Uso de PI System y Análisis Estadístico Monovariable y Multivariable para Control de Calidad y Gestión de Rendimiento.

Methanex Chile

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Summary

- Methanol Information
- Methanol Quality Monitoring (PI-SQC)
- Process Performance Monitoring(MSPC)
- Conclusions

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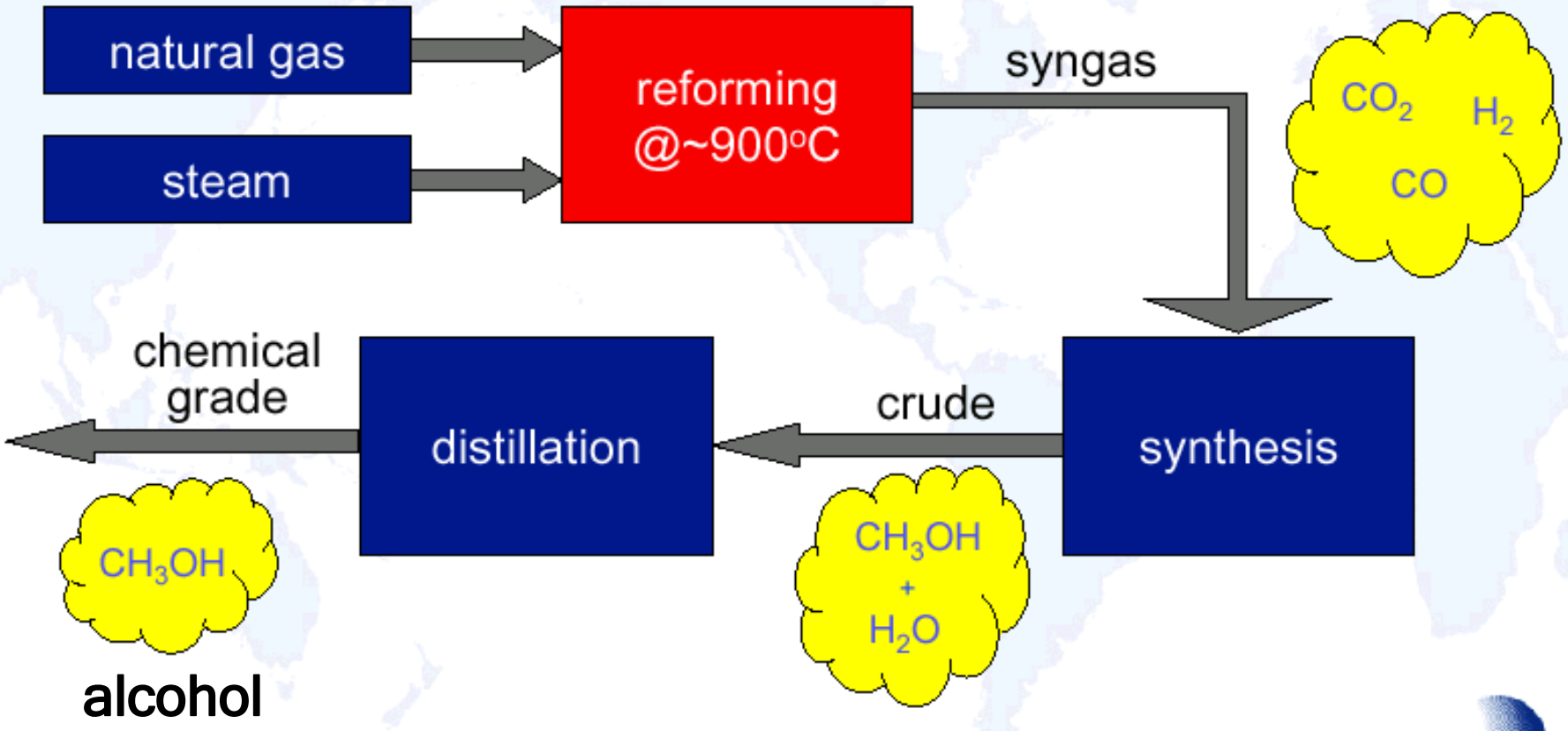
Methanol is...

- **Produced from natural gas**



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Methanol is...

- **Diversified end uses**

Formaldehyde

MDF
Plywood

Methyl Chloride

Silicones

Methyl Methacrylate

Clear acrylic
panels

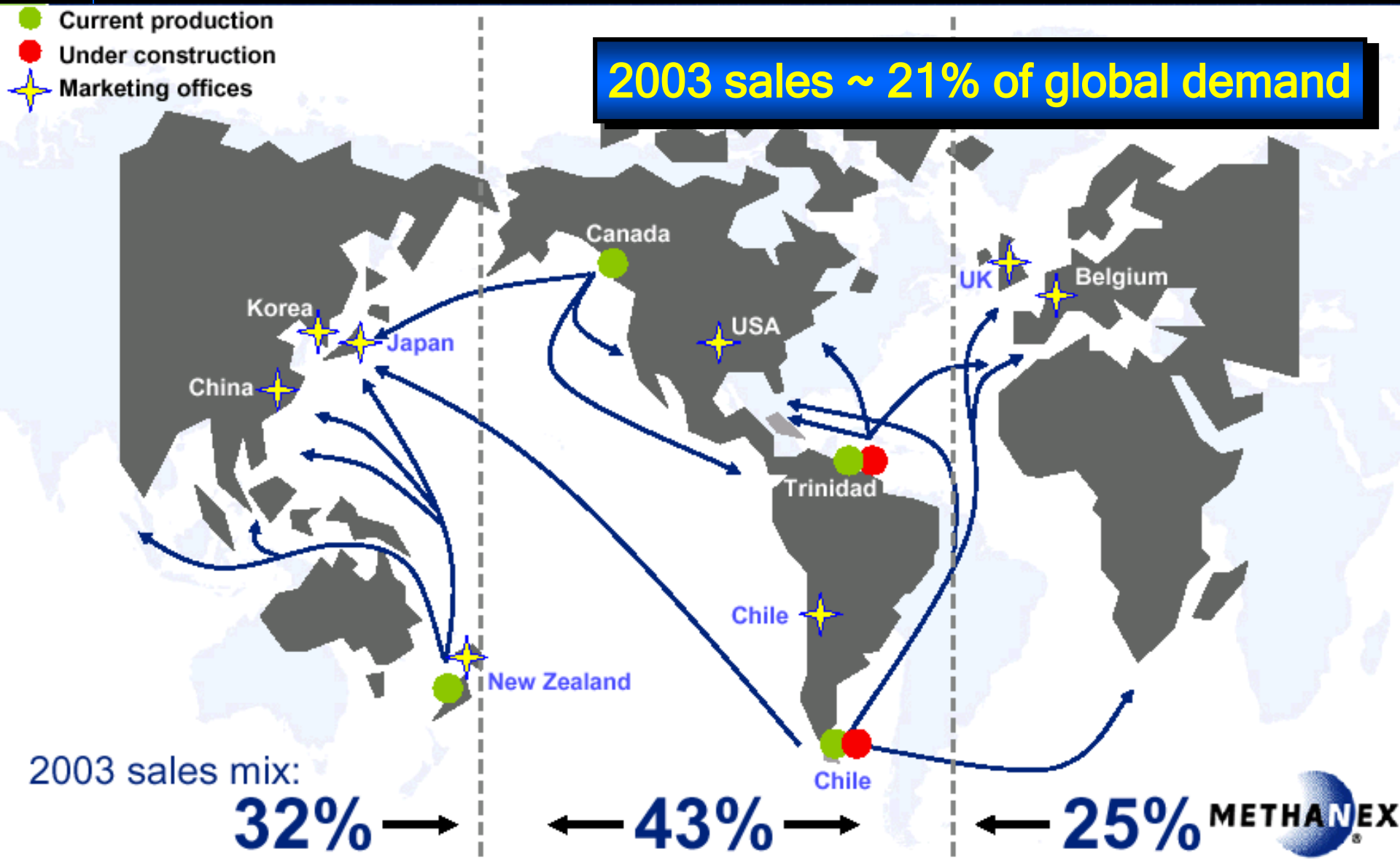
Acetic Acid

Paints
Adhesives

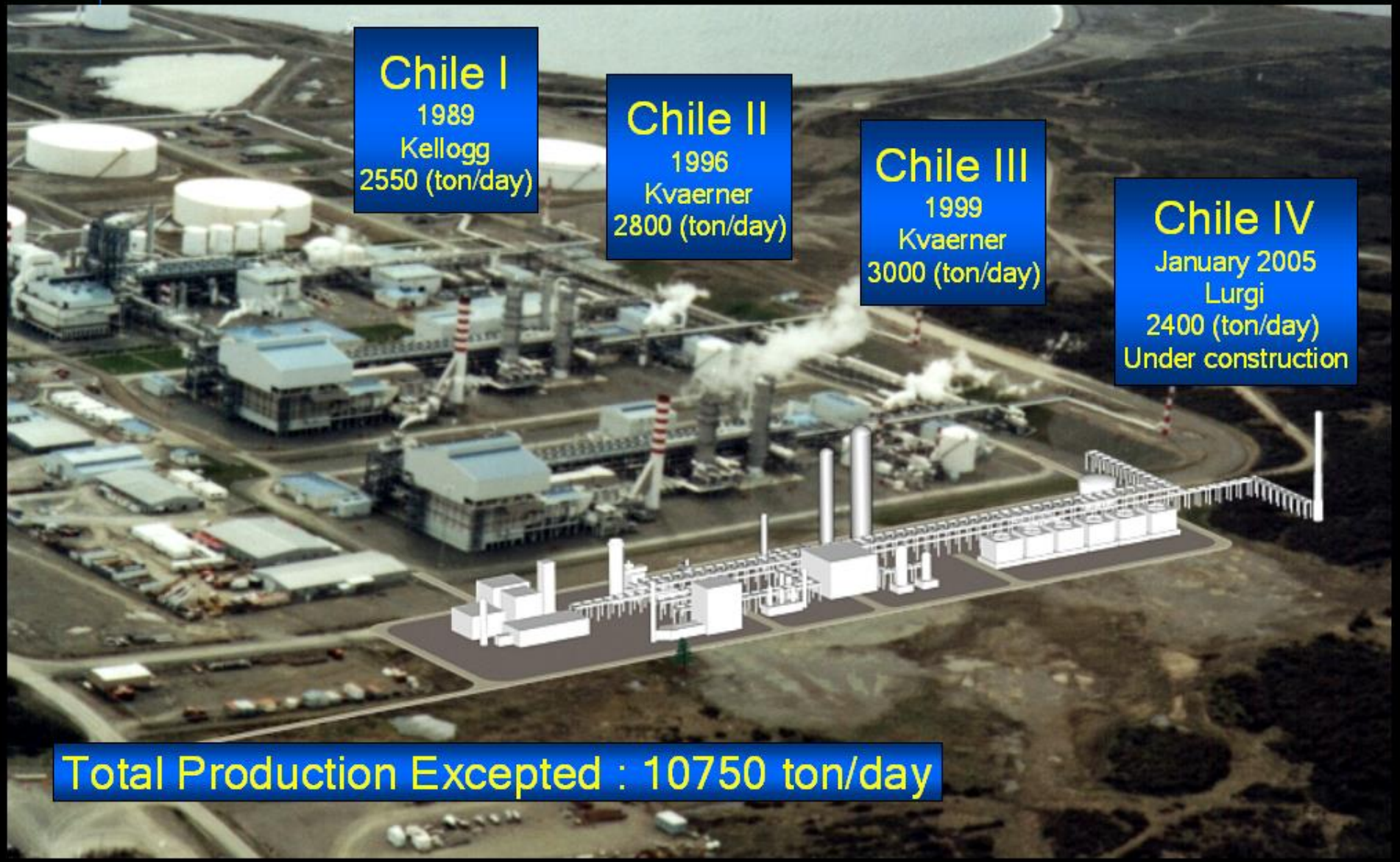
Dimethyl Terephthalate

PET bottles

Methanol Pipeline



Chile Plant Site



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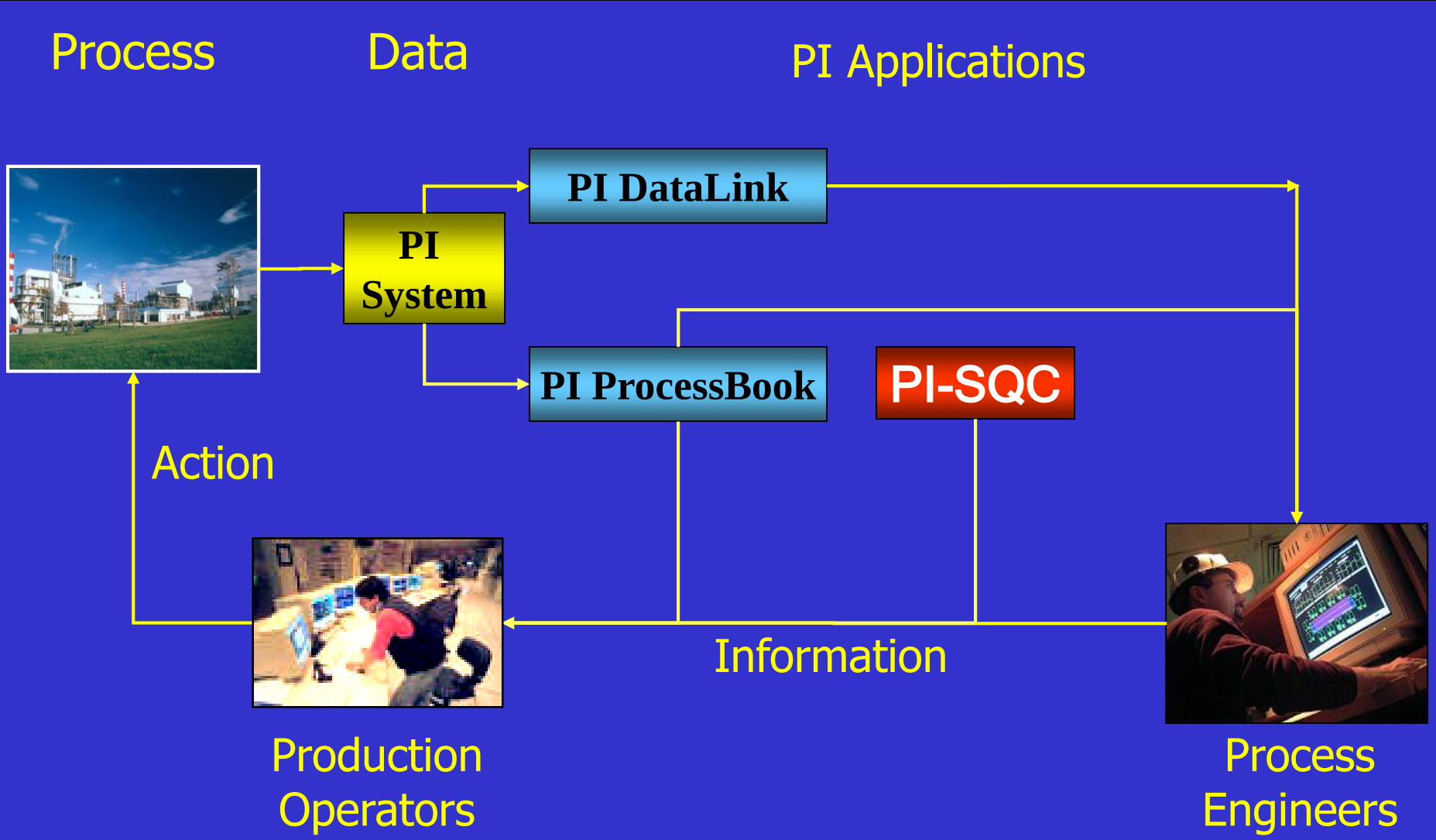
PI-SQC Application

Actual Monitoring with PI Applications



Statistical Quality Control

What is Statistical Quality Control (SQC)?

- Univariate statistical control
- Applied to efficiently monitor process variables and operational quality through control charts with upper and lower control limits

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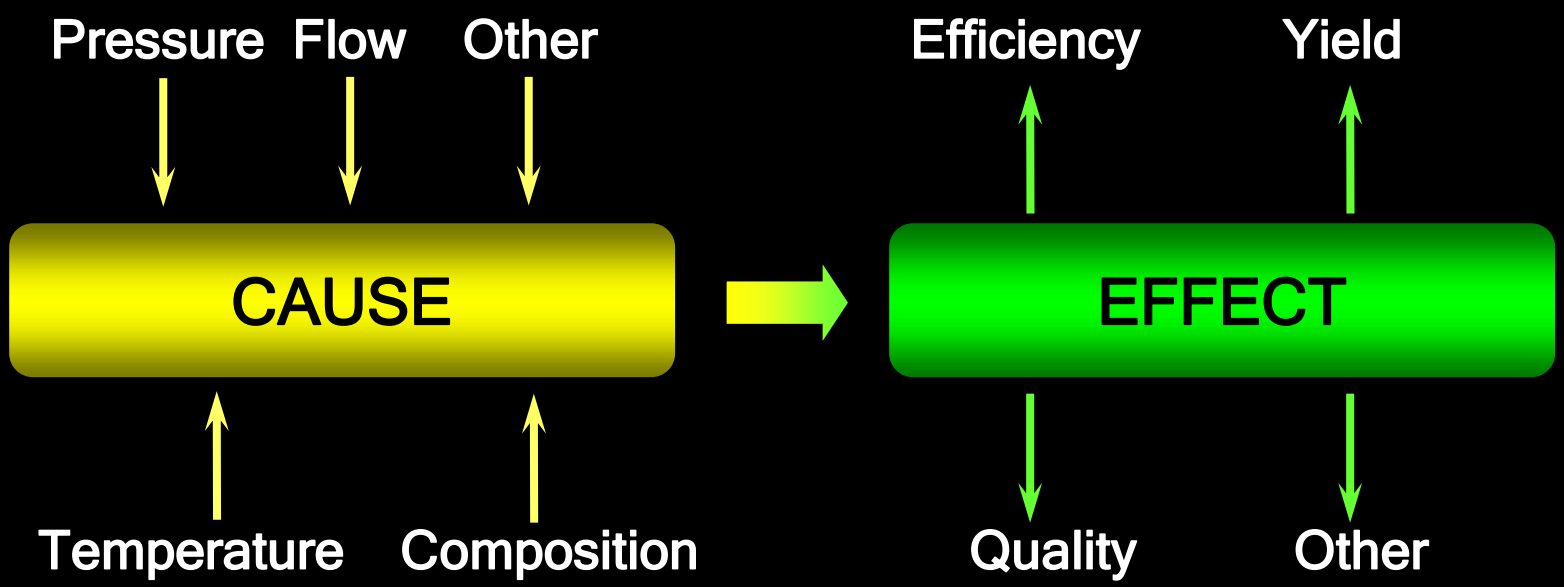
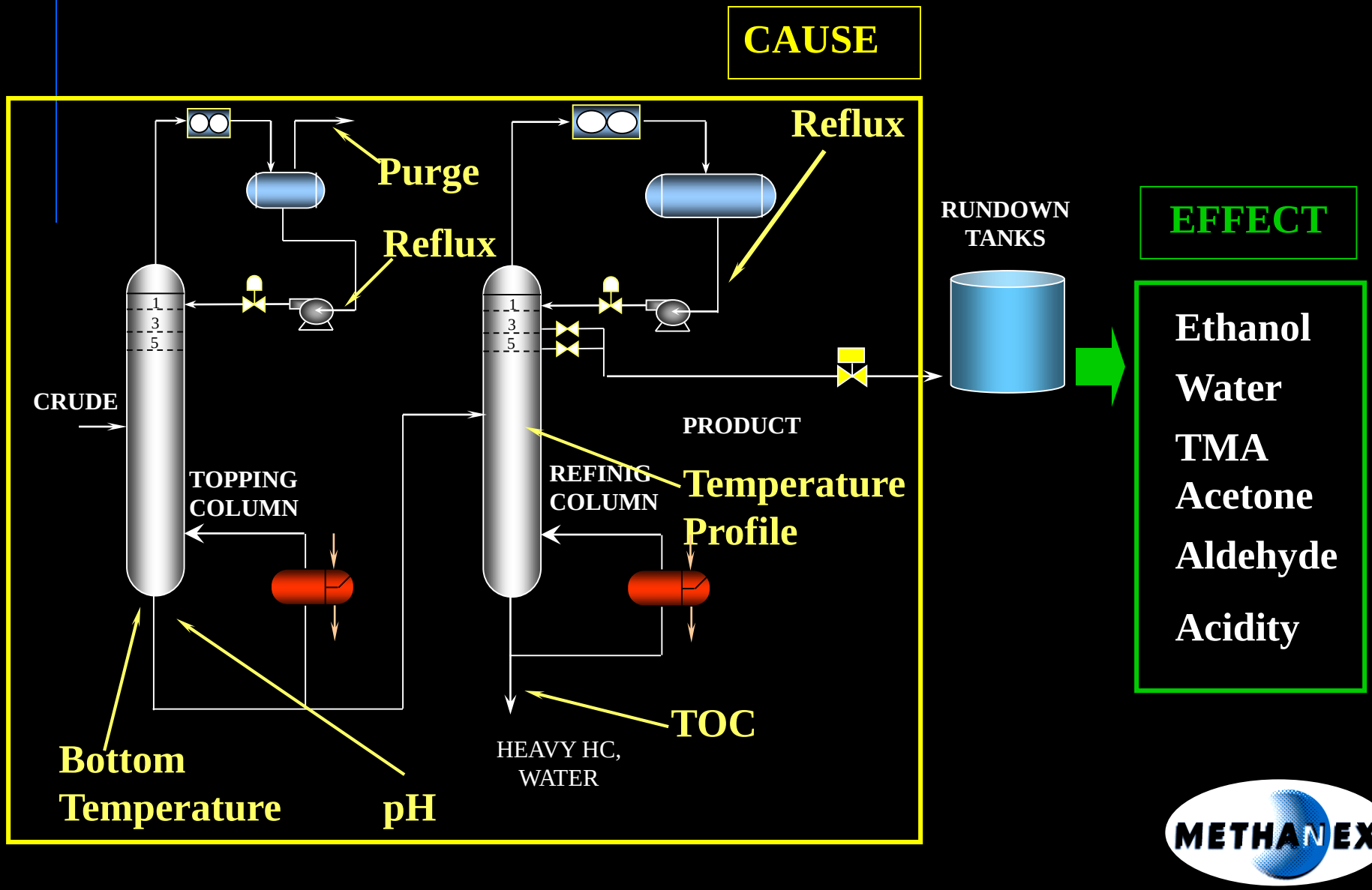
SQC Implementation

1. Determine cause-effect relationships between plant parameters, to determine key process variables



Cause -Effect SQC

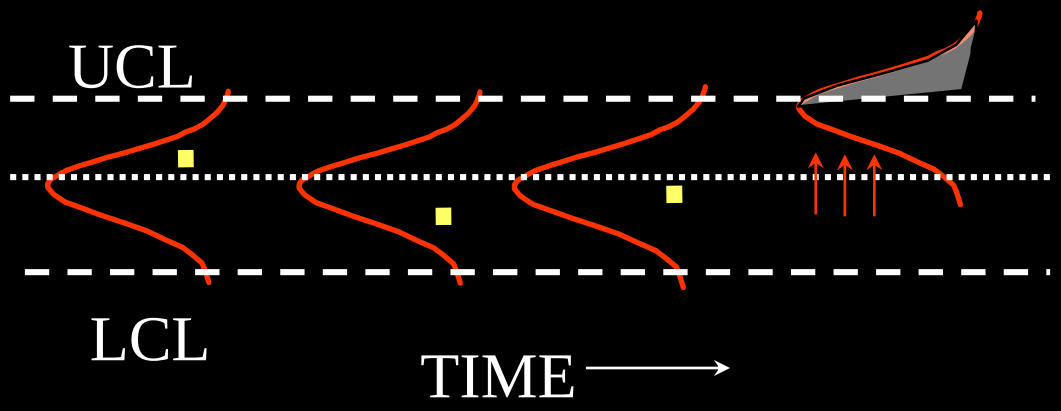


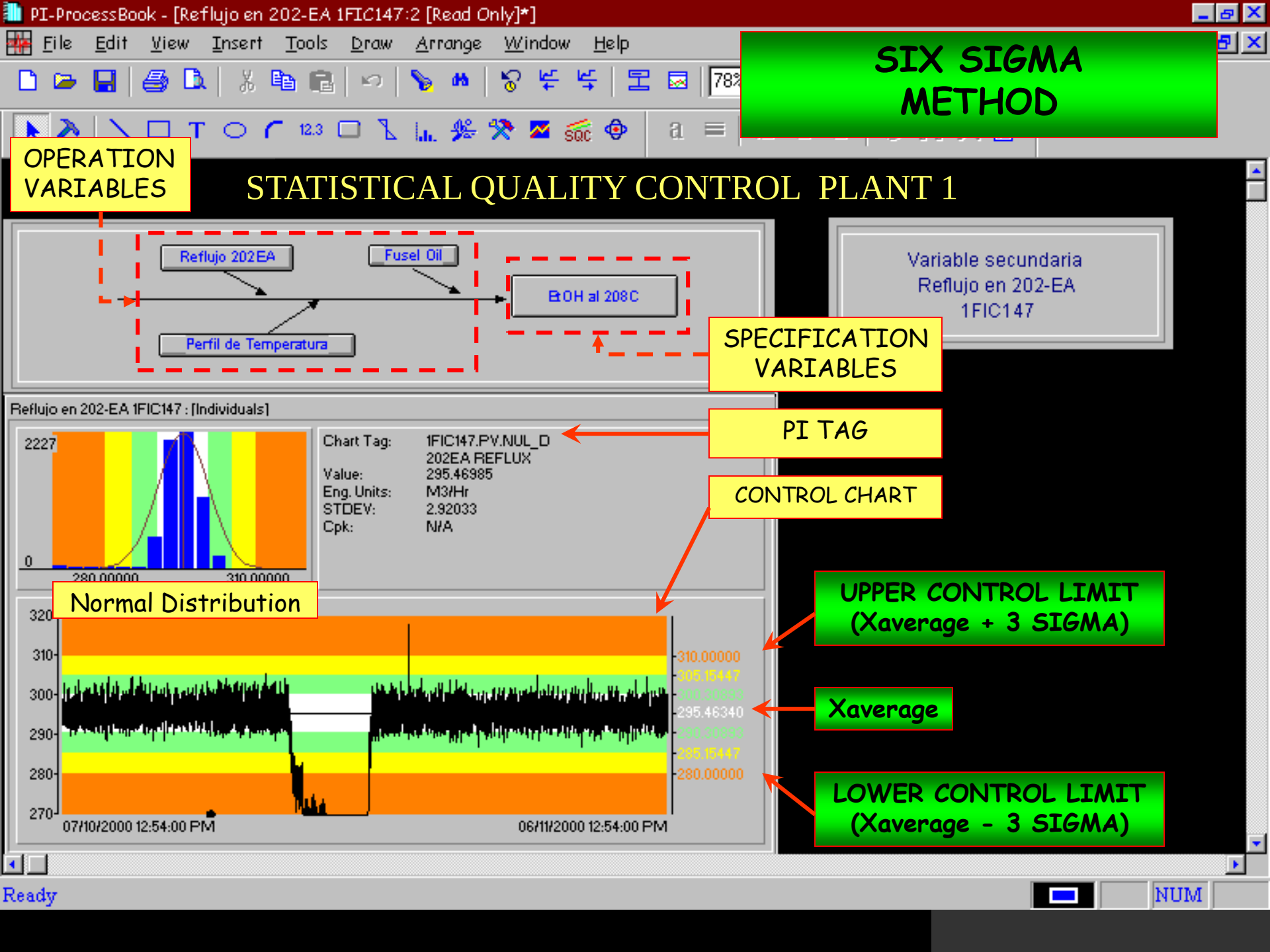
SQC Implementation

2. Determine control limits for each of the key process variables

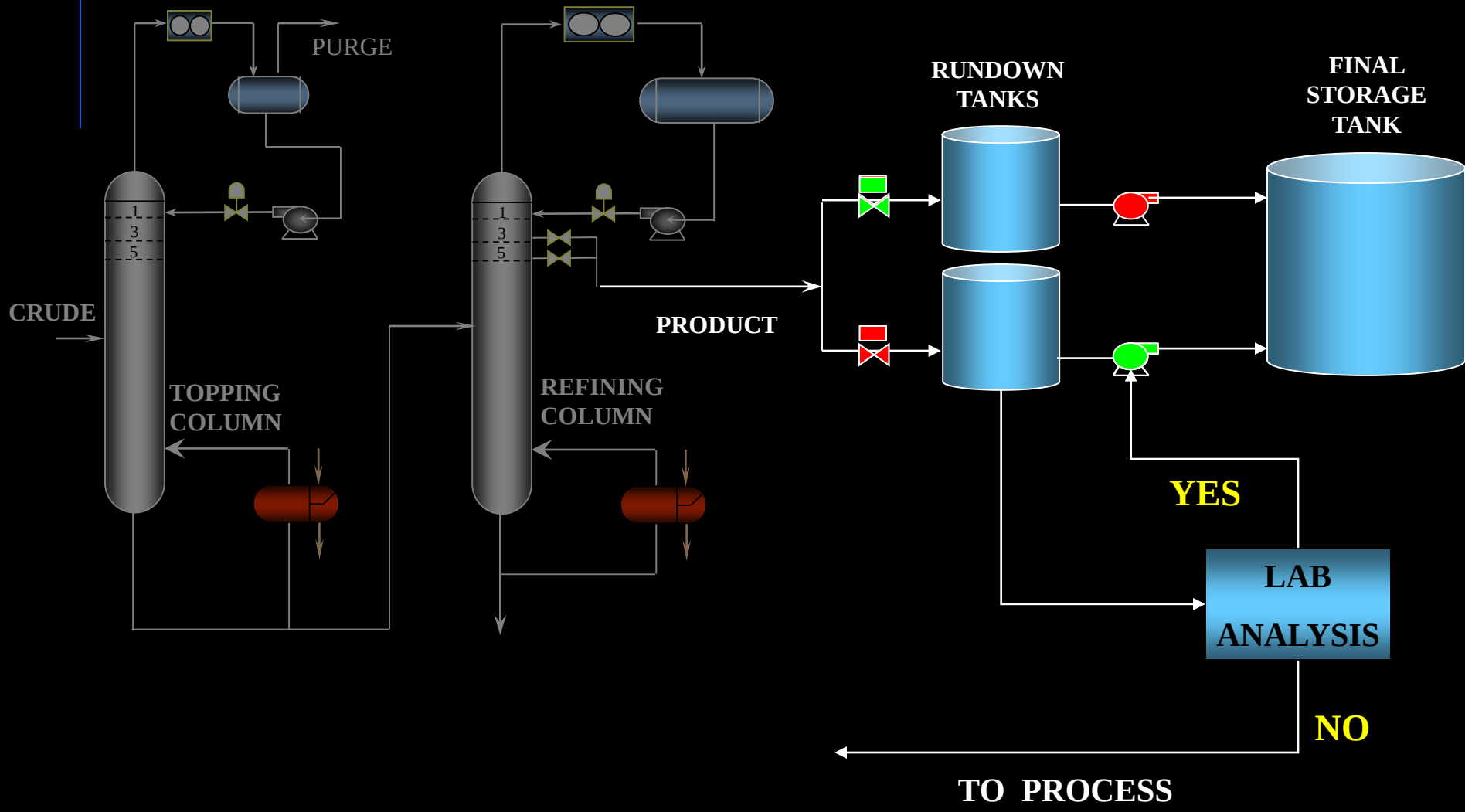
if data within control limits : under control

if data outside of control limits: find the assignable cause of the deviation

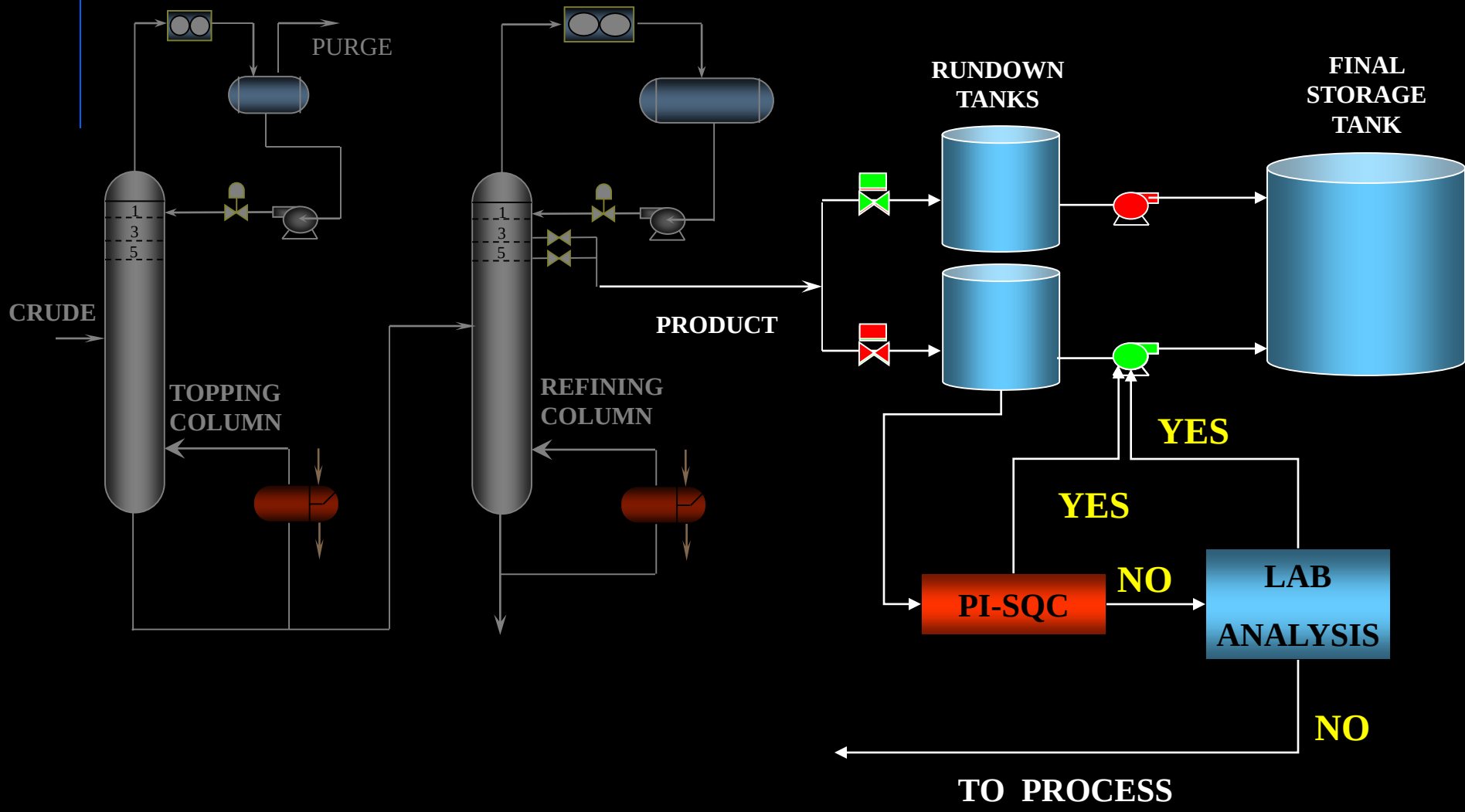



PI-ProcessBook - [Reflujo en 202-EA 1FIC147:2 [Read Only]*]
File Edit View Insert Tools Draw Arrange Window Help
SIX SIGMA METHOD
OPERATION VARIABLES
STATISTICAL QUALITY CONTROL PLANT 1
Reflujo 202EA
Fusel Oil
Perfil de Temperatura
EtOH al 208C
Variable secundaria
Reflujo en 202-EA
1FIC147
SPECIFICATION VARIABLES
Reflujo en 202-EA 1FIC147 : [Individuals]
PI TAG
Chart Tag: 1FIC147.PV.NUL_D
202EA REFLUX
Value: 295.46985
Eng. Units: M3/Hr
STDEV: 2.92033
Cpk: N/A
CONTROL CHART
Normal Distribution
UPPER CONTROL LIMIT (Xaverage + 3 SIGMA)
Xaverage
LOWER CONTROL LIMIT (Xaverage - 3 SIGMA)
310.00000
305.15447
295.46340
285.15447
280.00000
07/10/2000 12:54:00 PM
06/11/2000 12:54:00 PM
Ready
NUM

Before PI-SQC



SQC (Statistical Quality Control) 2001



SQC RESULTS

- Significant reduction in the number of Rundown laboratory analyses for all three plants.

From 3687 to 600 analyses/ year.

Money saved: US$ 270.000

- Reduction in the time spent by laboratory personnel in analysing the Rundown samples.

Time saved: 6 hours/day.

- Increased Plant Reliability: Since the implementation of SQC, product has always met quality specifications.

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Developments

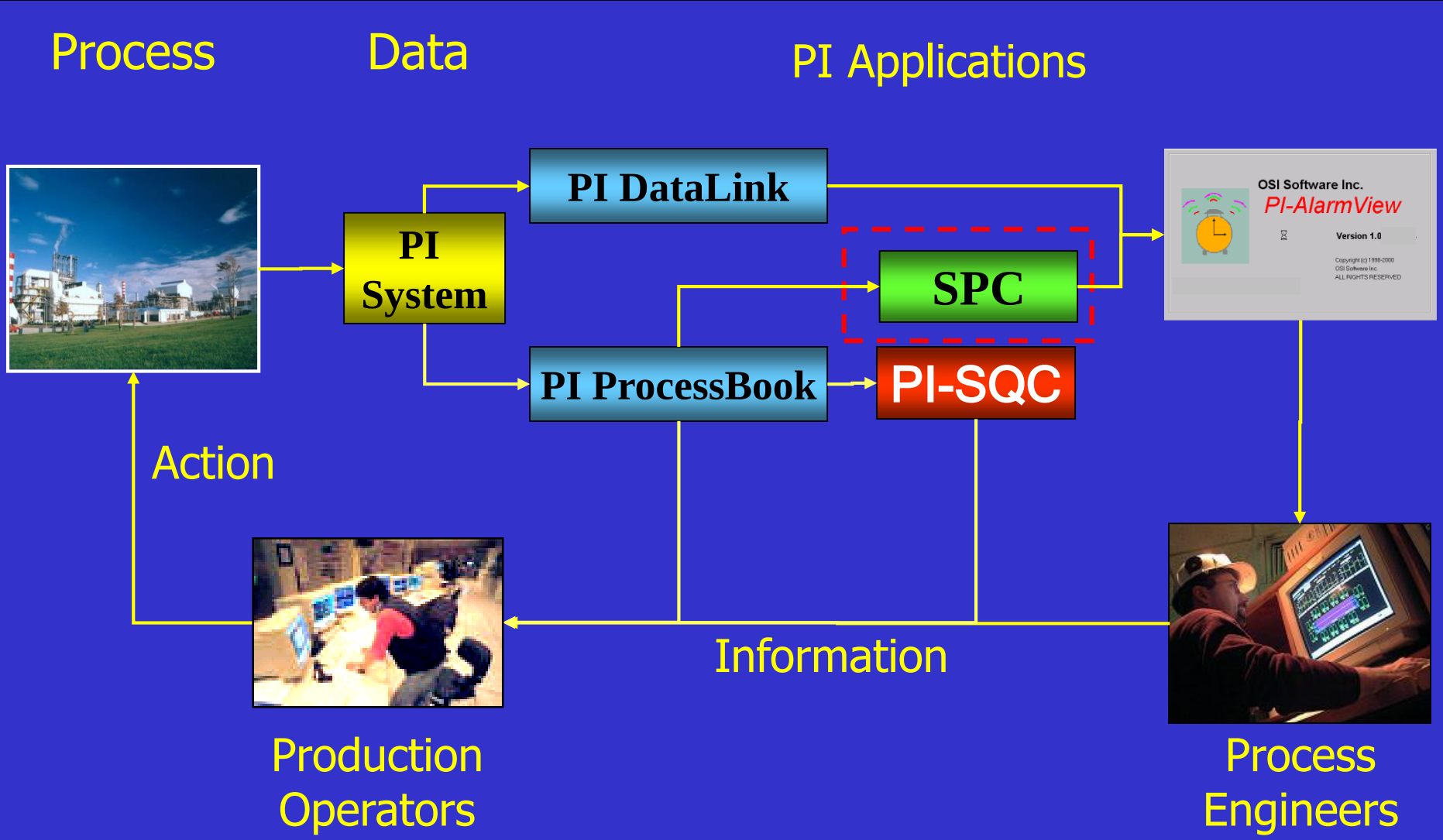
- SQC STATISTICAL QUALITY CONTROL (2001)

  Focus on Quality Product

- SPC STATISTICAL PROCESS CONTROL (2004)

  Focus on Process Performance

Process Performance



SPC Current Developments

- Display Developments in PI Processbook for each area of the plant
- Key Process Parameters were determined
- Obtain Optimal Control Limits for each parameter
- Implement PI AlarmView for rapidly detecting Process Variables that deviates outside their control limits

SPC - Expected Results

- Reduction and optimisation of the time necessary for proper monitoring of the process variables
- Possibility to quickly respond to any process variable deviation, thus increasing plant reliability
- Possibility to maintain optimal plant operating conditions
- Protection of equipment against operating conditions outside design specifications.

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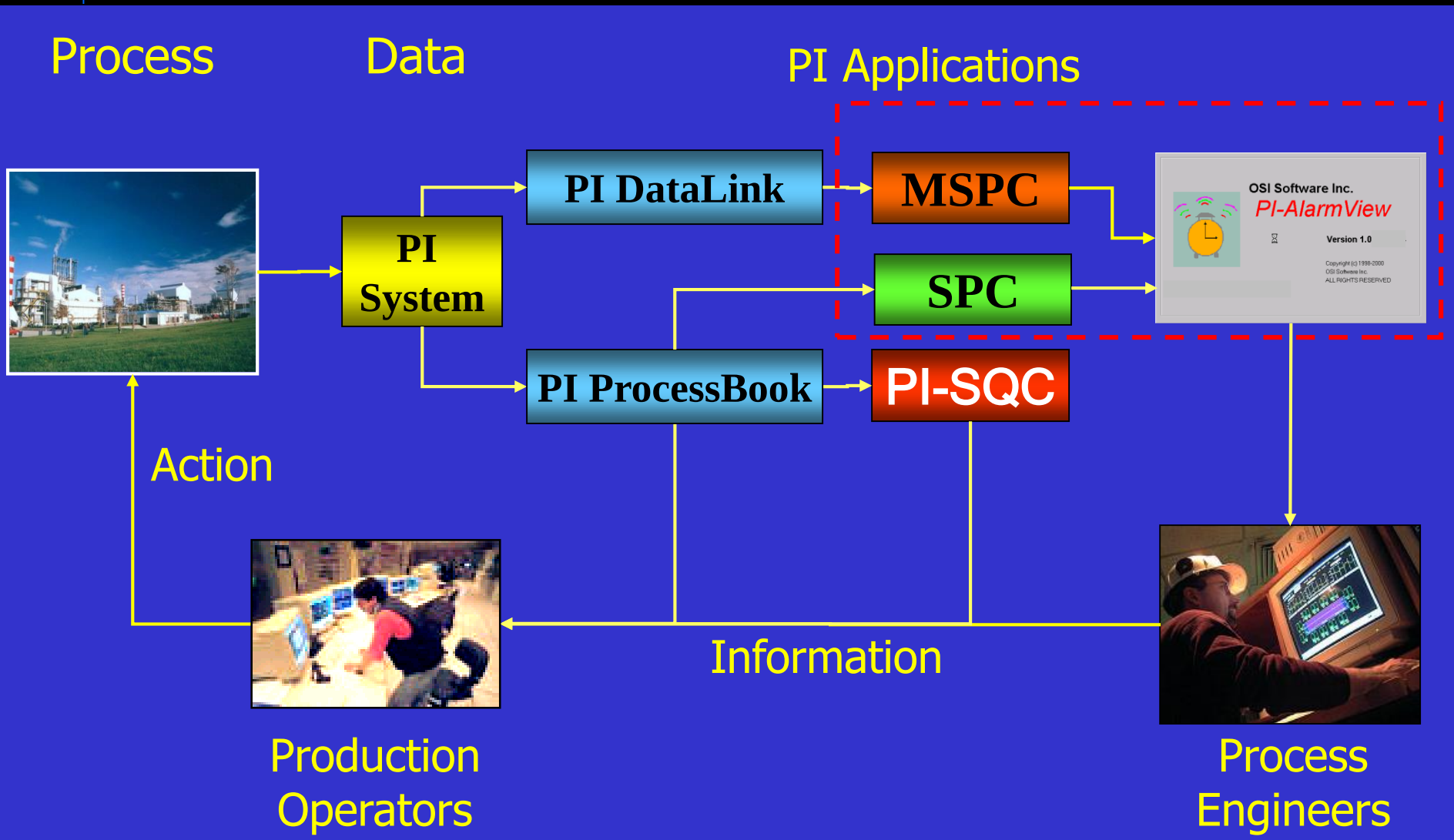
MSPC Multivariate
Statistical Process Control
Process Performance
Monitoring

Coming Soon 2004



What we did?

- Only in Reforming Area there are 202 Specifications and Operations Variables
- Monitoring all variables is difficult and you must choose the most important for do it, losing process information
- MSPC Models can resume all this information in a few pseudovariables named *Variability Factors* reducing the number of variables for monitoring, but without losing information of process behavior.

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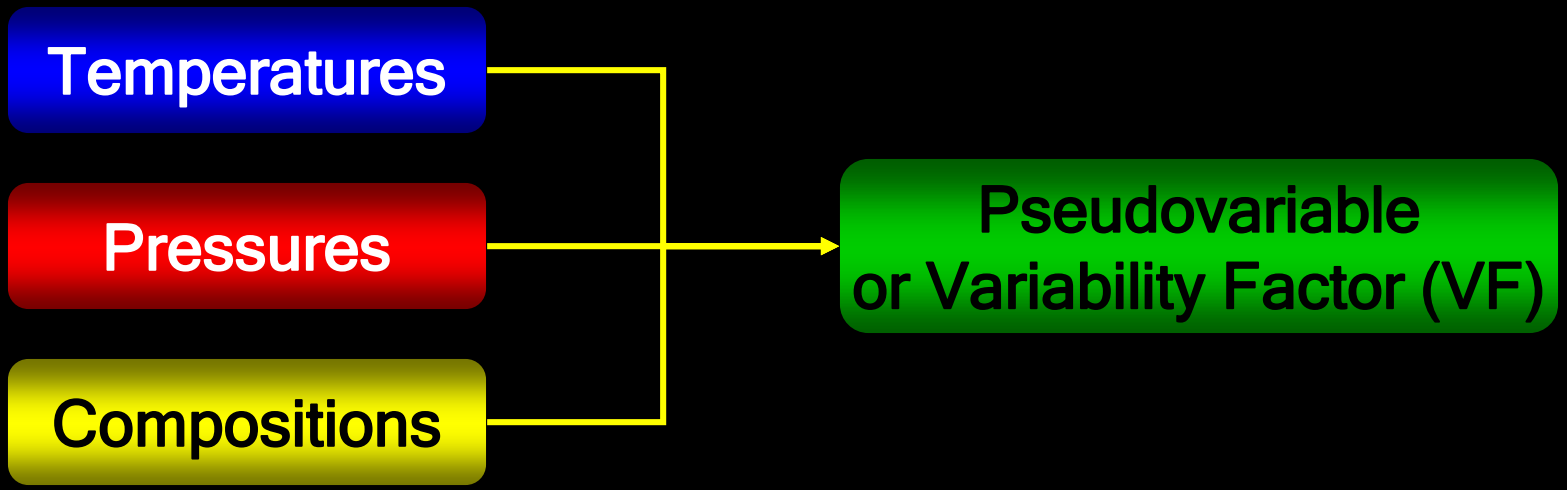
What we did?

- Replacing groups of variables with one representative pseudovariable each



What we did?

Reformer Operation Model (Chile II)

202 Specifications and Operation variables

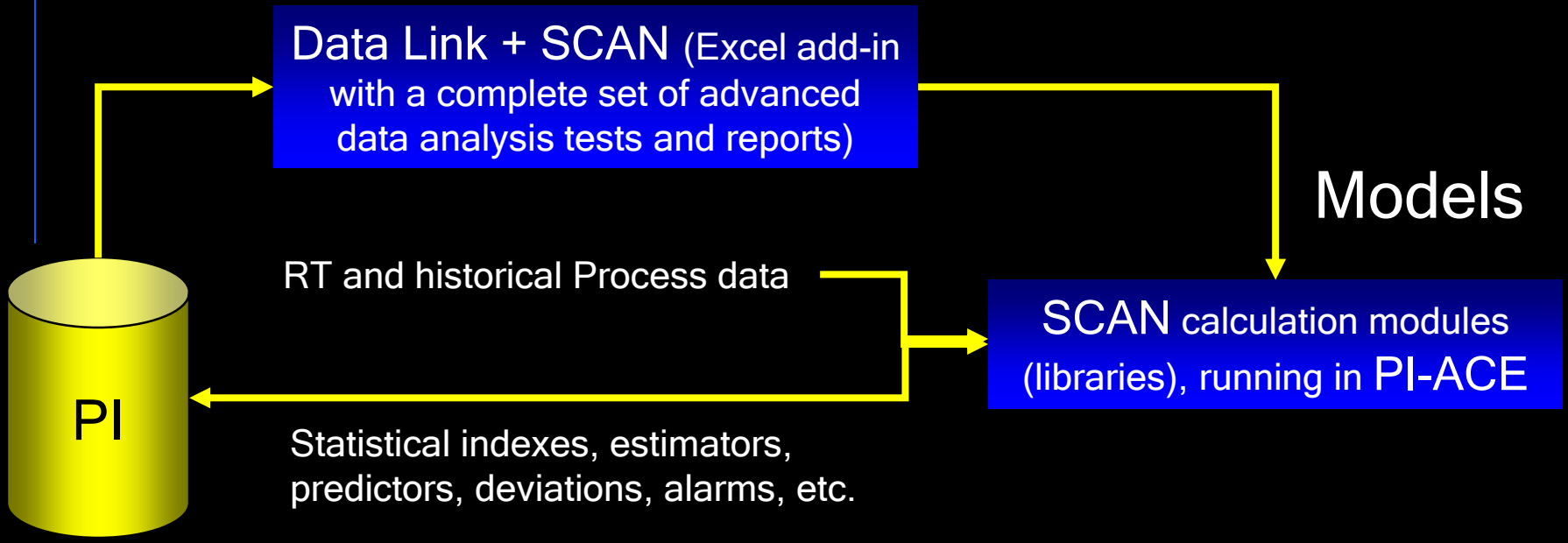
↓

Variability Factor Method

↓

18 Variability Factors

How we did?



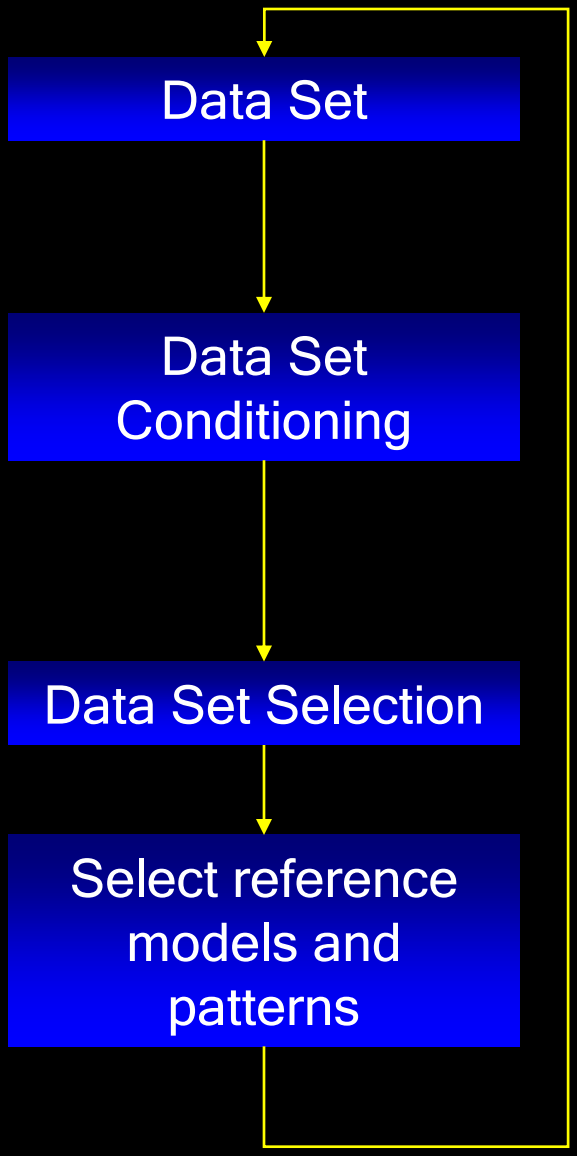
OFF LINE

Use of historical information for the analysis of cause-effect relationships and plant behavior patterns

ON LINE

Use of pattern parameters for early detection of abnormal Operational Conditions, quality predictors and Estimators for process variables.

Process Data Analysis :Off-Line analysis



Acquirement of data time series and related information: Representing normal operation, failures, seasonal changes, operation procedures, etc.

Checking for out of range, missing data

Filtering, Averaging

Generation of new (calculated) variables:

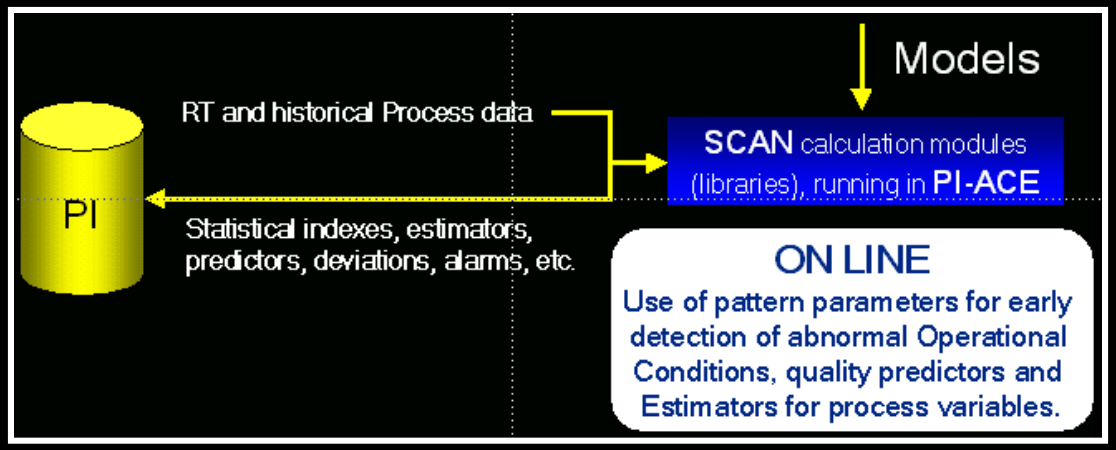
- Incorporation of Delayed Variables into the analysis
- Incorporation of phenomenological knowledge

Data Clustering, based on the operation characteristics which are being studied

Test application, definition of test sequences, selection of model parameters and variables, training refining

- Model and pattern definition (or “model training”) is an iterative process
- Data Link + Excel + SCAN: the training environment

Scan-PI :Online Applications



ACE Calculation

Calculation execution trigger based on:

- *Time (clock)*
- *TAG Value*

- Tests are managed as ACE calculations
- Test inputs are “PI TAG´s”
- Test outputs are “PI TAG´s”
- Test parameters are maintained in PI MDB modules

This inherently modular architecture allows for:

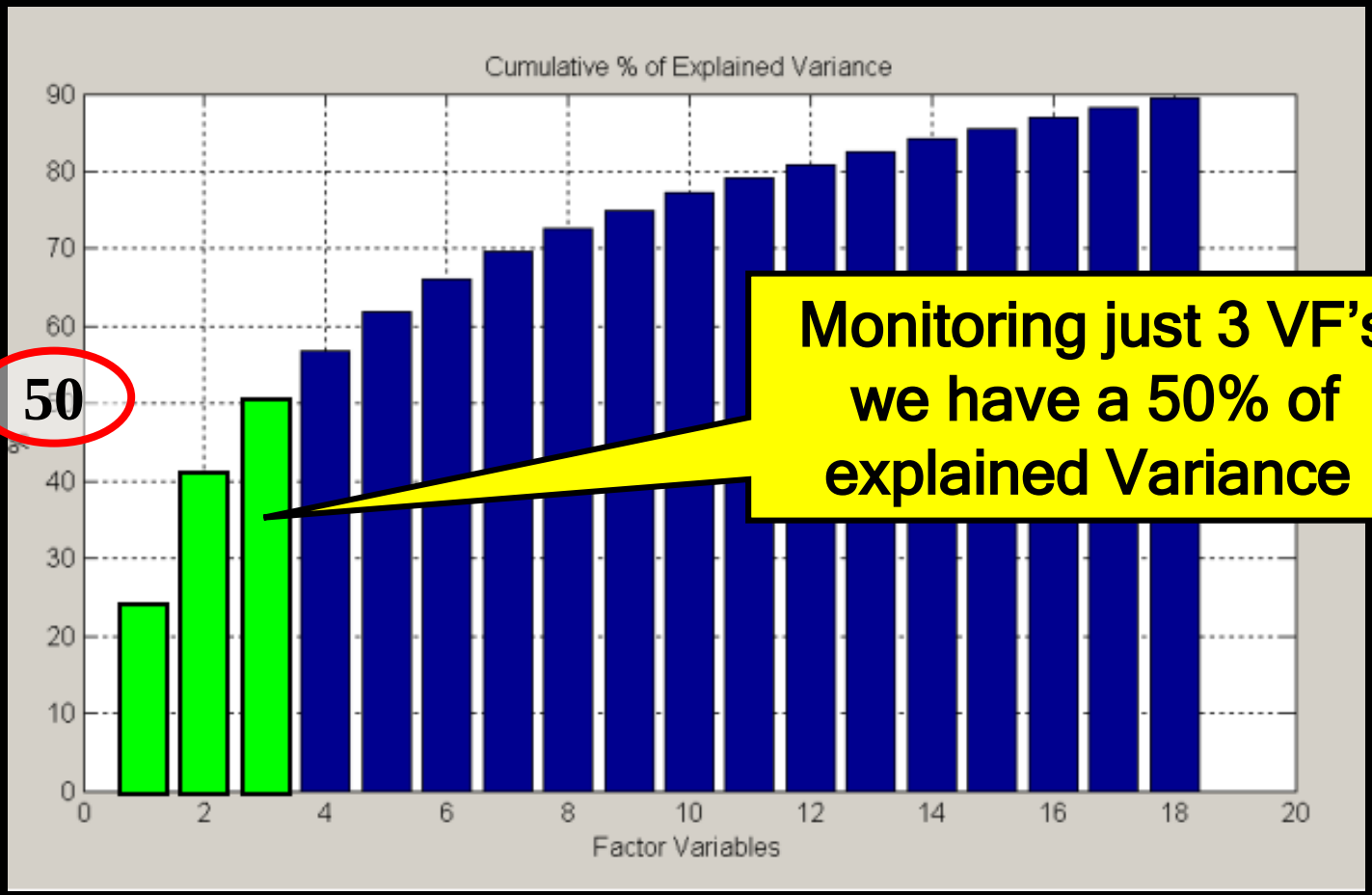
<u>Test enable/disable</u>:

- Run $Test_1$ whenever ....., or TAG Value is ..... or..... GT than .....
- Run a $Test_2$ every ..... [min]

<u>Multi-test Linking</u>

- $Test_1$(input) equals $Test_2$(output)

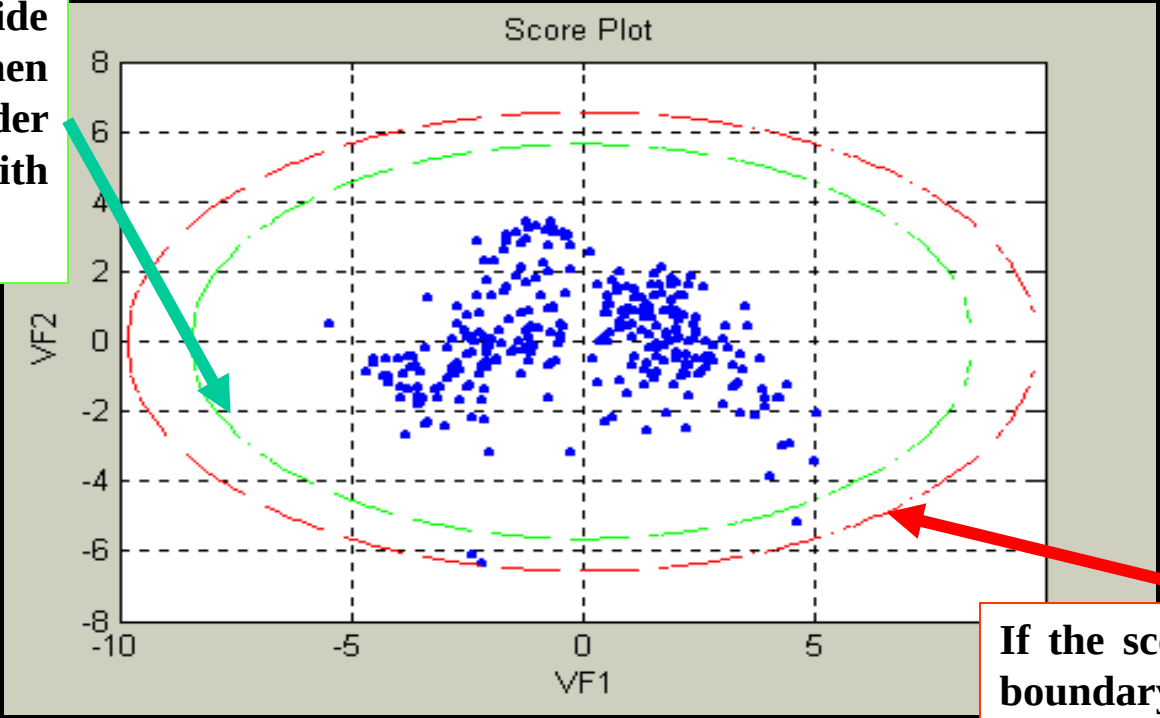
2002-2003 MSPC Reformer Model Chile II



Current MSPC : Score Plot

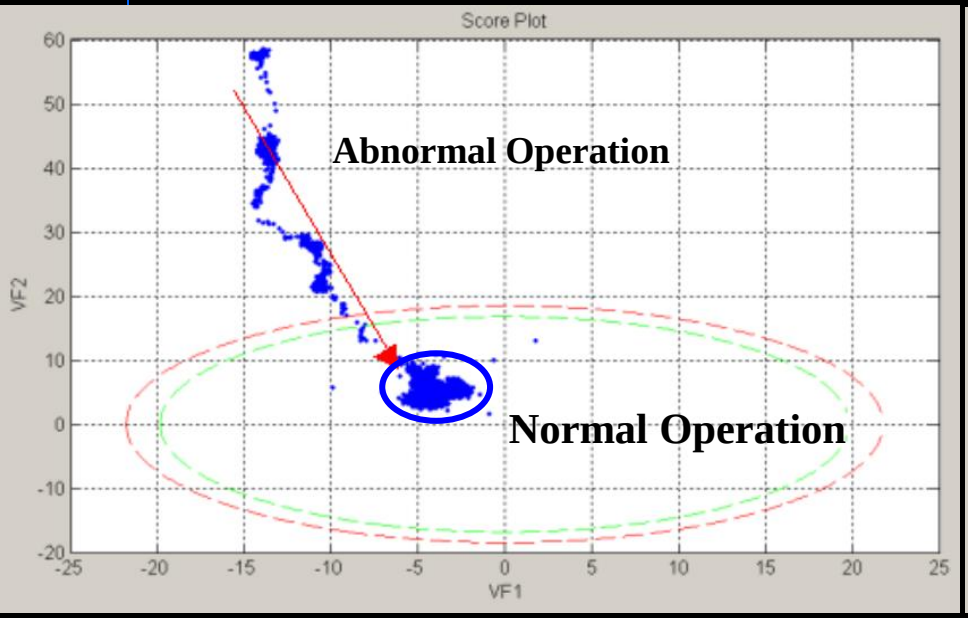
The Score Plot defines the statistical boundaries for desired (or normal) operation of the entire process. Thus, it is possible to define the membership of the present behavior to any desired operational condition.

If the score is inside this boundary, then process is under desired operation with a 95% confidence

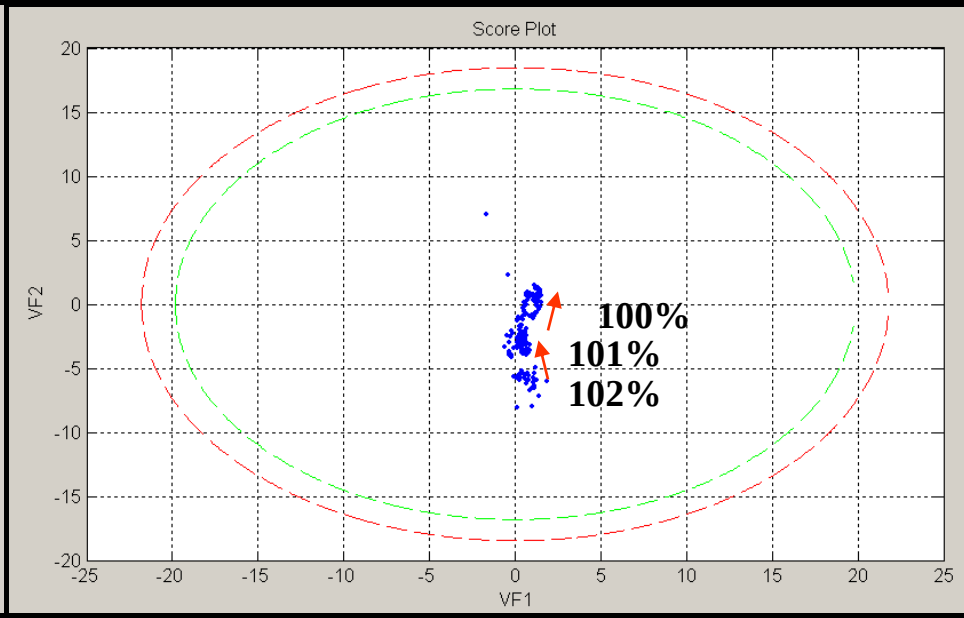


If the score is inside this boundary, then process is under desired operation with a 99% confidence

Now MSPC can detect :

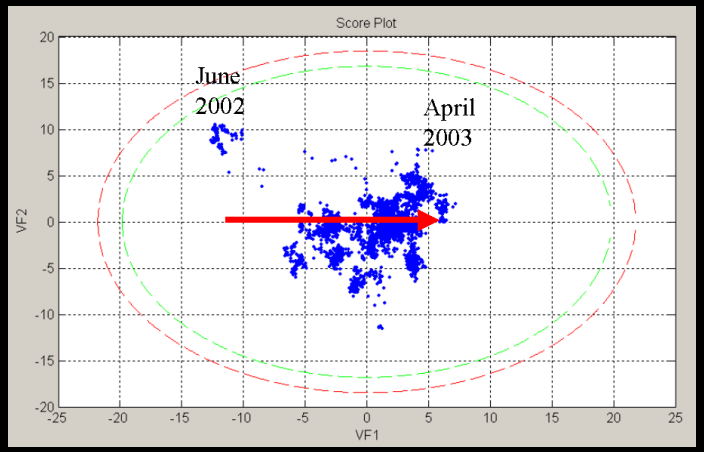


abnormal to normal operation change
It was monitored using only 1 chart

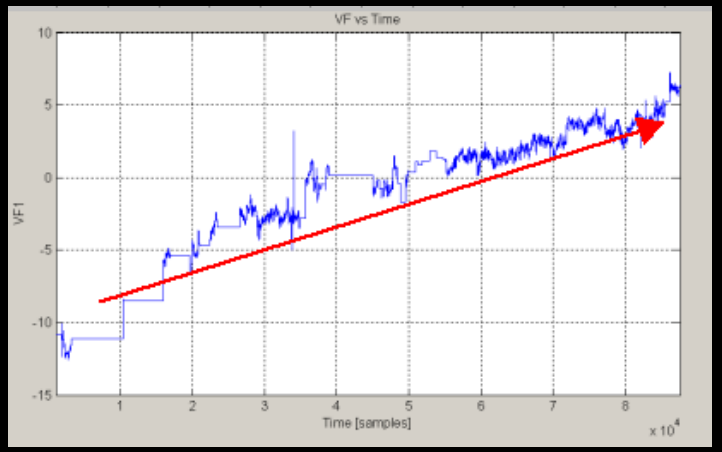


feed gas change on Reformer Area
(Normal Operation)

2002-2003 MSPC Reformer Analysis



Normal Operation June2002-April 2003



Variability Factor Analysis shown no constant behavior for VF1 only.

More important operation variables for VF1 :

Descripción	Tags	Loadings
E-104 MXD TEMP.prom	2TI1452 A/B/C	0.2587
E-105 NG TEMP.prom	2TI1451 A/B/C	0.2397
PREHEAT COMB. AIR	2TI1449.PV.NUL_D	0.2313
H-101 TO BURNER 1 prom	2TI1340 A/N	0.2176
SUPRHT STM HDR	2TIC1458.PV.NUL_D	0.2132
E-106 Combustion Air Temp.prom	2TI1453/1454 A/B/C	0.2130
Temp.Mixed Feed to Reformer	2TIC1448.PV.NUL_D	0.2113
E-107A BULL TEE TEMP.prom	2TI1361-(1-3)LCP.CV(1-4).NUL_D	0.2105

All these variables are located on Convection Reforming Area

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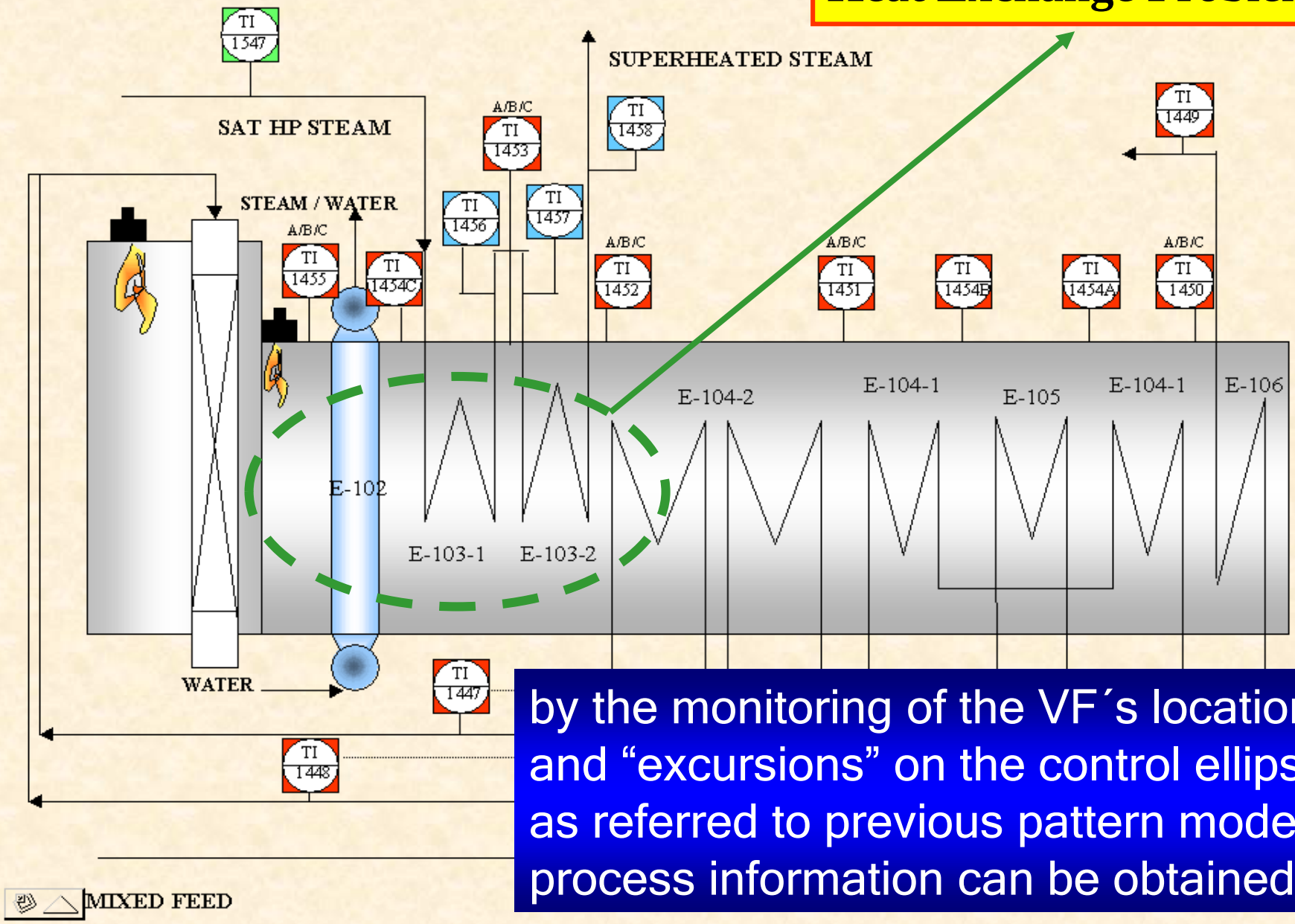
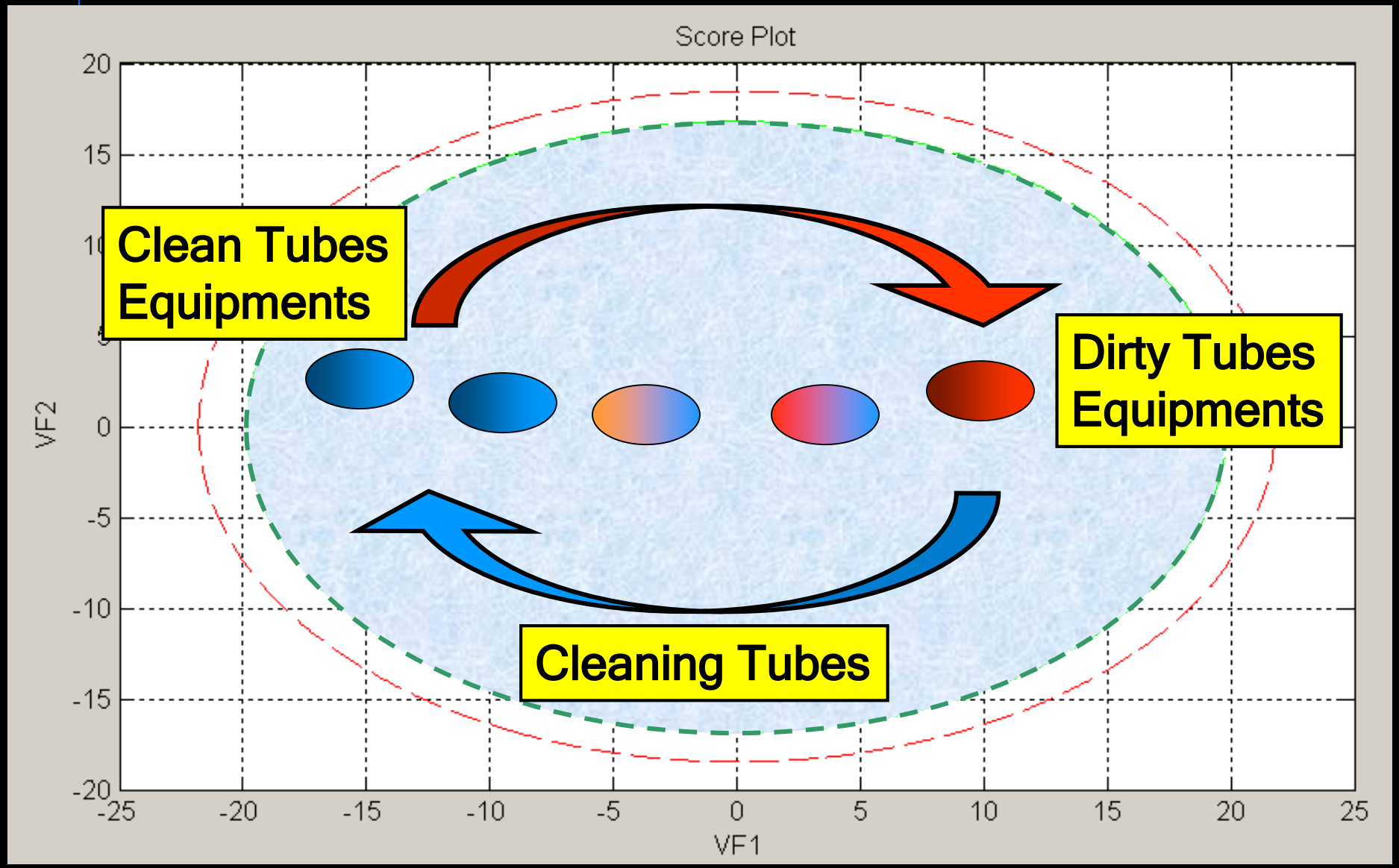
Heat Exchange Problem

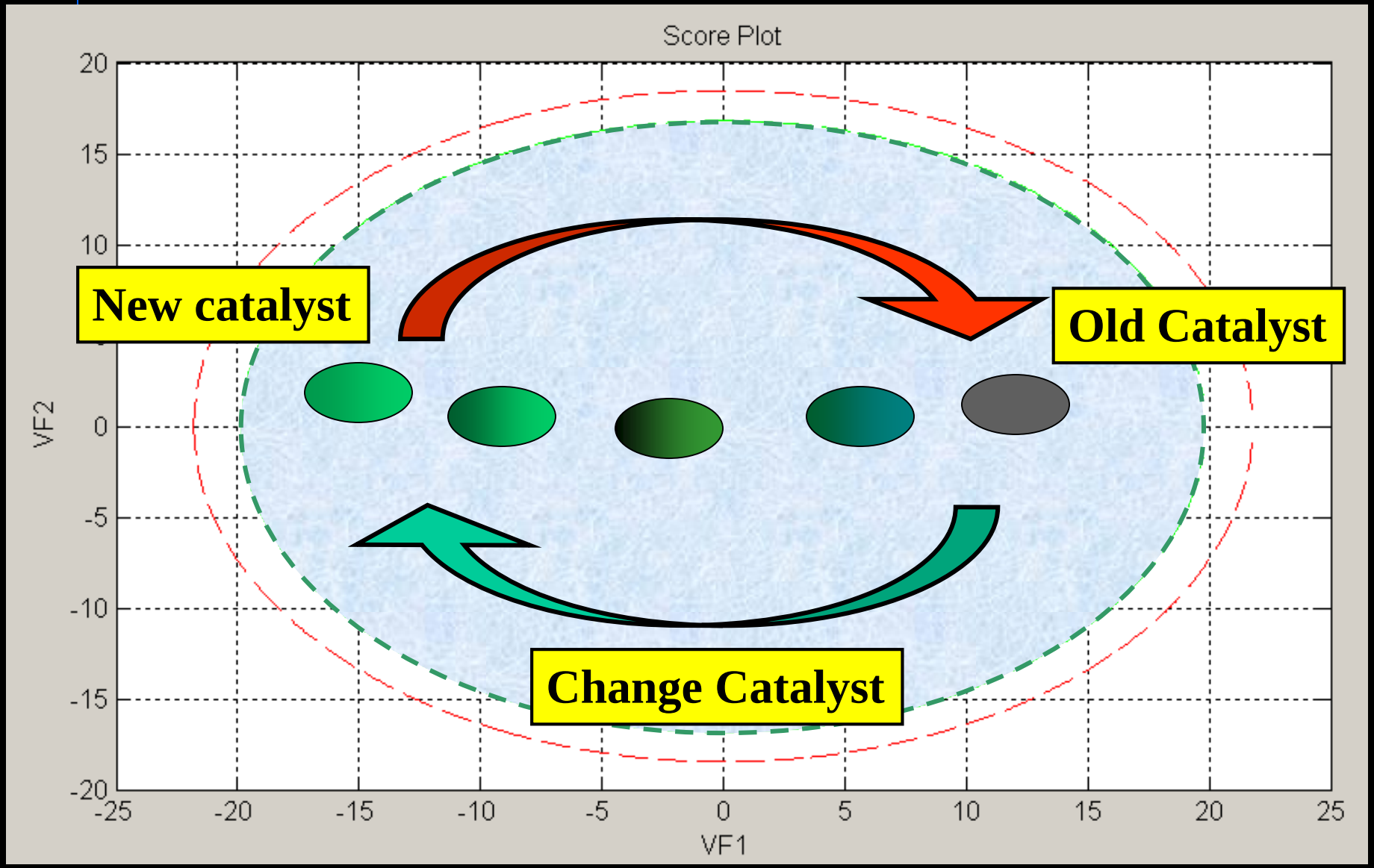


by the monitoring of the VF´s location and “excursions” on the control ellipse, as referred to previous pattern models, process information can be obtained

MSPC model can monitoring reformer heat exchange



MSPC model can monitoring reformer catalyst life



Current MSPC Developments

- Generate MSPC models for Reforming, Synthesis and Distillation areas for three methanol Plant
- Upgrade to **PI+ACE+SCAN (MSPC) online**

Results expected MSPC Online

- Effect of interaction of process variables on product
- Integration of control of all areas and plants
- Overall view of operating conditions
- Complementary information to PI-SQC

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Conclusions

1. Easy, fast, economical way to maintain optimal process conditions and quality control by monitoring process variables

2. Quick response time in case of process variable deviation from normal operating conditions

3. Protection of equipment against operating conditions outside design specifications

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Thank You.

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