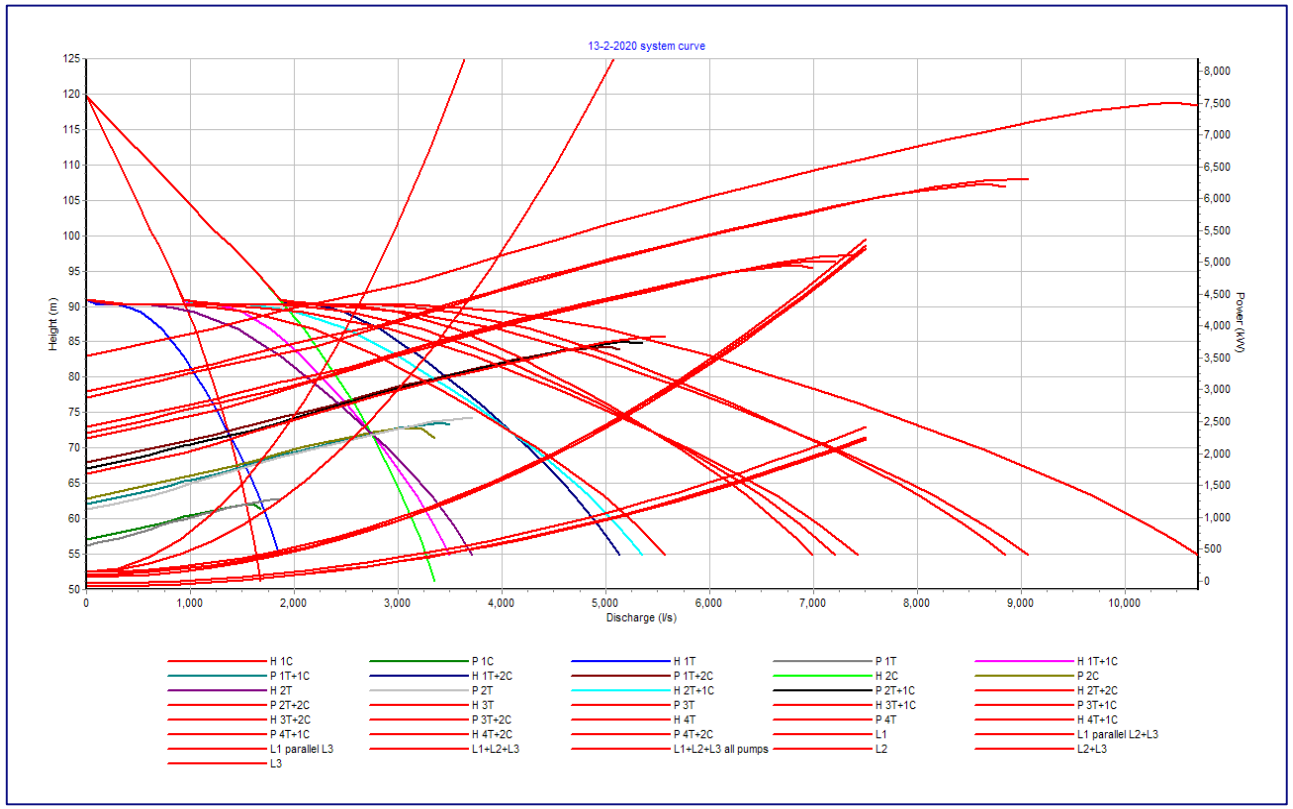


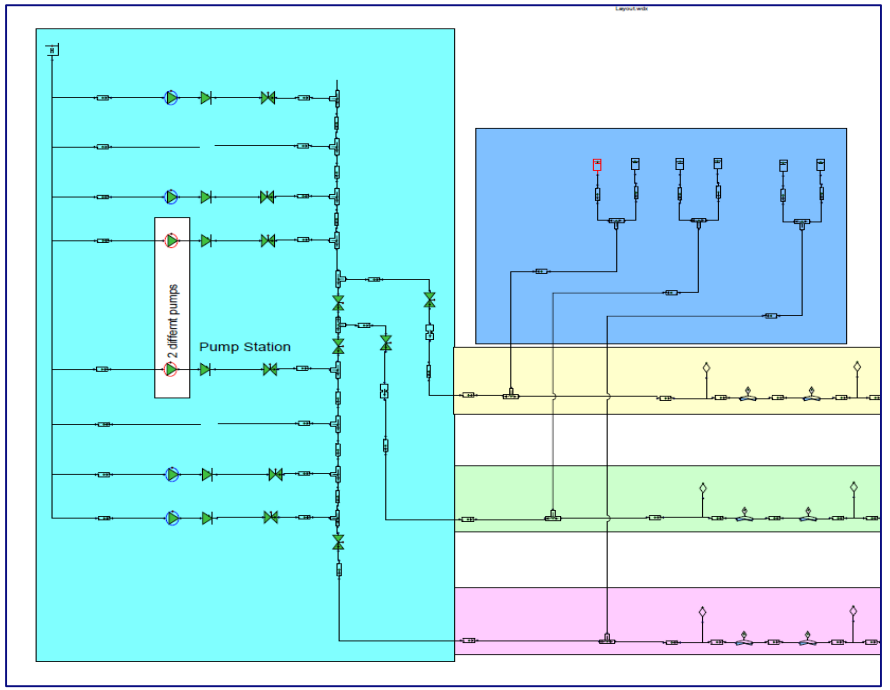


Why Benchmark!

2. Operation

Complicated systems needs more than manual calculated indications





Case	Suction Reservoir head (m)	Discharge LPS	Consumption factor power/Flowrate kW/LPS
case L1 or L2 T	13.317	1660.7	0.7506
case L1 or L2 1C + 1T	13.667	2591.3	0.8688
case L1 or L2 2 T	13.667	2571.2	0.8649
case L3 T	13.317	1715.5	0.7340
case L3 1C + 1T	13.667	2808	0.8296
case L3 2 T	13.667	2820.8	0.8214
case L3 2C	13.667	2792	0.8379
case L2+3 3T	14.017	4447.4	0.7999
case L1+2+3 4T	14.967	6263.8	0.7768
case L1+2+3 3T +1C	14.967	6198.6	0.7814
case L1+2+3 3T +2C	15.167	7142.6	0.8199
case L1+2+3 4T +1C	15.167	7164.7	0.8165
case L1+2+3 4T + 2C	15.367	7926.1	0.8566
case L1 and L2+L3 1C1T +1	15.167	7108	0.8220
case L1 and L2+L3 2T +1C2	15.167	7094.2	0.8201
case L1 and L2+L3 1C2T + 1	15.367	7599.5	0.8741

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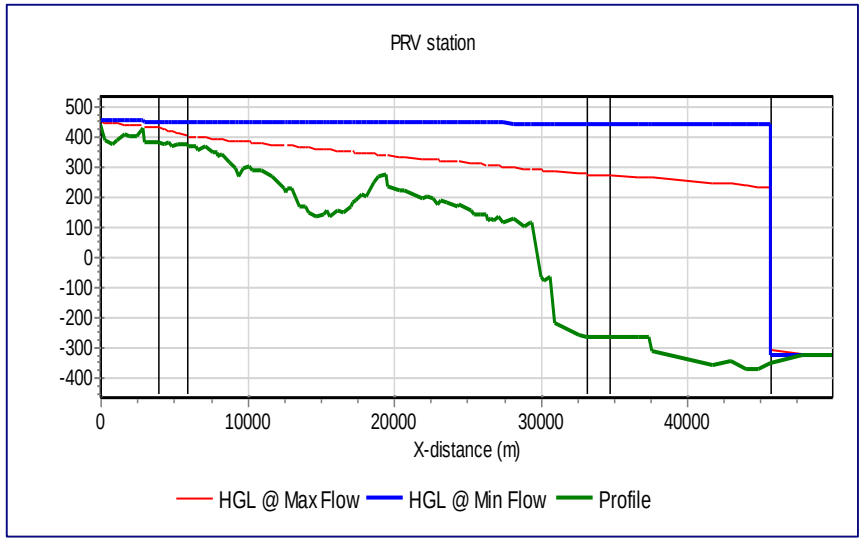
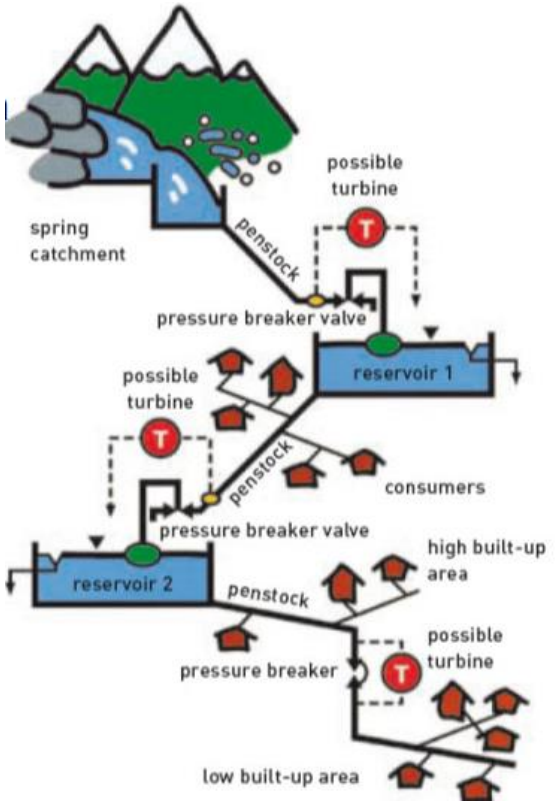
Why Benchmark!

3. Control Valves



Cavitation Check based on valve manufacturer data
Additional benefit power loss need to be checked

	Flow CMH	Head loss (m)	MW/Year	AED/Year
Min	50.00	765.101	913.26	164,386.68
Max Flow	600.12	636.821	9,122.76	1,642,096.20
Avg			5,018.01	903,241.44



IHE Material for small Hydro turbine plant course

4. NRV Valves

NRV Received Data during design

D	0.4	m
K	0.722923	(-)
Rminor =	2.333315	(m3/s)^2/m
Kv	7525.952	(m3/hr)/1bar
Cv	8700	(GPM)/1PSI

The actual value which includes closing assisting springs and counterweight
k=6.36 circa, 10 times the resistance!

D	0.4	m
K	6.36	(-)
Rminor =	20.52761	(m3/s)^2/m
Kv	2537.342	(m3/hr)/1bar
Cv	2933.167	(GPM)/1PSI

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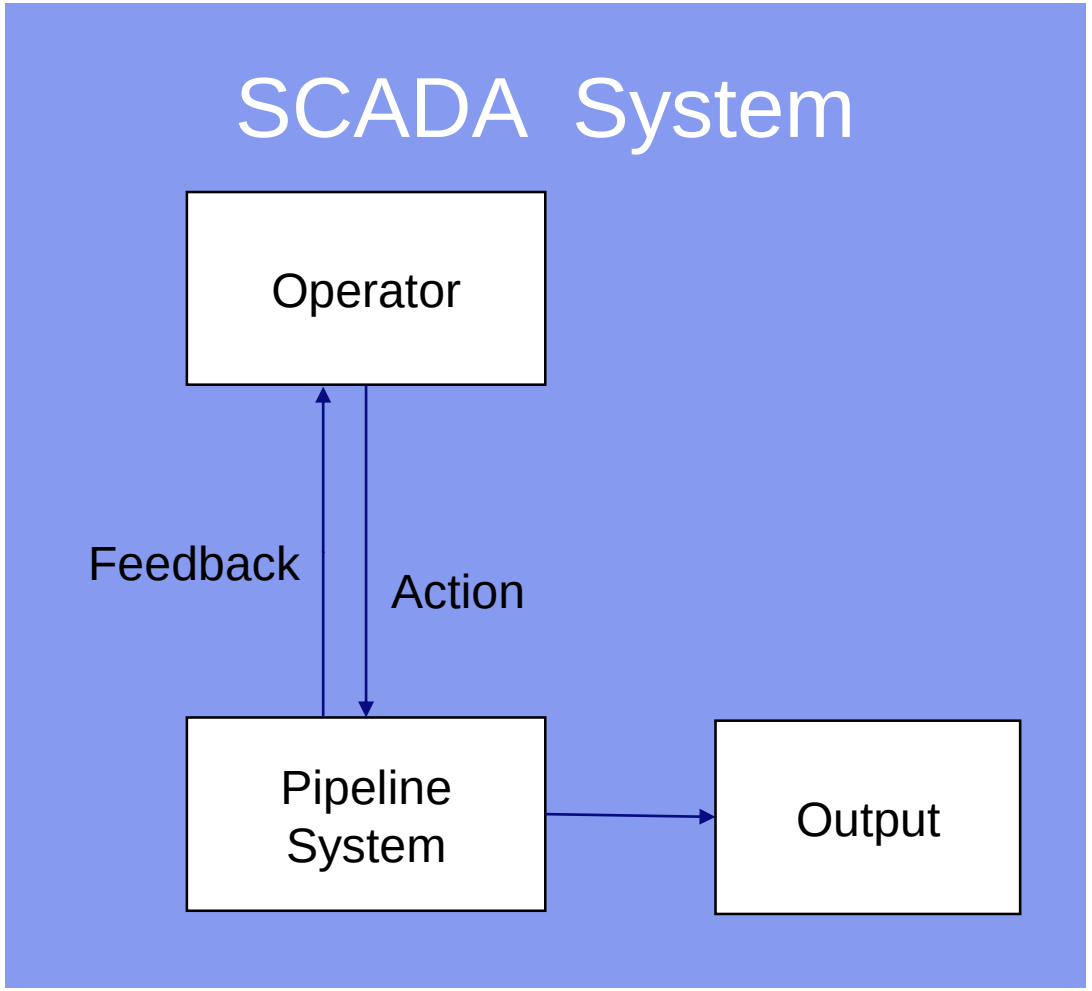
The Imitations of existing Monitoring system

Existing Monitoring system



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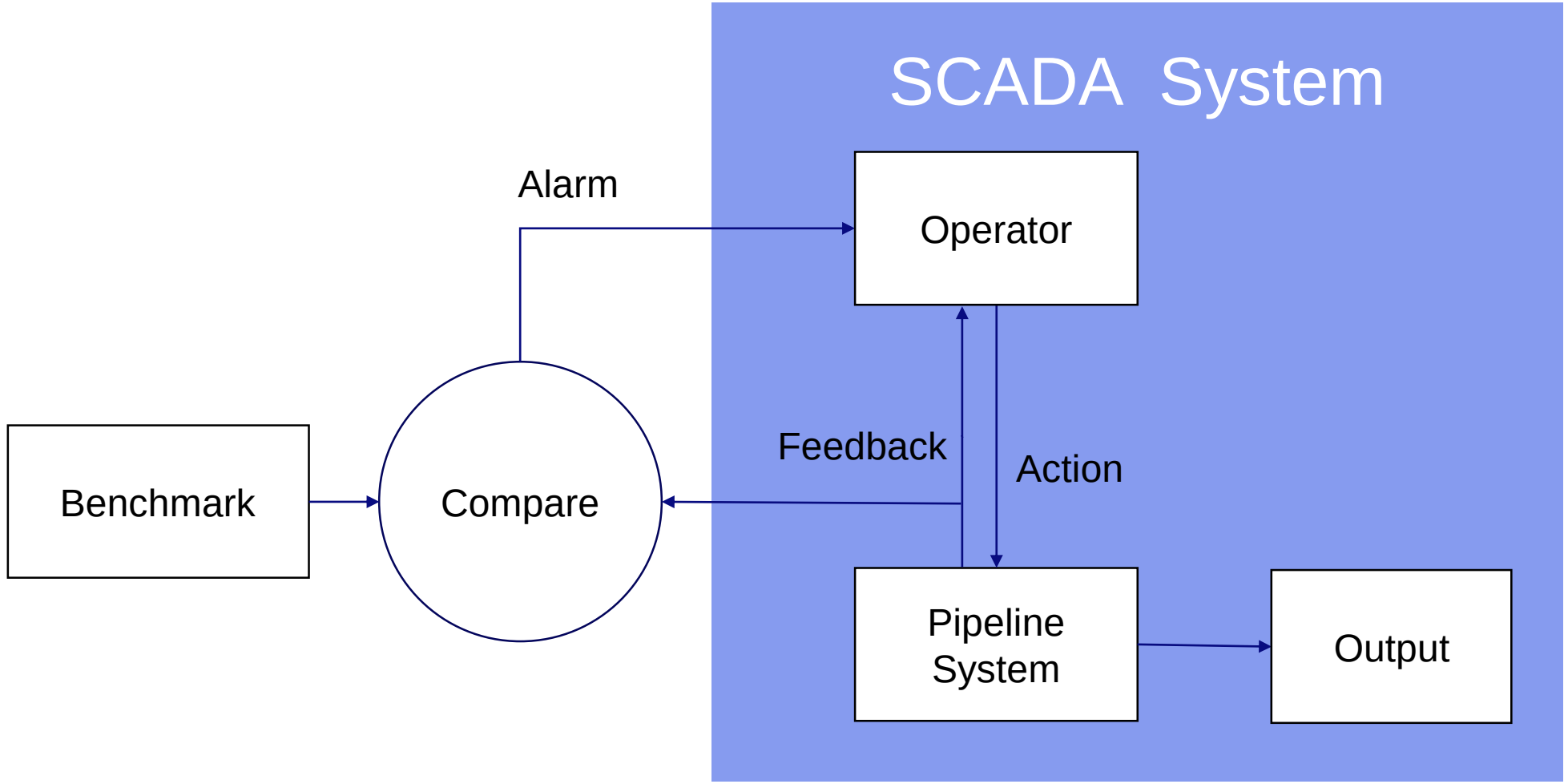
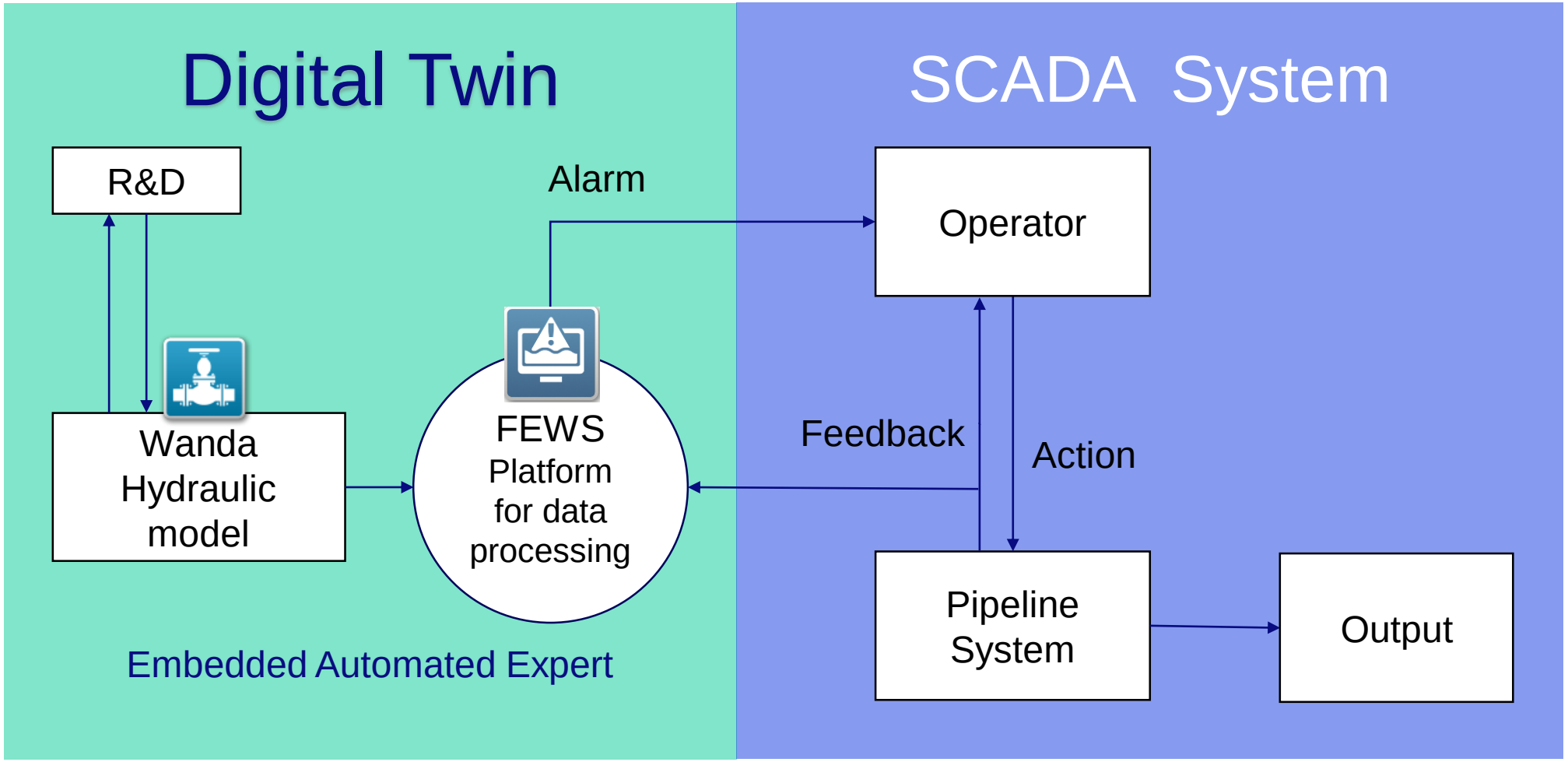
The Imitations of existing Monitoring system



The Imitations of existing Monitoring system



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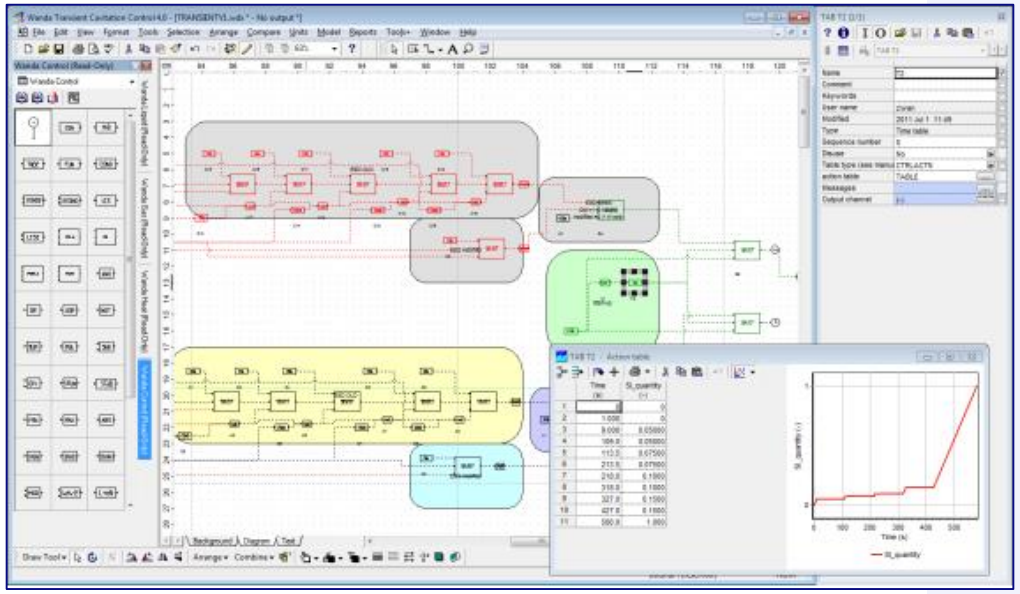
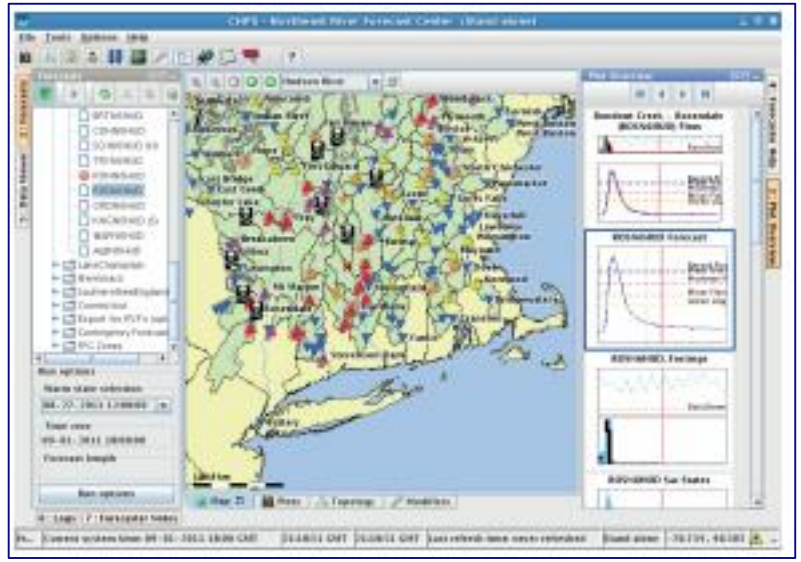
Digital Twin, How!

WANDA

- Simulation tool for hydraulic in pipeline system
- Main advantages of WANDA:
  - Build by engineers for engineers
  - Validated against lab and field data
  - Used worldwide by major engineering firms
  - Extensive control module to model normal operation of pipeline including e.g. PID controllers
  - Fully function Python API to run Wanda from Python

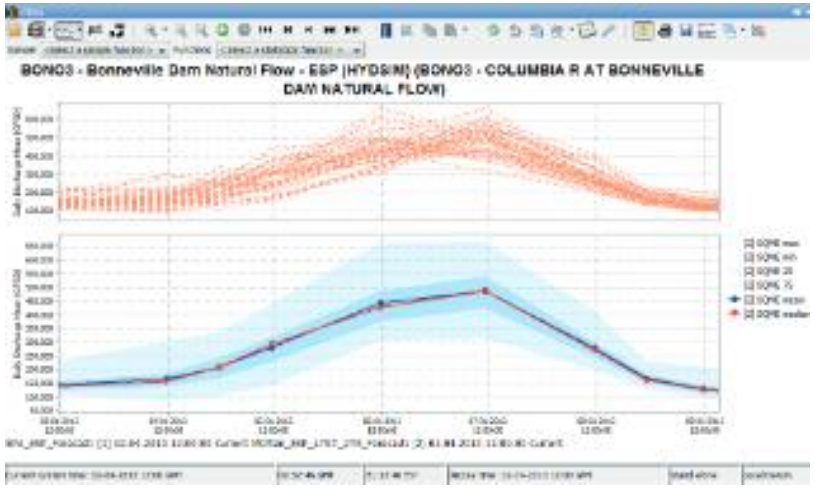


Digital Twin, How!



FEWS

- Real time operational data integration platform
- FEWS can gather data from different sources and use it to run different models
- FEWS can visualize the data and raise alarm when values exceed a threshold
- Used world wide for a.o. flood forecasting systems
- Free software
- Can run stand alone or as server-client setup



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How to come to a digital twin

- Create hydraulic model of the system
- Calibrate model with measurement data
- Make measurement data available for import in FEWS (SCADA or CSV)
- Configure FEWS
  - Determine performance indicators
  - Setup dashboard
  - Set alarms
  - Etc.

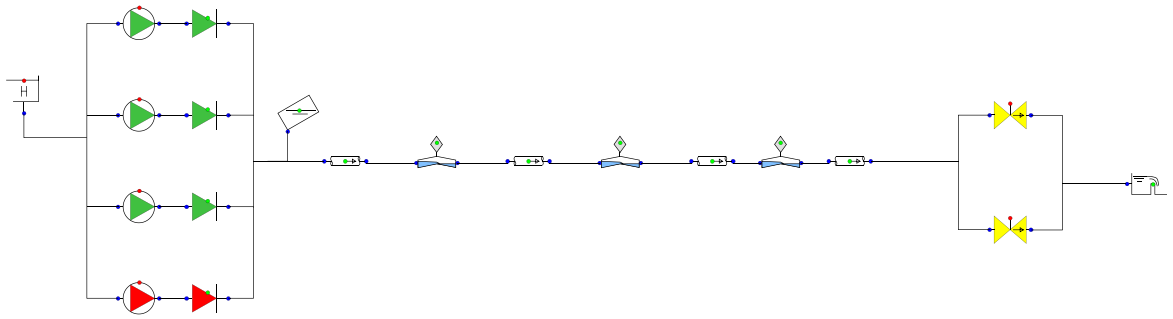
System performance (%)

	Booster	PS-1	PS-2	PS-3
Day	98.74	89.52	96.10	81.53
Week	98.04	96.33	97.73	95.00
Month	-	-	-	-

	Pipe 1-2	Pipe 2-3	Pipe 3-4
Day	99.98	99.95	99.95
Week	90.98	90.98	90.98
Month	-	-	-

Example system for demonstration purposes

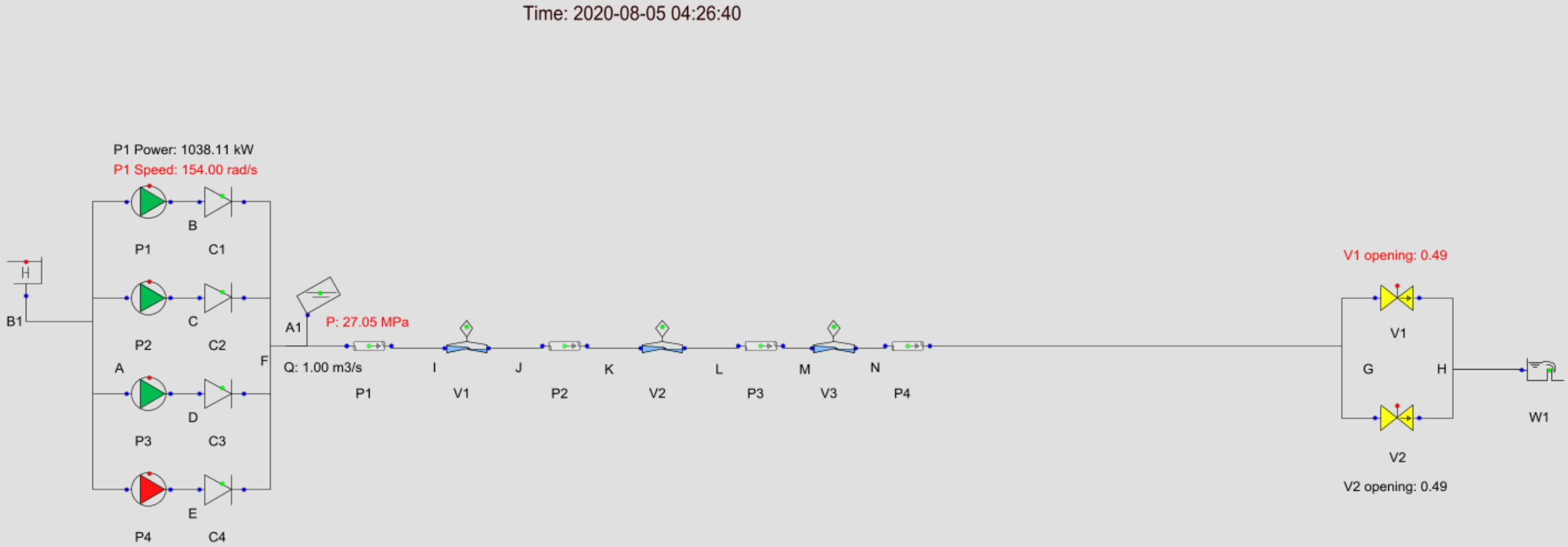
- DN1000 single pipeline 96 km
- Capacity: 1 m^3/s
- 4 pumps (3+1) set to control the discharge
- 2 control valve set to upstream pressure of 2.5 barg
- 8 Surge vessels of 100 m^3 each

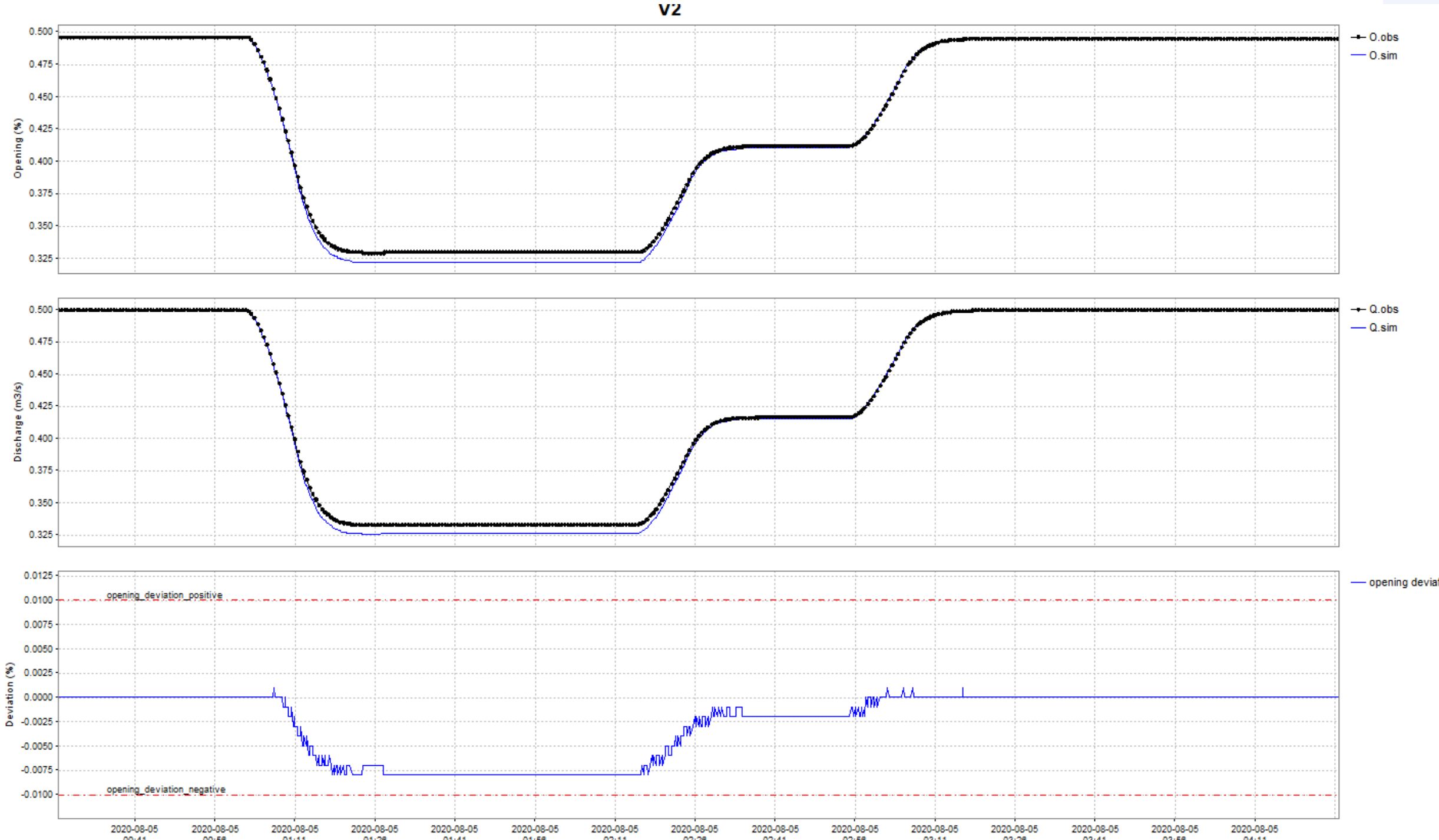


And now?

- If you are intrested and want to know what how this can work for your system contact us:
- Sam.vanderzwan@deltares.nl
- mina@exergiaengineering.com

Demonstration System




V2
Opening (%)
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
O.obs
O.sim
Discharge (m3/s)
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
Q.obs
Q.sim
Deviation (%)
0.0125
0.0100
0.0075
0.0050
0.0025
0.0000
-0.0025
-0.0050
-0.0075
-0.0100
opening_deviation_positive
opening_deviation_negative
opening deviat
2020-08-05
2020-08-05
2020-08-05
2020-08-05
2020-08-05
2020-08-05
2020-08-05
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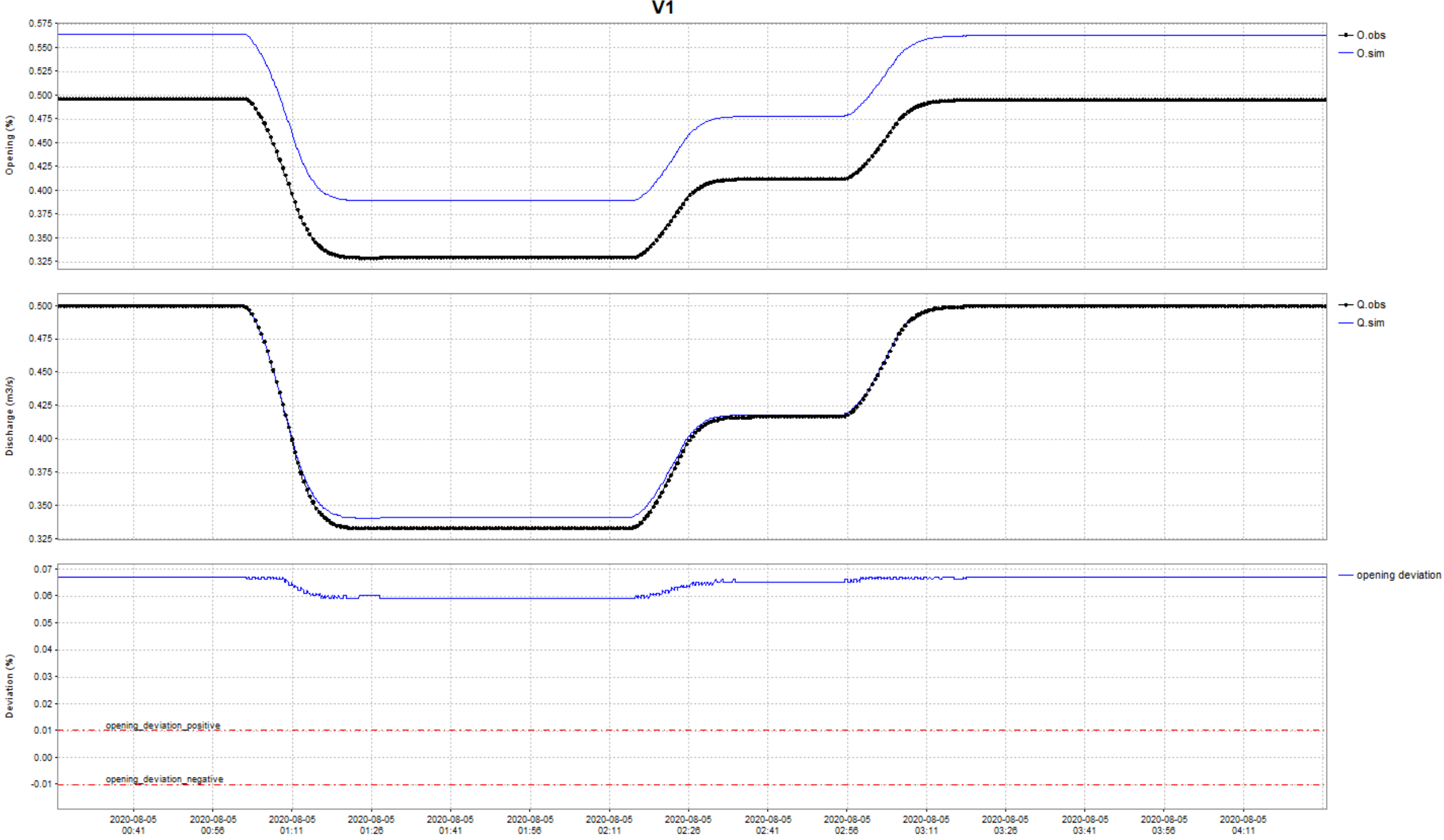
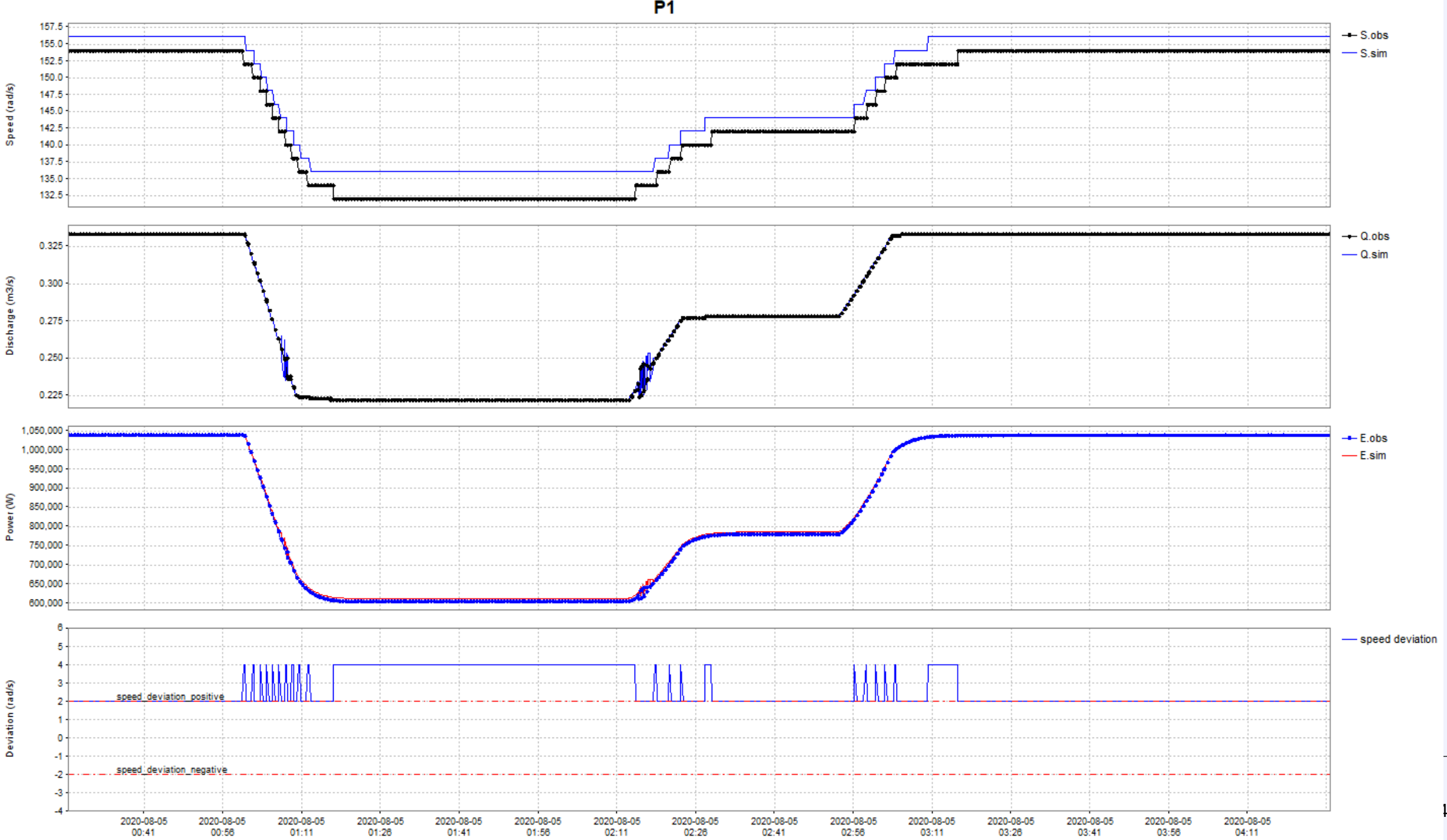
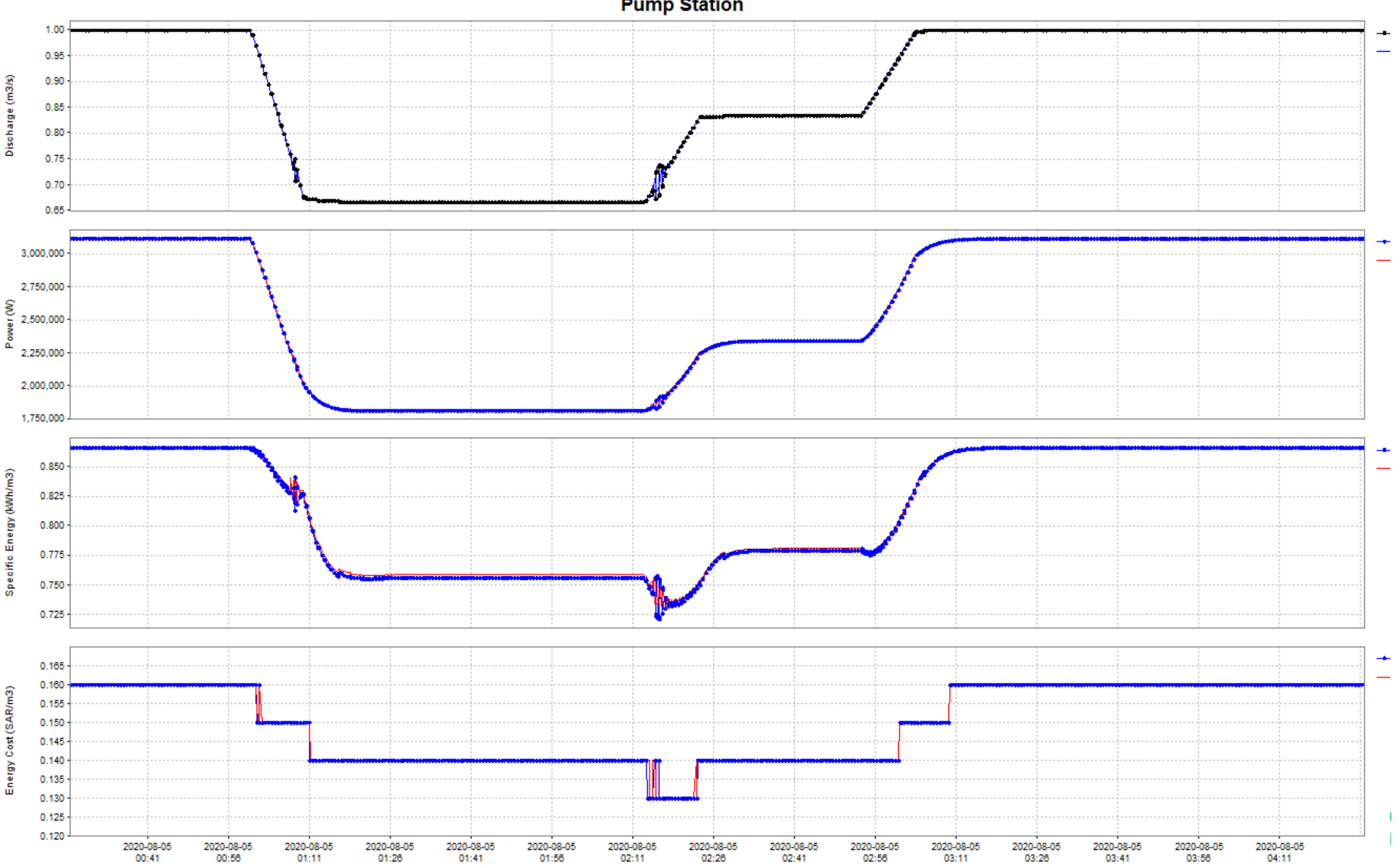

V1
Opening (%)
0.575
0.550
0.525
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
O.obs
O.sim
Discharge (m3/s)
0.500
0.475
0.450
0.425
0.400
0.375
0.350
0.325
Q.obs
Q.sim
Deviation (%)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
opening_deviation_positive
opening_deviation_negative
opening deviation
2020-08-05 00:41
2020-08-05 00:56
2020-08-05 01:11
2020-08-05 01:26
2020-08-05 01:41
2020-08-05 01:56
2020-08-05 02:11
2020-08-05 02:26
2020-08-05 02:41
2020-08-05 02:56
2020-08-05 03:11
2020-08-05 03:26
2020-08-05 03:41
2020-08-05 03:56
2020-08-05 04:11


P1
Speed (rad/s)
157.5
155.0
152.5
150.0
147.5
145.0
142.5
140.0
137.5
135.0
132.5
S.obs
S.sim
Discharge (m3/s)
0.325
0.300
0.275
0.250
0.225
Q.obs
Q.sim
Power (W)
1,050,000
1,000,000
950,000
900,000
850,000
800,000
750,000
700,000
650,000
600,000
E.obs
E.sim
Deviation (rad/s)
6
5
4
3
2
1
0
-1
-2
-3
-4
speed_deviation_positive
speed_deviation_negative
speed deviation
2020-08-05 00:41
2020-08-05 00:56
2020-08-05 01:11
2020-08-05 01:26
2020-08-05 01:41
2020-08-05 01:56
2020-08-05 02:11
2020-08-05 02:26
2020-08-05 02:41
2020-08-05 02:56
2020-08-05 03:11
2020-08-05 03:26
2020-08-05 03:41
2020-08-05 03:56
2020-08-05 04:11


Pump Station
Discharge (m3/s)
1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
Power (W)
3,000,000
2,750,000
2,500,000
2,250,000
2,000,000
1,750,000
Specific Energy (kWh/m3)
0.850
0.825
0.800
0.775
0.750
0.725
Energy Cost (SAR/m3)
0.165
0.160
0.155
0.150
0.145
0.140
0.135
0.130
0.125
0.120
2020-08-05 00:41
2020-08-05 00:56
2020-08-05 01:11
2020-08-05 01:26
2020-08-05 01:41
2020-08-05 01:56
2020-08-05 02:11
2020-08-05 02:26
2020-08-05 02:41
2020-08-05 02:56
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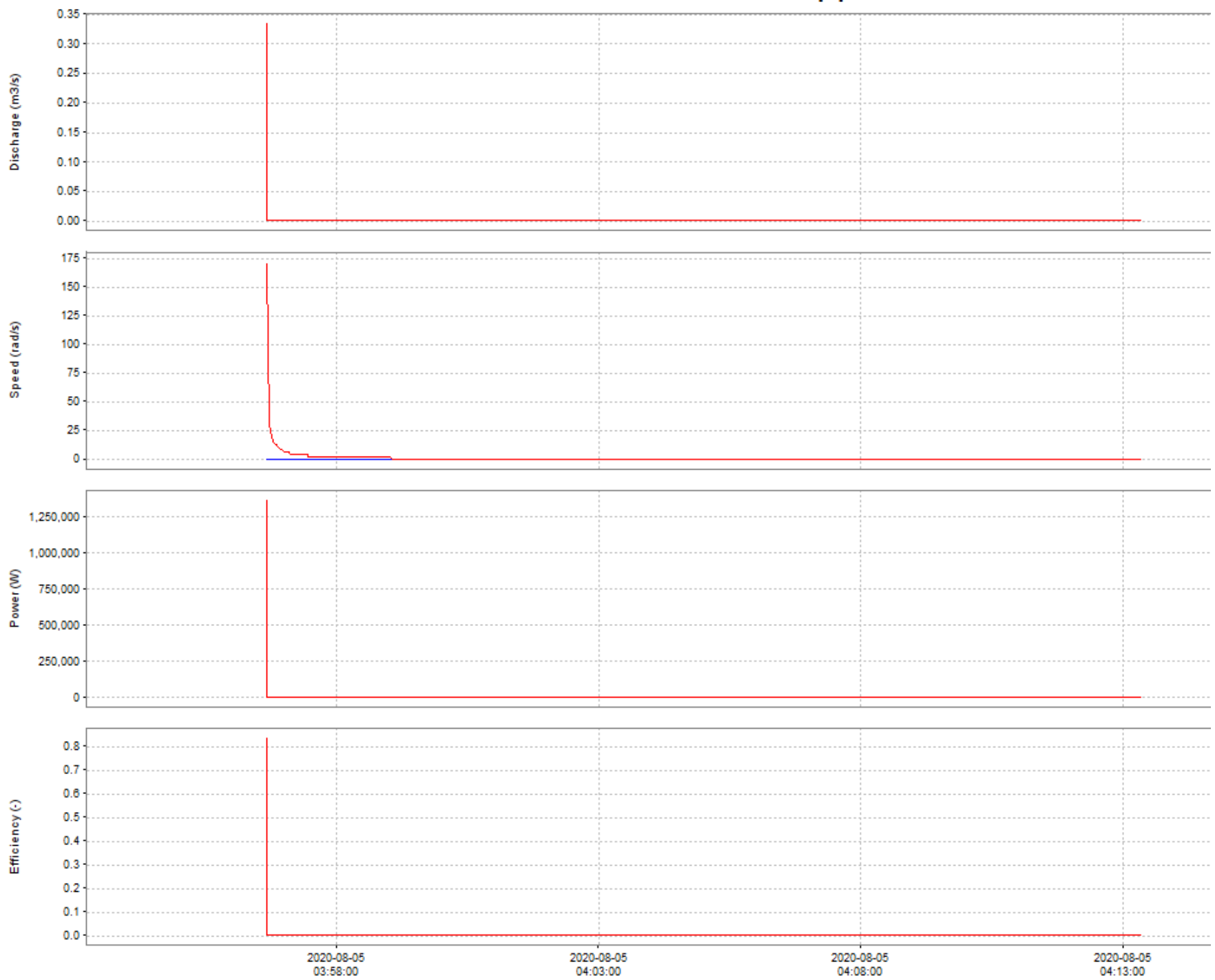
2020-08-05 03:41
2020-08-05 03:56
2020-08-05 04:11



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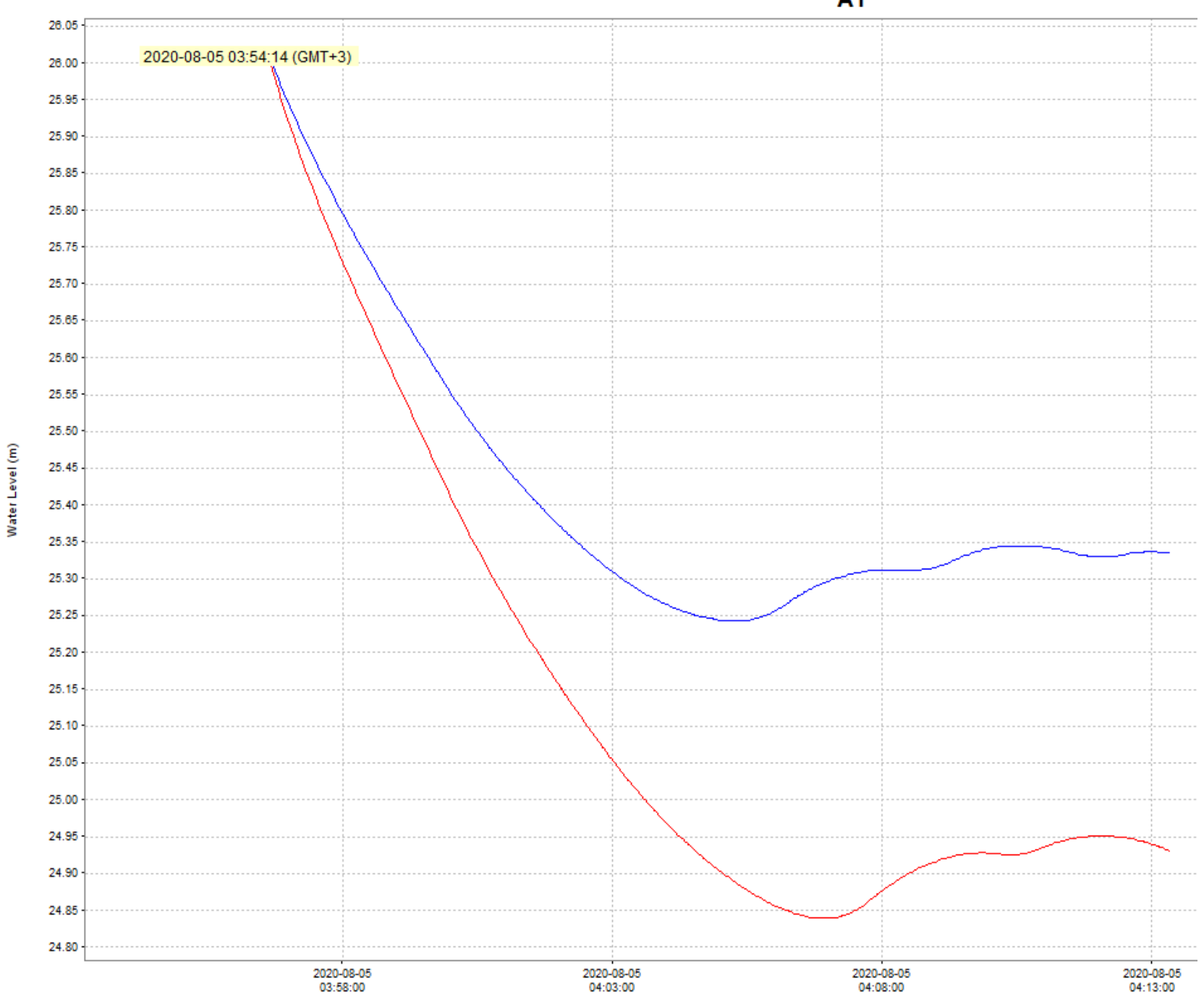

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