Chemical Safety Leadership and Leading Indicators

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EFCOG's Eleventh Annual Joint Chemical Workshop
March 10, 2009

Thanks to Bill Von Holle

Recent Chemical Issues Affecting Nuclear Facilities

- Recent glove box explosion in the Waste Processing Facility at LLNL B695 involved an unexpected reaction while converting uranium hydride to uranium oxide.
- Drum deflagration in Area G at LANL and the exposure of personnel to toxic fumes.
- Hanford tank S-102 spill of highly radioactive waste and the exposure of many to toxic chemical fumes.
- Red Oil issues at MOX and the Waste Solidification Facility at Savannah River Site.

GENERAL CHILTON, Commander, U.S. Strategic Command: *"…they [nuclear weapons] are physics experiments when used, but they are chemistry experiments every day they sit on the shelf."*

The role of ISM is to identify all hazards!

Objectives

- **A few thoughts about leadership**
- **Safety performance metrics**

  “You Don’t Improve What You Don’t Measure” -- CCPS
- **Role of leading indicators to prevent accidents**
- **Green chemistry**

Safety Culture

Safety culture is an organization's values and behaviors – modeled by its leaders and internalized by its members – that serve to make nuclear safety an overriding priority.*

- Dating back to SEN-35-91, it's DOE Policy;
- EFCOG/DOE ISMS Safety Culture Task Team; assessment tool is being developed.
- Acting DS Kupfer Memorandum on January 16, 2009 on Strengthening Safety Culture as a way of taking ISM to the next level.

*INPO, *Principles for a Strong Nuclear Safety Culture*, November 2004.

"Safety Culture is the vessel of continuous improvement in which the ISMS approach to doing work resides." Pamela Horning, Chair, EFCOG

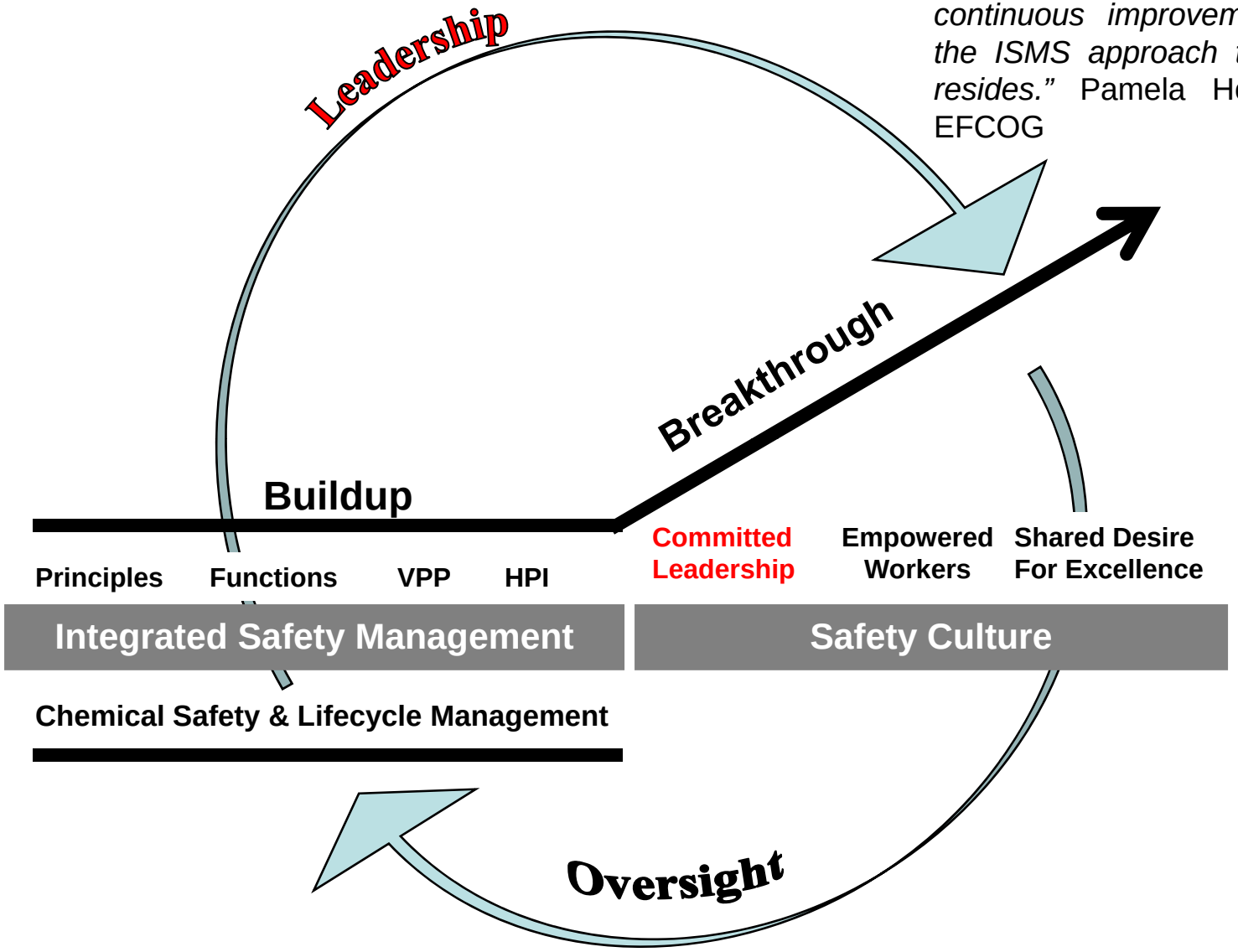


Figure adopted from: Jim Collins, Good to Great; HarperCollins Publishers, NY; 2001.

Management vs. Leadership

"Management is the process of assuring that the program and objectives of the organization are implemented.

"Leadership, on the other hand, has to do with casting vision and motivating people." **John C. Maxwell**

A Call for Leadership

Sampling of recent Board-to-DOE letters found

- **60% had safety culture-related issues**
- **58% had observations from multiple sites/activities**
- **Top five issues (in order):**
  - Failure to follow organization's own requirements---Most chemical incidents are caused by failure to identify the hazards. *(F. Simmons, et al, Asking the Right Questions, J. Chem. Health Safety, 2009, In Press)*
  - Inadequate resource prioritization or allocation
  - Ineffective or inadequate oversight
  - Inadequate justification for decision
  - Ineffective or incomplete corrective actions

Performance Metrics

- If it ain't measured, it ain't managed.
- Overreliance on DART/TRC as a safety metric is inappropriate for high hazard defense nuclear facilities and can lead to complacency.
  - CCPS doesn't include OSHA in its PSI.
- Metrics can be used to balance priorities between mission and safety, an ISM guiding principle.
- For safety, leading indicators that prevent accidents have the greatest value.

U.S. CHEMICAL SAFETY AND HAZARD INVESTIGATION BOARD

INVESTIGATION REPORT

REFINERY EXPLOSION AND FIRE

(15 Killed, 180 Injured)

KEY ISSUES:

SAFETY CULTURE
REGULATORY OVERSIGHT
PROCESS SAFETY METRICS
HUMAN FACTORS

BP

TEXAS CITY, TEXAS
MARCH 23, 2005

REPORT NO. 2005-04-I-TX
MARCH 2007

The BP Texas City Disaster

- In 2004 BP Texas City had the lowest OSHA recordable injury rate in its history, nearly one-third of the oil refining sector average.
- However, in the last 32 years, BP Texas City had 39 fatalities, worst of any US workplace in recent history.
- Preceding the March 2005 explosion, leading indicators like spills were ignored and lagging indicators (fatalities) were tolerated while management concentrated on the OSHA injury rate, which does not include fatalities.

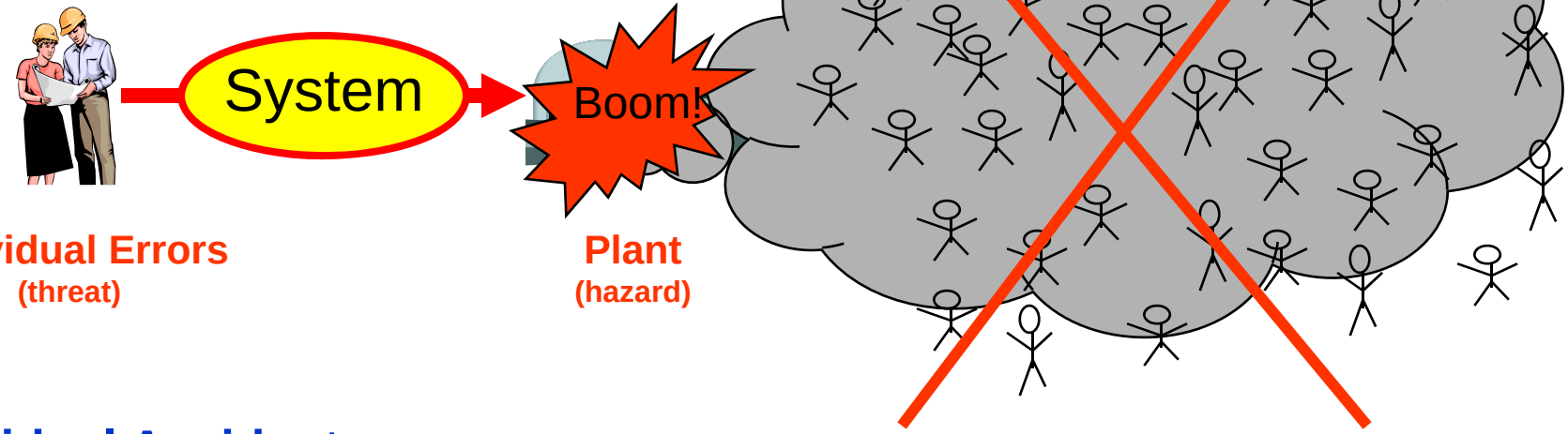
Texas City, con't

- The "blow down drums" in use at the plant were obsolete and should have been replaced.
- As the CSB discovered, in 1992 OSHA determined that the drum and stack were not constructed in accordance with the American Society of Mechanical Engineers' Boiler and Pressure Vessel Code.
- This obvious engineered control, e.g., flare, was never installed and the unsafe equipment was allowed to persist until the accident.

Systems Accident vs. Individual Accident

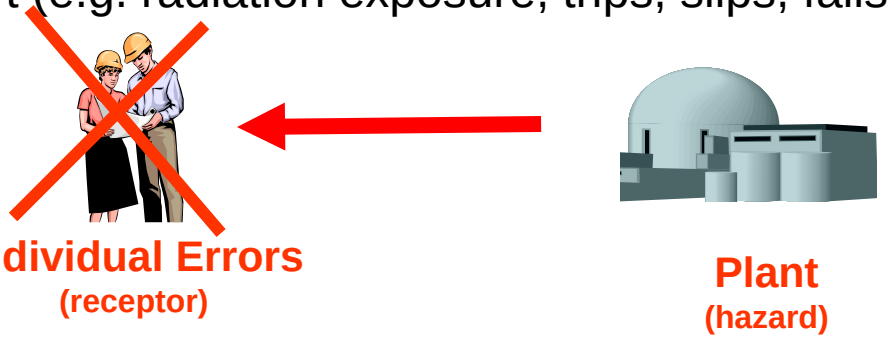
Systems Accident

System accident, system fails allowing threat (individual errors) to release hazard and as a result many people are adversely affected.



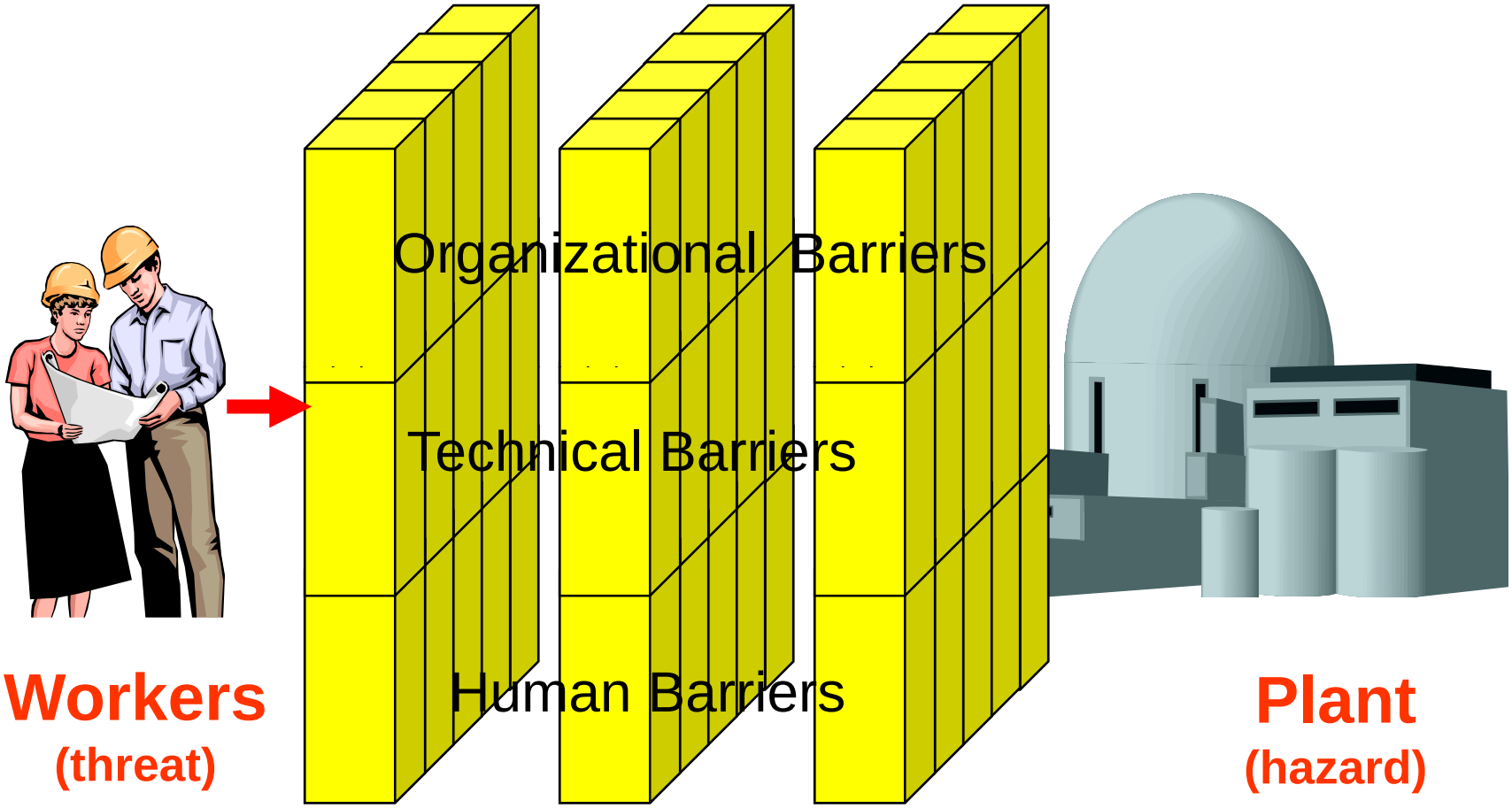
Individual Accident

Individual accident, the worker is not protected from the plant and the worker gets hurt (e.g. radiation exposure, trips, slips, falls, industrial accident, etc.).



ISM Workshop, DOE-ID, *CFA a Tool to Assess the Effectiveness of the HRO*, Hartley, Supina, and Tolk, B&W Pantex, 2008.

Barriers Between Workers and Plant*

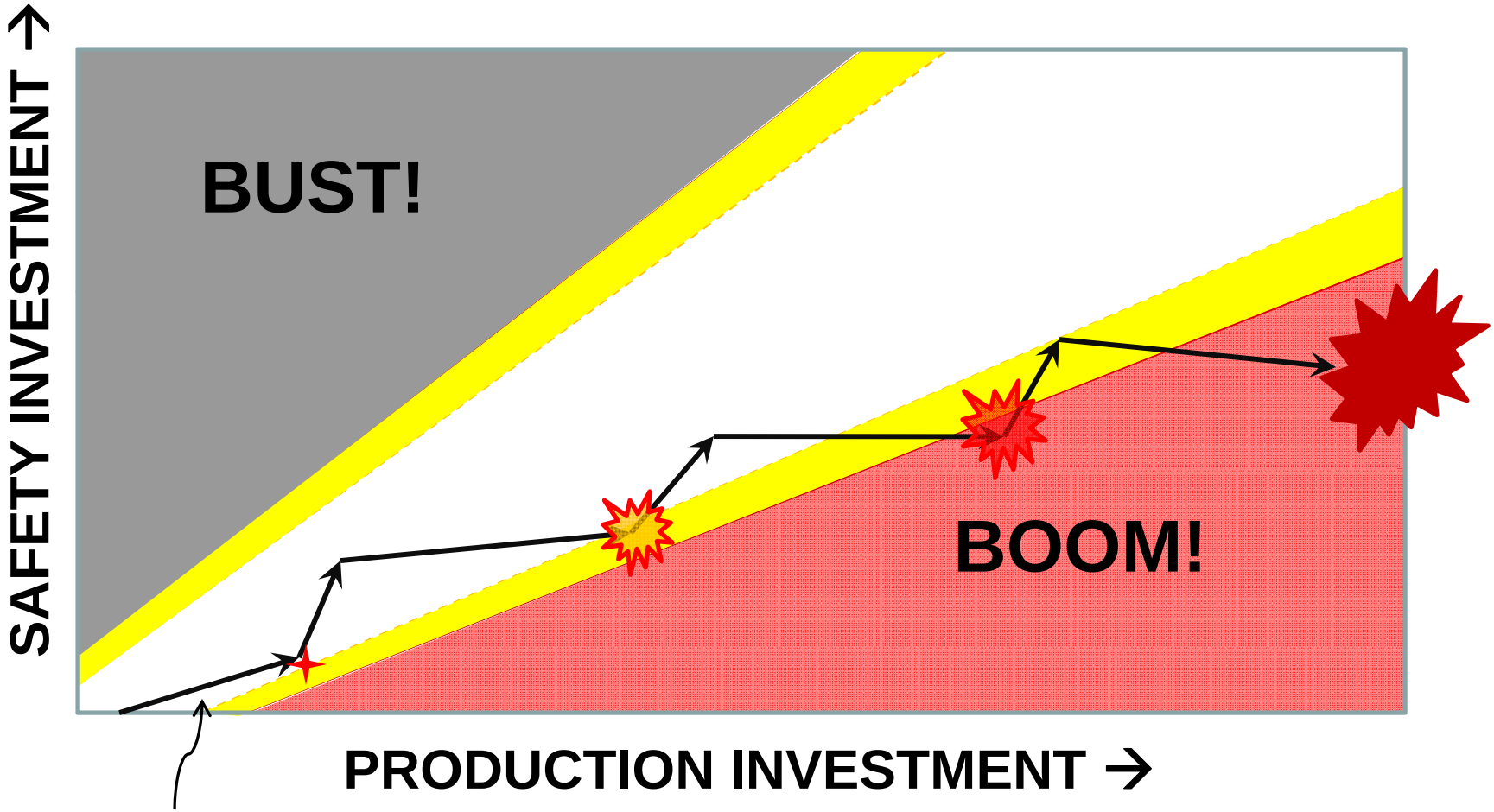


Defense-in-Depth

**High Reliability Operations*, Hartley, Tolk, and Swaim, B&W Pantex, 2008.

A Modified "Reason Model"

(modified from Reason, 1997 and Starbuck, 1988)



The slope and direction of this line is driven by the organization's desire to "economically optimize" the relative cost of safety in the activity. As safety deficit increases, slope may go negative, leading to more rapid degradation.

Leaders Anticipate Problems

LAGGING INDICATORS measure events that have already taken place and past trends.

LEADING INDICATORS predict the likelihood of an event before it occurs and support productivity.

Process Safety Leading and Lagging Metrics, Center for Chemical Process Safety, 2008.

The UK Health and Safety Executive has proposed using a system of "dual assurance" with both leading and lagging indicators.

4-Step Process for Leading Indicators

1. Select a set of hierarchy of goals based on desired outcomes (link mission and safety).
2. Identify institutional and activity-specific safety programs that are key to meeting each goal; focus on the most critical components.
3. Determine metrics that best monitor the health of those key programs*; in the end, it's always people, processes, and equipment.*
4. Determine metrics that best monitor the status of the missions that are linked to the same goal.

4-Step Process (con't)

- The trends over time are more important than absolute values, and comparison between the mission and safety metrics are the key
- Interpreting the observed trends:

Positive –	Safety Indicators improve faster than mission Indicators
Stable –	Equivalent improving trends
Negative –	Safety Indicators improving slower than mission Indicators
Danger –	Safety Indicators are declining

PANTEX Example

Vision: "Center of Excellence for assembly/disassembly of weapons."

– **Pinnacle events to avoid**
  - Worker fatality
  - IND/HEVR
  - Offsite release of SNM

MISSION METRICS
- Assembly
- Disassembly

– **Initial leading indicators**
  - TSR violations
  - Nuclear safety system maintenance backlog
  - Unplanned LCO entries
  - Personnel trained/qualified as a percentage of staff on board
  - Safety system availability – defense-in-depth

DOE Green Chemistry Initiatives

- LANL has embarked on a *"Greening of the Hazardous Material Life-cycle"* with direct impacts on worker safety, Emergency Management, and AB operations at LANL.
- Y-12 has designed green practices into the Uranium Production Facility conceptual design.
  - Metal production; saltless direct oxide reduction
  - Waste prevention
  - Increased energy efficiency.
- Reduction of hazardous materials is a design goal of RRW.

Green Chemistry, con't

- Green chemistry should be viewed as an "engineered" control for worker safety.
- By using inherently safer materials and processes, the hazard is removed or significantly reduced.
- Green chemistry will pay long-term dividends by reducing the potential for accidents, including explosions, fires, and chemical/nuclear releases.

Consider the Future

- Committed leadership drives safety culture
  - Safety culture is measured by workers' behaviors
- Overreliance on DART/TRC as a safety metric is inappropriate for high hazard defense nuclear facilities and can lead to complacency.
- Performance metrics can be used to balance priorities between mission and safety, an ISM guiding principle.
- For safety, leading indicators that prevent accidents have the greatest value.
- Green Chemistry that reduces chemical hazards is an engineered control beneficial to overall chemical/nuclear safety.
- What's good for safety is what's good for business.