

# **Ranking of Chemical Facilities Based on the Potential to Cause Harm to the Public (PCHP)**

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**Dr. M. Sam Mannan, PE, CSP, DHC, FAIChE, FICChemE, PSPE**

**Regents Professor and Executive Director**

**TEES Distinguished Research Professor**

**Holder of T. Michael O'Connor Chair I**

**Mary Kay O'Connor Process Safety Center**

**Artie McFerrin Department of Chemical Engineering**

**Texas A&M University System**

**College Station, Texas 77843-3122, USA**

**(979) 862-3985, [mannan@tamu.edu](mailto:mannan@tamu.edu)**



**MARY KAY O'CONNOR  
PROCESS SAFETY CENTER**  
TEXAS A&M ENGINEERING EXPERIMENT STATION

# Introduction

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- ❑ Quite often the intrinsic properties that make chemical substances hazardous are the same properties that make the same substances useful to the public and the environment
- ❑ Chemical hazards can harm the environment as well as the public
- ❑ Rating system to assess hazards of different facilities in chemical industries is crucial for designing emergency response plans and effectively communicate to people the hazards they are exposed to when living near a facility
- ❑ Hazard and risk are not the same and the words (and more specifically meaning) are not interchangeable or synonymous
- ❑ Objectives:
  - Develop a methodology to assess chemical process facilities based on their potential to cause harm to the public (PCHP)
  - Apply the methodology to rank chemical facilities in Great Houston area

# PCHP Index

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- PCHP is a function of
  - Material Inherent Property
    - Flammability, Reactivity, Toxicity
    - Represented by Material Hazard Index (MHI)
  - Quantity
  - Population Density
  - Incident History \*

□  $PCHP\ Index = MHI * F_Q * F_{PD} * F_{IH}$

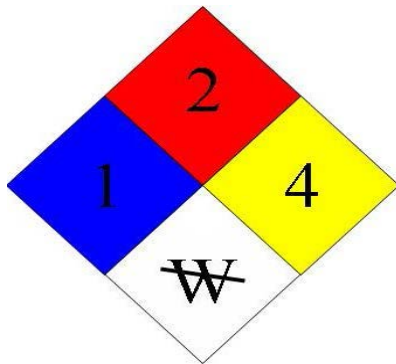
where  $F_Q$  represents penalty value for quantity

$F_{PD}$  represents penalty value for population density

$F_{IH}$  represents penalty value for incident history

# Material Hazard Index (MHI)

- ❑ Material Inherent Properties : flammability, reactivity, toxicity
- ❑ NFPA Hazard Diamond<sup>[1]</sup>



**Red:** degree of flammability (NF)

**Yellow:** degree of reactivity (NR)

**Blue:** degree of health hazard (NH)

White: special hazards

- ❑ NF and NR are used to rate flammability and reactivity
- ❑ Protective Action Criteria Value<sup>[2]</sup> corresponding to life-threatening health effect (PAC-3) is used to modify NH to rate toxicity

# Material Hazard Index (MHI) Cont.

## ❑ Modified NH Determination Guide

PAC-3 ranges (mg/m <sup>3</sup> )	Modified NH
[0,100]	4
(100, 1,000]	3
(1,000, 10,000]	2
(10,000, ...)	1

# Material Hazard Index (MHI) Cont.

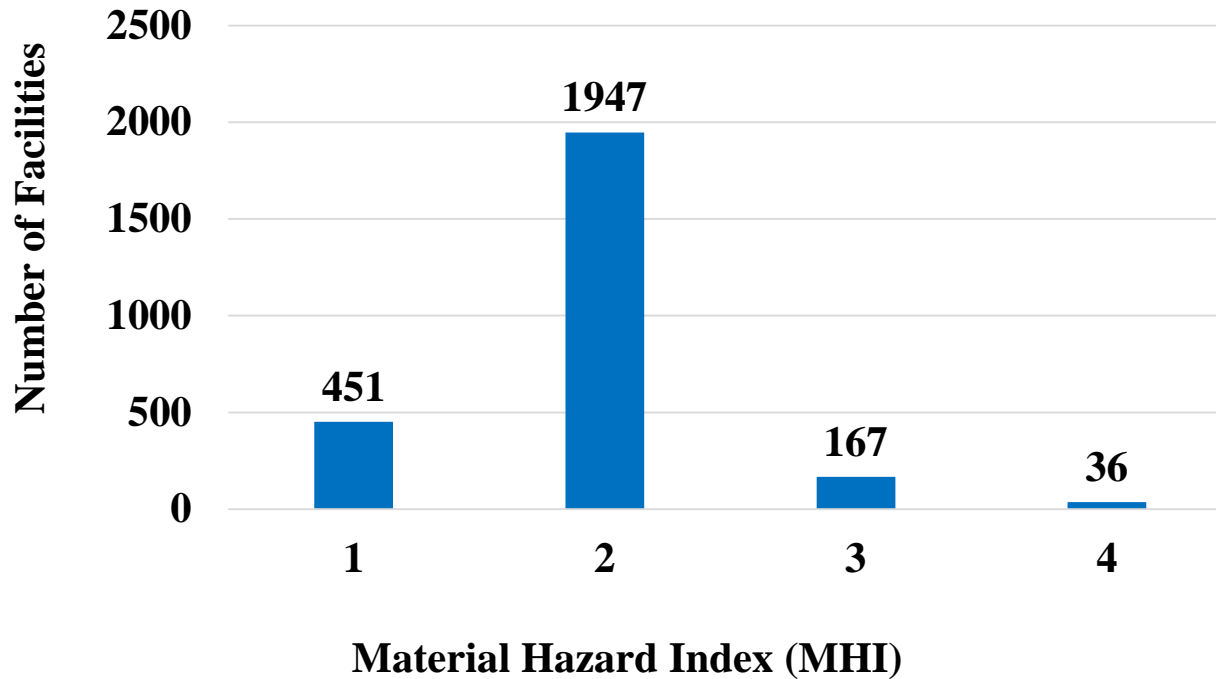
- Material Hazard Factor (MHF)

$$\text{MHF} = 2^{\text{NF}} + 2^{\text{NR}} + 2^{\text{Modified NH}}, \text{ in range of } [4,48]$$

- MHI Determination Guide

Material Hazard Factor (MHF)	Material Hazard Index (MHI)
[4,12)	1
[12,24)	2
[24,36)	3
[36,48]	4

# MHI Distribution



# Penalty Value of Population Density

- ❑ Given coordinate of a facility, population in a radius of two miles near the facility can be found by using LandView, which is a geographic information system software
- ❑ Penalty Value of Population Density Determination Guide

Population in 2-Mile Radius	Penalty Value
[10, 100)	1.2
[100, 1,000)	1.4
[1,000, 10,000)	1.6
[10,000, 100,000)	1.8
[100,000, ...)	2

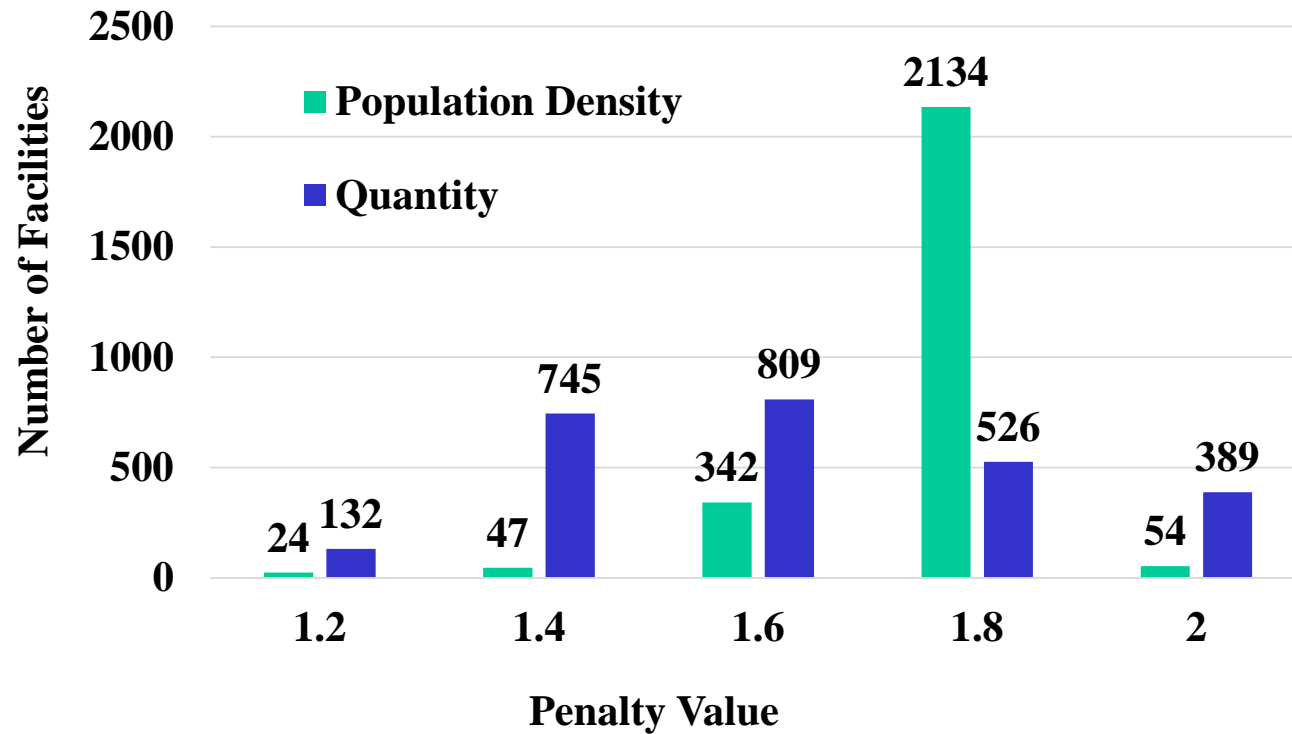


# Penalty Value of Quantity

## □ Penalty Value of Quantity Determination Guide

Quantity Range (Pounds)	Penalty Value
[1, 100)	1.2
[100, 1,000)	1.4
[1,000, 10,000)	1.6
[10,000, 100,000)	1.8
[100,000, ...)	2

# Penalty Value Distribution

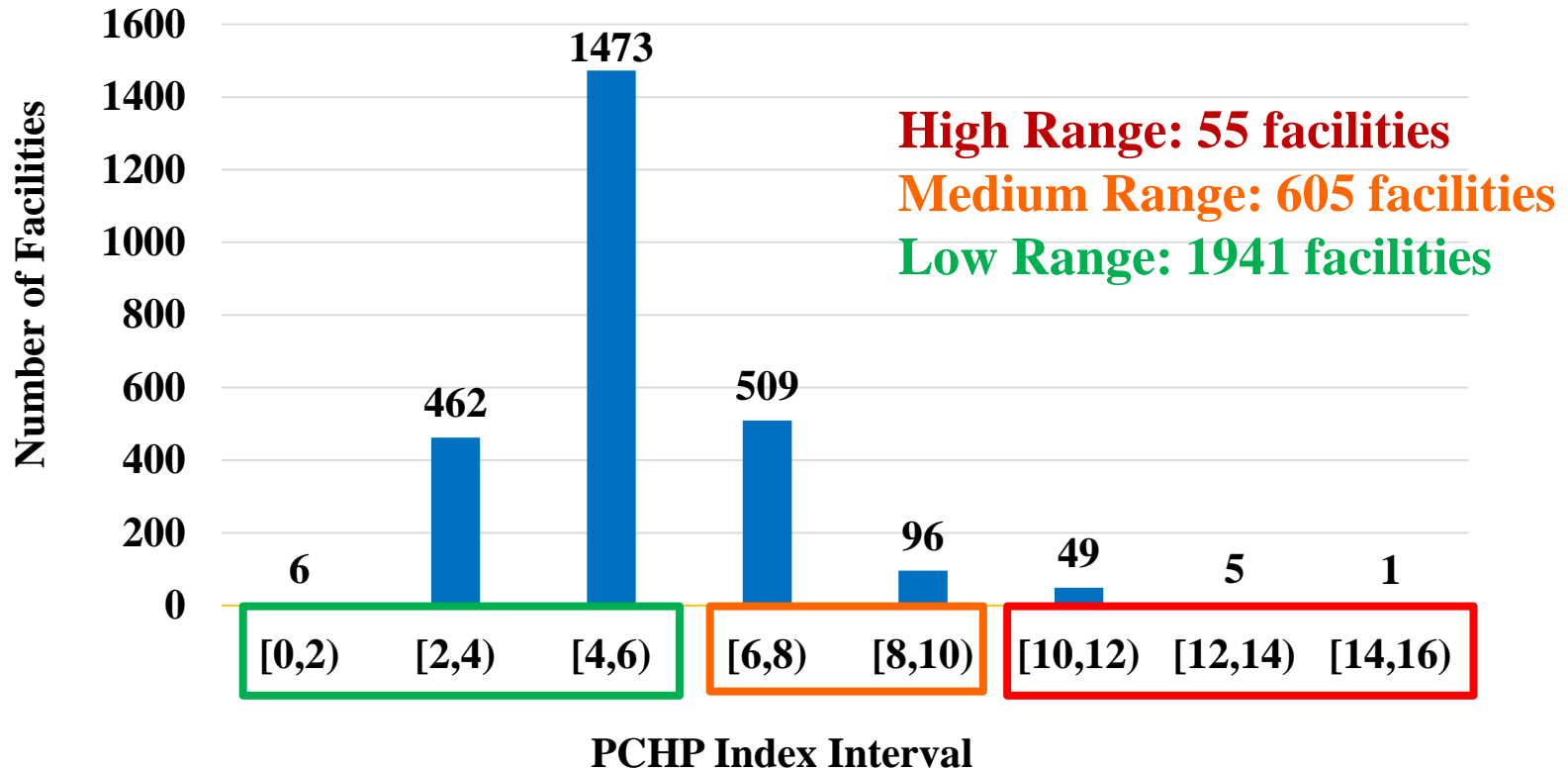


# Results

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- ❑ PCHP Index for 2601 facilities in Great Houston area were calculated
- ❑ For facilities with multiple chemicals, the PCHP Index was first calculated for each chemical, and PCHP Index of the facility was estimated by selecting the chemical that has the highest PCHP Index

# PCHP Index Distribution



# Conclusions

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- ❑ PCHP Index was developed to rate chemical facilities based on their potential to cause harm to the public
- ❑ PCHP Index for 2601 chemical facilities in Great Houston area were calculated. Those facilities which were ranked in highest range of PCHP Index need to take proper actions to manage the risk associated with the hazard
- ❑ PCHP Index can be used to engage in a dialog for better risk management, emergency response planning, and sharing information with the public and emergency responders

# References

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[1] National Fire Protection Association (2012). NFPA 704: Standard System for The Identification of The Hazards of Materials for Emergency Response.

[2] Emergency Management Issues Special Interest Group. Chem PACs/TEELs. <https://orise.orau.gov/emi/scapa/chem-pacs-teels/default.htm>