

# Discussion Today: Setting Global Standards

- Perspective
  - Just how big is the 2<sup>nd</sup> largest "Global Chemical Company"?
  - Global Standard of Care:
    - Dow Internal Global EH&S Standards IH Standards
- Global risk assessment and management strategies in Dow
  - Qualitative Exposure Assessment in Dow
  - OELs and Exposure Monitoring
  - Performance-Based Exposure Limits
- REACH: Impacts on our products and exposure assessment
  - DNELs and OELs



# Global EH&S in a Global Chemical Company

- The largest chemical company in the US, and #2 worldwide (ahead of ExxonMobil and behind BASF)
- Plastics, chemicals, and agricultural products
- > 3,000 products
- > 175 countries
- ~43,000 people worldwide

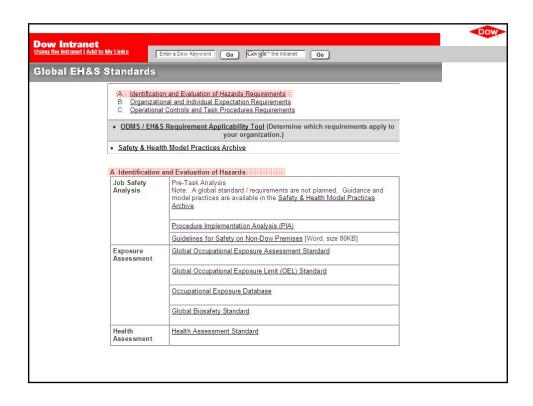


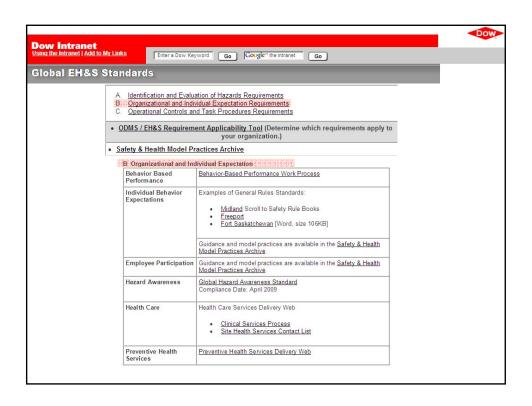
# A Globally Responsible William of the company Striving to Be Globally Responsible William of the company Striving to Be Globally Responsible

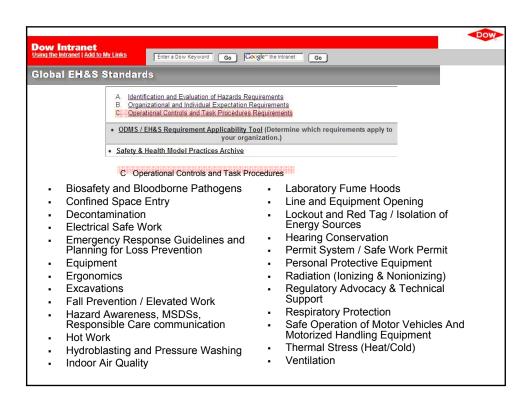


# Providing a Global Standard of Care: Occupational Risk Management (ORM)

- Global Standards for Risk Assessment and Risk Management by IHs
  - OEHS Professionals participate with NGOs, legislators and regulators to develop standards
  - >50 Dow GLOBAL EH&S Standards: Expect 100% compliance within Dow facilities
    - 17 Industrial Hygiene focused Global Standards
  - Responsible Care® Standards for Products: Expect 100% compliance for all users of our products
  - EH&S Metrics for compliance, injury/illness, releases to environment
- Exposure Assessment Issues
  - OELs and Hazard Evaluations
  - Monitoring Methods
  - Standardized Exposure Control Strategies -> PB-ECLs







## **Global Exposure Assessment Std:** Requirements

### Occupational Exposure Assessment - Scope and Applicability -(ODMS Element 06.05.A.02)

Exposure Assessment Standard - Start

Scope and Applicability

Requirements

Requirements

Compliance Verification

Self-Assesment

Documentation and Recordkeeping

Implementation Guide

Tasks and Procedures

Roles and Responsibilities

Frequently Asked Questions

**Definitions and Acronyms** 

Revision History

Correspondence

Global EH&S >06.05 - Employee Health and Safety Standards> Occupational Exposure Assessment > Requirements

- Qualitative Exposure Assessments (QEAs) shall be conducted to evaluate worker exposures to chemical, physical, biological and ergonomic hazards with potential health significance in the workplace.
- 2. QEAs shall be conducted using the Dow QEA process and will be used to establish priorities for quantitative assessments (e.g. air monitoring), training, health surveillance and exposure contro activities.
- 3. QEAs shall be updated annually and when there are changes that may significantly impact
- 4. Based on QEA results and other exposure information, work environments shall be quantitatively based on QLA results and other exposure information, which entries the operation of equitable and other exposure down assessed for potential health hazards. An approved Quantitative Exposure Assessment Plan shall be used to collect exposure data for correlation with safety / medical information and to evaluate compliance with occupational exposure limits.
- 5. A system shall be established to ensure data quality, including the use of validated quantitative exposure assessment techniques
- 6. Procedures shall be established for the timely documentation and communication of findings from qualitative and quantitative exposure assessments to employees and their supervision
- 7. Data management systems shall be used to organize, store and retrieve qualitative and quantitative exposure data as well as work history data. Quantitative exposure assessment data shall be communicated in reports (see report requirements).
- 8. A member of the Industrial Hygiene Expertise Center or their designee shall review Qualitative Exposure Assessment, Quantitative Exposure Assessment Plans, and Exposure Assessment

## Global OEL Std: Requirements

### 06.05.A.02 Occupational Exposure Limit Standard

Occupational Exposure Limits (OELs)

Scope & Applicability

Requirements

Process & Procedures

Documentation

Recordkeeping

Training/Knowledge/Skills

Tools, Templates & Checklists

Appendices

Print Page

### Occupational Exposure Limits (OELs) - Requirements

A printable page is available.

These requirements have been developed for use with the global requirements for Exposure Assessment (06.05.A.02):

- 1. The IHG Review Board shall establish IHGs, BEGs, & EEPGs for chemical, biological and physical agents for which recent toxicological or other pertinent information suggests that existing guidelines or requirements may not be appropriate.

  These exposure limits shall be established by Dow health professionals serving on the Dow IHG
- Review Board for certain chemical, biological, or physical agents handled within or produced by The Dow Chemical Company. The Dow HG Review Board shall consist of an EH&S representative in a management/leadership role from each of the following functions:

  EH&S Product Safety

  - Industrial Hygiene Expertise
     Health Services Expertise
     Regulatory Affairs
     EH&S Legal
- This business supporting the development of an IHG shall establish a business Health Team to assist in the review of hazard data and propose an IHG value. For non-Dow products, the BOL is the molecule "owner", and for Dow products, the GPL is the molecule "owner".

  Dow IHGs, ACGIH TLVs® and AIHA WEELs® shall be included on Dow's Material Safety Data Sheets (MSDSs) along with applicable National (country-specific) regulatory occupational exposure limits as a part of the company's Global Hazard Awareness Requirements and Responsible Care® product stewardship responsibilities.
- The IHG development process at The Dow Chemical Company shall be led by the Occupational Exposure Limits Technical Focal Point. The role designee shall be determined by Dow's Global Industrial Hygiene Expertise Center.

# Globally 35 Certified IHs >2000 EH&S Professionals



# Global Risk Assessment & Management Standard?

- More global regulations require some form of documented risk assessment
- How do you assess, and then mitigate, risks of handling chemicals?
  - Differences country to country
  - Differences state to state
  - Shipping, import, & export differences globally
  - Hazard communication differences
  - Enforcement differences

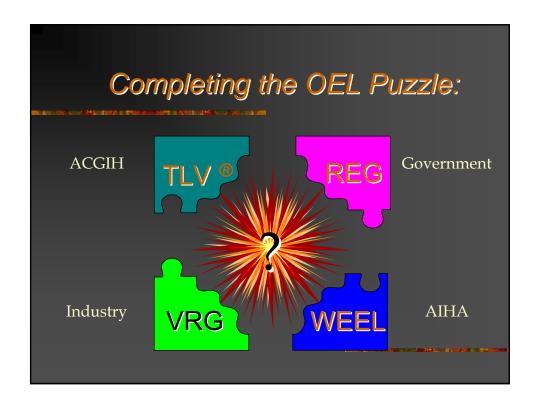
# Industrial Hygiene Value = Anticipate the Hazards of 'Exposures' Recognize the Risks of that 'Exposure' Control the Risks of potential 'Exposure'

# Focus Today

- Assessing hazards and risks from exposures to chemicals in a globally responsible way
   Defer control strategies to another time!
- Hazard and Risk Assessment Strategies
  - Setting OELs vs. lack of OELs
  - Setting PB-ECLs
- Product Guidance Sheets

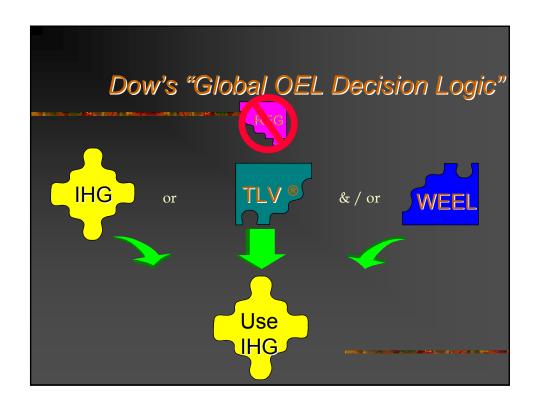


# Regulatory - Set and enforced by government agencies e.g. OSHA PEL, MSHA PEL Authoritative - Set and recommended by credible organizations e.g. ACGIH TLV, AIHA WEEL Internal - Devised by organizations for internal use and/or recommendation e.g. Company Exposure Guideline Working - Informal limit established in order to resolve an exposure assessment. Typically based on sparse toxicity data.









# Global Risk-Based Approach

- Many small and medium-size companies use available information to estimate hazards and risk management strategies
  - OELs, if any
  - NFPA or HMIS ratings
  - EU "R" and S phrases
  - Families of Chemicals or by analogy to "known" materials
  - Current 'risk assessments' done by agencies leveraged and recalculated for OELs (e.g. OEHHA/HESIS and US EPA)
  - DNELS use only a NOAEL/LOAEL 'uncertainty factor' algorithm for community and worker OELs

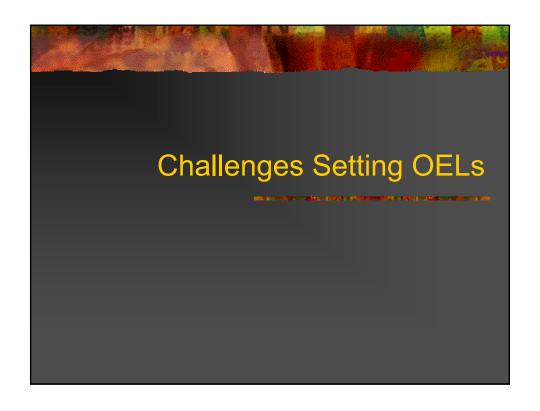
# Regulatory OELs

- Many regulatory agencies adopt TLVs®
- EU Annex I augmented by:
  - Country and State-specific Regulatory OELs
  - REACH DNELs \*\* Process just announced!
- USA Federal PELs augmented by:
   USA State OSHA PELs \*\* some hope here!
- NCELs (EPA) come and go based on SNURs and PMNs
- Proposal to adopt NIOSH RELs for MSHA (by legislative change)

\*\* More info later

## Guideline OELs - Can't use in the EU

- NIOSH RELs current focus elsewhere due to lack of PEL-setting by OSHA and budgetary restraints
- MAK functioning as usual
- TLV® organization under duress due to lawsuits
- DECOS no longer will set guidelines due to resources – defer to DNELs/DMELs and EU Annex I OELs
- WEEL functioning as usual, all volunteers and resources limited



# Setting OELs: Challenges

- Prioritization of substances needing OELs
- Diversity of committee membership
- Availability of data
- Perception of committee setting OELs
- Resources time, data, and finance
- "Harmonization" of OELs

# OELs: Challenges of the Future

- Leveraging information with other OELsetting bodies
  - Reference and data sharing
  - Stakeholder involvement and input
  - Monitoring Methods
  - Validation of "Banding" models
- "Weight of Evidence" approach vs. NOAEL algorithms (EU DNELs)

## **REACH DNELs and DMELs**

### DNEL:

- The Derived No-Effect Level (DNEL) is defined in Annex 1 of REACH as the level of exposure above which humans should not be exposed.
  - Manufacturers and importers are required to calculate DNELs as part of their Chemical Safety Assessment (CSA) for any chemicals used in quantities of 10 tons or more per year.
  - The DNEL is to be published in the manufacturer's Chemical Safety Report and, for hazard communication, in an extended Safety Data Sheet.

### DMEL:

- Derived Minimum Effect Level (DMEL), based on some concept of acceptable or negligible risk, (such as the "Threshold of Toxicological Concern")
- Continued question: "Should such materials automatically be banned because they cannot be adequately controlled?"

# **EU Indicative Occupational Exposure Limits** (IOELs) *versus DNELs*

- May use an EU "IOEL" in place of developing a DNEL, or the derivation of a DNEL when there is already an IOEL, has to be documented in the registrant's Chemical Safety Report
- IOEL- values are health-based, non-binding values, derived from the most recent scientific data available and taking into account the availability of measurement techniques.
  - Since they do not consider 'technical or economic feasibility' they are considered 'health based'

# EU Binding Occupational Exposure Limit (BOEL) versus DNELs

- BOELs reflect socio-economic and technical feasibility factors in addition to health-based toxicological information taken into account when establishing IOELs.
  - BOELs have been set for 4 substances.
- When a BOEL exists the registrant cannot use it in place of a DNEL without an evaluation of the scientific background for setting the BOEL to eliminate the impact of technical and socio-economic feasibility.
- Consequently, information and toxicological evaluations of health effects used for setting the BOEL may, as for IOELs, be used and taken into account in deriving the DNEL.

# **EU National Occupational Exposure Limits** versus DNELs

- Member States may set national OELs for other substances than those included in Community legislation
  - Various approaches may be used;
    - in some cases the OELs are purely health based values and in other cases they may take into account feasibility factors.
  - A registrant cannot use a national OEL in place of a DNEL without an evaluation of the scientific background for setting the national OEL.
  - In cases where toxicological information and evaluations of health effects used for setting the national OEL are documented and available, this may, as for IOELs, be used and taken into account in deriving the DNEL.

# Summary of Remaining Issues EU DNELs

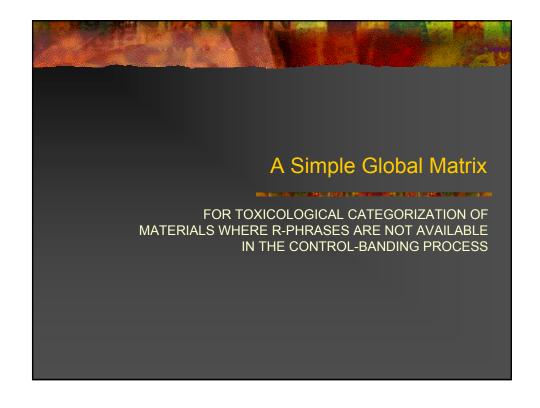
- Currently under this guidance, companies are prohibited from using:
  - company internal OELs
  - OELs developed by non EU standard-setting organizations (e.g. TLV, MAK, DECOS, etc.), or
  - creating OELS for new compounds going forward

### These OELs can not be used

- even when the values were set using the same methodologies as the IOELs.
- even when the toxicological bases for the OELs are current

# OELs: More Challenges of the Future

- Continued international collaboration of OEL-setting bodies, governments and industry towards "Harmonization" of OELs
- Improving science-based setting of OELs
  - Evaluation of "Performance-based Banding"
  - Use of "cardinal numbers" in setting limits where data set is brief
- Extended workshifts (10 12 16 hours) WEEL Committee 2008
- Dermal and Respiratory Sensitization (R-SEN and D-SEN)
- Tox and Human Data generation and availability



# **Topic Discussions**

- Sources of Health Hazard Ratings (Limited Comparison)
  - EU Risk Phrases the e-COSHH essential
  - HMIS vs. NFPA
    - Acute vs. Chronic Hazards / Risks
  - Converting Safety Data Sheet (SDS) Hazard Phrases to Risk Phrases
- Simple Matrix to Convert SDS Health Hazards to Risk
- Assigning Controls to manage risks
- Assigning PPE to manage risks

# Categorizing Health Hazards to Risks

- EU Risk Phrases
  - Categorizes chemicals that are "DANGEROUS"
- NFPA Standard 704 ....
  - Identification of Fire Hazards of Materials
  - Acute effects only
- ► HMIS®
  - HMIS<sup>®</sup> is not intended for emergency circumstances
  - Identifies risk category with '\*' for chronic effects



- SDS hazards → Risk?
  - Detailed compilation of hazards



# **Consider These Limitations**

- R-Phrases
  - Some countries do not have knowledge of R-phrases
  - Does not assign phrases to chemicals considered "not dangerous"
- NFPA designated for acute effects or "fire hazard" situations
  - Not specific .. can't use the designation
  - Chronic hazards needed
  - Not readily accessible on SDS
- HMIS categories identify risks
  - Can't use the designation #, & target organ effects may not be listed
  - Not on SDS
- SDSs
  - Expertise required to determine the "RISK"
  - Statements are far from standardized

### Health Hazard Risks Considered for **Control Banding** ☐ R26/28 **₽** R42/43 ☐ R48/25 ☐ R20/21 ☐ R27 ☐ R43 ☐ R49 □ R45 ☐ R27/28 □ R20/21/22 □ R60 **▼** R20/22 ☐ R28 ☐ R61 ☐ R48/20 ☐ R34 ☐ R62 ☐ R48/20/21 ☐ R48/20/21/22 ☐ R21/22 ☐ R35 ☐ R63 ☐ R36 □ R64 □ R22 R36/37 □ R48/20/22 □ R36/37/38 □ R48/20/22 □ R36/38 □ R48/21/12 □ R37 □ R48/22 ▼ R37/38 □ R48/23 □ R23 ☐ R65 ☐ R23/24 ☐ R66 ☐ R23/24/25 ☐ R67 R68 Muta cat 3 □ R23/25 □ R24 ☐ R24/25 ☐ R38 R48/23/24 R40 Carc cat 3 R48/23/24/. R40 Muta cat 3 R48/23/25 ☐ R25 R48/23/24/25 □ R26 ☐ R26/27 ▼ R41 ☐ R48/24 ☐ R26/27/28 ☐ R42 ☐ R48/24/25 □ None of the above R-phrases apply. If you wish to see a full description of what the R-phrases mean click here



# **International Mandate**

- An international mandate to harmonize was adopted at the United Nations Conference on the Environment and Development (UNCED) in 1992 in Brazil:
  - A globally-harmonized hazard classification and compatible labeling system, including material safety data sheets and easily understandable symbols, should be available, if feasible, by the year 2000.

What should be done until this effort is reality?

Need a simplified matrix!

# **Health Hazards to Consider:**

- Acute Toxicity
- Skin Corrosion/Irritation
- Serious Eye Damage/Eye Irritation
- Respiratory or Skin Sensitization
- Germ Cell Mutagenicity
- Carcinogenicity
- Reproductive Toxicity
- Target Organ Systemic Toxicity Single & Repeated Dose

WEEL Banding Matrix - Validation							
Criterion	Α	В	С	D	E		
Acute toxicity (Rat oral LD50)	>2,000 mg/kg	300-2,000 mg/kg	50-300 mg/kg	5-50 mg/kg	<5 mg/kg		
Acute toxicity (Rat inhalation LC50)	>10,000 ppm	>10,000 ppm	1000-10,000 ppm	100-1000 ppm	1-100 ppm		
Sensory irritation (RD50)	>3,000 ppm	>3,000 ppm	300-3000 ppm	30-300 ppm	1-30 ppm		
Skin or eye irritation	mild to moderate	moderate to severe	severe to corrosive	corrosive	corrosive		
Irritation threshold (ppm)	>1000	100-1000	10-100	1-Oct	<1		
Target organ toxicity NOEL	>1000 ppm >100 mg/kg/d	>1000 ppm 10-100 mg/kg/d	100-1000 ppm 1-10 mg/kg/d	10-100 ppm 0.1-1 mg/kg/d	1-10 ppm <0.1 mg/kg/d		
Severity of target organ toxicity	se	verity of the toxicity	can push the above	NOEL into a higher	cell		
Repro/dev tox NOEL	>300 mg/kg/d	30-300 mg/kg/d	3-30 mg/kg/d	0.3-3 mg/kg/d	<0.3 mg/kg/d		
Reproductive toxicity	sev	verity of the toxicity of	can push the above	NOEL into a higher	cell		
Developmental toxicity	sev	verity of the toxicity	can push the above	NOEL into a higher	cell		
Genetox	negative	equivocal	likely / limited or based on in vitro	positive WOE including in vivo	positive WOE and potent		
Cancer dose	>300 mg/kg/d	30-300 mg/kg/d	3-30 mg/kg/d	0.3-3 mg/kg/d	<0.3 mg/kg/d		
Carcinogenicity potential	sev	verity of the toxicity of	can push the above	NOEL into a higher	cell		
Warning properties / odor	good	good	fair to none	poor to none	poor to none		
WEEL range (mcg/m3 and ppm)	≥1000	≥100, <1000	≥10, <100	≥1, <10	<1		
Skin notation	No	Yes	Sensitization notation	No	Yes		



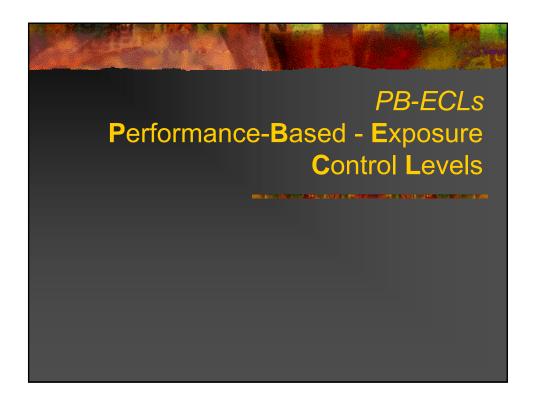
# SDS Phrases vs. R-Phrases Until a global harmonized R-Phrase system is available, could categorize SDS statements according to: Not Dangerous / Hazardous Harmful: Caution Toxic: Warning Very Toxic: Dangerous

	Harmful: <u>Ca</u> ution
R-Phrases	Statement Statement
R20	Harmful by inhalation
R20/21	Harmful by inhalation and in contact with skin
R20/21/22	Harmful by inhalation, in contact with skin and if swallowed
R20/22	Harmful by inhalation and if swallowed
R21	Harmful in contact with skin
R21/22	Harmful in contact with skin and if swallowed
R22	Harmful if swallowed
R36	Irritating to eyes
R36/37	Irritating to eyes and respiratory system
R36/37/38	Irritating to eyes, respiratory system and skin
R36/38	Irritating to eyes and skin
R37	Irritating to respiratory system
R37/38	Irritating to respiratory system and skin
R38	Irritating to skin
R65	Harmful: may cause lung damage if swallowed
R66	Repeated exposure may cause skin dryness or cracking
R67	Vapours may cause drowsiness and dizziness
R68	Possible risk of irreversible effects
R68/20	Harmful: possible risk of irreversible effects through inhalation
R68/20/21	Harmful: possible risk of irreversible effects through inhalation and in contact with skin
R68/20/21/ 22	Harmful: possible risk of irreversible effects through inhalation, in contact with skin and if swallowed
R68/20/22	Harmful: possible risk of irreversible effects through inhalation and if swallowed
R68/21	Harmful: possible risk of irreversible effects in contact with skin
R68/21/22	Harmful: possible risk of irreversible effects in contact with skin and if swallowed
R68/22	Harmful: possible risk of irreversible effects if swallowed

R-Phrases	Statement
R23	Toxic by inhalation
R23/24	Toxic by inhalation and in contact with skin
R23/24/25	Toxic by inhalation, in contact with skin and if swallowed
R23/25	Toxic by inhalation and if swallowed
R24	Toxic in contact with skin
R24/25	Toxic in contact with skin and if swallowed
R25	Toxic if swallowed
R33	Danger of cumulative effects
R34	Causes burns
R40	Limited evidence of a carcinogenic effect
R41	Risk of serious damage to eyes
R42	May cause sensitization by inhalation
R43	May cause sensitization by skin contact
R42/43	May cause sensitization by inhalation and skin contact
R60	May impair fertility
R61	May cause harm to the unborn child
R62	Possible risk of impaired fertility
R63	Possible risk of harm to the unborn child
R64	May cause harm to breast-fed babies

	Very Toxic: Dangerous
	Including Long-Term Effects
R26	Very toxic by inhalation
R26/27	Very toxic by inhalation and in contact with skin
R26/27/28	Very toxic by inhalation, in contact with skin and if swallowed
R26/28	Very toxic by inhalation and if swallowed
R27	Very toxic in contact with skin
R27/28	Very toxic in contact with skin and if swallowed
R28	Very toxic if swallowed
R30	Can become highly flammable in use
R32	Contact with acids liberates very toxic gas
R35	Causes severe burns
R39/23	Toxic: danger of very serious irreversible effects through inhalation
R39/23/24	Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/23/24/25	Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/23/25	Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/24	Toxic: danger of very serious irreversible effects in contact with skin
R39/24/25	Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/25	Toxic: danger of very serious irreversible effects if swallowed
R39/26	Very Toxic: danger of very serious irreversible effects through inhalation
R39/26/27	Very Toxic: danger of very serious irreversible effects through inhalation and in contact with skin
R39/26/27/28	Very Toxic: danger of very serious irreversible effects through inhalation, in contact with skin and if swallowed
R39/26/28	Very Toxic: danger of very serious irreversible effects through inhalation and if swallowed
R39/27	Very Toxic: danger of very serious irreversible effects in contact with skin
R39/27/28	Very Toxic: danger of very serious irreversible effects in contact with skin and if swallowed
R39/28	Very Toxic: danger of very serious irreversible effects if swallowed

	Very Toxic: Dangerous
	Including Long-Term Effects
R45	May cause cancer
R46	May cause heritable genetic damage
R48	Danger of serious damage to health by prolonged exposure
R48/20	Harmful: danger of serious damage to health by prolonged exposure through inhalation
R48/20/21	Harmful: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/20/21/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/20/22	Harmful: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/21	Harmful: danger of serious damage to health by prolonged exposure in contact with skin
R48/21/22	Harmful: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/22	Harmful: danger of serious damage to health by prolonged exposure if swallowed
R48/23	Toxic: danger of serious damage to health by prolonged exposure through inhalation
R48/23/24	Toxic: danger of serious damage to health by prolonged exposure through inhalation and in contact with skin
R48/23/24/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed
R48/23/25	Toxic: danger of serious damage to health by prolonged exposure through inhalation and if swallowed
R48/24	Toxic: danger of serious damage to health by prolonged exposure in contact with skin
R48/24/25	Toxic: danger of serious damage to health by prolonged exposure in contact with skin and if swallowed
R48/25	Toxic: danger of serious damage to health by prolonged exposure if swallowed
R49	May cause cancer by inhalation



# **QEA Basics – Current Process**

- List of chemicals with potential for exposure
  - Assign "hazard class" from OEL or tox properties (R-phrases or SDS statements)
  - Determine the Degree of Exposure
  - Determine the Duration or Frequency of Exposure
  - Focus on Priority 1, 2, and 3 for exposure control

Building the Matrix: Negligible Effects							
	Ac	ute Effects	S	Exposu	re Limit		
Oral	4 Hr.	4 Hr.	Skin	OEL	OEL		
LD50- Rats (Mg/Kg)	Inhalation LC50- Rats (Vapor)	Inhalation LC50- Rats (Aeroso l) (Mg/m3)	LD50- Rabbits	PPM (vapor)	(mg/m3) (dust)		
				500-999	(5-10)	$\begin{array}{c} \textit{NEGLIGIBLE}  \textit{Effect} \\ \\ \text{no danger classification present} \\ \\ \text{no symbol or } R \text{ phrases assigned} \end{array}$	

Building the Matrix: Low Effects							
		ute Effect	_		re Limit		
Oral	4 Hr.	4 Hr.	Skin	OEL	OEL		
LD50- Rats	Inhalation LC50- Rats (Vapor)	Inhalation LC50- Rats (Aerosol)	LD50- Rabbits	PPM (vapor)	(mg/m3) (dust)		
(Mg/Kg)	(Mg/m3)	(Mg/m3)	(Mg/Kg)				
>2000	>20,000	>5000	>2000	50-499	(1-4.9)	Symbols Xi: irritating (except sensitizing agent)  R phrases R36 irritating to eyes R37 irritating to the respiratory system R38 irritation to skin	

	Building the Matrix: Moderate Effects							
Acute Effects Exposure I								
Oral	4 Hr.	4 Hr.	Skin	OEL	OEL			
LD50- Rats	Inhalation LC50- Rats (Vapor)	Inhalation LC50- Rats (Aeroso l)	LD50- Rabbits	PPM (vapor)	(mg/m3) (dust)			
(Mg/Kg)	(Mg/m3)	(Mg/m3)	(Mg/Kg)					
200 - 2000	2000 - 20,000	1000 - 5000	400 - 2000	10 - 49	(0.1-0.9)	Symbols Xn: harmful C: Corrosive R phrases R20 harmful by inhalation R21 harmful in contact with skin R22 harmful if swallowed R33 danger of cumulative effects R34 causes burns R40 possible risks of irreversible effect R41 risk of serious damage to eyes R42 may cause sensitization by inhalation (Xi) R43 may cause sensitization by skin contact (Xi) R62 possible risk of impaired fertility R63 possible risk of harm to the unborn child R64 may cause harm to breast fed babies		

	Build	ling t	he M	atrix:	Ser	ious Effects
Oral	4 Hr.	4 Hr.	Skin	OEL	OEL	
LD50- Rats	Inhalation LC50- Rats (Vapor)	Inhalation LC50- Rats (Aerosol)	LD50- Rabbits	PPM (vapor)	(mg/m3) (dust)	
(Mg/Kg)	(Mg/m3)	(Mg/m3)	(Mg/Kg)			
<200	<2000	<1000	< 400	<10	(<0.1)	SERIOUS Effect
						Symbols:
						T : toxic
						T+:very toxic
						R phrases:
						R23 toxic by inhalation
						R24 toxic in contact with skin
						R25 toxic if swallowed
						R26 very toxic by inhalation
						R27 very toxic in contact with skin
						R28 very toxic if swallowed
						R35 causes serious burns
						R39 danger of very serious irreversible effects
						R45 may cause cancer
						R46 may cause heritable genetic damage
						R48 danger of serious damage to health by prolonged exposure
						R49 may cause cancer by inhalation
						R60 may impair fertility
						R61 may cause harm to the unborn child

## Within Dow - With or Without an OEL

- Priority 1 Not allowed to continue working \_\_\_\_Stop work to assess exposures and remediate as appropriate
- Priority 2 Baseline monitoring.... adjust exposures with PPE, Controls, etc. and ongoing monitoring
- Priority 3 Baseline monitoring to ensure compliance with OEL
- Priority 4 QEA validates risk to worker is low... baseline monitoring
- Priority 5 QEA validates risk to worker is negligible... no further action needed unless exposure potential changes

Within Dow - With or Without an OEL

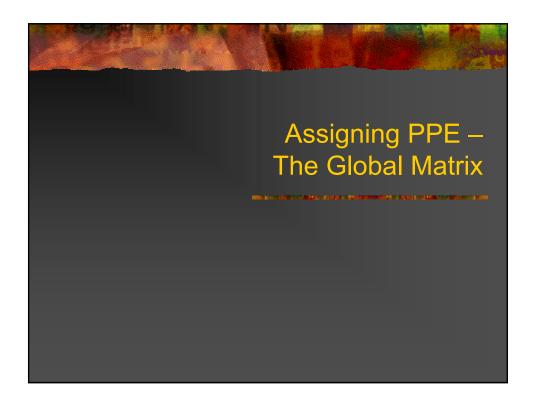
What concentration do we target for monitoring without an OEL?

# Dow Rule: No OEL → No Monitoring

- Current Approach:
  - Designate a "Hazard Class" based on the R-phrases, MSDS phrases, and typical tox endpoints
  - Design to control concentrations within 'order of magnitude' concentration ranges [band] based on:
    - Hazards
    - Quantity
    - Temperature of process
    - Volatility/dustiness
    - Frequency and Duration of exposure

### Generic CONTROL BANDING: Risk Assessment and Management Exposure Control Generic Risk Approach Assessment 13743 10 Potential (risk management) Substances Combination of Type of s allocated to hazard allocated a health hazard approach needed to dustiness or and exposure group using Std. volatility band potential achieve and a band for factors adequate the scale of use e nifeses determine control desired level of control

	Po	entials - otential for h		
Least Hazard	dous ———			ost Hazardou
Α	В	С	D	E
Skin, eye irritants; unclassified	Harmful on single exposure	Toxic, corrosive, etc.	Very toxic, toxic to reproduction	Asthma, can- cer, genetic damage
R36 R38 No R	R20 R21 R22	R23, 24, 25 R34, 35 R37 R41, R43 R48/20/21/22	R26, 27, 28 R40 carc. R48/23/24/25 R60, 61, 62, 63	R42, R43,R45, R49 R46, R68
1 to 10 mg/m <sup>3</sup> dust 50 to 500 ppm vapour	0.1 to 1 mg/m <sup>3</sup> dust 5 to 50 ppm vapour	0.01 to 0.1 mg/m³ dust 0.5 to 5ppm vapour	<0.01 mg/m <sup>3</sup> dust <0.5 ppm vapour	



Hazard	EU Risk Phrase	SDS Tox Description	PPE Assignment Prior to Risk Assessment
High / Danger	4; T; T+		
Carcinogenicity	R45 may cause cancer		Protect appropriate route of exposure with respirator or other
Mutagenicity	R46 may cause heritable genetic damage		PPE and engineering controls
Subchronic & Chronic	R48 danger of serious damage to health by prolonged exposure		
Carcinogenicity	R49 may cause cancer by inhalation		
Reproductive	R60 may impair fertility		
Developmental	R61 may cause harm to the unborn child		
Eye	R35 causes serious burns; R39 danger of very serious irreversible effects	Corrosive; Impairment of vision; blindness; · Splash Potential · Particles that could get under glasses · Working in areas with overhead splash potential	Chemical Goggles - no option
Skin Contact	R24 toxic in contact with skin; R27 very toxic in contact with skin; R35 causes serious burns	Short, single exposure may cause severe burns; prolonged repeated exposure may cause severe burns	Face shield; Protective gloves; Full skin coverage with appropriate barrier material
Inhalation	R23 toxic by inhalation; R26 very toxic by inhalation;	Excessive concentrations readily attainable & may cause death; single brief exposure may cause death (LC50 1-hr < 200 ppm or < 2 mg/liter	Appropriate respirator mandatory unless complete containment is verified for all aspects of the operation With no chance of release or emission
Skin Absorption	R39 danger of very serious irreversible effects	May be fatal if absorbed through the skin; LD50 < 200 mg/kg	All skin and mucous membranes protected with appropriate barrier PPE including but not limited to goggles, full hooded impervious suit, face shield; shoe coverings; etc.
Ingestion	R25 toxic if swallowed; R28 very toxic if swallowed	LC50 < 50 mg/kg; Single dose oral toxicity high or very high, severe burns of the mouth	Policy enforced for personal hygiene and no eating, smoking etc. plus decontamination of PPE prior to removal.

Hazard	EU Risk Phrase	SDS Tox Description	PPE Assignment Prior to Risk Assessment
Moderate/ Warning	3; Xn: harmful; C: Corrosive		
Long-Term Effects (Subchronic & Chronic)	R40 possible risks of irreversible effect		
Reproductive	R62 possible risk of impaired fertility		
Developmental	R63 possible risk of harm to the unborn child		Protect appropriate route of
Subchronic & Chronic	R64 may cause harm to breast fed babies		exposure with respirator or other PPE and engineering controls
Eye	R39 danger of very serious irreversible effects; R41 risk of serious damage to eyes	Moderate or severe irritation; some irreversible damage possible	Chemical Goggles - no option
Skin Contact	R21 harmful in contact with skin; R-43; R34 causes burns	Severe irritation; prolonged or repeated exposure may cause skin burns; allergic skin reaction in humans	Protective gloves; Skin coverage with appropriate barrier material based on potential for contact with the chemical; optional Face shield
Inhalation	R20 harmful by inhalation; R-45 (Cancer); R42 may cause sensitization by inhalation (Xi)	Excessive concentrations readily attainable & may cause death; single brief exposure may cause death	Appropriate respirator mandatory unless complete containment is verified for all aspects of the operation. Risk assessment of practices and engineering controls required to remove the respirator requirement.
Skin Absorption	R33 danger of cumulative effects; R43 may cause sensitization by skin contact (XI)	A single prolonged exposure may cause absorption in harmful amounts; repeated exposure could cause death	All skin and mucous membranes with potential for exposure protected with appropriate barrier PPE; Risk assessment required of practices & engineering controls to remove the minimum PPE requirement.
Ingestion	R22 harmful if swallowed	Single dose or toxicity LC50 > 50 mg/kg < 500 mg/kg	Policy enforced for personal hygiene and no eating, smoking etc. plus decontamination of PPE prior to removal.

Hazard	EU Risk Phrase	SDS Tox Description	PPE Assignment Prior to Risk Assessment
Low / Caution	2; Xi: irritating (except. sensitizing agent: => 3)		
Eye	R36 irritating to eyes; R41 risk of serious damage to eyes	Corrosive; Impairment of vision; blindness; · Projectiles · General protection	Chemical Goggles - no option
Skin Contact	R38 irritation to skin	Short, single exposure may cause severe burns; prolonged repeated exposure ay cause severe burns	Face shield; Protective gloves; Full skin coverage with appropriate light weight barrier material
Inhalation	R37 irritating to the respiratory system	Excessive concentrations readily attainable & may cause death; single brief exposure may cause death (LC50 1-hr < 200 ppm or < 2 mg/liter	Appropriate respirator mandatory unless complete containment is verified for all aspects of the operation. With no chance of release or emission
Skin Absorption	R21-Harmful in contact with skin	May be fatal if absorbed through the skin; LD50 < 200 mg/kg	All skin and mucous membranes protected with appropriate light weight barrier PPE
Ingestion	R-22 Harmful if swallowed	LC50 < 50 mg/kg; Single dose oral toxicity high or very high, severe burns of the mouth	Policy enforced for personal hygien and no eating, smoking etc. plus decontamination of PPE prior to removal.

Hazard	EU Risk Phrase	SDS Tox Description	PPE Assignment Prior to Risk Assessment
Negligible / Precautionary	1		
Eye	N/A	No corneal injury; slight transient irritation; essentially non-irritating	Safety Glasses
Skin Contact	N/A	Slight transient irritation; essentially non- irritating	Lab coat or uniform; Light barrier gloves
Inhalation	N/A	No adverse effects, not likely to be hazardous; dust may cause irritation; exposure to vapors unlikely	None
Skin Absorption	N/A	LD50 >2000 mg/kg	Lab coat or uniform; Light barrier gloves
Ingestion	N/A	LD50 >2000 mg/kg	Policy enforced for personal hygien and no eating, smoking etc. plus decontamination of PPE prior to removal.
	Non-hazardoı	us determination must be a	rchived!

	(ŠDS –	Risk Categ	ories)	
	(303 /	/ Kisk Caleg	Ulles)	I
Signal Words	Danger	Warning	Caution	Not Classified
Hazard	(High)	(Moderate)	(Low)	as Dangerous
Flammability	Flashpoint < 20°F Extremely flammable liquid and vapor	20°F ≤ F.P. < 100°F Flammable liquid and vapor. Flammable Solid.	100°F ≤ F.P. < 200°F Combustible liquid and vapor.	Flashpoint ≥ 200°F
Reactivity	Ready detonation or explosive decomposition at normal temperature and pressure	Normally unstable. Detonation possible with strong initiation. Violent reaction with water.	Unstable at elevated temperatures and pressures. Reacts nonviolently with water.	Essantially nonreactive
Skin Absorption	$LD_{50} \leq 200 mg/kg$ May be fatal if absorbed through skin.	200 < LD <sub>50</sub> ≤ 1000 mg/kg A single prolonged exposure may cause absorption in harm- ful amounts; repeated exposure could cause death	1000 < LD <sub>50</sub> ≤ 2000 mg/kg Repeated exposure may result in absorption of harmful amounts even though LD <sub>50</sub> may be unknown or is > 2000 mg/kg.	LD <sub>50</sub> > 2000 mg/kg
Inhalation	LC <sub>50</sub> ≤ 200 ppm or ≤ 2mg/liter for 1 hr. Excessive concentrations readily attainable and may cause death; single brief exposure may cause death	200 < LC $_{50}$ $\leq$ 2000 ppm, or 2 < LC $_{50}$ $\leq$ 20 mg/liter for 1 hr. Excessive concentrations readily attainable and may cause death; single brief exposure may cause death	LC <sub>50</sub> <000 ppm, or > 20 mg/liter for 1 hr. Could be hazardous on single exposure; simple asphyxia; may cause irritation to upper respiratory tract/lungs/eyes; prolonged excessive exposure	LC <sub>20</sub> >2000 ppm, or > 20 mg/liter. No nationse offices, not likely to be hazardous, distimaly chilise imistion, exposure to veners unlikely.
Ingestion	LC <sub>50</sub> ≤ 50 mg/kg Single dose oral toxicity high or very high; severe burns of mouth.	50 <ld <sub="">50 &lt; 500 mg/kg Single dose oral toxicity moderate or moderate to high.</ld>	may cause adverse effects.  500 <ld 2000="" 50="" dose="" kg="" low="" mg="" moderate.<="" or="" oral="" single="" td="" to="" toxicity="" ≤=""><td>LD<sub>50</sub> &gt; 2000 mg/kg</td></ld>	LD <sub>50</sub> > 2000 mg/kg
ye/Skin Contact Eye	Impairment of vision; blindness; corrosive.	Moderate or severe irritation, injury.	Slight irritation; slight corneal injury.	No corneal injury; slight, transient irritation.
Skin	Short, single exposure may cause severe burns; prolonged, repeated exposure may cause severe burns	Severe irritation; prolonged or repeated exposure may cause skin burns; allergic skin reaction in humans.	Slight to moderate irritation, even a burn on single, prolonged, or repeated exposure; allergic skin reaction in susceptible individuals	Essentially nonirritating

