

# SmartProcess™ Fractionator



Improve operation efficiency, while reducing costs with Emerson's SmartProcess Fractionator

- Maximize fractionator columns throughput
- Maximize the feed rate against unit constraints at required product quality when desired
- Stabilize and control product qualities to specifications
- Maximize the yield of more valuable side draws up to quality limits
- Minimize the energy consumption of the unit
- Maintain consistent operation across all shifts to reduce operator workload

## Introduction

Fractionator columns yield intermediates and finished products that drive bottom line refinery business results. They can also be bottlenecks, if not operated safely and in optimum balance with refinery and market demands.

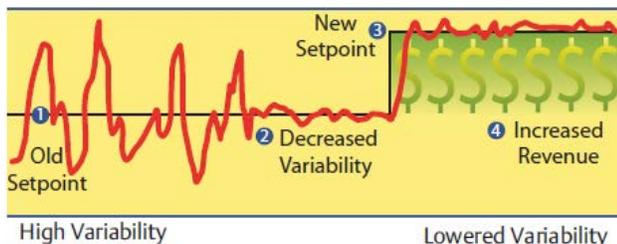
The keys to profitability in fractionator column operations demand operational excellence in the areas of safety, optimizing throughput and yields, maximizing heat recovery, dealing with crude composition changes, maximizing equipment availability, and consistent, stable and reliable unit operations, day after day.

Emerson Process Management has a long history of providing total automation solutions that improve performance in these key operating areas, through our SmartProcess Fractionator solution, a pre-engineered, modular solution for model predictive control (MPC) of fractionator columns using DeltaV™'s embedded advanced process control (APC) technologies. This solution includes software and services to implement MPC and Neural modules for control of any four product oil fractionator column.

## Benefits

Oil fractionator columns are often highly constrained, with significant controller interactions and long time constants. Advanced Process Control (APC) is an ideal method for optimizing fractionator performance. Emerson's SmartProcess Fractionator takes the effort of implementing APC on these units to a new level of ease and cost effectiveness. Now even small-capacity units can capture the benefits of APC that larger refiners have been enjoying for years:

- • 3-5% higher throughput
- • 30-80% reduction in product quality variability
- • 2-5% improvement in distillate yields
- • 2-5% reduction in energy costs.



APC benefits include reduced variability, energy costs, and increased yield and throughput.

Using flexible, pre-engineered templates, process control engineers can configure an advanced control application to accommodate a variety of process units, including:

- Crude atmospheric distillation
- Vacuum distillation
- FCC main fractionators
- Hydrocracker fractionators
- Coker fractionators
- Hydrotreater multi-sidecut fractionators

Based on solving the column heat and material balance, the templates can be made to match any configuration of product draws, pumparounds, external feeds, heaters and refluxes. Standard calculation results include:

- Pumparound exchanger duty
- Pressure-compensated temperatures
- Dew point of top tray
- Hydrocarbon and steam enthalpy correlations
- Jet flooding
- Mass balance error

## Product Description

Fast implementation APC solution that is easy to setup, use, and maintain. This automation solution also minimizes disturbances from crude switching, thus minimizing impact to all downstream units.

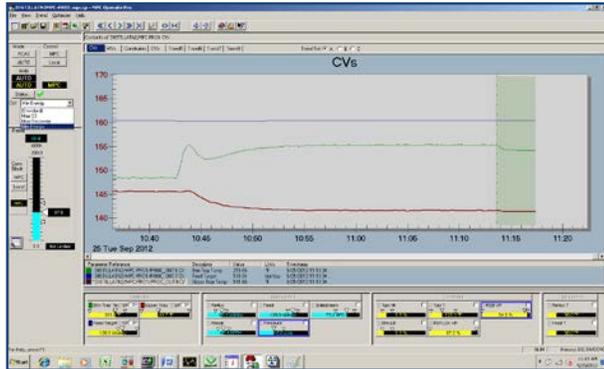
While the solution can be implemented on top of legacy control systems, it is specifically designed to run in a DeltaV digital automation system, working with smart field devices to improve product quality, recovery and energy efficiency. The DeltaV embedded APC tools provide a platform to control and optimize the fractionation process using an embedded linear program. The solution provides closed-loop product quality control using a real-time, multivariable controller that calculates optimal control moves for safe, stable operation.

Advanced control applications supplied with the SmartProcess Fractionator application, include a combination of advanced regulatory control functions, custom calculations and embedded DeltaV APC technologies such as Model Predictive Control (MPC) and Neural Net inferential modeling. The solution allows customization to meet the process design, control objectives and the regulatory control strategy for each specific unit.

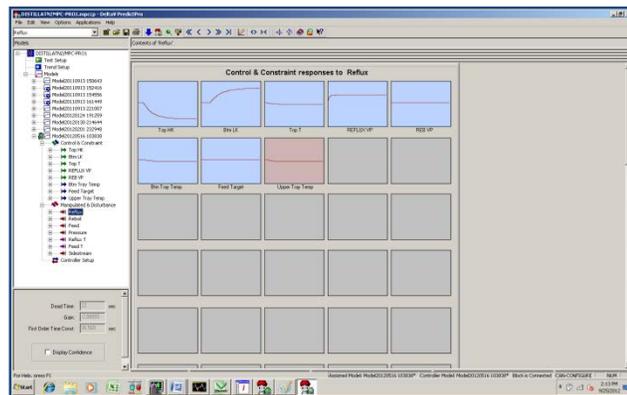
### DeltaV PredictPro - Model Predictive Control

The Product Description and Specification may contain Model Predictive Control (MPC) is a technique to provide improved control of multivariable process units. MPC uses dynamic models of the process, and a record of its past behavior, to predict how the process will behave in the future. These predictions are then used to determine an optimum sequence of control actions that ensure all process control objectives are achieved simultaneously. The process models are obtained from unit testing and are adjusted online using plant measurements to ensure future predictions and actions are always consistent with desired process operation.

MPC is ideal for controlling fractionator columns, where there is more than one interacting controlled variable, long time constants and multiple equipment limits and operating constraints that must be observed. With MPC, future constraint violations are predicted such that adjustments can be made in advance to prevent critical limits from being violated. Priorities are used to achieve the desired controller behavior when one or more constraints must be violated, allowing the most critical controlled variables or constraints to always be maintained..



DeltaV PredictPro Operator display trends history as well as future predictions.

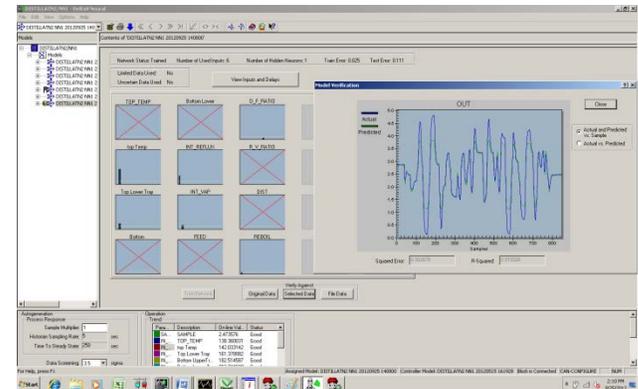


Embedded DeltaV PredictPro tools use dynamic process models to predict future behavior.

Emerson’s DeltaV Predict/PredictPro represents a new generation of Model Predictive Control solutions, completely embedded in the control system. Its ease-of-use is unmatched in the industry. Most clients are able to maintain the application on their own with limited training and experience. The SmartProcess Fractionator includes PredictPro licenses for 15 MV’s, sufficient to control a typical 4-sidecut fractionators column.

## DeltaV Neural - Inferential Modeling

Fractionation processes usually exhibit long response times for product compositions to react to changes in variables like feed rate, heater outlet temperature, product draw rates, and reflux rate. Laboratory samples are only performed a few times a day. On-line analyzers provide results many times per hour, but may not be installed or justified as part of an automation project. In the absence of frequent product analysis, various inferential techniques can be used to predict the real-time product quality values used for control purposes. One such technique uses the embedded DeltaV Neural application to predict real-time quality values.



Easily Create Product Quality Predictions with DeltaV Neural

DeltaV Neural can be easily applied to automatically create non-linear process models using historical data. Once placed on-line the predictions from DeltaV Neural modules can be used for operator guidance or, in some cases, as part of a closed-loop advanced control application. These predictions are updated periodically from either laboratory samples or on-line analyzers.

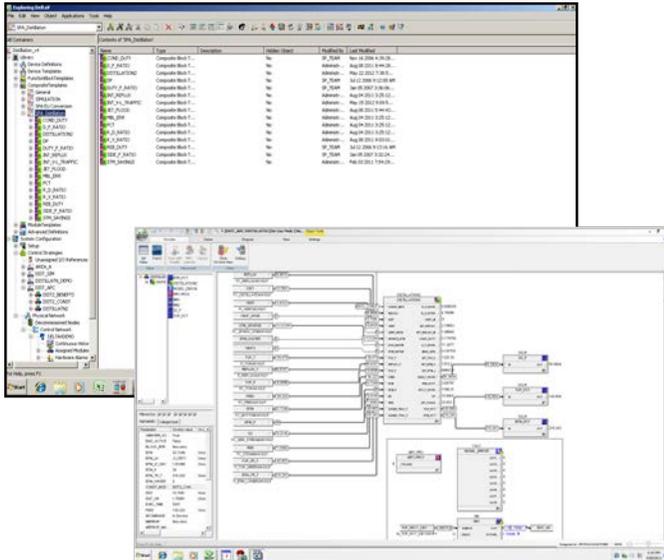
The SmartProcess Fractionator license includes the necessary DeltaV Neural modules needed for quality models of two products.

## SmartProcess Fractionator Library

The SmartProcess Fractionator Library includes the following components:

- DeltaV Module libraries, templates and composites
- Standard fractionation calculation blocks:
  - Hydrocarbon and steam enthalpy calculations
  - Vapor/liquid traffic in each section of the column
  - Jet flooding
  - Dew Point
  - Reboiler and condenser duties
  - Overflash%

- Pressure compensated temperature
  - Material balance error
  - Engineering unit conversions
  - Energy savings
- Example SmartProcess Fractionator configuration with simulation and graphic
  - Documentation: Installation and Configuration Guides, Sample Functional Design Spec



Standard DeltaV Libraries Make Configuration Easy

## Certified Consultant Engineering Services

Emerson's Certified Solutions Consultants provide standard engineering services to design, configure, install and commission a complete SmartProcess solution. The scope can cover individual fractionators or complete fractionation trains including heaters, light ends columns and auxiliary equipment. At the start of a project, our consultants will review the process, operating objectives, constraints and economics to design the APC strategy, benchmark current performance and develop a project execution plan.

A standard methodology is used for implementing SmartProcess applications as follows:

- Kickoff meeting and site survey
- Regulatory control performance audit
- Preliminary step tests and column step test design
- Functional Design Specification
- Fractionator column step tests and model identification
- Controller simulation and testing
- Operator Training
- Commissioning and tuning.

Most of these activities are done on-site using the actual plant DeltaV system and tools. For a single Fractionator column, with good performing regulatory controls, the SmartProcess application can be implemented in about 4 to 6 weeks from kickoff meeting to on-line operation.

## Optional Engineering Services

Emerson, through our field services offices and Local Business Partners offer a full range of services to assist our clients with their automation systems. Clients have the option of performing some of the work internally or requesting support from Emerson. Some examples of optional services which are often included as part of a SmartProcess implementation project include:

- Graphics Development: Custom APC operator screens or displays, modifications to existing displays.
- P&ID Review and Control Strategy Recommendations: In some situations, Emerson's consultants can review P&ID's prior to construction and recommend modifications to the regulatory control strategies for improved performance.
- New Instrumentation or Analyzers: At times, a SmartProcess application will justify installing additional instrumentation or on-line analyzers.
- Regulatory Control Improvement: As part of the SmartProcess implementation process, Emerson's consultant will identify any malfunctioning or poorly performing instrumentation, valves and control loops. However, engineering services to analyze the issue, troubleshoot and correct the problems are additional.

## DeltaV Hardware and Software

SmartProcess Fractionator applications are standard DeltaV modules that can be implemented in either a controller or an application station. The additional load these APC modules place on a DeltaV system is expected to be nominal, since the execution frequency for the APC functions is typically much slower than the regulatory controls and can therefore be implemented on the existing platform without any additional hardware investment. For more heavily loaded systems, Emerson can advise of recommended changes.

Licenses for the DeltaV APC tools (PredictPro and Neural) are bundled with the SmartProcess Application Library modules as described below

## SmartProcess Fractionator License

The SmartProcess Fractionator is licensed on a per-unit basis. On installation of the software, a standard "click-wrap" license agreement stipulates the terms of the license and restricts use to the specific columns for which it was licensed.

Licenses for the DeltaV APC tools are bundled with the SmartProcess application and include the following embedded products:

- DeltaV PredictPro – Up to 15 MV's per column
- DeltaV Neural – Up to 2 Neural modules per column

## System Compatibility

SmartProcess Fractionator applications are available on DeltaV v11.3 and higher systems.

## Ordering Information

Description	Model Number
SmartProcess Fractionation for One Column; Includes 1 Base License, 15 DeltaV PredictPro Output (MV) licenses, 2 DeltaV Neural licenses, SmartProcess Fractionation Library, and Configuration Guidelines.	VF1046B1C1
SmartProcess Fractionation for Two Columns; Includes 1 Base License, 1 Extension License, 30 DeltaV PredictPro Output (MV) licenses, 4 DeltaV Neural licenses, SmartProcess Fractionation Library, and Configuration Guidelines.	VF1046B1C2
SmartProcess Fractionation for Three Columns; Includes 1 Base License, 2 Extension Licenses, 45 DeltaV PredictPro Output (MV) licenses, 6 DeltaV Neural licenses, SmartProcess Fractionation Library, and Configuration Guidelines.	VF1046B1C3
SmartProcess Fractionation for Four Columns; Includes 1 Base License, 3 Extension Licenses, 60 DeltaV PredictPro Output (MV) licenses, 8 DeltaV Neural licenses, SmartProcess Fractionation Library, and Configuration Guidelines.	VF1046B1C4
SmartProcess Fractionation License – Extension License for additional Column(s). (Includes 15 DeltaV PredictPro Output (MV) licenses, 2 DeltaV Neural licenses for each quantity ordered)	VF1046E1
Annual SmartProcess Fractionation Application Support – Base License	VF1046S1
Annual SmartProcess Fractionation Application Support- Extension License	VF1046S2

## Related Products

- **Control Performance Consulting Studies:** It is a well-proven fact that performance of the regulatory control system, from sensor to valve, is critical for safe and reliable plant operations and realizing benefits of Advanced Process Control strategies. Whether it is caused by malfunctioning control devices or poor loop tuning, Emerson's consultants have the experience and skills to identify, troubleshoot and correct any control-related issues.
- **SmartProcessFractionator Annual Support:** Guaranteed access to new versions, enhancements and updated documentation. With an Application Support agreement, you can rest assured that expert help is only a phone call away and your SmartProcess Fractionator will remain current with Don't insert any section breaks after prerequisites. The last page footer should be different and contain all of the contact and copyright information!

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