Meeting Today's Societal Expectations: Process Risk Management Programs of The Dow Chemical Company

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The Dow Chemical Company

An Unsettled Public

An Overview

- Dow's Commitment to EH&S Excellence
  - Drive to Zero
  - 2005 EH&S Goals
  - 2015 Sustainability Goals
- Developing a Rigorous Process Safety Program
  - Work Processes and Operating Discipline
  - Metrics
  - Culture
  - Personalization
- The Role of the Chemical Industry

Drive to Zero

DOW

DOW

Drive to Zero

DOW

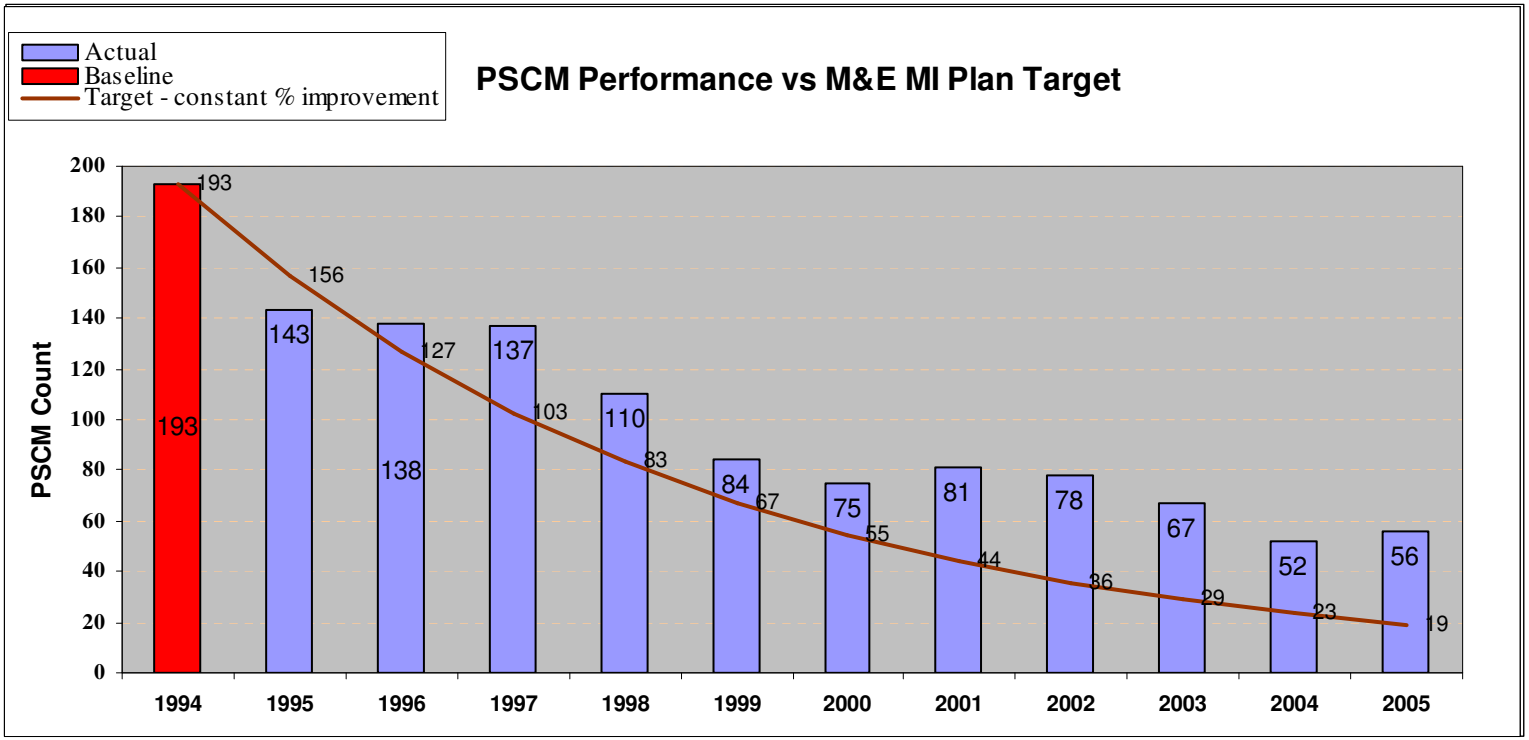
Goals set in 1996 for 2005

- Injuries and Illnesses: Reduce 90%
- LOPCs: Reduce 90%
- Transportation incidents: Reduce 90%
- Process Safety incidents: Reduce 90%
- Motor vehicle incidents: Reduce 50%

Performance vs. Goals

1996-2005

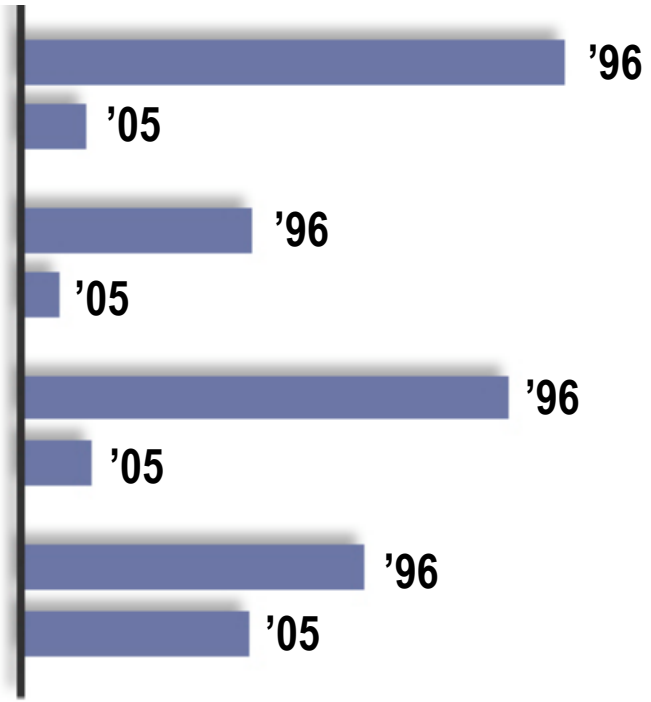
- Process Safety: Goal to reduce by 90% Actual reduction: 71%



Performance vs. Goals

1996-2005

- LOPCs:
  Down 72%
- Transportation incidents:
  Down 65%
- Injury and Illnesses:
  Down 84%
- Motor vehicle incidents:
  Down 39%



Putting it another way…

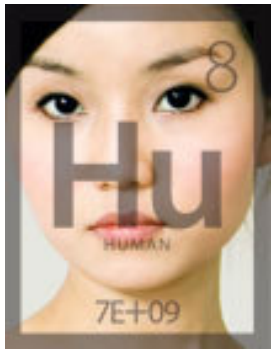
During the past 10 years…

- 13,000 employees did not suffer an injury or illness
- 10,500 LOPCs did not occur
- 150 motor vehicle accidents, with potential to cause injury or fatality did not occur
- 1,100 Process Safety incidents did not occur

2015 Sustainability Goals

Collaborate
Listening, learning, talking and taking action – we're helping our communities to be better places to live and work for everyone.

Elevate
We seek to understand our impact on global ecosystems, and will work towards the efficient and effective use of our precious resources.



Innovate
We will use our technology to develop products to improve the quality of life around the world, while ensuring those products are managed safely throughout their lifecycles.

Perform
We're raising the sustainability bar, setting targets to address some of the world's most pressing challenges and tracking our performance publicly, year after year.

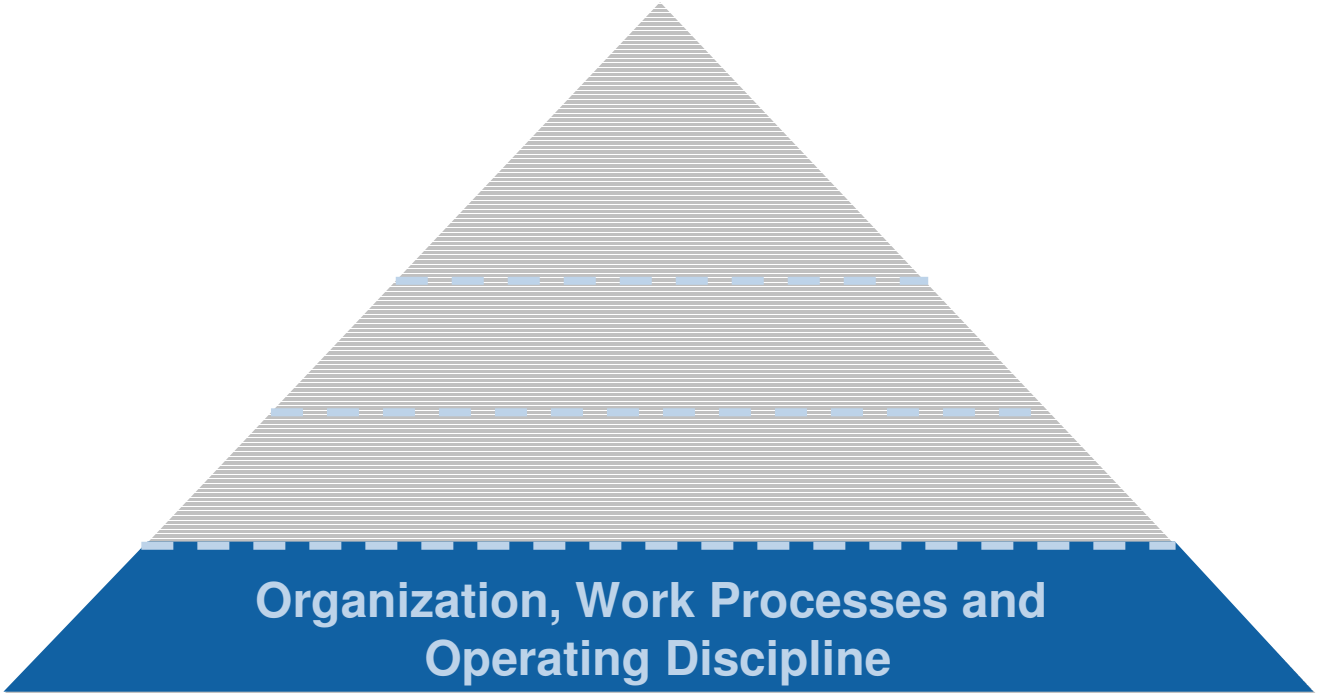
This is sustainability at Dow.

2015 Sustainability Goals

By 2015, Dow will achieve, on average, a 75 percent improvement based on 2005 results.

- Injury rate of 0.08 for Dow and contractors combined
  - 75 percent reduction in severity, and NO FATALITIES
- All sites combined will have fewer than 75 LOPCs
- All sites will reduce process safety incidents by 75 percent, reduced severity rate by 95 percent
- All Dow employees combined will reduce the MVA rate to 1.5
- Additional goals: security, waste and emission reduction or resource conservation
- ….(other goals)

Pyramid of Process Safety Performance



Organization, Work Process and Operating Discipline

- **Process safety beings with the design and control of a facility**

Organization:

- 25 Technology Centers worldwide
- 30 full-time process safety professionals (Process Safety Technology Leaders)
- Chief Process Safety Engineer
- Dedicated analytical research roles for reactive chemicals program
- Strong dedication to process safety issues by internal Process Automation and Process Engineering functions
- Key Manufacturing and EH&S roles: Production Leaders, Business Manufacturing Leader, EH&S BOL, Site EH&S Responsible Care Leaders

Dow's Process Safety History

Pre-1960 - Fire Protection Engineering
1963 - Corporate Safety & Loss Prevention Department formed
1964 - Fire and Explosion Index (Risk Analysis)
1966 - Reactive Chemicals Program
1974 - Loss Prevention Principles issued
1976 - Minimum Requirements (First Edition)
1978 - Operations Practices (Minimum Requirements Emphasis)
1982 - Fire Protection Practice Manual
1986 - Chemical Exposure Index (CEI)
1990 - Chemical Engineering Hazard Guidelines issued.
1991 - Guidelines for Management of Change
1994 - Process Risk Management Guidelines for Facilities and Distribution
1994 - Guidelines for Hazard and Operability Study
1997 - Process Safety Expertise Center established
1997 - Global Reactive Chemicals Global Standard issued
1998 - TDCC Business EH&S Risk Evaluation Work Process
1999 - Global Mechanical Integrity Standard issued
2000 - Introduction of Layers of Protection Analysis tool

Dow's Process Safety History

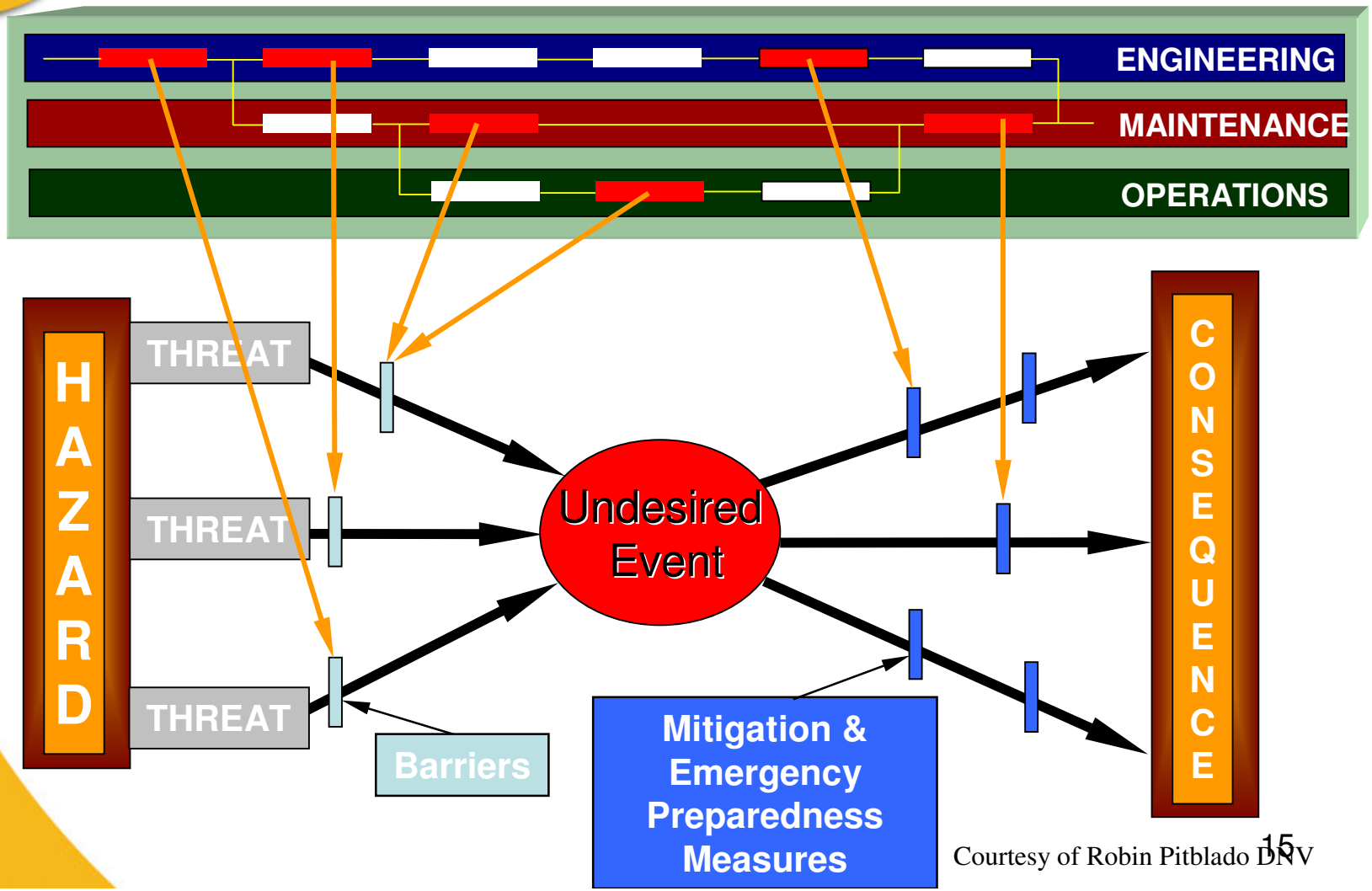
And our "history" never stops growing.
We continuously improve upon our existing programs….

Pre-1960 - Fire Protection Engineering
1963 - Corporate Safety & Loss Prevention Department formed
1964 - Fire and Explosion Index (Risk Analysis)
1966 - Reactive Chemicals Program

Although we already had a rich tradition in Process Safety, with the integration of best practices from UCC's Operational Safety program we've added to or enhanced several of our programs.

1991 - Guidelines for Management of Change
1994 - Process Risk Management Guidelines for Facilities and Distribution
1994 - Guidelines for Hazard and Operability Study
1997 - Process Safety Expertise Center established
1997 - Global Reactive Chemicals Global Standard issued
1998 - TDCC Business EH&S Risk Evaluation Work Process
1999 - Global Mechanical Integrity Standard issued
2000 - Introduction of Layers of Protection Analysis tool
2001 - Enhanced Process Risk Management Program
2002 - Enhanced Layers of Protection Analysis
2004 - Update to all Dow Loss Prevention Principles
2006 - Enhanced Building Overpressure Analysis
…. and many more…..

The Bow-Tie Diagram



Courtesy of Robin Pitblado DNV

Work Processes and Guidelines

- **Corporate-wide work processes** and guidelines for implementation of Operating Discipline, Management of Change, Mechanical Integrity programs, Training, Project reviews and more

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Dow corporate Operating Discipline Management System (ODMS)

Web based. Accessible to all employees world-wide

Topic

11. COMBUSTIBLE DUSTS AND SOLIDS
- 11.1 Combustible Dusts
- 11.2 Foamed Plastics
- 11.3 Foamed Plastic Insulation

12. BUILDINGS
- 12.1 Purged Control Rooms
- 12.2 Occupied Plant Buildings Subject to External Hazards
- 12.3 Office Buildings
- 12.4 Warehouse Buildings
- 12.5 Laboratories
- 12.6 Laboratory Fume Hoods
- 12.7 Process Analyzer Outdoor Buildings/Enclosures

13. FIRED EQUIPMENT
- 13.1 Safety and Control of Fired Equipment
- 13.2 Heat Exchange Systems
- 13.3 Outdoor Oil Fired Boilers
- 13.4 Furnaces Heating Flammable Materials

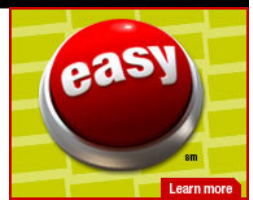
14. RELIEF AND VENT SYSTEMS
- 14.1 Pressure/Vacuum Relief Systems
- 14.2 Flare Systems
- 14.3 Flame Arresters and Detonation Arresters

15. INSTRUMENT AND COMPUTER CONTROL
- 15.1 Instrument Installation
- 15.2 Emergency Shutdown
- 15.3 Process Control Computer and Business Mini-Computer Safeguards
- 15.4 Safety Instrumented Systems

16. ROTATING PROCESS EQUIPMENT
- 16.1 Critical Rotating Equipment
- 16.2 Safe Operation of Gas Turbines
- 16.3 Steam Turbine Generators
- 16.4 Deadheaded Pumps

17. PIPING
- 17.1 Introduction and Scope
- 17.2 Definitions and Abbreviations
- 17.3 Codes and References
- 17.4 Piping Materials
- 17.5 Piping Material Specifications
- 17.6 Piping Design
- 17.7 Piping Fabrication
- 17.8 Piping Installation
- 17.9 Piping Operation and Maintenance
- 17.10 Utility Piping (DELETED)
- 17.11 Potable Water and Breathing Air (DELETED)

Dow's Key Process Automation Systems and Tools



- **State Based Control -** Like pressing the "Easy" button
  - Dow internally developed control system beginning in 1970's
  - Automated Operator Work Processes (Startup, Shutdown, Runs steps)
  - Automated Process State Degradation Handling (Abnormal Situation Management)
  - In 2001, Dow Standardized on the ABB 800xA

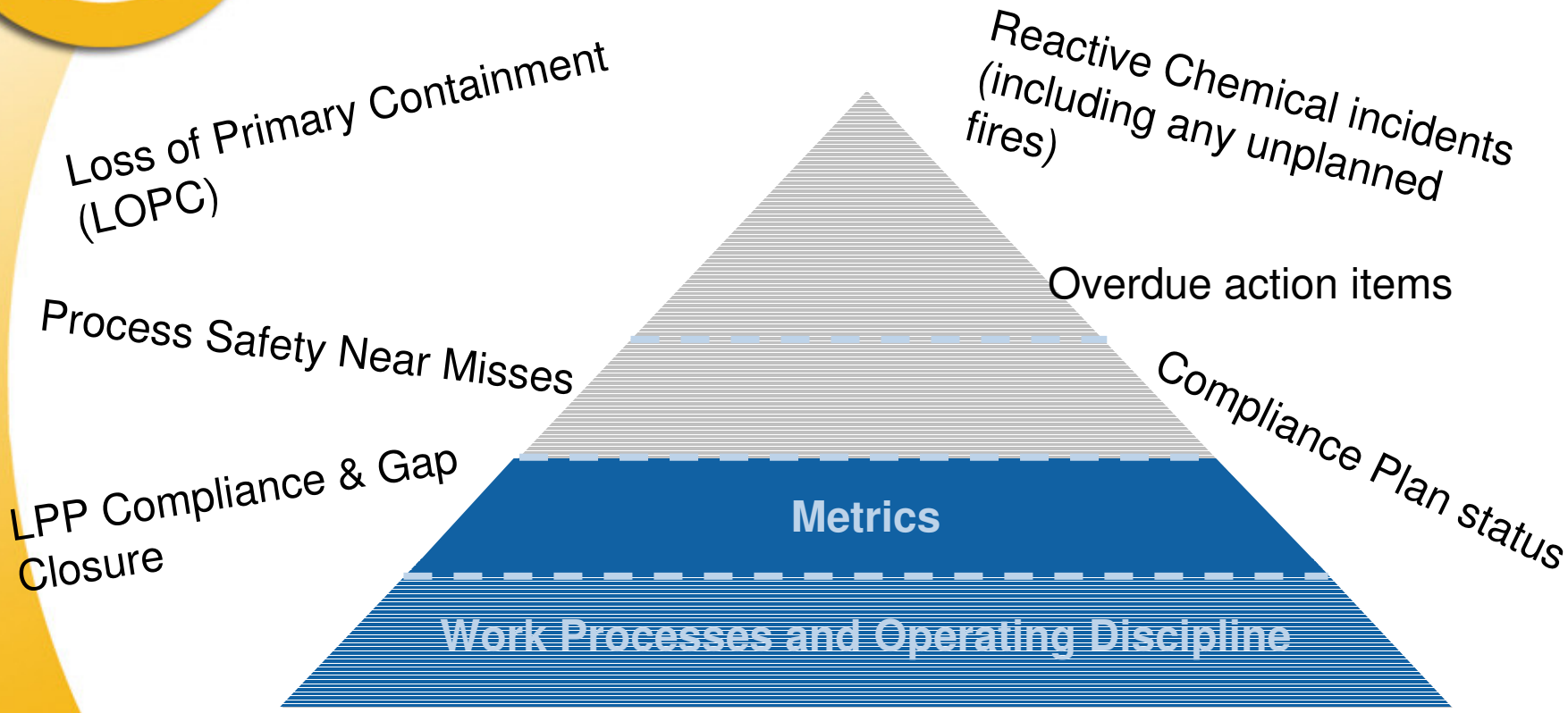
State Based Control:

- Plant-Wide Coordination of Startup and Degradation
- Automation of Frequent Operations
- Process Upsets Handled by Automation Program
- Alarms Only Enabled when Required
- Control Strategies are State Dependent

Benefits:

- **Increased productivity**
- **Reduced variability**
- **Improved EH&S performance**
- **Fewer nuisance alarms**
- **Enforces operating discipline**

Pyramid of Process Safety Performance



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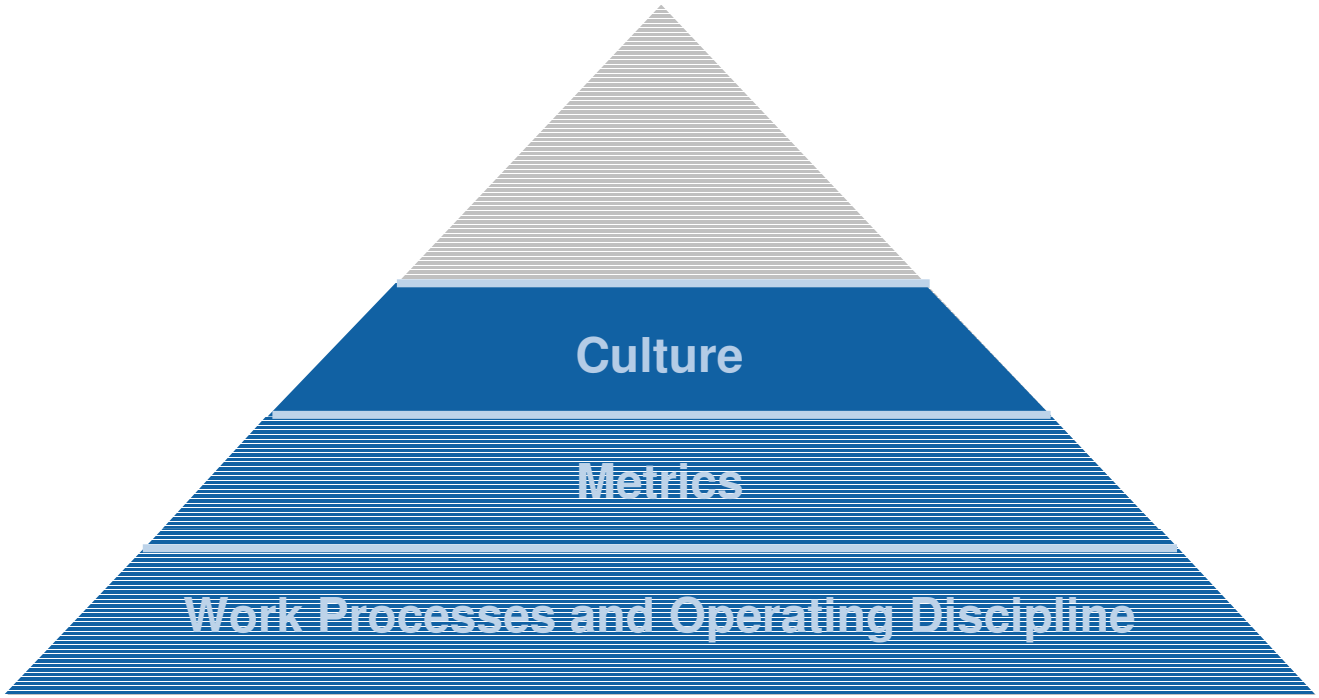


Culture – Ownership and Accountability at all levels

Company and Business Leaders

- Set Performance Vision
- Provide the resources
- Hold organization accountable
- Hold themselves accountable
  - Annual ratings, bonuses and career opportunities hinge on success

Culture – Ownership and Accountability at all levels

Plant Leaders

The most important player with respect to culture!

- Their pay and career movement must be dependent on safety performance
- Must be held responsible for results not just implementation
- Dow performs a "New Leader Review" within the first six months of any new Production Leader arriving to a new role. This NLR is intended to demonstrate knowledge/competency of the reactive chemical and process safety hazards present in the plant.
  - As the final reviewer of all MOCs, we want the Production Leader to be fully aware of the hazards and mitigations in place to prevent incidents in the plant prior to approving changes.

Culture – Ownership and Accountability at all levels

Plant Operators

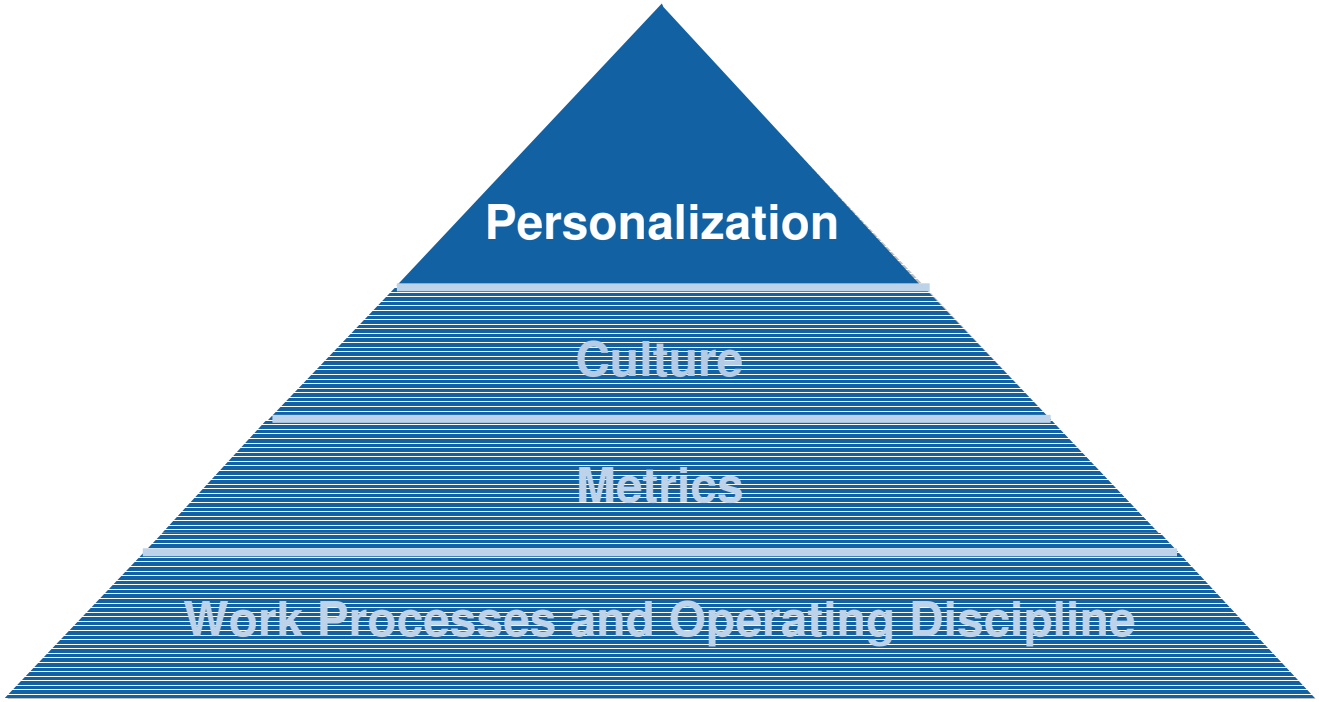
- Where it all comes together; your front line of defense
- Employment must be contingent upon safety performance
- Plant Leader must hold employees accountable
- “Balance of Consequences” applied to behaviors

Culture – Ownership and Accountability at all levels

Process Engineers, Process Automation, Design

- Utilize Inherently Safer designs
- Incorporate Process Automation which will take a plant to a safe state even without operator intervention
- Follow recognized industry standards
- Emphasis the importance of Management of Change and Pre-Startup Safety Reviews whenever building or changing the process.

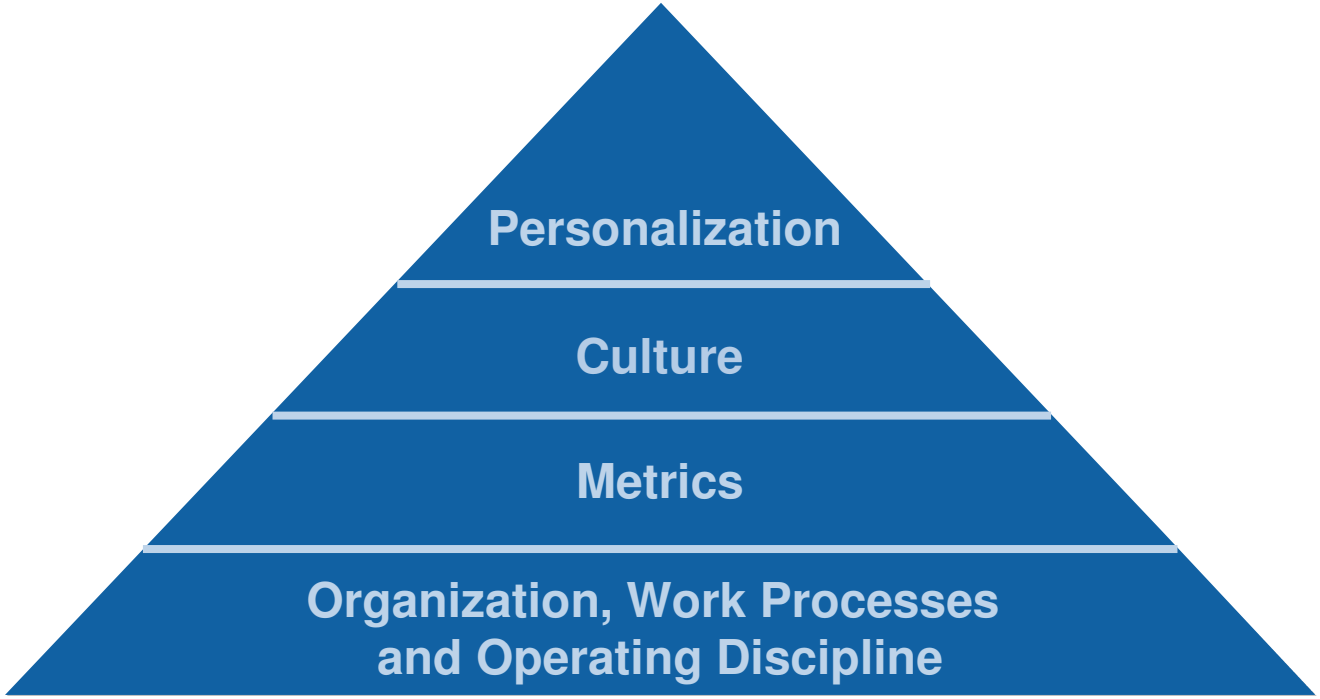
Pyramid of Process Safety Performance



Characteristics of Safety Performance Intangibles

- The entire organization must personalize process safety and what it means to them.
- Communication is constant, timely, and personal
- Make safety performance data relevant– go beyond the numbers
- The consequences of an incident are internalized, individually…from the operator level to the corporate leader level.
- Total ownership of performance across the entire organization
- Must be kept fresh, creativity is the key

Pyramid of Process Safety Performance



A Call to Action

Thank You