AN INTRODUCTION TO RISK BASED PROCESS SAFETY

Bob Wasileski

RWasileski@BakerRisk.com

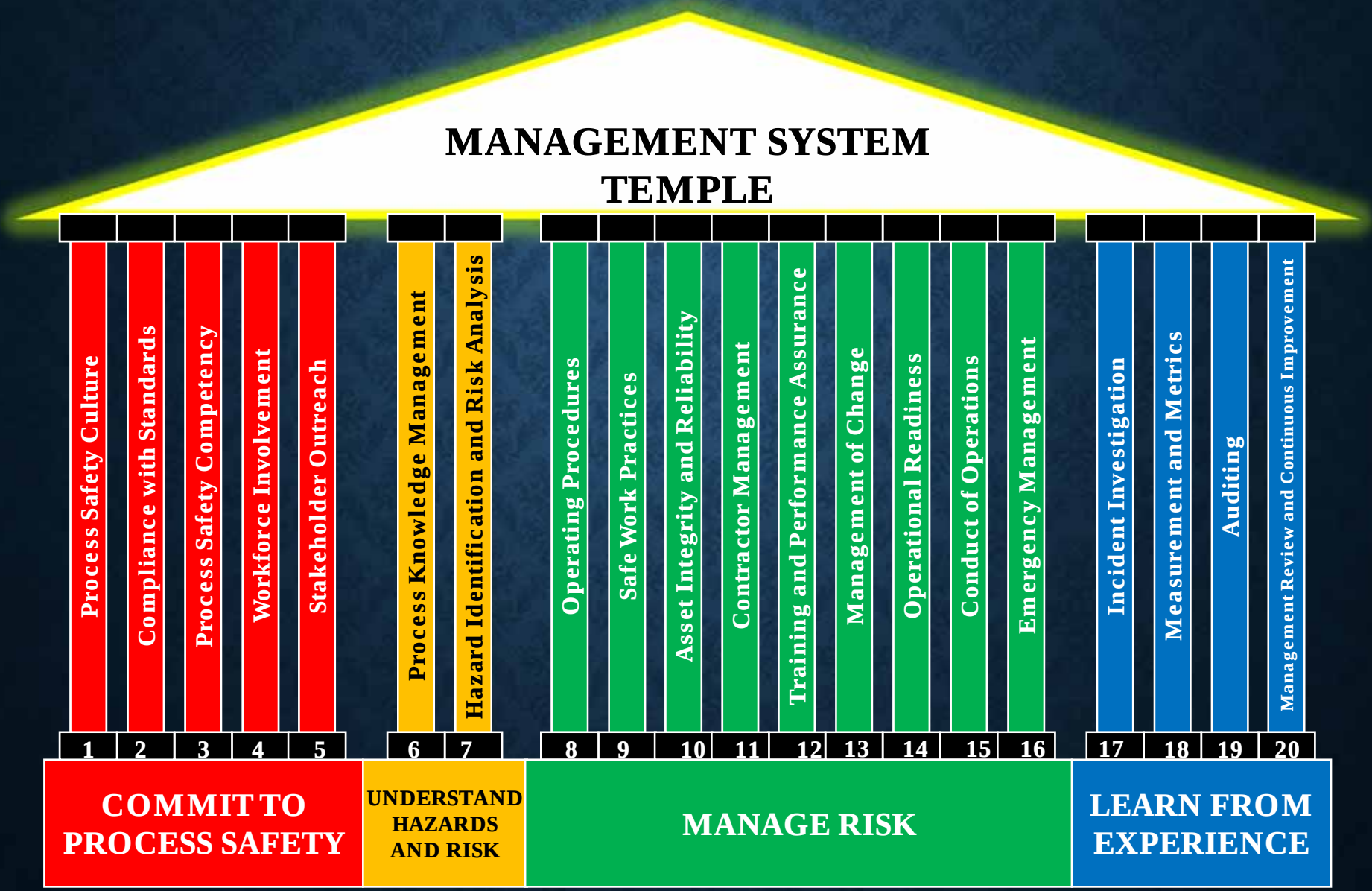
January 6th, 2017

-REEF MEETING-

G/L FOR RISK BASED PROCESS SAFETY (CCPS, 2007)

- ✓ **Framework for Process Safety Programs**
- ✓ **Builds upon the Original '12 Elements' published in 1989 in *G/Ls for Technical Management of Chemical Process Safety***
- ✓ **Not ALL Hazards and Risks are Equal!**
- ✓ **Allows an Organization to Allocate Limited Resources in the most Cost Effective Manner**
- ✓ **Spend Too Much $$$ on Risk = Go Broke Slowly**
- ✓ **Spend Too Little $$$ on Risk = Go Broke Over-night**

RISK BASED PROCESS SAFETY



U.S. OSHA PROCESS SAFETY MANAGEMENT STANDARD

14 Key Elements

- Employee Participation
- Process Hazards Analysis
- Training
- Pre-startup Safety Review
- Hot Work Permit
- Incident Investigation
- Compliance Audit
- Process Safety Information
- Operating Procedures
- Contractors
- Mechanical Integrity
- Management of Change
- Emergency Planning
- Trade Secrets

CCPS
RISK BASED PROCESS SAFETY

20 Key Elements

- Commit to Process Safety
  - Process Safety Culture
  - Compliance with Standards
  - Process Safety Competency
  - Workforce Involvement
  - Stakeholder Outreach
- Understanding Hazards & Risks
  - Process Knowledge Management
  - Hazard Identification & Risk Identification
- Manage Risk
  - Operating Procedures
  - Safe Work Practices
  - Asset Integrity & Reliability
  - Contractor Management
  - Training & Performance Assurance
  - Management of Change
  - Operational Readiness
  - Conduct of Operations
  - Emergency Management
- Learn from Experience
  - Incident Investigation
  - Measures & Metrics
  - Auditing
  - Management Review & continuous Improvement

COMPARISON

CCPS	OSHA
Commit to Process Safety	
Process Safety Culture	
Compliance with Standards →	OSHA 1910.119 (d)(3)(ii),
Process Safety Competency	
Workforce Involvement →	Employee Participation
Stakeholder Outreach	
Understanding Hazards & Risks	
Process Knowledge Management →	Process Safety Information (PSI)
Hazard Identification & Risk Identification →	Process Hazard Analysis (PHA)
No CCPS Match ←	Trade Secrets

COMPARISON

CCPS	OSHA
Manage Risk	
– Operating Procedures	Operating Procedures
– Safe Work Practices	Hot Work Permit
– Asset Integrity & Reliability	Mechanical Integrity
– Contractor Management	Contractors
– Training & Performance Assurance	Training
– Management of Change	Management of Change (MOC)
– Operational Readiness	Pre-startup Safety Review
– **Conduct of Operations**	
– Emergency Management	Emergency Planning
Learn from Experience	
– Incident Investigation	Incident Investigation
– **Measures & Metrics**	
– Auditing	Compliance Audit
– **Management Review & continuous Improvement**	

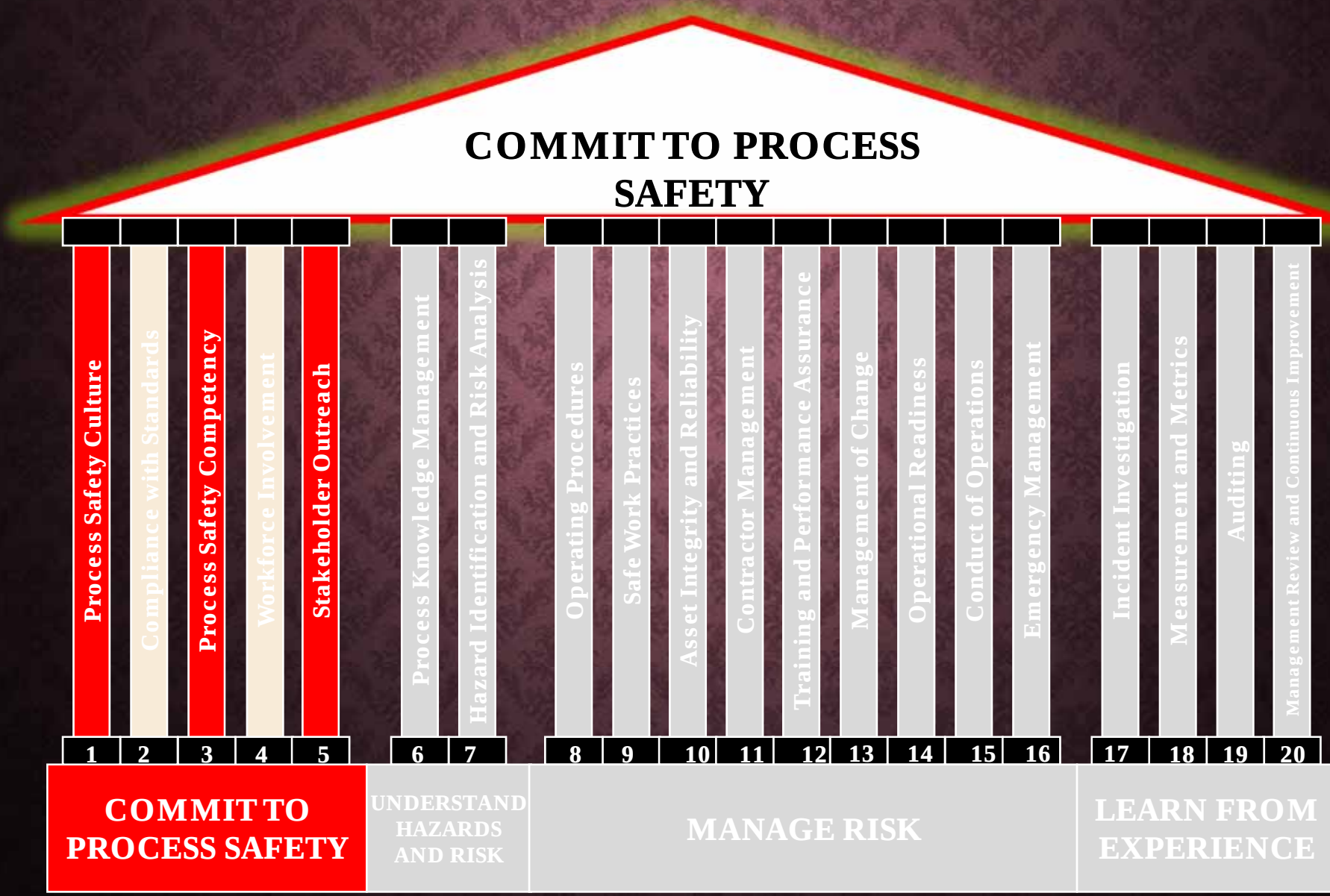
CCPS ELEMENTS WITHOUT AN OSHA MATCH

1) Process Safety Culture
2) Process Safety Competency
3) Stakeholder Outreach
4) Conduct of Operations
5) Measures & Metrics
6) Management Review & Continuous Improvement
7) Compliance with Standards (not an OSHA element but implied by OSHA 1910.119 (d)(3)(ii))

RECENT EXPERIENCE WITH ONE CLIENT…

- ✓ Client has ~15 Sites across 6 Countries
- ✓ RBPS Audits / 1 week at each location / 3-5 auditors
- ✓ Much less constrained than regulatory PSM Audit
- ✓ Opportunity to apply breadth of knowledge (much like an Insurance Survey)
- ✓ Opportunity to take a deep dive into protocol areas (much like a traditional audit)
- ✓ Latitude with recommendations (e.g., "do less")
- ✓ Sites very receptive to recommendations

RISK BASED PROCESS SAFETY



COMMIT TO PROCESS SAFETY
(1) PROCESS SAFETY CULTURE
WHAT DOES IT LOOK LIKE?

- Culture is the **value system** of an organization.
- Culture is reflected in the way that people **think and act**.
- Culture determines **what is acceptable and what is not**.
- Culture must evolve and must be practiced and supported **at all levels**.

Element 1 Case Study:
BP Texas City, March 2005

COMMIT TO PROCESS SAFETY

(1) PROCESS SAFETY CULTURE

THE SYMPTOMS OF A WEAK CULTURE

1) *Assign little value to process safety*

2) *Have a poorly developed sense of their vulnerabilities*

3) *Have a poor understanding of risk*

4) *Devote minimal or no resources to risk control*

5) *Overlook process safety warning signs*

6) *Practice poor housekeeping (in the plant)*

7) *Accept and normalize poor performance and other deviations*

8) *Strong reliance on management to identify hazards / take action*

COMMIT TO PROCESS SAFETY
(3) PROCESS SAFETY COMPETENCY
THREE KEY ACTIONS

1) Continuously **improve** knowledge and proficiency.
2) Ensure that appropriate **information** is available to employees who need it when they need it.
3) Consistently **apply** what has been learned.

Element 3 Case Study:
Macondo Well Blowout, April 2010

COMMIT TO PROCESS SAFETY
(5) STAKEHOLDER OUTREACH
WHAT ARE THE BENEFITS?

1) Sharing information with industry peers will **improve** process safety performance for everyone (REEF Meetings).

2) Sharing information in proactive ways with community and government stakeholders will build **trust** and **commitment**.

3) Promoting openness and responsiveness with an effective outreach program will increase all stakeholders' **confidence** in the company.

RISK BASED PROCESS SAFETY

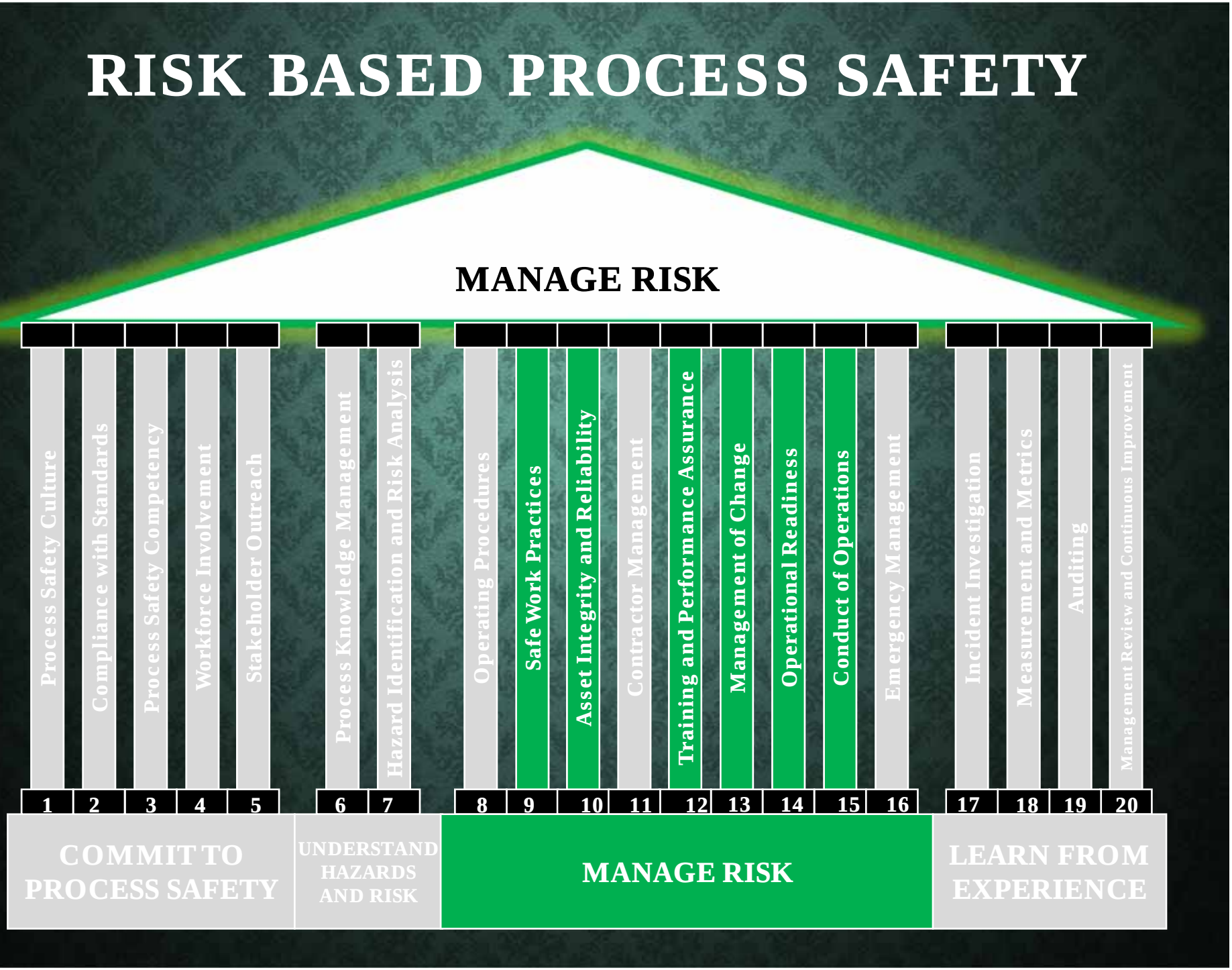
UNDERSTAND HAZARDS & RISK
(6) PROCESS KNOWLEDGE MNGMNT SIGNALS INDICATING A WEAK SYSTEM

1. Information is not **accessible** or personnel are unaware of how to **access**
2. Information cannot be readily **located** within documents
3. Personnel have low confidence that the process knowledge is **current** and **accurate**
4. Can you think of examples you've seen?

UNDERSTAND HAZARDS & RISK
(7) HIRA
QUESTIONS TO INVESTIGATE

1) What methodology is used most often in the company? Is it appropriate for the complexity, novelty and inherent hazards of the operation?
2) How are PHA leaders "qualified"?
3) How is the team prepared? Have they been trained in the methodology used?
4) Are accident reports and case studies used?
5) How often are HIRA or PHA revalidations done?
6) **What are some others???**

RISK BASED PROCESS SAFETY



MANAGE RISK
(9) SAFE WORK PRACTICES
HAZARD CONTROL FOR NON-ROUTINE TASKS

- Operating Procedures = Element 8
- Maintenance Procedures = Element 10
- **All other non-routine tasks** = Element 9
- Hot Work
- Confined Space Entry
- LOTO
- Excavation and Digging
- Fire Protection Impairments
- Others?

Element 9 Case Study:
Piper Alpha Offshore Platform,
North Sea, Scotland, July 1988

MANAGE RISK
(10) ASSET INTEGRITY & RELIABILITY COMMON METRICS

- *Percent of overdue ITPM tasks*
- *Number of emergency work orders per month*
- *Number of temporary repairs currently in service*
- *Number of deferred repairs*
- *Percent of ITPM tasks which reveal a hidden failure*
- *Equipment availability*
- *Equipment reliability*
- *Total time charged to ITPM tasks each month*
- *What others can you think of?*

MANAGE RISK
(12) TRAINING & PERFORMANCE ASSURANCE

- **Training**
  - Practical instruction in job and task requirements and methods
- **Performance assurance**
  - The means by which workers demonstrate that they understood the training and can apply it in practical situations

Element 12 Case Study:
Ocean Ranger Offshore Drilling Rig, Canada, February 1982

MANAGE RISK
(12) TRAINING & PERFORMANCE ASSURANCE - TENETS

- Initial training
  - **Before** operating the process
- Refresher and supplemental training
  - **At least** every 3 years
- Communication of change
  - Training, if required
- Contractor training
- Verification of understanding
- Training **must be** documented

MANAGE RISK

(13) MANAGEMENT OF CHANGE SCOPE SHOULD ALWAYS INCLUDE:

1) **Physical / Equipment changes**
   - New facilities, Modifications to existing facilities, Mothballing, Remediation, Decommissioning and Recommissioning
2) **Process Conditions**
   - Outside of Normal Operating Limits
3) **Chemicals** (Feedstocks, Catalysts, etc.)
4) **Process Control and Software changes**
5) **Organizational and Personnel changes**
6) **Maintenance and Operating Procedures**
7) **Suppliers**
8) **Changes-in-service**

Element 13 Case Study:
Nypro Ltd., Flixborough, UK.,
June 1974

MANAGE RISK
(14) OPERATIONAL READINESS

- Is applied ***more broadly*** than Pre-Startup Safety Review (PSSR) which it evolved from.
- Addresses start up from ***all non-operating conditions***, not only from those resulting from new or changed processes (MOC)
- Experience has shown that the frequency of incidents is ***higher during transient conditions*** such as startup and shutdown (up to 50% of incidents?)

Element 14 Case Study:
Pneumatic Testing Accident, Brazil
January 26, 2006

MANAGE RISK
(15) CONDUCT OF OPERATIONS
HOW IT IS DEFINED

- The execution of operational and management tasks in a deliberate and structured manner
- Institutionalizes the pursuit of excellence in the performance of every task
- Minimizes variations in performance
- "Say what you are going to do, and do what you said you were going to do!"

Element 15 Case Study:
Tosco Avon Refinery, Martinez, CA.
January 1997

MANAGE RISK
(15) CONDUCT OF OPERATIONS AREAS WHERE IT APPLIES

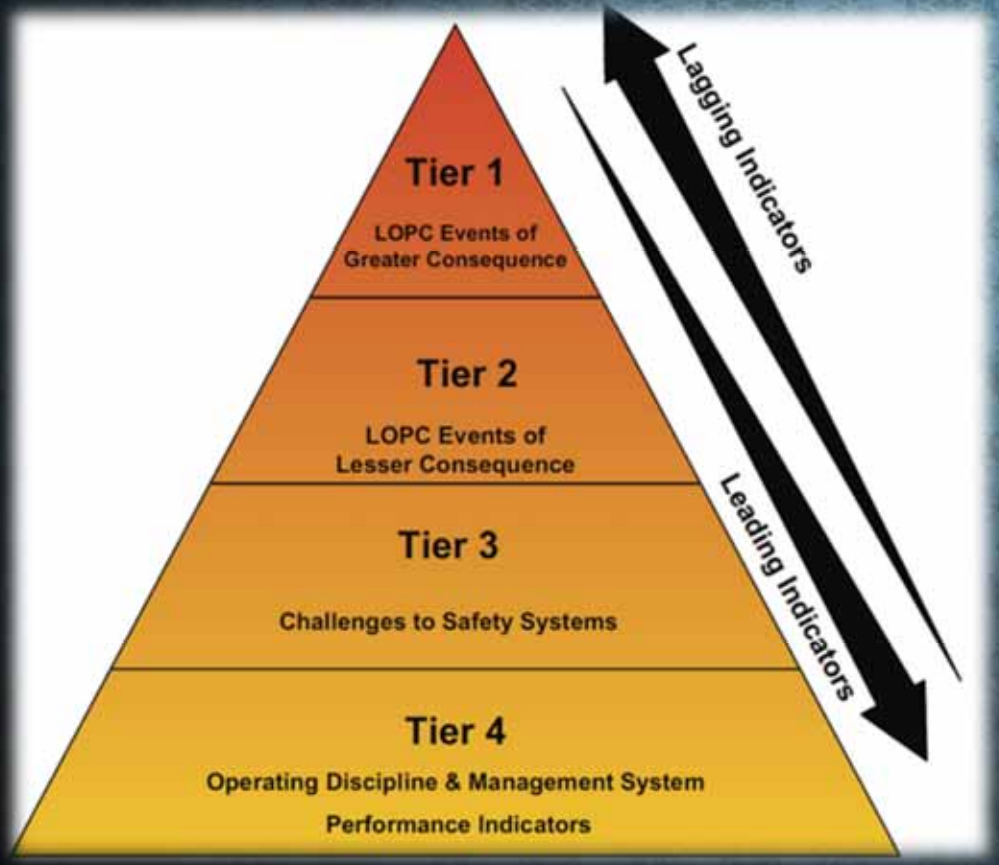
- *Training and Certification*
- *Use of Procedures*
- *Shift Turnover / Handover in operations*
- *Equipment Turnover to/from maintenance*
- *Safety System Impairments*
- *Operational Readiness*
- *Management of Change*
- *Others?*

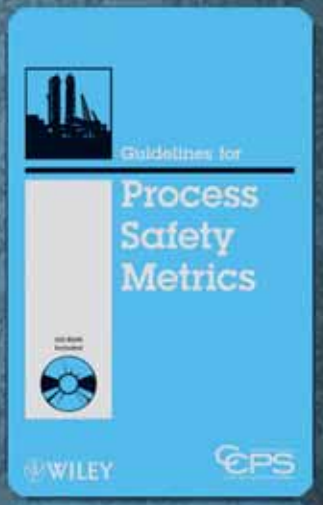
RISK BASED PROCESS SAFETY

LEARN FROM EXPERIENCE

(18) MEASUREMENT & METRICS

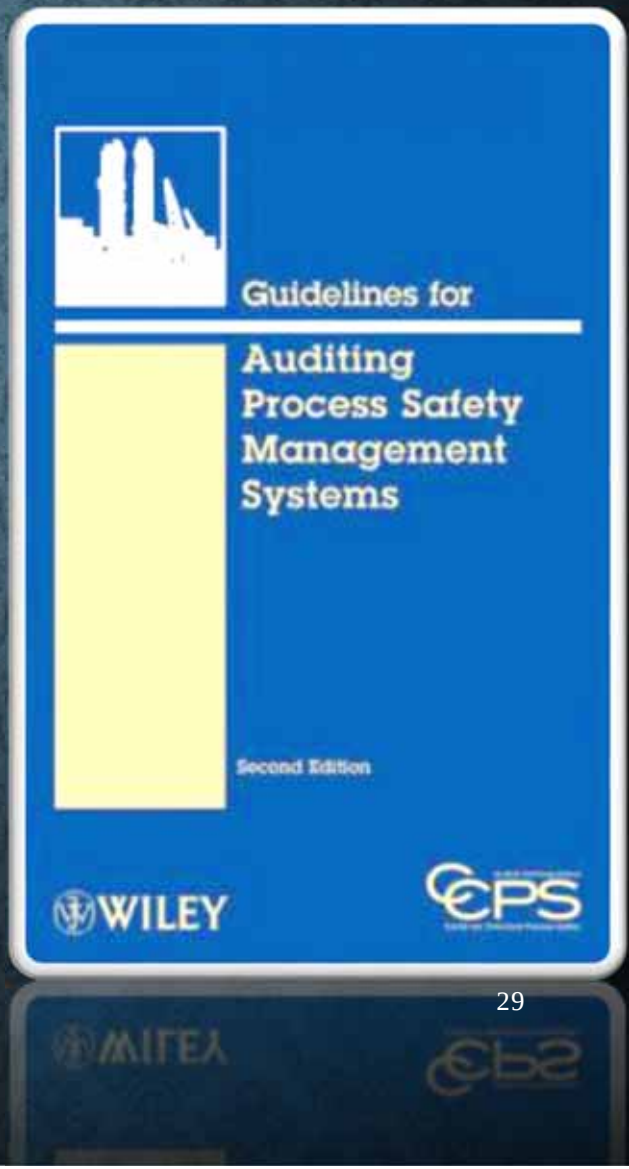
LEADING & LAGGING INDICATORS





LEARN FROM EXPERIENCE
(19) AUDITING

- A systematic, **independent review** to verify conformance with prescribed standards of care
- AIChE CCPS "Guidelines for Auditing Process Safety Management Systems", 2nd Edition (2011)
- CPL 03-00-004 - Petroleum Refinery Process Safety Management National Emphasis Program
- CPL 03-00-014-PSM Covered Chemical Facilities National Emphasis Program



LEARN FROM EXPERIENCE
(20) MANAGEMENT REVIEW & CONTINUOUS IMPROVEMENT

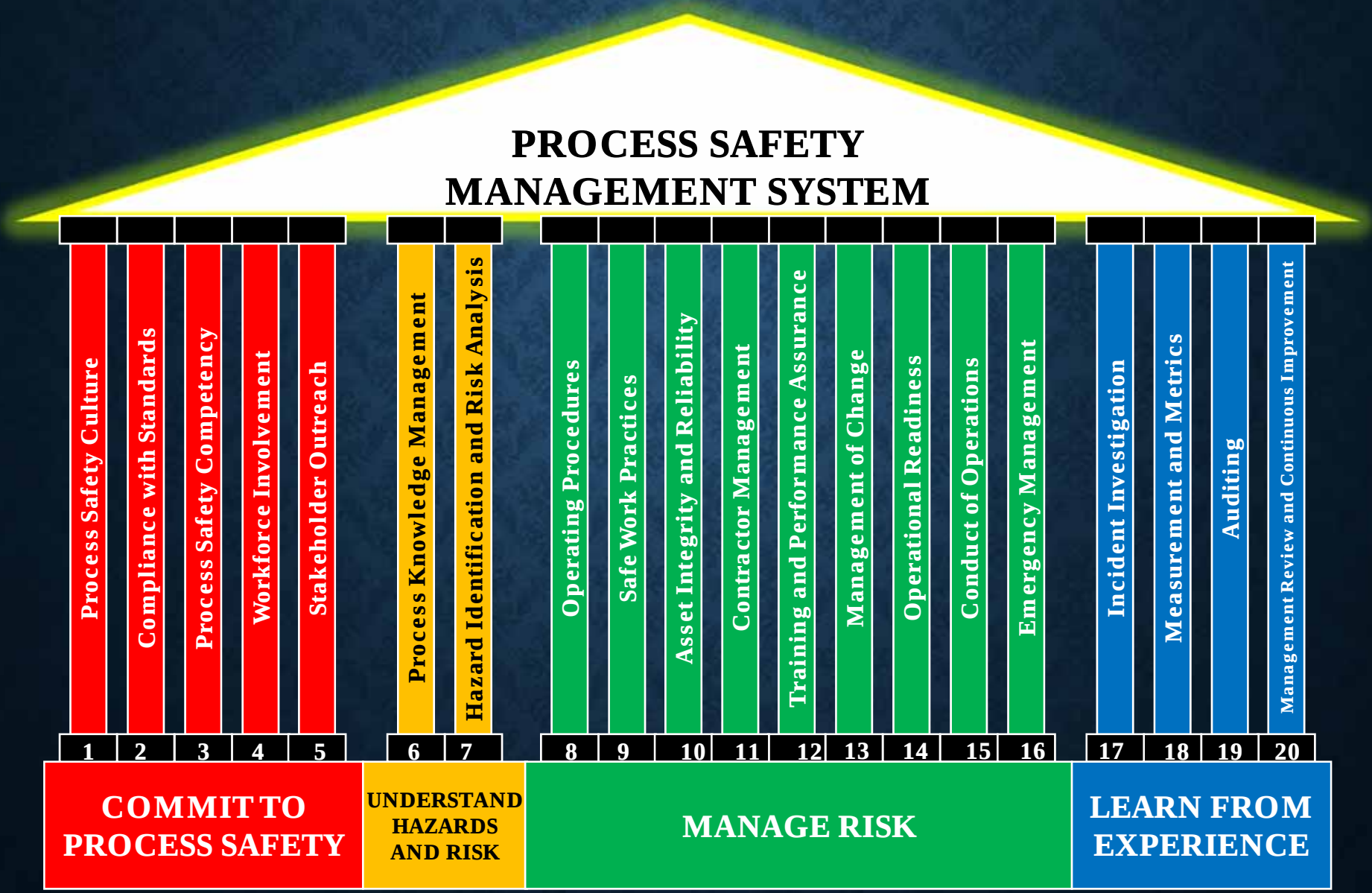
TRIGGERS

- **Regulatory Changes**
- **Audit Results**
- **Facility Self-Assessments**
- **Process Safety Metrics**
- **Incident Investigation Results**
- **Employee Comments and Suggestions**

MANAGEMENT RESPONSES

- ***When was the written program last revised?***
- ***How do our programs compare to industry practice?***
- ***Do we have overdue action items or inspections?***
- ***Do we have bypassed safety critical interlocks?***

QUESTIONS?


PROCESS SAFETY MANAGEMENT SYSTEM
Process Safety Culture
Compliance with Standards
Process Safety Competency
Workforce Involvement
Stakeholder Outreach
Process Knowledge Management
Hazard Identification and Risk Analysis
Operating Procedures
Safe Work Practices
Asset Integrity and Reliability
Contractor Management
Training and Performance Assurance
Management of Change
Operational Readiness
Conduct of Operations
Emergency Management
Incident Investigation
Measurement and Metrics
Auditing
Management Review and Continuous Improvement
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
COMMIT TO PROCESS SAFETY
UNDERSTAND HAZARDS AND RISK
MANAGE RISK
LEARN FROM EXPERIENCE