Concepts for Developing NBC Respirator Requirements

PROJECT STATUS
NBC Requirements Specific Tasks

NIST-NIOSH-SBCCOM Strategic & Operational Plan

- Assess threats and vulnerability
- Develop NBC respirator requirements using threats
- Develop & validate test methods
- Conduct applied laboratory research to fill gaps
- Qualify collaborating laboratories
- Establish application procedures and processes
- Issue NIOSH NBC respirator approvals
NBC Respirator Requirements Process

Step 1: Conduct hazard and vulnerability assessments to learn:

- Most probable agents
- Most probable delivery scenarios
- Emergency responder service requirements
Potential Terrorism Agents vs NIOSH Approvals

20 NIOSH Chemical Gases & Vapors

- Ammonia
- Chlorine
- Chlorine Dioxide
- Methylamine
- Carbon monoxide
- Chloroacetophenone
- Organic vapors
- Chlorobenzylidene malonitrile
- Formaldehyde
- Ethylene Oxide
- Mercury vapor
- Nitrogen dioxide
- Hydrogen Chloride / Cyanide / Fluoride / Sulfide
- Phosphine
- Sulfur dioxide
- Vinyl chloride
- Acid gases

158 Terrorism Chemicals
Relative Inhalation Toxicities

Median Lethal Dosage (LCT50) by Inhalation
mg·min/m³

10
100
1000
10000
100000
1000000

VX
GF
Sarin (GB)
Soman (GD)
Tabun (GA)
Lewisite (L)
Sulfur Mustard (HD)
Nitrogen Mustard (HN)
Methyl Isocyanate
Parathion
Phosphine
Arsine
Nitrogen Cyanide (AC)
Hydrogen Cyanide (CN)
Cyanogen Chloride (CK)
Phosphamidon
Acrolein
Cyanogen
Tetraethyllead
Arsine (SA)
Hydrogen Sulfide
Formaldehyde
Chlorine
Bromine
Methyl Bromide
Hydrogen Chloride
Ethylene Oxide
Sulphur Dioxide
Ammonia
Carbon Monoxide

10
3

CDC
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Hazard & Vulnerability Assessment

- Analyze available Threat/Vulnerability Data
- Develop Time-Phase/Location-Phase Hazard Profile
  - Indoor Location
  - Outdoor Location
  - CWA, BWA, and TICs
- Determine Health/Safety Standards Needs
- Overlay Hazard Assessment Data with Concentration/Time Profile and Health Standards Data to assess Personnel Vulnerabilities

![Diagram showing concentration-time profile and health standards](image)

**HEALTH STANDARDS**
- IDLH
- STEL
- WPL
- AEGL
- AEL
- GPL

User Input

**Military (Outdoor)**

**Indoor**

Scenarios Dependent Analysis

Daily Operation
Single Exposure
How Long
Acceptable Risk
NBC Respirator Requirements Process

Step 2: **Determine appropriate performance standards:**

- Evaluate current respirator standards
- Determine applicability, adequacy, limitations, and gaps in current standards
- Propose a comprehensive battery of performance and design requirements for each respirator class
- Develop and publish NIOSH Standard Testing/Operating Procedures to measure compliance
NBC Respirator  
Standard Development

Review all potential test standards for applicability (Military & Civilian)

- Select appropriate “Family” of tests
- Determine performance standards to be met
- Determine test parameters
- Public involvement with process & procedures
Domestic Standards Evaluation

ACGIH – American Conference of Governmental and Industrial Hygienists
ANSI – American National Standards Institute
ASAE or SAE – American Society of Automotive Engineering
ASME – American Society of Mechanical Engineers
ASTM – American Society for Testing and Materials
EPA – Environmental Protection Agency (USA)
MIL – U.S. Department of Defense
NFPA – National Fire Protection Association (USA)
NIOSH – National Institute for Occupational Safety and Health
OSHA – Occupational Safety and Health Administration
International Standards Evaluation

AFNOR – France
BS or BSI – United Kingdom
CEN or EN – European Community
CNS – China
CSA – Canada
DIN – Germany
GOST-R - Russia
ICONTEC – Columbia
MODUK – United Kingdom
NATO – North Atlantic Treaty Organization

Israel
JISC – Japan
KNITQ – Korea
SAA – Australia
SABS – South Africa
SNZ – New Zealand
Preliminary Assessment

• NIOSH standards based on general industry and mining

• No NIOSH approvals for CWA or BWA

• Military standards based on open battlefield BWA & CWA

• Military masks are not evaluated against TICs

• Need NBC respirator requirements specific to terrorism

• NIOSH and SBCCOM working on new NBC respirator approval procedures
NBC Requirement Adjustments

• Neither NIOSH nor U.S. military mask standards address terrorism:
  - in small enclosed spaces
  - in large enclosed arenas
  - with many TICs/TIMs

• NIOSH industrial respirator test standards may need concentrations adjusted for terrorism

• SBCCOM military mask test standards may need concentrations adjusted for terrorism
Operational & Scientific Issues

♦ For SCBA
  - system and component permeation and penetration
  - fit characteristics

♦ For air-purifying respirators (all above plus)
  - realistic exposure estimates for challenge concentrations
  - breakthrough and end-point concentrations
  - breathing flow rates
  - carbon dioxide buildup and oxygen depletion
  - hot and cold temperature function
  - human wear factors
    (drinking, fogging, communications)

♦ For assessment of future respirator technologies
NBC Respirator Standards Process

Step 3: Test Method Development and Validation:

- Evaluate existing NIOSH & SBCCOM procedures
- Adjust for NBC terrorism threat levels
- Develop new procedures for new agents
- Validate accuracy, precision, reproducability
- Publish NIOSH Standard Testing/Operating Procedure
Test Method
Development & Validation

- Establish test procedures
- Develop test protocol
- Validate test method/procedures
- Document
- Public involvement with process & procedures

Approved and Validated Test Methods
NIOSH Respirator Certification Program

- 7172 Certificates of Approval Issued since 1972
  453 - 13F - Self-contained breathing apparatus
  178 - 14G - Gas masks
  340 - 19C - Supplied-airline respirators
  4133 - 21C/84A - Particulate respirators
  2068 - 23C - Chemical cartridge respirators

- 62 Manufacturers - 42 Domestic
  - 20 Foreign, 16 Countries
  - 85 manufacturing sites
CBRN Future Activities

- NIOSH-SBCCOM Joint NBC Respirator Standards Development Team progressing well
- CDC support and National Personal Protective Technology Laboratory in process
- NIST-NIOSH-SBCCOM Public Meeting on “Standards for Respiratory Devices Used to Protect Workers Against Chemical, Biological, Radiological, and Nuclear Agents” April 17-18, 2000
- NBC Requirements for SCBA in FY 2001
- NBC Requirements for other respirator classes FY02-03
- NIOSH-NIST laboratory qualifications program will follow