aspentech | Technology That Loves Complexity

Achieving Production Excellence with GDOT

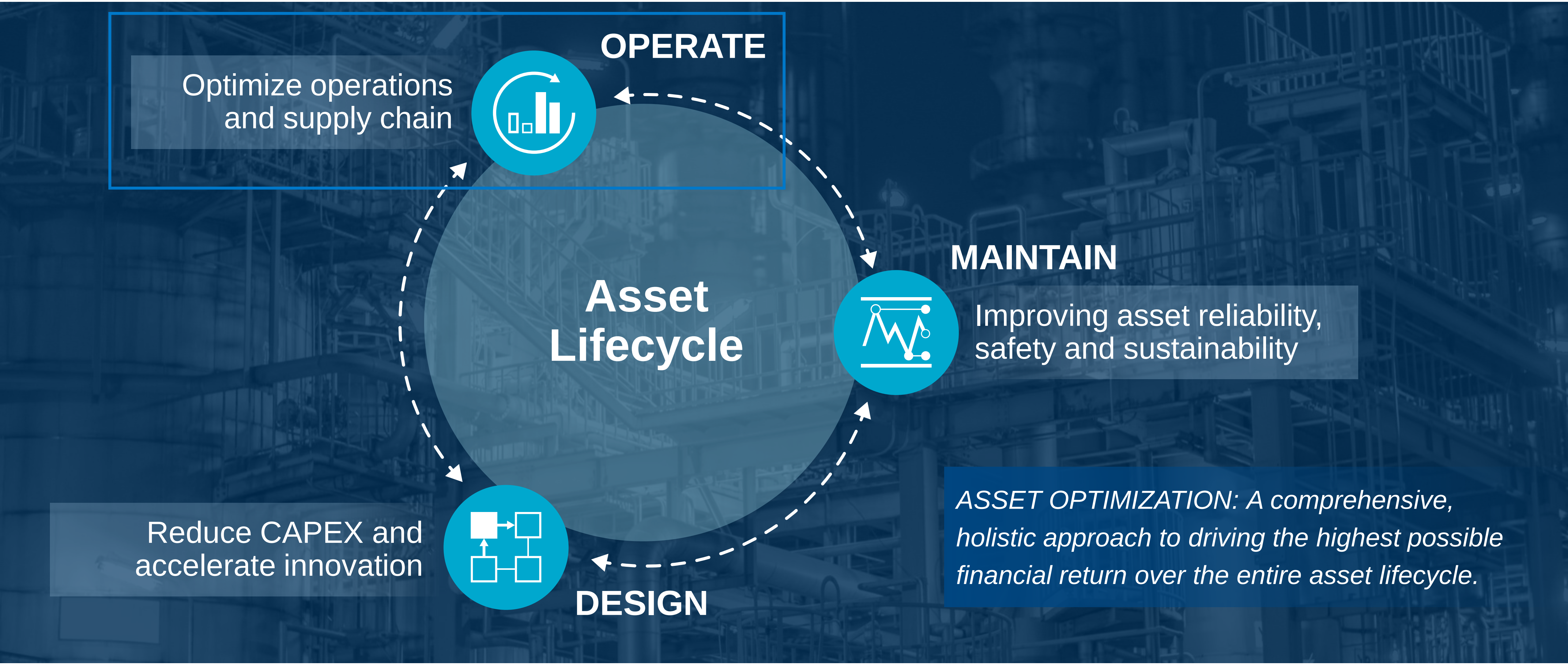
Klas Dahlgren, GDOT Global Practice Director

The following slides have been modified for distribution

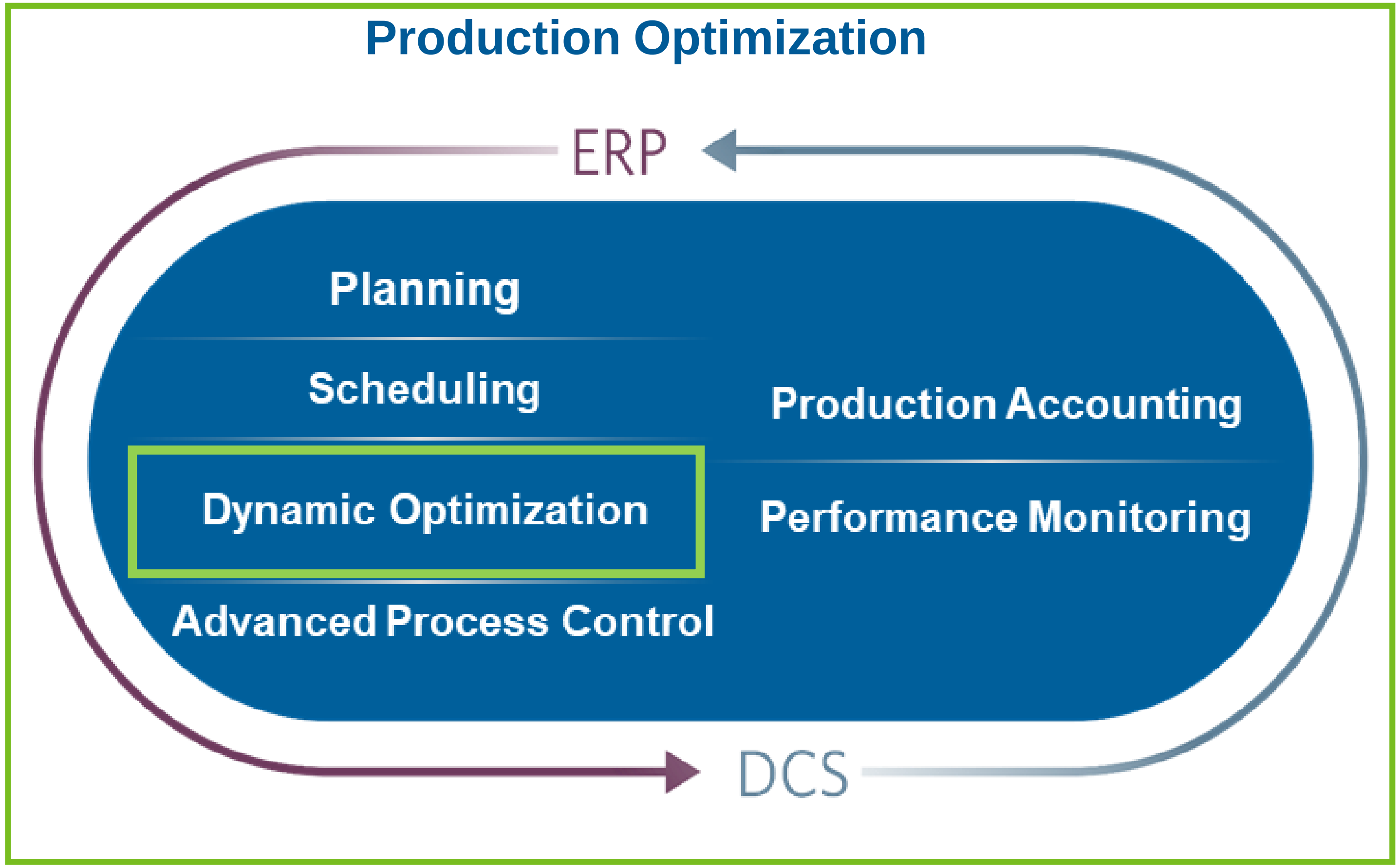
Presentation Overview

- GDOT introduction
  - GDOT – Key to Unified Production Optimization
  - What is GDOT, **G**eneric **D**ynamic **O**ptimization **T**echnology
  - Typical Benefits and Applications of GDOT in Refining
  - Diesel Case Study
  - Gasoline Optimization
- GDOT Software Overview

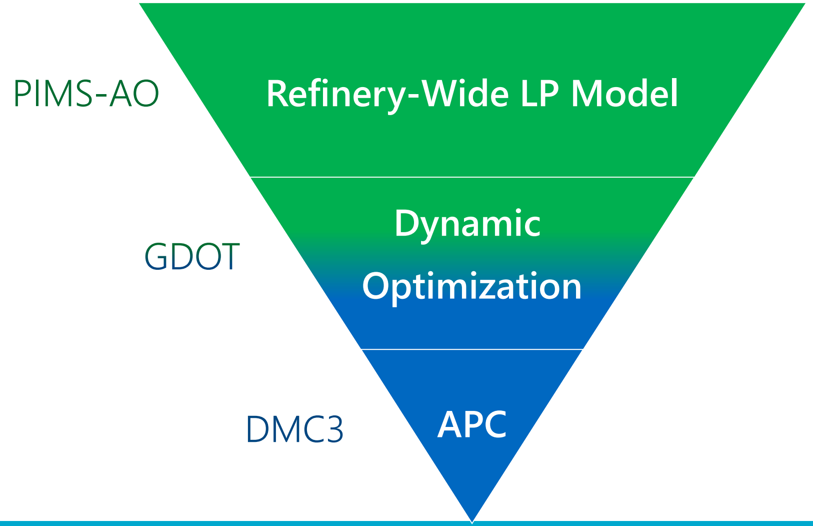
GDOT and Asset Optimization



GDOT – Key to Unified Production Optimization



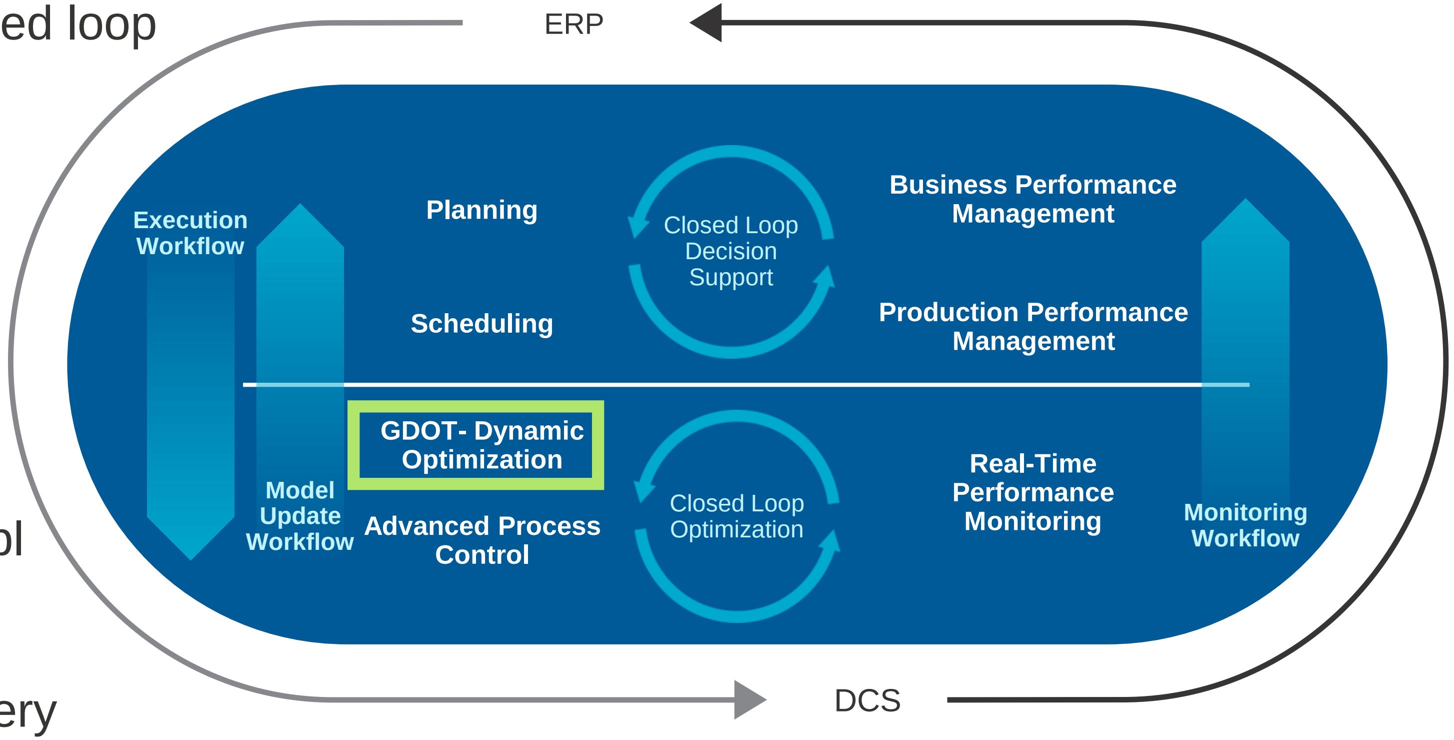
- GDOT enables **unified production optimization** for refineries & petrochemical companies
- Improves operating margins by closing the **gaps between refinery wide planning/economics and individual unit operations**



Running to the Limits of Performance, Always

GDOT – Enabling Closed Loop Production Optimization

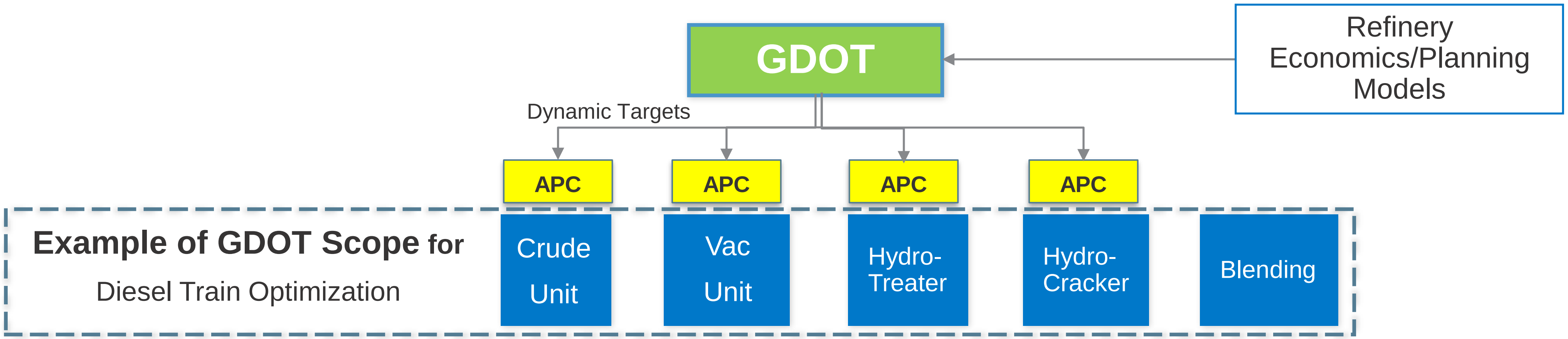
- Captures value by operating the refinery closer to plan
- Dynamically coordinates multiple units in closed loop by automatically adjusting APCs
- Easily deployed and maintained by APC Engineers
- Over 25 implementations at 16 companies to date
- Improves Refinery Margin by $0.25 - $0.40/bbl $15M – $30M for a mid size refinery
- 5+ typical process areas to optimize per refinery



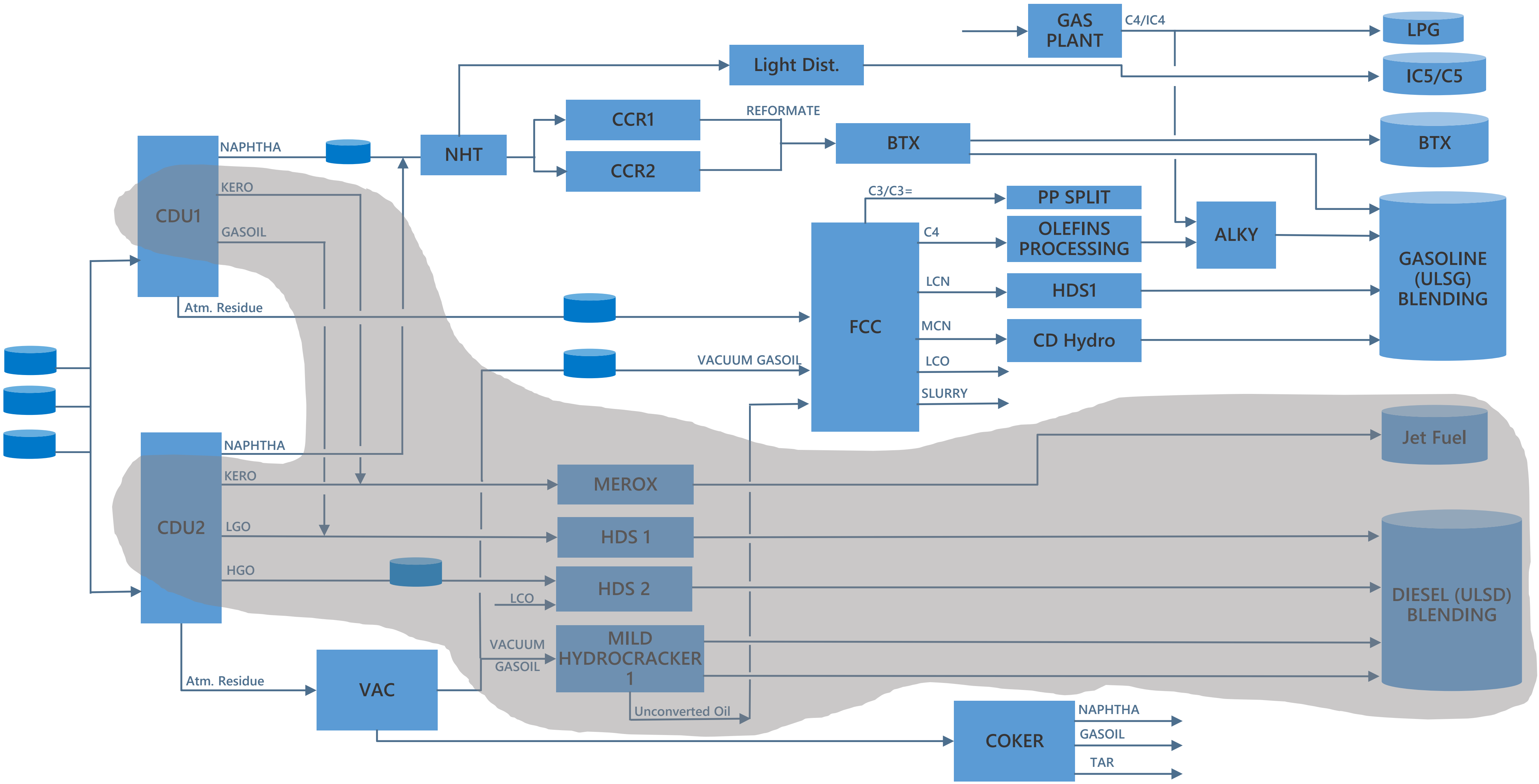
Running to the Limits of Performance – 24x7, minute-by-minute

What is GDOT?

- GDOT is a new generation of dynamic optimization technology that
  - aligns production planning with the actual operation of process units
  - successfully combines refinery planning models (like PIMS AO) with dynamic APC models (like DMC3)
  - uses patented dynamic data reconciliation & parameter estimation technology to maximize advantage of minute-by-minute process feedback
  - runs in a real time environment (typically every minute, just like APC controllers), but the scope of optimization is much larger
  - is designed to be maintained by site control engineers



GDOT Scope - Example of Middle Distillate Application



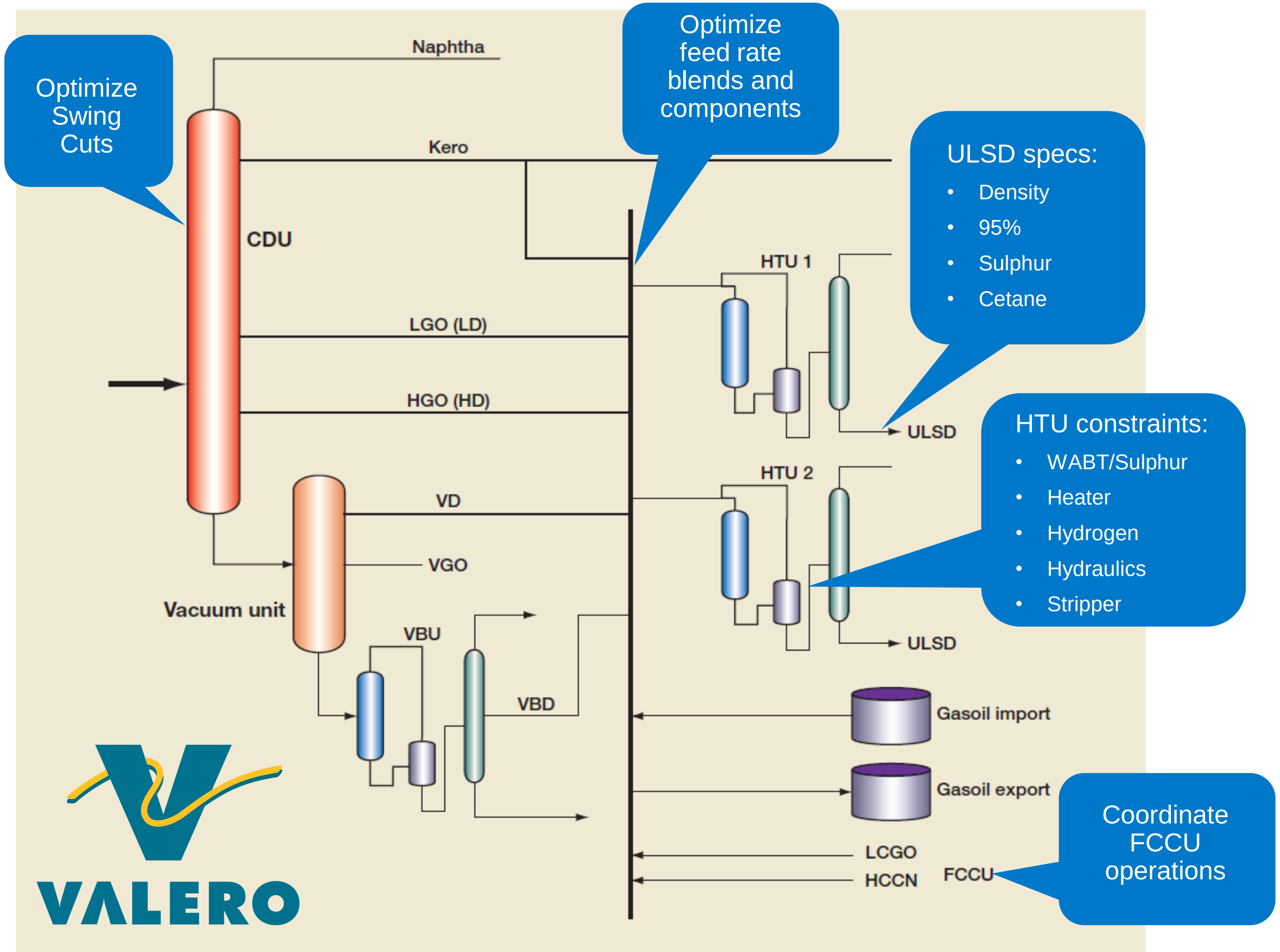
GDOT Applications and Typical Benefits ($15M - $30M per year)

- **Naphtha Processing including Aromatics**
- **Middle Distillate Processing**
- **Residue Processing**
- **H2 Network Optimization**
- **Utility Optimization**

Examples of audited achievements with petroleum refining applications include

Naphtha Processing	Distillate Processing	Residue Processing	H_2 & Utility Systems
Increase aromatics yield by **5%** *& reduce gasoline quality giveaway*	*Increase diesel production by* **10%** *and reduce quality giveaway*	*Increase conversion by* **3%** *on feed*	*Reduce fuel gas & H2 losses by 50%+. Benefits are much higher if refinery is short on H2.*
$3M to $5M+ / year	**$4M to $10M / year**	**$3M+ / year**	**$1M to $3M+ / year**

Benefits Case Study: Valero Pembroke ULSD Optimizer (1)



Petroleum Technology Quarterly (PTQ) Magazine, issue: Q2 - 2011

- Benefits
  - 10% Improvement in ULSD production
  - $10+ Million/year
- Application Brief
  - Coordinates CDUs/VDUs, HDS, and blending of Diesel & Jet fuel (8-10 APC Controllers)
- Application Objectives
  - Maximize Middle distillate production
  - Reduce off spec production
  - Minimize giveaways
  - HDS unit/catalyst optimization

Benefits Case Study: Valero Pembroke Publication (2)

Petroleum Technology Quarterly 2011 Q2

Modelling for ULSD optimisation

On-line coordination and optimisation of refinery process units led to a 10% increase in middle distillate production

KLAS DAHLGREN *Apex Optimisation/Dynaproc*
AN RIGDEN *Chevron* HENRIK TERNDRUP *Apex Optimisation*

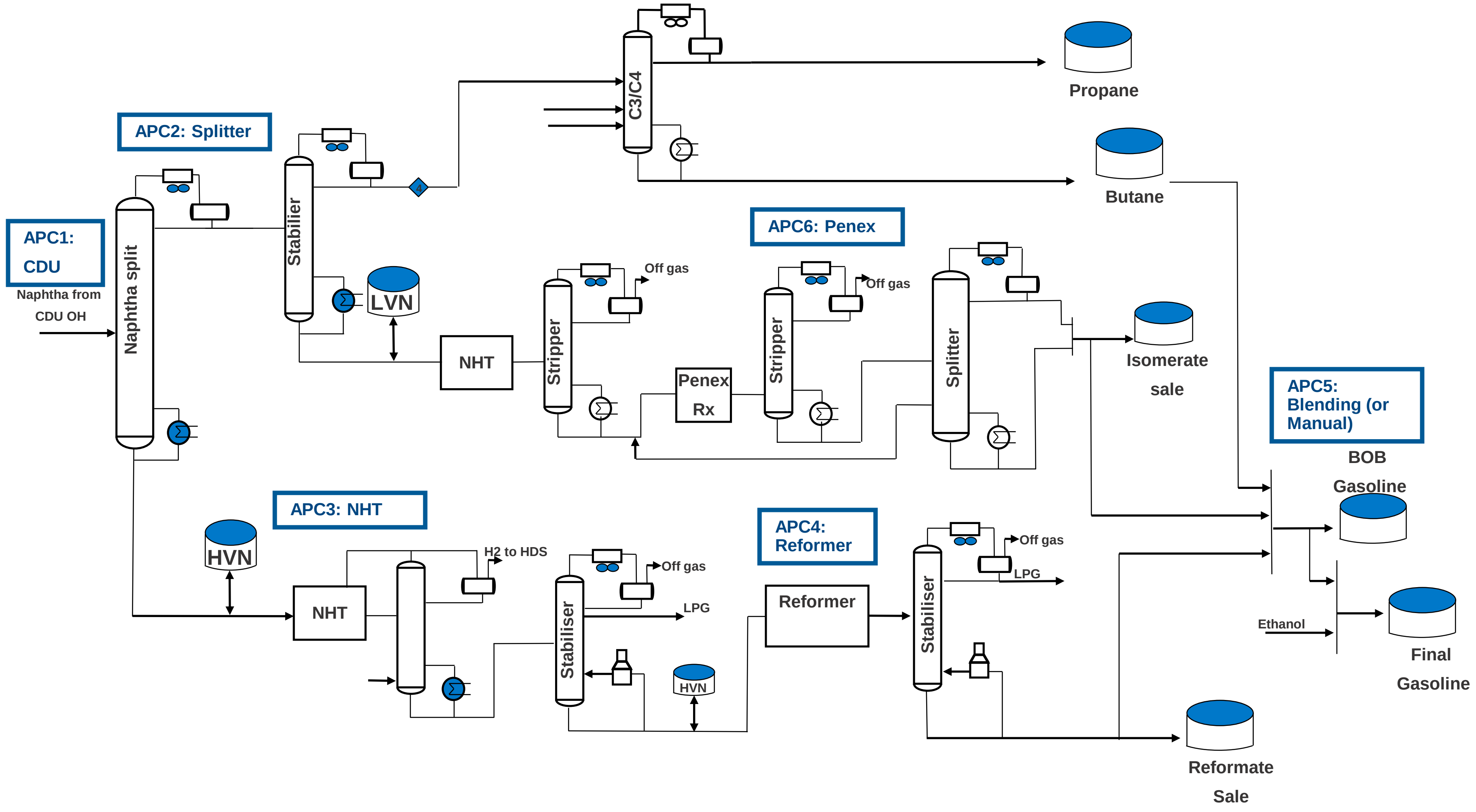
The Chevron Pembroke oil refinery is a complex and large (220 000 b/d) processing site. This case study examines the improvements achieved by a project with a high return on investment, which resulted in better operation of the process units involved in middle distillate production and

components, which include kerosene, several straight-run gas oil streams and FCC product streams such as HHCN and light cycle gas oil (LCGO). The decision-making process for these blends involves several refinery areas and console operators in different control rooms across the site.

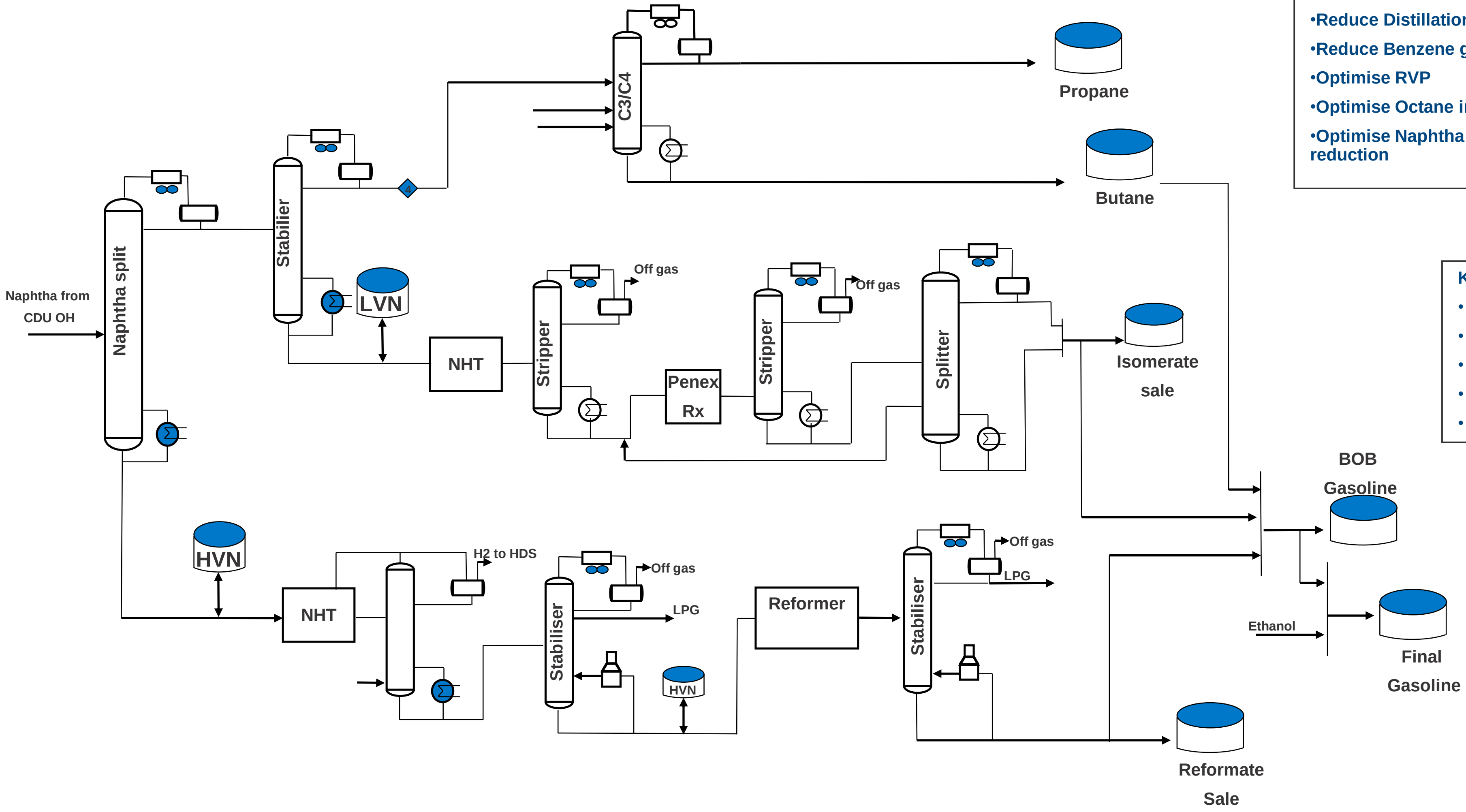
Like many other ULSD-producing refineries, the Pembroke site blends middle distillates directly from the process unit rundown lines prior to hydrotreating. The main advantages of this approach, compared to a conventional batch blending system, are lower tank storage and manpower requirements, and the

Gasoline Optimization

Gasoline - Typical APC Deployment



GDOT Gasoline Optimization – Objectives and Typical Constraints



Optimisation objectives:

- Reduce Distillation giveaway
- Reduce Benzene giveaway
- Optimise RVP
- Optimise Octane in pool
- Optimise Naphtha separation (Energy reduction

Key quality constraints:

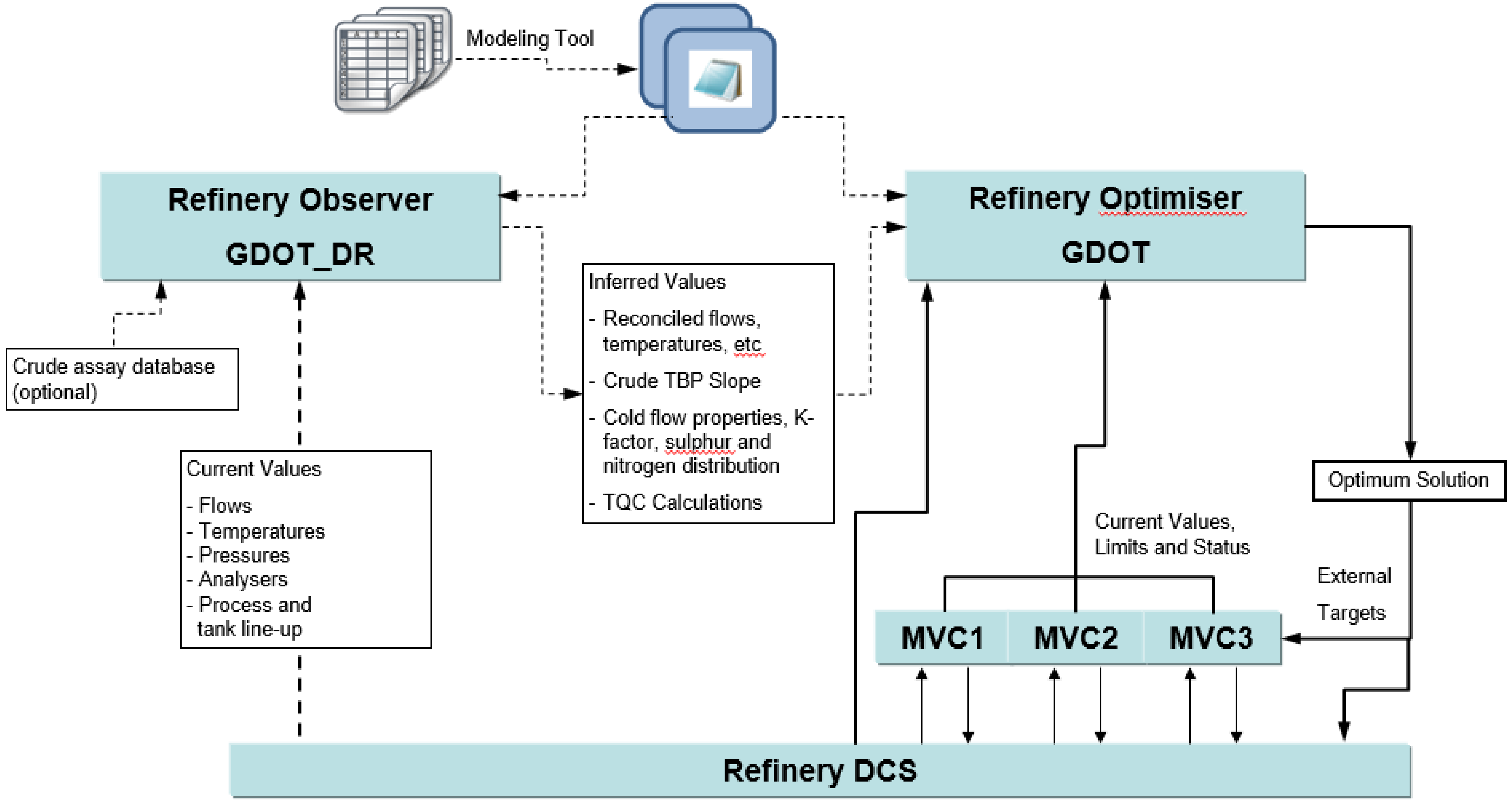
- Octane
- RVP
- Distillation
- Density
- Volatility index

Production planning constraints:

- Reformate sale
- MOGAS Delivery schedule
- LVN/HNV inventory

GDOT Software Overview

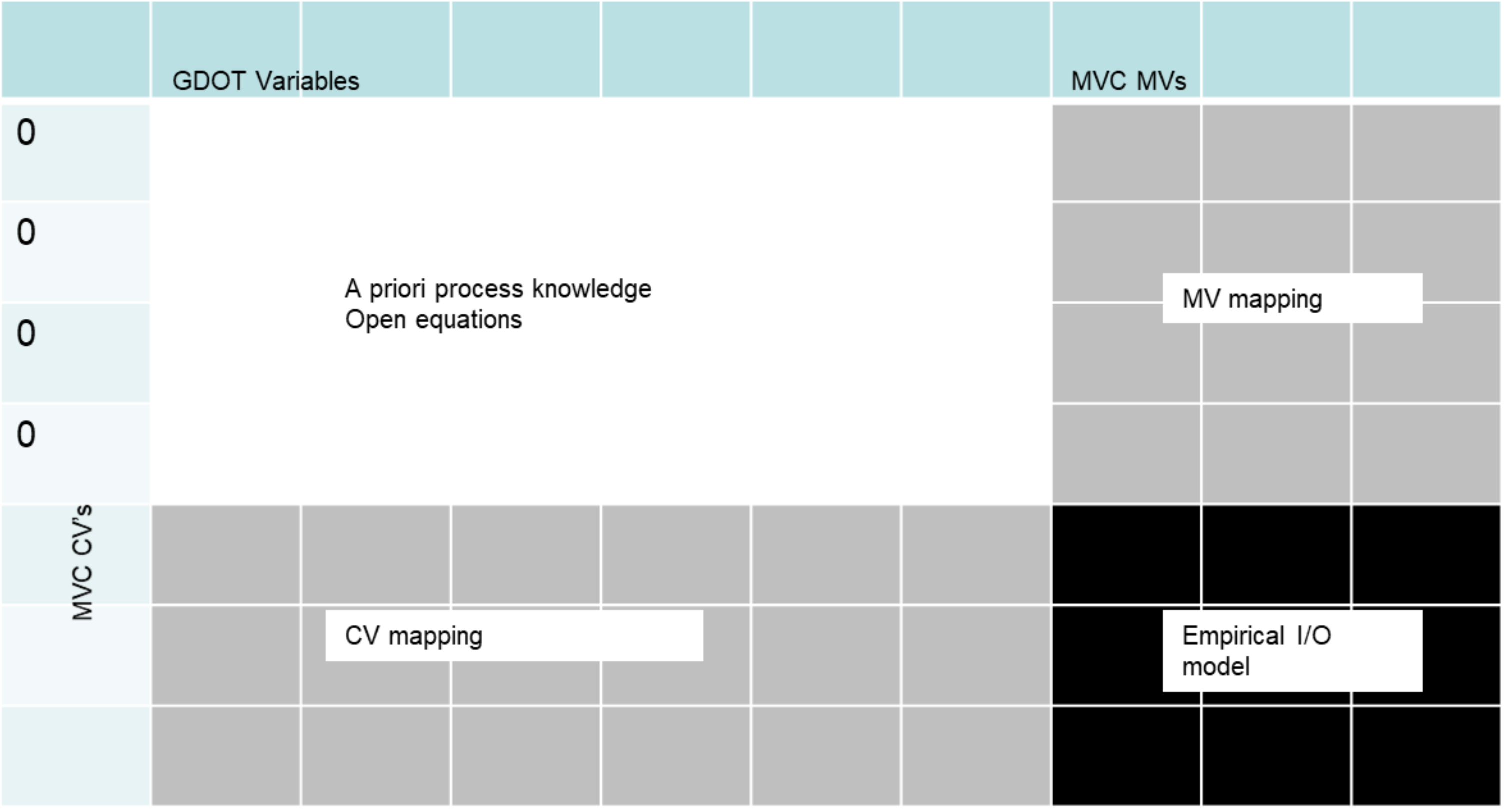
GDOT Application Structure



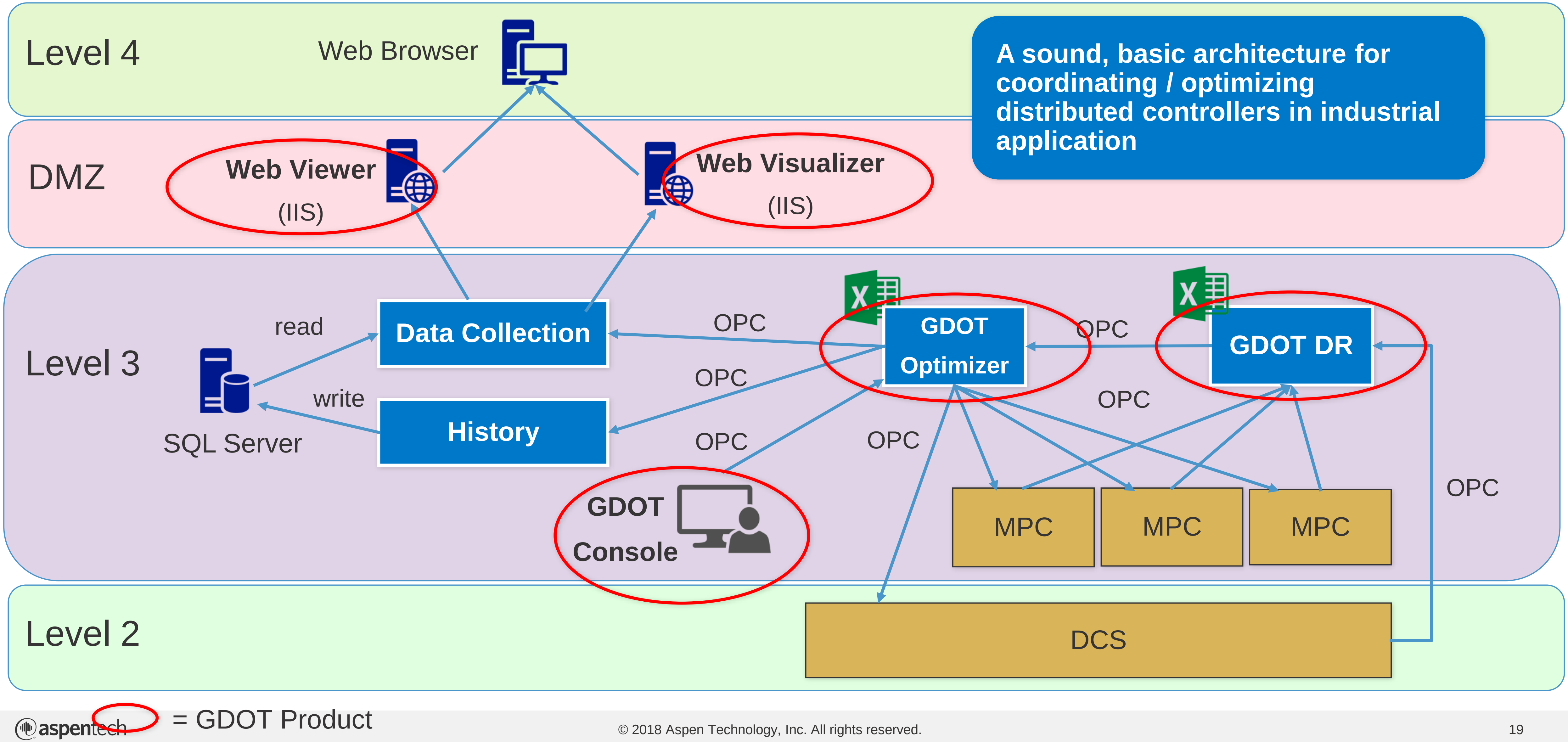
GDOT Product Components

Module	Functionality
Offline Problem definition:	
Excel-based UI with function library	Build material balance and dynamic models, configure online applications
On-line Calculation Server:	
GDOT DR	Real-time data reconciliation for unknown parameters and measurements in the model
GDOT Optimizer	Calculate steady-state targets and communicate to controllers
On-line Monitoring and Visualization:	
GDOT Console	Windows-based visualization tool for online application
Web Visualizer	Web-based online visualization tool with flowsheet style graphic display

GDOT Hybrid (Grey box) Models



GDOT Software Architecture



GDOT Web Viewer – Web-based End-User Interface to Monitor Optimization Results (View Only)

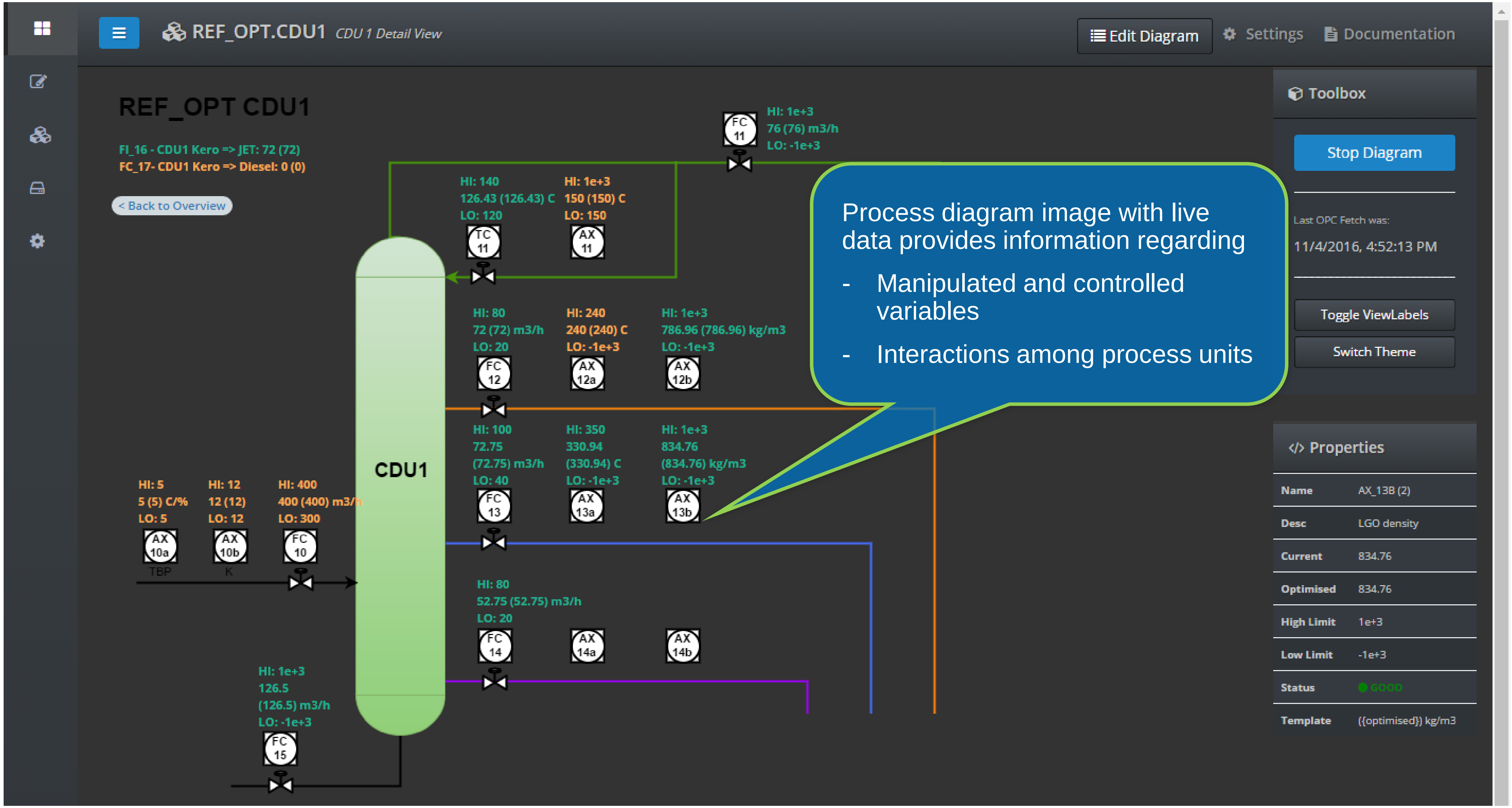
GDOT® WebViewer v2

14 0 GDOT.REF_OPT.1

MV VIEW (GDOT.REF_OPT.1/localhost)

#	MV Name	Status	Current	Optimized	Low Limit	High Limit		
1	FC_10 - Crude Feed	GOOD	400	400	300	400	HIGH	
2	TC_11 - Top	GOOD	126.429	126.429	120	140	GOOD	
3	FC_12 - Kero	GOOD	72	72	20	80	GOOD	
4	FC_13 - LGO	GOOD	82.748	82.748	40	100	GOOD	
5	FC_14 - HGO	GOOD	42.748	42.748	20	80	GOOD	
6	AX_10A - Crude TPB Slope	GOOD	5	5	5	5	HILO	
7	AX_11A - Naphtha 95%	GOOD	150	150	150	1E+30	LOW	
8	AX_12A - Kero 95%	GOOD	240	240	-1E+30	240	HIGH	
9	AX_13A - LGO 95%	GOOD	343.436	343.436	-1E+30	350	GOOD	
10	AX_14A - HGO 95%	GOOD	396.871	396.871	-1E+30	400	GOOD	
11	FC_11 - Naphtha	GOOD	76	76	-1E+30	1E+30	GOOD	
12	FC_15 - Residue	GOOD	126.503	126.503	-1E+30	1E+30	GOOD	
13	AX_10B - Crude K factor	GOOD	12	12	12	12	HILO	
14	AX_12B - Kero density	GOOD	786.957	786.957	-1E+30	1E+30	GOOD	
15	AX_13B - LGO density	GOOD	837.835	837.835	-1E+30	1E+30	GOOD	
16	AX_14B - HGO density	GOOD	875.163	875.163	-1E+30	1E+30	GOOD	

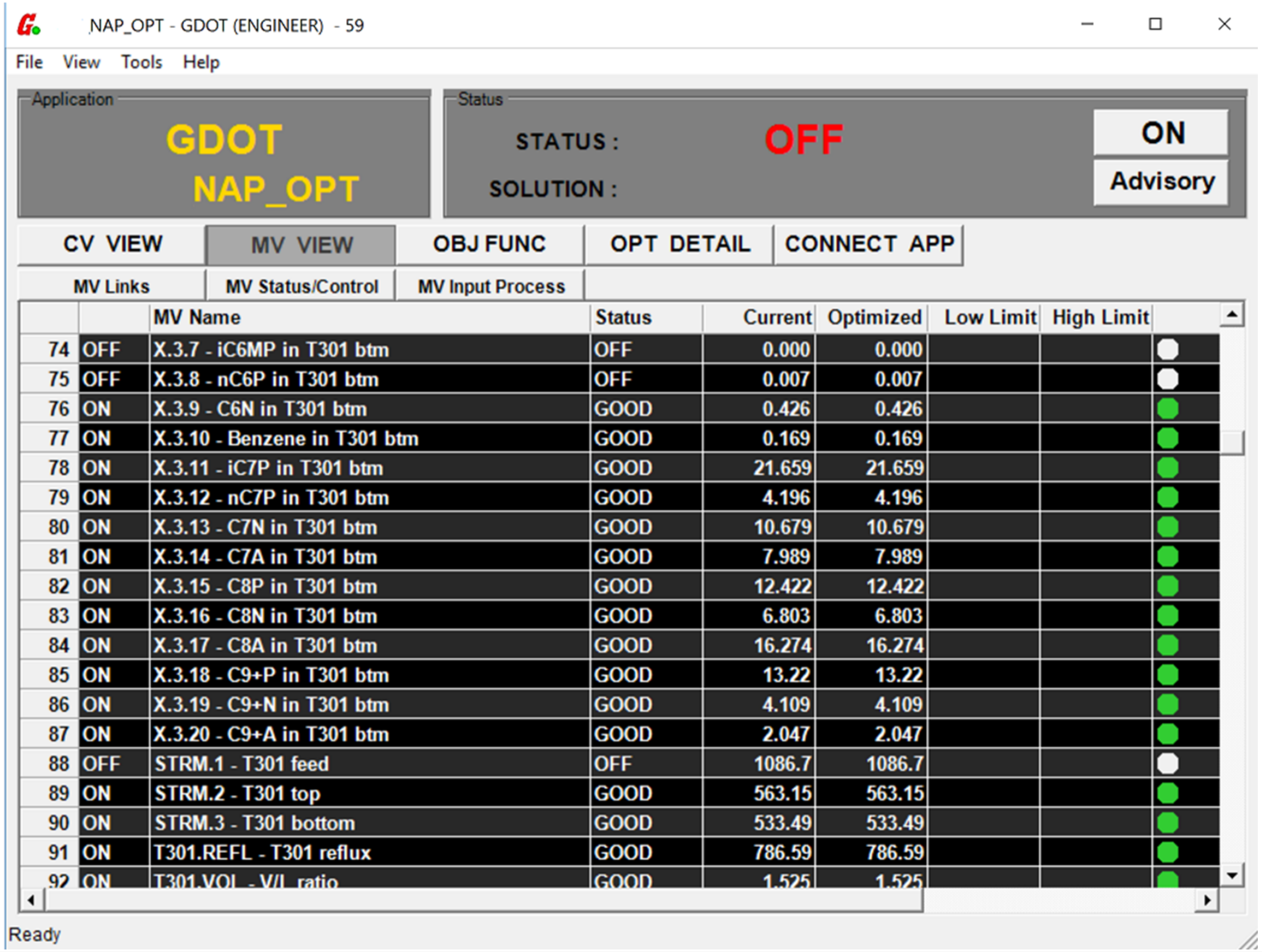
GDOT Web Visualizer – Web-based End-User Interface with Process Diagram Image and Live Data Display



Process diagram image with live data provides information regarding

- Manipulated and controlled variables
- Interactions among process units

GDOT DR “Plant Observer”



		MV Name	Status	Current	Optimized	Low Limit	High Limit
74	OFF	X.3.7 - iC6MP in T301 btm	OFF	0.000	0.000		
75	OFF	X.3.8 - nC6P in T301 btm	OFF	0.007	0.007		
76	ON	X.3.9 - C6N in T301 btm	GOOD	0.426	0.426		
77	ON	X.3.10 - Benzene in T301 btm	GOOD	0.169	0.169		
78	ON	X.3.11 - iC7P in T301 btm	GOOD	21.659	21.659		
79	ON	X.3.12 - nC7P in T301 btm	GOOD	4.196	4.196		
80	ON	X.3.13 - C7N in T301 btm	GOOD	10.679	10.679		
81	ON	X.3.14 - C7A in T301 btm	GOOD	7.989	7.989		
82	ON	X.3.15 - C8P in T301 btm	GOOD	12.422	12.422		
83	ON	X.3.16 - C8N in T301 btm	GOOD	6.803	6.803		
84	ON	X.3.17 - C8A in T301 btm	GOOD	16.274	16.274		
85	ON	X.3.18 - C9+P in T301 btm	GOOD	13.22	13.22		
86	ON	X.3.19 - C9+N in T301 btm	GOOD	4.109	4.109		
87	ON	X.3.20 - C9+A in T301 btm	GOOD	2.047	2.047		
88	OFF	STRM.1 - T301 feed	OFF	1086.7	1086.7		
89	ON	STRM.2 - T301 top	GOOD	563.15	563.15		
90	ON	STRM.3 - T301 bottom	GOOD	533.49	533.49		
91	ON	T301.REFL - T301 reflux	GOOD	786.59	786.59		
92	ON	T301.VOL - V/L ratio	GOOD	1.525	1.525		