

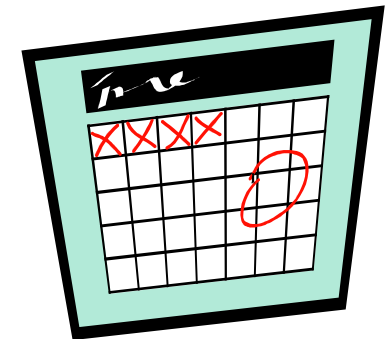


OMC 2013 – 21 March – Riccardo Martini

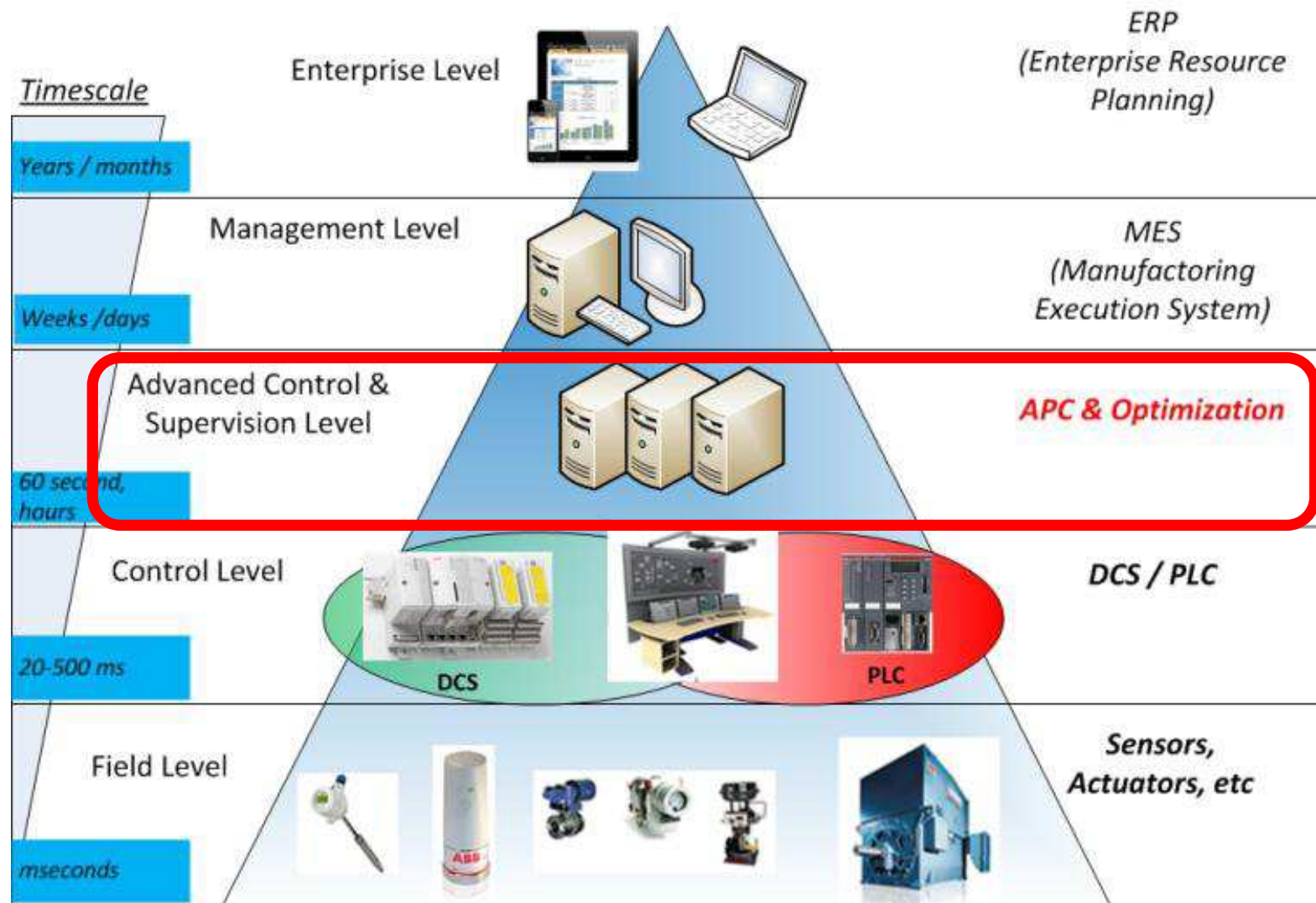
Advanced Process Control applications to improve industrial productivity and operational effectiveness in the Oil & Gas industry

Presentation Agenda

- Brief Introduction to Advanced Process Control
- Sample applications
 - APC on Oil & Gas Separators & Stabilizer
 - APC on Acid Gas Removal unit

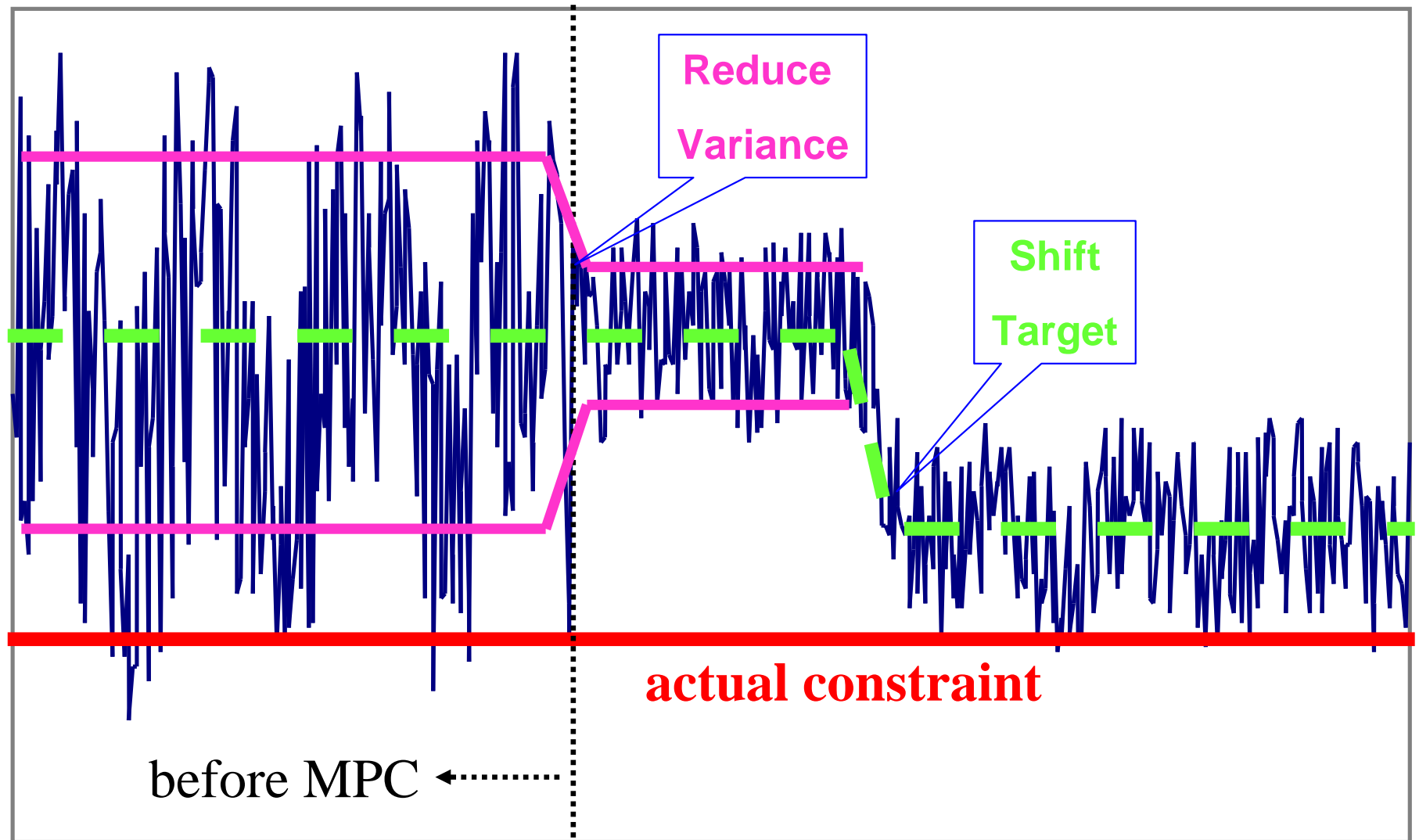


Advanced Process Control - Positioning



How APC Improves Performance (1)

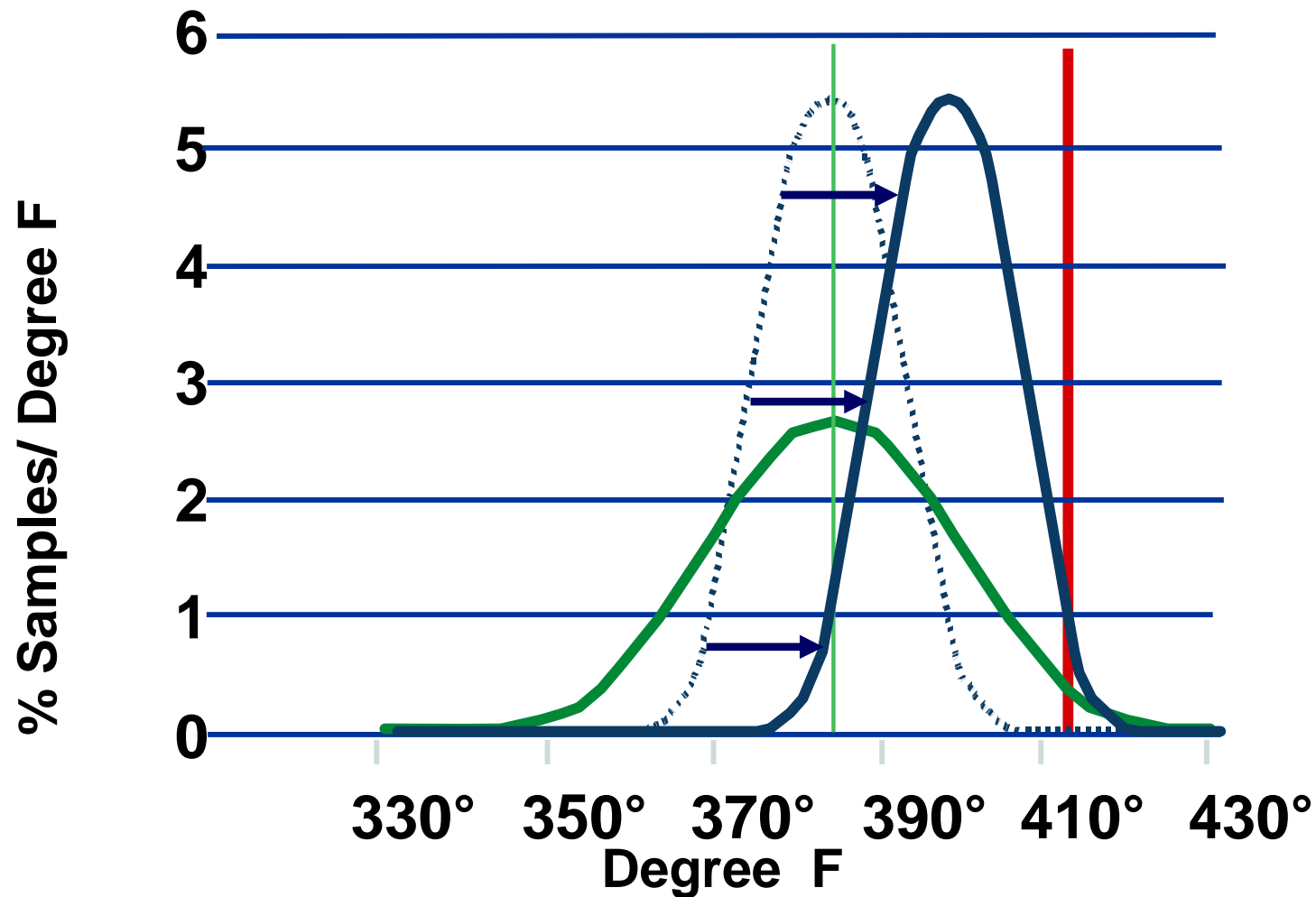
Time domain view



How APC Improves Performance (2)

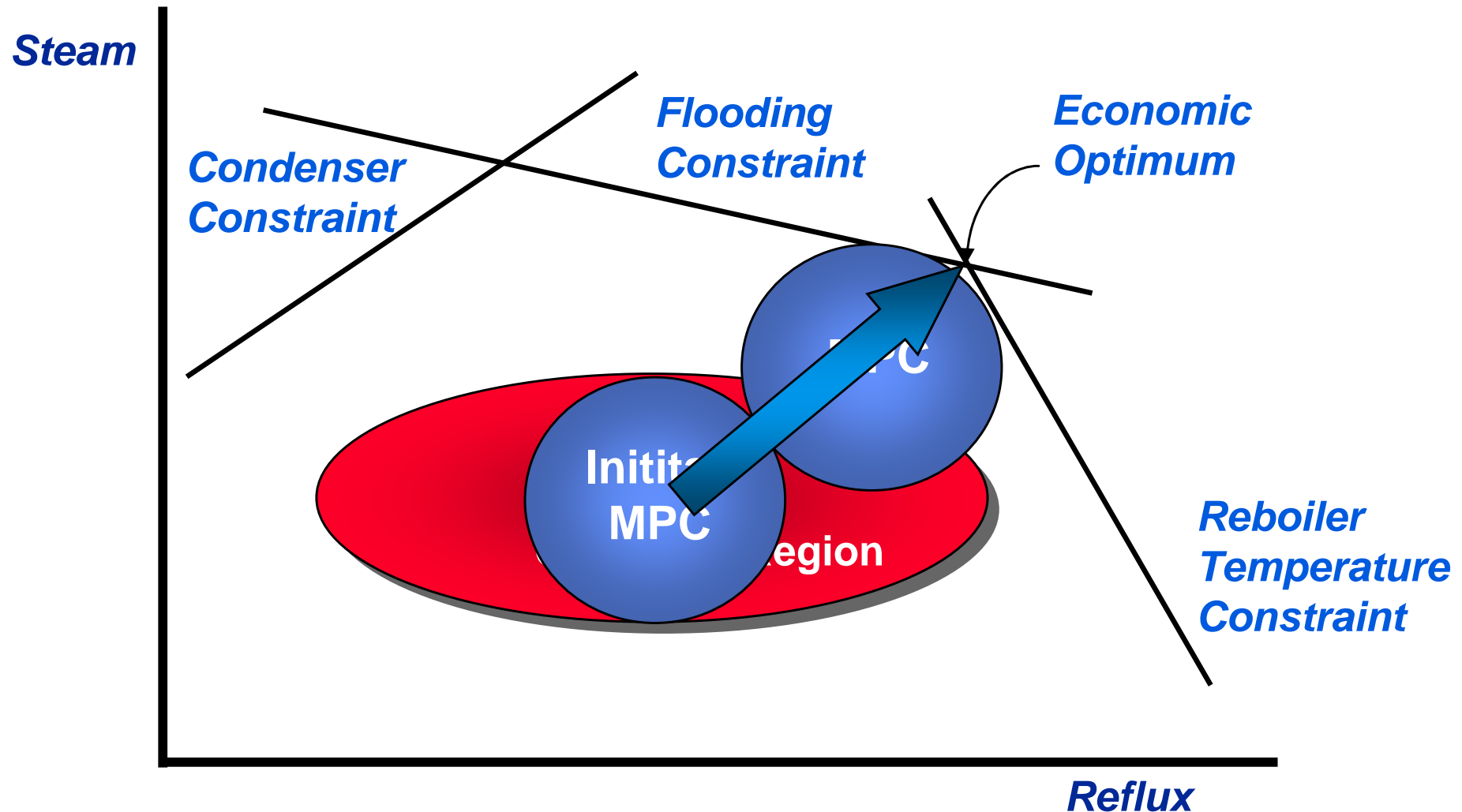
Statistical view

Reduces Variance And Pushes To Limit

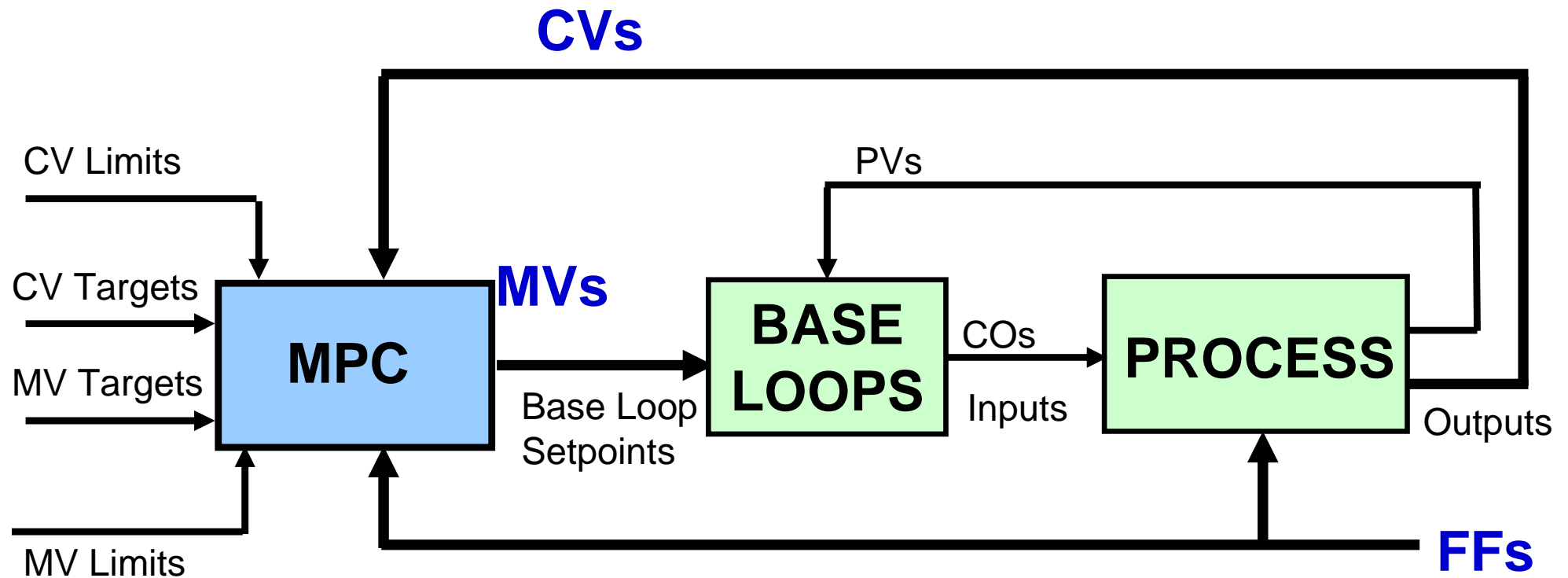


How APC Improves Performance (3)

- Handling simultaneous constraints and variables



How APC Improves Performance (4)



MVs = Independent, Manipulated Process Inputs (Base Controller SPs)

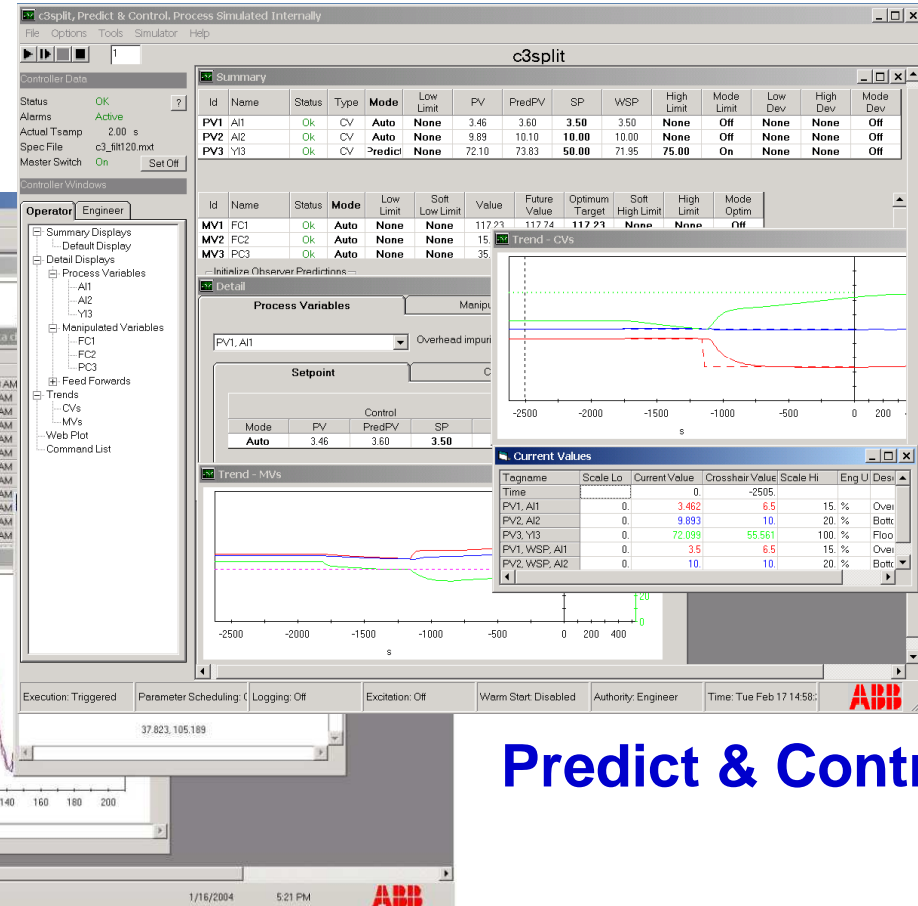
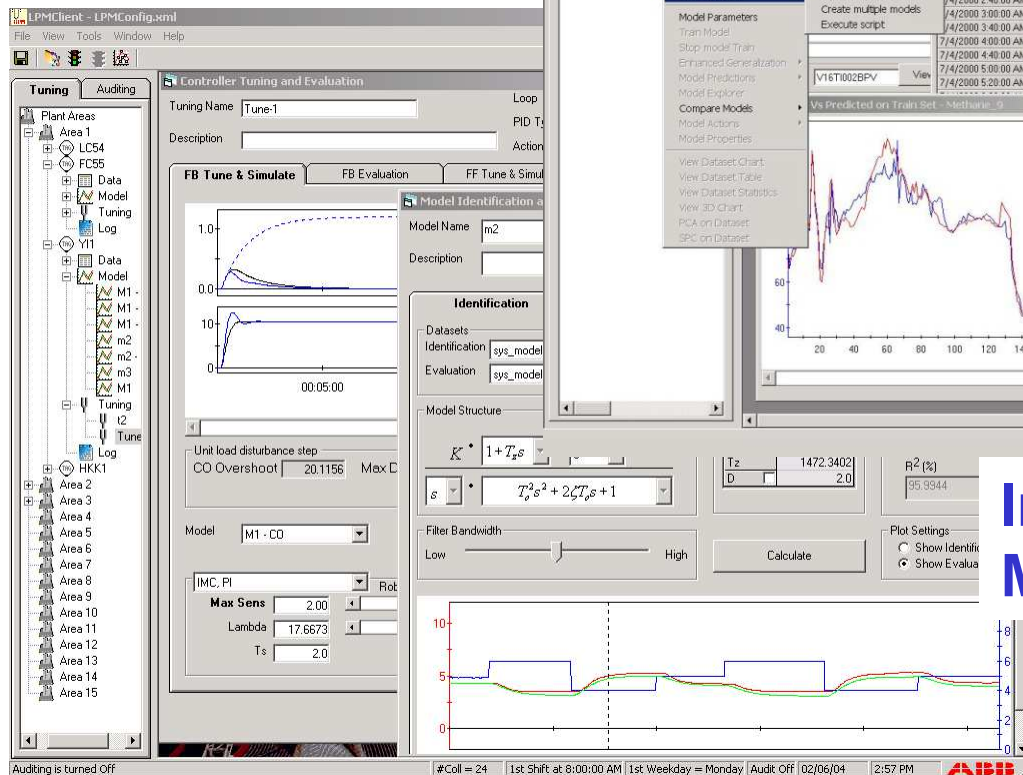
CVs = Dependent, Controlled (Constraint) Process Outputs

FFs = Independent, Process Inputs (Disturbances)

APC & Optimization Suite

- Deliver state of the art technology
- Create a suite of products that have consistent look and feel that work together seamlessly
- Reduce service and maintenance efforts

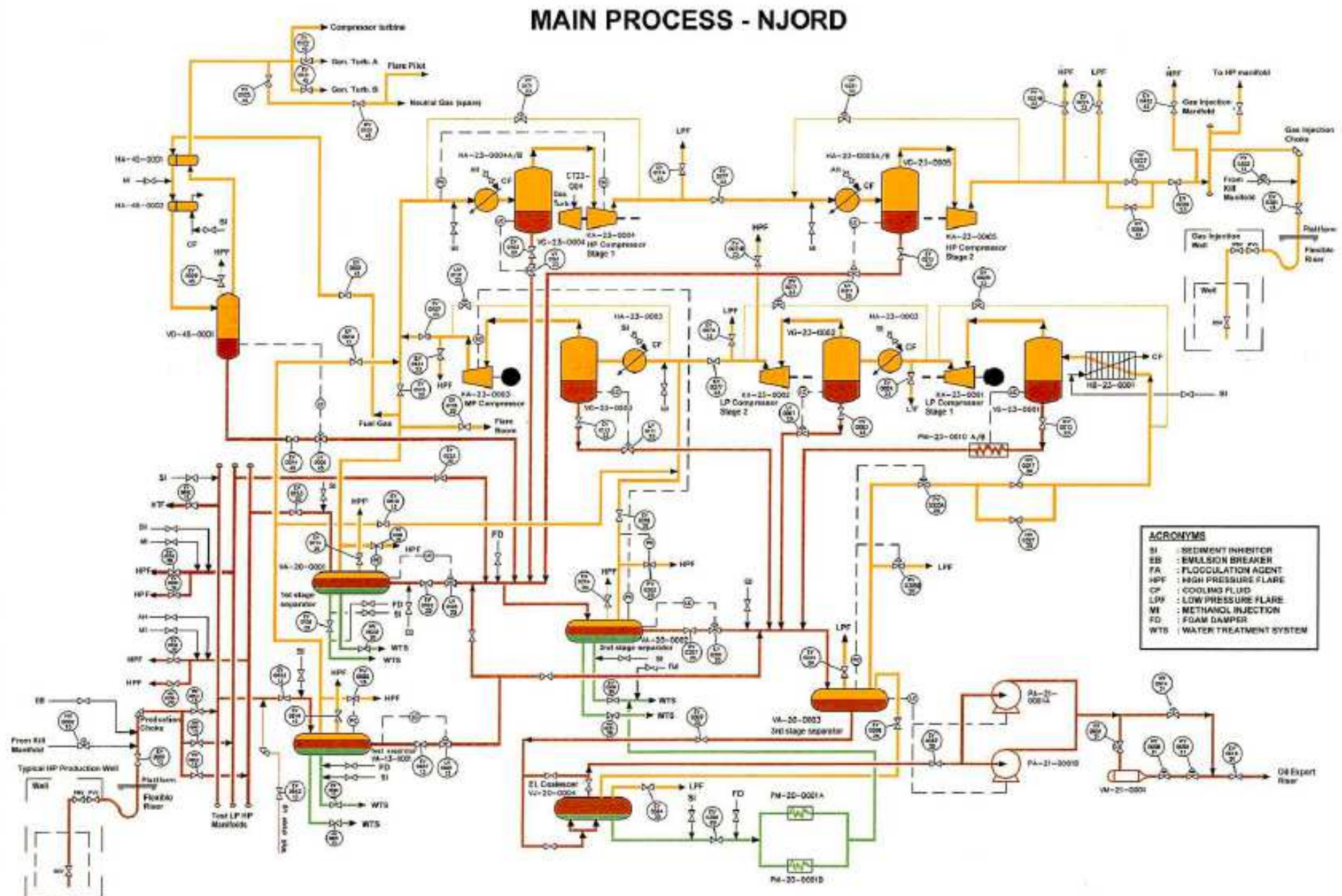
Loop Scan/Track



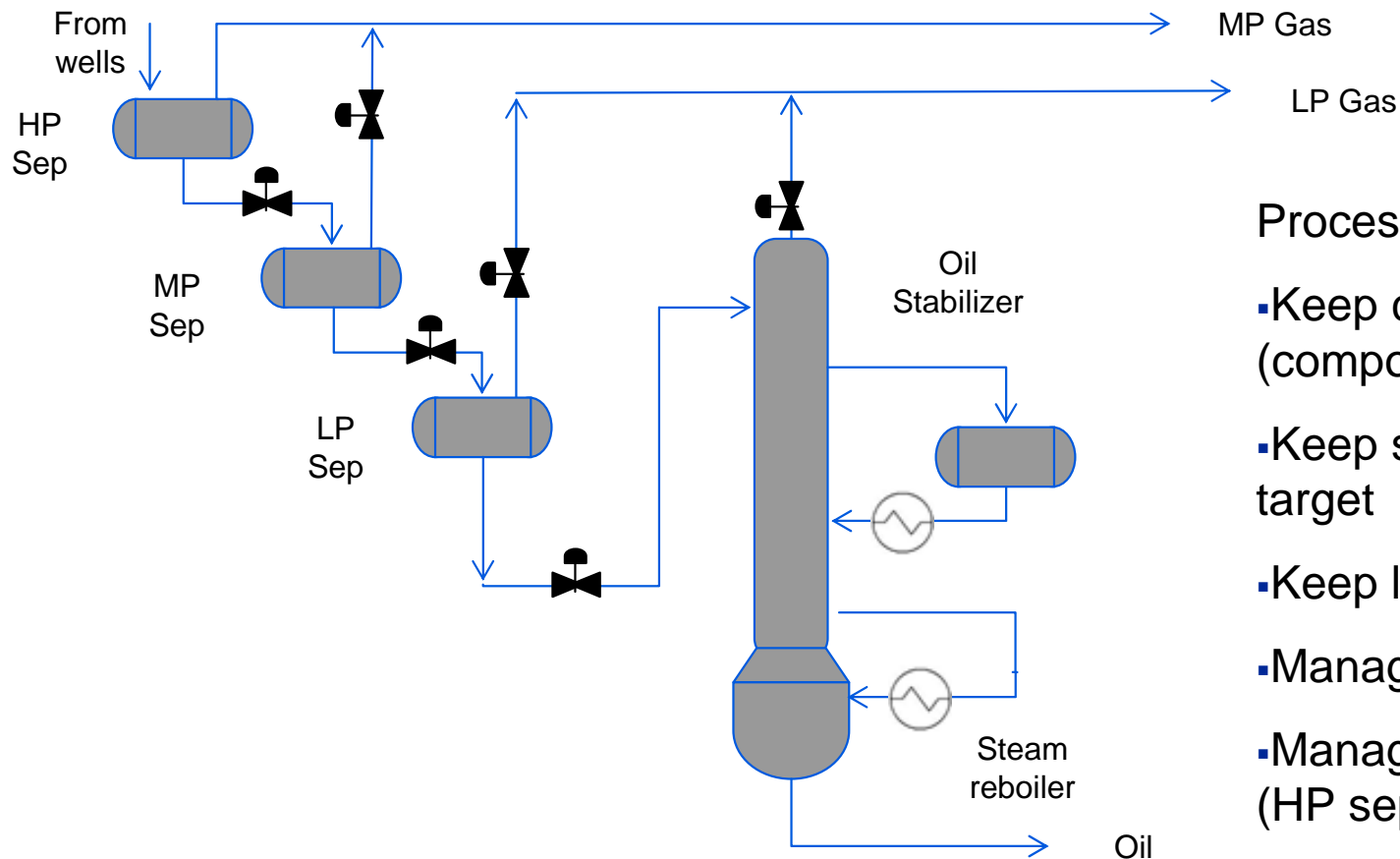
Predict & Control

Inferential Modeling Platform

Gas & Oil Separation – Typical configuration



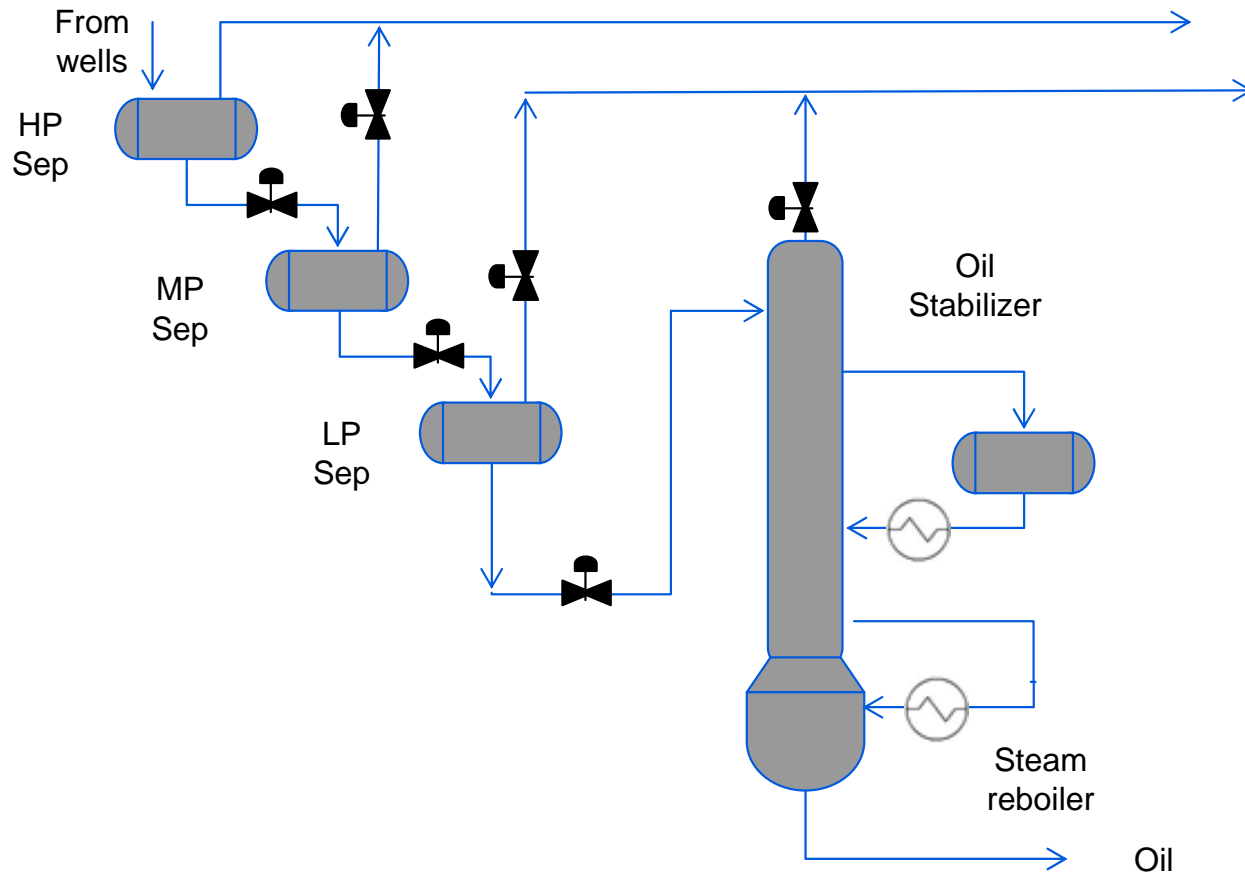
Gas & Oil separators – basic diagram & objectives



Process control Main Objectives :

- Keep column temperature (composition) at target
- Keep separators pressure at target
- Keep levels in range
- Manage composition changes
- Manage flow variations in inlet (HP separator)
- Preserve stable operation

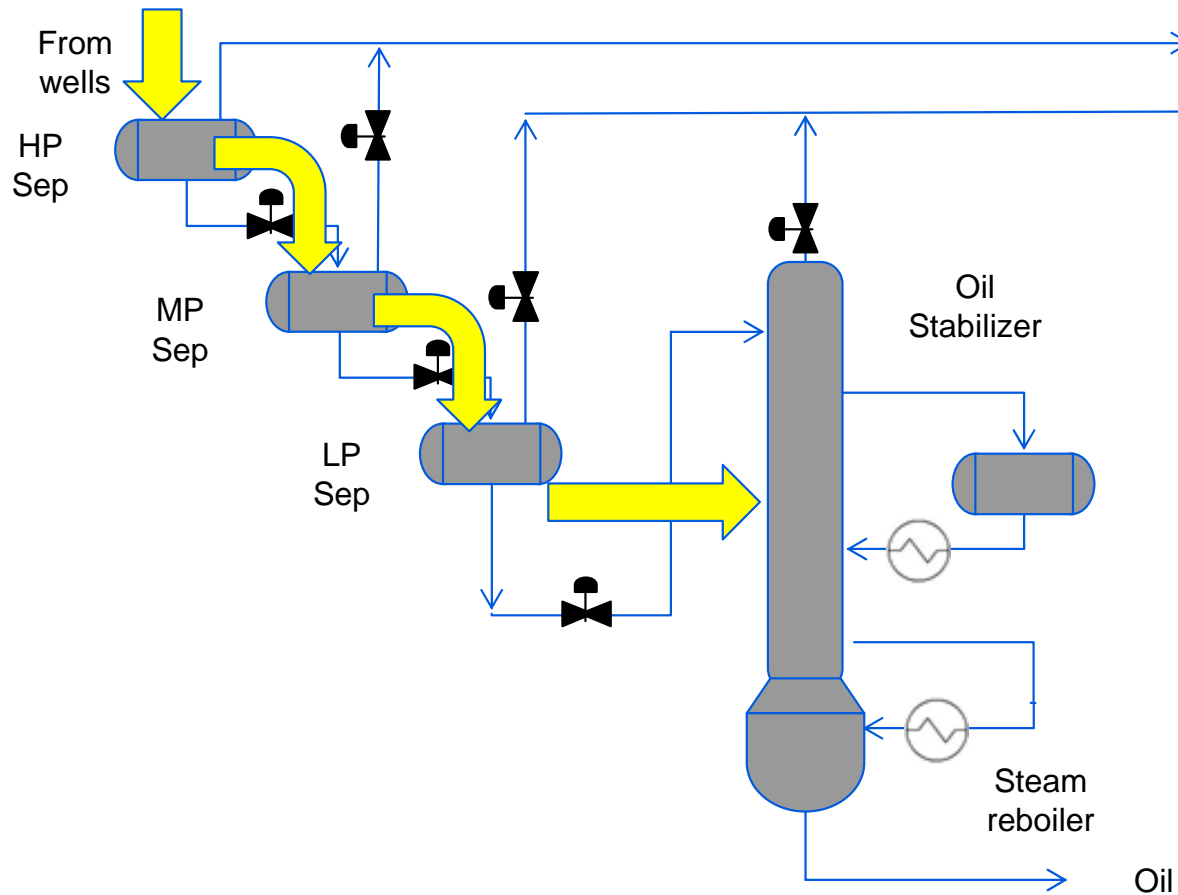
Gas & Oil separation – process control



- Oil & gas separation by means of sequence of separators and stabilizer column
- Hi pressure separator affected by large disturbances that get cascaded to lower pressure separators and column
- Advanced process control strategies provide better results than standard DCS control schemes
- Moving from multiple local objectives to coordinated overall objectives



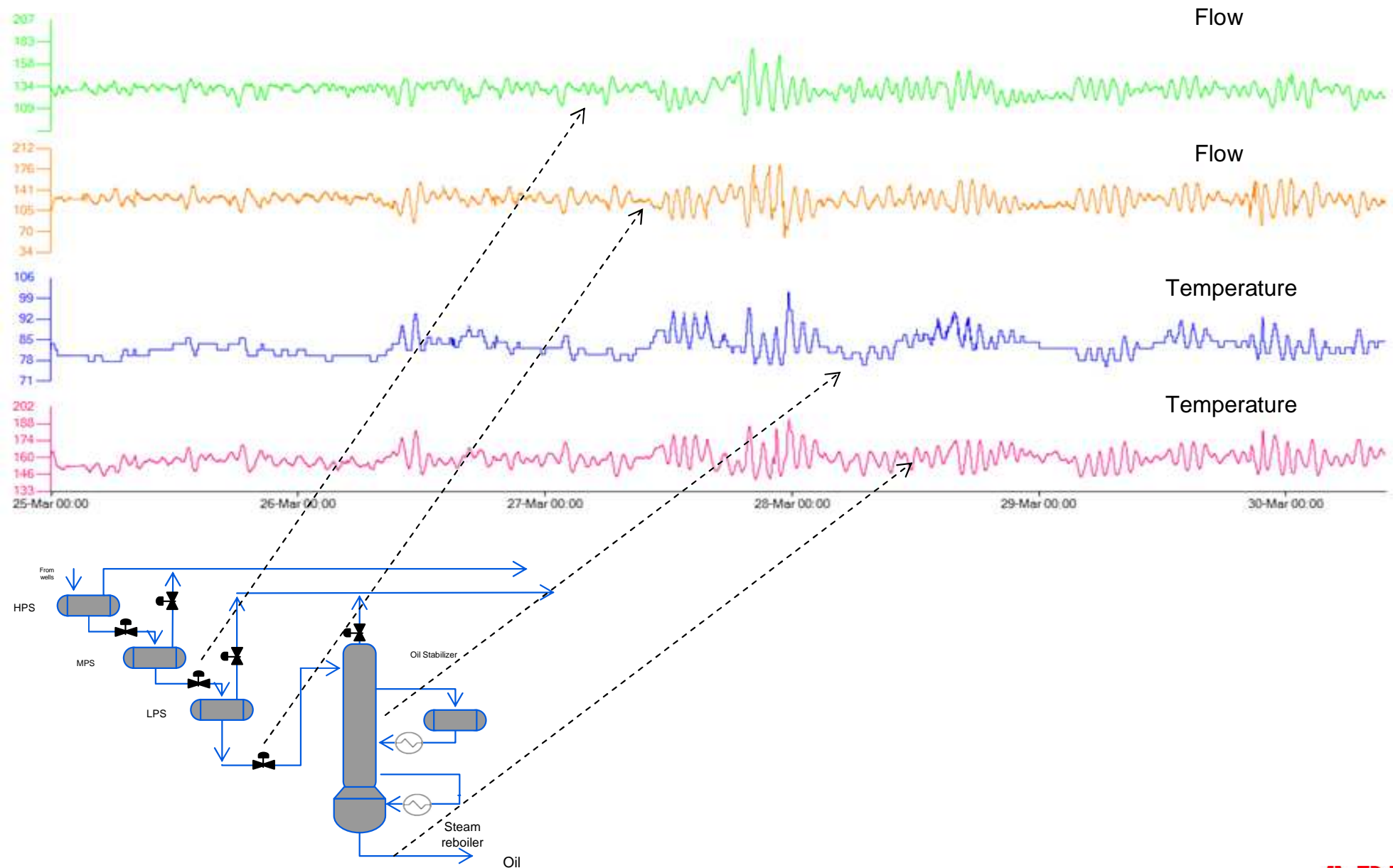
Gas & Oil separation – disturbance path



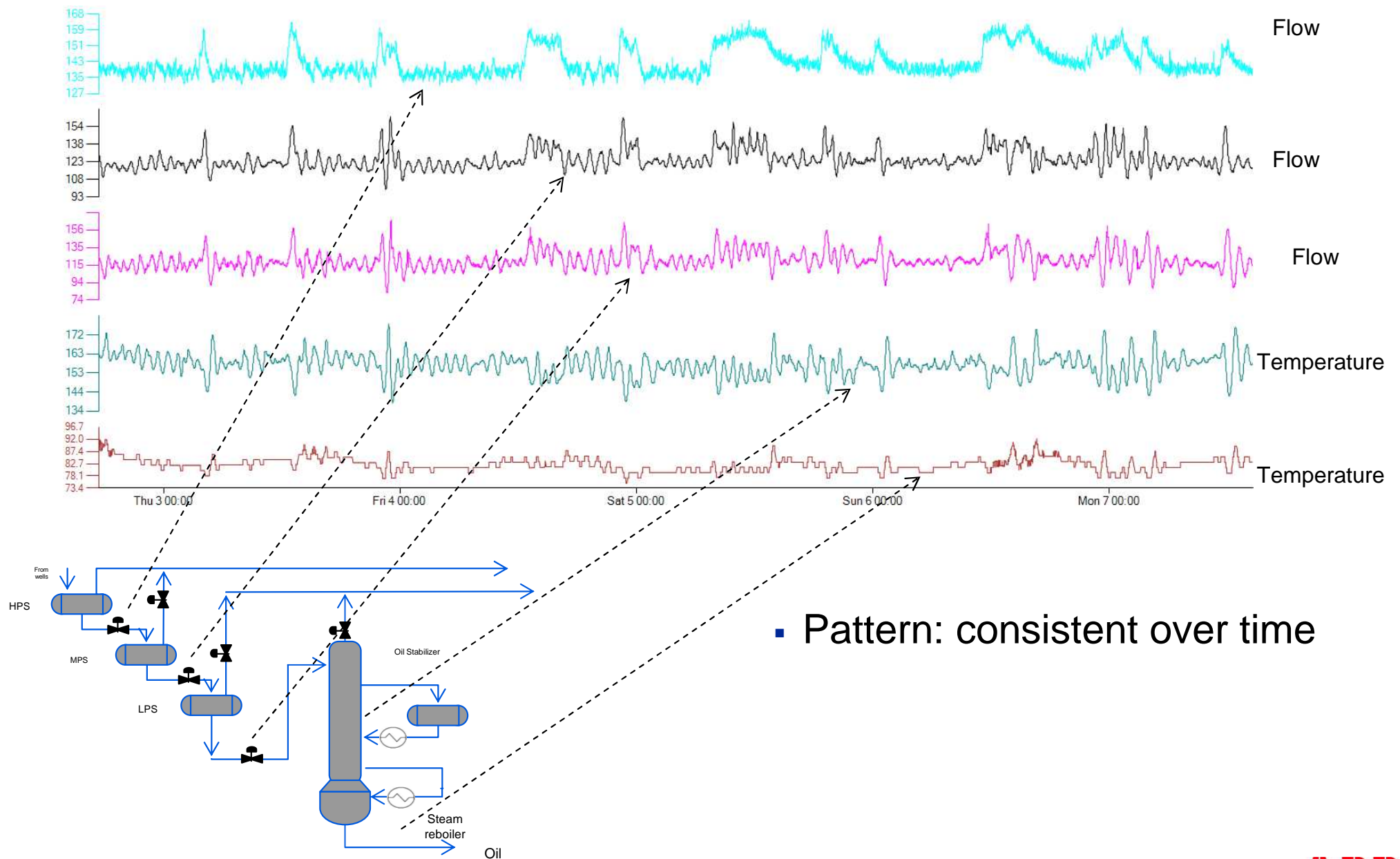
- Hi pressure separator affected by large disturbances
- Disturbances get cascaded to lower pressure separators and stabilizer
- If level control is tight disturbance is fully propagated or even amplified



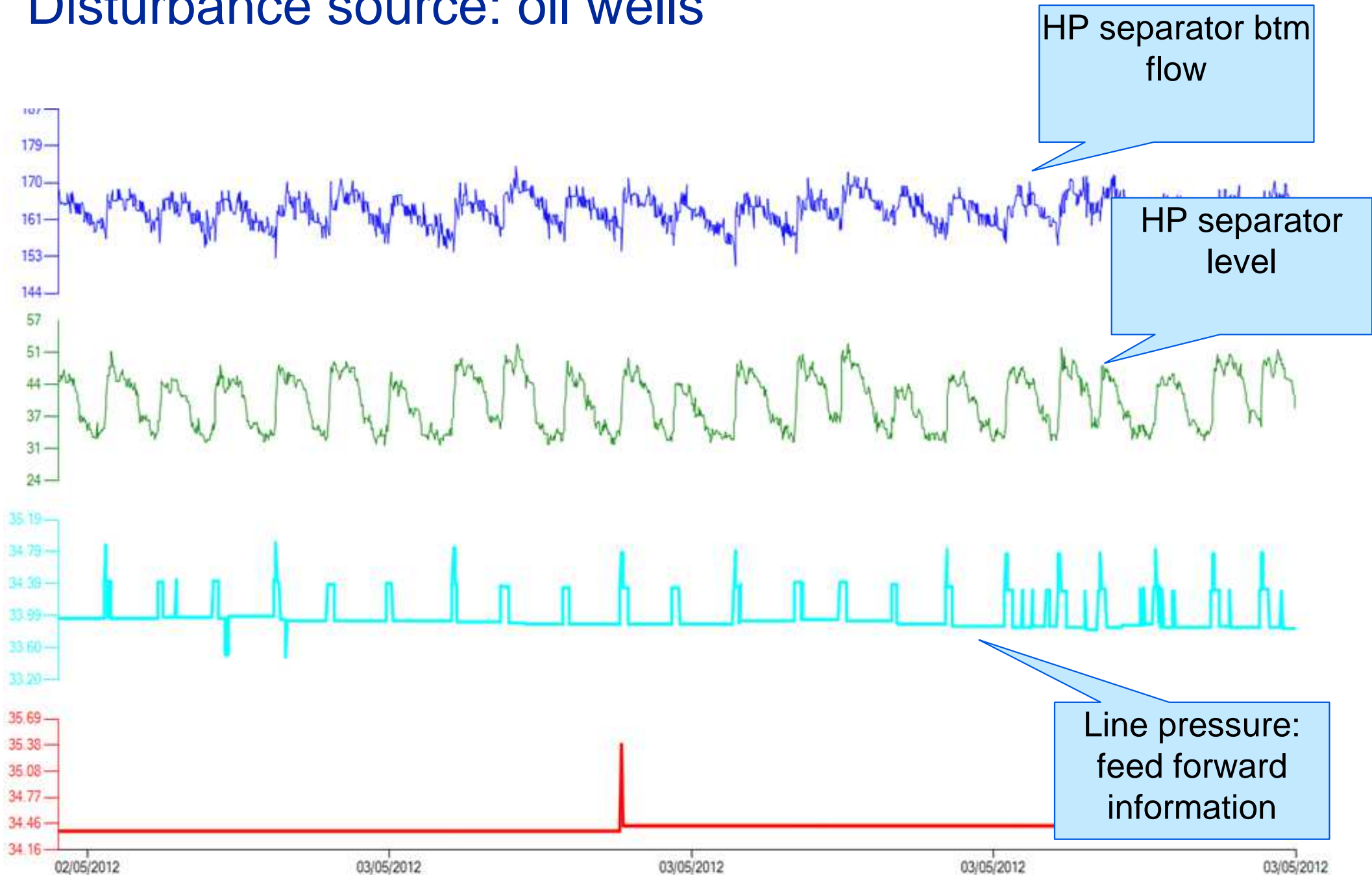
Separator trends – prior to implementation



Separator trends – consistent pattern



Disturbance source: oil wells



APC Solution

- DCS control scheme modifications and re-tune
- Advanced Process Control implementation
 - Keep level in range, use level buffer to smooth disturbance transfer
 - Coordinate column feed with steam to improve temperature control
 - Use existing well pressure to anticipate level/temperature changes
- Main CVs
 - HP, MP, LP levels
 - Stabilizer temperatures
- Main MVs
 - Level flows (HP to MP, MP to LP, LP to column)
 - Steam
 - P.A.
- FFs
 - Line pressure



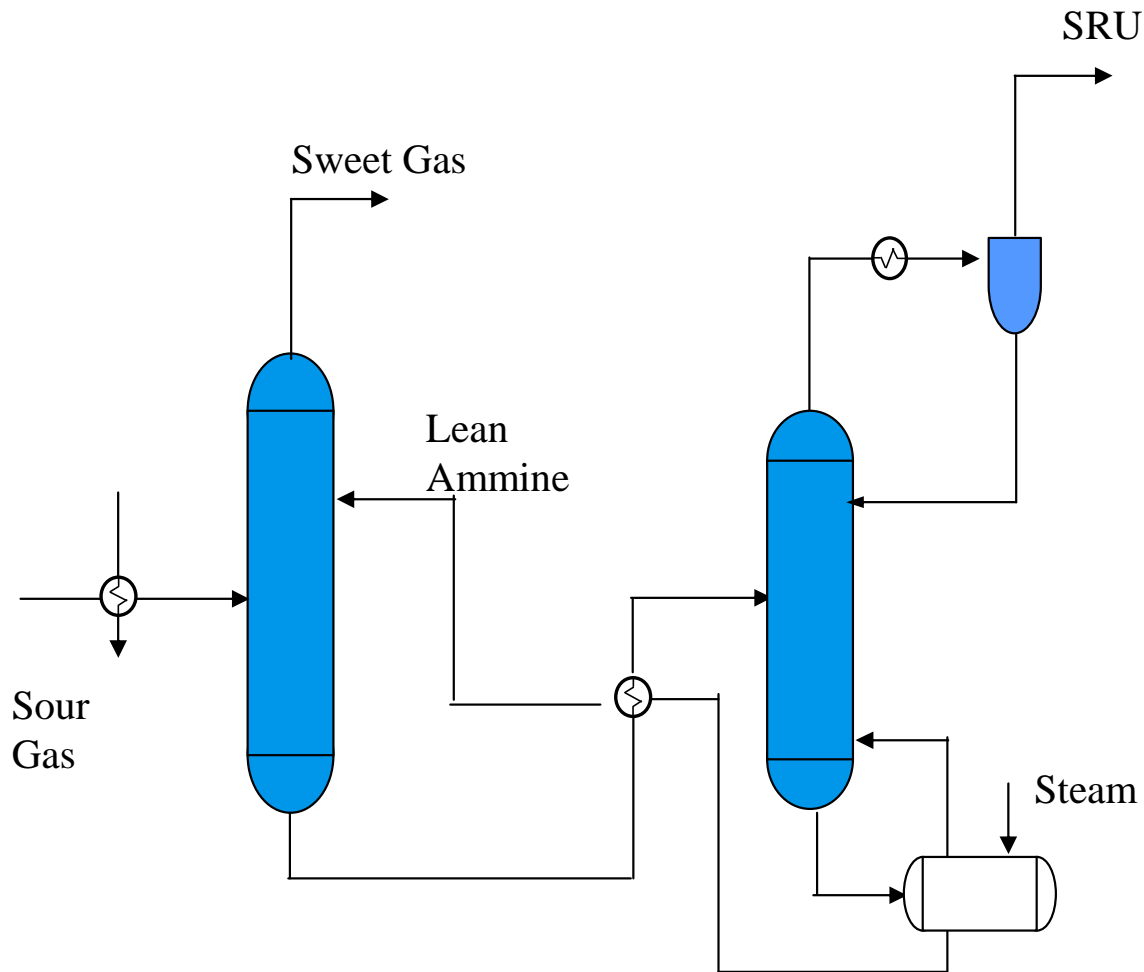
APC Results

Results:

- Improvement in temperature control (std. dev. Decrease >60%)
- Consistent composition control
- Process stabilization
- Reduction in operations workload



Acid Gas Removal unit



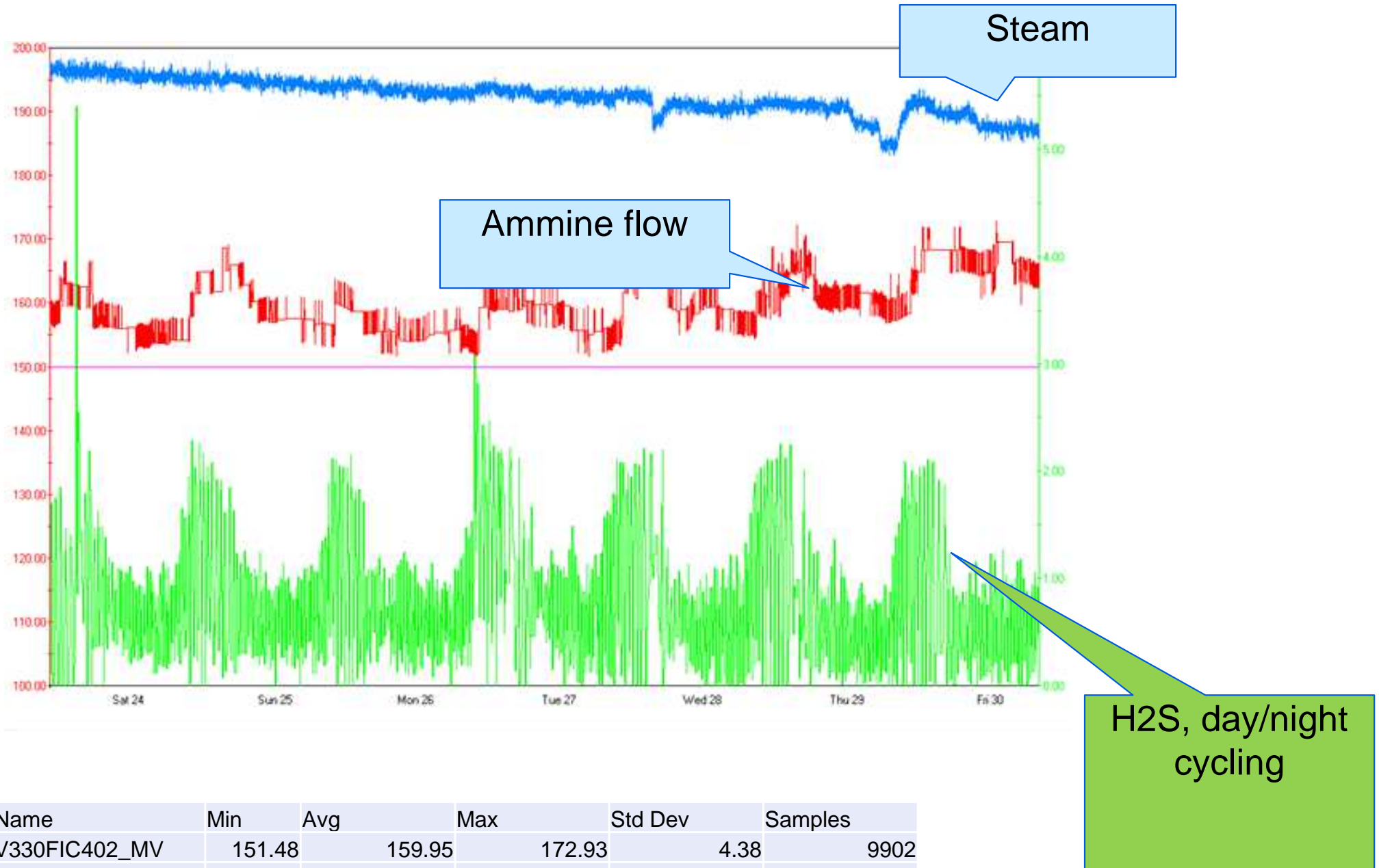
- Chemical separation
- Ammine injection to separate H₂S from sour gas
- Rich ammine sent to regenerator for H₂S stripping
- Different ammine types or solvents could improve efficiency but overall still large LP consumer

Preliminary evaluation

- Residual H₂S not consistently at specification – large fluctuations
- Multiple trains with inconsistent residual H₂S
- Ammine circulations typically kept at constant value
- Steam/ammine ratio typically kept at constant value
- Potential improvement also in the area of gas inlet temperature control (refrigerant)
- Large potential savings with APC implementation

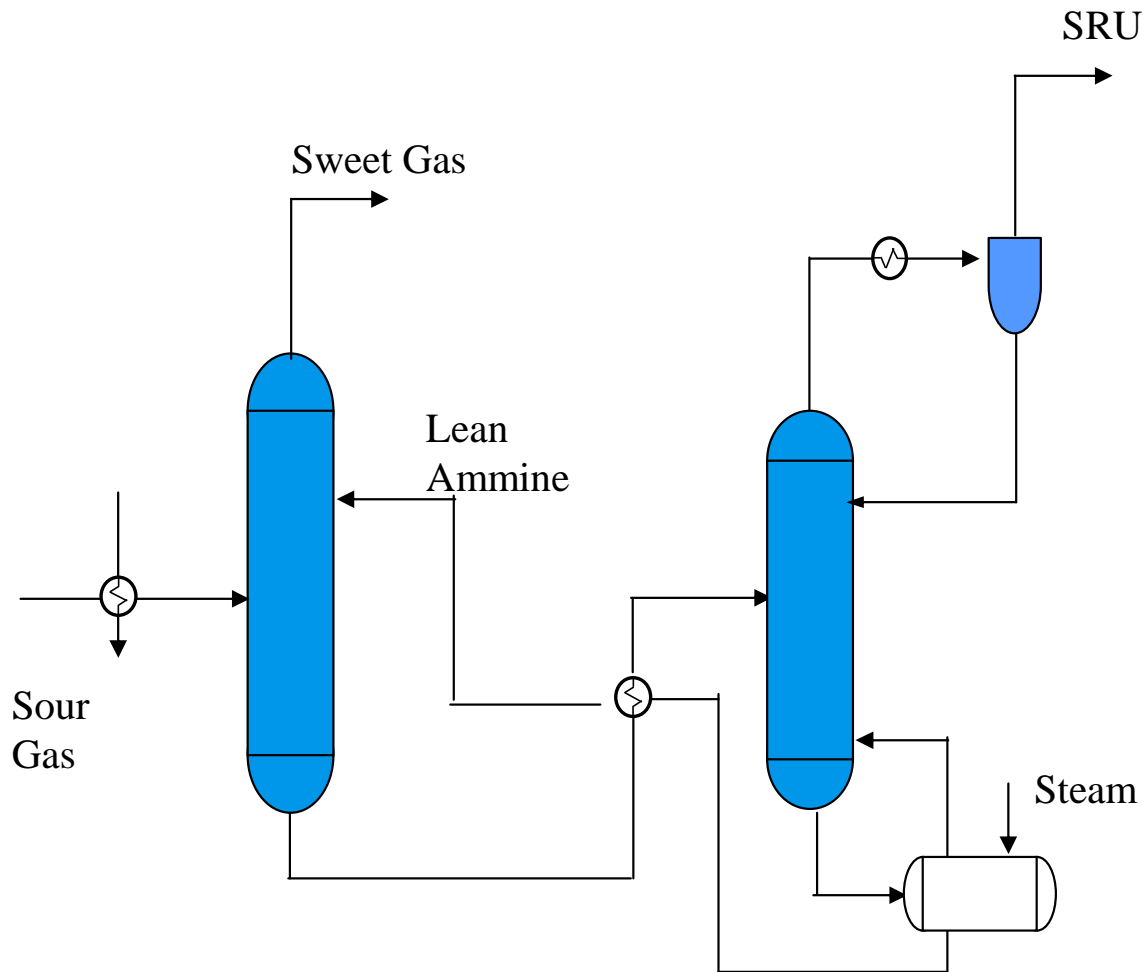


Addolcimento Gas – Unità 330 L4



Name	Min	Avg	Max	Std Dev	Samples
V330FIC402_MV	151.48	159.95	172.93	4.38	9902
V330AT401_VALUE	-0.05	0.78	5.4	0.58	9902
V330FIC402_OUT	37.5	37.5	37.5	-1	9902
V330FIC412_MV	19897.5	20768.06	21354.38	260.64	9902

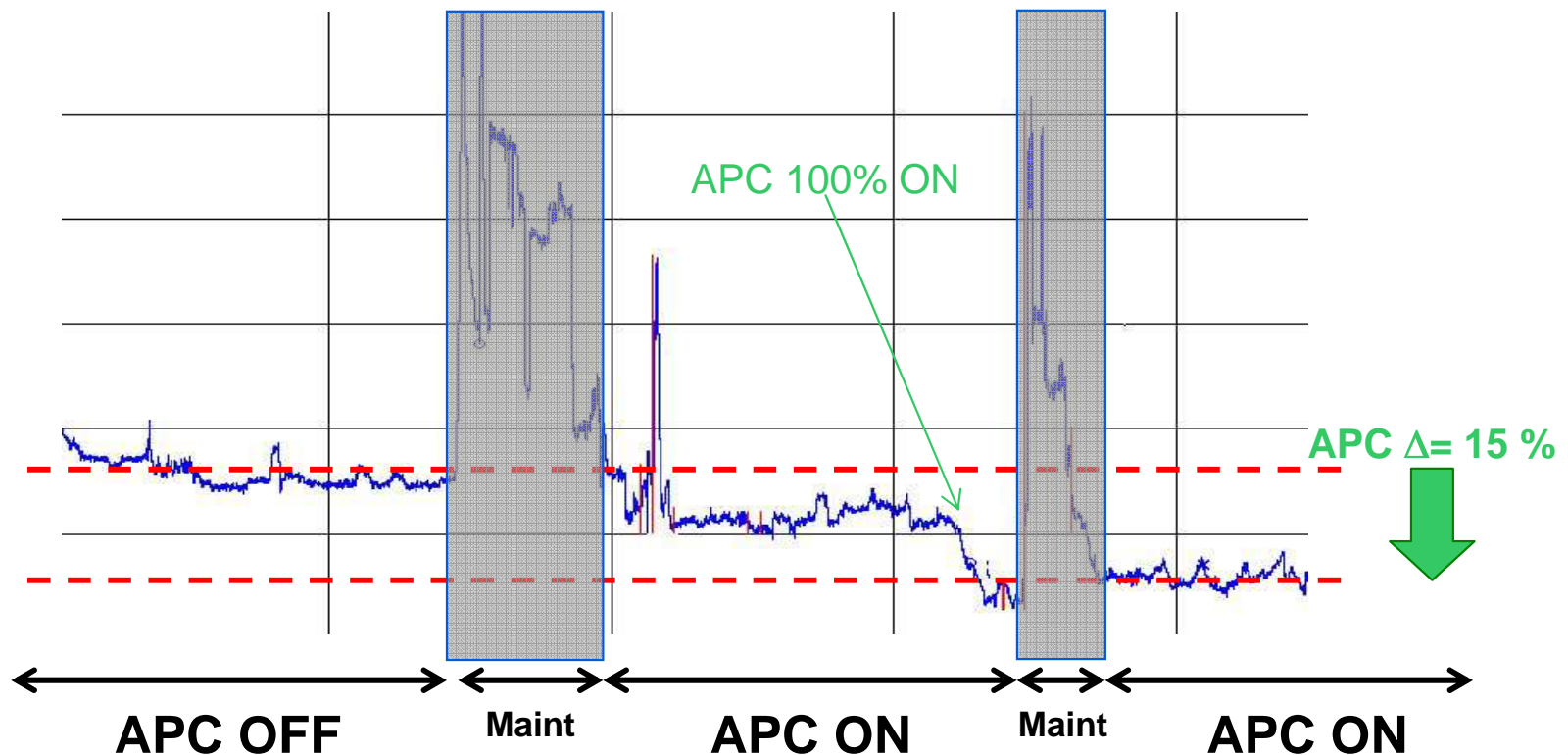
Acid Gas Removal unit



- Main CVs
 - Residual H₂S
 - Regen top temp
 - Sour gas inlet temp
- Main MVs
 - Ammine injection
 - Steam/ammine ratio
 - Refrigerant
- Objectives
 - Maintain specs, minimize steam usage

Results

- Consistent control of H₂S
- Large energy savings (steam savings ~ 15%)
- Unit stabilization
 - Reduction of disturbances to downstream units - SRU



Conclusions

- APC can provides large, tangible benefits to the O&G industry
- APC Software and technology in the mature stage
- In addition to financial benefits, other operational benefits can be achieved
 - Stabilization of operations
 - Reduction of operators workload

