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Using performance indicators to drive improvement in process safety performance

Tank Storage Association, Coventry, 22nd September 2011

Outline of presentation

- What is process safety?
- The need for performance indicators
- Performance indicator (PSPI) principles
- Method for developing PSPIs
- Example for petroleum storage
- Conclusions

Process safety accidents



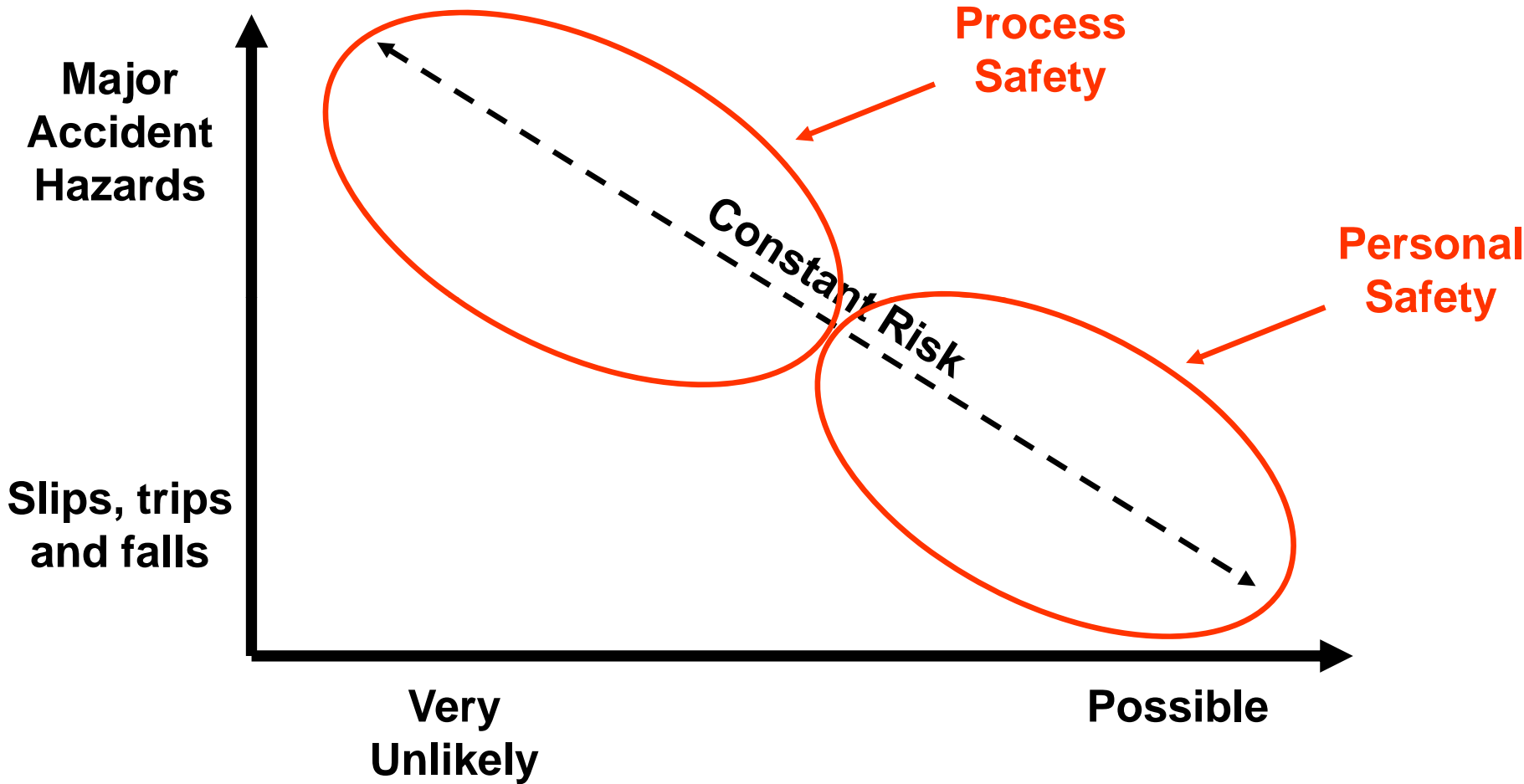
Texas City 2005



Buncefield 2005

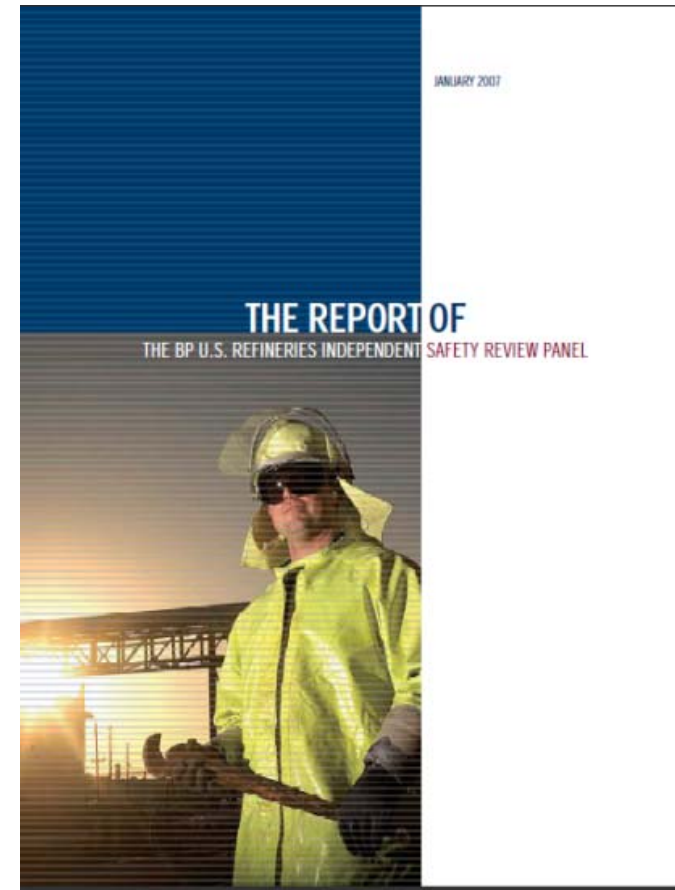
- 2nd June 2011 Chevron Pembroke refinery explosion kills 4
- 30th July 2011 Formosa Petrochemical fire shuts down refinery
- 1st August 2011 Tula, Mexico Refinery fire kills 3
- 15th August 2011 Shell Gannet pipeline leak

What is process safety?



BP Texas City – Baker Report, 2007

- BP primarily used injury rates to measure process safety performance at its U.S. refineries before the Texas City accident
- BP's reliance on injury rates significantly hindered its perception of process risk
- BP now monitors at the corporate level several leading and lagging process safety metrics



Buncefield: Why did it happen, 2011

- At the site there was no adequate framework to set process safety indicators
- The measurement of a number of relatively simple indicators would have alerted management to the underlying problems that led to the incident
- Safety management systems at COMAH sites should specifically focus on major hazard risks and ensure that appropriate process safety indicators are used and maintained

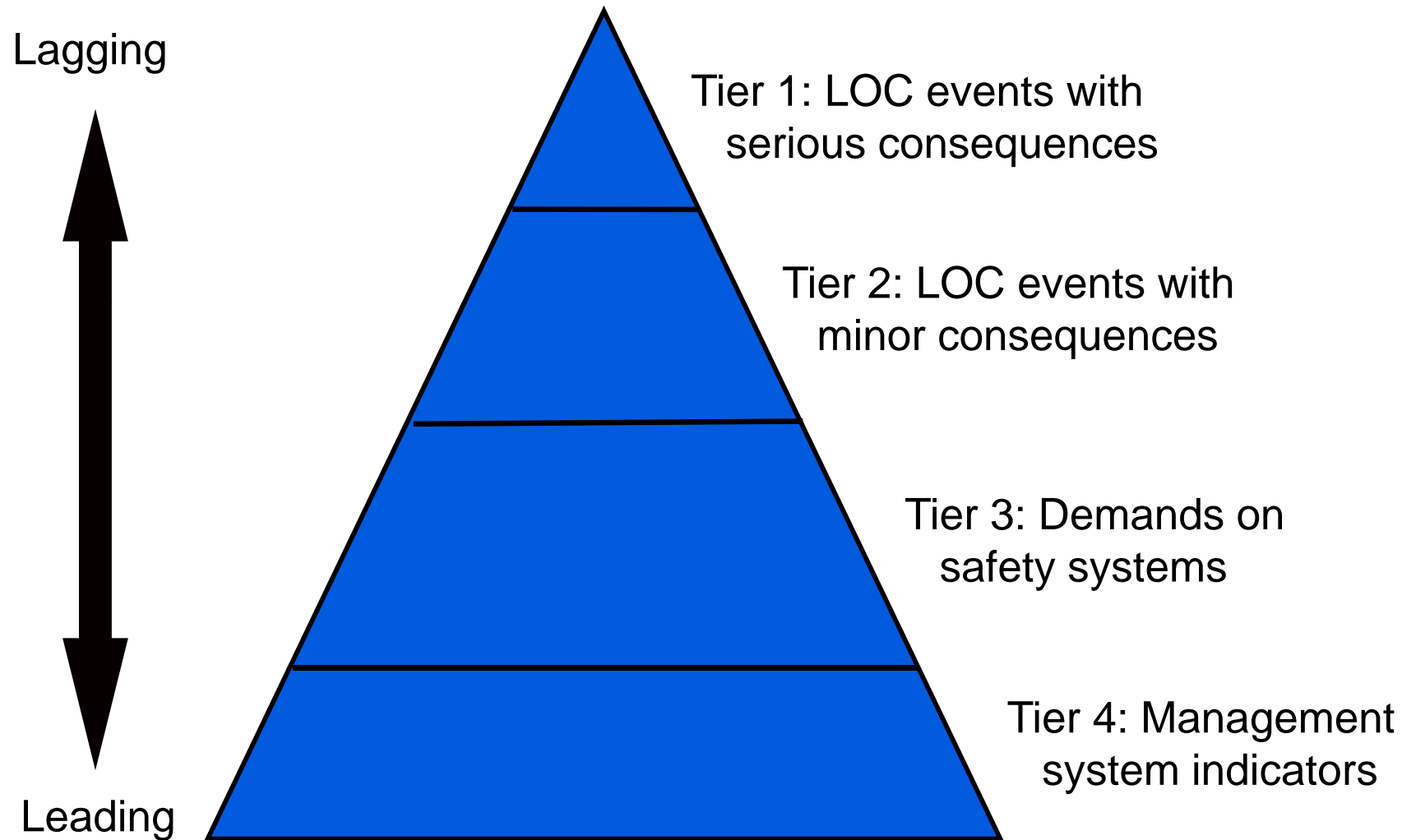


Buncefield: Why did it happen?

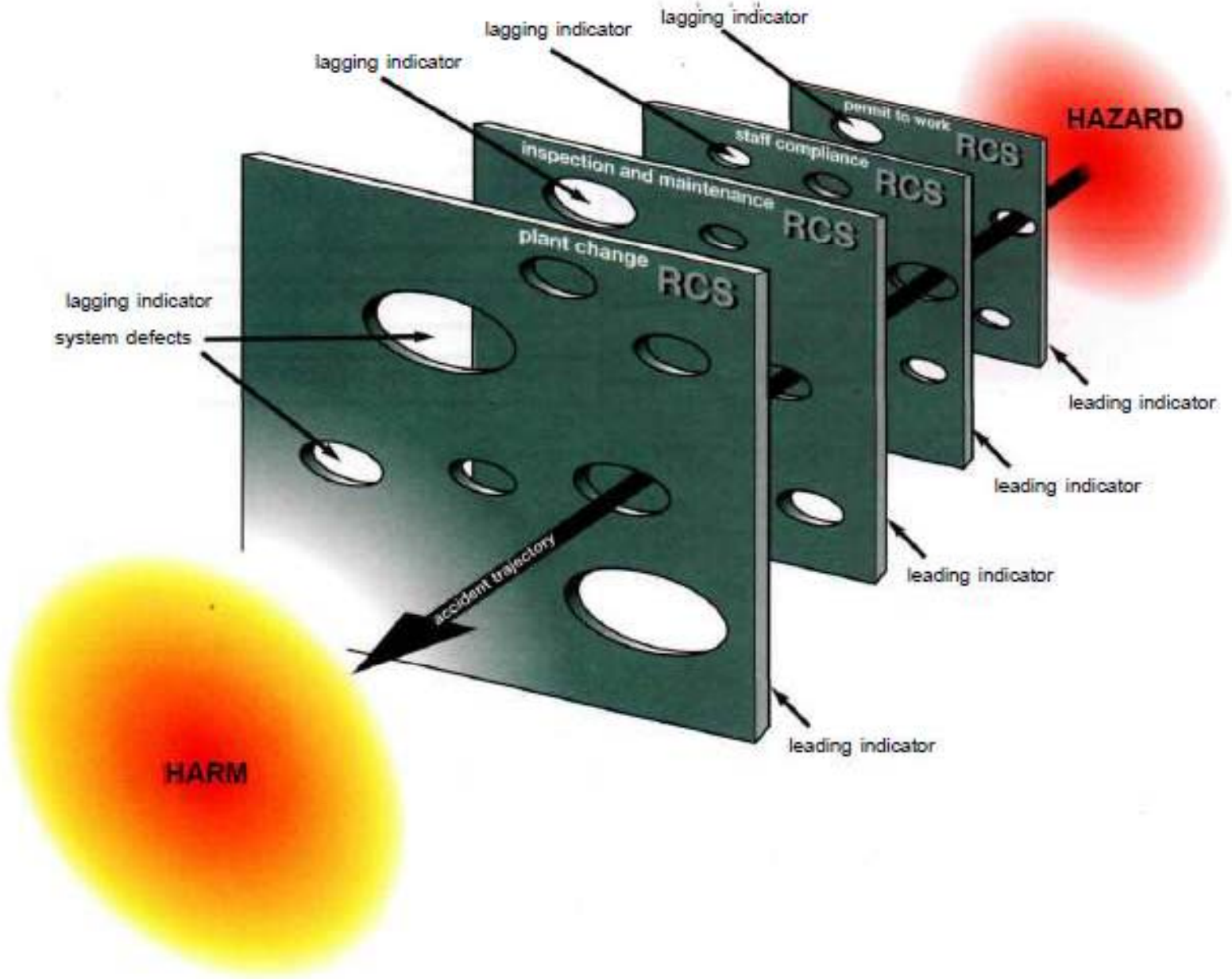
The underlying causes of the explosion and fire at the Buncefield oil storage depot, Hemel Hempstead, Hertfordshire on 11 December 2005



API 754 Process safety pyramid



HSG 254 Layers of Protection Model

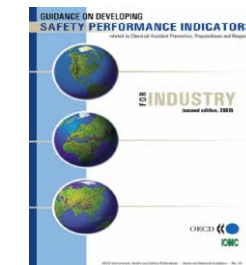


HSE expectation for COMAH sites

- Programme for PSPIs to demonstrate process risk is being managed
- KPIs set according to risk profile of process
- Expect workforce involvement and analysis of risk
- Have both Outcome (Lagging) and Activity (Leading) indicators
- Use findings from KPIs to drive improvements on site
- KPIs linked to leadership and used to inform high level decision making

Developing PSPIs – Overall objectives

- Select a set of PSPIs for a site/plant, ideally 6-10
 - HSE quote: “Organisations don’t need KPIs to monitor everything – focus on a few vulnerable aspects”
- Meeting ‘relevant good practice’
 - HSE guidance (HSG254)
 - Other guidance (API-754, CCPS, OECD)
- Leading and lagging indicators
- Focused on areas of highest risk
- Manageable number of indicators



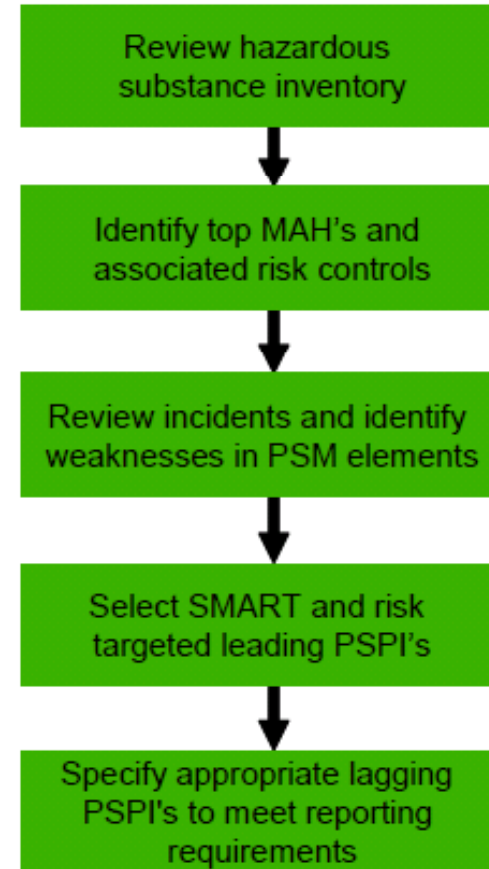
Process Safety Performance Indicators for the Refining and Petrochemical Industries

ANSI/ISO RECOMMENDED PRACTICE 754
FIRST EDITION, APRIL 2010



Preparation

- Allows targeting of indicators towards key process safety risks
- What things does the site fear happening?
- Checklist of data to review
 - Inventory of dangerous substances
 - MAH scenarios, e.g. from COMAH Safety Report
 - Key risk control systems and safety critical equipment
 - History of incidents and near misses
 - Audit reports, process safety actions
- Establish key areas of weakness
 - General risk control systems – elements of PSM system
 - Process operational - specific layers of protection

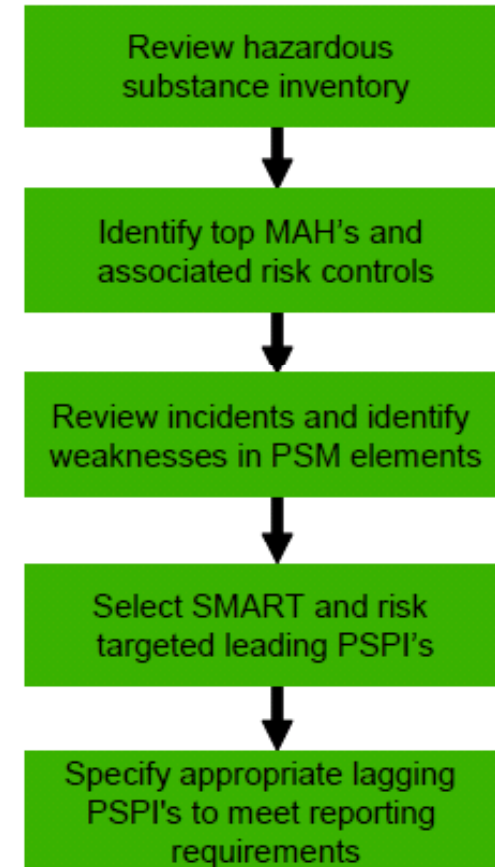


Lagging indicators

- Loss of containment event and process safety incident definitions and reporting
 - Do you have clear definitions?
 - API754 and CCPS provide examples
 - Are you capturing all the data?

Leading indicator selection

- Multi-disciplinary team from technical and operations
- Develop familiarity with site MAH and data from Preparation Phase
- Select the 6-8 MAH of greatest concern
- Develop MAH vs. risk controls matrix
 - Risk controls grouped as people, systems, equipment
- Brainstorm potential indicators
- Test if the indicators are SMART
 - Sufficient, Measurable, Accurate, Reliable, Targeted
- Screen down to max 10 risk-targeted indicators
 - Complete PSPI data sheet for each indicator
 - Gather initial data if available
 - Set initial targets



What should your organisation do?

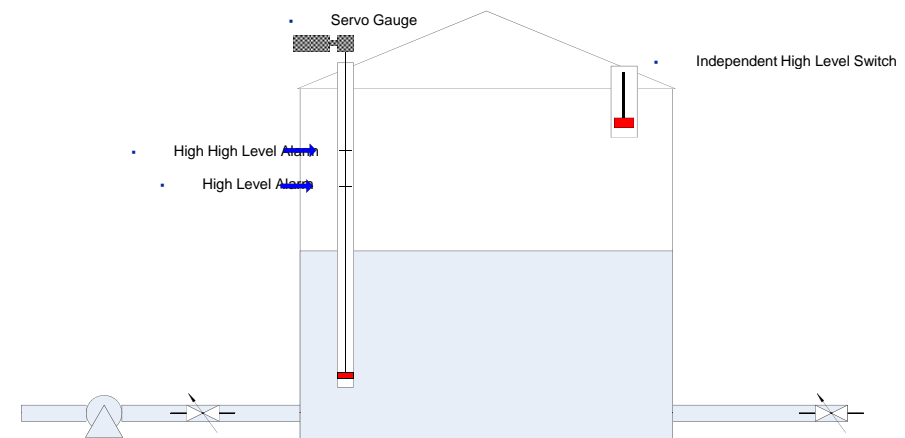
- Don't worry about the distinction between leading and lagging indicators
 - Think of activities (leading) and failures in use or failure to achieve intended outcome (lagging)
- Start small – what's important to improve?
 - What do incidents say that needs to be improved?
 - Indicators should be set to reflect the main process safety vulnerabilities
- Focus on what is likely to go wrong most quickly and with the greatest consequences.
- Look for indicators that generate data frequently enough to talk about a rate
 - Drive down the rate of failures in use
- Be prepared to change tack if KPIs are not improving performance
- Expect to take 3 -5 years to fully implement effective indicators (HSE)

Typical MAH on tank storage depots

- Internal explosion in tank
- Tank overpressure
- Tank overfill
- Road tanker drive-away
- Pipeline rupture



- Tank Overfilling



Typical MAH scenario

Scenario	Consequence	Prevention/ Control	Mitigation
<p>Overfilling of tank during import of petroleum via underground line due to level sensor failure or operator error failing to isolate tank at high level</p>	<p>Overflow from tank into bunded area, release of vapours creating flammable vapour cloud, source of ignition resulting in flash fire leading to pool fire in bund, potential for vapour cloud explosion in confined locations</p>	<p>Monitoring of tank levels during import. Dependent high level alarm on tank. Independent high high level trip sensor on tank with trip of isolation valve on feed line.</p>	<p>Overflow routed into bunded area to limit spread of liquid. Bund area classified under DSEAR Regs to control ignition sources. Fire detection and fire fighting equipment.</p>

Bold – Safety critical elements

Weaknesses at Buncefield before accident

- Single VDU for monitoring levels in all tanks, only one tank visible on screen at a time
- Practice of 'working to alarms' in control room, sensor gave user, high and high high alarms
 - Lack of common practices on when to stop filling
- Level gauge 'stuck' routinely, 14 times in 3 month period prior to accident
 - Supervisors brought small alarm clock into control room as a back-up device
- Padlock missing on high level trip, arm had dropped disabling sensor – lack of understanding by installer
- Defect logging system not being used effectively

PSPIs that could have prevented accident

- Percentage of tank fill operations where tank filled beyond the intended level
- Percentage of critical tank level control actions completed correctly as procedure (e.g. calculate head space, set up flow route, monitor change in level)
 - Periodic sample check for each operator
- Percentage of tank level transmitters and control room read-out inspected and maintained to schedule

Judith Hackitt, Chair, HSE



“Without collecting and acting on information that shows the system is actually working and delivering control of risk, you cannot be sure that your major hazards are being controlled”

“No successful company could stay in business for long without accurate information on its financial performance – so why act differently when it comes to process safety?”

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