

# Hazard Analysis

## Respirator Canister Challenges



Draft for Discussion





# Sorbant / Media Based Classification of Challenge Agents

- Classification into Agent Families
- **Test Representative Agent (TRA)** required for each family of agents.
- **Back up data** with other agents within family are being generated.
- **Biological and Radiological** agents are addressed as particulates requiring mechanical P-100 media



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## **Families / Test Representative Agents (TRA)**

- **Acid Gas / TRA = SO<sub>2</sub>, H<sub>2</sub>S, CNCL, COCl<sub>2</sub>, HCN**
- **Base Gas / TRA = Ammonia**
- **Hydrocarbon / TRA = Carbon Tetrachloride or Cyclohexane**
- **Hydrides / TRA = Phosphine**
- **Isocyanate / TRA = ??**
- **Carbon Monoxide / TRA = Carbon Monoxide**
- **Nitrogen Oxide / TRA = NO<sub>2</sub>**
- **Particulate / TRA = DOP**
- **Formaldehyde / TRA = Formaldehyde**
- **Unknown / further study required**
- **Air Supplied - Air Supplied respirators required**



# First Step: Hazards Concept

- Need to develop a standard immediately
- Addressing the initial vulnerability assessment list of chemical agent hazards (151) to develop data to confirm the Agent Families and Test Representative Agent.(TRA) will time consuming
- Chemical Agent Hazard List has not been finalized by the NIOSH Toxicologists, list could grow to >200 chemicals





## Test Representative Agents

- **Ammonia** - NIOSH (42 CFR Part 84) & EN (141)
- **Carbon Monoxide** - NIOSH
- **Carbon Tetrachloride** - Organic Vapor - NIOSH
- **Cyanogen Chloride** - Military (EA-DTL-1704A)
- **Cyclohexane** - Organic Vapor - EN
- **Formaldehyde** - NIOSH
- **Hydrogen Cyanide** - NIOSH, EN & Military
- **Hydrogen Sulfide** - NIOSH & EN
- **Nitrogen Dioxide** - NIOSH & EN
- **Phosgene** - Military
- **Phosphine** - NIOSH
- **Sulfur Dioxide** - NIOSH & EN
- **DOP** - NIOSH (P-100 Particulate Test)





# First Step Hazard Concept: Protection Summary

- Testing of the TRA should provide protection for the following Chemical agents (108) on the NIOSH CWA /TIC Threat List (151), plus Particulate Biological agents (13) & Particulate Radiological/Nuclear agents (16):
  - 61 **Organic Vapor Family**, with vapor pressures less than those of Carbon Tetrachloride and Cyclohexane (TRA). By using this logic would including GB and HD.
  - 27 **Acid Gas Family**, TRA's = Cyanogen Chloride, Phosgene, Hydrogen Cyanide, Hydrogen Sulfide, and Sulfur Dioxide.
  - 3 **Base Gas Family**, TRA = Ammonia.
  - 4 **Hydride Family**, TRA = Phosphine.
  - 6 **Nitrogen Oxide Family**, TRA = Nitrogen Dioxide.
  - 1 **Formaldehyde Family**, only member of family and is TRC.
  - 3 **Carbon Monoxide Family**, TRA = Carbon Monoxide
  - 32 **Particulate Family**, TRA = DOP



## Organic Vapor Family

| Organic Vapor Family  |                                   | Acid Gas Family              |
|---|-----------------------------------|------------------------------|
| acetone cyanohydrin   | mustard, lewisite mixture         | boron tribromide             |
| acrylonitrile   | nitrogen mustard HN-1             | boron trichloride            |
| allyl alcohol   | nitrogen mustard HN-2             | boron trifluoride            |
| allyl chloroacetate   | nitrogen mustard HN-3             | bromine                      |
| bromoacetone  | n-propyl chloroformate            | bromine chloride             |
| bromobenzylcyanide  | o-chlorobenzylidene malononitrile | bromine trifluoride          |
| chloroacetone   | parathion                         | carbonyl fluoride            |
| chloroacetoneitrile   | perchloromethyl mercaptan         | chlorine                     |
| chloroacetophenone  | phenyl mercaptan                  | chlorine pentafluoride       |
| chloroacetophenone / chloroform / chloropicrin (23/38.4/38.4) | phenylcarbylamine chloride        | chlorine trifluoride         |
| chloroacetyl chloride   | phenyldichloroarsine              | chlorosulfonic acid          |
| chloropicrin  | phosgene                          | cyanogen chloride            |
| chloropivaloyl chloride                                       | oximedichloroformoxime            | dichlorosilane               |
| crotonaldehyde  | sarin                             | ethyl phosphonous dichloride |
| cyclohexyl methylphosphonate                                  | sec-butyl chloroformate           | fluorine                     |
| dibenz-(b,f)-1,4-oxazepine                                    | soman                             | hydrogen bromide             |
| diketene  | tabun                             | hydrogen chloride            |
| dimethyl sulfate  | tert-octyl mercaptan              | hydrogen cyanide             |
| diphenylchloroarsine  | tetraethyl                        | hydrogen fluoride            |
| diphenylcyanoarsine   | dithiopyrophosphate               | hydrogen iodide              |
| distilled mustard   | tetraethyl lead                   | hydrogen sulfide             |
| ethyl chloroformate   | tetramethyl lead                  | phosgene                     |
| ethyl chlorothioformate                                       | tetranitromethane                 | phosphorus trichloride       |
| ethyl phosphorodichloridate                                   | trimethoxysilane                  | silicon tetrafluoride        |
|   | trimethylacetyl chloride          |                              |
|   | V-Sub X                           |                              |



| Base Gas Family         | Nitrogen Oxide Family | Hydride Family | Formaldehyde Family | Carbon Monoxide Family | Particulate Family                 |
|-------------------------|-----------------------|----------------|---------------------|------------------------|------------------------------------|
| allyl amine             | nitric acid           | arsine         | formaldehyde        | carbon monoxide        | adamsite                           |
| ammonia                 | nitric acid, fuming   | germane        |                     | iron pentacarbonyl*    | sodium azide                       |
| dimethyl hydrazine, 1,2 | nitric oxide          | phosphine      |                     | nickel carbonyl*       | sodium fluoroacetate               |
| methyl hydrazine        | nitrogen dioxide      | stibine        |                     |                        | +                                  |
|                         | nitrogen tetraoxide   |                |                     |                        | (13) Biological Agents             |
|                         | nitrogen trioxide     |                |                     |                        | (16) Radiological / Nuclear agents |
|                         |                       |                |                     |                        |                                    |
|                         |                       |                |                     |                        |                                    |
|                         |                       |                |                     |                        |                                    |







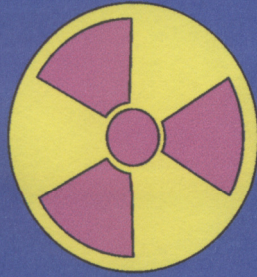
# Particulate Biological Agents

(USAMRIID and/or CDC Lists)

- Anthrax
- Brucellosis
- Glanders
- Pneumonic Plague
- Tularemia
- Q Fever
- Smallpox
- Venezuelan Equine Encephalitis
- Viral Hemorrhagic Fevers
- T-2 Mycotoxins
- Botulism
- Ricin
- Staphylococcus Enterotoxin B







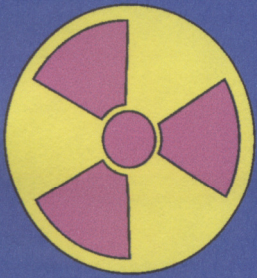
# Particulate Radiological/Nuclear Agents

(USAMRIID and/or DOE Lists)

- Hydrogen 3
- Carbon 14
- Phosphorous 32
- Cobalt 60
- Nickel 63
- Strontium 90
- Technetium 99m
- Iodine 131
- Cesium 137
- Promethium 147
- Thallium 204
- Radium 226
- Thorium 232
- Uranium 235 & 238
- Plutonium 239
- Americium 241







# Respiratory Protection

The Department of Energy recommends full-face respiratory protection for entrance into a radiologically contaminated area. *DOE/RW-0362 SR Office of Civilian Radiological Waste Management*

The respiratory threat can be eliminated by employing High Efficiency Particulate Air (HEPA) or P100 filters. *Domestic Preparedness Technician-HAZMAT Course*

The U.S. Army specifies a M40 full-face gas mask with a two-element canister containing (HEPA) filtration and ASZM-T Cooperite carbon filtration media.



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# Systems Based Permeation & Penetration Challenges

- Respirator systems, unlike canisters, will be challenged with chemical warfare agents.
- Challenges are based on the Most Creditable Event indoor scenarios
- Sarin (**GB**) vapor challenge = 2000 mg/m<sup>3</sup>
- Distilled Sulfur Mustard (**HD**) vapor challenge = 300 mg/m<sup>3</sup>, liquid droplet challenge approximately 10 g/m<sup>3</sup>
- Test protocols will be consistent with use scenarios





# System Test - Sarin (GB)

