OSU

Breakout Session

The Role of APC in Process Threat Management

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9:15 – 10:15 am

PCSF Forum Meeting
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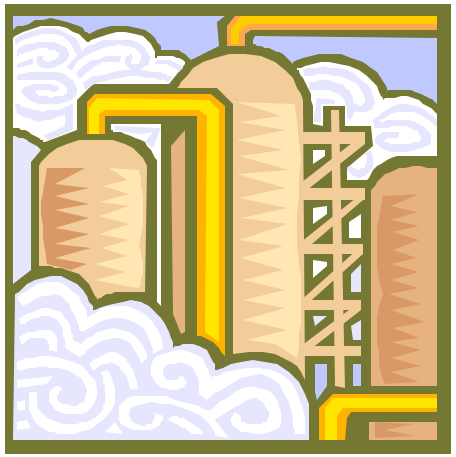
Presentation Outline

- *Background & problem*
- *Opportunities for APC*
- *Key issues w/ new APC opportunities*
- *Summary*



Process Industries

11-Sep-2001

Process Safety Management	*Process Threat Management*
"PROBABLE"	*"POSSIBLE"*

Post 9/11 Response

- *Site security guidelines and vulnerability assessment methodologies developed:*
  - ACC / Chlorine Institute / SOCMA
  - NIJ / Sandia Labs
  - SOCMA
  - AIChE CCPS
  - API / NPRA
- *NIPC chemical sector ISAC*
- *Proposed federal legislation*

Response Philosophy*

- ***DETER*** *an attack if possible.*
- ***DETECT*** *an attack if it occurs.*
- ***DELAY*** *the attacker until appropriate authorities can intervene.*
- ***RESPOND*** *to … control a release …*

* *Security Vulnerability Assessment Methodology for the Petroleum and Petrochemical Industries*, API/NPRA, May 2003.

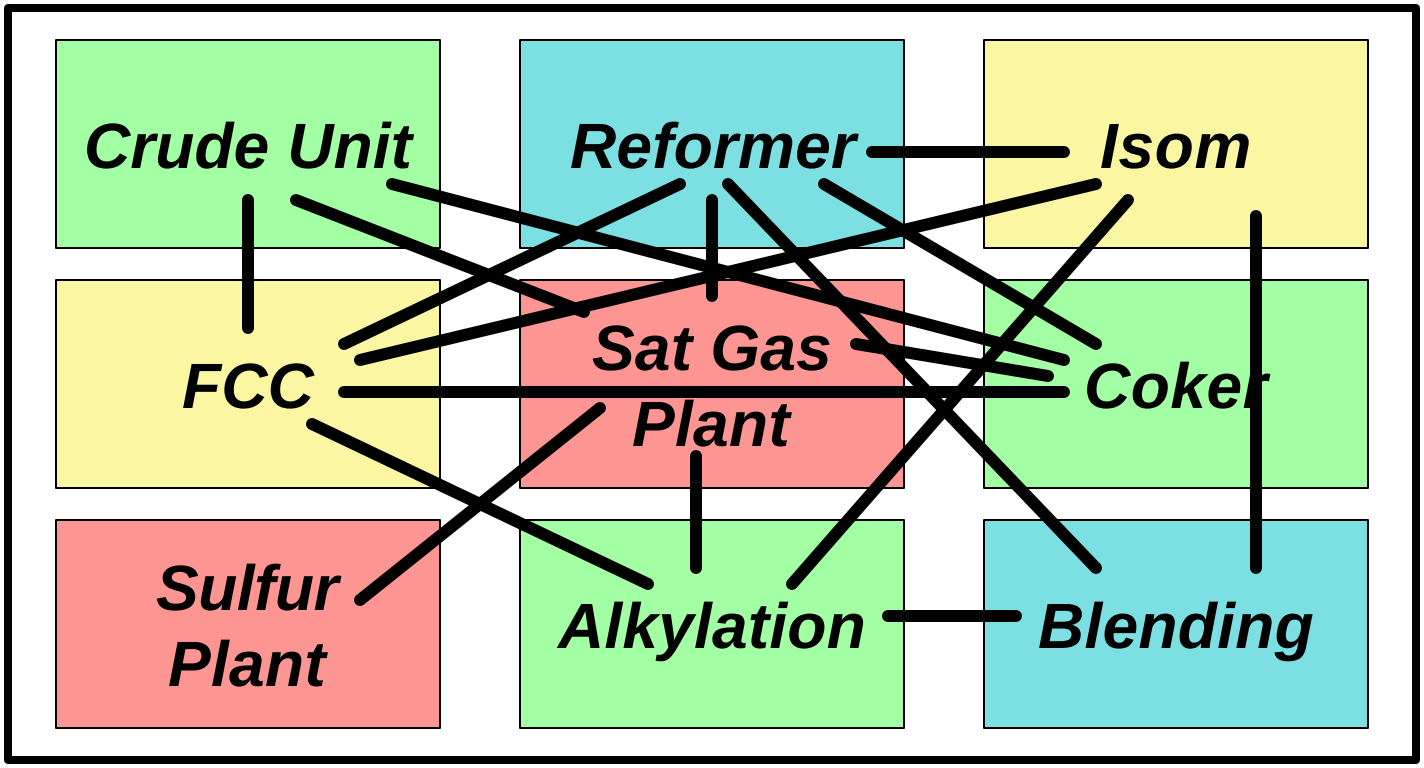
Response Philosophy (restated)

Prevention

Mitigation

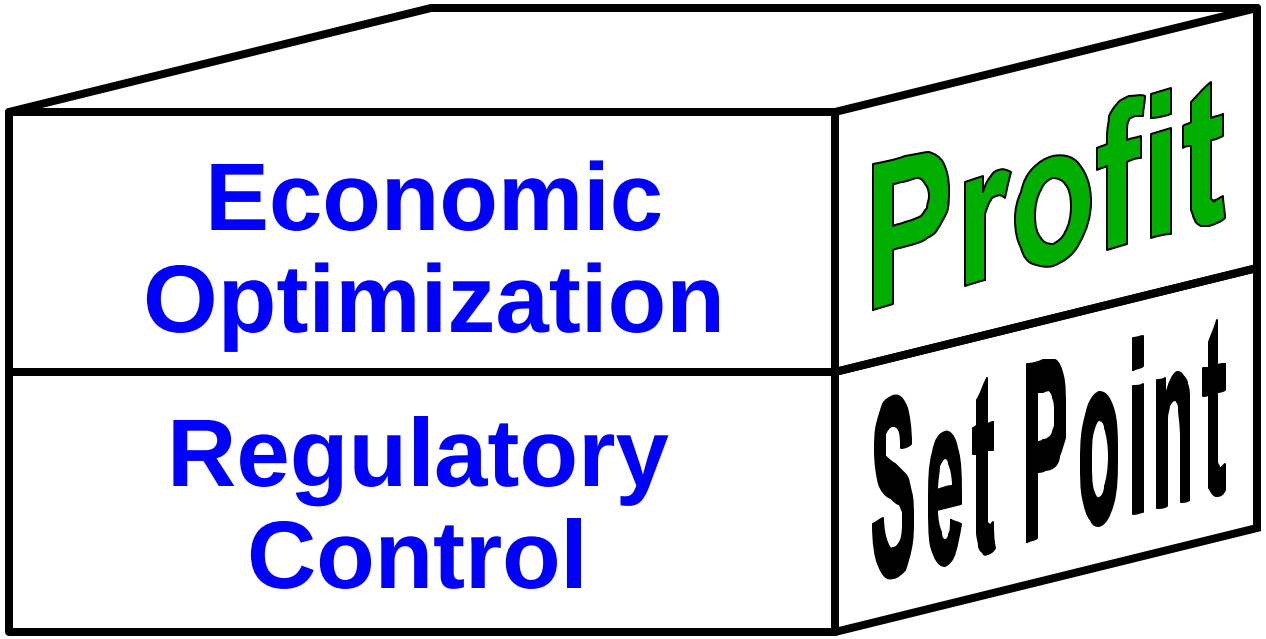
Process Threat Management (PTM)

Problem Definition



Petroleum Refinery

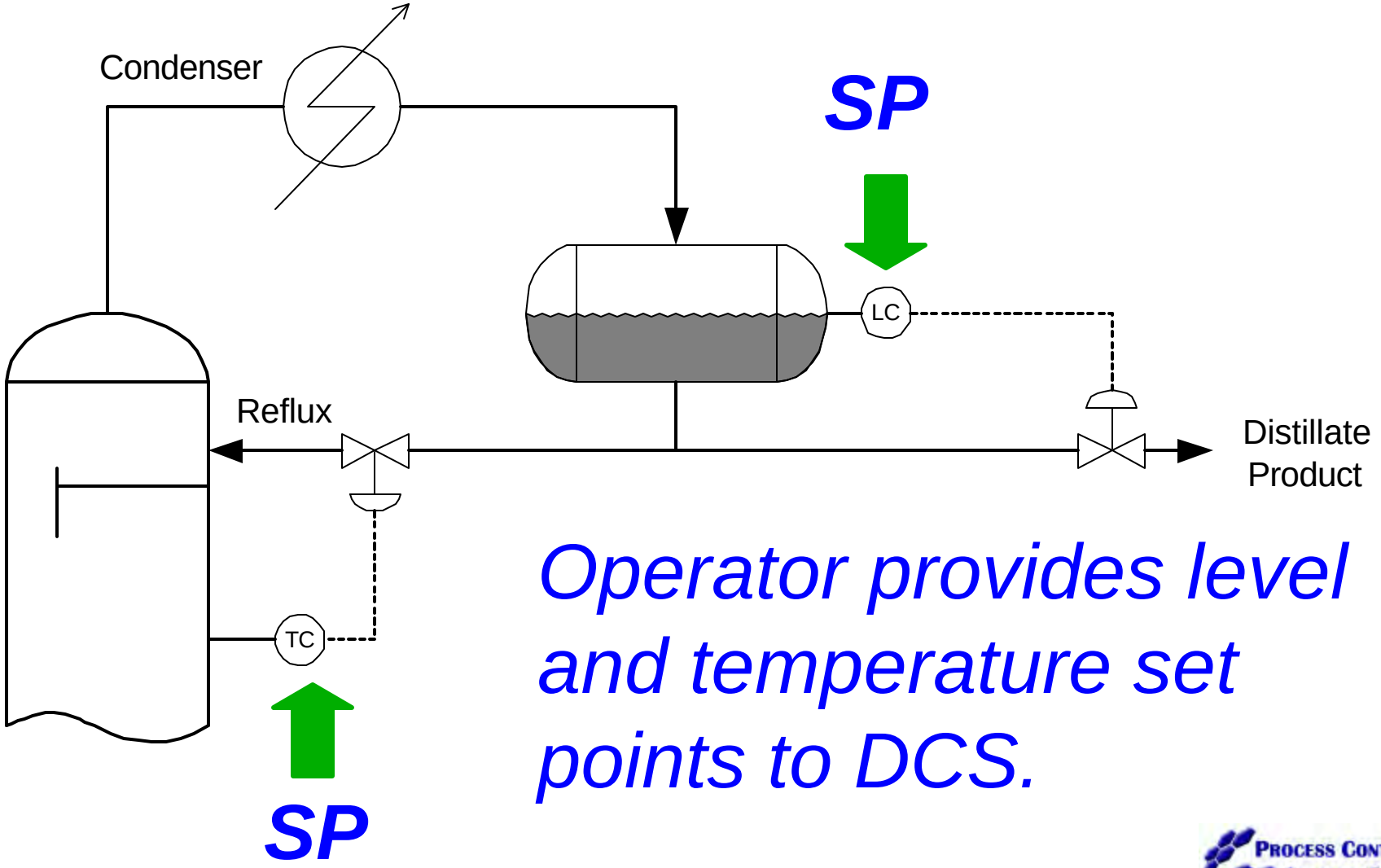
Control System Automation



APC

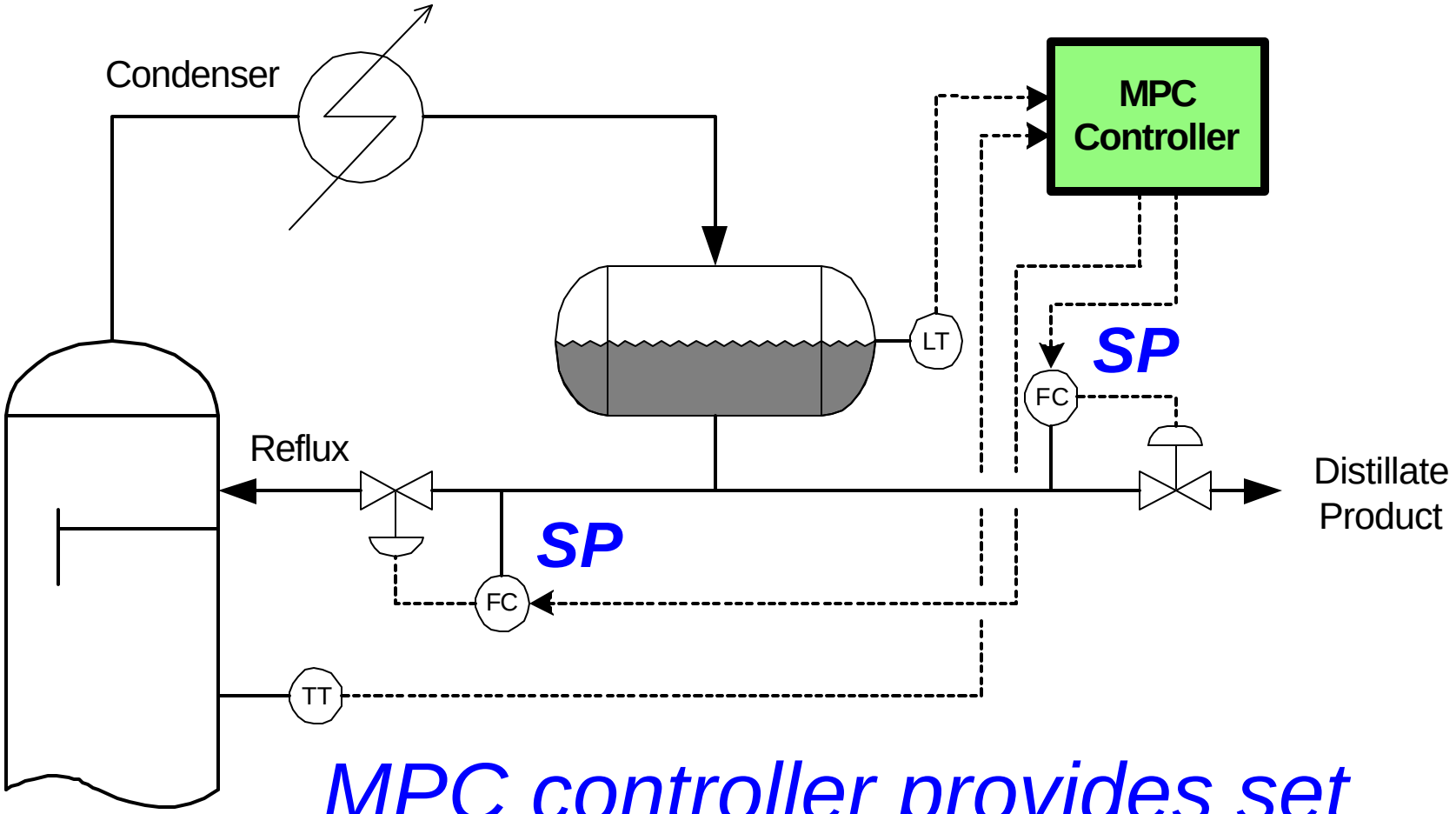
DCS

Basic Regulatory Control



Operator provides level and temperature set points to DCS.

APC Control

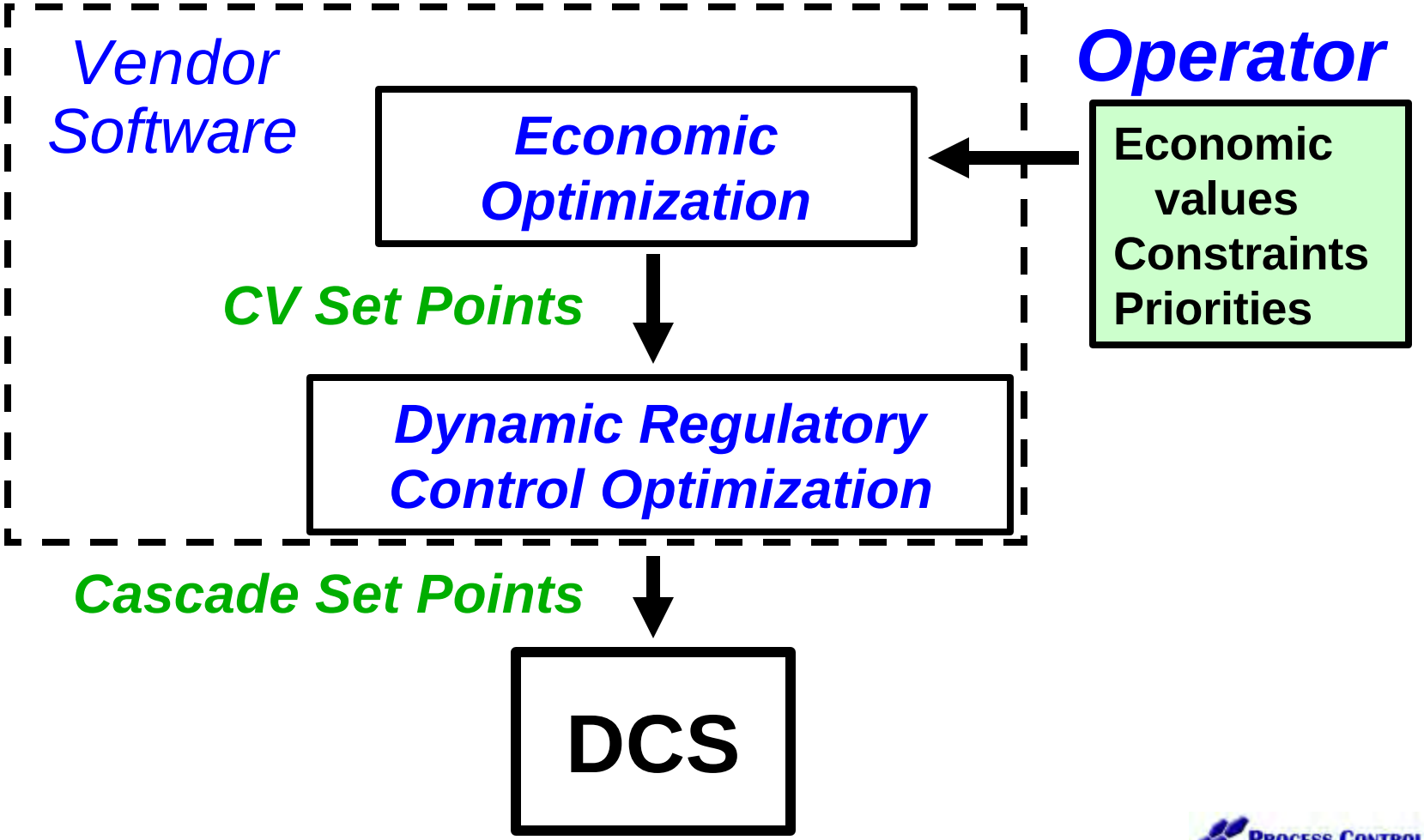


MPC controller provides set points to cascade controllers.

MPC Controller

- *Employs dynamic models relating manipulated (MVs) and controlled variables (CVs)*
  - *interactions*
  - *time delay*
  - *feedforward*
- *Closer operation to constraints*
- *Significant investment in $ and time to develop, implement, and maintain*

Commercial MPC Capability



Opportunities to Exploit APC

1. *Near Term (conventional):*

   Transition management to reduced operating rate.

2. *Long Term (unconventional):*

   Conversion of APC mode from economic optimization to safety optimization.

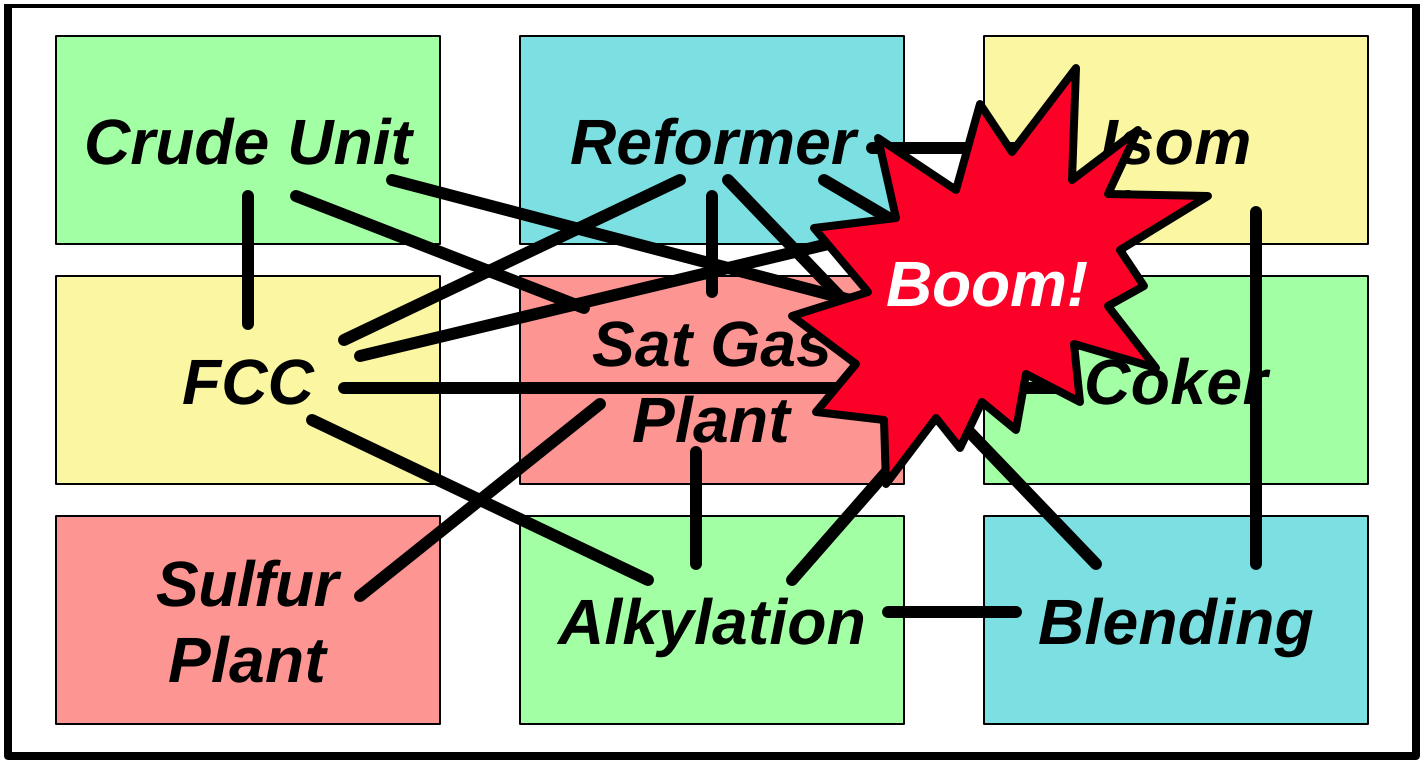
Opportunities to Exploit APC - cont

3. *Long Term (unconventional):*

   Undesirable trajectory detection.

   - *sabotage, compromised control system*
   - *crisis management*

Organized Attack



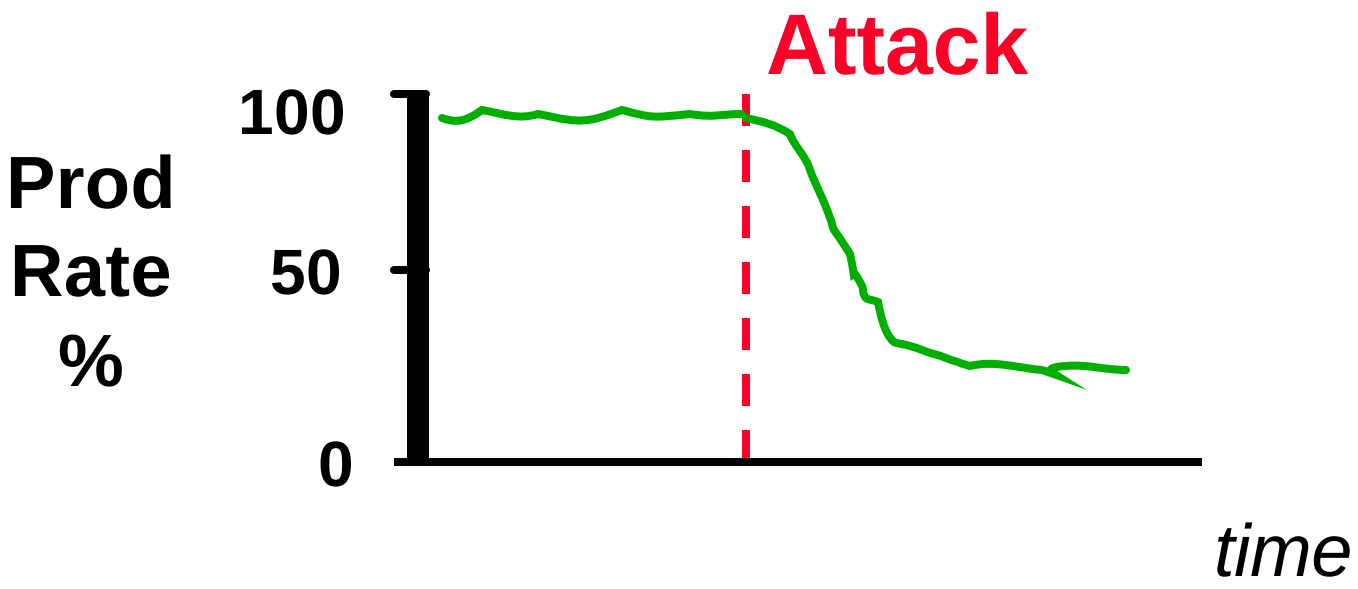
Petroleum Refinery

Base Assumption

Greatest opportunity to minimize impact on plant and public welfare is operator response.

What can we do to assist the operator?

Initial Operator Response



1. Cut rates
2. Assess situation

Current Role of APC

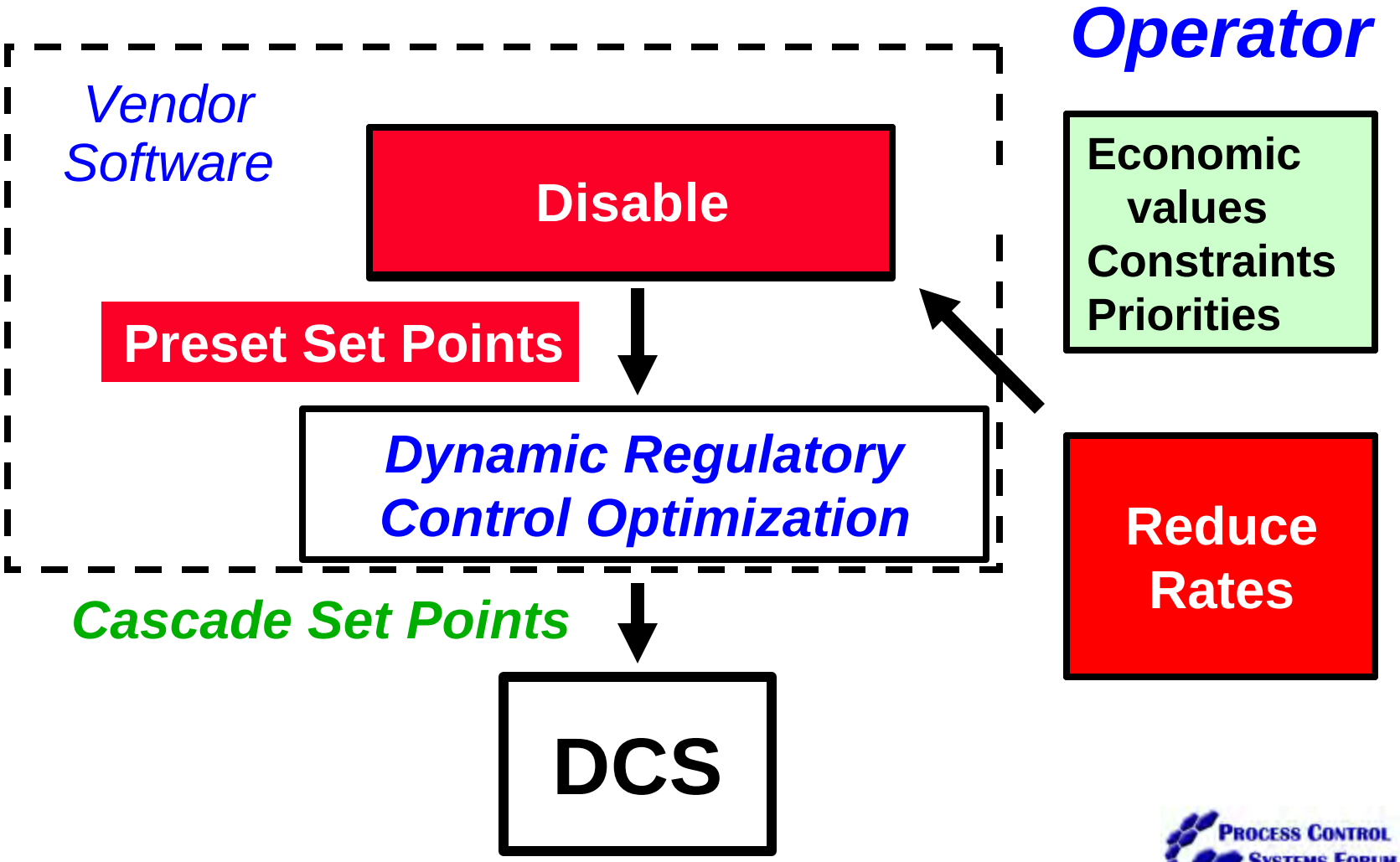
ON – routine operation

Economic optimization

OFF – emergency situations

All set points provided by operator

1. APC Transition Management to Reduced Operating Rate



"One-Button" Rate Reduction

- **DCS option**
  - *Bypasses dynamic regulatory control optimization*
  - *Extensive operator attention required*
- **APC option**
  - \+ *Minimizes demands on operator*

"One-Button" APC Issues

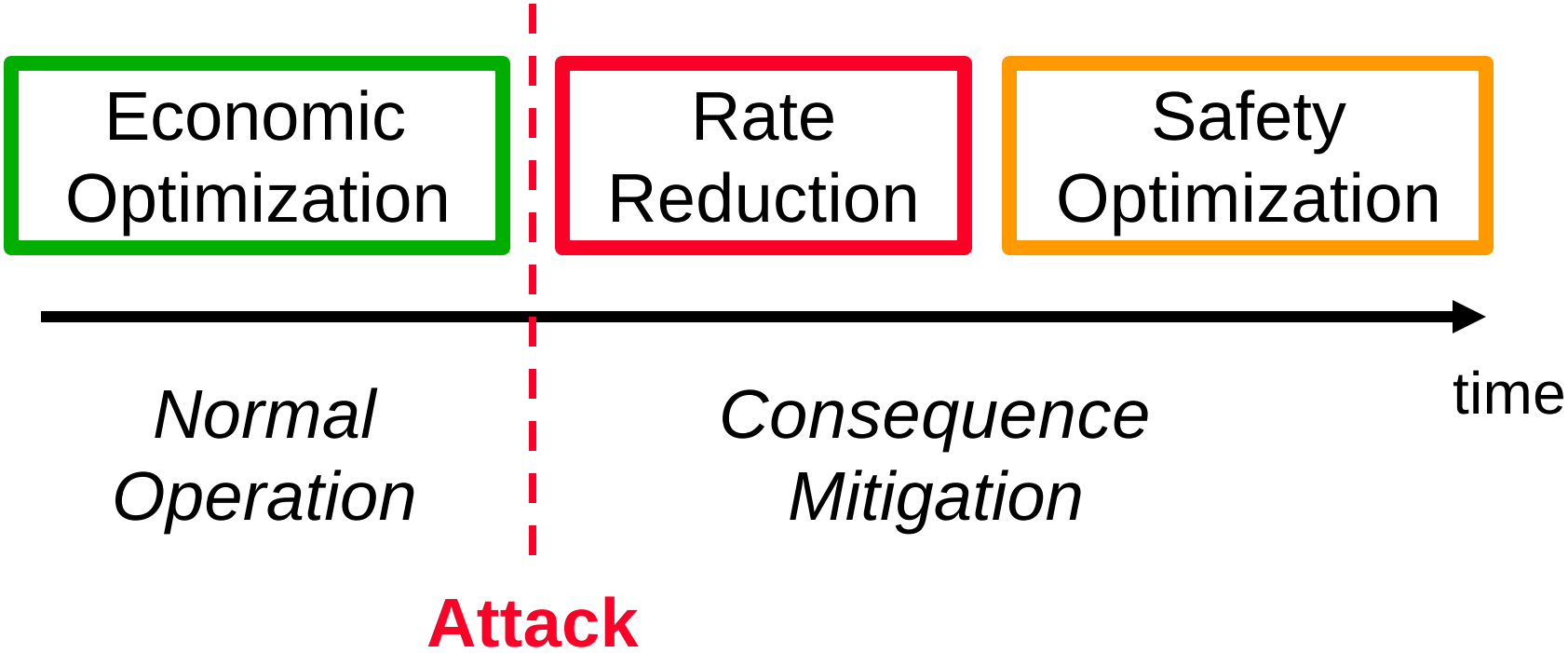
- *Constraint and priority consistency*
- *'Bumpless' transfer*
- *Additional dynamic models*
- *Exception handling*
- *Testing and validation*

"One-Button" APC Transition Management

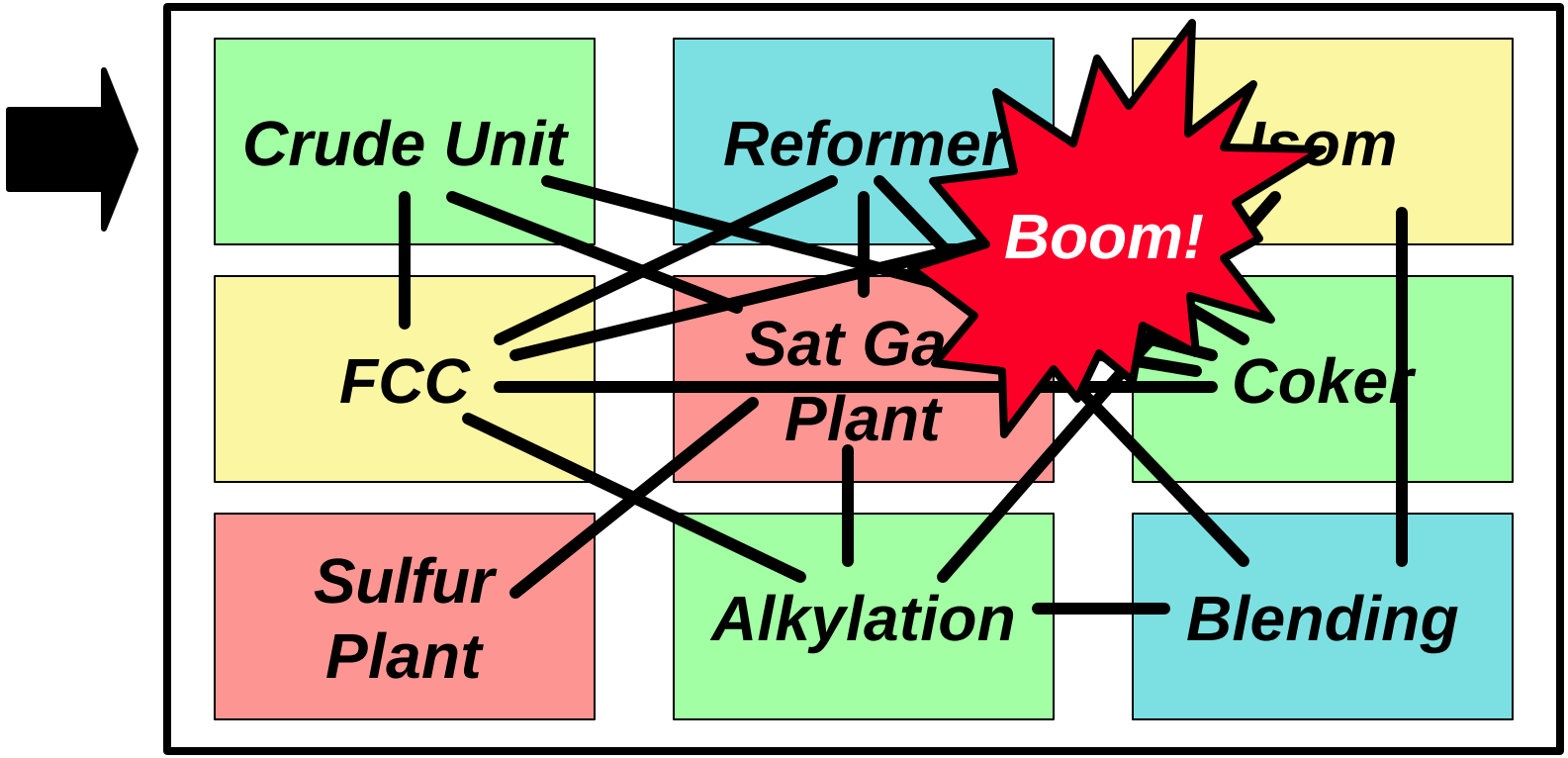
New application/feature for existing technology

Applicable for any plant emergency

2. APC Safety Optimization Mode

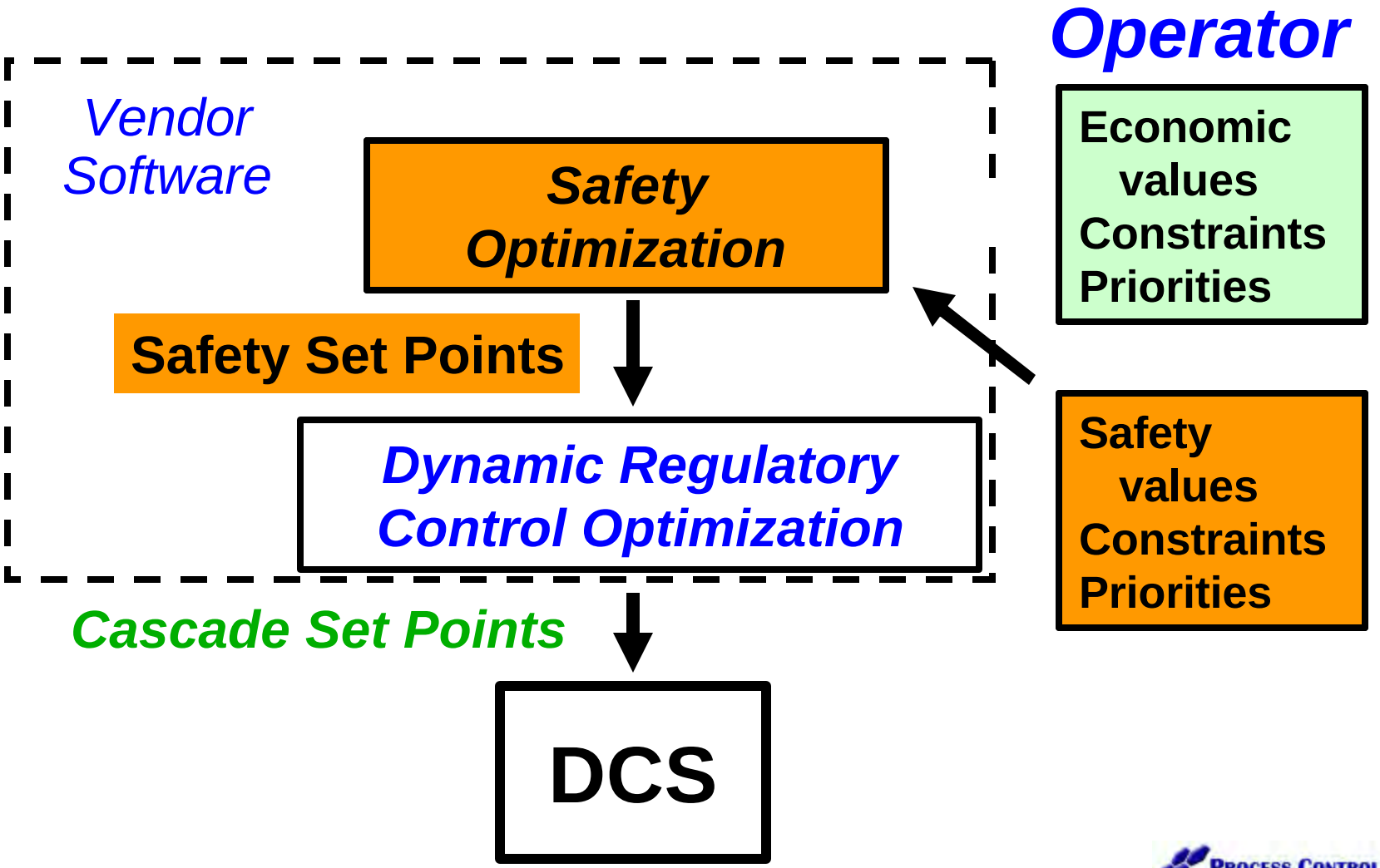


Intra- and Inter-Unit Operational Safety



Petroleum Refinery

APC Safety Optimization Mode



APC Safety Mode Issues

- *Safety CVs*
- *Optimum value of safety CVs*
  - *Fixed*
  - *LP-type safety objective function*
  - *Plant-wide safety optimization*
- *Unusual evasive procedures*
- *APC controller execution frequency*
- *"One-Button" APC issues*

APC Safety Optimization Mode

Next generation technology

Successful development requires collaboration between safety and controls communities.

Applicable for any plant emergency

3. Undesirable Trajectory Detection

- *Leverage model predictive capability*
- *Watchdog*
- *Identify "self-destruct" input signatures with or without APC*
  - *Insider collusion*
  - *Compromised control system*
- *Set point / controller output lockout*

Trajectory Detection Issues

- *New "look-ahead" technology*
- *MV profile interpretation*
- *MPC/DCS authentication*
- *Safety objective function cross-over*
- *Execution frequency*
- *Override considerations*

Summary

- *Mitigation must be addressed in addition to security*
- *Empower operator to minimize consequences*
- *APC is knowledge-rich; exploit in new ways to assist operators*
- *Benefits apply to any plant emergency*

Acknowledgments

- *Jan Wagner, OSU ChE*
- *Industrial colleagues with operations, controls, and process safety responsibilities*

In the immortal words of Pogo:

"Gentlemen, we is faced with insurmountable opportunities!"

Questions & Comments