The Importance of Standards to the Future of the Hydrocarbon Processing Industry

REFCOMM GALVESTON

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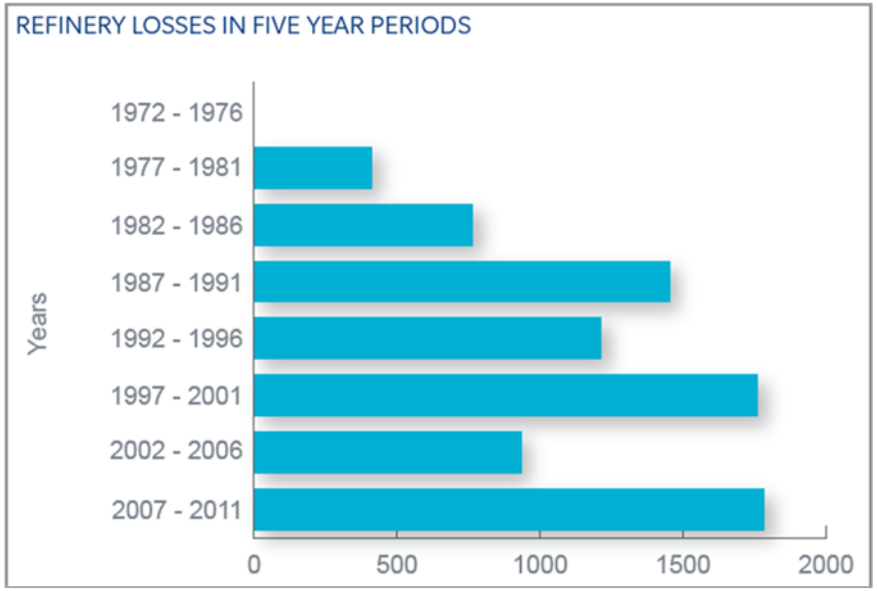
Industry Trends Impacting Process Operations

Refinery losses - upward trend



Source: Energy Practice of Marsh Ltd, a division of Marsh McLennan

Start up and shutdown events continue to be significant causes of refinery losses

Skills leaving the workforce

10,000 'Baby Boomers' per day retiring over the next 20 years

400,000 years of experience being lost per day

Incidents – Can Operators Cope?

Operator error or overload?

Three Mile Island, 1979

"the principle cause was human error"

Kern Oil Refinery Bakersfield, 2005

Workers over pressurized a pump casing which resulted in an explosion

Ciniza Refinery Gallup, 2004

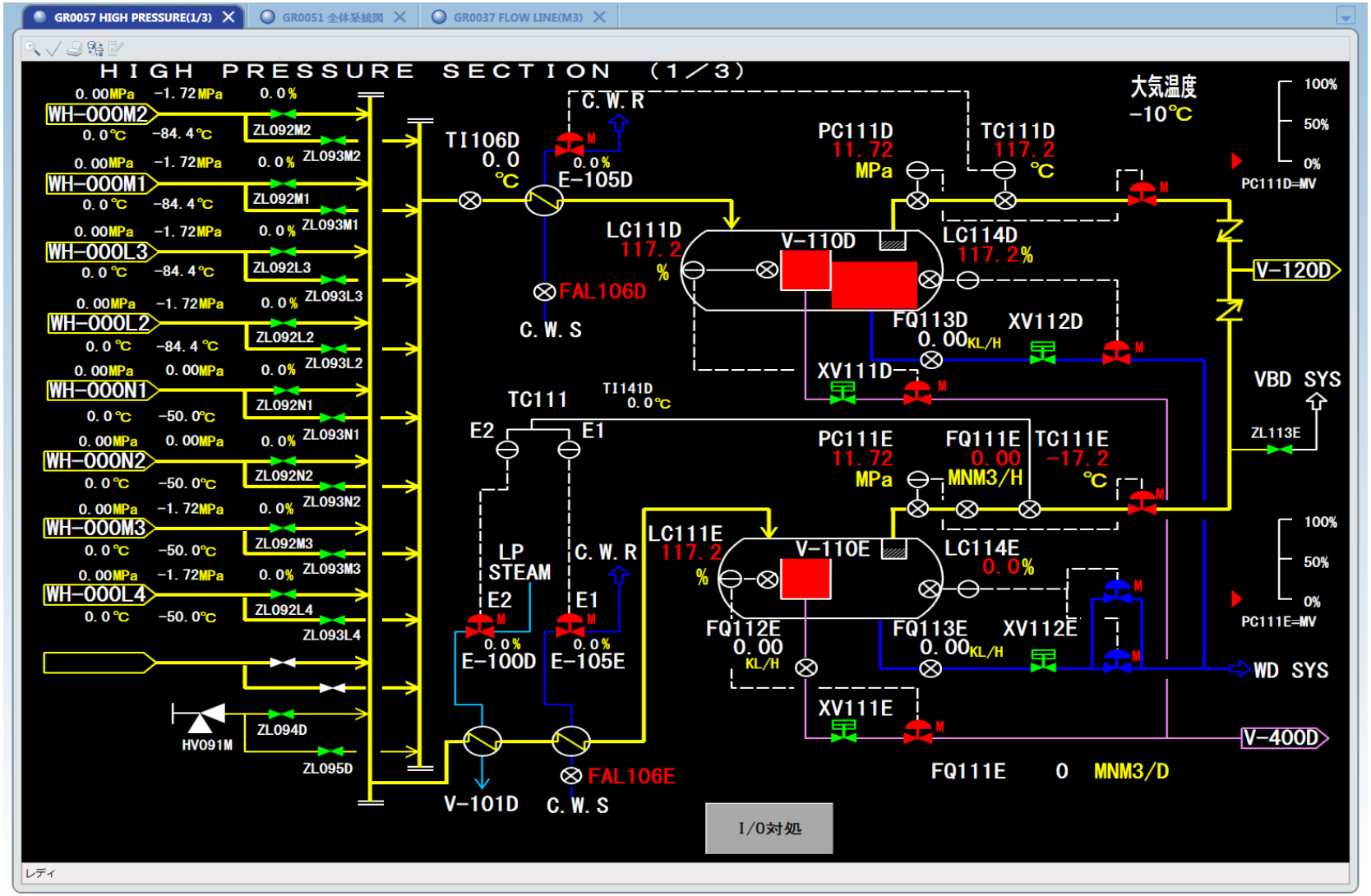
A shut off valve was not closed as required which caused a release of flammable liquids and caused subsequent explosions

Texaco, Milford Haven, 1994

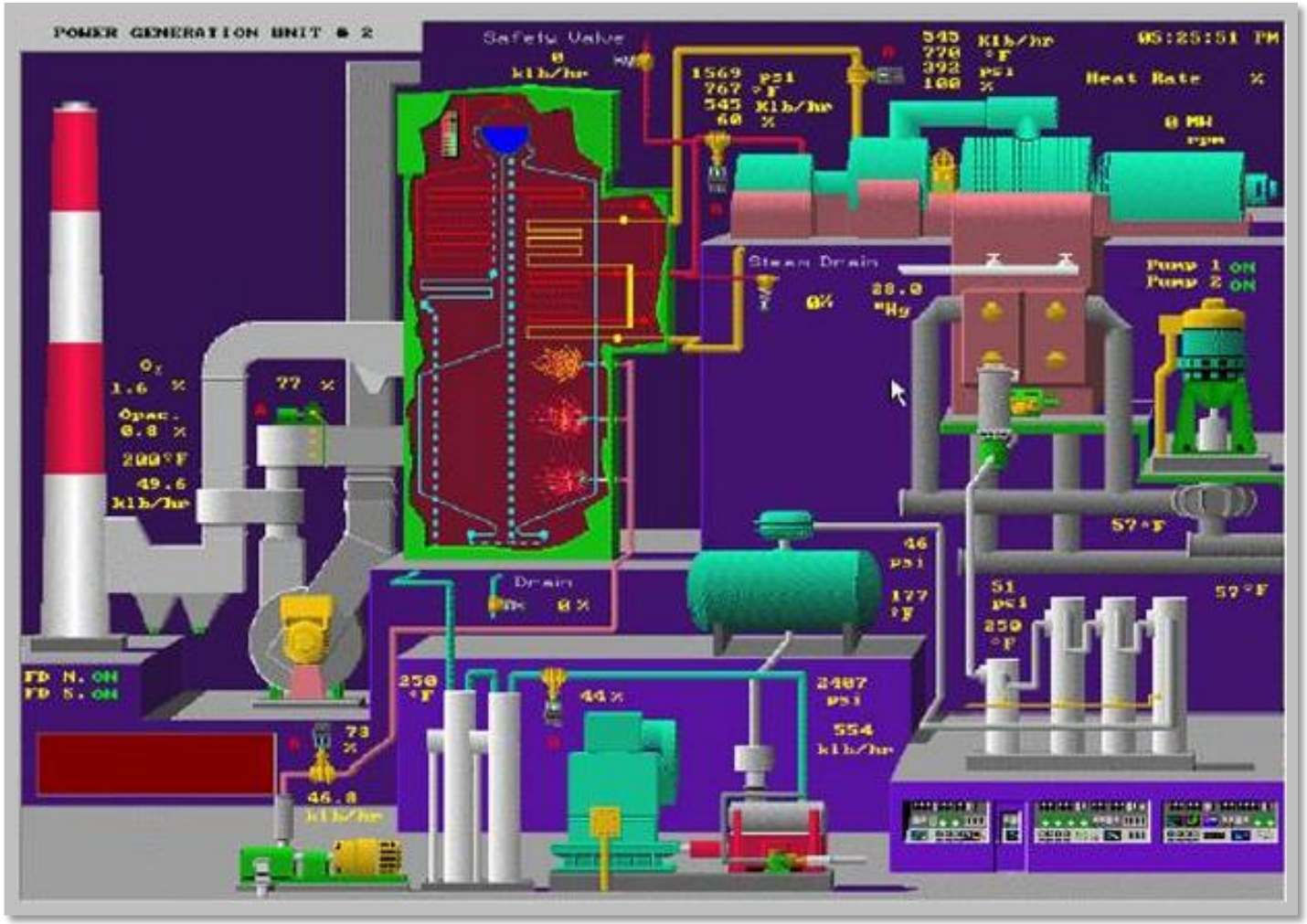
Operators had to recognize, acknowledge and act on 275 alarms in 11 minutes

Split Second Decisions

Now Try Operating a Plant the Same Way!



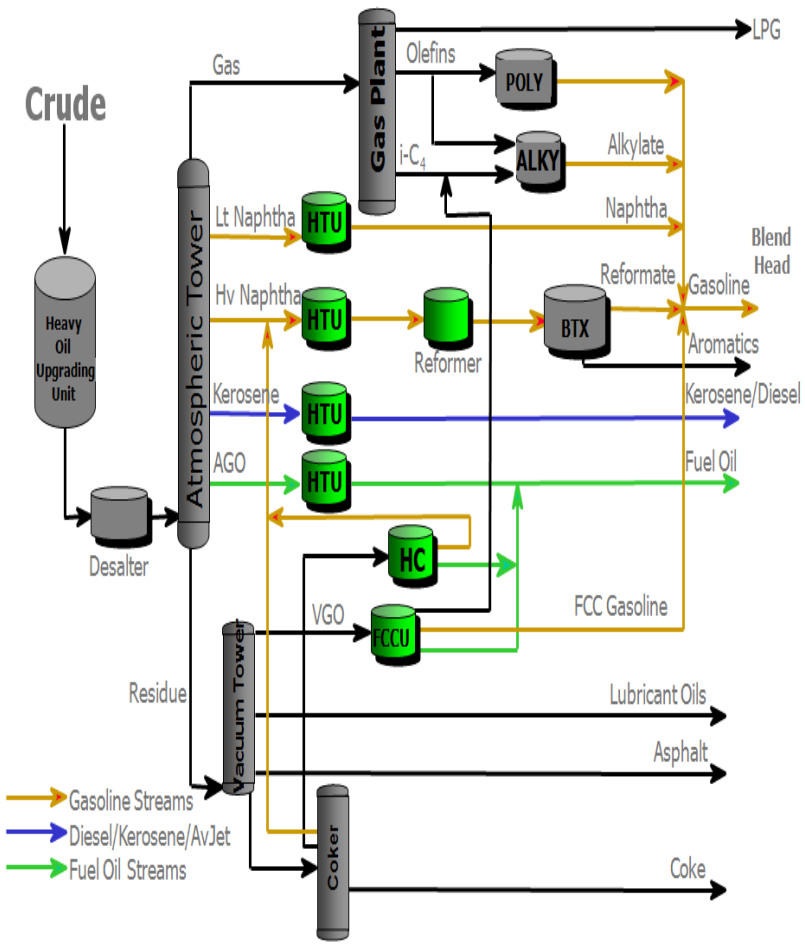
Is This a Good Operator Interface?



Where are the alarms – are they critical?

Flexibility in Operations is Important

- Startup
  - Frequency
  - Operator skill & experience
- Shutdown
  - Scheduled vs. Unscheduled
  - Operator skill & experience
- Feedstock and product transitions
  - Crude sourcing
  - Campaign based production
- Managing abnormal conditions
- Changing unit feeds & products
- Cycling of equipment

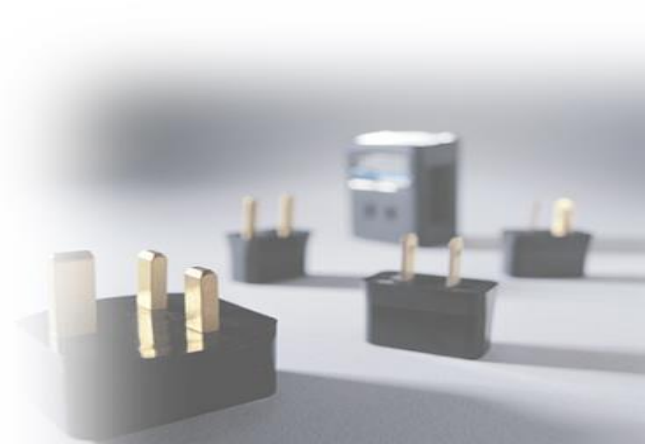


Operators Need Help

Manufacturers have realized that standards save money and lives

- Consistent and Safe Operations Companywide
- Knowledge Retention
- 'Act Instinctively'

Smart phones work anywhere in the world

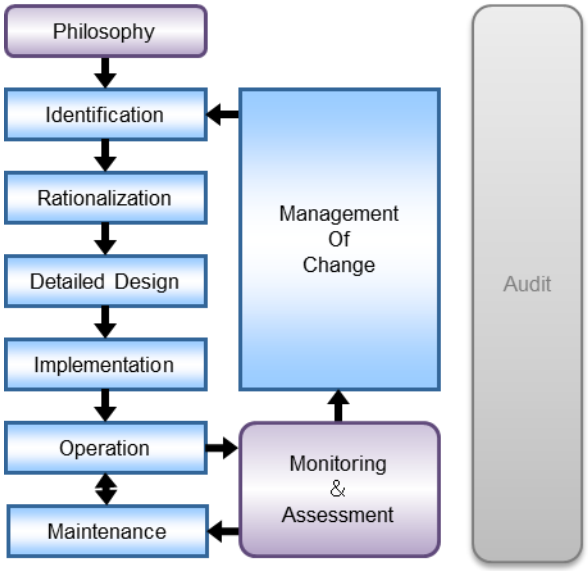


How many plugs or adaptors do you need?

Manufacturers are taking part in and driving more industry standards

Standards Based Decision Support

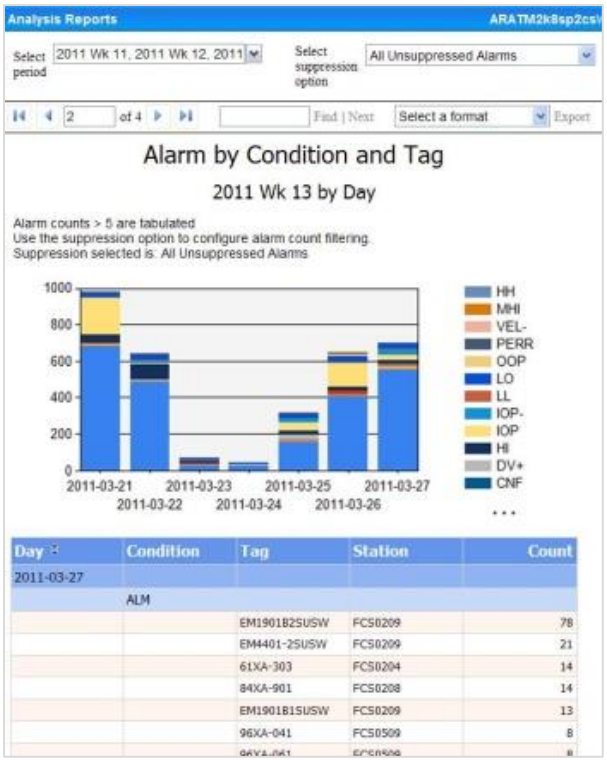
Comprehensive Alarm Management (ISA18.2)



ISA18.2 Lifecycle

Ensure the right alarms are detected

Either the operator or the system can take action



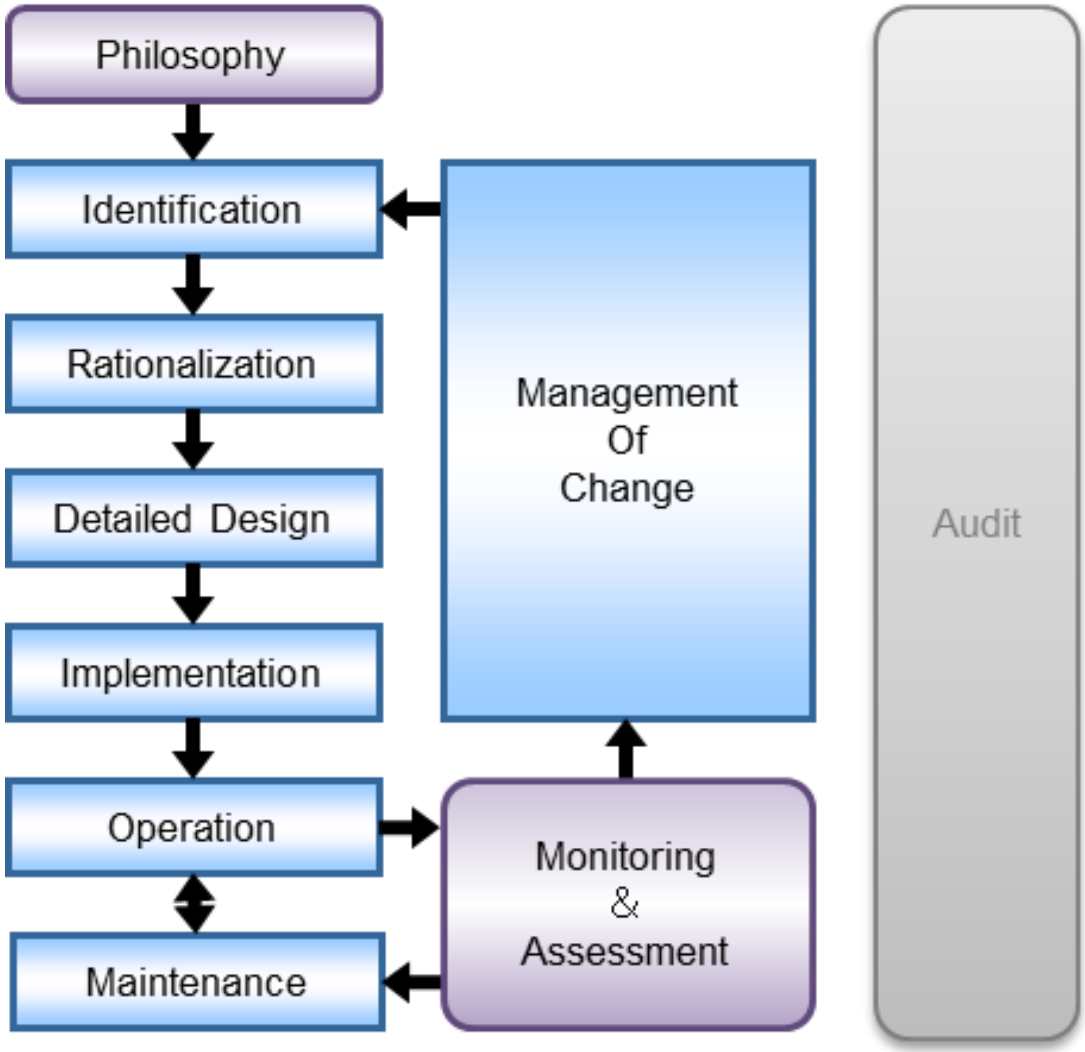
Limit alarms to what the operator has time and ability to handle

Alarm Philosophy

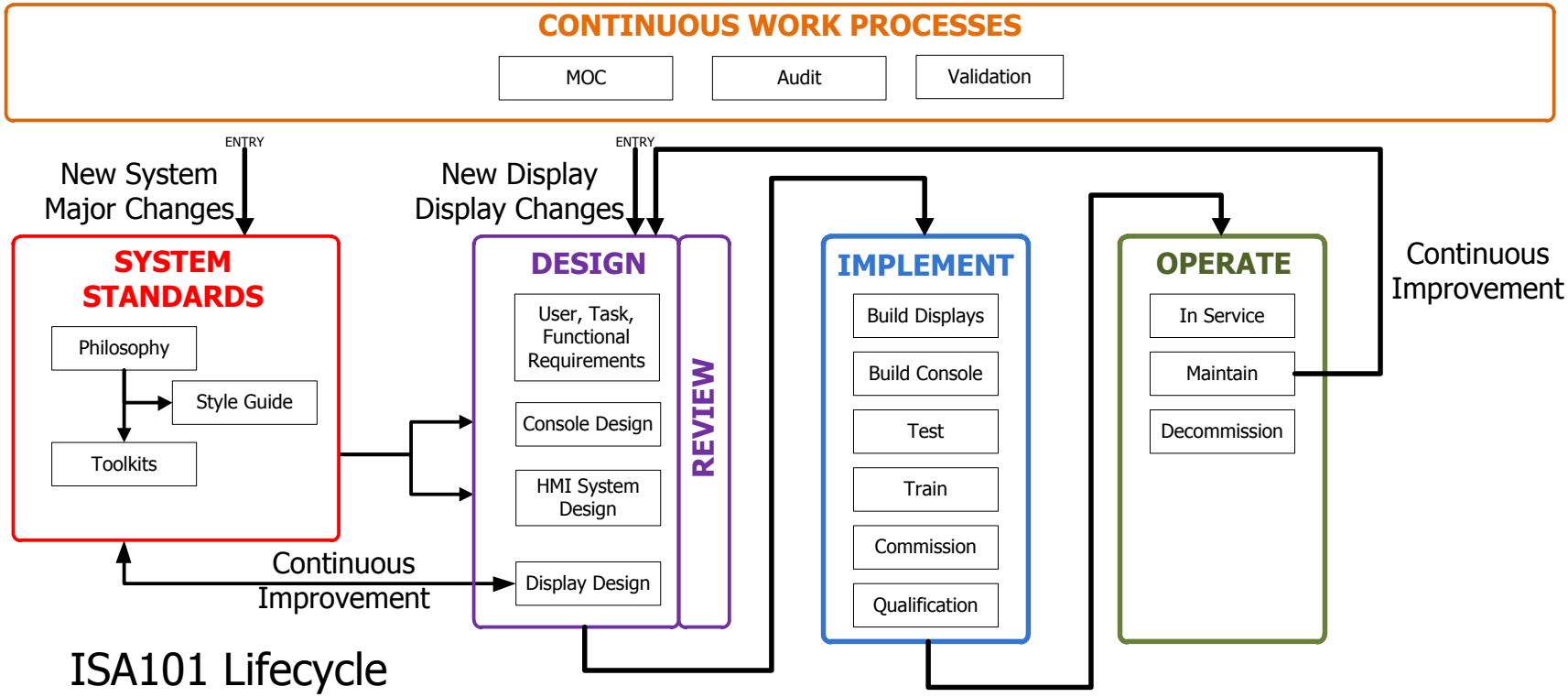
Alarm Rationalization

Continuous monitoring and optimization

ISA18.2 Alarm Management Lifecycle



Advanced HMI Management (ISA101)



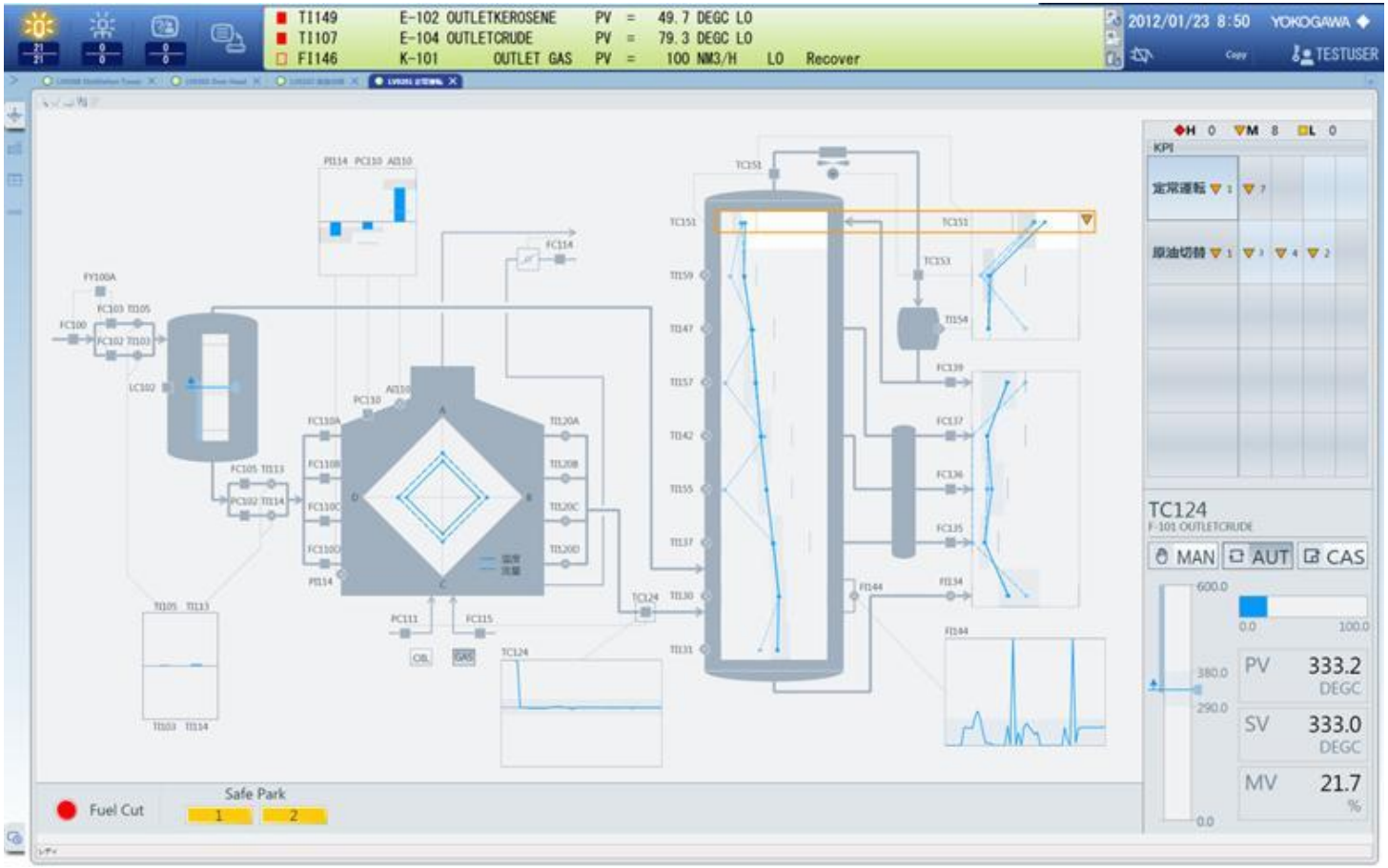
Design Based on Operator Tasks

Incorporate Human Factors (color, layout, navigation)

Provide Situational Awareness (trends, profiles)

Clear Indications – Items That Need Attention

This is a Good Graphic



- No contrasting colors
- Easy to identify alarms
- Information in context
- Low density

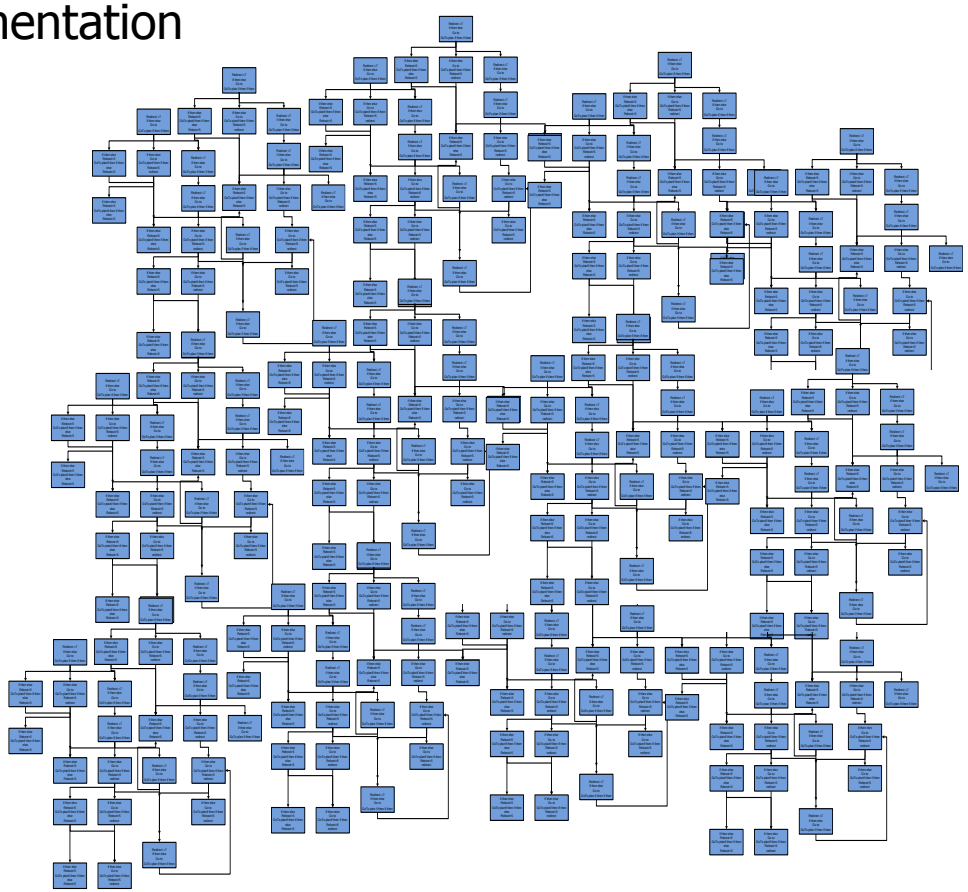
Issues with Procedure Automation

Many attempts at automating procedures have not met expectations

- Legacy programs and control systems
- Minimal structure and documentation
- Modification difficulties

Lack of confidence by operators

- Revert to using manual procedures out of frustration and inflexibly of the automated procedures



Procedure Management (ISA106)

Committee formed in 2010 in response to these industry issues

Three technical reports, then a standard

- TR1 – Models and Terminology
- TR2 – Work Processes (Lifecycle of Automated Procedures)
- TR3 – Examples of Automated Procedures

ISA–TR106.01

Technical Report:

Procedure Automation for Continuous Process Operations – Models and Terminology

- Models: Concepts to give the industry a common mental model for automated procedures
- Terminology: Definitions to give the industry a common language for automated procedures

User driven committee with representatives from most of the major energy companies in upstream, downstream and chemicals

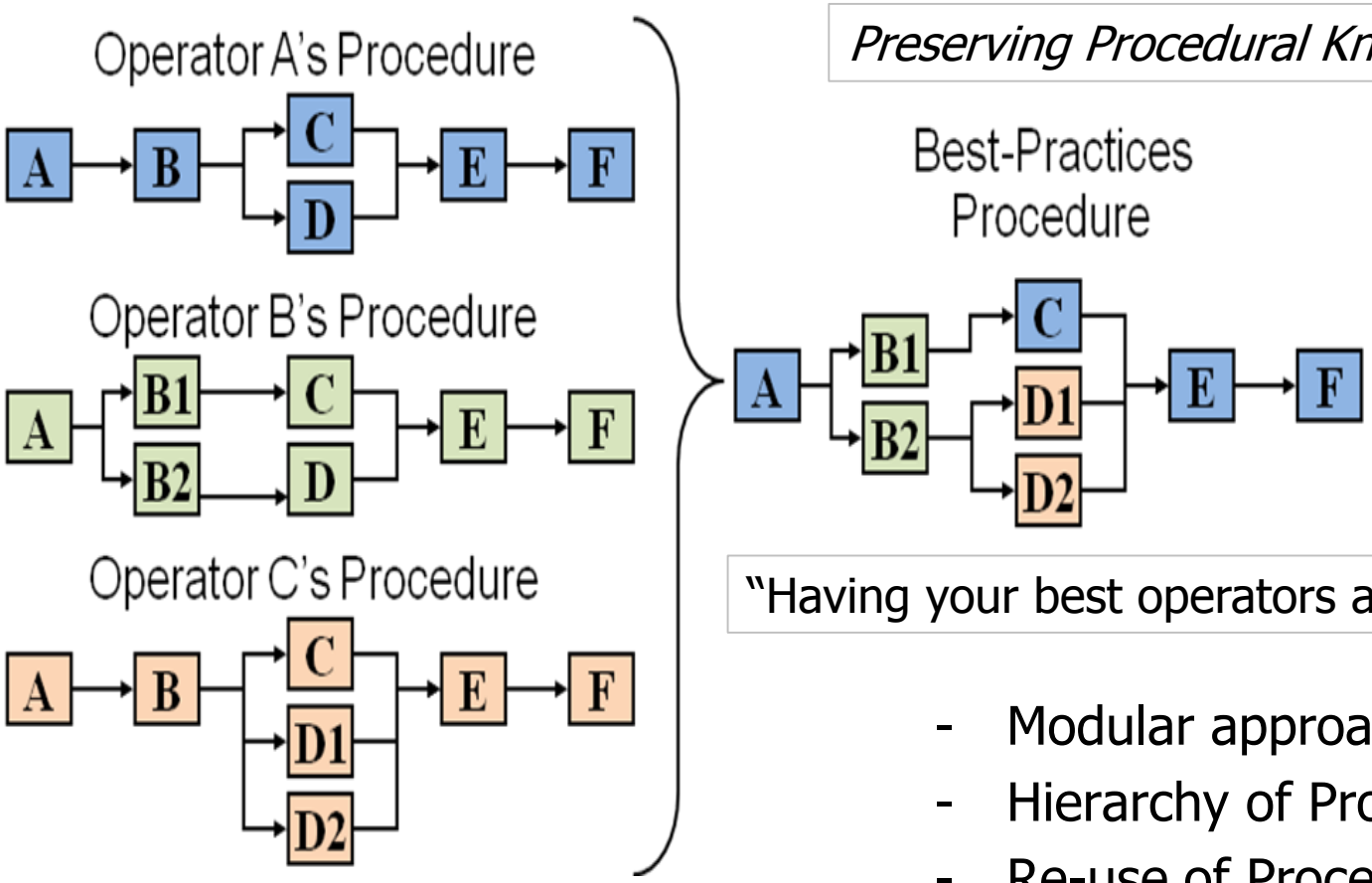
Capturing Procedural Knowledge

Much "procedural knowledge" is in the heads of the most experienced operators

They have their own tweaks that are often not in the SOPs or are their interpretation of an SOP

Automated procedures can capture the knowledge of the best operator on his/her best day…every day!

Procedure Management (ISA106)



Preserving Procedural Knowledge

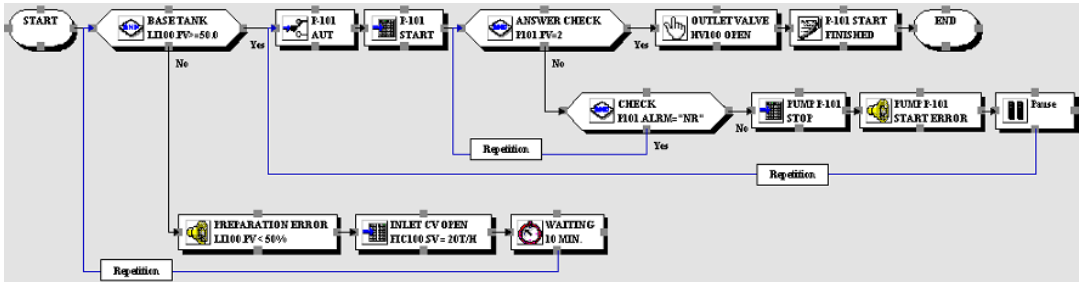
"Having your best operators all day, every day"

- Modular approach
- Hierarchy of Procedures
- Re-use of Procedural Logic
- Multi-site Consistency
- Scalable Approach

Capturing Best Practices Procedures

Modular Procedural Automation

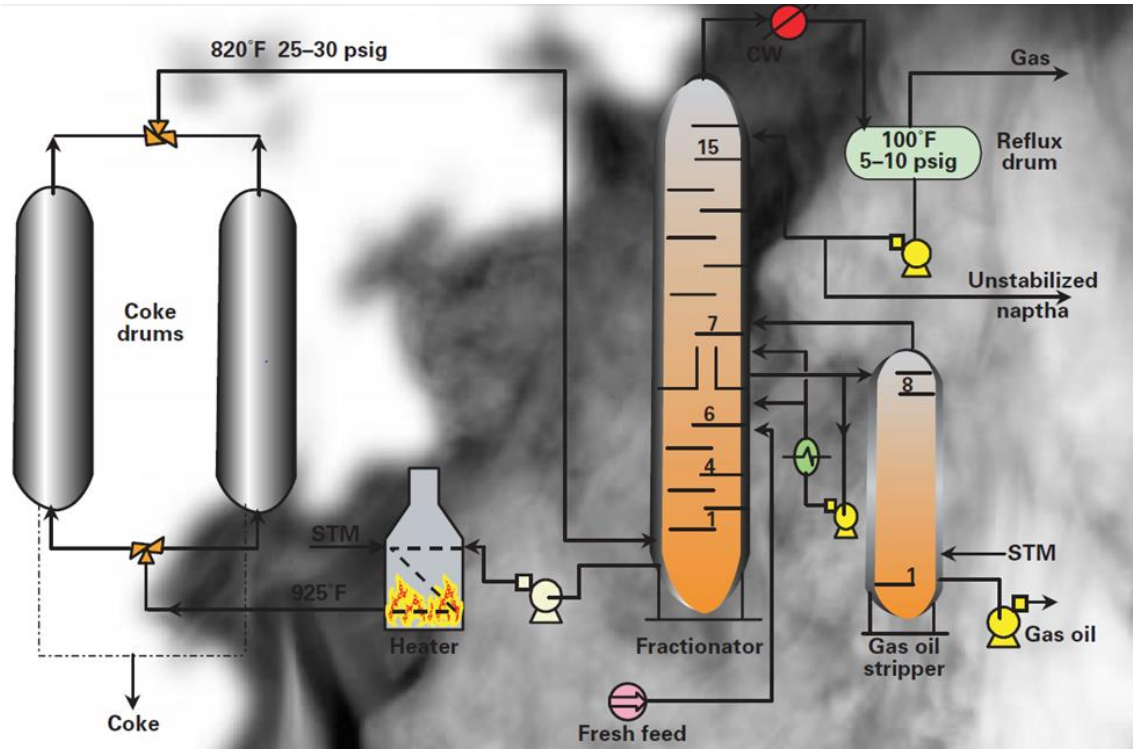
- MPA is Yokogawa's approach to procedure automation
  - Consultative methodology
  - Document and automate procedure operations in continuous processes
  - Modular design approach
  - Standardized implementation within sites and across companies
- Standardize and Automate Procedures
- Improve Plant Operating Efficiency
- Improve Safety of Plant Operations



What Types of Procedures are Automated?

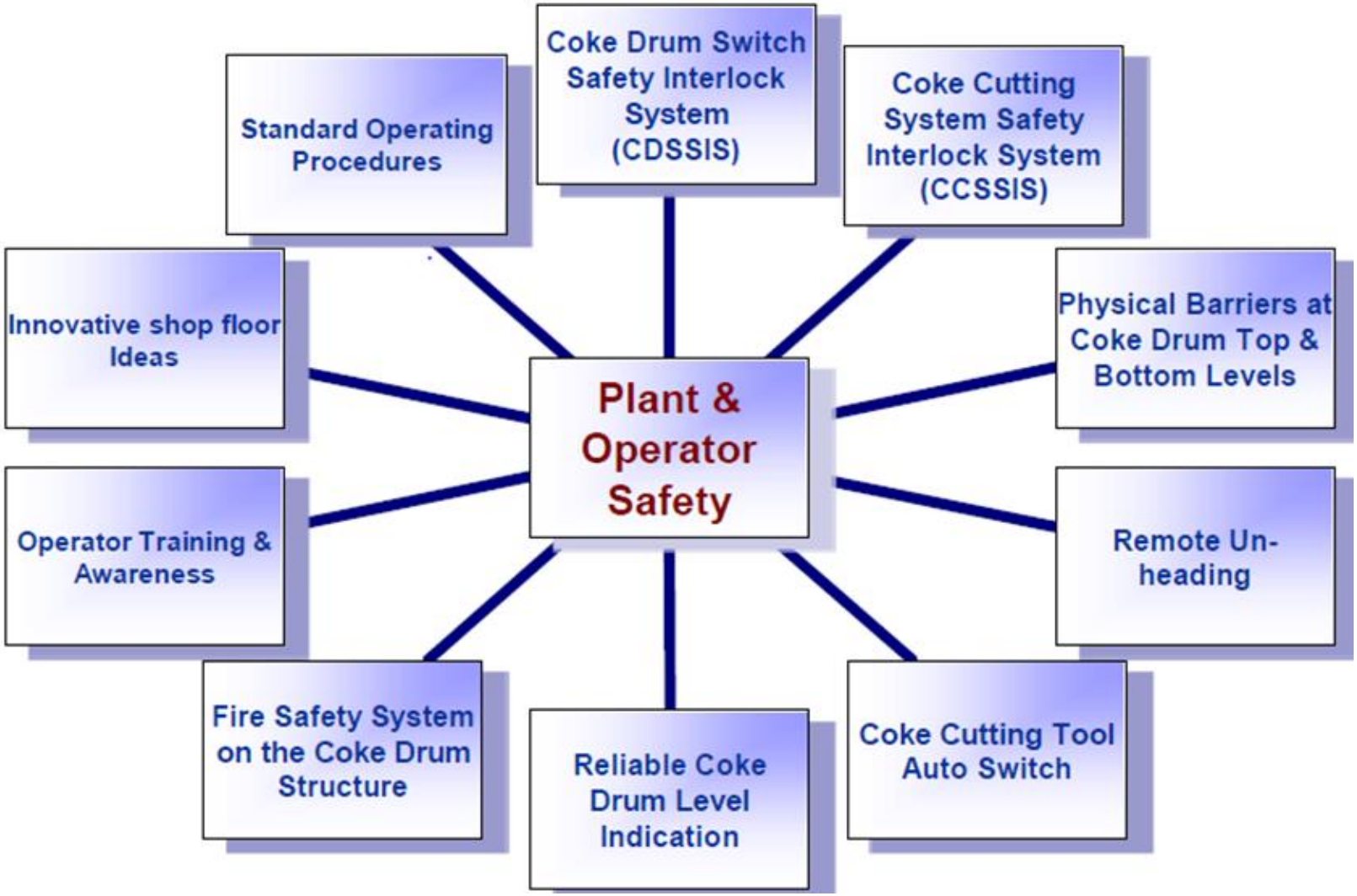
- What Types of Procedures are Automated?
  - Routine planned process changes and operations
  - Unit startups and shutdowns
  - Assistance to operators during facility upsets
- Consider procedures that are performed frequently
- Consider procedures that can help avoid significant losses or produce significant gains (Financial, Safety, or Environmental)

Hazards Associated With Delayed Coker Operations



- Specific operational hazards
  - Coke drum switching
  - Coke drum head removal
  - Coke cutting (hydro blasting)
- General operational hazards
  - Coke transfer, processing and storage

Personnel Safety is Paramount



Coke Drum Switching

- Multiple drums, many valves
- Differences in valving
  - Difficult to distinguish and can lead to unintended drum inlet or outlet stream routing
- Valve control stations, for remotely activated valves, may not always clearly identify the operating status of different drums and modules
- Activating the wrong valve because of mistakes in identifying the operational status of different drums and modules has led to serious incidents

Coke Drum Switch Safety

Permissive for Coke Drum 'Feed Isolation Valve' operation *The 'Feed Isolation valve' of a particular Coke Drum will operate only when* *1. Coke Drum top cover is closed* *2. Coke Drum bottom cover is closed* *3. 'Switch valve' is in 'BYPASS' or 'OTHER COKE DRUM' mode*	***Permissive for 'Switch Valve' operation*** *The 'Switch Valve' will not move towards a particular Coke Drum until* *1. Its' 'Feed Isolation valve' is open* *2. Both its' 'Vapor valves' are open* *3. Its' 'Drain valve' is closed*
Permissive for Coke Drum 'Drain Valve' operation *The 'Drain valve' of a particular Coke Drum will operate only when* *1. Coke Drum top cover closed* *2. Coke Drum bottom cover closed* *3. Coke Drum feed isolation valve closed* 17th April' 12	***Permissive for Coke Drum 'Heading/ un-heading'*** *Heading & un-heading operation of the Coke drum will be allowed only when* *1. 'Feed Isolation valve' closed* *2. 'Vapor valves' closed* *3. 'Blow down isolation valves closed* *4. Switch valve in 'BYPASS' or 'OTHER COKE DRUM' mode* *5. Vapor temperature is 'safe'* *6. Coke Drum pressure is 'safe'* 6

Averting and Controlling Possible Hazards

- Conduct human factors analyses to identify, evaluate, and address potential operator actions that could compromise the safe operation of the coke drum system.
- Provide interlocks for automated or remotely activated valve switching systems.
- Provide interlocks for valves that are manually operated as part of the switching/decoking cycle to avoid unanticipated valve movement.
- Color code and clearly label valves and control points to guard against incorrect identification.
- Provide indicator lights at valve and valve control stations to help the operator determine which is the correct valve station for the intended operator action.
- Use the "buddy system" (employees working in pairs) to help verify accurate valve or switch identification.
- Conduct periodic and documented training focusing on the importance of activating the correct valve or switch and the consequence of incorrect activation.
- Apply MPA (Modular Procedural Automation) to ensure the 'best operator' is running the plant 24x7

Delayed Coking – Drum Cool Down

EXAPILOT

EMERGENCY BUTTON

COKE A DRUM COOLING PROCEDURE

EXAPILOT START

TOTAL RUNNING TIME
0 HR 5 MIN

TA-XXXX RUNNING CHECK

PIXXXXPV **** < SET XX
FCXXXXPV **** >SET XX

COOLING START
(MIN FLOW INJECTION))

WATER FILLING START

WATER FILLING END
(LIXXX XX% REACH)

LIXXXPV ****

PP-XXXX STOP

COKE DRUM

ALARM LIST

Interlock V/V CHANGE

MP8 18-FCXXX CLOSE

XX m3/hr HOLD TIME DELAY

PIXXX HIGH, FLOW DOWN

PIXXXPV **** < SET XX

XXX->XXX INCREASE DELAY

LIXXX FILLING DELAY

EXAPILOT U-XXXX
NORMAL OPERATIONS

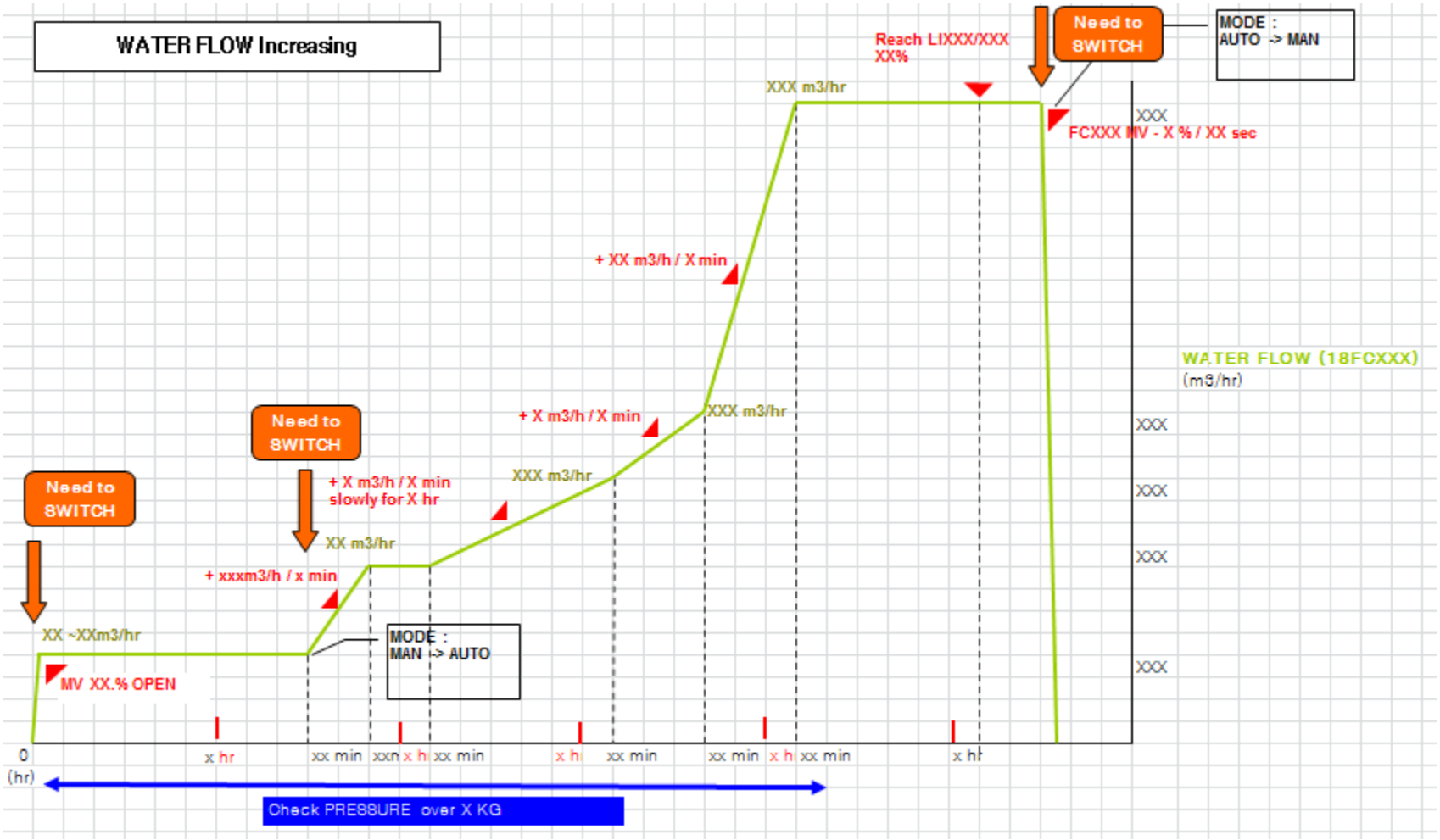
COKE A DRUM
COOLING PROCEDURE

COKE B DRUM
COOLING PROCEDURE

CHECK POINT

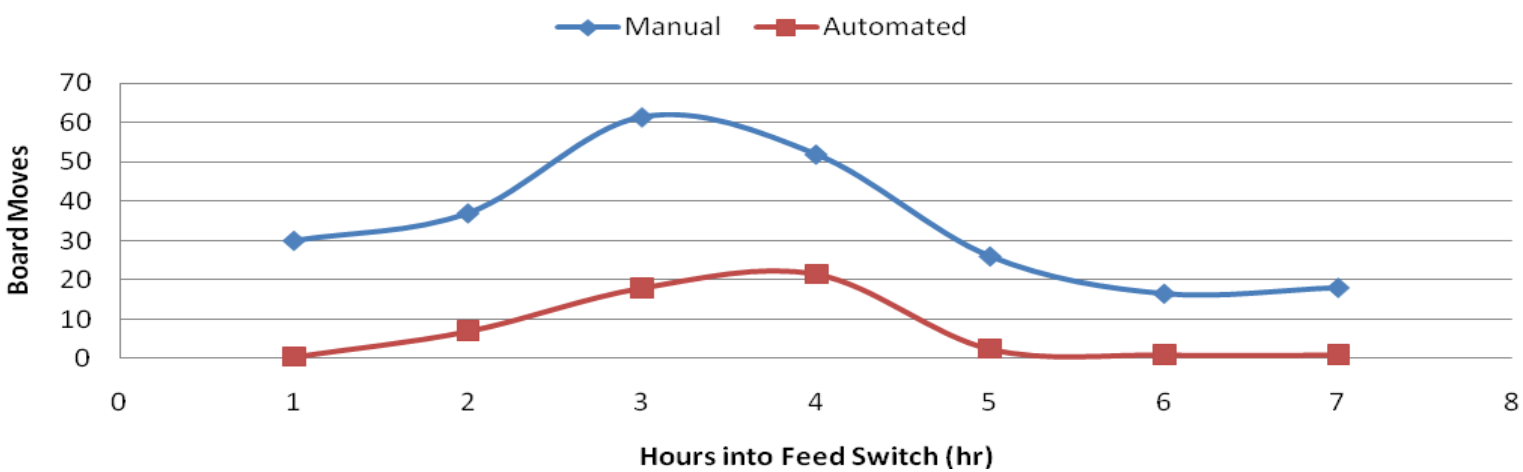
WATER FLOW	18FCXXX.PV
PRESSURE	18PIXXX.PV
18TIXXX	18TIXXX.PV
FCXXX MODE	18FCXXX.MODE
LIXXX	18LIXXX.PV
LIXXX	18LIXXX.PV

Delayed Coking – Drum Cool Down



Hydroprocessing Transition Improvement

- A refinery operations team recognized there was a large optimization opportunity to automate a feed switch
- Benefits in automating the feed switch procedure were:
  - Operator workload reduced by 60%
  - A 42% reduction in product yield loss
  - Increased feed throughput during transition by 18%
  - Reduced feed switch transition time by 36%



Console Operator Moves per Hour Comparison from paper "Improving Refinery Unit Transitions Using Process Automation Technology in a base Oil Hydroprocessing Facility. AIChE Spring 2011 Robert M. Tsai, Chevron, Richmond, CA

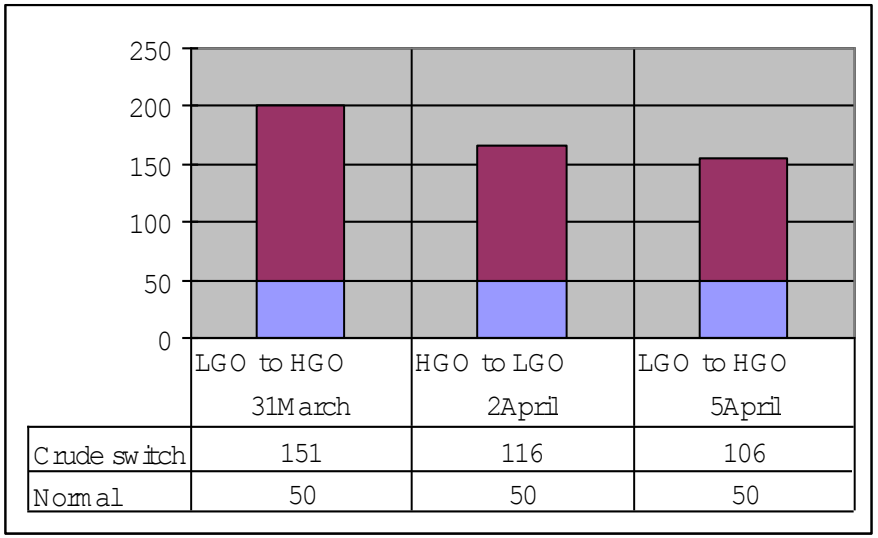
Crude Unit - Automation of Crude Switchover

- Purpose
  - Operator workload was higher than in normal operations
  - Operation time and product quality depended on the skills of operators
- Ramping Techniques
  - Junior operators
    - Ramp feed temperature linearly at the same rate
  - Veteran operators
    - Change the ramping rate according to the temperature zone

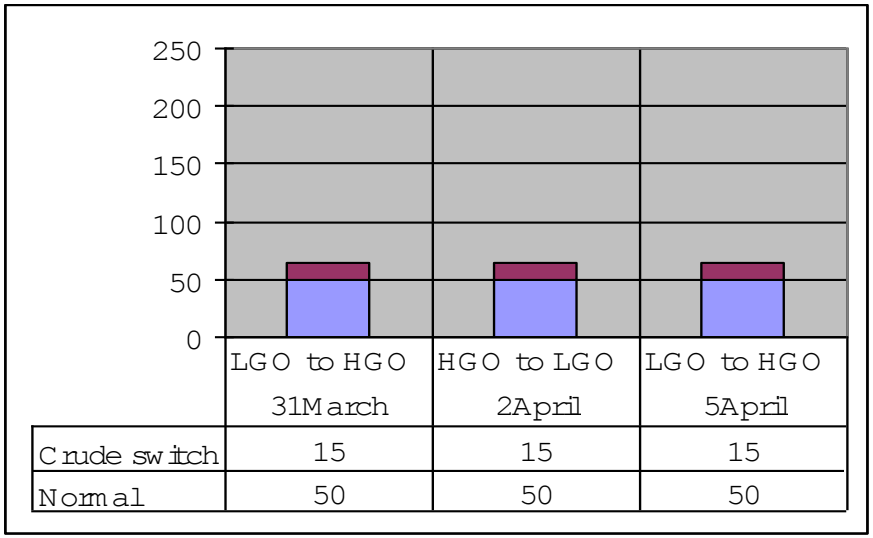
Crude Unit - Automation of Crude Switchover - Benefits

- 90% of manual operations were automated
- All monitoring was automated
- 2000 unnecessary alarms were suppressed
  - Operators can do other work during crude switchover
  - Missed steps and missed procedures were prevented
  - Safer operation was achieved

Number of PCS operation by operators



Done by operator



Done by MPA

Summary

- Operators are leaving the workforce and taking key skills with them
- Newer operators are expected to come up to speed faster
- Standards can help to capture the knowledge of the veterans
- Standards make knowledge transfer easier and more effective
- Modularizing and automating procedures makes changes faster, safer and more reliable