



***Meeting Today's Societal Expectations: The Use  
of Process Safety Metrics to Drive Performance  
Improvements***

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## An Overview



- **Dow's Commitment to EH&S Excellence**
  - Drive to Zero
  - 1995 - 2005 Goals
  - 2006 - 2015 Goals
- **Opportunity for Global Process Safety Metrics for Industry**
  - Overview of the CCPS Process Safety Metrics





## 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%

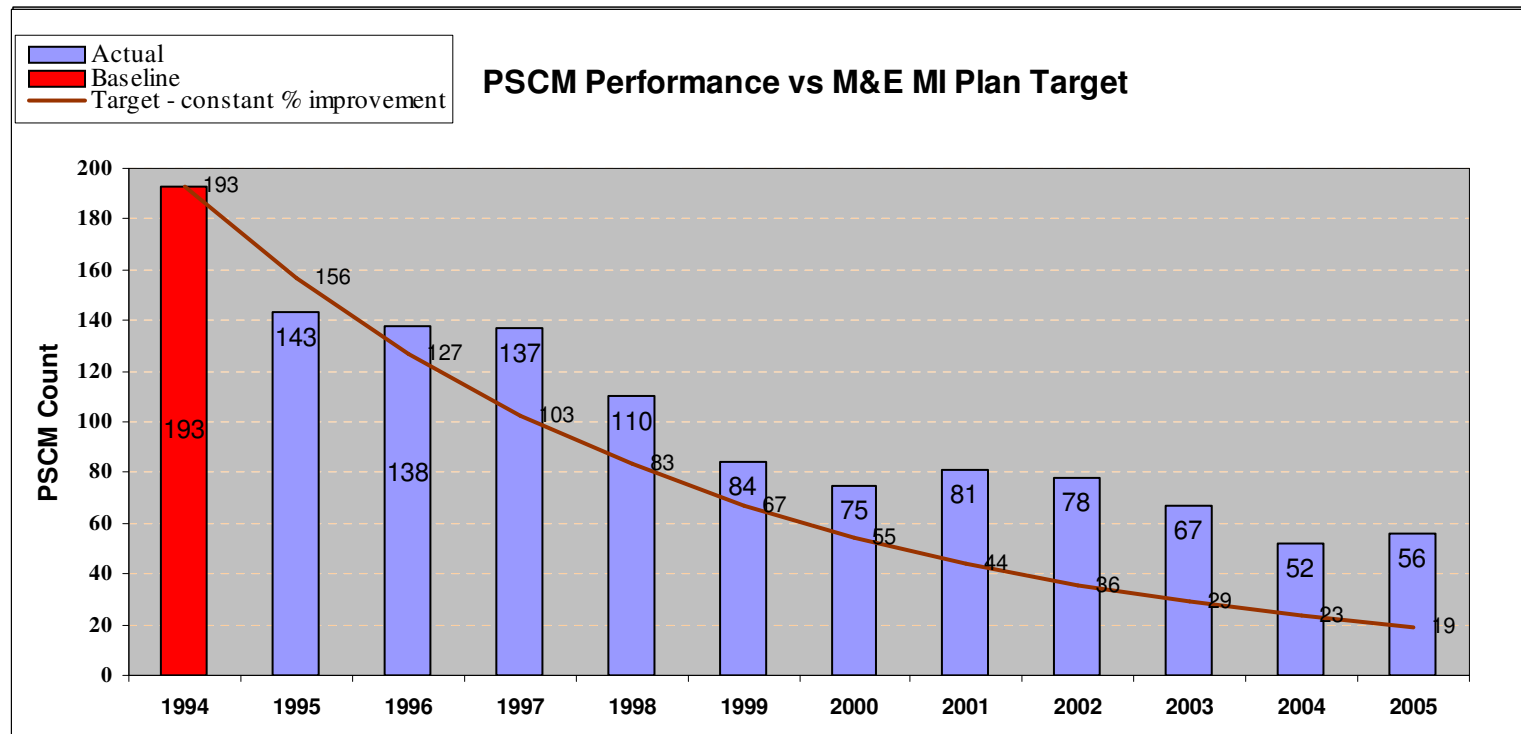


# Performance vs. Goals

## 1996-2005



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



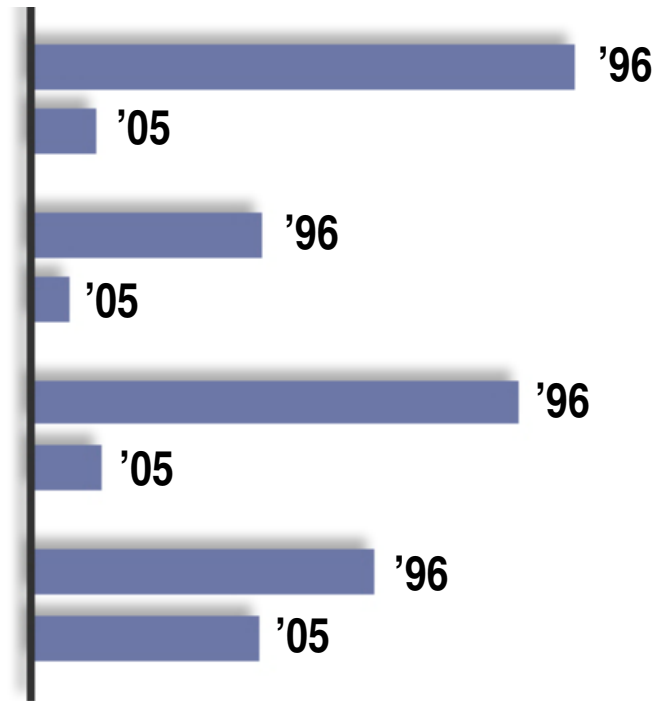


# Performance vs. Goals

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



**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)







# Global Process Safety Metrics

## Driving Consistency and Improvement



## New metrics proposed by Center for Chemical Process Safety (CCPS)

- Deliverables in December 2007
  - Common Industry-Wide Lagging Metric
  - Near-Miss or Other Lagging Metrics
  - Leading Metrics
- <http://www.aiche.org/ccps/metrics/index.aspx>.
- Guideline Book - by 1Q 2009





# Process Safety Metrics

- Several companies and some trade organizations have established process safety metrics programs, but their programs:
  - Differ from organization to organization
  - Are often based upon incident definitions that are not well aligned to the actual hazard of the event





# CCPS Process Safety Metric Project

- Initiated in 2006
- “Breakthrough” opportunity would be to develop a common industry lagging metric
- Many stakeholders invited to participate:
  - companies in North America, Europe, India, and Brazil,
  - ACC, American Petroleum Institute (API), National Petrochemical and Refiners Association (NPRA), European Process Safety Centre (EPSC), CONCAWE
  - US OSHA, EPA, CCCHD, Chemical Safety Board (CSB), Health Safety Executive (HSE) of UK
  - United Steelworkers (USW)
  - Wharton Business School, Texas A&M Safety Center, Members/staff of the Baker Panel





# Criteria used by Team for selecting the Lagging Metric

Criteria	Weighting
Likely acceptance broadly by industry:	
Simplicity to apply	4
Leverages existing data (Comparable)	3
Accuracy / Relative Differentiation	
Considers the relative toxicity or flammability of chemicals released	5
Differentiates events with little potential health impact or process safety risk	5
Less subject to variability in interpretation	4
Considers the release conditions	3
Data useful by multiple stakeholders	
Corporate Leadership	5
Process Safety SMEs	3
External (Regulators, NGOs, Labor)	3
Legal liabilities	1
Which brings the greatest measure of safety	4
Ability to compare (or index) results from small and large companies	4
Identifies enough events to differentiate statistics shifts in performance	5





# Types of Options considered (examples)



## Chemical Release TQs:

- Release quantities specified in EPA 40 CFR 355.40 Appendix A (“Extremely Hazardous Substances”)
- TQs based upon chemical IDLH values
- TQs based upon chemical ERPG-3 values
- TQs based upon NFPA hazard ratings
- TQs based upon GHS classifications
- A single TQ (e.g., 25 kg) for all chemicals
- **TQs based upon United Nations Dangerous Goods classifications**

Did not adequately consider volatility of material (e.g., TDI and Phosgene treated equally)



## Fire/Explosions:

- “Any unplanned flame”
- \$5,000 - \$10,000 - **\$25,000** - \$50,000
- Equipment damage only vs. “**Direct Cost**”
- with & **without** Business Interruption costs included

The best relationship to process safety risk (when using UN Model Practice 15 or DOT graph for toxics)





# Recommended Common Lagging Process Safety Metric #1

## Count of Process Safety Incidents (PSI)

### Criteria:

- Any releases of material or energy from a process unit resulting in:
  - Employee/contractor lost time injury, or
  - Fire or Explosion resulting in \$25,000 of direct cost to the company, or
  - Chemical release from the primary containment (i.e., vessel or pipe)\*, greater than chemical release threshold quantities, linked to global UNDG criteria

\* Excluding releases to designed control device specifically designed for that event (e.g., flare, scrubber, or PSV designed per API 521 or equivalent)

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# Thresholds

## Material Hazard classification as defined by United Nations Dangerous Goods definitions:

	<u>"Process Safety incident TQ"</u>
All TIH Class A materials	5 kg (11 lbs.)
All TIH Class B materials	25 kg (55 lbs.)
All TIH Class C materials	100 kg (220 lbs.)
All TIH Class D materials	200 kg (440 lbs.)
"Packing Group I" materials & "Flammable Gas"	500 kg (1100 lbs.)
"Packing Group II" materials & "Flammable Liquid"	1000 kg (2200 lbs.)
"Packing Group III" materials & "Combustible Liquid" & Division 2.2 - Nonflammable, Nontoxic Gases	2000 kg (4400 lbs.)

Note: Currently, the definitions allow flexibility to use either the NFPA-30, UN Dangerous Goods, or GHS definitions for "flammable gas", "flammable liquid", or "combustible liquid". The expectation is that companies will migrate to the GHS or UNDG definitions over time.





## Proposed Common Lagging Metric #2

### Process Safety Incident Rate (PSR)

- Count of incidents per man-hour
- Include both employee and contractor man-hours

**Total count of all PS incidents x 200,000**  
**Total employee & contractor work hours**







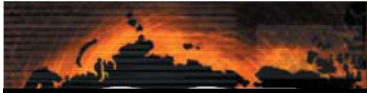
## Proposed Common Lagging Metric #3

### Process Safety Severity Rate (PSSR)

- The cumulative severity-weighted rate of process safety incidents per the formula described within this document.
- Assign score of 1, 3, 9, or 27 points in each category per following slide. Maximum score 108
- Sum the scores of each incident
- Divide by the same man-hour unit as PSR

$$\frac{\text{Total severity score for all PS incidents} \times 200,000}{\text{Total employee \& contractor work hours}}$$





## Table 2: Process Safety Incidents & Severity Categories

Severity Level (Note 4)	Safety/Human Health (Note 5)	Fire or Explosion (including overpressure)	Potential chemical impact (Note 3)	Community/environment impact (Note 5)
<b>NA</b>	Does not meet or exceed Level 4 threshold	Does not meet or exceed Level 4 threshold	Does not meet or exceed Level 4 threshold	Does not meet or exceed Level 4 threshold
<b>4</b> (1 point used in severity rate calculations for each of the attributes which apply to the incident)	Injury requiring treatment beyond first aid to employee or contractors associated with a process safety incident (In USA, incidents meeting the definitions of an OSHA recordable injury)	Resulting in \$25,000 to \$100,000 of <b>direct cost</b>	Chemical released within secondary containment or contained within the unit - see Note 2A	Short -term remediation to address acute environmental impact. No long term cost or company oversight. Examples would include spill cleanup, soil and vegetation removal.
<b>3</b> (3 points used in severity rate calculations for each of the attributes which apply to the incident)	Lost time injury to employee or contractors associated with a process safety event	Resulting in \$100,000 to 1MM of <b>direct cost</b> .	Chemical release outside of containment but retained on company property <b>OR</b> flammable release without potential for vapor cloud explosives - see Note 2B	Minor off-site impact with precautionary shelter-in-place <b>OR</b> Environmental remediation required with cost less than \$1MM. No other regulatory oversight required. <b>OR</b> Local media coverage
<b>2</b> (9 points used in severity rate calculations for each of the attributes which apply to the incident)	On-site fatality - employee or contractors associated with a process safety event; multiple lost time injuries or one or more serious offsite injuries associated with a process safety event.	Resulting in \$1MM to 10MM of <b>direct cost</b> .	Chemical release with potential for injury off site or flammable release resulting in a vapor cloud entering a building or potential explosion site (congested/confined area) with potential for damage or casualties if ignited - see Note 2C	Shelter-in-place or community evacuation <b>OR</b> Environmental remediation required and cost in between \$1MM - 2.5 MM. State government investigation and oversight of process. <b>OR</b> Regional media coverage or brief national media coverage.
<b>1</b> (27 points used in severity rate calculations for each of the attributes which apply to the incident)	Off-site fatality or multiple on-site fatalities associated with a process safety event.	Resulting in <b>direct cost</b> >\$10MM	Chemical release with potential for significant on-site or off-site injuries or fatalities - see Note 2D	National media coverage over multiple days <b>OR</b> Environmental remediation required and cost in excess of \$2.5 MM. Federal government investigation and oversight of process. <b>OR</b> Other significant community impact



## Recommendations – Metrics

- **CCPS recommends that all companies and trade associations collect and report the three lagging metrics**
- **Recommend that all companies implement the appropriate Leading metrics and Near Miss reporting as described in the CCPS metric document**





# Strong industry support

- **ACC Board anticipated to approve in June.**
- **API Started using new definitions on 1/1/08\***  
\*API is not yet using the severity metric
- **Many international companies (e.g., SASOL) already planning to implement.**
- **Numerous other groups and companies showing interest**
  - NPRA, SOCMA, European Process Safety Centre, Contra Costa County CAER organization, Canadian Chemical Producers Assn., Australian chemical industry group
- **Per one ACC company CEO from a German company**

*“This is the first effort we’ve seen that has a legitimate chance of leading to a global process safety metric”*





## Dow's position on CEFIC PS Metrics



- Dow is strong supporter of CEFIC implementing mandatory process safety metric reporting for CEFIC members & associations.
- Reporting metrics on a consistent basis will not only benefit peer-to-peer benchmarking and transparency, but will benefit industry as a whole by demonstrating to the public that our performance is improving
- Dow strongly supports the concept of a single global metric....rather than varying country-by-country (or association-by-association) metrics.
- We would prefer that everyone align behind the CCPS Process Safety Metrics. However, if CEFIC or other groups cannot support the existing CCPS metrics – we should work hand-in-hand with CCPS and other associations to make changes.





**Thank You**



# Team Members

## Organization

3M  
ABS Consulting  
ACC  
Acutech  
Air Products  
Albemarle  
API  
Bayer Material Science  
BP  
Braskem  
CCPS  
Chevron Phillips Chem.  
CONCAWE  
Contra Costa CHD  
Dow  
DuPont  
Eli Lilly  
EPA  
EPSC  
ExxonMobil  
Henkel  
Honeywell Specialty Mat.

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## Organization

Husky Oil  
INEOS  
JLM Consulting  
Nalco  
Lyondell  
MKOCPS  
Monsanto  
Nova  
NPRA  
OGP  
OSHA  
Reliance  
PPG Industries  
Rohm & Haas  
Shell  
SIS-Tech  
Solutia  
Suncor  
UK HSE  
US Chemical Safety Board  
USW  
Valero  
Wharton

At the time when the metric definitions were developed in 2006 & 2007. Some changes to membership has occurred since.

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# Example of new TQs

Substance	Threshold Quantities (lbs.) based upon:		Change vs. CERCLA
	Current API/ACC TQs: <b>EPA CERCLA TQ</b> (or 5000 lb. flammable)	UN Dangerous Goods hazard categories	UN Dangerous Goods hazard categories
	<b>total release amount</b>	<b>total release amount</b>	<b>total release amount</b>
n-Pentane	5000	2200	-
Petroleum distillates (naphtha)	5000	2200	-
Phenol	1000	2200	+
Phosgene	10	11	unch
Propane	5000	1100	-
Propylene oxide	100	1100	+
Styrene	5000	4400	-
Sulfur dioxide	500	220	-
Toluene	5000	2200	-
Toluene 2,4-diisocyanate	100	2200	+
Gasoline	5000	2200	-
Naptha	5000	2200	-
Hydrogen fluoride, anhydrous	100	220	+
		Decrease	27
		Increase	13
		Unchanged	3

