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Performance monitoring as a key for continuous improvement of the efficiency in Power Plants

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Agenda

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Presentation agenda

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About MPA

A brief introduction about MPA and its business

2

PMAX in daily monitoring

The use of PMAX as primary tool for performance monitoring of our power plants

3

Energy Excess predictions

How we use PMAX and PEPSE to predict capacity, excess energy and generation costs

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Gas mass flow corrections using FAMOS

How we use these calculations in performance test analysis

5

Automation of weekly performance reports

How we use PMAX and RTIME to automatically generate performance reports

6

PMAX Efficiency Alarms

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About MPA

Who we are

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About MPA

Mitsui & Co. Power Americas (MPA) is the second-largest private power generator in Mexico with more than 3GW of installed capacity today. MPA is a Power Generation Developer and Asset Management Company with a proven track record and knowledge of combined cycles, cogeneration, utility-scale solar and wind farms. MPA offers solutions to generators and electricity customers to improve their daily operations.

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timeline

MPA History

Our History

2006

Valladolid

530 MW

2009

Falcon

Acquisition of 5 Combined Cycle Plants

2,235 MW

2013

EDI/EDP

Joint Venture Mitsui – EDF Renewables

328 MW

2020

Calera

COD

530 MW

MPA services

Energy Supply

Customized solutions that save company's money on those ever-increasing electric bills. MPA is a Qualified Supplier operating in the Wholesale Market. We help improving our customers' daily operations with solutions such as excess energy.

Operation and Maintenance

From distributed and on-site generation to large-infrastructure generation projects, we can assist throughout the whole process of developing, operating, maintaining or monitoring assets.

Project Development

We specialize in generating new power assets, focusing on solar and cogeneration technologies. From on-site to off-site solutions, we're always looking for the next new greenfield/brownfield opportunity.

Asset Management Services

We specialize in digital services, solutions to help manage power assets and make the most of them without having to increase infrastructure. Constant optimization and continuous innovation allow us to build a tailored solution to each power plant.

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PMAX in daily monitoring

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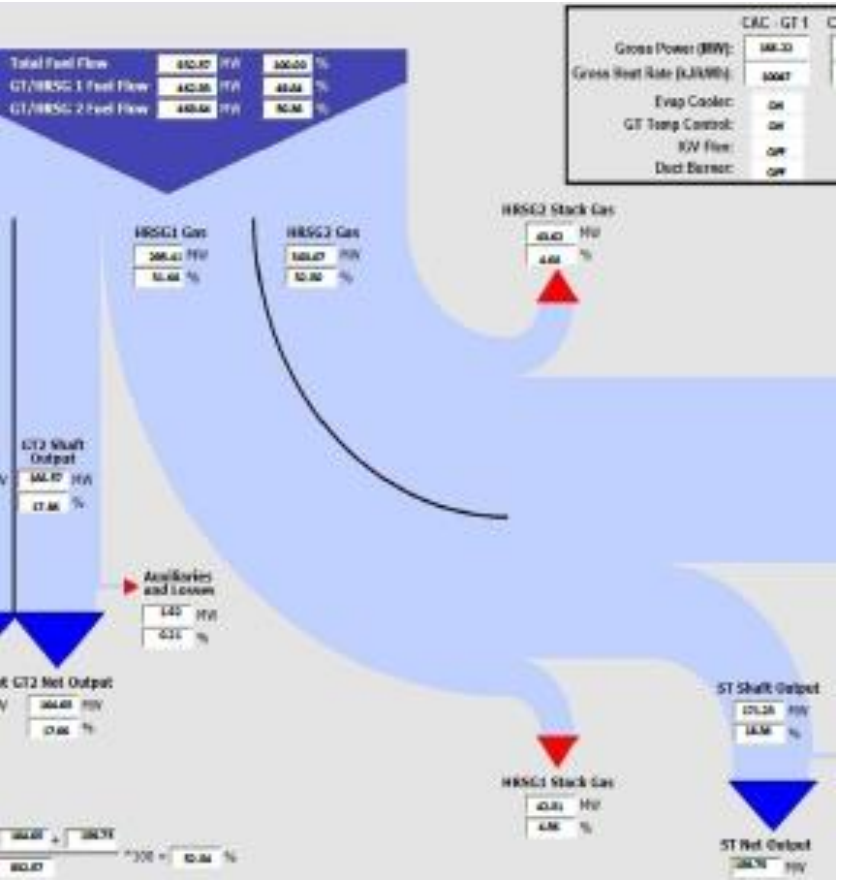
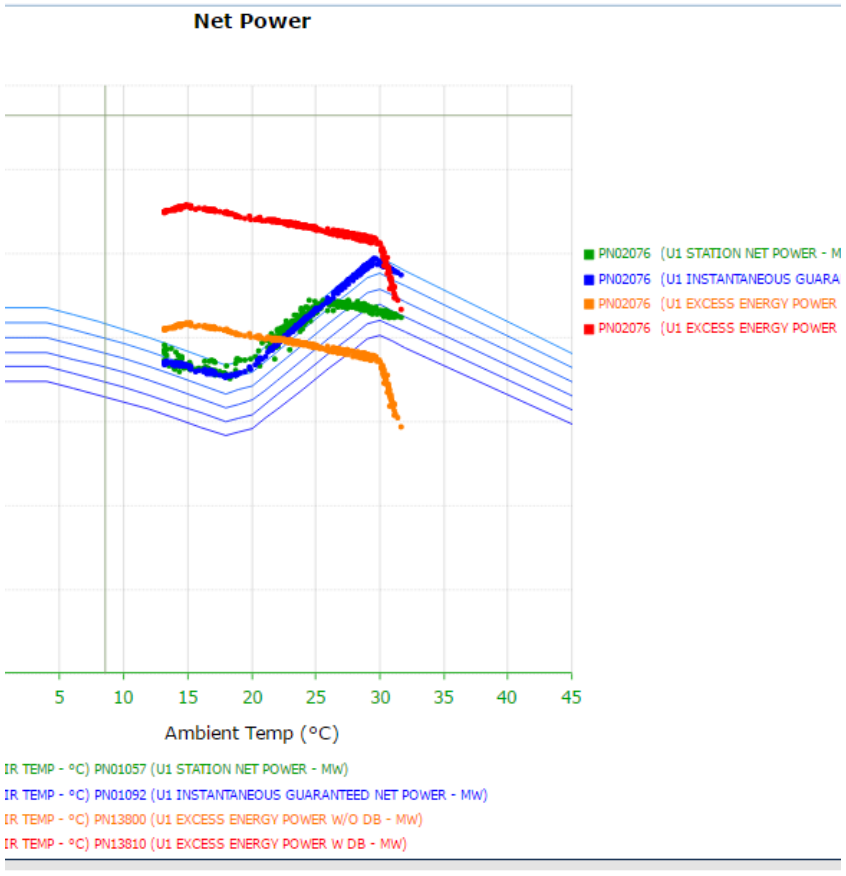
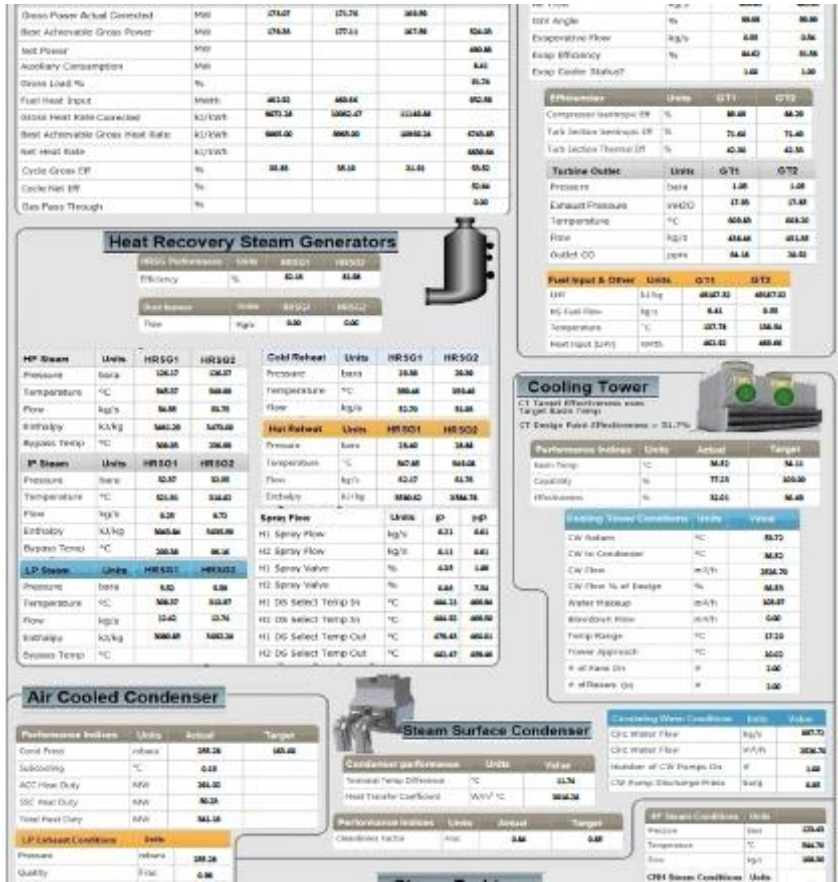
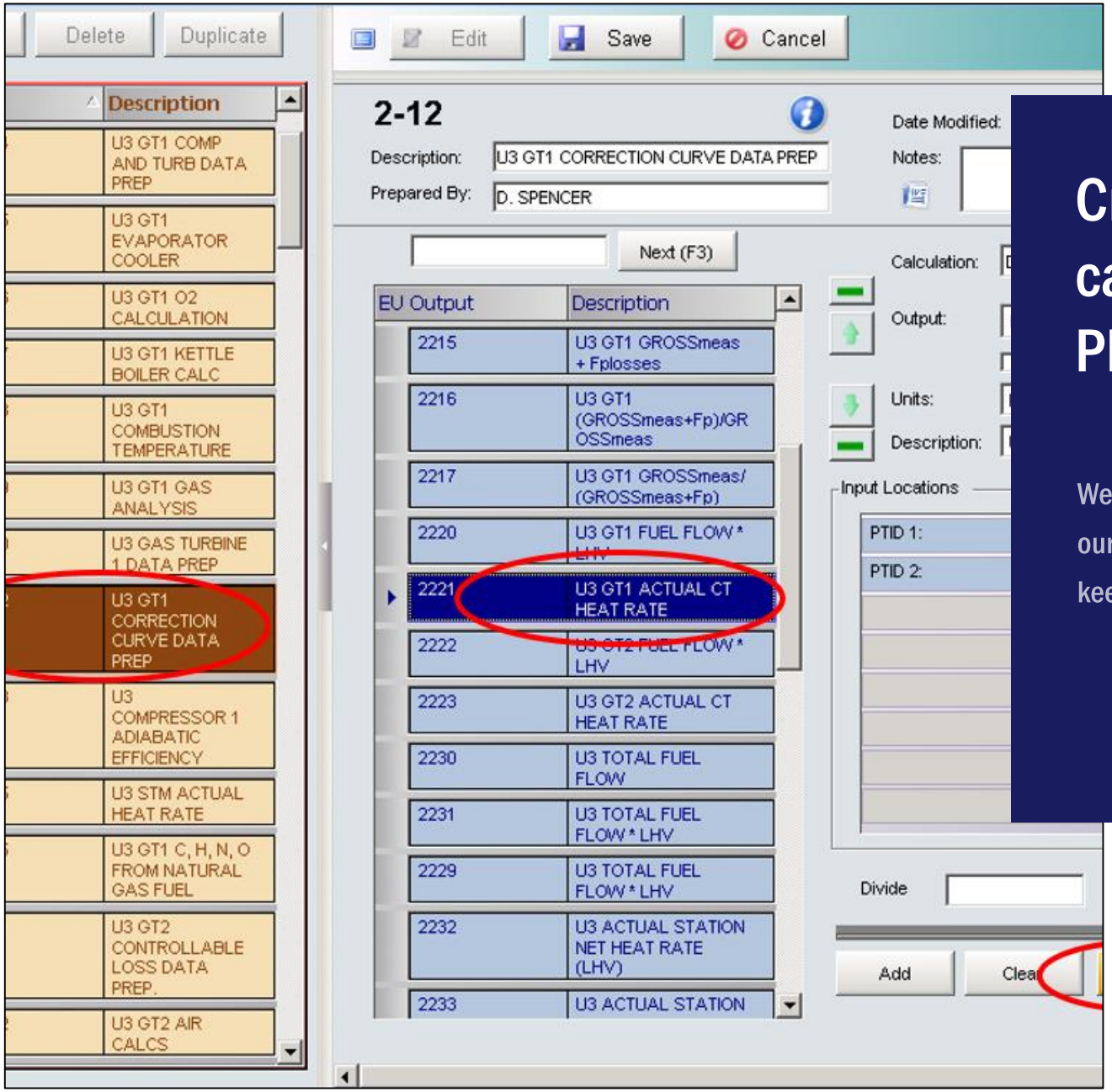
Visualization of the most important performance variables

We have customized screens with real-time trends and KPIs for each of our plants. We can compare the actual performance with the best **achievable of some variables. This provides us with valuable insights to detect any sign of degradation**, e.g. a leakage in an ACC or loss of efficiency in a compressor.









Creation of new calculations within PMAX

We can create and modify calculation points in PMAX according to our needs. This enables us to continuously improve our analysis and keep track of the good performance of our assets.

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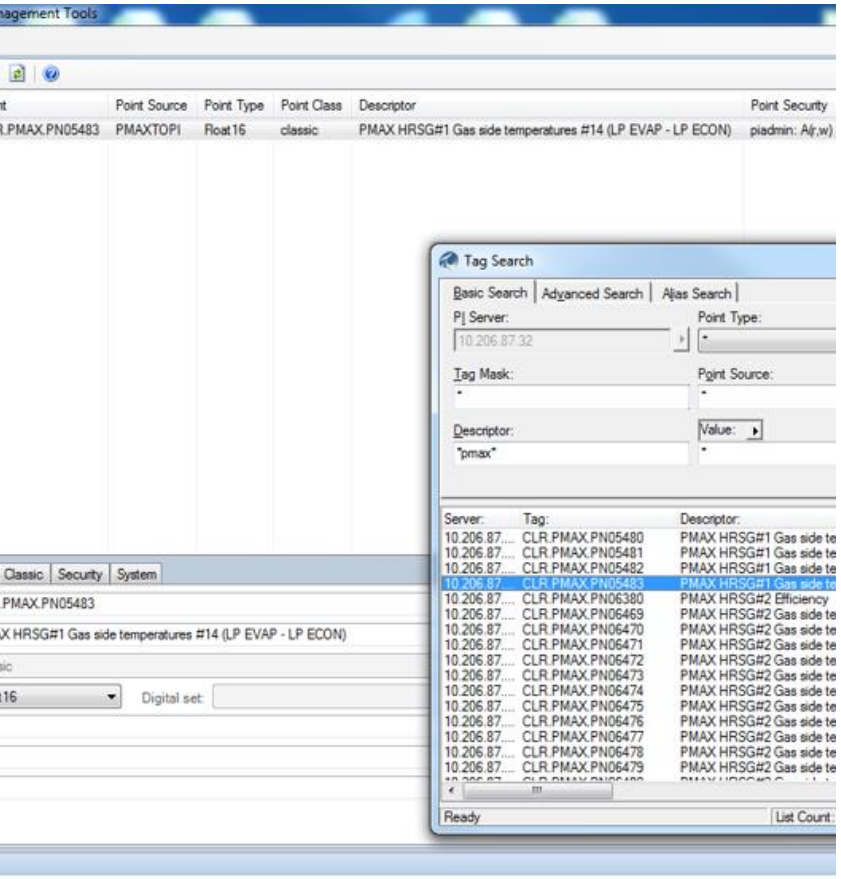
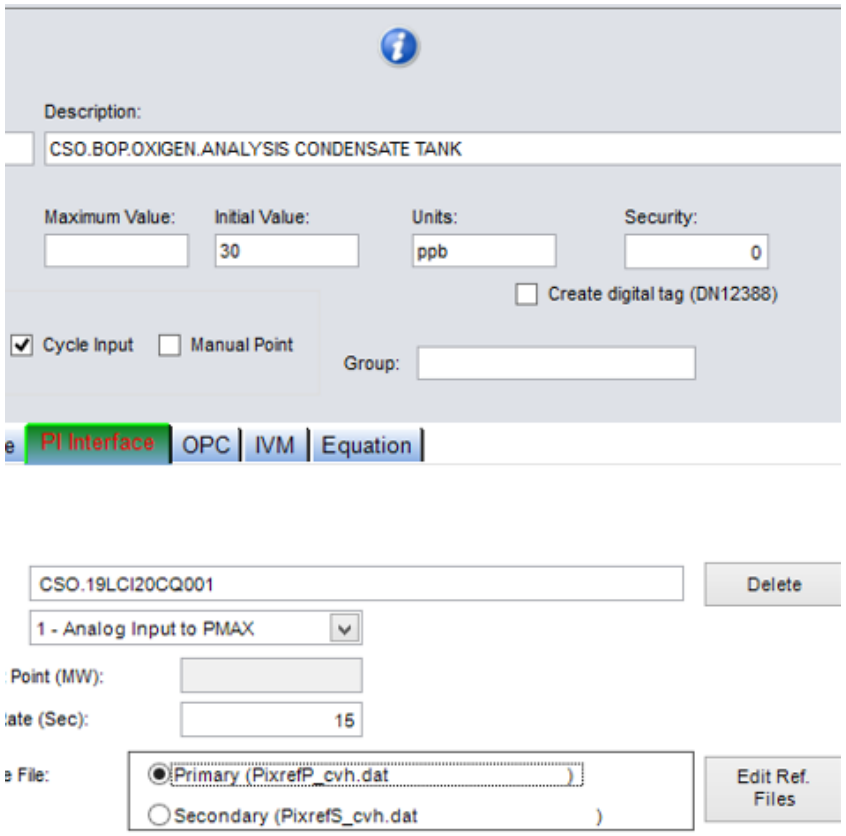
Interaction between PI and PMAX

We have a bidirectional communication between our PI System and PMAX, which allows us to add PI tags into PMAX screens as well as importing PMAX points into PI through the creation of new tags.





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Energy Excess Predictions

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Energy excess predictions

One of the most **convenient uses of FAMOS** is the calculation of future excess energy and generation costs. We have implemented these in all our plants of the Fleet.

1

PEPSE calculations

This data is calculated using PEPSE, the PMAX Heat Balance Tool, based on the ambient conditions forecast and performance test results

2

Notification e-mails

PMAX automatically sends an e-mail to each plant and to the O&M Supervision team.

3

Review

This data is compared with O&M Supervision's models to provide an accurate offer to the market.

-DEC-19 BAD 12 Health
6:18:11 IVM 6 Alarm

24 hour Prediction runs daily. The forecast inputs mus
be updated to have correct values in the table.
Last Run Time: 12/15/2019 20: 8
Forecast Date:12/17/2019

Hour	Ambient Temp Forecast (°C)	Relative Humidity Forecast (%)	Wet Bulb Temp Forecast (°C)	Baro. Pressure Forecast (bara)	Power Factor Forecast (frac)	Gas Fo (U MM
1	24.4	96	23.9	1.018	0.9900	3
2	24.4	92	23.3	1.018	0.9900	3
3	24.4	88	22.8	1.018	0.9900	3
4	23.9	84	22.2	1.019	0.9900	3
5	23.3	76	20.6	1.019	0.9900	3
6	22.2	67	17.8	1.019	0.9900	3

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Gas mass flow corrections

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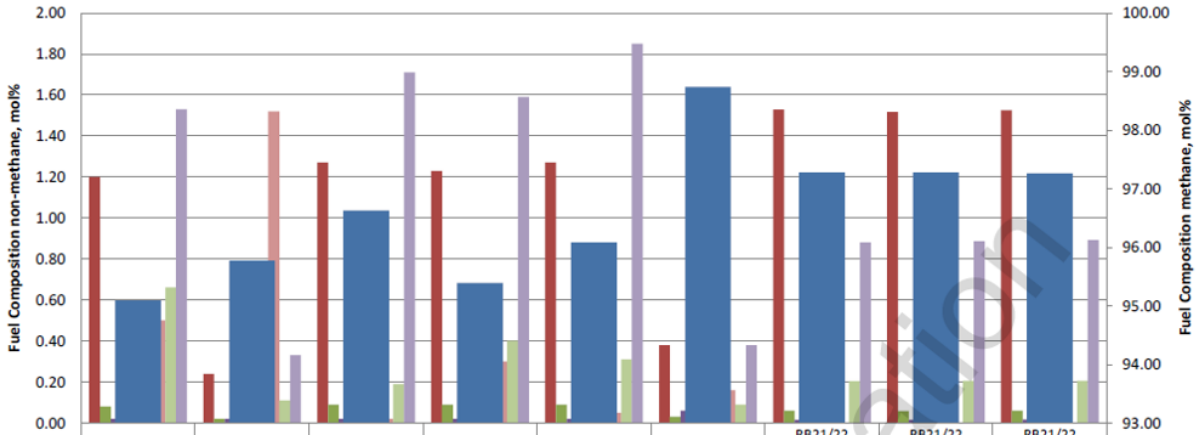
Gas mas flow corrections for performance tests

- Flow measurements are automatically corrected by temperature, pressure and density according to ASM-MFC 3M-2004.
- We store the historical data in our PI server
- Heat Rate calculations are more accurate
- For performance tests, this data is automatically corrected to reference conditions

Rio Bravo RB21 & RB22 Pre-Outage: Fuel Composition Test Point (TP) Comparison



	RB21 PreOutage TP1 Lab Sample	RB21 PreOutage TP2 Lab Sample	RB21 PreOutage TP3 Lab Sample	RB22 PreOutage TP1 Lab Sample	RB22 PreOutage TP2 Lab Sample	RB22 PreOutage TP3 Lab Sample	RB21/22 PreOutage TP1 Site Chromatograph	RB21/22 PreOutage TP2 Site Chromatograph	RB21/22 PreOutage TP3 Site Chromatograph
C2H6	1.20	0.24	1.27	1.23	1.27	0.38	1.53	1.52	1.53
C3H8	0.08	0.02	0.09	0.09	0.09	0.03	0.06	0.06	0.06
iC4H10	0.02	0.02	0.02	0.02	0.02	0.06	0.02	0.02	0.02
nC4H10	0.02	0.10	0.02	0.02	0.02	0.01	0.01	0.01	0.02
iC5H12	0.00	0.32	0.00	0.00	0.00	0.01	0.00	0.00	0.00
nC5H12	0.02	0.50	0.01	0.01	0.01	0.03	0.00	0.00	0.00
C6H14	0.50	1.52	0.02	0.30	0.05	0.16	0.00	0.00	0.00
N2	0.66	0.11	0.19	0.40	0.31	0.09	0.20	0.20	0.21
CO2	1.53	0.33	1.71	1.59	1.85	0.38	0.88	0.89	0.89
CH4	95.09	95.77	96.63	95.39	96.08	98.74	97.28	97.28	97.26

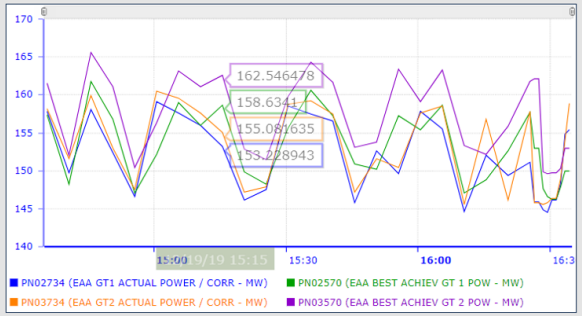
Information

GT1 Exhaust Temp	°C	598.7	603.0	620.0	616.3	612.0	-2.2	
GT1 Load	%	91.0						
GT1 Thermal Efficiency	%	40.1						
GT2 Gross Power	MW	161.3	158.9	154.0	158.2	155.4	3.8	0.7
GT2 Gross Heat Rate (Calculated Flow)	kJ/kWh	10449	10473	10176	10371	10412	0.4	0.5
GT2 Gross Heat Rate (Measured Flow)	kJ/kWh	8919	8940	10176	10371	10412	-14.3	0.5
GT2 Exhaust Flow	kg/s	372.6	359.4	409.8	418.4	423.6	-12.0	
GT2 Exhaust Temp	°C	579.1	583.1	620.0	614.3	610.3	-5.1	
GT2 Load	%	90.5						
GT2 Thermal Efficiency	%	40.4						

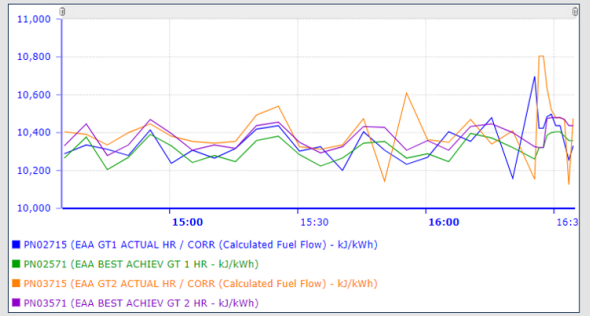
Measured Gas Flow	kg/s	8.24	8.29
Calculated Gas Flow	kg/s	9.43	9.72

Trend Start Time 12/19/2019 14:25:18 | Trend End Time 12/19/2019 16:25:18 | Archive Rate 5.00 Minutes | Update Rate 1.00 Minutes

GT Gross Corrected Generation Actual vs. Best Achievable (MW)



GT Gross Corrected Heat Rate Actual vs. Best Achievable (kJ/kWh)



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Automation of performance weekly reports

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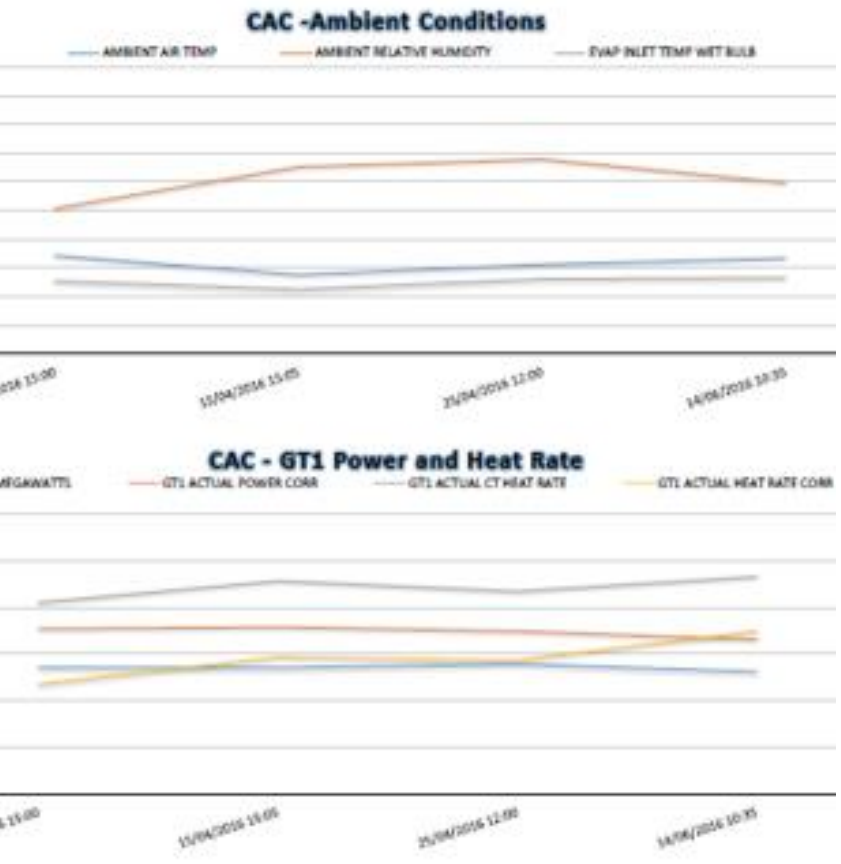
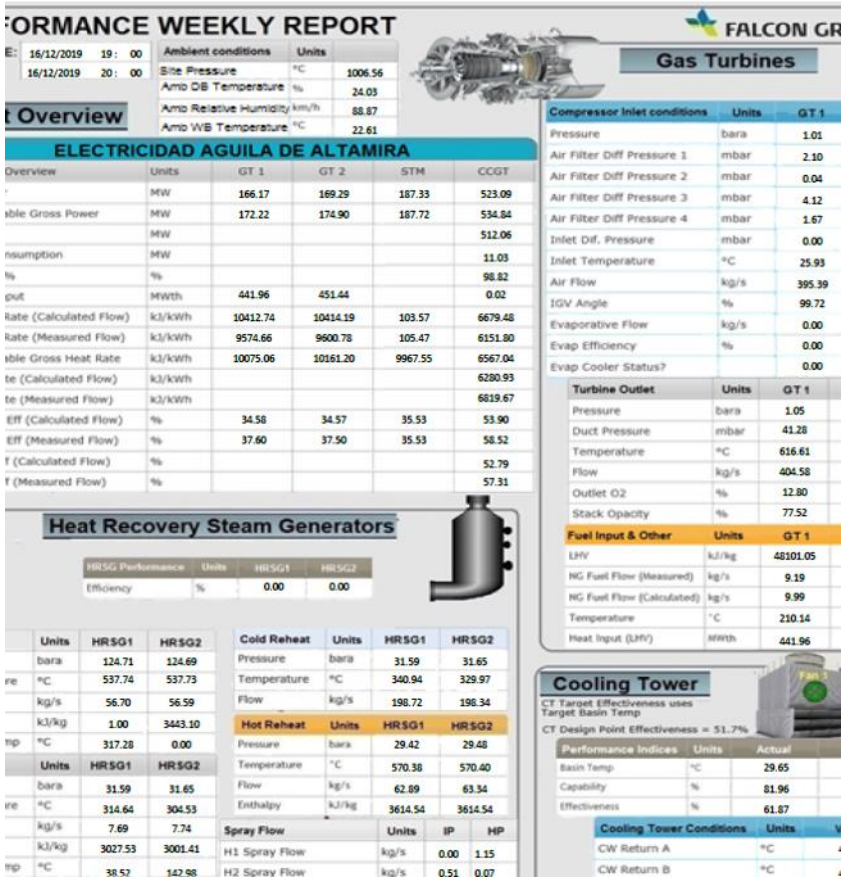
Falcon Group Performance Weekly Reports

By combining the capabilities of both Excel and PMAX (RTIME), we have developed a solution to create semi-automated performance reports. This enables us to devote more time to analyze our data and get meaningful insights faster.





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PMAX Efficiency alarms

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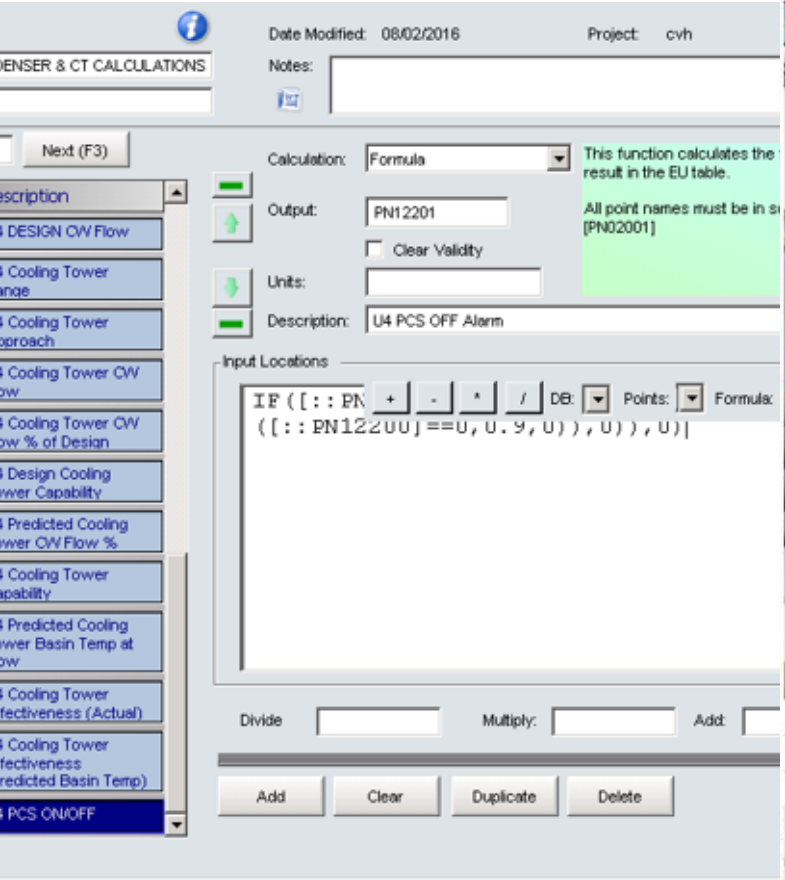
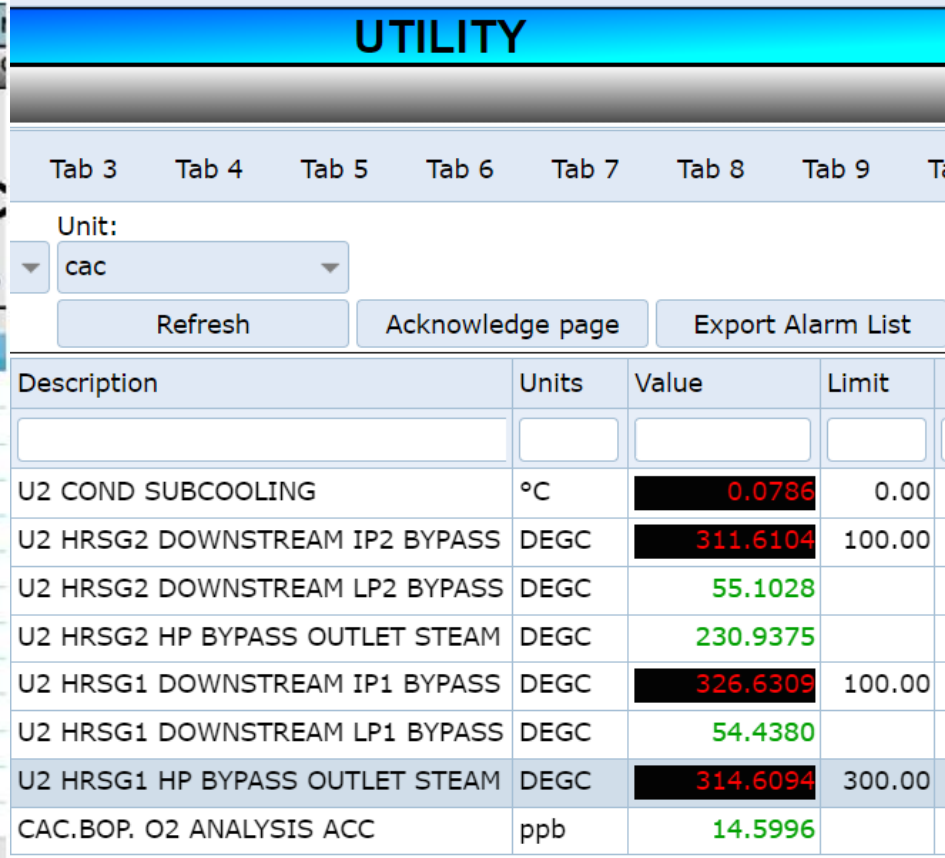
PMAX Efficiency alarms

We have created customized alarms that the operator can see on his monitoring screens. Through this feature, it is easier to get an updated overview of the most recent performance issues that may require immediate attention.

The monitoring engineers can see all the performance alarms and alerts from each plant at the same time.





Description	Units	Value	Limit
U2 COND SUBCOOLING	°C	0.0786	0.00
U2 HRSG2 DOWNSTREAM IP2 BYPASS	DEGC	311.6104	100.00
U2 HRSG2 DOWNSTREAM LP2 BYPASS	DEGC	55.1028	
U2 HRSG2 HP BYPASS OUTLET STEAM	DEGC	230.9375	
U2 HRSG1 DOWNSTREAM IP1 BYPASS	DEGC	326.6309	100.00
U2 HRSG1 DOWNSTREAM LP1 BYPASS	DEGC	54.4380	
U2 HRSG1 HP BYPASS OUTLET STEAM	DEGC	314.6094	300.00
CAC.BOP. O2 ANALYSIS ACC	ppb	14.5996	

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Conclusions

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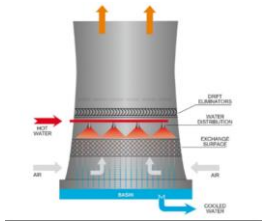
Achievements

Thanks to the use of PMAX solutions, MPA has achieved important results in the operations and efficiency improvement.



PCS ON/OFF alarms

The use of the PCS has been more efficient since we created ON/OFF alarms based on the current ambient conditions. This has led to significant reductions in operation times (up to 150 h less per year) and therefore important savings in make-up water.

O_2 leakages in the ACC

High concentrations of O2 were found and alarmed by PMAX in the ACC. This was detected by a deviation in the condenser pressure respect to the Best Achievable.

Detection of compressor degradation

We were able to detect a degradation of up to 1.3% and 1% in the compressors of one of our plants, which meant an 80 kJ/KWh Heat Rate degradation in the whole combined cycle plant. After this finding, an inspection was made so both compressors, bell mouth, IGV and CR1 were found dirty and cleansed afterwards.

Accuracy in performance test calculations

With gas mass flow corrections now we are able to calculate corrected power and heat rate according to norm ASME MFC-3M-2004 with more accuracy, which in some cases can lead to a bigger revenues.

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Thank you!