

SmartProcess™ Blend



Enhance the process control of continuous in-line blenders by using Emerson's SmartProcess Blend package

- Additional blender capacity.
- Minimize quality giveaways (from specification or deviation from schedule targets).
- Reduce touchups and re-blends.
- Lower inventory requirements.
- Increase capacity to produce higher-value blends.
- More effective use of components.
- Lower costs of implementation.

Introduction

Typically, refiners use linear programming (LP) tools to plan the refinery crude runs, production slates and product blending requirements. These tools produce average targets for the blending pool and predict component production over a fixed period, sometimes several periods. The targets from the Monthly Planning LP's are optimal, but they are based on aggregate models and represent an average over the whole period. These monthly plans provide guidelines about where to end up at the end of each period, but not necessarily how to get there. Scheduling systems often have a finer level of detail, but they also assume that all components and heels will be of certain product quality. In reality, what actually exists in the plant rarely matches all assumptions.

Emerson's SmartProcess Blend package is a comprehensive in-line blending control system that provides a tight link between the refinery's blend schedulers and the blend operators. The system assists the operator in managing, controlling, optimizing and reporting on all blend operations all in an integrated DCS environment.

Benefits

Off-spec blends have wide implications for a refiner. Correcting a blend after it is made ties up equipment, people, tankage and sometimes jetties and ships. Often in the process, more high-value components are used just for expediency and contingency. Using more valuable components affects the overall refinery yield slate and can create an imbalance in the components for future blends.

Emerson's SmartProcess Blend package includes complete regulatory control and optimization of an automated blend process using such features as closed-loop quality control and heel compensation, so re-blends can be reduced by ensuring blends meet specifications the first time.

Increasing gasoline and diesel regulations call for tighter quality specifications, more components and more product grades. To deal with this complexity and the uncertainty in component quality, schedulers and operators tend to "play it safe" and operate with a comfortable safety margin above specification. This quality "giveaway" can be very expensive. Emerson's SmartProcess Blend package uses on-line analyzers to continually trim the recipe to achieve the desired final product specification while minimizing deviation from the planner's recipe. In this way, components which are planned for future blends are saved for that purpose and not used to correct errors in the current one.

Manual start up sequences for blenders can be time consuming and error prone, particularly when multiple blenders share equipment. A minor lineup error can have significant quality and safety consequences. Emerson's SmartProcess Blend package includes fully or partially automated lineups, with equipment interlocks, ramp up, ramp down sequences and continuous route integrity checks. The system includes a centralized fail alert system that can automatically shut down a blend if a problem is encountered.

Emerson Process Management has the process expertise and engineering experience to provide a turnkey solution. The project can be a new blend control or a revamp of an existing one, and Emerson's capabilities include design, construction and installation of a fully instrumented, skid-mounted, in-line blenders, analyzer houses and sample systems.

Emerson has delivered blend control optimization applications to refineries, terminals and blending facilities around the world.

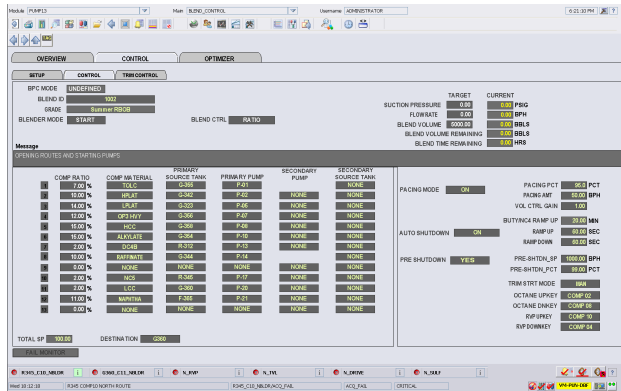
Product Description

Emerson's SmartProcess Blend package is a complete, integrated suite of applications native to the DeltaV platform. There is no custom hardware or software. The application covers all activities from blend scheduling and optimization to on-line control of the final blend properties. The system is designed as a set of generic templates that are configured to meet the specific refinery's blending needs. The system is capable of handling complex blending requirements such as those required for reformulated gasoline – with multiple headers, up to 25 components and up to 25 quality specifications – but it can also be used for simple, recipe-based ratio blending. The full package is built on a modular design that provides the ability to select the necessary modules as needed to meet particular project requirements. The main modules included in the Blending suite are:

- Regulatory Controls
- Routes
- Quality Control
- Order Management
- Off-line Optimization
- On-Line Optimization
- Tank Quality Integration
- Analyzer Interfaces

Blend Regulatory Control

The Blend Regulatory Control modules automate the blend startup, operation and shutdown sequences. The blend sequence performs the lineups, ramping, pacing and ratio control functions. Blend recipes can specify a primary and secondary component tank and DeltaV blend controls can perform a "flying tank" switch during a blend. At the end of the blend, when blend target amount is reached, the module automatically stops the blend in the required manner (for example a preshutdown level can be specified). The system is designed to handle multiple blenders operating concurrently with some common (shared) equipment.



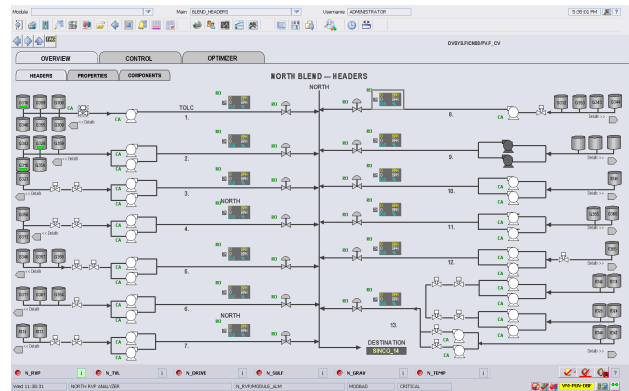
Example Main screen for initiating or terminating a blend.

The Blend Regulatory Control module can be operated in a number of different modes:

- Ratio Control – Component ratios are set by the operator and used to set the component flow controller based on the Master Flow target.
- Volume Control – Component flows are adjusted to control the totalizer ratios to their target values. This allows the system to compensate for starting or pacing conditions that have caused the aggregate ratios to deviate from their desired target.
- Quality Control – Optional module to control key qualities using a predictive controller with on-line analyzer feedback.
- Optimization – Optional module to control and optimize up to 25 qualities in either the header or the finished product tank, compensating for the heel material.

Routes

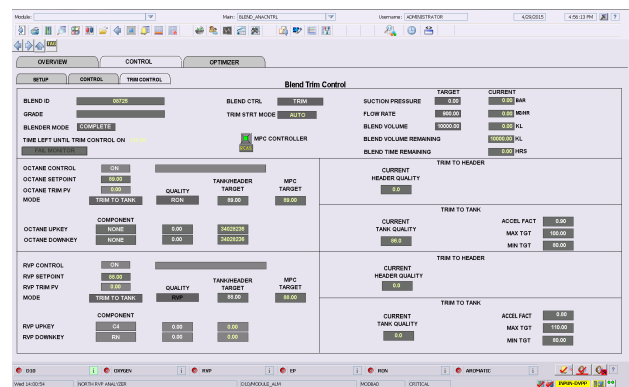
When multiple blenders are involved, component and finished product tanks, pumps, valves, and lines can often be shared between blend headers. Emerson’s Route module performs the sequencing and interlocks for lining up the component and finished product tanks to the blend headers. The main blend sequence initiates the opening or closing of routes based on the tanks and blend header included in the recipe. The route module then checks the state of the devices in the route and handles the execution of the sequence for operating a route. Interlocks are provided in special pump and valve equipment modules to preserve the equipment in a particular state so as to prevent contamination when the route has been opened. An example of a Route display is provided in the following figure.



Example of a Route Module display

Quality Control

The Quality Control module provides predictive control of the blend header for up to 2 blend qualities. This function utilizes on-line analyzers on the blend header to adjust configurable ratios for each of the target qualities. The Quality Control module utilizes the embedded DeltaV PredictPro Model Predictive Control (MPC) block for manipulating the key ratios. This MPC block automatically handles the interactions between components to achieve stable control of both qualities.



Example display from the Quality Control module

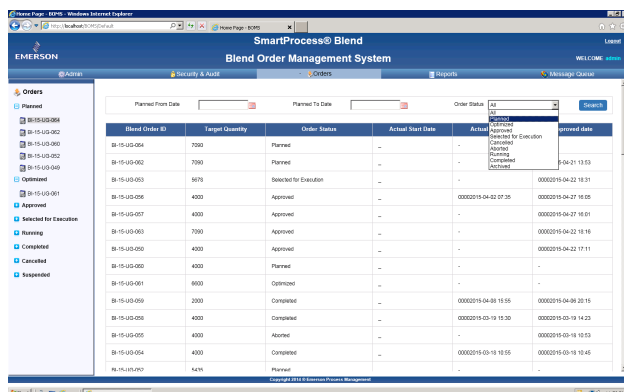
Blend Order Management

The Blend Order Management application provides the link between the blend planners or schedulers and the operators in the control room. Starting with a planned blend order, the system provides a web-based, multi-language interface to create, optimize and track blend orders through the system. The system can be integrated to most blend planning and scheduling systems using XML. Approved orders and recipes for forecasted product shipments are downloaded to the Blend Order Management system from the scheduler. These recipes are the initial starting point for the Blend Optimization module. The recipes are checked initially for feasibility and flagged if problems are detected.

Blend orders are managed throughout their life cycle using a set of folders that represent the different states of an order: Planned, Optimized, Approved, Selected for Execution, Running, or Completed. The Blend Order record is updated automatically from DeltaV as the order moves through each state.

The Blend Order Management system provides the user interface to the Off-line Blend Optimizer. A Blend Scheduler can load the current component qualities, costs and availabilities, and run an off-line case to adjust the planned recipe to meet specifications. When the scheduler is happy with the result, the blend order is approved and becomes available to the control room operators to execute.

From DeltaV consoles, operators can select orders from the list of approved blend orders for setup and execution by DeltaV. Once the blend order has been started in DeltaV, the state goes to “Running”. When the blend is complete, the system automatically captures the actual blend results, changes the state to “Complete” and stores the data in the Blend Order database.



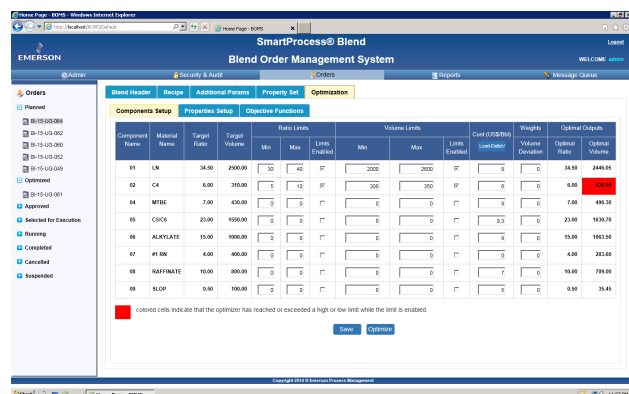
Example query screen from the Blend Order Management

A final blend report is generated automatically by the blend reporting system. Additional preconfigured reports are available in the system including Actual versus planned component usage, quality giveaway, equipment utilization, and production against targets. The system maintains a history of the Blend Orders and is able to display and report on a variety of views for this data. The reporting tool can summarize blends by period of time, product, blender, and other sort criteria. The system also provides useful reports on tanks (e.g. quantities, products, qualities) and configuration data as well (e.g. list of products, qualities, etc. defined in the system).

Off-Line Optimization

An optional Offline Blend Optimizer is provided to support “what-if” calculations by the blend scheduler or operator. The objective for this optimizer is to calculate optimum blend recipe for a given batch based on entered component properties, economics, and available inventories. It uses the same optimization algorithm, blend models, objective functions and constraints as the On-Line optimizer.

The system allows the user to load the current tank data in DeltaV, modify any of the inputs, limits, costs, etc. and select from multiple objective functions. The user can execute the optimizer and run “what-if” cases. Using an intuitive interface, a user can easily identify which constraints or limits are active in the solution and whether the problem is feasible or not.



Component Constraint page from the off-line optimizer

On-Line Optimization

The On-Line Optimization module utilizes a non-linear optimization algorithm to calculate the set of component ratios subject to quality and component availability constraints that best achieves (the optimum) an objective function selected by the operator. The On-Line Optimizer can be operated in either one of two modes:

- Final Batch – Blending to a tank with existing material (a heel) where the final total batch quality is on target.
- Continuous – Blending to a destination (loading point – pipeline or ship) where the instantaneous header quality must always be on target.

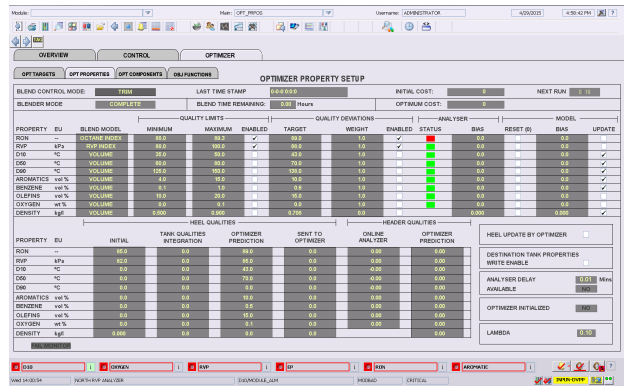
The On-Line Optimization module is designed to use analyzer feedback to update the optimizer quality predictions to compensate for variations in the actual component qualities. It uses the same non-linear blend models used by the Off-line Blend Optimizer. Header quality targets are included in the blend order, but can either be manually adjusted by the operator.

The objective function used by the optimizer can be configurable based on a combination of 1 to 4 different penalty functions each with weighting factors that can be adjusted by the planner: The 4 penalties include:

1. Minimize the weighted deviation from original planned recipe.
2. Minimize total batch cost.
3. Minimize weighted deviation from planned component utilization in the batch.
4. Minimize quality giveaway.

The optimizer is also set up to observe the following constraints:

- Max/min ratios for each component
- Max/min quality limits on header outlet
- Max/min availability of components in the batch



Blend On-line Optimization module display

Tank Quality Integration

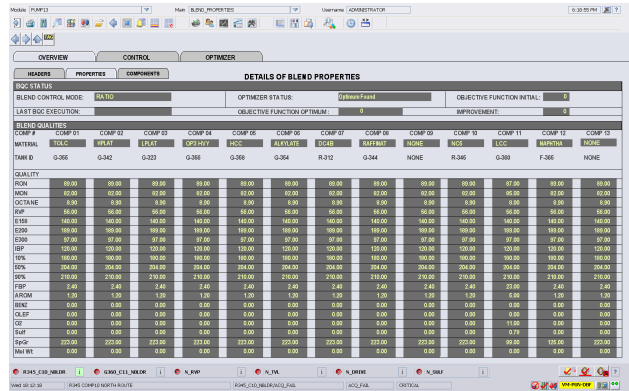
The SmartProcess Tank modules are integrated with the blender application to provide operator access to tank levels, volumes and quality information. Tank property sets maintain the best estimate of all the qualities in each tank, either from the laboratory or from the Tank Quality Integration module. The Quality Integration module utilizes available on-line analyzers, current tank inventory and blend flow to integrate tank qualities using standard blend models. Where on-line analyzers are not available, predicted qualities from the optimizer or laboratory data may be used. The system automatically accommodates bad analyzer data and disables controls and quality calculations when an on-line analyzer fails. If laboratory updates are available, the Tank Quality Integration resets to start integrating from this point forward.

A Tank Properties display provides the operator with a matrix format showing all of the current qualities for the tanks used in the blend setup. An example Tank Property screen is shown at the right.

Analyzer Interfaces

The SmartProcess Blend includes a number of analyzer interfaces – from FTNIR, to RVP, Distillation, Sulfur and Density. Others can be easily accommodated.

Furthermore, these analyzers can be configured to accomplish inline blend certification – ILBC.



Tank Quality Integration screen

Certified Consultant Engineering Services

Emerson has a number of Certified Solutions Consultants within its offices around the world. For each SmartProcess® project a Certified Consultant will be assigned to provide technical leadership throughout project implementation. Emerson will accept turn-key responsibility for the engineering services to design, configure, install and commission a complete SmartProcess Blend solution. At the start of a project, the Certified Consultant will review the instrumentation, operations, constraints and economics to design a blend control and optimization system, benchmark current performance and prepare a project execution plan.

Blend projects are implemented by one of the Emerson Engineering centers, depending on the geographical location of the end user. In addition to the Certified Consultant, a lead engineer will be assigned to manage the hardware, software, system integration and engineering teams. Once a design has been approved, the DeltaV system configuration can begin under the oversight of the lead engineer and the Certified Consultant.

Optional Engineering Services

Emerson, through our field services offices and Local Business Partners, offers a full range of services to assist our customers with their automation systems. Because our SmartProcess Blend modules are standard DeltaV applications, customers 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:

- Control Performance Audit – Review performance and troubleshoot field devices and control loops.
- Analyzer Systems – Review requirements, design procure and install on-line analyzers, sample systems, enclosures, houses.

SmartProcess Blend Annual Support

Through the Global Service Center, Emerson provides one-number call-in support for DeltaV and all of the Emerson-supplied equipment and software. Annual Support includes guaranteed access to new versions, enhancements and updated documentation along with unlimited telephone and remote support of the application. With an Application Support agreement, you can rest assured that expert help is only a phone call away and your SmartProcess Blend will remain current with future system upgrades. The first year SmartProcess® Blend support is required. Subsequent years are optional.

Hardware and Software Requirements

SmartProcess Blend control functions utilize standard DeltaV modules that can be redundant and executed in either a controller or an applications station.

Following are the typical software and hardware requirements for running the non-DeltaV software required for this solution.

The Blend Order Management and Off-line Optimizer (with LINGO platform) system are installed on a separate server grade machine with following hardware and software specifications.

Type	Requirement
Hardware	1 GHz or higher microprocessor
Hardware	512 MB or higher RAM
Hardware	2 GB or higher free hard-disk space
Hardware	SVGA or higher resolution video (1024 x 768 or greater)
Hardware	100-BaseT network transmission speed or better
Software	Microsoft® Windows® 2008 R2 (32 or 64 bit) (with current service packs)
Software	.NET framework 4.0 or higher
Software	IIS 7.5 (Internet Information Services)
Software	SQL Server 2008 R2 or higher
Software	Windows Installer 4.0 or higher (included in Operating System)
Software	Crystal Reports 13.0 Runtime
Software	Lingo14.0 for optimization function

A DeltaV Application station is also required for connecting DeltaV with the Blend Order Management server. This application station will include some web services and OPC client software as well as Microsoft IIS (Internet Information Systems). This application station will also have the LINGO online optimizer installed on it.

User access to the Blend Order Management system is through a Web-browser (Internet Explorer 9 or 10 only). Security is provided with user ID and passwords.

System Compatibility

SmartProcess Blend applications are available on DeltaV v11.3 and higher systems. The Blend Order Management and Optimization modules are only available on v12.3 and higher.

Ordering Information

Part Number	Description
VF1051B1H1	SmartProcess Blend Regulatory Control for first Header; Base License
VF1051E1H1	SmartProcess Blend Regulatory Control for Additional Headers; Extension License
VF1051B1T1	SmartProcess Blend Trim Control for first Header; Base License; Includes PredictPro with 2 MV's
VF1051E1T1	SmartProcess Blend Trim Control for Additional Headers; Extension License; Includes PredictPro with 2 MV's
VF1051B1R1	SmartProcess Blend Routes for first Header; Base License
VF1051E1R1	SmartProcess Blend Routes for Additional Headers; Extension License
VF1051B1A1	SmartProcess Blend Advanced Control for first Header; Base License; Includes On-line and offline Optimizer and Order Management
VF1051E1A1	SmartProcess Blend Advanced Control for Additional Headers; Extension License; Includes On-line and offline Optimizer and Blend Order Management
VF1051S1	Annual Application Support for SmartProcess Blend Regulatory Control for first blender;
VF1051S2	Annual Application Support for SmartProcess Blend Regulatory Control for additional blenders;
VF1051S3	Annual Application Support for SmartProcess Blend Trim Control for first blender
VF1051S4	Annual Application Support for SmartProcess Blend Trim Control for additional blenders
VF1051S5	Annual Application Support for SmartProcess Blend Advanced Control for first blender
VF1051S6	Annual Application Support for SmartProcess Blend Advanced Control for additional blenders

Related Products

- **MicroMotion Coriolis Meters:** Coriolis meters have proven very valuable in blender service due to their high accuracy, large turn-down ratio, minimal maintenance cost and direct mass and density measurements. Emerson's MicroMotion business is a leader in the Coriolis market with a broad offering and enhanced capabilities such as on-line meter verification.
- **Fisher Control Valves:** Accurate and reliable control of the components going to the blender is critical for producing quality batches according to plan. Emerson's Fisher business unit provides high quality control valves for every service.
- **Motor Operated Valves:** Emerson's TopWorx and Bettis business units provide the on-off valve and actuators needed to automate the tank lineup process for the blender.
- **Pump Health Monitoring:** Emerson's Pump Health Monitoring Solution combines process and equipment data as a single number, reporting pump health Indication for pump vibration, cavitation, bearing temperature, strainer plugging and seal fluid/hydrocarbon leaks.

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