LA-5470-PR

LA-5470-PR

PROGRESS REPORT

247
2-24-74

Progress Report
Respirator Studies for the
AEC Division of Operational Safety
January 1 through June 30, 1973

los alamos
scientific laboratory

of the University of California

LOS ALAMOS, NEW MEXICO 87544

MASTER

UNITED STATES
ATOMIC ENERGY COMMISSION
CONTRACT W-7405-ENG. 36

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

This is the first report on the status of the Respirator Studies for the AEC Division of Operational Safety.

In the interest of prompt distribution, this progress report was not edited by the Technical Information staff.

Printed in the United States of America. Available from
National Technical Information Service
U. S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22151
Price: Printed Copy \$4.00, Microfiche \$1.45

LA-5470-PR
Progress Report
UC-41

ISSUED: December 1973

Progress Report

Respirator Studies for the AEC Division of Operational Safety

January 1 through June 30, 1973

Edwin C. Hyatt, Project Manager
Bruce J. Held
Darell J. Bevis
Tom O. Moore

Work supported by the US AEC's Division of Operational Safety.

NOTICE

This report was prepared as an account of work sponsored by the United States Government. Neither the United States nor the United States Atomic Energy Commission, nor any of their employees, nor any of their contractors, subcontractors, or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness or usefulness of any information, apparatus, product or process disclosed, or represents that its use would not infringe privately owned rights.

Key

RESPIRATOR STUDIES FOR THE AEC DIVISION OF OPERATIONAL SAFETY

by

Bruce J. Held, Edwin C. Hyatt, Project Manager
Darell A. Bevis, and Tom O. Moore

ABSTRACT

The LASL Respirator Research and Development Section, Industrial Hygiene Group, performed studies and conducted training for the Division of Operational Safety (DOS) during the second half of FY 1973. The major work involved development and initiation of a training course for AEC contractors and AEC personnel; writing a Respirator Manual for use by the AEC and their contractors; providing consulting services for the DOS and contractors; man testing several respirators; and holding a three-day Respirator Symposium jointly sponsored by the DOS, the Directorate of Regulatory Standards, and LASL.

I. INTRODUCTION

A. Scope and Priorities

The AEC's Division of Operational Safety started funding the LASL Respirator Research and Development Section, Industrial Hygiene Group, in January 1973. Initial funding supported two full-time technicians and the equivalent of one full-time staff member.

Initial priorities were to set up training courses for AEC contractors and Operations Office personnel, and organize a three-day Respirator Symposium for contractors, licensees, and AEC personnel. In addition, man testing of various respirators of interest to AEC contractors was started, as was preparation of the Respirator Manual for use by contractors.

B. Relationship to Other Sponsors of Respirator Studies

The Respirator Research and Development Section has been conducting studies for the AEC Directorate of Regulatory Standards since 1969 and for the National Institute

for Occupational Safety and Health (NIOSH) since 1971. Each sponsor has definite programmatic areas of emphasis and responsibility, which, in combination with the DOS program, cover a broad spectrum of respirator research interests. Some activities are jointly sponsored, such as the AEC Respirator Guide and the three-day symposium. Such joint support enhances and accelerates the time to produce an end result because more man hours can be concentrated on these particular projects. Regular progress reports are submitted to each sponsor.

II. AEC RESPIRATOR SYMPOSIUM

A major activity during this reporting period was the three-day Respirator Symposium held on February 6, 7, and 8. The Symposium was jointly sponsored by the AEC Division of Operational Safety (DOS), the AEC Directorate of Regulatory Standards (DRS), and the LASL Industrial Hygiene Group. Approximately 75 AEC, contractor, and licensee personnel attended. The sessions consisted

of 10-minute reports by representatives from each facility on that facility's respirator program, invited papers, and two panel discussions. (See Appendix A for Agenda and List of Companies represented.)

The overall impression gained from the various presentations was that many programs were being upgraded, but all had major weaknesses. Many of the weaknesses were due, in part, to a lack of available information on specific subjects. These included medical limitations of users, proper training methods (including visual aids), and back-up data to obtain management support.

III. RESPIRATOR MANUAL

A rough draft of an AEC Respirator Guide was completed and is being submitted jointly to DOS and DRS for initial reviews. The first draft was directed more toward licensees rather than AEC contractors in that some references are made to requirements in a proposed change to Title 10, Code of Federal Regulations, Part 20. However, only slight revisions are necessary to adapt it for contractors, and it may be feasible to develop one document to fit the needs of both contractors and licensees. The Table of Contents of the Guide is given in Appendix B.

IV. TRAINING PROGRAM

The DOS respirator training program for contractors was initiated at the end of April. Four sessions were held by the end of June with a total attendance of 22 people. Attendance is generally limited to six people per session.

The course was initially scheduled for two days. After the first two sessions, it was apparent that the material could not be adequately covered in this time period, and the course was lengthened to two and a half days. Mr. David Woods, a professional health educator with the Hazards Control Group, Lawrence Livermore Laboratory, was asked to critique the second session of the course, and his suggestions have been

helpful in improving the course sequencing, presentations, and visual aids.

The course is given on the second and fourth weeks of each month. All courses are filled through calendar year 1973, and course dates have been set for 1974. At the request of DOS, training has been scheduled for the first half of FY 1974 for 28 Department of Labor, Occupational Safety and Health Administration personnel and eight Department of Health, Education and Welfare, National Institute of Occupational Safety and Health personnel.

Dates have been set or are being set for training AEC personnel at each Operations Office except Savannah River, Nevada, and San Francisco. Washington Headquarters personnel are scheduled for July.

A Respirator Training Manual was prepared and a copy is given to each trainee. (See Appendix C for Table of Contents.) The Manual is loose-leaf to permit additions and up-dating as needed. A file of names and addresses of all Manual holders is maintained in order to send out revisions. Training outlines were also prepared for contractor, Operations Offices, and OSHA and NIOSH personnel. The contractor training outline is presented in Appendix D.

V. QUANTITATIVE MAN TESTS

Quantitative man tests were run on seven makes of half-face masks which use high-efficiency filters (99.97% efficient against 0.3 micron-sized particles). A total of 202 tests was run on 185 subjects using either monodisperse or polydisperse dioctyl phthalate (DOP) or sodium chloride (NaCl) aerosols.

The results listed in Table I will be used in establishing protection factors (PF's) for the DOS Respirator Manual. Man test data from previous tests are included in Table I for completeness.

TABLE I
MAXIMUM PROTECTION FACTOR OBTAINED BY SUBJECTS
WEARING APPROVED HALF MASK RESPIRATORS

Type of Respirator	No. of Test Subjects	Percent subjects with maximum PF listed					
		1000	100	50	20	10	5
1. Acme 8201-R (old model) 21B-100	52	13	81	88	92	96	100
2. Acme 8201-R (new model) Ext 21B-100	30	33	40	63		77	100
3. A0 6057 21B-98	44	20	52	61	88	93	100
4. A0 5057 Ext 21B-98	32	69	87	100			
5. MSA Custom Comfo 21B-90	71	42	82	90	94		100
6. MSA Custom Comfo II 21C-135	17	71	100				
7. Pulmosan C-263 21B-131	36	25	75	86	94	100	
8. Welsh 7580 21B-105	56	55	75	80	89	93	100
9. Willson 1009 21B-94	30	7	30	43	63	70	100

The old Acme 8201-R had a PF of 10 for 96% of the men tested. The new model is too large for many people and has a PF of 10 for only 77% of those tested.

The A0 6057 and 5057 listed in Table I have an elastic head strap with four point suspension. The A0 6057 with the two point suspension, single rubber loop only, was also tested, but not included in Table I. Thirteen of 30 men tested with the two point suspension could not achieve a protection factor of 5 and its use should be discouraged.

The new MSA, Comfo II continues to be good, with a PF of 100 for the 17 men tested. It is the only mask in the Table which has been approved under 21C. The approval number is TC-21C-135. The older model Custom comfo achieved a protection factor of 20 for 94% of the 71 men fitted.

The Pulmosan C-263 was the last respirator approved under Schedule 21B in 1972. The approval number is 21B-131. It has a PF of 10 for 100% of the 36 subjects tested.

The Welsh 7580 with both two point (not shown on Table I) and four point head strap suspension was tested. Of the 27 men tested with the two point suspension, 26% could not achieve a protection factor of 10. However, 93% of the 56 men tested on the 7580 with four point suspension achieved a protection factor of 10. Welsh does not sell the two point suspension device with high-efficiency filters. Since the filters are interchangeable between the two types of devices, care should be taken that the two point suspension device not be issued for use with high-efficiency filters.

The poor fitting qualities of the Willson 1009 (only 70% of 30 men tested achieved a protection factor of 10) lead to the recommendation that it be used only if a careful fitting test is performed.

VI. RECIRCULATING BREATHING APPARATUS TESTS

Tests were run on an MSA Chemox Oxygen Breathing Apparatus to determine if it could

TABLE II
EXERCISES PERFORMED AND TIME THE
MSA CHEMOX WAS UNDER NEGATIVE PRESSURE

Exercise	Length of Time Exercise was Performed	% Time Unit Under Negative Pressure
Sitting	6 min	0
Walking-Level Ground	10	1
Bending, Stooping	5	10
Walking-Hilly Terrain	25	20
Jogging-Level Ground	1	99
Jogging-4 mph on tread mill	4	95
Sitting after jogging	5	50

be drawn to a negative pressure and, if so, under what conditions and for what percentage of time. Results are given in Table II. The initial tests indicate that the protection afforded by this device is no greater than the demand open circuit breathing devices. Since the facepiece is under nega-

tive pressure part of the time under simulated work conditions, an interim protection factor of only 100 is recommended.

Other devices of the recirculating type will be tested during the next reporting period, using different people with a firm test schedule of exercises.

APPENDIX A

RESPIRATOR SYMPOSIUM FOR AEC CONTRACTOR AND LICENSEE H & S PERSONNEL

February 6, 7, and 8, 1973

Tuesday, February 6

Chairman - Dr. Don Ross, DOS

- 8:15 - 8:30 a.m. - Registration (Note: Buses will leave motels for Auditorium promptly at 8:00 a.m.)
- 8:30 - 8:45 a.m. - Welcome - Harold M. Agnew, Director, LASL;
George L. Voelz, M.D., Health Division Leader, LASL;
Harry F. Schulte, Industrial Hygiene Group Leader, LASL
Announcements
- 8:45 - 9:00 a.m. - Minimum Acceptable Respirator Program Specified in ANSI
Z88.2 - Dr. Don Ross, DOS
- 9:00 - 10:00 a.m. - Contractor and Licensee Reports
- 10:00 - 10:30 a.m. - Coffee Break
- 10:30 - 11:30 a.m. - Contractor and Licensee Reports
- 11:30 - 12:30 - Lunch
- Chairman - Bruce Reinert, ALOO
- 12:30 - 3:00 p.m. - Contractor and Licensee Reports
- 3:00 - 3:30 p.m. - Coffee Break
- 3:30 - 3:50 p.m. - Freon Man Test Systems - Maureen Hamilton; Environmental
Health Sciences, Hanford Environmental Health Foundation
- 3:50 - 4:10 p.m. - DOP Man Test Systems - G. Sauders, REECO, NTS

(cont)

Tuesday, February 6 (contd)

- 4:10 - 4:30 p.m. - Respirator QC Program at Rocky Flats - C. Skaats, Dow Chemical Company
- 4:30 - 4:50 p.m. - The Development of the Mound Laboratory Supplied Air Bubble Suit - G. Phillabaum, Mound Laboratory

Wednesday, February 7

Chairman - Ed Hyatt, LASL

Announcements

- 8:30 - 9:30 a.m. - Contractor and Licensee Reports
- 9:30 - 9:50 a.m. - Respirator Cartridge Efficiency Studies at LLL - G. Nelson, LLL
- 9:50 - 10:20 a.m. - Coffee Break
- 10:20 - 10:40 a.m. - Methyl Iodide Adsorption Efficiencies of Impregnated Carbons - Dr. D. T. Pence, Allied Chemical Corporation, Idaho Falls
- 10:40 - 11:00 a.m. - LASL Anthropometric Survey and Selection of a Representative Test Panel - A. Hack, LASL
- 11:00 - 11:20 a.m. - DOS and DREP Sponsored Respirator R & D at LASL - J. Caplin, DREP, and J. Maher, DOS
- 11:20 - 12:20 - Lunch
- Chairman - Jerrold Caplin, DREP
- 12:20 - 12:40 p.m. - LASL Respirator R & D Projects and Their Relationship to Amendments of 30 CFR Part 11 and OSHA Standards - Ed Hyatt, LASL
- 12:40 - 1:00 p.m. - Interim Protection Factors for High-Efficiency Filter Respirators and SCBA - John Pritchard, LASL
- 1:00 - 1:20 p.m. - Interim Protection Factors for Disposable and Dust Respirators - Charles Richards, LASL
- 1:20 - 1:40 p.m. - SCBA Training Program at LLL - S. Walker, LLL
- 1:40 - 2:00 p.m. - LASL Respirator Training and AEC Program being Developed for Contractors - Bruce J. Held, LASL
- 2:00 - 3:00 p.m. - Review and Presentation of Various Visual Aids on Respiratory Protective Devices Training - Darell Bevis, LASL
- 3:00 - 3:30 p.m. - Coffee Break
- 3:30 - 3:50 p.m. - Visual Aids Continued
- 3:50 - 4:50 p.m. - Panel Discussion on Film, Videotape, and Slide/Tape Production Costs and Benefits: Panel - Moderator, J. Maher, DOS; N. Bolton, ORNL; J. Caplin, DREP; R. Colgan, Sandia; B. Held, LASL; J. Lipera, LLL; R. Wellnitz, LASL
- 5:15 - 6:30 p.m. - Social Hour at the Red Room (Beside Science Museum) Hosted by Harold M. Agnew, Director, LASL
- 7:30 p.m. - Dinner at Community Hall - M.C., Ed Hyatt; Speaker, Edwin J. Kloos, U. S. Bureau of Mines, Pittsburgh, Pa.

Thursday, February 8

Moderator - Dr. Don Ross, DOS

Announcements

- 8:30 - 12:00 noon - Panel Discussion on Problems and Recommendations Not Covered. Open to all attendees for questions and comments.
Panel - J. Maher, DOS; J. Caplin, DREP; E. Hyatt, LASL;
E. Kloos, B of M; J. Lipera, LLL
- 12:00 - 1:00 p.m. - Lunch
- 1:00 - 3:00 p.m. - Tour and Demonstration of LASL Man Test Systems

Respirator Symposium Attendees

Please list below any topics, questions, or problems you have on respirators which you would like the panel to discuss on Thursday morning. Turn in to Don Ross or any of the panel members before Thursday.

CONTRACTORS AND LICENCEES REPRESENTED

Aerojet Nuclear Co.		Florida Power & Light Co.	
Idaho Falls, Idaho	(C)	Miami, Florida	(L)
Allied Chemical Corp.		Goodyear Atomic Corp.	
Idaho Falls, Idaho	(C)	Piketon, Ohio	(C)
Allied Gulf Nuclear Services		Hanford Environmental	
Barnwell, South Carolina	(L)	Health Foundation	
Argonne National Laboratory		Richland, Washington	(C)
Argonne, Illinois	(C)	Kerr-McGee	
Argonne National Laboratory		Grants, New Mexico	(L)
Idaho Falls, Idaho	(C)	Lovelace Foundation for Med. Ed.	
Battelle Columbus Labs		Albuquerque, New Mexico	(C)
Columbus, Ohio	(C)	Mason & Hanger-Silas Mason Co.	
Battelle Pacific Northwest Lab		Amarillo, Texas	(C)
Richland, Washington	(C)*	Mason & Hanger-Silas Mason Co.	
Bendix Corporation		Burlington, Iowa	(C)
Kansas City, Missouri	(C)	Monsanto Research Corp.	
Boston Edison Co.		Dayton, Ohio	(C)
Plymouth, Massachusetts	(L)	National Lead Company of Ohio	
Dairyland Power Cooperative		Cincinnati, Ohio	(C)
Genoa, Wisconsin	(C-L)	Nine Mile Point Nuclear Station	
Dow Chemical Company		Lycoming, New York	(L)
Rocky Flats, Colorado	(C)	Nuclear Fuel Services	
E. I. duPont de Nemours & Co.		West Valley, New York	(L)
Aiken, South Carolina	(C)	Reynolds Electrical &	
Exxon Nuclear		Engineering Co.	
Richland, Washington	(C)	Nevada Test Site	(C)

Rochester Gas & Electric Co.	Union Carbide Corp.-ORNL
Rochester, New York (L)	Oak Ridge, Tennessee (C)
Sandia Laboratories	Union Carbide Corp.-K-25
Albuquerque, New Mexico (C)	Oak Ridge, Tennessee (C)
United Power Association	Union Carbide Corp.-Y-12
Elk River, Minnesota (C-L)	Oak Ridge, Tennessee (C)
University of California-LASL	Union Carbide Corp.
Los Alamos, New Mexico (C)	Paducah, Kentucky (C)
University of California-LBL	Union Carbide Corp.
Berkeley, California (C)	Grand Junction, Colorado (L)
University of California-LLL	(C) Contractor
Livermore, California (C)	(L) Licensee

APPENDIX B

TABLE OF CONTENTS

1. INTRODUCTION
 - 1.1 Purpose
 - 1.2 Scope
 - 1.3 Background
2. BASIC POLICY REGARDING USE OF RESPIRATORS
 - 2.1 Use Conditions
 - 2.1.1 Routine Operations
 - 2.1.2 Non-Routine Operation
 - 2.1.3 Emergencies
 - 2.2 Work Periods
3. ELEMENTS OF AN ACCEPTABLE PROGRAM
 - 3.1 Regulations Pertaining to Respirator Usage
 - 3.1.1 General Respiratory Program Regulations and Recommendations
 - 3.1.2 Breathing Air Specifications
 - 3.1.3 B of M/NIOSH
 - 3.1.4 U. S. Atomic Energy Commission (10 CFR Part 20)
 - 3.1.5 Minimum Acceptable Program Requirements Summary
 - 3.2 Policy Statement
4. EVALUATION OF HAZARDS
 - 4.1 Classification of Hazards
 - 4.1.1 Oxygen Deficiency
 - 4.1.2 Toxic and Nuisance Atmospheres
 - 4.2 Air Sampling Program
5. CLASSIFICATION, DESCRIPTION AND LIMITATIONS OF RESPIRATORS
 - 5.1 Facepieces, Hoods and Suits
 - 5.1.1 Facepieces
 - 5.1.2 Hoods
 - 5.1.3 Suits
 - 5.2 Respirator Types, Descriptions and Limitations
 - 5.2.1 Air-Purifying Respirators
 - 5.2.2 Filters and Sorbents (Air-Purifying Media)
 - 5.2.3 Limitations on Air-Purifying Respirators
 - 5.3 Atmosphere Supplying Respirators, Descriptions and Limitations
 - 5.3.1 Air-Line Respirators - Demand, Pressure Demand, Continuous Flow
 - 5.3.2 Self-Contained Breathing Apparatus (SCBA) Description and Limitations
 - 5.4 Combination Respirators
 - 5.4.1 Air-Line Respirator - Air-Purifying Respirator
 - 5.4.2 Self-Contained Breathing Apparatus - Air-Purifying Respirator
 - 5.4.3 Self-Contained Breathing Apparatus - Air-Line Respirator
 - 5.5 Hose Masks with Blower and Hose Masks without Blower
 - 5.6 Emergency Use, Escape, and Rescue Devices
 - 5.6.1 Self-Contained Breathing Apparatus
 - 5.6.2 Air-Purifying Respirators
 - 5.6.3 Combinations Respirators

6. PROTECTION FACTORS
7. SELECTION OF EQUIPMENT
 - 7.1 Approved or Accepted Equipment
 - 7.1.1 Subpart K, 30 CFR Part 11, and B of M Schedule 21B
 - 7.1.2 Other Subparts and Schedules
 - 7.1.3 AEC Testing Programs
 - 7.1.4 Selection Guidance from Other Resources
 - 7.1.5 "Accepted" Devices
 - 7.1.6 Sorbent Cartridges and Canisters
 - 7.2 Activities of Wearer
 - 7.3 Individual Wearer Requirements
 - 7.3.1 Fit
 - 7.3.2 Anthropometric Criterion
 - 7.3.3 Medical Limitations
 - 7.4 Wearer Comfort
8. TRAINING
 - 8.1 Qualifications of Training Personnel
 - 8.2 Extent of Training
 - 8.3 Contents of Training Program
 - 8.4 Drills
 - 8.5 Fitting of Respirators
 - 8.5.1 Quantitative Man Tests
 - 8.5.2 Qualitative Tests
9. MAINTENANCE
 - 9.1 Minimal Acceptable Maintenance Program
 - 9.2 Inspection, Testing and Repair
 - 9.3 Storage
 - 9.4 Inventory and Control
 - 9.5 Issuance of Respirators
 - 9.6 Contamination Surveys/Decontamination
 - 9.7 Collection After Use
 - 9.8 Cleaning and Disinfection
 - 9.9 Maintenance of Air or Oxygen Supplies
10. QUALITY ASSURANCE
 - 10.1 New Equipment
 - 10.1.1 Air-Purifying
 - 10.1.2 Air-Line Respirators
 - 10.1.3 Self-Contained Breathing Apparatus (SCBA)
 - 10.2 Inspections and Tests After Cleaning and Maintenance
 - 10.3 Periodic Checks of Items in Storage
11. BIO-ASSAY PROGRAM
 - 11.1 Bio-Assay Techniques
 - 11.1.1 Sampling
 - 11.1.2 Analysis
 - 11.2 Bio-Assay Sampling
12. ADMINISTRATION
 - 12.1 Qualifications of Responsible Person in Charge
 - 12.2 Procedures and Standards
 - 12.3 Evaluation of Effectiveness
 - 12.3.1 Wearer Acceptance
 - 12.3.2 Evaluation of Protection
 - 12.4 Records
 - 12.4.2 Procurement Information
 - 12.4.3 Maintenance Information
 - 12.4.4 Training and Fitting Records
 - 12.5 Methods of Staying Abreast of New Developments in the Field
13. SPECIAL PROBLEMS
 - 13.1 Communications
 - 13.2 Prescription Glasses
 - 13.3 Facial Hair
 - 13.4 Dentures
 - 13.5 Protective Headgear
 - 13.6 Use in Extremes of Temperatures

REFERENCES

APPENDIX C
TABLE OF CONTENTS

BUFF SECTION

TRAINING

1. Outline
2. Respirator Selection Guide
3. Listing of Available Visual Aids
4. "Basic Elements of Respiratory Protection"

BLUE SECTION

STANDARDS AND REGULATIONS

1. 288.2, "Practices for Respiratory Protection"
2. 248.1, "Marking Compressed Gas Containers"
3. 286.1, "Commodity Specification for Air," also known as Compressed Gas Association Specification G-7.1
4. ACGIH TLV Guide
5. Excerpt from Title 10, Code of Federal Regulations, Part 20
6. OSHA Section on Respiratory Protection, Title 29, Code of Federal Regulations, Section 1910.134
7. Federal Specification BB-A-1034a, "Compressed Air for Breathing Purposes"
8. Federal Specification GGG-M-125d, "Mask, Air Line, and Respirator, Air Filtering, Industrial"
9. Interim Federal Specification GG-B-00675b, "Self-Contained Breathing Apparatus"

PINK SECTION

BUREAU OF MINES/NIOSH

1. Title 30, Code of Federal Regulations, Part 11
2. Circular 8559, "Bureau of Mines Approved Devices"
3. Addendum to Bureau of Mines Circular 8559
4. Description of devices approved under schedule 21B

APPENDIX D

DOS RESPIRATOR TRAINING OUTLINE

0 Introduction:

RESPIRATORS: Probably the oldest means known to man to protect himself from inhalation of hostile atmospheres. Use of respirators, of sorts, has been traced back as far as the first century A.D. Now, almost 1900 years later, with almost unbelievable advances in all fields of science, knowledge of the use of respiratory protective devices remains in the dark ages. This conclusion is drawn from the numerous reports of continual misuse of respirators. Advances in technology applied to the design and construction of respirators have not been accompanied by the needed knowledge applied to selection and use of the devices. All too many still select and use respirators on "faith" without regard to the limitations or the safety precautions that should accompany the use of the device.

Self-contained breathing apparatus were introduced to the United States in the 1800's and adopted for mine rescue applications in 1910. In 1918 the government

appointed the U. S. Bureau of Mines, an agency of the Department of the Interior, to test and approve satisfactory devices. On March 5, 1919, the Bureau initiated the use of test Schedule 13 which covered testing and approval of self-contained breathing apparatus. From 1919 to Nov. 1944 the Bureau established four other schedules for testing and approval of respiratory protective devices, those schedules and the date they were initiated are as follows: Schedule 14, gas masks, May 22, 1919; Schedule 19, supplied air respirators, April 28, 1927; Schedule 21, filter type dust, fume and mist respirators, August 20, 1934; and Schedule 23, non-emergency gas respirators (chemical cartridge respirators), November 13, 1944. These schedules have been reviewed and revised as necessary to correlate with advancing respirator technology. The latest revisions of the schedules are covered in Title 30, Code of Federal Regulations, Part 11. The responsibility of respirator testing and approval is being shifted to the National Institute for Occupational Safety and Health. With selection of approved devices and using them within their known limitations, considerable respirator misuse has been alleviated.

There are many situations in which respiratory protective devices are a must, either for emergency or routine use. Respiratory protective devices are intended to serve as adjuncts to other control measures, not as substitutes for them.

1.1 Purpose

- 1.1.1 To cover areas peculiar to the nuclear industry as it exists within the AEC contractor family.
- 1.1.2 Provide information relevant to compliance with OSHA requirements and ANSI Z88.2.
 - 1.1.2.1 Permissible practice
 - 1.1.2.2 Minimal acceptable program
 - 1.1.2.3 Use of respirators
 - 1.1.2.4 Maintenance of respirators
- 1.1.3 Training of respirator program supervisors to enable them to initiate or update their program to meet current requirements or special problems.
- 1.1.4 Provide information relevant to new methods of fitting and training and new developments in respiratory protective equipment.

1.2 Scope

- 1.2.1 Provide applied training on:
 - a. Fitting tests both qualitative and quantitative
 - b. Use of SCBA and air line equipment
 - c. Respirator maintenance
 - d. Quality assurance test methods for both new and used equipment
 - e. Use of visual aids for training
- 1.2.2 Demonstration and use of new equipment relevant to the field (both testing and protective devices).

2.0 Elements of a Minimum Respirator Program (Z88.2 and OSHA)

2.1 Administration

- 2.1.1 One qualified individual shall be responsible for program
- 2.1.2 Management support

2.2 Supply approved or accepted devices to meet needs

- 2.2.1 B of M/NIOSH certification (30 CFR 11)
- 2.2.2 Accepted devices - LASL tested

- 2.3 Provide fitting and training on use of devices
- 2.4 Maintenance and cleaning of devices
- 2.5 Written SOP's
- 3.0 Selection and Use
 - 3.1 Selection to be made only by qualified individual
 - 3.2 Respiratory hazard (288.2, Sect. 4, page 11) and guide for selection of respirators (288.2, Section 6, page 19) and interim selection guide.
 - 3.2.1 Nuclear materials
 - 3.2.2 Dissemination of contaminants
 - 3.2.3 Formation of secondary products
 - 3.2.4 Evaluation of hazards
 - 3.3 Interim Respirator Selection Guide
 - 3.3.1 How selection guide numbers established
 - 3.3.2 Selection of respirators using guide
 - 3.4 Classification of Respiratory Protective Devices
 - 3.4.1 Approved devices
 - 3.4.2 Accepted devices
 - 3.5 Selection of Devices
 - 3.5.1 Match the device to the hazard
 - 3.5.2 Limitations of respiratory protective devices
 - 3.5.2.1 Air purifying devices
 - 3.5.2.1.1 Oxygen deficiency
 - 3.5.2.1.2 Contaminant concentrations
 - a) Selection guide
 - b) Gas and vapor (0.1%-0.5%)
 - 3.5.2.2 Self-contained breathing apparatus
 - 3.5.2.2.1 Duration of air supply
 - 3.5.2.2.2 Contaminant concentration
 - a) Selection guide
 - b) Demand mode
 - c) Pressure demand mode
 - 3.5.2.3 Supplied air equipment
 - 3.5.2.3.1 Air supply
 - 3.5.2.3.2 Contaminant concentration
 - a) Selection guide
 - b) Demand
 - c) Pressure demand
 - d) Continuous flow
 - 3.5.3 Limitations of respiratory protective device users
 - 3.5.3.1 Medical limitations
 - 3.5.3.1.1 Physiological factors
 - a) Cardiac limitations
 - b) Pulmonary limitations
 - 3.5.3.1.2 Psychological factors
 - a) Wearer acceptance (comfort)
 - b) Claustrophobia
 - c) Stress conditions

- 3.5.3.1.3 Periodic exams? Yes
 - 3.5.3.1.4 Medical release forms
 - 3.5.3.1.5 Fatigue
 - a) How long can user wear RPD
 - 3.5.3.2 Anthropometric limitations
 - 3.5.3.2.1 Face sizes (correlation to respirator fit)
 - 3.5.3.2.2 Facial abnormalities
 - a) Scars
 - b) Growths
 - c) Broken bones
 - d) Abnormal shape
 - 3.5.4. Emergencies
 - 3.5.4.1 Non-nuclear
 - 3.5.4.2 Nuclear
- 3.6 Respirator use
 - 3.6.1 When?
 - 3.6.1.1 While evaluating engineering controls
 - 3.6.1.2 When engineering controls not feasible
 - 3.6.1.3 Non-routine operations
 - 3.6.1.4 Emergencies
 - 3.6.2 Development of standard procedure covering:
 - 3.6.2.1 Proper selection, use and care
 - 3.6.2.2 Routine use
 - 3.6.2.3 Emergency use
 - 3.6.3 Specify correct respirator for each job
 - 3.6.3.1 Personal issues marked clearly
 - 3.6.3.2 Qualified person making selection
 - 3.6.4 Written procedures covering safe use of respirators for:
 - 3.6.4.1 Routine operations
 - 3.6.4.2 Emergencies
 - 3.6.5 Storage
 - 3.6.5.1 Controlled temperature
 - 3.6.5.2 Clean-dry
 - 3.6.5.3 Plastic or paper bags
 - 3.6.5.4 Storage cabinets - special - stationary
 - 3.6.5.4.1 Location
 - 3.6.6 Inventory and control
 - 3.6.6.1 Inventory of devices
 - 3.6.6.2 Control of equipment
 - 3.6.6.2.1 Issue of devices
 - 3.6.6.2.1.1 Fitting, issue and laundry records
 - 3.6.6.2.2 Surveillance of use
 - 3.6.7 Periodic inspections
 - 3.6.7.1 At least monthly if not used
 - 3.6.7.2 Cleaned and inspected at least monthly or as needed for routine use
- 4.0 Training and Education of User
 - 4.1 Importance - cite misuses

- 4.2 OSHA requires qualified instructor
- 4.3 Elements of good training program
 - 4.3.1 Lecture and demonstration on:
 - 4.3.1.1 Inspection of device (possible malfunction)
 - 4.3.1.2 Limitations
 - 4.3.1.3 Care and maintenance
 - 4.3.1.4 Storage
 - 4.3.1.5 Donning
 - 4.3.2 Actual use of device
 - 4.3.3 Use of visual aids
- 5.0 Cleaning and Maintenance (see washer and dryer in basement, OHL)
 - 5.1 Qualified personnel
 - 5.2 Cleaning
 - 5.2.1 Water temperature 120-140°
 - 5.2.2 Detergents
 - 5.2.3 Machine or hand wash
 - 5.2.4 Sterilize???
 - 5.3 Drying
 - 5.3.1 Air dry
 - 5.3.2 Drying cabinet
 - 5.4 Inspection and reassembly
 - 5.5 Decontamination limits
 - 5.6 Leak test
 - 5.7 Filter and canister reuse
 - 5.7.1 High efficiency filters
 - 5.7.1.1 Aesthetically good
 - 5.7.1.2 Pressure drop
 - 5.7.1.3 Penetration (DOP)
 - 5.7.1.4 Threads and sealing surface
 - 5.7.1.5 Decontamination limits
 - 5.7.2 Sorbent cartridges and canister
 - 5.7.2.1 No!
- 6.0 Possible Impediments or Defects of Devices
 - 6.1 Air purifying devices
 - 6.1.1 Single use dust masks
 - 6.1.1.1 Poor seal
 - 6.1.2 1/4 mask
 - 6.1.2.1 Strap suspension
 - 6.2.1.2 Maintaining seal
 - 6.1.3 1/2 masks
 - 6.1.3.1 Strap suspension (2 or 4 point)
 - 6.1.3.2 Strap material
 - 6.1.3.3 Exhalation valve and seat
 - 6.1.3.4 Exhalation valve cover
 - 6.1.3.5 Cartridge holder threads and gaskets
 - 6.1.4 Full face masks
 - 6.1.4.1 Headband serrations
 - 6.1.4.2 Lens

- 6.1.4.3 Exhalation valve
 - 6.1.4.4 Speaking diaphragm
 - 6.1.4.5 Canister connector
 - 6.1.4.6 Deterioration or distortion
 - 6.1.5 Gas masks
 - 6.1.5.1 Canister and harness
 - 6.1.5.2 Corrugated breathing tube
 - 6.1.5.3 External check valve
 - 6.2 Self-contained breathing apparatus
 - 6.2.1 Regulator
 - 6.2.1.1 Diaphragm
 - 6.2.1.2 Pressure demand spring adjustment
 - 6.2.1.3 Low pressure warning device
 - 6.2.2 Facepiece
 - 6.2.2.1 Head harness
 - 6.2.2.2 Exhalation valve
 - 6.2.2.3 Corrugated breathing tube
 - 6.2.3 Cylinder
 - 6.2.3.1 Cylinder valve lock
 - 6.2.3.2 Cylinder gauge
 - 6.2.3.3 Hydrostatic testing
 - 6.2.4 High pressure hose
 - 6.2.5 Carbon dioxide sorbent
 - 6.2.6 Breathing bag
 - 6.3 Supplied air equipment
 - 6.3.1 Air supply hose
 - 6.3.1.1 Quick disconnects
 - 6.3.2 Facepiece
 - 6.3.2.1 Corrugated breathing tube
 - 6.3.2.2 Exhalation valve
 - 6.3.3 Regulator
 - 6.3.3.1 Diaphragm
 - 6.3.4 Hoods
 - 6.3.4.1 Noise (80 db)
 - 6.3.5 Suits
 - 6.3.5.1 Exhalation valves
 - 6.3.5.2 Zippers
- 7.0 Quality Assurance
- 7.1 New equipment
 - 7.1.1 Air purifying
 - 7.1.1.1 Facepieces
 - 7.1.1.2 Cartridges and canisters
 - 7.1.2 Supplied air
 - 7.1.2.1 Masks, hoods, and suits
 - 7.1.2.2 Regulators
 - 7.1.2.3 Compressors

7.1.3 SCBA

7.1.3.1 Mask assembly

7.1.3.2 Regulators and alarms

7.1.3.3 Cylinder assembly

7.2 Laundered Devices

Same as new devices with addition of:

a. Leak check of facepieces

b. Testing of reusable filters

8.0 Special Problems

8.1 Communications

8.2 Prescription glasses

8.3 Temperature extremes

8.4 Escape devices

8.4.1 Air purifying

8.4.2 Self-contained

8.5 Nuclear emergencies

8.5.1 On site

8.5.2 Off site

9.0 Tests and Procedures for Fit Testing Respirators (Applied Training with the Equipment)

9.1 Qualitative tests

9.1.1 "Smoke house"

9.1.2 Training hood

9.1.3 Chamber or room

9.1.4 Field tests

9.1.4.1 Positive pressure test

9.1.4.2 Negative pressure test

9.1.4.3 Iso-amyl acetate

9.1.4.4 Irritant smoke tube

9.2 Quantitative man tests

9.2.1 Fitting chamber or hood

9.2.2 Simulated work conditions

9.2.3 Challenge atmospheres and instrumentation

9.2.3.1 Polydisperse DOP

9.2.3.2 Monodisperse DOP

9.2.3.3 Freon-12

10.0 New Developments

Show and tell on new devices and new testing equipment

11.0 Applied training with air purifying devices

12.0 Applied training with SCBA use of equipment used at trainees facility

13.0 Applied training with supplied air devices, hoods, suits, facepieces, etc. Use of equipment used at trainees' facility.

14.0 Demonstration of laundering equipment