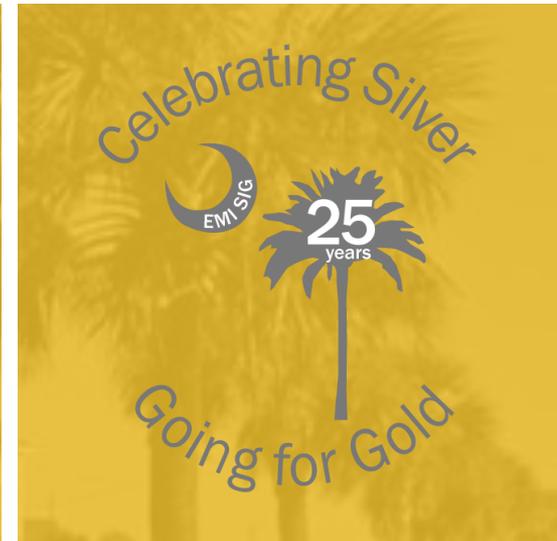


# PAC/TEEL Development Team Accomplishments

Jayne-Anne Bond, Doug Craig,  
Po-Yung Lu, Tom Tuccinardi



Emergency Management Issues Special Interest Group  
Annual Meeting, May 2-5, 2011  
Charleston Marriott, Charleston, South Carolina

## What are TEELs - Who are we?

- Temporary Emergency Exposure Limits – TEELs
- Doug Craig created these values in the 1990's
  - 1991 Rev. 1 **TEEL** dataset (86 chemicals)
  - 2010 Rev. 26 **PAC** dataset (3,388 chemicals)
- OEM - NA-41
- TEEL development team
- DOE publication DOE-HDBK-1046-2008
- The TAG

## Question

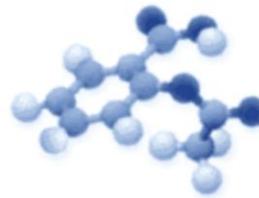
What is the difference between a PAC and a TEEL?



## Highlights of Activities

- Annual updates of exposure limits (e.g., TLVs)
- AEGL (2) and ERPG updates
- Toxicity data ongoing review – oldest ~780
- TEEL value requests, questions
  - <https://orise.orau.gov/emi/forms/TEELRequestForm.html>
  - <https://orise.orau.gov/emi/forms/TEEL-RequestforReview-Form.html>
- Populate/update data fields

# Our Product: PACs Revision 26



## Protective Action Criteria (PAC) with AEGLs, ERPGs, & TEELs: Rev. 26 for Chemicals of Concern (09/2010)

### TABLES in PDF and Excel Format

The following is a description of each table. There are introductions at the beginning of the tables that provide table-specific information.

**Table 1** is an alphabetical list of chemical substances, their Chemical Abstract Services Registry Numbers (CASRN), and some physical constants. This table includes columns with the primary references used for TEEL derivation of each chemical, the lowest value found for the lower explosive limit (LEL) in parts per million (ppm), and the National Fire Protection Agency (NFPA) Health Hazard Rating (HHR). Future reviews will result in continuous updates to this data. There are also columns that provide the date of the original derivation of the PAC values, the date of the last technical review of the data and/or the PAC values.

**Table 2** is an alphabetical list of the chemical substances and their corresponding PAC values. For the most part, values are given in parts per million (ppm) for gases and volatile liquids and in milligrams per cubic meter (mg/m<sup>3</sup>) for solids, particulates (aerosols) and nonvolatile liquids. There is a column that indicates which TEEL or PAC values have changed since the last revision. The final column in this table contains technical comments and information provided by the PAC Development Team.

### LINKS

[Table 1: Chemical-specific data for PAC chemicals \(pdf\)](#)

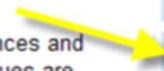
[Table 2: PACs by Chemical Name \(pdf\)](#)

[Table 3: PACs by CASRN No. \(pdf\)](#)

[Table 4: PACs by Chemical Name \(mg/m<sup>3</sup>\) \(pdf\)](#)

[PACs Revision 26 \(xls\)](#)

[Changes from PACs Rev. 25 to PACs Rev. 26 \(xls\)](#)



**LOADING...**

# Enhancing and Updating the TEEL Development Methodology

Jayne-Anne Bond, Thomas Tuccinardi,  
Doug Craig, Po-Yung Lu



Emergency Management Issues Special Interest Group  
Annual Meeting, May 2-5, 2011  
Charleston Marriott, Charleston, South Carolina

# Introduction

- TEEL development methodology has remained fundamentally unchanged since the 1990s
- Applied in accordance to DOE O 151.1C and the EMG
- Methodology reflected favorably on the DOE for more than 20 years
- Independent Review Team appointed by NA-41 provided several recommendations
- It is time to update the procedure based on new data and the recommendations from the outside review team

# Timeline

Year	Activity
1991	Revision 1: TEEL dataset 86 chemicals
1995	"Alternative Guide Limits for Chemicals without ERPGs"
1995	Revision 9: First use of toxicity based TEEL values
2000	"Derivation of Temporary Emergency Exposure Limits"
2008	DOE-HDBK-1046-2008, "Temporary Emergency Exposure Limits for Chemicals: Methods and Practice"
2009	"The Cook Book"
2010	Revision 26: PAC dataset 3,388 chemicals
2011	The Handbook v2.1
Future	Relational database

# The PAC Dataset

- Definitions
- Searchable database
- PACs in Excel & PDF formats
- Archives
- Acronyms



## Protective Action Criteria (PAC) with AEGLs, ERPGs, & TEELs: Rev. 26 for Chemicals of Concern (09/2010)

This site allows users to access the U.S. Department of Energy's (DOE's) current data set of Protective Action Criteria (PAC) values in a variety of ways: as a searchable database, as an Excel file, and as a series of tables in PDF format. It also provides archived versions of the PACs for reference.

PAC values in the searchable database and tables correspond to Revision 26, published September 2010. This database provides information for 3,388 chemicals.

Emergency exposure limits are essential components of planning for the uncontrolled release of hazardous chemicals. These limits, combined with estimates of exposure, provide the information necessary to identify and evaluate accidents for the purpose of taking appropriate protective actions. During an emergency response to an uncontrolled release, these limits may be used to evaluate the severity of the event, to identify potential outcomes, and to decide what protective actions should be taken. In anticipation of an uncontrolled release, these limits may also be used to estimate the consequences of an uncontrolled release and to plan emergency responses.

### LINKS

[PAC Definitions](#)

[Search the PAC Database for AEGLs, ERPGs, and TEELs](#)

[PAC Data in Tabular Form \(Excel and PDF files\)](#)

[PAC Data Archives \(Excel & PDF Files\)](#)

[Acronyms and Abbreviations for the PAC Dataset](#)

# Chemical of Most Interest: A Comparison

2010	2008
1. Chlorine	1. Chlorine
2. Ammonia	2. Ammonia
3. Perchloroethylene	3. CO
4. Benzene	4. HF
5. Methyltetrahydrofuran	5. Benzene
6. Hydrogen	6. Methanol
7. Methylfuran	7. Carbon Dioxide
8. Amyl Alcohol	8. Sulfuric Acid
9. CO	9. HCl
10. Nitrogen	10. Acetone

## Top 10 States

1. California (11%)
2. Colorado
3. Tennessee
4. District of Columbia
5. Washington
6. Massachusetts
7. New Jersey
8. Idaho
9. Virginia
10. New York



## Top 10 Countries

1. United States (65%)
2. Canada
3. Germany
4. France
5. Spain
6. Israel
7. Australia
8. Japan
9. China
10. Belgium



# Independent Review Team

- Develop/calculate more robust/updated adjustment factors
- Develop/calculate more robust/updated multiplying factors
- Develop a process or criteria to identify materials in the PAC dataset that are not likely to cause an operational emergency

# Analyses

- Adjustment factors
  - Craig et. al.
  - Means of ratios - toxicity data: ERPGs
- Chemicals with AEGL and ERPG values
- Toxicity data
  - LD50, LC50, TDLo, etc.
- Statistics
- AEGLs only
- More statistics



# Adjustment Factors

- Identify all chemicals with AEGl values
- Extract “all” toxicity data for those chemicals
  - LD50, LC50, LDLo, LCLo, TDLo, and TCLo
  - Human, dog, monkey, rat, mouse, rabbit, guinea pig, and hamster
  - Inhalation, oral, dermal, intraperitoneal, and intravenous
- Calculate ratios
- Statistics.....



# Methods: Adjustment Factors - Statistics

- Calculated:
  - Means
  - Medians
  - Modes
  - Sample variance
  - Standard deviations
  - Confidence intervals (using an  $\alpha$  of 0.05)
  - Skewness and kurtosis statistics
- Log-transformed the ratios; and repeat
- Identified and deleted the outliers
- And repeat.....problem?

# The Proposed Adjustment Factors

	TEEL-3				TEEL-2	
	LC50	LD50	LCLo	LDLo	TCLo	TDLo
Proposed Adjustment Factors	423	2	51	1	110	10
“Derivation of Temporary Emergency Exposure Limits” (Craig et al., 2000) “Temporary Emergency Exposure Limits for Chemicals: Methods and Practice” (DOE-HDBK-1046-2008)	100	2	100	1	15	1.5

# Multiplying Factors

- Used to calculate TEEL values from other PAC values when the data are lacking
- Identified all chemicals with AEGL values
- Removed chemicals for which the  $AEGL-2 = AEGL-3 \div 3$
- Calculated the ratios of
  - AEGL-3:AEGL-2 (N = 214)
  - AEGL-2:AEGL-1 (N = 162)
- Statistics...

## Methods: Multiplying Factors - Statistics

- We calculated the means...
- Data DID meet the assumptions of normality
- Outliers were identified and removed
- And repeat
- The means were rounded

# Proposed Multiplying Factors

Level	Factor
TEEL-3	PAC-2 x <b>6</b>
TEEL-2	PAC-3 ÷ <b>6</b> PAC-1 x <b>11</b>
TEEL-1	PAC-2 ÷ <b>11</b>

# Candidate Chemicals

- Identify materials that are candidates for removal from the PAC dataset
- Will not cause an operational emergency
  - Cannot attain toxic concentrations in the air
  - Inability to generate high airborne levels
- NFPA HHR-0
- Foods, lab scale items, solids
- One-time effort
- A list of chemicals has been identified and will be given to NA-41 for consideration

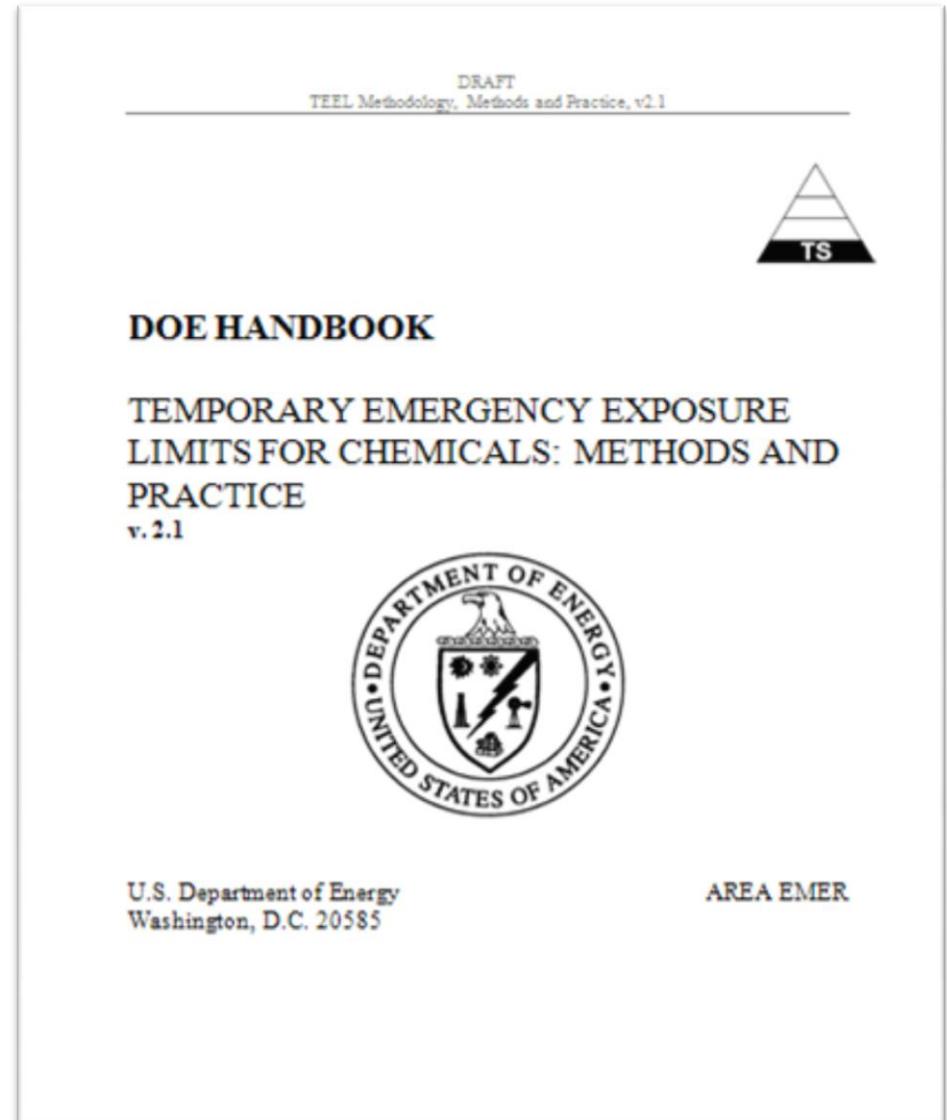
## Candidate Chemicals: What is this?

- $C_{12}H_{22}O_{11} + NaCl + CH_2NaO_3 + C_8H_8O_3 + C_{18}H_{32}O_2 + C_9H_8O + C_6H_{10}O_5 \rightarrow ?$
- @ 23°C?
- @ 191°C for 15 minutes?

# TEEL Review Panel

- Resolve conflict
- Data exclusion
- Exceptions to the default process
- TEEL values conflict with their definitions
- Where professional judgment is needed
- Consider sources that cannot be confirmed

# The Handbook v2.1



# The Handbook v2.1

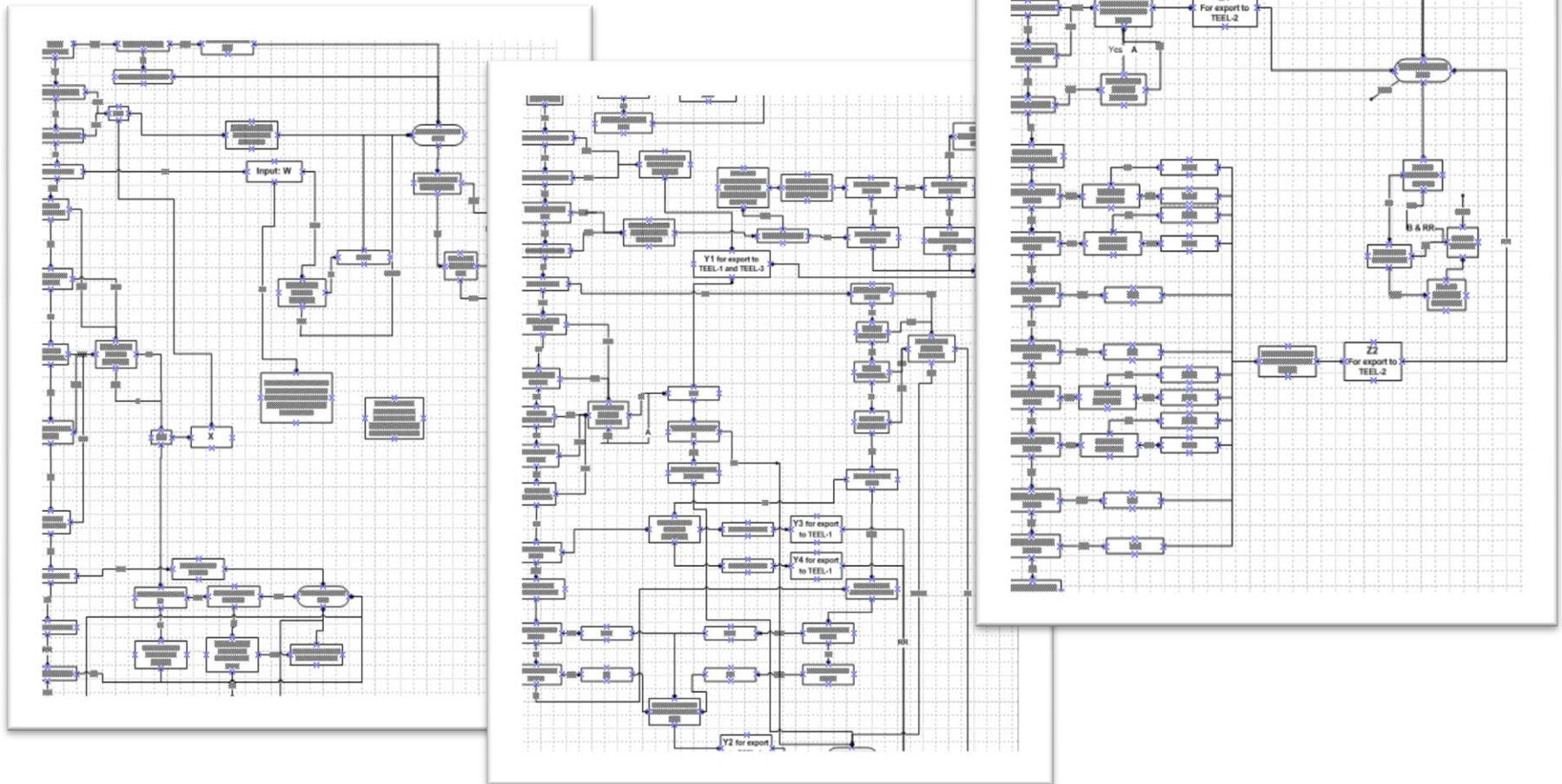
DKAF 1  
 TEEL Methodology, Methods and Practice, v2.1

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# Relational Database



**QUESTIONS?**