



# Platform for Advanced Control and Estimation



# Rapid deployment with robust performance to maximize ROI from complex APC applications

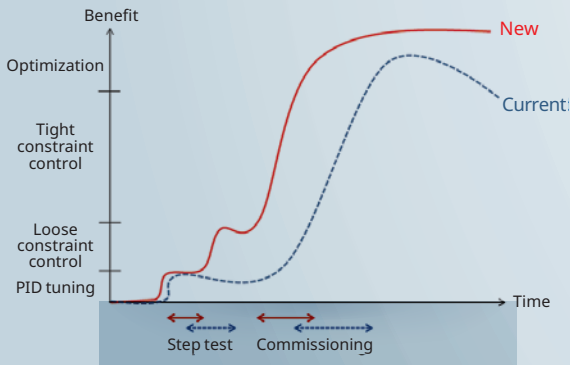
Platform for Advanced Control and Estimation brings multi-variable control, quality estimation, complex calculation, user interface definition all in one application dramatically reducing deployment time and simplifying maintenance for robust performance.

## Sustained Performance with Advanced Monitoring & Diagnosis Tool

Good control performance deteriorates over time due to changes in Feed Qualities, Plant dynamics, new control objectives, new operating modes, etc.

The Advanced Monitoring and Diagnosis Tool constantly monitors the Control Applications' performance, Model Errors and other metrics. Dynamic tuning of On-line Controller can be carried-out. There is also an interactive performance analysis tool that can help engineer to identify the bad actors.

Once the bad actors are found they are fixed to sustain good control performance securing the APC-generated benefits.

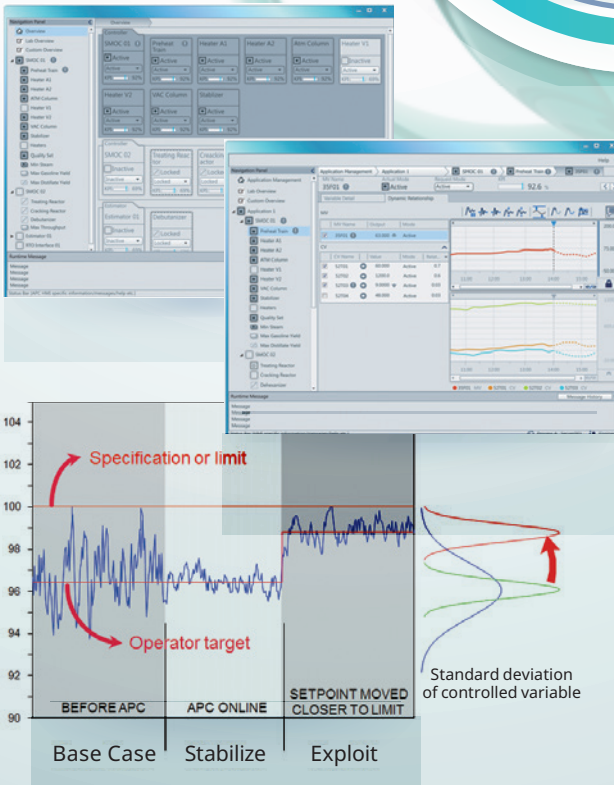


Full support  
For Rapid  
Deployment

## Achieve High Control Performance in less commissioning time with state-of-the-art on-line Commissioning Tool

The capability to run a "Staged" (Read only) version in parallel with the "Live" (Read and Write) version allows the Control Engineer to validate the modifications before going live, checking the controller response with different tuning parameters, changes in Controlled Variable and Manipulated Variable etc., and swap the "Live" version for the "Staged" version with no down time.

The commissioning tool comes with powerful Trending Functions that help engineer to quickly identify model mismatches. This on-line commissioning environment reduces commissioning efforts and time by half.

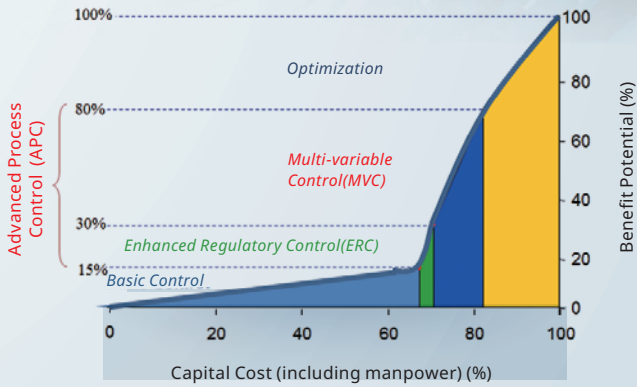


## Estimate benefits of introducing Advanced Process Control

Benefits of introducing Advanced Process Control are estimated through a feasibility study using our experience with achieving controllability improvement based on the historical operating data analysis.

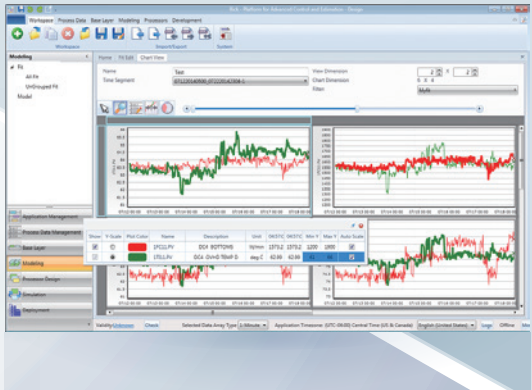
## Stable base layer control with Advanced Regulatory Controls

Stable baselayer control is the first Step towards Stable Operation. Our standard Advanced Regulatory Control modules can be deployed rapidly to achieve stable control prior to introduction of Advanced Process Control.



## Automatic Step-Tests with integrated dynamic modeling tools dramatically reduce modeling time

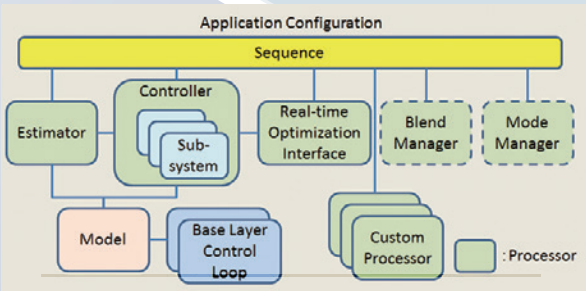
The Automatic Step Testing is designed to excite the plant for full dynamic response while continuing process control and economic optimization. The powerful identification and modeling tools allow engineer to quickly extract the dynamic model from the plant responses. This integrated tool can reduce the step-testing and modeling efforts by half as compare with traditional manual Step Testing.



## Holistic Advanced Process Control Application

Advanced Process Control applications usually need to work with other applications such as Quality Estimators, User Calculations and Base Layer Control Blocks.

This platform empowers the Control Engineer to rapidly develop APC applications having sequenced multiple processors (Controller, Estimator, etc.) and all the supporting functions in the same environment, including customization of User Interface to the Control Application. This holistic environment drastically reduces the application development time.





# Multivariable Optimizing Control & Robust Quality Estimation

Co-developed with Shell, one of the world's leading pioneers in development and application of Advanced Control Technologies in the Energy Industry. The latest Platform for Advanced Control and Estimation is the best in class Suite to Rapidly Deploy and Sustain Advanced Control Applications that generate benefits through-out the plant Lifecycle.

## Design Time

Design Time provides the Single-Workspace for process data management, process dynamics modeling, processor and sequence design and scenario-based simulation based on Best-Practices in Advanced Process Control deployment. Seamless sharing of information between Design Time and Run Time in the same workspace empowers the Control Engineer to develop complex Applications rapidly.

### Preliminary Controller Design

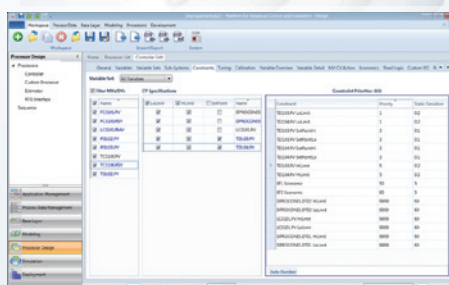
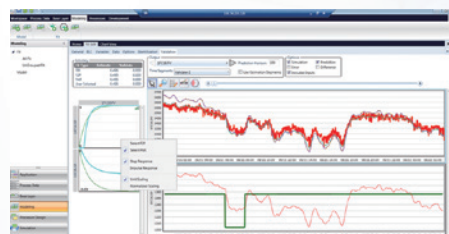
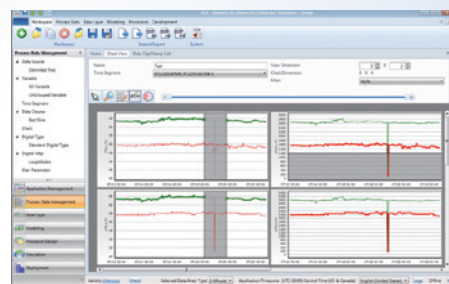
Define preliminary control matrix which consists of Controlled Variables (CV) and Manipulated Variables (MV) for the Automatic plant step response test under the Run Time.

### Robust Model Identification

The plant step response data is imported to the Design Time and cleaned using various tools, such as bad slicing, data clamping and rule-based cleaning, for model identification. Multiple Linear Dynamic Models can be identified over a wide operating range using the model statistics with traffic light indication of the Model's Robustness. Multiple model elements for a single Input/output pair and non-linear gain formulas are supported.

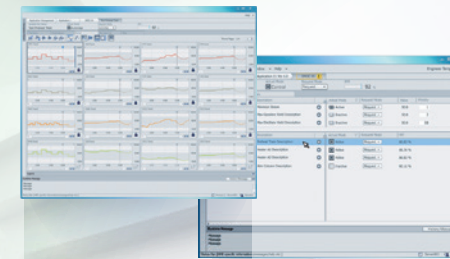
### Complex Application Development

A Complex plant-wide application can be developed within the same Workspace with multiple types of processors such as plant-wide Controller with multiple sub-systems, Estimator, Real-time Optimization Interface and Custom Processor. Controller model transfer functions are changeable online and multiple model elements can be switched to handle processes with non-linear dynamics. Custom processor provides versatile capability to build a custom calculation and/or logic using VB or C#.



## Run Time

Run Time environment supports two RUN modes; Staged (Read only) and Live (Read and Write). Running the two modes in parallel allows the Control Engineer to validate modifications in a Staged version before swapping with the Live version. Human-Machine Interface panel is organized hierarchically for easy visualization of process condition and control system status. Operator/engineer can easily and quickly access the relevant information by clicking the icons, navigation tree and breadcrumb.



### Auto step testing

Initiate automatic plant step response tests with the Preliminary Controller Design. The plant step response data is stored in the embedded historian. Tiled trends support engineer to validate process responses for dynamic model Identification.

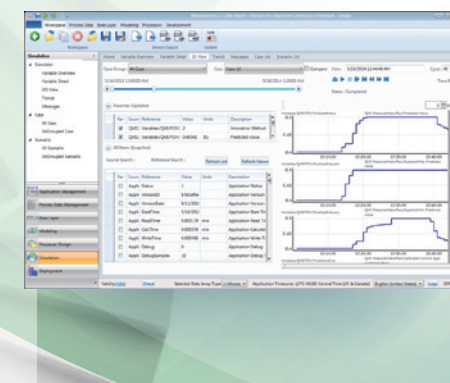
### New Human-Machine Interface with Key Performance Indicator Faceplate

The New Human-Machine Interface adopts a new Key Performance Indicator Faceplate with health status to improve interaction with the Operator and Control Engineer. The Human-Machine Interface panel is defined using Variable-Sets to organize the variables in strategically relevant groups. It comes with an integrated powerful trending tool and Dynamic Relationship panel to support operation and application maintenance, especially for very large applications.



### Online Tuning

Support the Control Engineer in validation of integrated Estimator Model and Controller Tuning using real process data in Real-Time before putting the application in Live active control. Flexible controller tuning and comprehensive simulation allow engineer to test the entire runtime application under different situations in parallel. Introducing the new concept of Best Performance Value (BPV), defined as the most desired point of operation of a CV, in case of infeasibility, the controller optimizes MV move plans to slow the movement of CVs away from their BPVs, yielding superior transient dynamic performance of the controller.



Seamless collaboration  
for  
continuous improvement



# Advanced Regulatory Controls

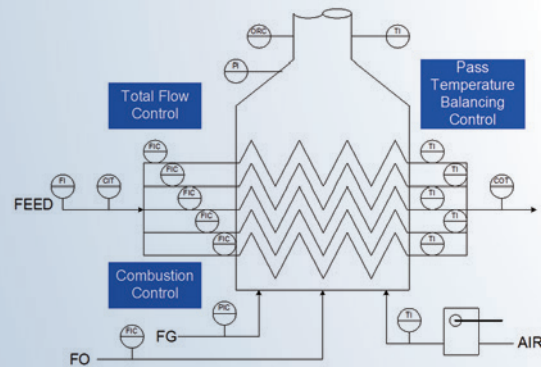
are field-proven, user-friendly and off-the-shelf standard function libraries designed to stabilize base layer control and can be used in conjunction with Multivariable Optimizing Control and Robust Quality Estimation to achieve desired control and operating objectives.

## The Shell Surge Volume Control (SSVC)

is designed to take full advantage of the Surge Capacity available in the plant to achieve a more stable operation. The SSVC module manages the surge vessel's level within specified limits while minimizing flow fluctuation entering or leaving the surge vessel. The algorithm is designed to work not only for one surge volume but also for cascading surge volume such as cascading Distillation Columns. The algorithm will take advantage of periods when there are no large disturbances to bring the level to ideal set-point, to make capacity to absorb the next large disturbances.

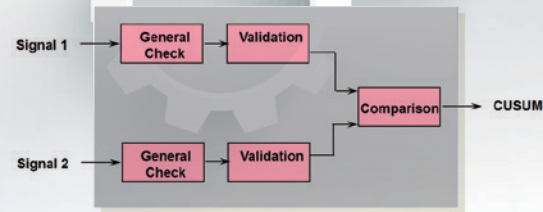
## Furnace Pass Balancing (BALANCE)

is designed to evenly distribute the heat energy absorbed by each pass in a multi-pass heating furnace. The BALANCE module improves Furnace Efficiency by passing more flow through those passes with higher heat recovery, balancing the outlet temperature of each pass. Each BALANCE module can manage up to two furnaces with up to two cells/chambers. Each cell can have up to 16 passes (coils) and each pass can have up to a maximum of 5 skin temperatures reading. The BALANCE module also manages the total Flow through the Furnaces, which is a very valuable tool for the management of Heating Furnace.



## Measurement Validation and Comparison

algorithm (hereinafter called the MVC) is designed to validate two field measurements of the same process output variable for comparison. Deviations between two field measurements above a reference value are continuously accumulated, and when the accumulated value exceeds a certain limit, an alarm results.



# Advanced Monitoring & Diagnosis

is designed to sustain and improve the performances of Advanced Process Control Applications deployed and base layer control loops.

## Hierarchal performance monitoring

The web viewer provides a browser-based monitoring and reporting interface to the on-line database. The monitoring view summarizes by date control performance and operator interventions for the chosen asset type and the customizable asset level hierarchy. Web property pages can be used to navigate from the top of the hierarchy to the bottom and vice versa, and provide property information about all data items, from the Location configuration down to a single Tag.

## Reporting

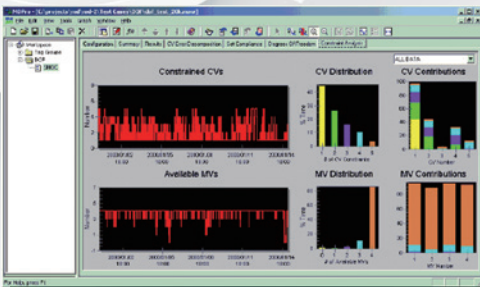
The real-time reporting tool uses current data to highlight the bad actor base layer or advanced control loops that require operator and / or engineer action now. Executive report summarizes performance for the whole location, using Assets from the preferred hierarchy level. Escalation reports per monitoring type are customizable. The reports can be emailed and printed or exported to a file for use in Excel.



## Interactive performance analysis

The off-line diagnostic tools use statistical methods to extract the essential control performance information and provide interactive analysis screens to find root causes of control problem.

- Profit variable calculation
- Benefit forecasting
- Response plots
- Controlled variable error decomposition
- Degrees of freedom analysis
- Constraint analysis
- PID tuning function





Synaptic Business Automation underlies a process of co-innovation and collaboration with customers that leverages Yokogawa's domain knowledge and digital automation technologies to create sustainable value.

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