ADVANCED PROCESS MODELLING FORUM 2017
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Model-based real-time monitoring of a subsea gas pipeline network

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gPROMS

Users and interfaces

1 - Engineer

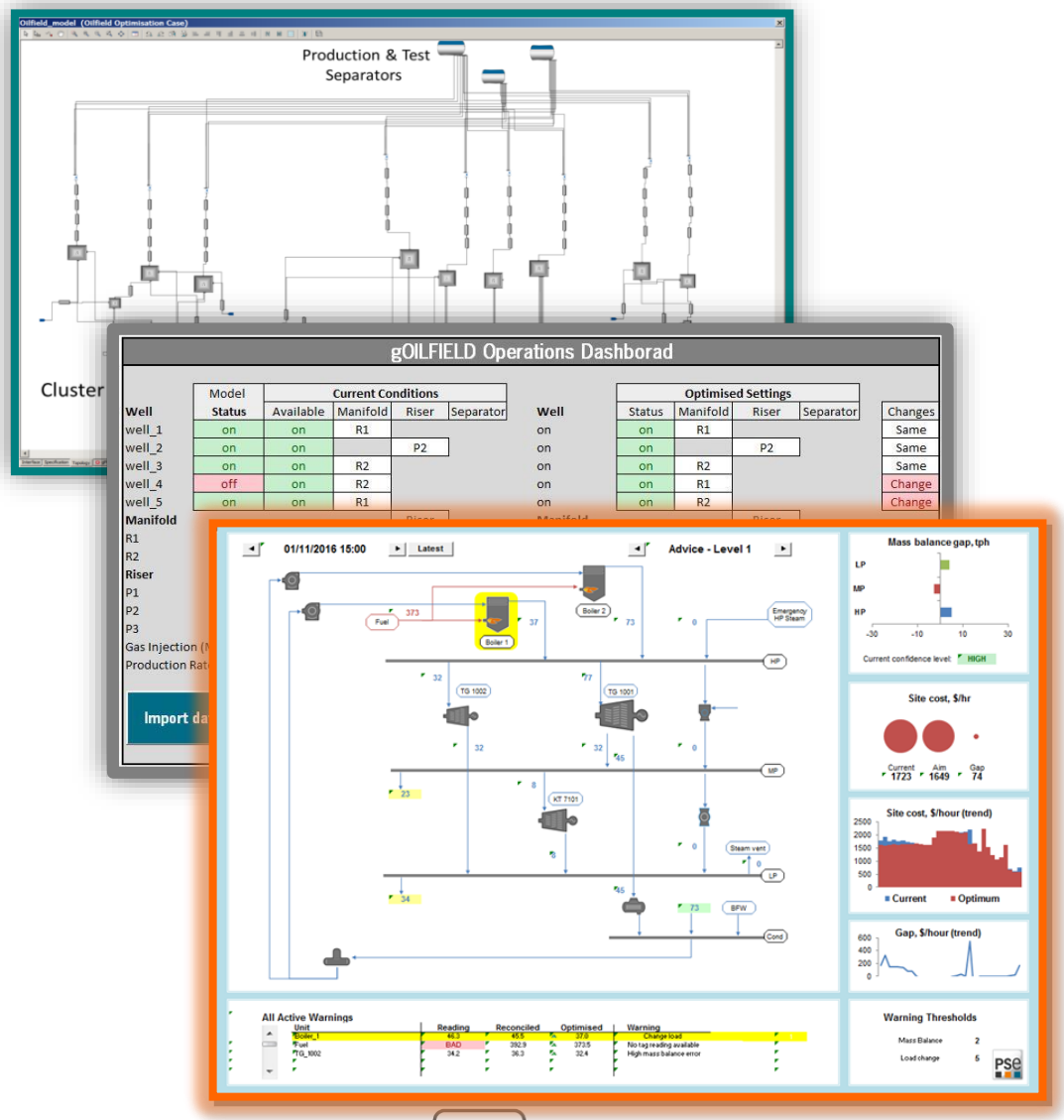
Create process models in a flowsheet environment; validate models and perform scenario analyses with complete flexibility

2 - Planner

Utilise models to ensure optimal system behaviour over short, medium and long term horizons

3 – Online Advisor

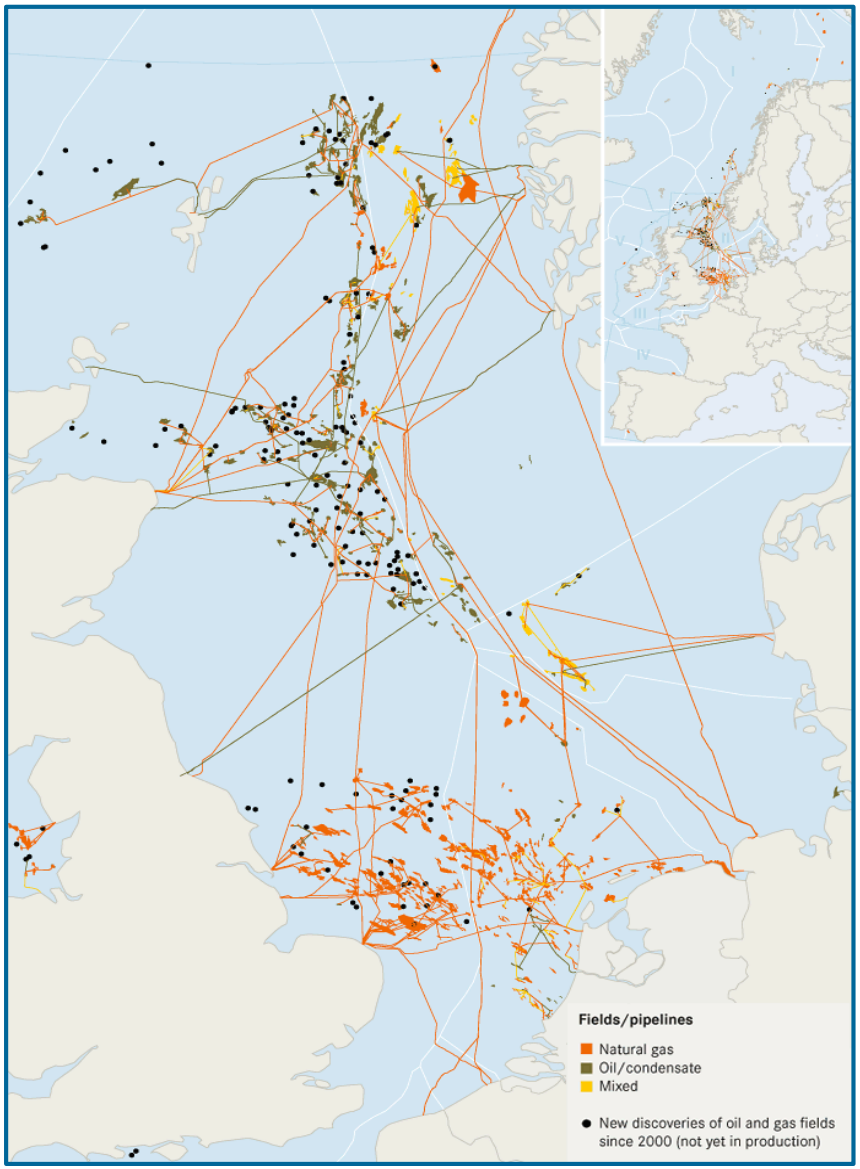
Continuously (i) validate and reconcile online measurements and (ii) calculate and display advice for optimising current operation



gPROMS Natural gas gathering networks

North sea asset: gPROMS based pipeline monitoring and planning solution

Overview



Gas gathering network

- ~12 shippers
- ~1,000 km of pipeline network
- ~ 5 days residence time

Data available

- Online for shippers flowrate and composition
- Historical for terminal flowrate and composition

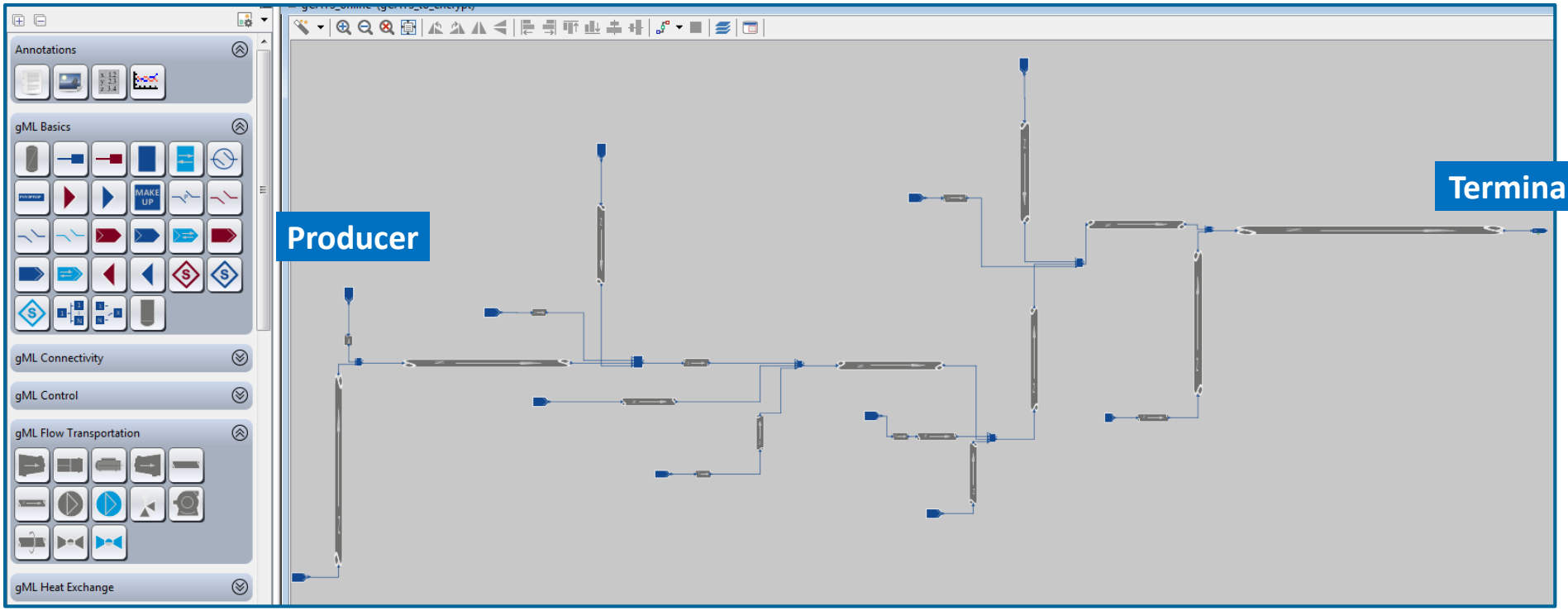
Objective

Forecast terminal flowrate and composition to ensure liquid condensate does not arrive at the terminal

Engineer

gPROMS model of the gas gathering network created and validated in ProcessBuilder

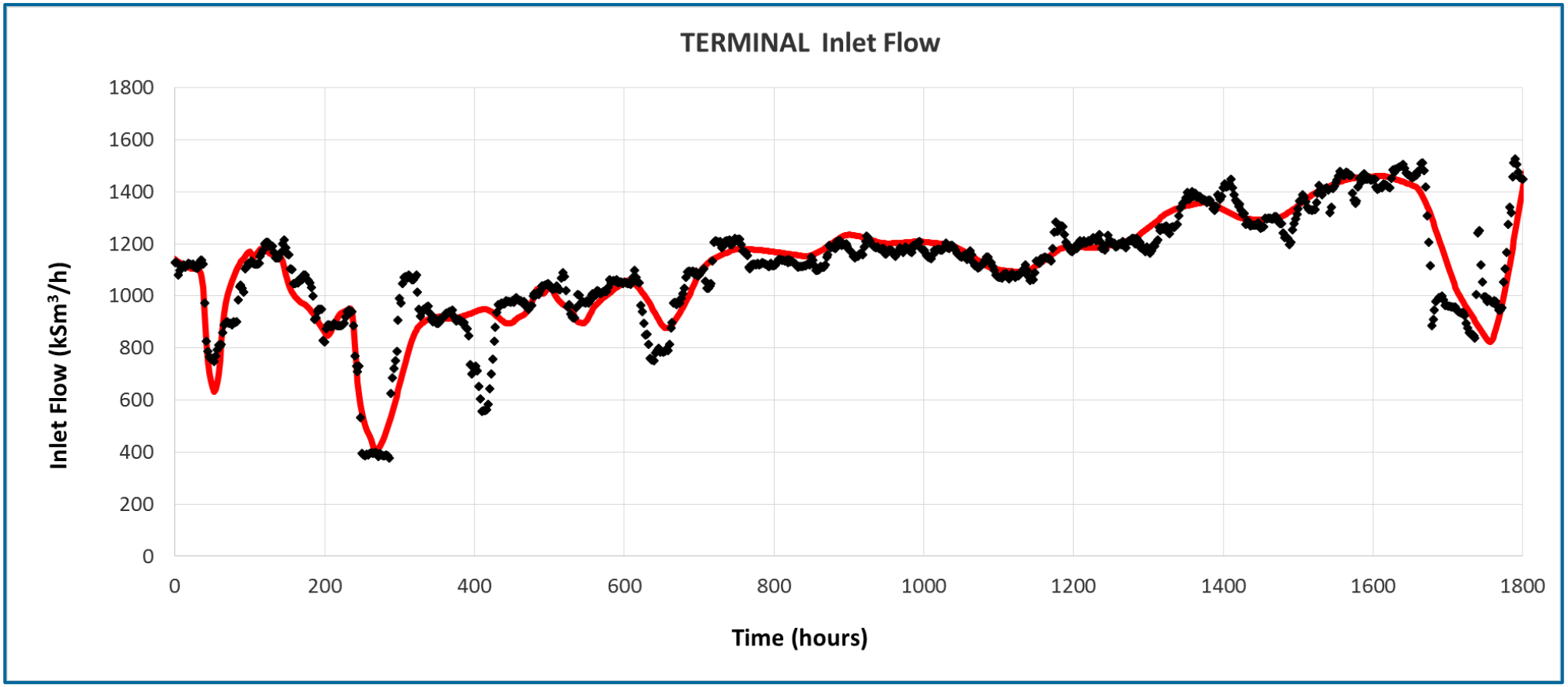
- model is sufficiently fast and robust for online applications



Easy support of deployed solutions [e.g. new producer ties in]

Engineer – validation

- Terminal KPIs calculated with producers input data up to current time
  - ~75 days worth of comparison
  - provides a clear picture of model's accuracy



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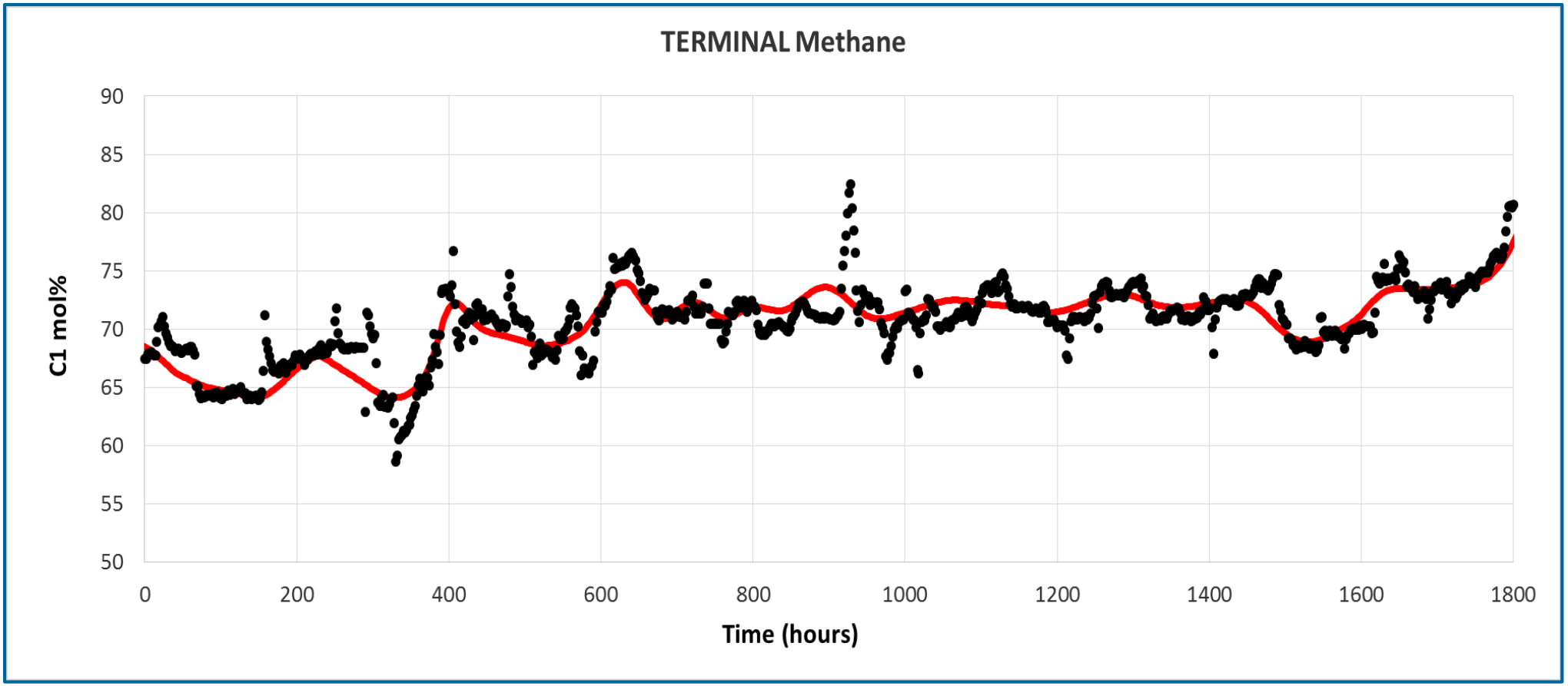
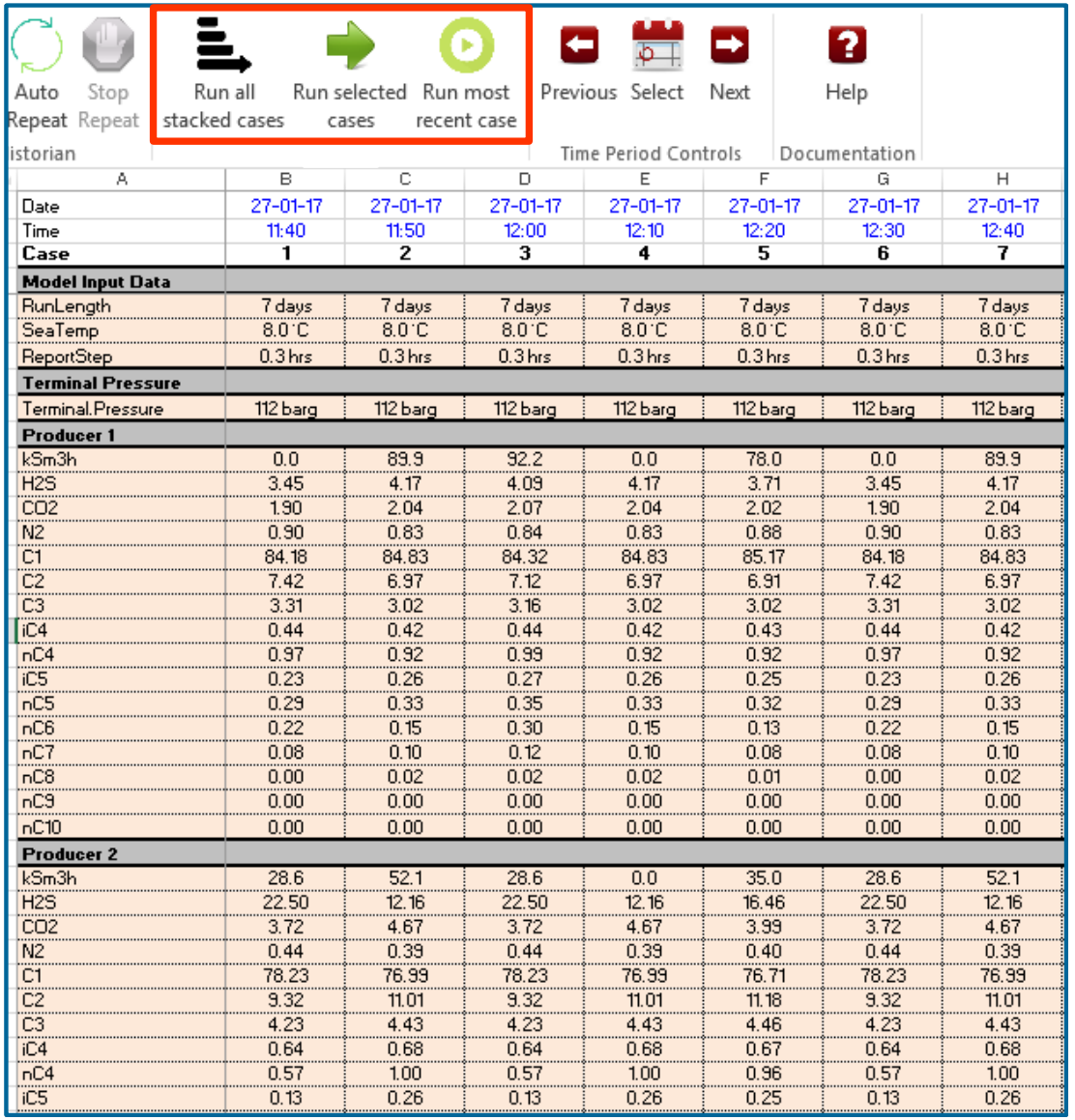


Planner

Planner Interface

User requirement

- Short, medium or long term planning
- User defined future or “what-if” scenarios defining producer flowrate and composition at periodic intervals
- Start from any historic case [pipeline content] cf. Online Advisor
- or manual input



A	B	C	D	E	F	G	H
Date	27-01-17	27-01-17	27-01-17	27-01-17	27-01-17	27-01-17	27-01-17
Time	11:40	11:50	12:00	12:10	12:20	12:30	12:40
Case	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Model Input Data							
RunLength	7 days	7 days	7 days	7 days	7 days	7 days	7 days
SeaTemp	8.0 C	8.0 C	8.0 C	8.0 C	8.0 C	8.0 C	8.0 C
ReportStep	0.3 hrs	0.3 hrs	0.3 hrs	0.3 hrs	0.3 hrs	0.3 hrs	0.3 hrs
Terminal Pressure							
Terminal.Pressure	112 barg	112 barg	112 barg	112 barg	112 barg	112 barg	112 barg
Producer 1							
kSm3h	0.0	89.9	92.2	0.0	78.0	0.0	89.9
H2S	3.45	4.17	4.09	4.17	3.71	3.45	4.17
CO2	1.90	2.04	2.07	2.04	2.02	1.90	2.04
N2	0.90	0.83	0.84	0.83	0.88	0.90	0.83
C1	84.18	84.83	84.32	84.83	85.17	84.18	84.83
C2	7.42	6.97	7.12	6.97	6.91	7.42	6.97
C3	3.31	3.02	3.16	3.02	3.02	3.31	3.02
iC4	0.44	0.42	0.44	0.42	0.43	0.44	0.42
nC4	0.97	0.92	0.99	0.92	0.92	0.97	0.92
iC5	0.23	0.26	0.27	0.26	0.25	0.23	0.26
nC5	0.29	0.33	0.35	0.33	0.32	0.29	0.33
nC6	0.22	0.15	0.30	0.15	0.13	0.22	0.15
nC7	0.08	0.10	0.12	0.10	0.08	0.08	0.10
nC8	0.00	0.02	0.02	0.02	0.01	0.00	0.02
nC9	0.00	0.00	0.00	0.00	0.00	0.00	0.00
nC10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Producer 2							
kSm3h	28.6	52.1	28.6	0.0	35.0	28.6	52.1
H2S	22.50	12.16	22.50	12.16	16.46	22.50	12.16
CO2	3.72	4.67	3.72	4.67	3.99	3.72	4.67
N2	0.44	0.39	0.44	0.39	0.40	0.44	0.39
C1	78.23	76.99	78.23	76.99	76.71	78.23	76.99
C2	9.32	11.01	9.32	11.01	11.18	9.32	11.01
C3	4.23	4.43	4.23	4.43	4.46	4.23	4.43
iC4	0.64	0.68	0.64	0.68	0.67	0.64	0.68
nC4	0.57	1.00	0.57	1.00	0.96	0.57	1.00
iC5	0.13	0.26	0.13	0.26	0.25	0.13	0.26

Planner

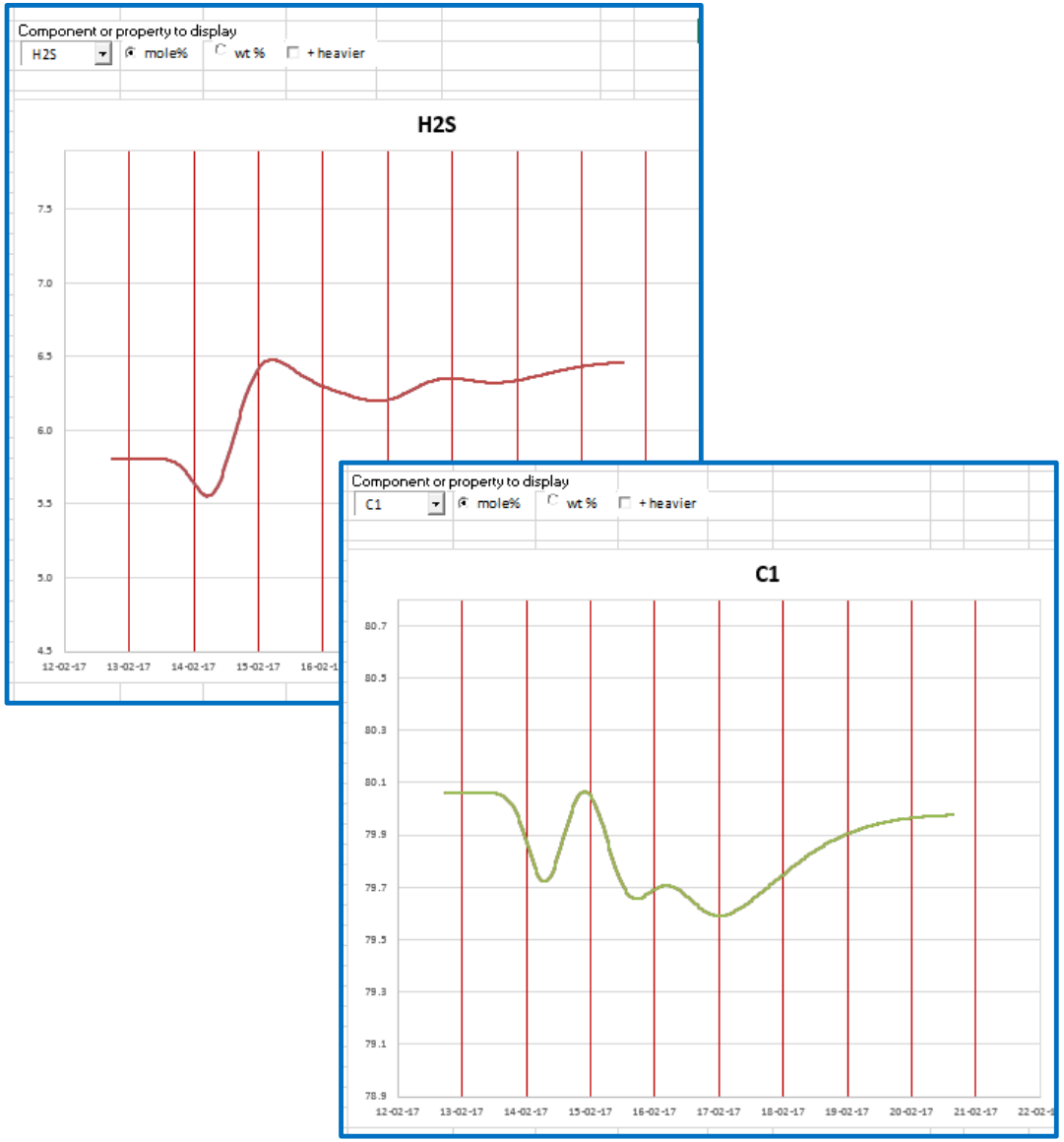
Planner Interface

User requirement

- Short, medium or long term planning
- User defined future or “what-if” scenarios defining producer flowrate and composition at periodic intervals
- Start from any historic case [pipeline content] cf. Online Advisor
- or manual input

Results

- KPIs: terminal flowrate and composition
- Flexible KPI plotting capabilities for report generation



Online advisor

Online advisor [24/7]

User requirement

- Installed behind data firewall
- Producers' flowrates and compositions retrieved from OSIsoft PI® Historian, usually every 30 min
- Data reconciliation
  - to check for outliers
  - value substituted by historical average if out of normal range

Description	ServerTAG	Units		
Terminal Pressure			Date	27-01-17
	T-07013.PJ	barg	Time	11:40
Producer 1			**Model Input Data**	
Flowrate	P1-Flow-STN	kSm3h	RunLength	7 days
H2S	P1-H2S-STN	mol%	SeaTemp	8.0 °C
CO2	P1-CHRM-CO2	mol%	ReportStep	0.3 hrs
N2	P1-CHRM-N2	mol%	**Terminal Pressure**	
C1	P1-CHRM-C1	mol%	Terminal.Pressure	112 barg
C2	P1-CHRM-C2	mol%	**Producer 1**	
C3	P1-CHRM-C3	mol%	kSm3h	89.9
iC4	P1-CHRM-IC4	mol%	H2S	4.17
nC4	P1-CHRM-NC4	mol%	CO2	2.04
iC5	P1-CHRM-IC5	mol%	N2	0.83
nC5	P1-CHRM-NC5	mol%	C1	84.83
nC6	P1-CHRM-C6	mol%	C2	6.97
nC7	P1-CHRM-C7	mol%	C3	3.02
nC8	P1-CHRM-C8	mol%	iC4	0.42
nC9	P1-CHRM-C9	mol%	nC4	0.92
nC10	P1-CHRM-C10	mol%	iC5	0.26
Producer 2			nC5	0.33
Flowrate	P2-JR25002_313	kSm3h	nC6	0.15
H2S	P2-JR25002_316	mol%	nC7	0.10
CO2	P2-JR25002_332	mol%	nC8	0.02
N2	P2-JR25002_331	mol%	nC9	0.00
C1	P2-JR25002_318	mol%	nC10	0.00
C2	P2-JR25002_319	mol%	**Producer 2**	
C3	P2-JR25002_320	mol%	kSm3h	52.1
iC4	P2-JR25002_321	mol%	H2S	12.16
nC4	P2-JR25002_322	mol%	CO2	4.67
iC5	P2-JR25002_323	mol%	N2	0.39
nC5	P2-JR25002_324	mol%	C1	76.99
nC6	P2-JR25002_326	mol%	C2	11.01
nC7	P2-JR25002_327	mol%	C3	4.43
nC8	P2-JR25002_328	mol%	iC4	0.68
nC9	P2-JR25002_329	mol%	nC4	1.00
nC10	P2-JR25002_330	mol%	iC5	0.26
Producer 3			nC5	0.22
Flowrate	P3-FI-03558	kSm3h	nC6	0.13
H2S	P3-88375	mol%	nC7	0.05
CO2	P3-88377	mol%	nC8	0.01
N2	P3-88376	mol%	nC9	0.01
C1	P3-88378	mol%	nC10	0.00
C2	P3-88379	mol%	**Producer 3**	
C3	P3-88380	mol%	kSm3h	10.0
iC4	P3-88381	mol%	H2S	0.00
			CO2	3.74

Online advisor

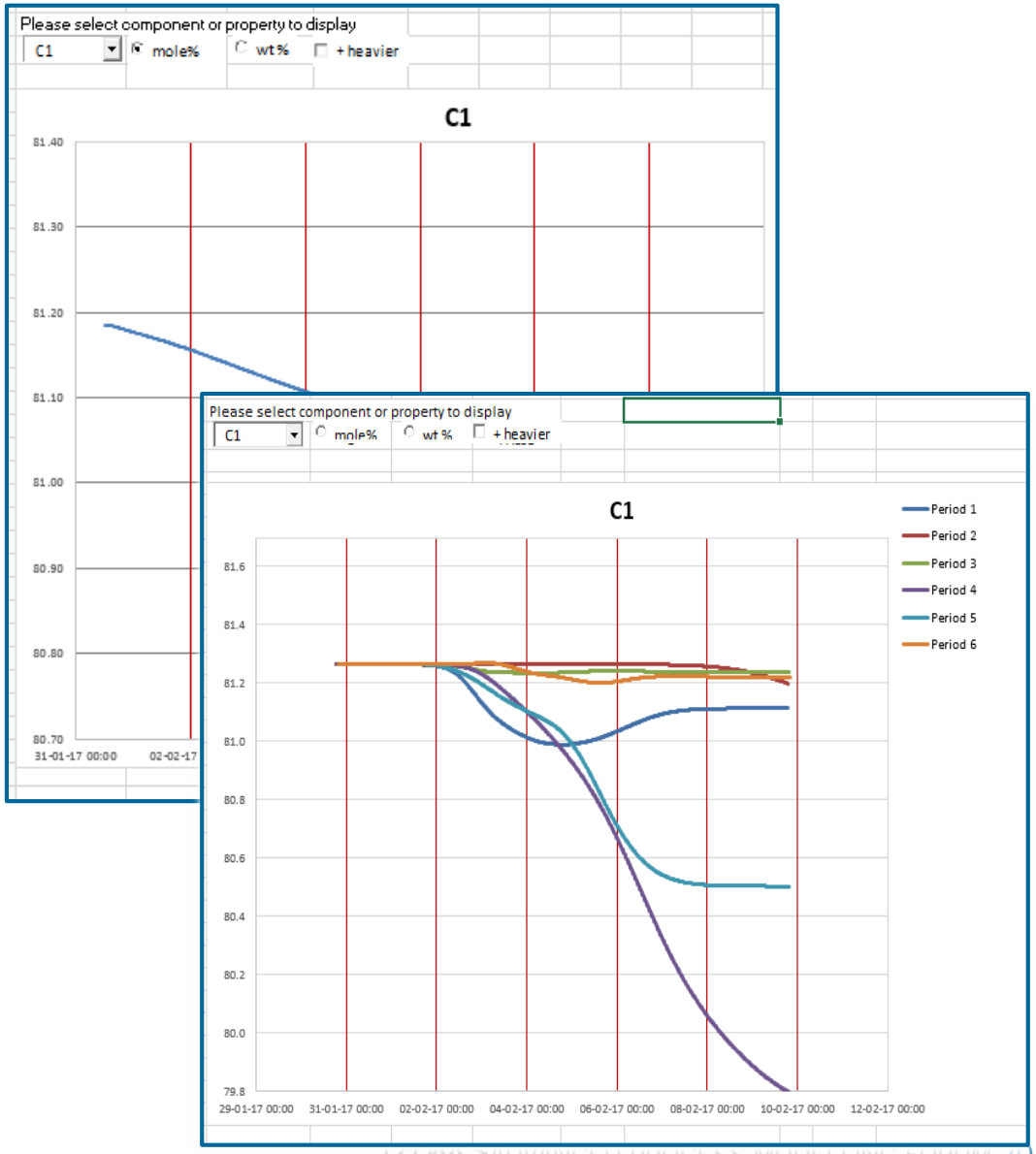
Online advisor [24/7]

User requirement

- Installed behind data firewall
- Producers' flowrates and compositions retrieved from OSIsoft PI® Historian, usually every 30 min
- Data reconciliation
  - to check for outliers
  - value substituted by historical average if out of normal range

Results

- KPIs: terminal flowrate and composition
- Current projection: always available for next 7 days
- Interactive chart: efficient archiving; past projections easily retrieved and plotted



Conclusions

- Critical Operational Support tool for North Sea gas pipeline network
- System has been installed
- On-line advisor
  - linked to OSIsoft PI® Historian to receive real time data
  - Running 24/7
- Engineer and Planner have been used by gas planners to take decissions and introduce new produces to the network

Thank you