

**ABB Advanced
Application Services**



**Oil Movements &
Blending**



ABB Oil Movement & Blending Applications

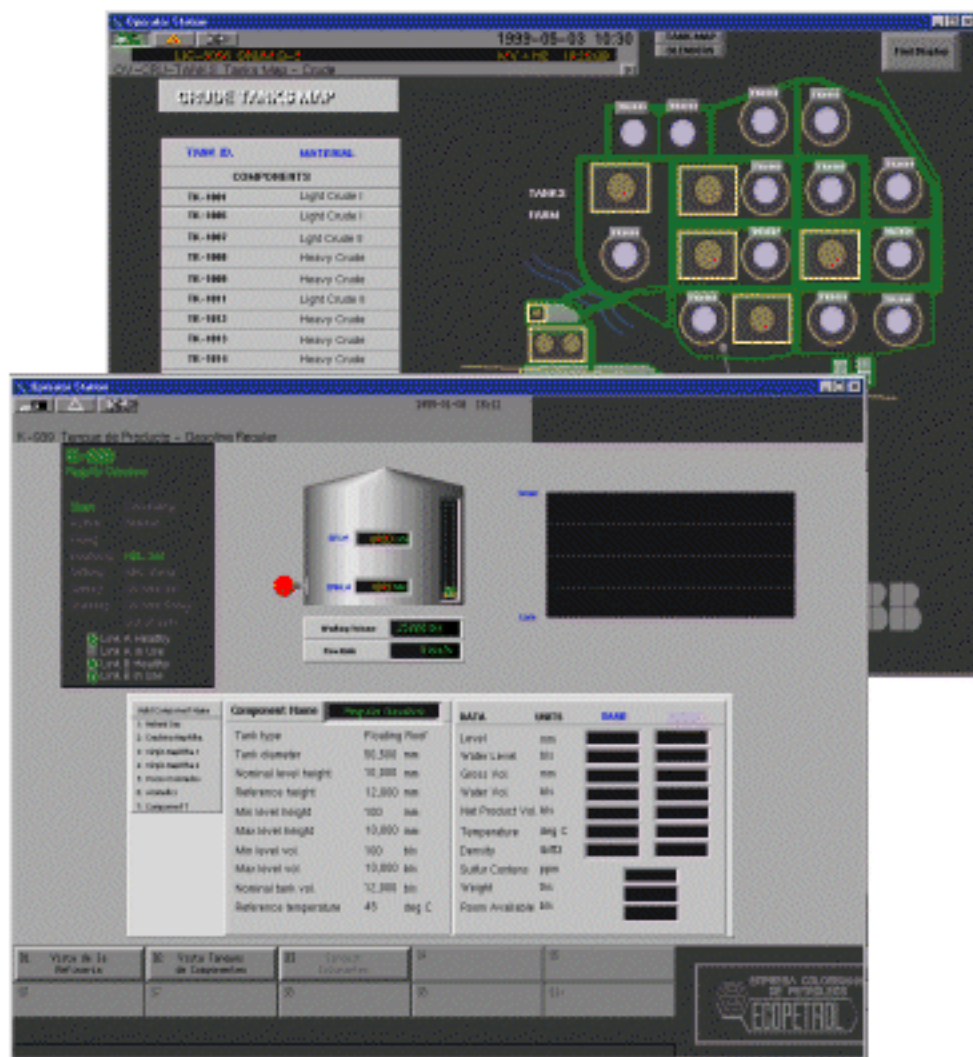
- **State-of-the-art OM&B Applications for Refinery Offsites and Terminal Tank Farms**
- **Experience & Global Reach**
 - >200 man-years of application engineering experience
 - gained over 30 projects, covering 70 blenders, in a dozen countries
- **Full-Scope, Closed-Loop Solutions comprising:**
 - Industrial IT DCS
 - all required field instrumentation
 - online analytical instrumentation
 - proprietary chemometric modeling technology
 - advanced blend property control & optimization
 - expert system movements automation
 - FEED through construction capability
 - Pay-for-Performance project financing

ABB OM&B Application Software Packages

- **TIMS** – *Tank Information Management*
- **RBC** – *Regulatory Blend Control*
- **ABC** – *Advanced Blend Control*
- **StarBlend** – *Offline Blend Planning*
- **iOM&S** – *Oil Movement & Storage*
- **CP&S** – *Crude Planning & Scheduling*

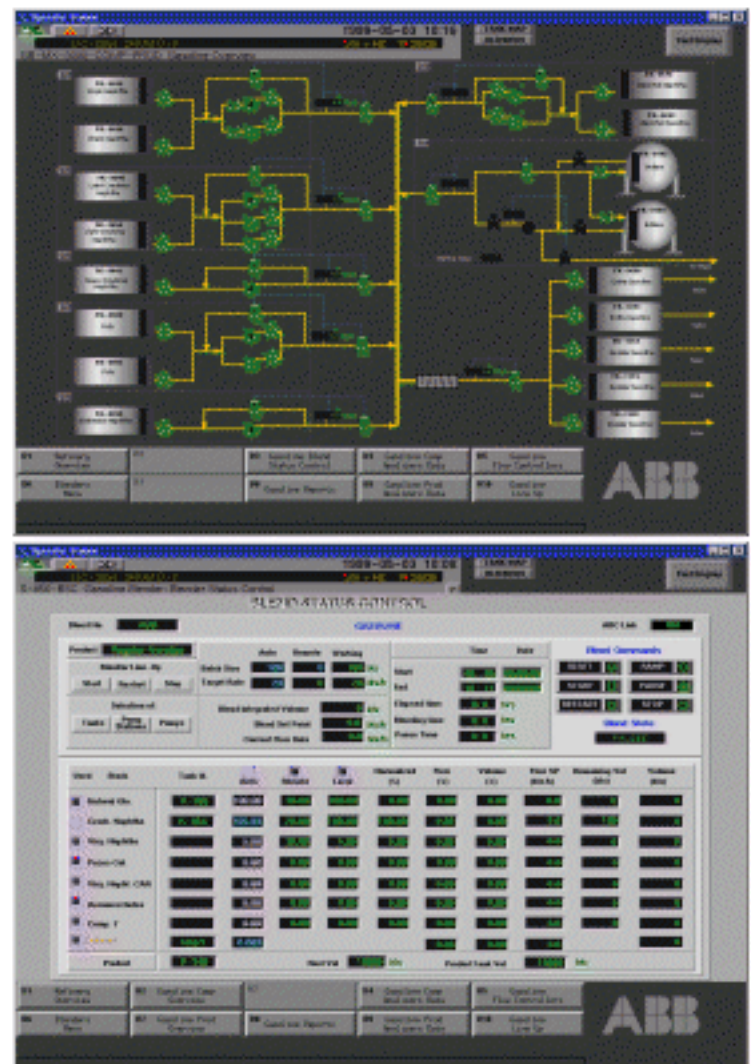
Tank Information Management System (TIMS)

- DCS-level interface to multiple tank gauging systems
- DCS &/or NT-based Operator Interface
- volume calculations from strapping tables or formulas
- ASTM/API volume correction
- gross/net volumes & capacities
- operating states



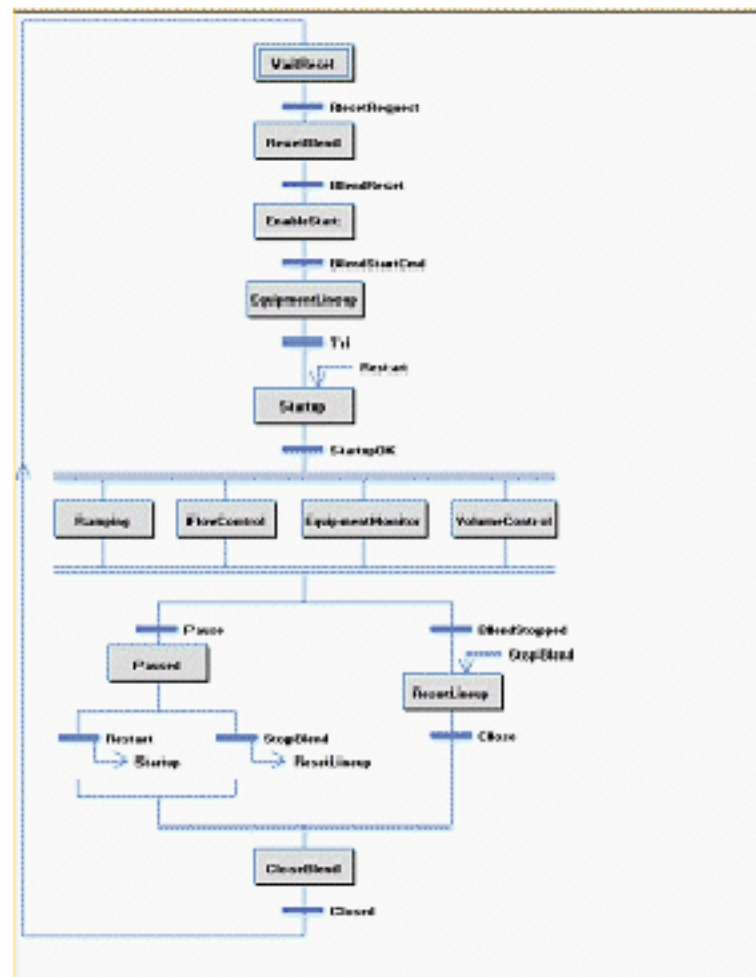
Regulatory Blend Control (RBC)

- standard configuration & programming for Advant, Symphony, & Industrial-IT DCS
- manual or automatic line-up
- automatic sequential control for start-up, ramps, and shutdown
- flow ratio control
- pacing control
- built-in simulator for testing and operator training



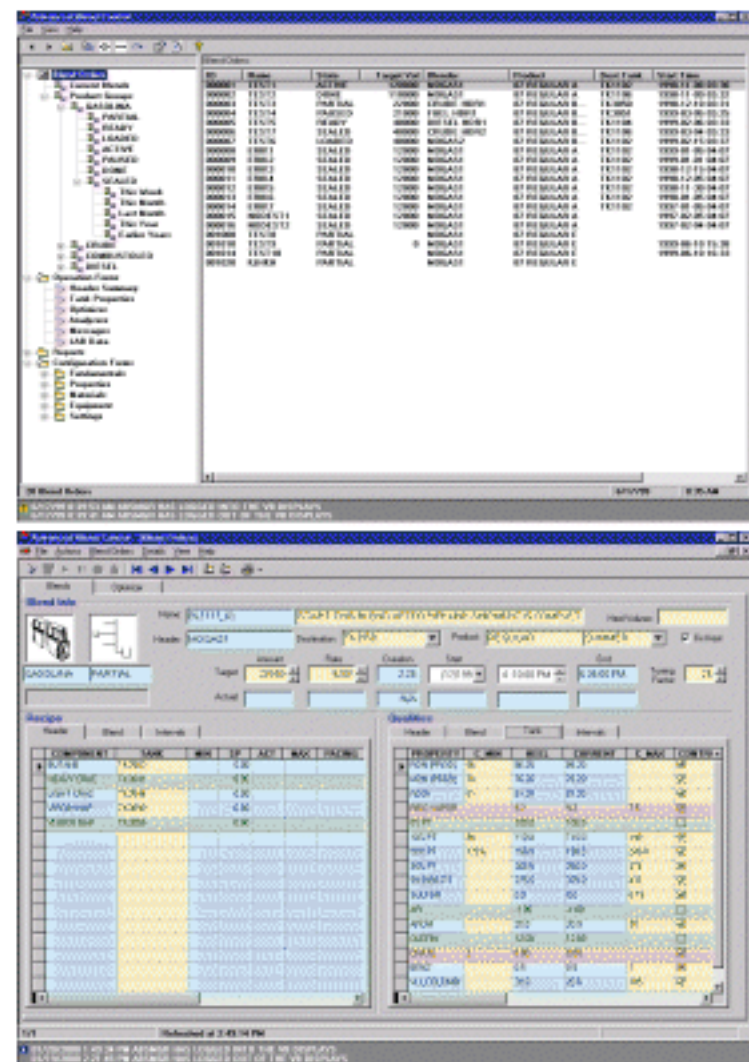
RBC for Industrial IT AC800M & Operate IT

- ABB's IIT DCS Technology
- Aspects & Objects
- Built-in OPC connectivity
- Full implementation of IEC 61131-3 standards (SFC, ST, & "blockware" used)
- Revision control via Control Builder Control Modules, not monolithic compiled code
- Offline, closed-loop testing via soft controller



Advanced Blending Control (ABC) Package

- Native-Windows, client-server design:
 - Oracle relational database
 - Visual Basic HMI
 - nonlinear optimization
- Comprehensive operations tool for:
 - offline planning
 - blend & general transfer order management
 - physical movement line-up
 - pre-blend optimization
 - optimal online control
 - monitoring & reporting
- Supports its own configuration & maintenance



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Advanced Blend Control

File View Help

Blend Orders

- Current Blends
- Product Groups
 - GASOLINA
 - PARTIAL
 - READY
 - LOADED
 - ACTIVE
 - PAUSED
 - DONE
 - SEALED
 - This Week
 - This Month
 - Last Month
 - This Year
 - Earlier Years
 - CRUDE
 - COMBUSTOLEO
 - DIESEL
- Operation Forms
 - Header Summary
 - Tank Properties
 - Optimizer
 - Analyzers
 - Messages
 - LAB Data
- Reports
- Configuration Forms
 - Fundamentals
 - Properties
 - Materials
 - Equipment
 - Settings

Blend Orders:

ID	Name	State	Target Vol	Blender	Product	Dest Tank	Start Time
000001	TEST1	ACTIVE	120000	MOGAS1	87 REGULAR A	TK1102	1998-11-08 03:30
000002	TEST2	DONE	110000	MOGAS1	87 REGULAR A	TK1106	1998-11-09 03:32
000003	TEST3	PARTIAL	22000	CRUDE HDR1	87 REGULAR B...	TK3050	1998-12-10 03:31
000004	TEST4	PAUSED	21000	FUEL HDR1	87 REGULAR B...	TK3051	1999-03-05 03:25
000005	TEST5	READY	40000	DIESEL HDR1	87 REGULAR B...	TK1104	1999-02-06 03:33
000006	TEST7	SEALED	40000	CRUDE HDR2	87 REGULAR B...	TK1106	1999-03-04 03:33
000007	TEST6	LOADED	40000	MOGAS2	87 REGULAR B...	TK1102	1999-02-15 03:37
000008	ERIK1	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1999-01-05 04:07
000009	ERIK2	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1999-01-01 04:07
000010	ERIK3	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1998-12-15 04:07
000011	ERIK4	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1998-12-05 04:07
000012	ERIK5	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1998-11-30 04:07
000013	ERIK6	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1998-01-05 04:07
000014	ERIK7	SEALED	12000	MOGAS1	87 REGULAR A	TK1102	1997-01-05 04:07
000015	NODEST1	SEALED	12000	MOGAS1	87 REGULAR A		1997-02-05 04:07
000016	NODEST2	SEALED	12000	MOGAS1	87 REGULAR A		1997-02-04 04:07
001008	TEST8	PARTIAL		MOGAS1	87 REGULAR E		
001010	TEST9	PARTIAL	0	MOGAS1	87 REGULAR E		1999-06-10 15:38
001014	TEST10	PARTIAL		MOGAS1	87 REGULAR E		1999-06-10 16:33
001020	KJHKH	PARTIAL		MOGAS1	87 REGULAR E		

20 Blend Orders

6/17/99 8:39:53 AM AB5MGR HAS LOGGED INTO THE VB DISPLAYS

6/17/99 8:39:41 AM AB5MGR HAS LOGGED OUT OF THE VB DISPLAYS

ABC Navigator Display

Tank Name: TK1102

In Service? ☒ YES

Material Name: REGULAR

Available Volume: 9

Product Group Name: GASOLINA

Last Read Time:

LAB TANK PROPERTIES DATA							
	PROPERTY	MIN	MAX	NEW VALUE	SAMPLE TIME	CURRENT VALUE	CURRENT TIME
	RON (PROD)	75	95	93.10		94.20	01/20/2000 3:27:42 PM
	MON (PROD)	60	85	82.10		83.00	04/05/1999 12:02:00 PM
	RDOI	70	95	87.60		84.00	04/05/1999 12:02:00 PM
	REID VAPOR P	5	18	71.2		7.0	04/05/1999 12:02:00 PM
	0% PT	100	400			124.3	01/20/2000 3:30:09 PM
	10% PT	70	200			160.2	01/20/2000 3:30:09 PM
	50% PT	125	350			218.2	01/20/2000 3:30:09 PM
	90% PT	0	425			367.1	01/20/2000 3:30:10 PM
	99.999% PT	375	450			432.0	01/20/2000 3:30:10 PM
	SULFUR	0	25	0.04		0.01	01/20/2000 3:30:10 PM
▶	API	-1	120			30.00	04/05/1999 12:02:00 PM
	AROM	0	50			30.0	04/05/1999 12:02:00 PM
	OLEFIN	0	50			9.00	04/05/1999 12:02:00 PM
	OXATE	0	100			8.00	04/05/1999 12:02:00 PM
	BENZ	0	5				
	VLI_COLOMBIA	20	110				
	E_V70C	5	40				

File View Help

Blend Orders

- Current Blends
- Product Groups
 - GASOLINA
 - CRUDO
 - COMBUSTOLEO
 - ACPM

Movement Orders

- Current Movements
- Product Groups
 - GASOLINA
 - TANK TRANSFER
 - CIRCULATION
 - RECEIPT
 - RUNDOWN
 - FEED
 - SHIPMENT
 - CRUDO
 - COMBUSTOLEO
 - ACPM

Operation Forms

- Storage & Line Properties
- Optimizer
- Analyzers
- Messages
- LAB Data

Reports

Configuration Forms

- Tags
- Fundamentals
- Properties
- Materials
- Equipment
- LIMS
- Movements
- Administration

Movement Orders:

ID	Name	State	Target...	Material	Source	Destination	Start Time	End Time
000146	MO-MAY10....	PARCIAL	10000	VIRGIN NAP	TK-3090	TK-3054	2002-05-10 14:05	
000145	MO-MAY10....	TERMI...	10000	VIRGIN NAP	TK-3055	TK-3090	2002-05-10 13:52	2002-05-10 14:05
000144	MO-MAY10....	TERMI...	10000	VIRGIN NAP	TK-3090	TK-3054	2002-05-10 13:48	2002-05-10 13:48
000143	MO-MAY09....	PARCIAL	10000	VIRGIN NAP	TK-3090	TK-3054	2002-05-09 17:04	
000139	JORTIZI	ACTIVE	10000	VIRGIN NAP	TK-3055	TK-3090	2002-05-10 10:52	2002-05-10 11:20
000138	MO-MAY08....	PARCIAL	10000	VIRGIN NAP	TK-3090	TK-3054	2002-05-08 09:56	
000126	HELLO	PARCIAL		VIRGIN NAP	DELETEME	NADIM	2002-05-01 10:47	
000125	NADIM MO...	TERMI...	10000	VIRGIN NAP	TK-3055	TK-3090	2002-05-10 12:30	

Select a Lineup

File Help

Lineup Name: NL3
Lineup Volume:
Default Lineup:

Source: DELETEME

Destination: NADIM

Isolation Valves:

Name	Type
MOV3	MOV
MOV4	MOV
MOV5	MOV
MOV6	MOV

In-Line Valves:

Name	Type
MOV1	MOV
MOV2	MOV

Pumps:

Name
GB-P-3400

OK Cancel

9 Orders LAB

6/5/02 5:56:56 PM ABSMGR HA ACCESADO A LOS DISPLAY DEL VB

ABC OMM Display

ABC Blend Optimization

- **Objective:**

- maximize profit,
- minimize give-away, &/or
- minimize recipe deviation

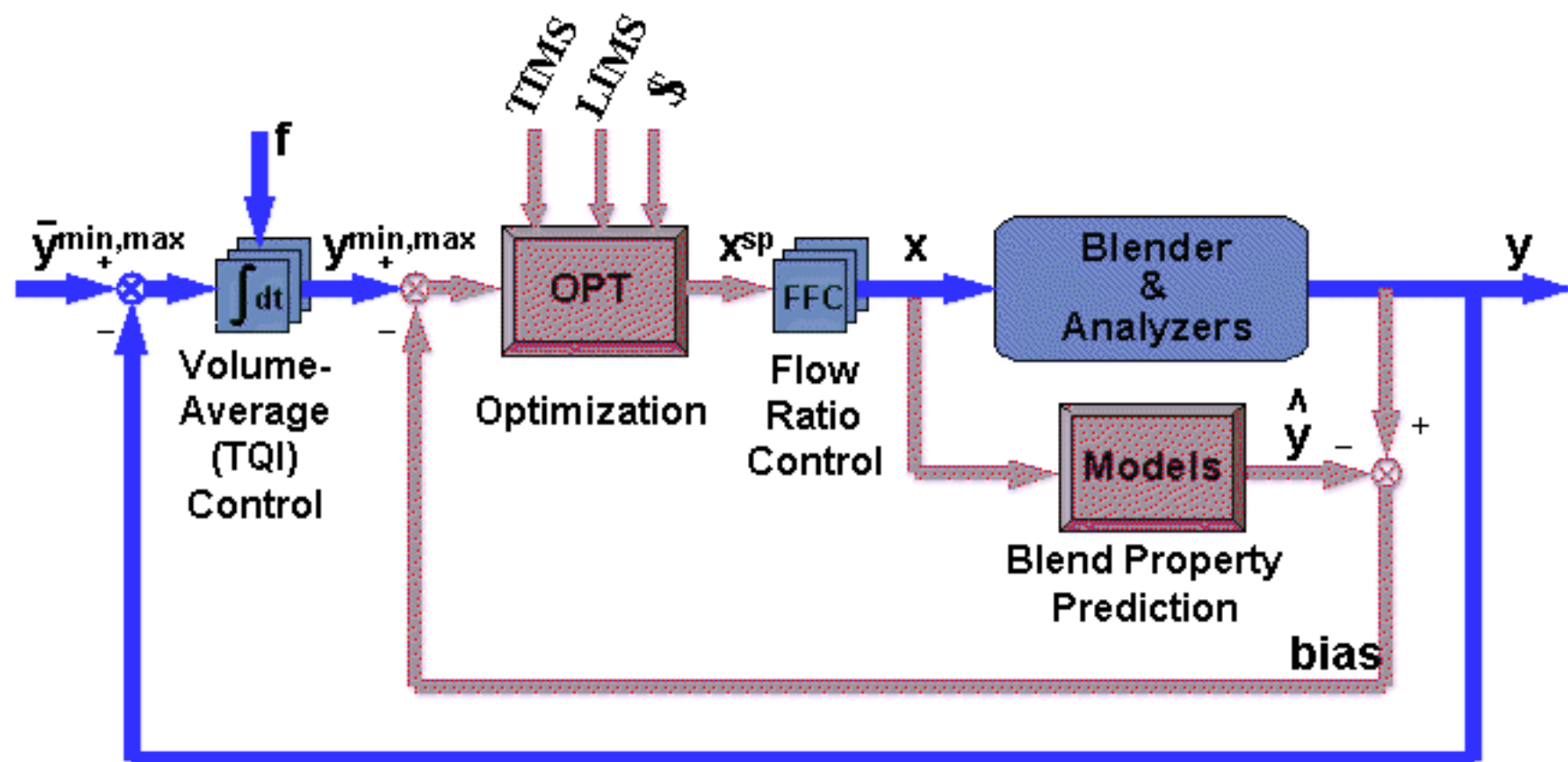
- **Subject to Constraints:**

- planner/operator recipe limits
(simple bounds)
- physical tank inventory/pump capacity/
rundown mass balance limits
(can further constrain recipe)
- product property specs
(nonlinear property correlations)

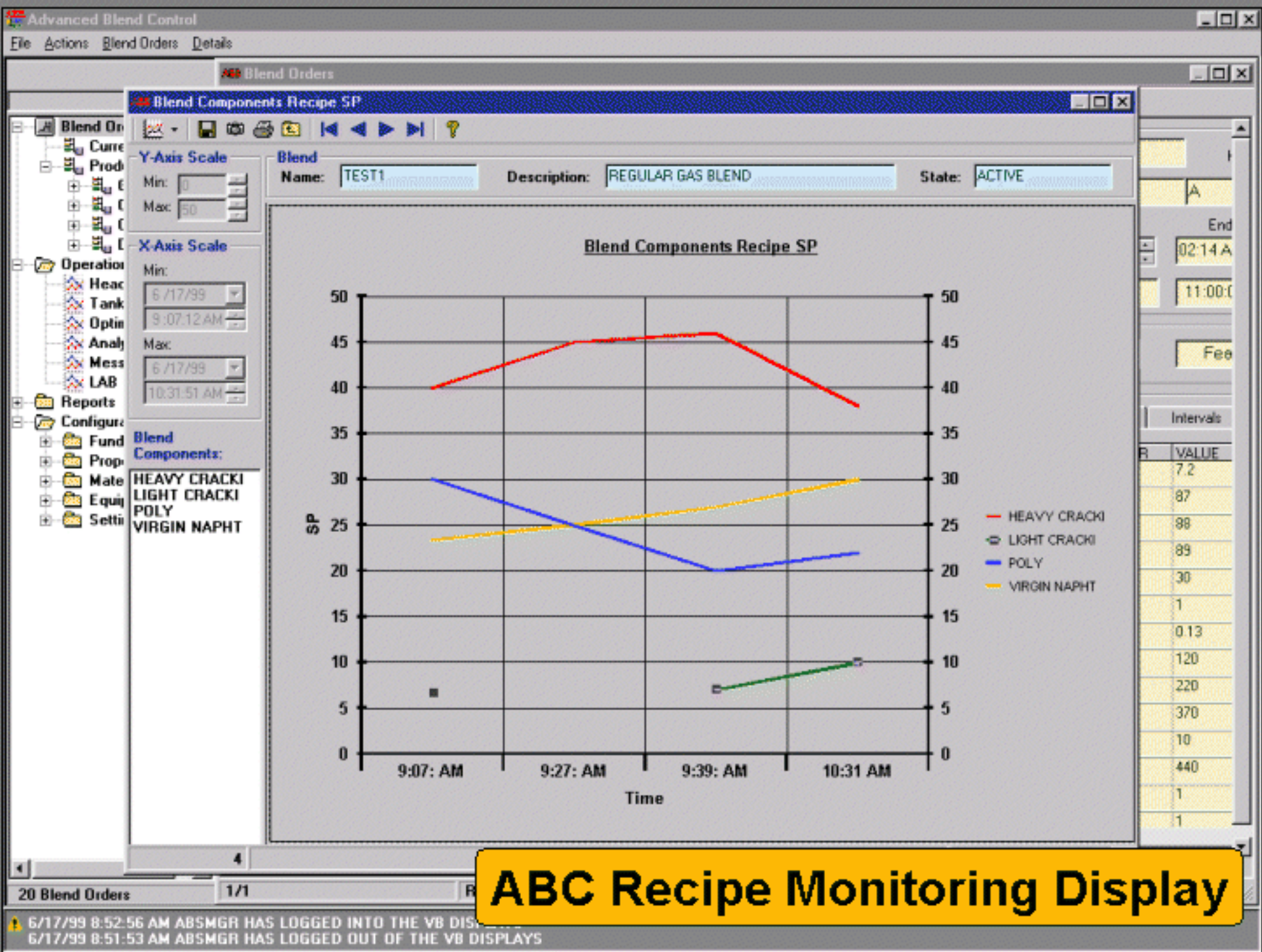
ABC Blend Optimization Features

- Objective to maximize profit, minimize give-away, &/or minimize recipe deviation
- GAMS nonlinear modeling/solution technology
- Utilizes StarBlend GAMS formulation for consistency when offered with offline planner
- User-tunable heel correction rate smoothes transition at on-spec volume
- Multi-header/multi-period formulation allows individual or global optimization
- Can be extended to incorporate future blends

ABC Online Optimization/Control

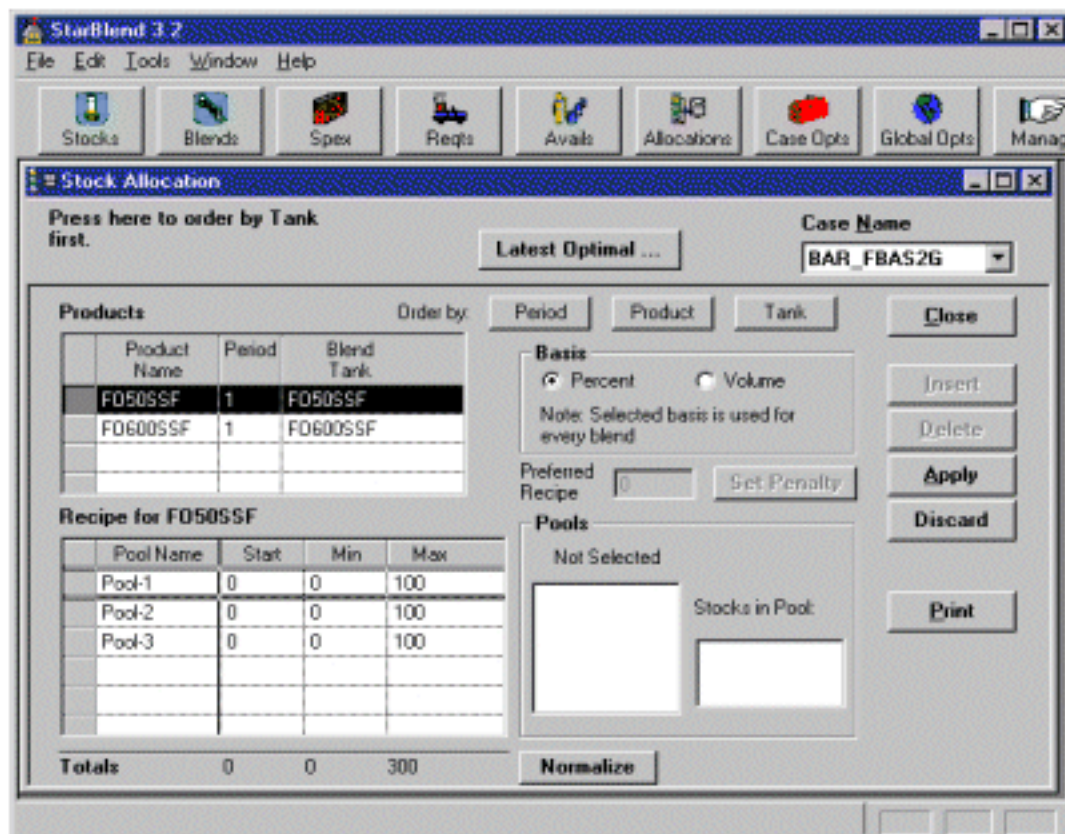


y = Property Vector	f = Blend Flowrate
x = Component Ratio Vector	$\hat{}$ = Model Dependent
d = Disturbance Vector	$-$ = Volume Averaged



StarBlend™ Offline Blend Planning

- Equiva (Shell) offline application
- Creates optimized plans for multiple blends across multiple time periods
- Integrates with ABC to automatically create blend orders



EQUIVA
SERVICES LLC

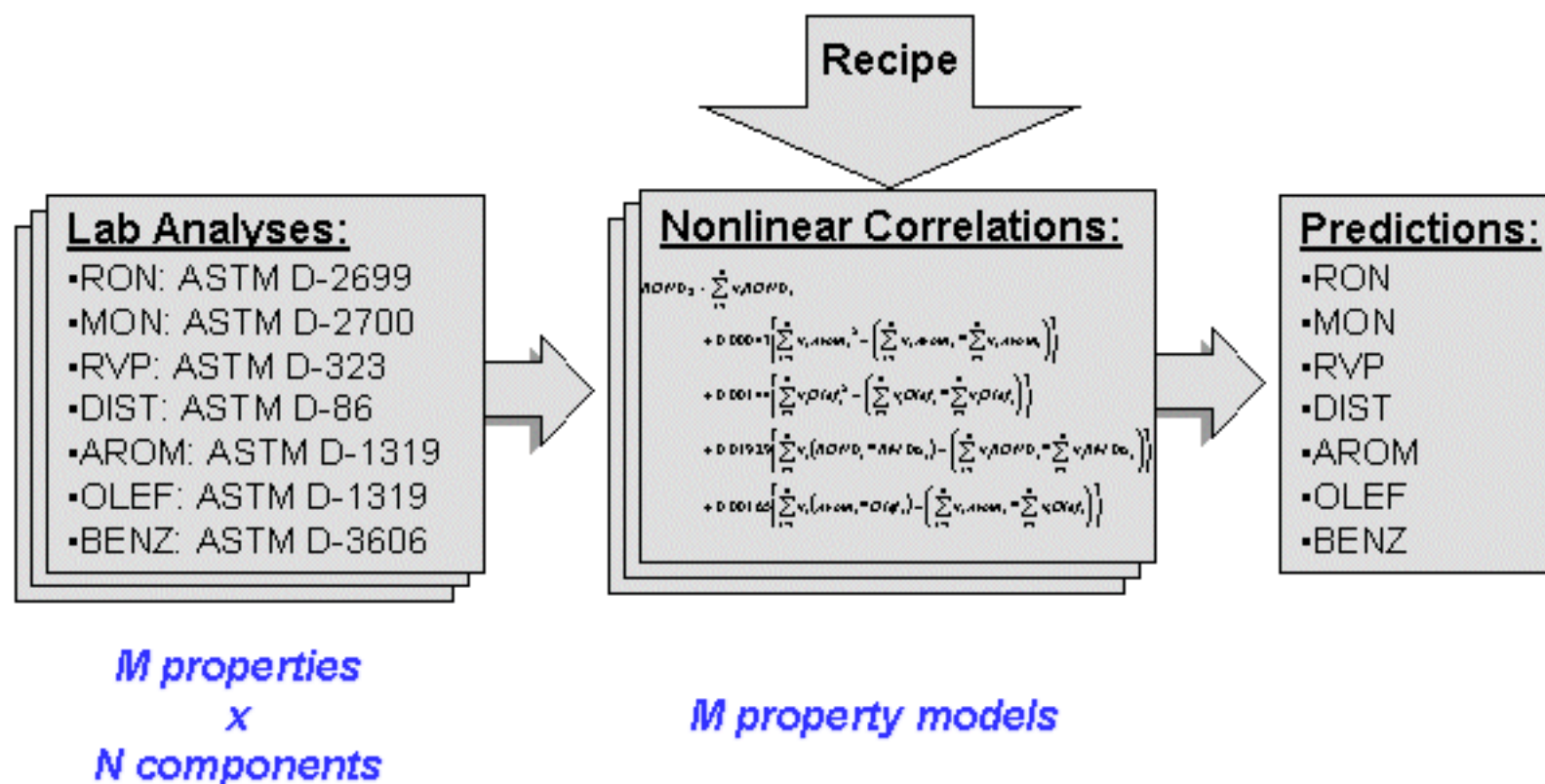


ABC Blend Optimization Models

- **Library of standard models**
 - conventional linear, index, interaction, Ethyl RT-70
 - generic & property-specific (e.g., cetane, VLI)
 - EPA & CARB models
- **Refinery site-specific models**
 - user-defined coefficients for standard correlation structures
 - client-proprietary structures added to GAMSware
- **Optional Topnir spectral blend models**
 - ABB-proprietary and patented technology
 - Exploits richness of component FTIR spectra to improve accuracy of blended property predictions
 - Approach virtually eliminates the need for conventional lab analyses of component stocks
 - Can provide recipe-independent, linear blend indices to higher level planning & scheduling systems



Conventional Blend Model Prediction



Topnir Spectral Blend Model Prediction

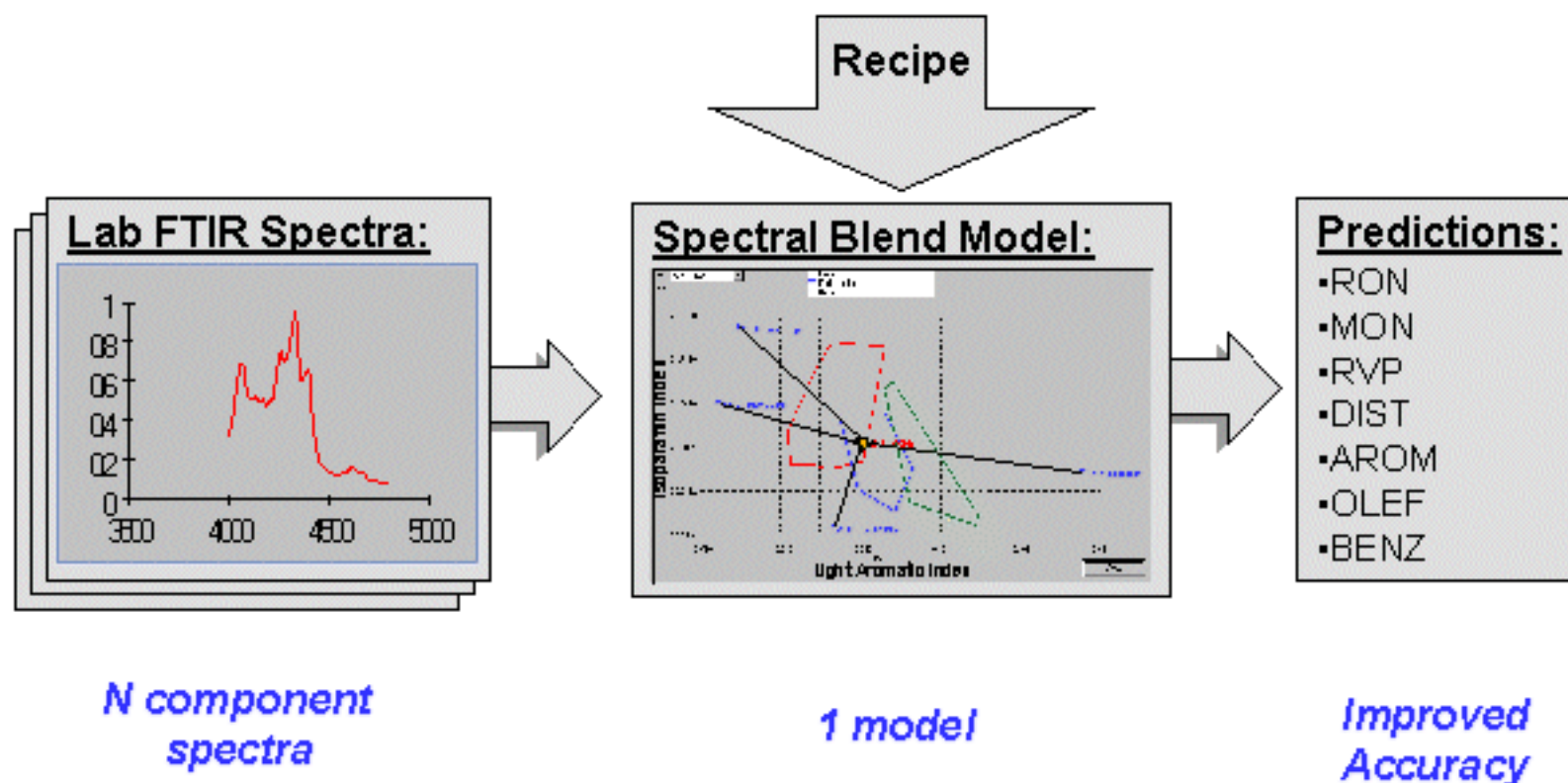


ABB Online Analytical Instrumentation

- Largest, most extensive supplier of online analytical instrumentation in the industry, with online analyzers for crude, fuel oil, kerosene, jet fuel, gasoline, and diesel in-line blenders
- Vista Model 4100 RVP analyzer is *the* industry standard
- Bomem Advance FT-NIR offers
 - high wavelength accuracy and precision
 - extremely low maintenance
 - model transferability between instruments
- Vista II Process GC for applications requiring extremely accurate distillation analysis
- Vista II Fuel Sulfur Analysis to 100 ppb
- Pastech is the industry's leading analytical instrumentation system integrator



ABB

ABB Blending Solutions

Closed-loop capability, closed-loop responsibility

ABC

*Property Control
& Optimization*



RBC

*Base Regulatory &
Sequential Control*

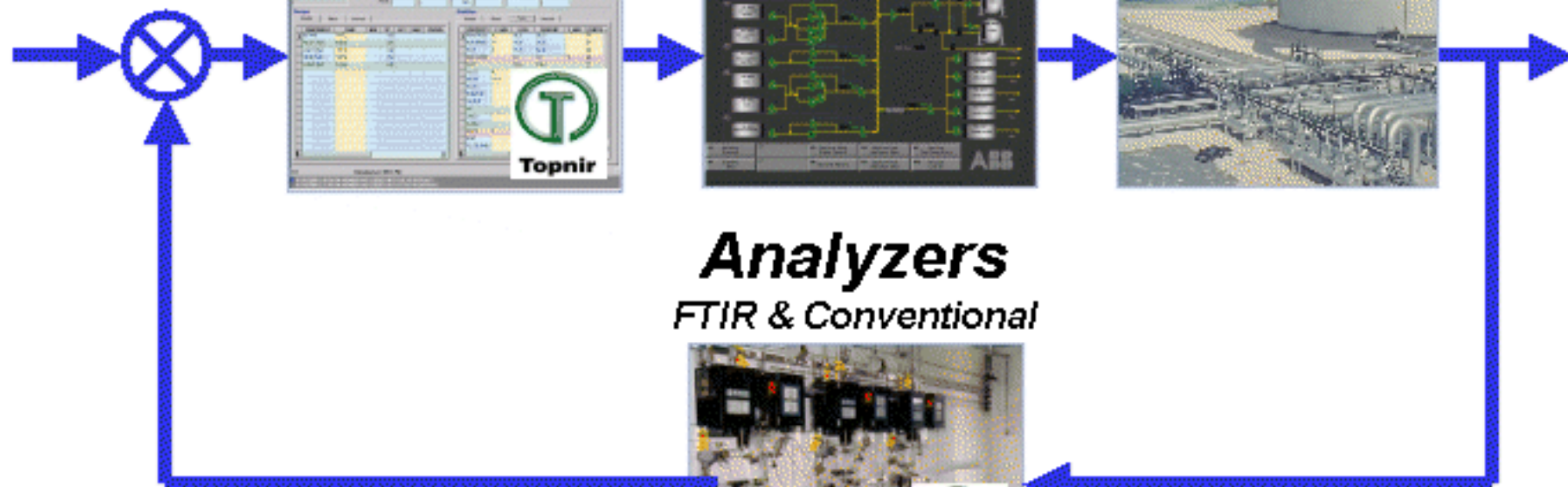


Blender



Analyzers

FTIR & Conventional



Phased Offline-to-Online Project Plan

■ Implementation:

- Begin with Bomem laboratory FTIR (purchase or Easy/IR lease)
- Develop Topnir chemometric models
- Implement ABC for optimal, offline planning
- Close ABC loops when inline blender, RBC, & online analyzers are installed
- Retain bench FTIR for component analyses



Topnir

■ Benefits:

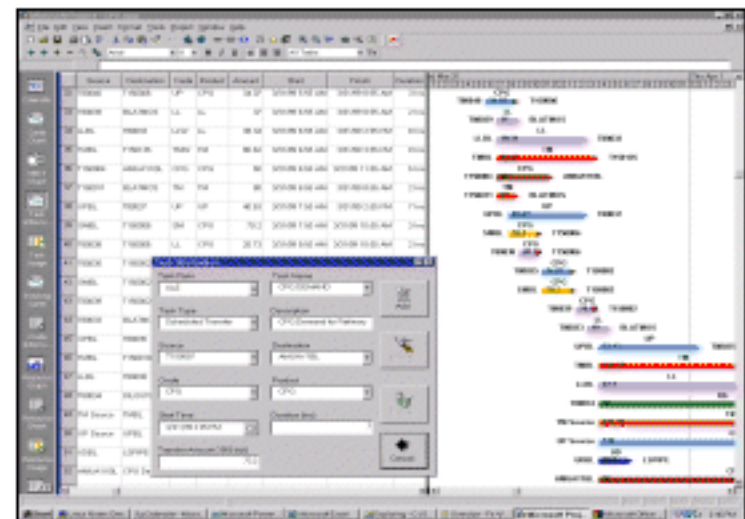
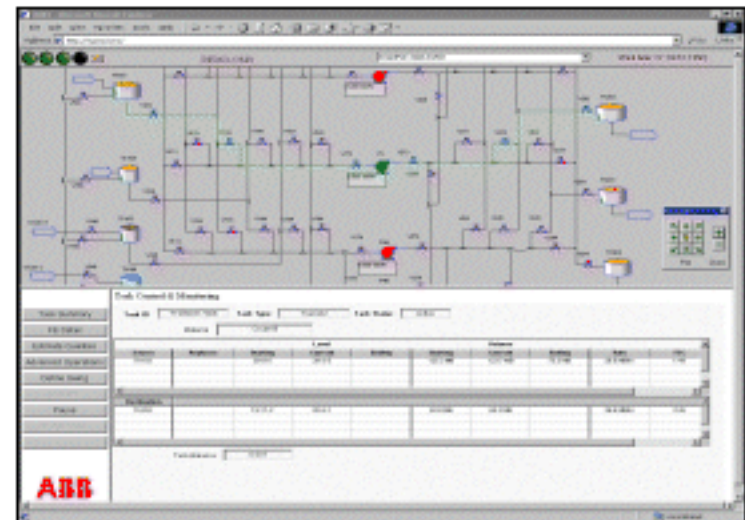
- Early return on low initial investment
- No investment compromised
- Closed-loop solution investment across multiple CAPEX budget cycles
- Phased training & site acceptance



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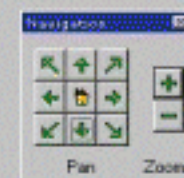
Intelligent Oil Movement & Storage (iOM&S)

- Graphical, object-oriented, expert system technology
- Optimal path selection, sequencing, & monitoring of typical tank farm operations
- Improves utilization of storage and equipment and efficiency of receipts, internal transfers, and shipments
- Enforces SOPs, safety, and environmental policies
- Eliminates incompatible material contamination
- Optional Crude Planning & Scheduling package



ABB

Wed Mar 17 10:31 1999



Task Balance	0.007
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Crude B

Task Balance	0.007
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ABER

iOM&S Functions

- **Select equipment (tanks, valves, pumps) for movements per daily operating orders**
- **Automatically select optimal path**
- **Generation of equipment operation sequences**
- **Terminate movements or swing source and destination tanks at specified levels or volumes**
- **Calculate stop gauges and total volumes shipped for custody transfer**
- **Monitor field element feedback, alarm, and service statuses**
- **Monitor tanks for improper movements**
- **Track movements and line contents to enforce material compatibility**

iOM&S Movement Types

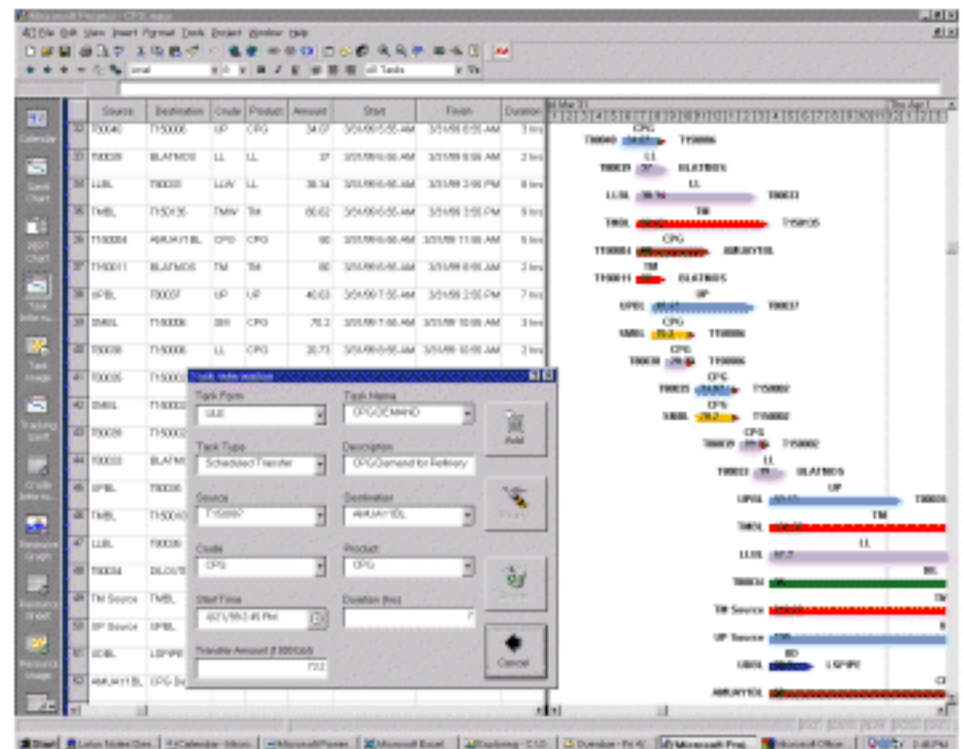
- tank to tank transfer
- tank water drainage
- tank circulation
- batch receipts & shipments, via pipeline or ship
- perpetual receipts & shipments, via pipeline
- sequential blend (sequential transfers from several component tanks to the same product tank)
- simultaneous blend (parallel transfers)
- manual transfer operation (operator specifies the source and destination, and the field elements to be committed)

iOM&S Software Design

- **iGES/AIEM (G2) graphical object-oriented design for tank farm objects & connectivity**
- **Underlying Oracle relational database**
- **G2 is completely hidden from operator and configuration engineer**
 - engineer interface via iGES
 - operator interface via browser
- **Configuration requires:**
 - topology (from plot plan, PFD, P&IDs)
 - project-specific rule-base
- **Can use inherent DCS/SCADA/PLC-level sequence table processing capability, or drive individual devices directly.**

Crude Planning & Scheduling (CP&S)

- Planning (~30 day) and scheduling (~3 day) of tank farm receipts, transfers, blends, and shipments
- Completely integrated with iOM&S package
- Proven MIP technology optimizes inventories, distribution, production, and giveaway
- Native-NT application integrated with MS Access & Project





Wed Mar 31												Thu Apr 1											
1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12



7 X

Economic Losses at the Blender

- Octane Giveaway
- Volatility Giveaway
- Sub-Optimal Recipes

VS.

- Reblends
- Inventory Cost
- Demurrage
- Missed Shipments



Bottom Line = \$0.05 - 0.25/bbl lost profits

Economic Benefits: Property Giveaway

Octane

- a reduction of 0.15 octane is generally achievable
- savings realized chiefly in lower reformer severity
- using a typical value of an "octane barrel":

$$(0.15 \text{ ON})(\$0.25/\text{ON bbl})(100,000 \text{ bbl/day})(350 \text{ days/year}) \\ = \$1,312,500/\text{year}$$

RVP

- an increase of 0.5 psi is generally achievable
- savings realized by maximizing n-butane volume
- using a typical value of a "psi barrel":

$$(0.5 \text{ psi})(\$0.08/\text{psi bbl})(100,000 \text{ bbl/day})(350 \text{ days/year}) \\ = \$1,400,000/\text{year}$$

Savings Beyond “Zero Giveaway”

	COST	PLAN	OPTIMAL
REFM	\$21.40	36.0	35.3
FCCG	\$20.35	35.0	35.9
ALKY	\$21.58	2.0	1.0
ISOM	\$19.71	14.0	15.0
LNAP	\$19.41	9.0	9.4
PENT	\$18.70	2.0	1.0
BUTN	\$12.50	2.0	2.4
RdON		87.1	87.1
RVP		9.0	9.0
COST		\$20.39	\$20.34