



HP-OP-009
Revision 0

ALLIED TECHNOLOGY GROUP FIELD OPERATIONS
HEALTH PHYSICS OPERATING PROCEDURE

PROJECT
DOSIMETRY

Prepared by:

Allied Technology Group, Inc.
Technical Support Office
1515 Main Street
Genoa, Ohio 43430

Allied Technology Group, Inc.

PROCEDURE/PLAN APPROVAL PAGE

This procedure: HP-OP-009, PROJECT DOSIMETRY has been reviewed and approved by the following:

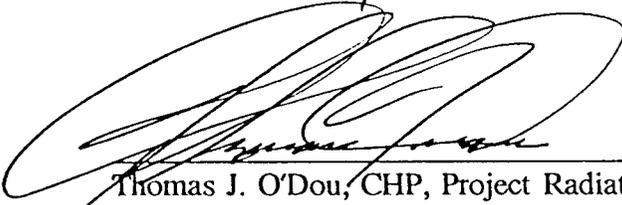
APPROVAL SIGNATURES:



William G. Haney, Project Director

4/12/95

Date



Thomas J. O'Dou, CHP, Project Radiation Safety
Officer, HP Technical Support

4/12/95

Date

REVISION RECORD INDICATING
LATEST DOCUMENT REVISION

Procedure Number: HP-OP-009

Title: Project Dosimetry

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Approval	9/21/94

**ALLIED TECHNOLOGY GROUP, INC.
PROJECT DOSIMETRY**

1.0 POLICY

Allied Technology Group, Inc.'s (ATG) position regarding personnel monitoring is more conservative than those of the Nuclear Regulatory Commission (10 CFR 20), the International Commission on Radiological Protection (ICRP), (Publication 26), and the National Council on Radiation Protection and Measurements (NCRP), (Report 39). ATG's position is that all radiation exposures, no matter how small, should be monitored and evaluated in the spirit of ALARA, and that all radiation exposures should be as low as reasonably achievable.

All personnel who work with radioactive materials will be assigned appropriate radiation personnel dosimetry and must wear that dosimetry when working. When not in use, that dosimetry will be stored and maintained in an appropriate manner.

2.0 PURPOSE

This procedure describes the requirements for radiation personnel dosimetry and the guidelines for use and maintenance of that dosimetry. Its purpose is to provide specific guidelines for the control of project dosimetry, occupational external radiation exposure records, and maintenance of a personnel exposure history for all ATG temporary Project personnel, visitors and groups for whom monitoring is required.

Records of personnel exposure to radiation is a vitally important part of working with radioactivity and as such will require strict attention to the details of this procedure.

3.0 RESPONSIBILITY

The Allied Technical Office, Genoa is responsible for administrating the initial order of project dosimetry and the maintenance of all occupational external radiation exposure records and personnel exposure history.

The Project Manager is responsible for enforcement of the project personnel dosimetry program. The Project Manager, Health Physics Supervisor or designee is responsible for the maintenance of all personnel exposure information for the project. Prior to the start of work, the Project Manager or designee shall obtain the following from each individual assigned to the project:

3.1 Site Registration Form

All new personnel and visitors required to enter a radiologically controlled area must complete a Site Registration Form (ATG Form 109) prior to starting work at a facility.

Completed Site Registration Forms will be retained with the individual's personnel exposure file. Site Registration Forms for ATG personnel will be updated annually or earlier if existing information is known to be incorrect.

3.2 Occupational Radiation Exposure History

An NRC Form 4 or equivalent must be completed by each individual and reviewed by the Project Manager or designee prior to the individual being permitted to work in a radiologically controlled area where a dose of more than 25 mRem could be received. Exposure results shall be listed on the Form 4 on a quarterly basis.

3.3 Dosimetry Assignment

The TLD badge number, name, social security number, whether or not a worker has a completed NRC Form 4, the monitoring period (date from...to) and the individual's date of birth shall be recorded on ATG Form 111a, for each individual monitored on a project. The original form will be maintained as a permanent record of the project monitoring. A copy will be maintained in the Genoa project office.

OCCUPATIONAL EXPOSURE LIMITS/ADMINISTRATIVE CONTROL LEVELS

4.1 Occupational Exposure Limits

4.1.1 Nuclear Regulatory Commission (NRC) limits per calendar year:

Whole Body (TEDE)	5 Rem
Eye Dose Equivalent	15 Rem
Skin Dose Equivalent	50 Rem
Organ Dose (CEDE)	50 Rem

4.2 Administrative Control Levels

4.2.1 ATG Radiation Administrative Control Levels per calendar year:

Whole Body	1.00 Rem
Eye Dose Equivalent	3.00 Rem
Skin Dose Equivalent	5.0 Rem
Organ Dose (CEDE)	5.0 Rem

The Radiation Safety Officer (RSO) shall approve exposure above the Annual Administrative Control Levels.

5.0 RADIOLOGICAL CONTROLLED AREAS

5.1 A radiologically controlled area (RCA) is considered to be any portion of a facility, plant, vehicle or project for which restrictions apply for purposes of occupational radiation exposure control. Radiation exposures received within the boundary of a restricted area are occupational exposures. As described in the applicable Project Detail Work Procedure, radiologically controlled areas will be established to provide the specific radiological controls necessary for the completion of the work scope and the protection of all project personnel. The following guidelines apply:

5.1.1 RCA Location

An RCA is always located within a restricted area as defined by 10 CFR20.3.

5.1.2 RCA Areas

Each radiation area, high radiation area, airborne radioactivity area, and contaminated area shall be contained within a radiologically controlled area.

5.1.3 RCA Personnel Monitoring

All personnel and casual visitors within an RCA will be provided with appropriate dosimetry and monitored for radiation exposure.

6.0 GENERAL REQUIREMENTS

All personnel who could potentially receive 25% or more of the permissible legal limit for external radiation exposure are required by 10 CFR 20 to be furnished with personnel monitors. In the interests of ALARA, all ATG personnel who work with radioactive material are required to wear appropriate radiation exposure monitors. Personnel working within an RCA will receive, at a minimum, a TLD and for work in areas with dose rates above 5 mrem/hour, a TLD and a low range Pocket Ion Chamber (PIC).

6.1 Pocket Ion Chamber

All personnel working in a radiologically controlled area may be issued/monitored by a Pocket Ion Chamber (PIC). PIC's may either be issued for an individual or group depending on the type and duration of work to be performed. The Project Manager or designee will determine if it will be necessary to issue individual or group PIC's. The PICs used for general radiation work will have a range of response of 0 to 200 millirem. PICs will be set to zero (0) at the start of each work shift.

6.2 TLD

Thermoluminescent Dosimeters (TLDs) are the permanent record of an individual's occupational radiation exposure. Upon receipt of Project dosimetry, TLDs and TLD finger

rings shall be stored in a low background area inside the project main office or in other designated storage locations when not in use. A (TLD) control badge shall be kept where the assigned badges are stored when they are not in use. All ATG personnel entering a Radiologically Controlled Area (RCA) where anticipated dose of 25 mRem could be received will be issued a TLD.

The individual's name, social security number, issue date, and date of return will be recorded on the Monthly Badge Issue Log, (ATG Form 111a).

6.3 Visitors/Group Monitoring

A casual visitor is any person touring or visiting the RCA on an infrequent basis, escorted while in the restricted area and not performing or supervising hands-on work.

Visitors will be issued a TLD on a case by case basis depending on the type and duration of the job. The Project Manager or designee shall determine if a TLD is to be issued to a visitor. TLDs will always be issued to occupational workers expected to exceed 25 mrem. A visitor expected to receive in excess of 25 mrem shall be trained as, and considered an occupational worker.

6.3.1 Visitor RCA Conditions

A visitor may be escorted into an RCA provided that:

- there are not entries into high radiation areas or airborne contamination areas,
- the external radiation exposure is limited to 50 mRem per year, or 10 mrem per entry.
- the visitor is furnished with a personnel radiation dosimeter.

6.3.2 Visitor Dosimetry

Visitors within an RCA shall receive, as a minimum, a low range, 0-200 mR Pocket Ionization Chamber (PIC).

Visitor TLD results are recorded on the Site Registration Form which is maintained at the facility. When a visitor is issued a TLD, the individual's name, social security number, issue date, and date of return will also be recorded on the Monthly Badge Issue Log.

6.4 Lost Badges

In the event of a lost TLD or PIC, the Project Manager or designee shall be notified immediately. A Lost Badge Report, (ATG Form 111) will be completed and filed in the

individual's exposure file. The dose estimated from all exposure received while the individual was in an exposure situation must be determined and recorded in the individuals' dose record.

In the event of multiple loss occurrences, the RSO shall be notified immediately.

7.0 PROJECT DOSIMETRY ISSUANCE/CONTROL

7.1 Prior to project commencement, the Project Manager and RSO will determine the appropriate radiation monitoring dosimetry required in accordance with the ATG Health and Safety Manual. The Project Manager or designee will contact the ATG Technical Support Office and provide them with the following information:

- ATG Project Name and Account Number
- Project start date and projected duration
- Appropriate dosimetry required for project
- Number of dosimetry requested
- Name, address, social security, birth date of project personnel to be monitored.
- Address dosimetry is to be shipped to.

7.1.1 Personnel assigned to projects will wear the appropriate badge dosimetry for no more than one month or the duration of the project, whichever is shortest.

It will be arranged at the time of initial project TLD order by the Technical Support Office as to how many month's supply of dosimetry will be required for the project. It will be the responsibility of the Project Manager or designee to return dosimetry to the vendor for processing at the end of each monthly monitoring period.

If the original projected project duration is extended, the Project Manager or designee shall inform the Technical Support Office so that the proper arrangements can be made to supply additional dosimetry from the vendor.

7.1.2 Dosimetry Processor (Vendor)

The dosimetry vendor must meet the criteria and be in accordance with ATG's Health and Safety Manual.

7.2 Upon receiving project dosimetry, the Project Manager or designee shall verify that the dosimetry received meets the requirements of the project. Any problems should be reported to the Technical Support Office, Genoa for immediate attention and resolution. All documentation received with dosimetry will be filled out completely. When all required

preliminary training and documentation has been completed as described in the project Detail Work Procedure, dosimetry will be issued to project personnel.

It is the responsibility of the Project Manager or designee to ensure that ATGF-111a, Badge Issue Log is completed at the time of dosimetry issuance and a copy is sent to the Technical Support Office, Genoa.

8.0 DOCUMENTATION

8.1 Radiation Work Permits

All personnel working in a radiologically controlled area must be assigned to a specific Radiation Work Permit (RWP), (ATG Form 113) applicable to the job being performed. A Radiation Work Permit Access Log, (ATG Form 114) will be attached to each RWP.

All personnel assigned to a job requiring an RWP shall sign the Access Log prior to starting work, indicating time in and starting PIC dose. Upon completion of the work or at the end of the shift, personnel shall sign out on the Access Log, indicating time out and the current PIC dose.

8.2 Weekly Available Exposure Report

A weekly accumulated estimated exposure report will be maintained and posted for employee review at the start of each work week. This report will reflect a running total of exposure available for the current calendar quarter. The beginning annual available exposure will be 1000 mRem for those individuals with a completed and signed Occupational Exposure History Form.

8.3 Occupational Radiation Exposure History Letter

An Occupational Radiation Exposure History Letter, (ATG Form 115) will be completed for all personnel for whom permanent exposure results have been obtained. Copies of this letter will be sent to the individual, and maintained in the individual's personnel exposure file by the ATG Technical Support Office, Genoa. For current employees, this letter will be completed annually. For former employees, this letter will be completed and mailed within thirty working days after results have been obtained.

Any time ATG is required to report an individual's exposure to the Department of Health or other Regulatory Agency a copy of the report will be sent to the individual.

8.4 Project Records/Documentation

Upon completion of the project, it will be the responsibility of the Project Manager or designee to forward all project records, logs, and communications regarding personnel exposure, exposure records, dosimetry records, and all other pertinent information about

personnel dosimetry and individual radiation protection for RSO review, and filing in anticipation of NRC review.

9.0 RECORDS

- 9.1 The following records are completed by this procedure and shall be maintained as specified in procedure ATG-R-01, Document Control.
 - 9.1.1 ATGF-109, Site Registration Form
 - 9.1.2 NRC Form 4
 - 9.1.3 ATGF-111, Lost Badge Report
 - 9.1.4 ATGF-111a, Badge Issue Log
 - 9.1.5 ATGF-112, Radiation Exposure Record
 - 9.1.6 ATGF-002, Radiation Work Permit
 - 9.1.7 ATGF-023, Radiation Work Permit Access Log
 - 9.1.8 ATGF-047, Occupational Radiation Exposure History

**SITE REGISTRATION FORM
ALLIED TECHNOLOGY GROUP, INC.**

PERSONAL INFORMATION

Name:		Date:
Social Security:	Date of Birth:	Project Name:
Permanent Address:		
City:	State:	Zip:

EMPLOYER INFORMATION

Employer's Name:	
Employer's Address:	
Name of Emergency Contact:	
Address of Emergency Contact:	
Emergency Contact Phone:	
Signature:	

MEDICAL HISTORY

List any condition or ailment that may affect your ability to perform your job:	
Indicate if you are epileptic or diabetic:	
List any allergies you have:	
List any medications you are now taking:	
Last Tetanus Shot date:	Date of Last Physical:
Signature:	
Date:	

FINAL PAYCHECK ADDRESS

Address:	
City:	
Phone:	
FedEx: <input type="checkbox"/>	Check box at left if you want your check Federal Expressed to you. \$10.00 fee is deducted from your final pay for this service. If not checked, paycheck will be sent regular mail.

APPROVED BY OMB NO. 3150-0005

EXPIRES:

NUCLEAR REGULATORY COMMISSION

U.S. NUCLEAR REGULATORY COMMISSION

ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: _____ MINUTES. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (MNB 7714), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0005), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

LIFETIME OCCUPATIONAL EXPOSURE HISTORY

JRC FORM 4
6-921
10 CFR PART 20

1. NAME (LAST, FIRST, MIDDLE INITIAL)		2. IDENTIFICATION NUMBER		3. ID TYPE		4. SEX		5. DATE OF BIRTH	
5. MONITORING PERIOD		7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ESTIMATE		10. ROUTINE	
11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE		18. TODE	
3. MONITORING PERIOD		7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ESTIMATE		10. ROUTINE	
11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE		18. TODE	
6. MONITORING PERIOD		7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ESTIMATE		10. ROUTINE	
11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE		18. TODE	
6. MONITORING PERIOD		7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ESTIMATE		10. ROUTINE	
11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE		18. TODE	
6. MONITORING PERIOD		7. LICENSEE NAME		8. LICENSE NUMBER		9. RECORD ESTIMATE		10. ROUTINE	
11. DDE	12. LDE	13. SDE, WB	14. SDE, ME	15. CEDE	16. CDE	17. TEDE		18. TODE	
19. SIGNATURE OF MONITORED INDIVIDUAL		20. DATE SIGNED		21. CERTIFYING ORGANIZATION		22. SIGNATURE OF DESIGNEE		23. DATE SIGNED	

LOST BADGE REPORT

REPORT DATE:	REPORT TIME:
INDIVIDUAL'S NAME:	BADGE NUMBER:
DATE BADGE LOST:	TIME BADGE LOST:
LOCATION IF KNOWN:	
APPLICABLE RWP NUMBER:	

EXPOSURE CALCULATION

1.	Exposure from dosimeter readings: (Total from date issued) through _____ (Date)	=	_____ mrem
2.	Current dosimeter reading: (If more than one dosimeter, use highest reading)	=	_____ mrem
3.	If individual was not wearing a dosimeter, or lost his dosimeter, assign highest exposure received by workers in the same area. If none, use dose rate x time in area for the same period.	=	_____ mrem
4.	Total estimated exposure to be assigned:	=	_____ mrem

THE METHOD USED TO ESTIMATE MY EXPOSURE AND THE ESTIMATED EXPOSURE ASSIGNED TO ME ARE ACCEPTABLE.

Employee's Signature	Date:
----------------------	-------

Calculated By:	Date:
----------------	-------

R.S.O. Approval:	Date:
------------------	-------

Form 5 Updated: <input type="checkbox"/> YES <input type="checkbox"/> NO	Report Voided (Not Necessary) <input type="checkbox"/>
--	--

Reason:

1995 RADIATION EXPOSURE RECORD

NAME:

SOCIAL SECURITY NO:

BIRTH DATE:

EXTREMITY BADGE NO:

LM BADGE NO:

LIFETIME WHOLE BODY EXPOSURE:

	WHOLE	SKIN	EXTREMITIES		LIFETIME HIGHEST WHOLE BODY
			LEFT	RIGHT	
JANUARY					
FEBRUARY					
MARCH					
QUARTER TOTALS					
APRIL					
MAY					
JUNE					
QUARTER TOTALS					
JULY					
AUGUST					
SEPTEMBER					
QUARTER TOTALS					
OCTOBER					
NOVEMBER					
DECEMBER					
QUARTER TOTALS					
ANNUAL TOTALS					

RADIATION WORK PERMIT (RWP)

WP #: _____

Regular Extended

SECTION I

Contract # _____	Date: / /	Time: _____
Location/Project: _____		
Exposure Category: <input type="checkbox"/> D&D <input type="checkbox"/> Demolition <input type="checkbox"/> Waste Processing <input type="checkbox"/> CHAR		
Job Description: _____ _____		
Estimated Start Date: / / Estimated End Date: / /		

SECTION II

Existing Radiological Conditions:

Radiation Survey No. _____ Airborne Survey No. _____ Contamination Survey No. _____

Existing General Area Radiation Level(s): β γ N _____ mR/hr/ γ _____ mrad/hr/corrected β _____ mrem/hr/N	Existing General Contamination Levels: _____ dpm/100cm ² $\beta\gamma$ _____ dpm/100cm ² α	Airborne DAC Level(s): α _____ % P $\beta\gamma$ _____ % P _____ % H ₃
Existing Maximum Radiation Level(s): β γ N _____ mR/hr/ γ _____ mrad/hr/corrected β _____ mrem/hr/N	Existing Maximum Contamination Level(s) _____ dpm/100cm ² $\beta\gamma$ _____ dpm/100cm ² α	Hot Particle? <input type="checkbox"/> Yes <input type="checkbox"/> No

Remarks: _____

SECTION III

Radiological Limits:

Maximum Allowed WB Exposure Rate γ N: _____ mR/hr or mrem/hr

Corrected β : _____ mrad/hr Maximum Extremity Exposure Rate: _____ mR/hr

Maximum Allowed Contamination Level $\beta\gamma$: _____ dpm/100cm² α : _____ dpm/100cm²

Maximum Allowed Airborne Concentration Level: _____ % DAC

Remarks: _____

Industrial Hygiene/Safety Concerns: _____

RADIATION WORK PERMIT (RWP)

WP #: _____

Regular Extended

SECTION IV

WORKER REQUIREMENTS

<u>CLOTHING:</u>	<u>DOSIMETRY:</u>	<u>INSTRUCTIONS:</u>	<u>RESPIRATORY:</u>
<input type="checkbox"/> Coveralls <input type="checkbox"/> Lab Coat <input type="checkbox"/> Cloth Hood <input type="checkbox"/> Paper Coveralls <input type="checkbox"/> Plastic Suit <input type="checkbox"/> Plastic Booties <input type="checkbox"/> Rubber Shoe Covers <input type="checkbox"/> Canvas Shoe Covers <input type="checkbox"/> Cotton Gloves <input type="checkbox"/> Rubber Gloves <input type="checkbox"/> Leather Gloves <input type="checkbox"/> Beta Goggles/Face Shield <input type="checkbox"/> Extra <input type="checkbox"/> Other Clothing Stay Time (Heat Stress, Radiation, Exposure Limits, etc.): _____ hrs.	<input type="checkbox"/> TLD <input type="checkbox"/> Film Badge <input type="checkbox"/> SRD <input type="checkbox"/> Standard <input type="checkbox"/> Elbows <input type="checkbox"/> Gonad Pack <input type="checkbox"/> Hot Cell Entry <input type="checkbox"/> Extremity <input type="checkbox"/> Head Pack <input type="checkbox"/> Special <input type="checkbox"/> Knees <input type="checkbox"/> Varying Field <input type="checkbox"/> Upper Field <input type="checkbox"/> Ground Field <input type="checkbox"/> Alarming Dosimetry <input type="checkbox"/> None	<input type="checkbox"/> Contact HP for Line Breaks <input type="checkbox"/> Protect Cuts <input type="checkbox"/> Pre-Job Briefing <input type="checkbox"/> Post-Job Briefing <input type="checkbox"/> Contact HP Prior to Work in New Areas <input type="checkbox"/> Modesty Required <input type="checkbox"/> Site Specific Instructions <input type="checkbox"/> Equipment Monitor at Job End <input type="checkbox"/> Clean Up Work Area During and After Job <input type="checkbox"/> Eating, Drinking, Smoking, Chewing Prohibited <input type="checkbox"/> Frisk Upon Exiting Contaminated Area <input type="checkbox"/> Have Prescribed HP Coverage or Stop Work <input type="checkbox"/> Exit Area Immediately Upon Emergency or Injury. Notify HP Immediately	<input type="checkbox"/> FFNP <input type="checkbox"/> FFAL <input type="checkbox"/> SCBA <input type="checkbox"/> PAPR <input type="checkbox"/> Dusk Mask <input type="checkbox"/> Half Face <input type="checkbox"/> Bubble Hood <input type="checkbox"/> _____ <u>Cartridges:</u> <input type="checkbox"/> Particulate <input type="checkbox"/> Vapor <input type="checkbox"/> Combination <input type="checkbox"/> Other _____ _____ _____

Special Instructions: _____

SECTION V

Health Physics Requirements

1. Job Coverage: Continuous Intermittent Start End of Job
2. Air Sampling: General Area Breathing Zone Lapel AgZ
 Tritium/C-14 Particulate Charcoal LoVol HiVol
3. Exposure Rate Surveys: Start of Job Continuous Monitoring Area Monitoring
 Intermittent Monitoring End of Job
4. Contamination Surveys: Start of Job Continuous Monitoring
 Intermittent Monitoring End of Job
5. Is the ALARA Consideration Complete and Attached? Yes No Why? _____
6. Other: _____

Allied Technology Group, Inc.
 47375 Fremont Blvd.
 Fremont, California 94538
 (800) 227-2840

OCCUPATIONAL RADIATION EXPOSURE HISTORY
 Exposure Year 1994

Name: _____ Social Security Number: _____
 Address: _____ Date of Birth: _____
 City: _____ State: _____ Zip: _____

The Occupational Radiation Exposure listed below was received by the above individual while assigned by Allied Technology Group, Inc.

Project/Location Monitored	Monitoring Method TLD/Film Badge	Record/Estimate	NRC License Number(s):

Abbreviations: NC - Not Calculated ND - None Detected NM - Not Monitored SA - See attached

Monitoring Period	Deep-Dose Equivalent		Shallow-Dose Equivalent		LDE	CEDE	CDE	TEDE	TODE
	X or γ	Neutron	Total DDE	Skin SDE, WB					
From									
To									

THIS REPORT IS FURNISHED TO YOU UNDER THE PROVISIONS OF THE NUCLEAR REGULATORY COMMISSION REGULATION 10CFR PART 20 TITLED "STANDARDS FOR PROTECTION AGAINST RADIATION". YOU SHOULD PRESERVE THIS REPORT FOR FURTHER REFERENCE. ALL DOSE EQUIVALENT VALUES ARE REPORTED IN MILLIREM.

Radiation Safety Officer: _____ Date: _____

ALLIED TECHNOLOGY GROUP FIELD OPERATIONS
HEALTH PHYSICS OPERATING PROCEDURE

AIR SAMPLING AND ANALYSIS

Allied Technology Group, Inc.
1515 Main Street
Genoa, Ohio 43430

Prepared by:

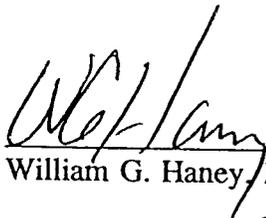
D. Spicuzza

Allied Technology Group, Inc.

PROCEDURE/PLAN APPROVAL PAGE

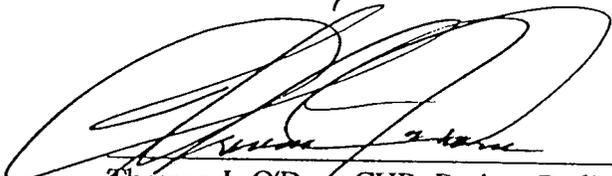
This procedure: AIR SAMPLING AND ANALYSIS, has been reviewed and approved by the following:

APPROVAL SIGNATURES:



William G. Haney, Project Director

4/12/95
Date



Thomas J. O'Don, CHP, Project Radiation Safety
Officer, HP Technical Support

4/12/95
Date

REVISION RECORD INDICATING
LATEST DOCUMENT REVISION

Procedure Number: HP-OP-010

Title: AIR SAMPLING AND ANALYSIS

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Approval	1/06/95

AIR SAMPLING AND ANALYSIS

1.0 SCOPE

This document provides guidelines for the selection, operation, and documentation of the results of air samples performed on A.T.G. field projects. The same basic method is used for both occupational samples (such as high-volume job-related samples and personal air samples), and for fence-line ambient air samples.

2.0 PURPOSE

The purpose of this procedure is to provide procedural guidance to ensure a) optimum and adequate protection of workers; b) conformance with sound health physics and radiological safety practices; and c) compliance with 10 CFR 20 and DOE Order 5480.11.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.2 10 CFR 20, Standards for Protection Against Radiation
- 3.1.3 HP-OP-002, Radiological Area Posting and Access Control
- 3.1.4 Respiratory Protection Program for A.T.G.
- 3.1.5 NUREG 0041, Manual of Respiratory Protection Against Airborne Radioactive Materials
- 3.1.6 ANSI N13.1-1969, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities
- 3.1.7 Regulatory Guide 8.25, Air Sampling in the Workplace
- 3.1.8 HP-IP-007, Operation and Calibration of the Model LV-1 Low Volume Air Sampler
- 3.1.9 HP-IP-008, Operation and Calibration of the Model H-9400 High Volume Air Sampler
- 3.1.10 HP-IP-003, Operation and Calibrations of the Ludlum Model-2929 Dual Channel Scaler

3.2 Definitions

- 3.2.1 **ALI (Annual Limit of Intake)** - Value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent H_{E50} of 5 rems (0.05Sv) or a committed dose equivalent H_{T50} of 50 rems (0.5Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in References 3.1.1 and 3.1.2.)
- 3.2.2 **Breathing Zone** - That region adjacent to the worker's mouth and nostrils from which air is drawn into the lungs while he/she performs his/her assigned work. Air taken from this region will represent the air the worker is breathing while he/she works. The samples collected to assess breathing zone concentrations normally are within 12" of the nostrils.
- 3.2.3 **Grab Sample** - A random, single sample taken over a short period of time (dependent upon flow rate) are based upon the minimum volume required.
- 3.2.4 **Lapel Sampler** - A battery operated portable air sampler with a sample collector fastened near the breathing zone.
- 3.2.5 **Marinelli Beaker** - A plastic or glass container used to sample for liquids or gases. These containers normally contain 500 ml.
- 3.2.6 **DAC (Derived Air Concentration)** - The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate $1.2m^3$ of air per hour), results in an intake of one ALI. DAC values can be found in References 3.1.1 and 3.1.2.
- 3.2.7 **DAC-Hour** - The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that nuclide, in hours. A facility may take 2,000 DAC-hours to represent one ALI.
- 3.2.8 **Monitor** -
- 3.2.8.1 To measure an airborne radioactive constituent or gross content of radioactive material continuously or at a frequency which permits an evaluation of the concentration over an interval of time.
- 3.2.8.2 An instrument or device used to take measurements.
- 3.2.9 **Particle** - An aggregate of molecules forming a solid or liquid ranging in size from a few molecular diameters to some tenths of millimeters (several hundred microns).
- 3.2.10 **Representative** - Indicates the quality and characteristics of the entire volume from which a sample is drawn.

- 3.2.11 **Sample** - A representative portion of an atmosphere of interest, or one or more separated constituents from a representative portion of an atmosphere.
- 3.2.12 **Vapor** - The gaseous form of materials that are liquids or solids at room temperature. Distinguished from non-condensable gases.

4.0 PRECAUTIONS, LIMITATIONS

- 4.1 Avoid unnecessary contamination of survey instruments through the use of plastic coverings and care in handling. Do not cover the air intakes or exhausts on air samplers.
- 4.2 Avoid unnecessary exposure when conducting air monitoring surveys by utilizing good ALARA practices.
- 4.3 Air samplers shall be operated in accordance with their operation and calibration procedure.
- 4.4 Air samplers used in confined spaces may ignite explosive gases. Extreme care shall be exercised including prior sampling of the atmosphere for explosive gas and O₂ content.
- 4.5 Samples should not be taken in such a manner as to contaminate the sample filter with materials which are not airborne or by sucking up loose contamination from surfaces near the sampling head. Caution should be used to minimize producing airborne material by the exhaust of the sampler.
- 4.6 The instrument (Ludlum Model 2929 or equivalent) used to screen air samples shall be designated by Health Physics Supervision.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

- 5.1.1 ATG Radiological Field Operations Manager(Project Manager) shall be responsible for:
- 5.1.1.1 Implementation of this procedure.
 - 5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.
 - 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.
 - 5.1.1.4 Periodic review of air sample data to verify effectiveness of engineering controls and the ATG respirator program.

5.1.2 Health Physics Supervisors shall be responsible for:

- 5.1.2.1 Assignment of Health Physics Technicians performing this procedure.
- 5.1.2.2 Reviewing and approving documentation generated by the use of this procedure.

5.1.3 Health Physics Technicians shall be responsible for:

- 5.1.3.1 Performance of the requirements of this procedure.
- 5.1.3.2 Adherence to other procedures referenced.
- 5.1.3.3 Documentation of all work performed under this procedure.

5.1.4 Employees shall be responsible for:

- 5.1.4.1 Notifying Health Physics prior to the start of any work under an RWP requiring respiratory protection.
- 5.1.4.2 Notifying Health Physics prior to entering any areas posted: "Airborne Radioactivity Area."

5.2 Qualifications

- 5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI 3.1-1987 to perform air monitoring and subsequent calculations.
- 5.2.2 Health Physics Technicians shall be qualified in accordance with procedures in the operation of equipment required to perform air monitoring.
- 5.2.3 Junior Health Physics/Decontamination Technicians shall perform air sampling and counting only under direct supervision of a Health Physics Technician meeting the requirements of Sections 5.2.1 and 5.2.2 of this procedure.

6.0 PROCEDURE

6.1 Prerequisites

- 6.1.1 ATG shall use, to the extent practicable, process or other engineering controls (e.g., containment or ventilation) to control the concentration of radioactive material in air.
- 6.1.2 Air Monitoring

Ambient air monitoring shall be performed in areas with the potential to exceed 10 percent of any derived air concentration (DAC) [see References 3.1.1 and 3.1.2].

Ambient air monitoring may be performed using portable air samplers or air monitoring systems. Ambient air monitoring shall be placed in strategic locations to detect and evaluate airborne contamination at work locations. Data obtained from air monitoring shall be used for assessing the control of airborne radioactivity in the workplace and may be used to evaluate the dose equivalent to radiation workers from internal sources.

6.1.3 Air monitoring systems shall be routinely calibrated and maintained, and should be capable of measuring one DAC when averaged over 8 hours.

6.1.4 Background Air Samples

Background air sampling should be performed in areas where work activities are not being performed. Consideration should also be made in sampling the work area prior to work starting in the area. The data obtained from these samples should be used as a baseline for work area ambient and breathing zone air samples.

6.2 Discussion

A comprehensive air-sampling program is essential to evaluate the hazards associated with work situations involving radioactive materials. In many instances, air sampling data can also provide the basis for development and evaluation of control procedures and can indicate whether or not operational changes are necessary to provide adequate protection for the worker. In conjunction with a respiratory protection program, air sampling data is necessary to define the air concentration levels so that the proper respiratory protective equipment can be selected. Since respiratory protection factors vary over several orders of magnitude, it is very important that an initial estimate be made of the air concentration levels, relative to specified regulatory limits. Thus, adequate protection can be provided while unnecessary inconvenience to the worker wearing a respirator is minimized. Air sampling programs may also be designed to estimate the release of contaminants to the general work area and to the outside environment.

6.2.1 An air sampling program directly related to respiratory protection should:

6.2.1.1 Provide an estimate of the potential intake of airborne radioactive materials and resulting exposure of the individual worker.

6.2.1.2 Provide data to assist in the selection of respiratory protective equipment that would provide adequate protection under exposure conditions.

6.2.1.3 Provide data for control of long-term exposure to workers.

6.2.1.4 Provide documentation of personnel exposures for legal or regulatory purposes.

- 6.2.1.5 Identify and characterize the contaminants and their sources.
- 6.2.1.6 Provide data for determining the requirements for engineering or administrative controls.
- 6.2.1.7 Indicate the continuing effectiveness of existing controls, and warn of deterioration of control equipment or operating procedures.
- 6.2.1.8 Provide a record of long-term trends showing variations in contaminant levels.
- 6.2.1.9 Continuously measure the level of airborne contaminants in and above work areas and warn of release of airborne contaminants to the outside environment.

6.2.2 Consideration in Air Sampling

An air sampling program must be designed and operated so that the data obtained are directly and meaningfully related to the problem of concern. As part of a respiratory protection program, the air-sampling procedures must take into account:

- 6.2.2.1 The physical and chemical state of the contaminant.
- 6.2.2.2 Aerodynamic size characteristics of airborne particulates.
- 6.2.2.3 Range of contaminant concentration.
- 6.2.2.4 Environmental conditions such as temperature.
- 6.2.2.5 Sampler location relative to the worker and the source of contamination.
- 6.2.2.6 Instrument operating and response characteristics.
- 6.2.2.7 Instrument portability.
- 6.2.2.8 Sensitivity of the associated analytical procedures relative to the specified concentration limits and quantity of material sampled.

6.3 General

6.3.1 Preparation and General Requirements for Airborne Radioactivity Surveys

- 6.3.1.1 Air may be sampled for various types of radioactive material (particulates, radioiodines, radiogases, or tritium.)

- 6.3.1.1.1 Particulates are normally collected on paper filter material.
- 6.3.1.1.2 Radioiodines are normally collected by charcoal cartridges.
- 6.3.1.1.3 Radiogases are normally collected as a fixed trapped volume of air.
- 6.3.1.1.4 Tritium is normally collected by bubbling air through water.

6.3.1.2 Air sampler and equipment.

- (a) Select calibrated instrumentation appropriate for the survey to be performed.
- (b) Performance check instrument(s) (as applicable) in accordance with the operation and calibration procedures.
- (c) Obtain other items needed, such as filters, bubblers or radiogas chambers.

6.3.1.3 Punch-Outs

- (a) Analyzing punched-out portions of filters too large to count in available instruments will not pose difficulties for accuracy or precision.
- (b) A filter ratio (FR) factor of 3.0 should be used for 4" diameter filters cut out to fit into the sampling tray of a Ludlum Model-2929 or equivalent for counting purposes.

6.3.1.4 Survey Documentation

- (a) Obtain necessary air sample filter(s) and any other material required to provide the necessary sample data.
- (b) The following data is normally required for each air sample and is recorded on Form ATGF-030.

NOTE: N/A should be recorded for items which are not applicable to the particular sample.

- * Type of sample; general area (GA), or breathing zone
- * (BZ).

- * Purpose of sample; that is, routine or non-routine, and special if non-routine.
- * A brief description of the task being performed.
- * RWP number the sample was obtained for, if available.
- * Sample location.
- * Sampler model and serial or ID number.
- * Sample start date and time.
- * Sample start flow rate.
- * Sample stop flow rate and vacuum, if applicable.
- * Sample average flow rate, as CFM or LPM.
- * Total sampling time; as days, hours, or minutes as appropriate.
- * Any specific sample analysis required (e.g., gamma or alpha isotopic).
- * If samples are collected in a sub- atmospheric area, the pressure in psia.
- * The name(s) of the individual(s) starting and stopping the sample.

6.3.1.5 Air Sample packaging considerations.

- (a) Particulate filters of different air samples should be placed in a separate envelope, poly bag, or other suitable container to ensure no possibility of cross contamination.
- (b) Charcoal cartridges and the upstream particulate filter should be placed in a clear poly bag or equivalent.
- (c) Tritium bubblers should be placed in a clear poly bag or equivalent, and other tritium sampling items placed in another bag.
- (d) Radiogas sample chambers should be placed in a clear poly bag or equivalent.

- 6.3.1.6 During collection and handling of air samples, caution must be used to prevent the samples from being contaminated by other sources of radioactive material.
- 6.3.1.7 Notify the Health Physics Supervisor of any unusual airborne radiological conditions identified, such as dust, smoke or chemicals.

6.4 Types of Air Samples

6.4.1 Low Volume and High Volume Air Samples

- 6.4.1.1 Low volume air samples are at a flow rate of 1 CFM (28.32 LPM) to 5 CFM (141.6 LPM).
- 6.4.1.2 High volume air samples are at a flow rate of 10 CFM (283.2 LPM) to 30 CFM (849.6 LPM).

6.4.2 General Area (GA) airborne surveys provide data representative of the air in an area, building, or room. GA surveys normally provide the data used for determining if an area is an Airborne Radioactivity Area for implementing posting and access controls. Using a low volume air sampler, the minimum volume for GA air samples is 100ft³ (2,832 liters).

- (a) GA samples are normally taken on a routine basis, including predetermined times and locations.
- (b) GA samples should be taken at between 3 to 6 feet above floor level.
- (c) Samples may be taken in a short period of time over a period of time varying from an hour up to one or more days, generally known as a "continuous sample".
- (d) Samples are normally obtained and analyzed as a minimum for particulates by gross alpha, beta-gamma counting.

6.4.3 Breathing Zone (BZ) airborne surveys provide data representative of the air that worker would be breathing during a particular task. The minimum volume for BZ air samples is 50 ft³ (1,416 liters).

- (a) BZ samples are normally taken as a minimum during the time when the highest concentrations of radioactive material are expected to be present.
- (b) BZ samples may be taken at any time to document low, high, and average concentrations of airborne radioactive material.

- (c) Samples are normally taken in a position which would be representative of the air which would be breathed by a worker, regardless if a respirator is being worn or not. The samples should be taken within a circumference of 12 inches of the worker's head, if possible.
- (d) Samples are normally analyzed for particulates.

6.4.4 Grab and Continuous Samples and Samplers.

- (a) Grab samples are taken with a high volume sampler. The minimum volume required for grab samples using a high volume sampler is 150ft³ (4,248 liters).
 - * Grab samples represent the concentrations during the relatively short period of sampling time and may be useful to estimate peak concentrations if this type of data is required.
 - * Continuous samples are normally taken with low volume air samplers due to the long run times involved. The minimum volume for continuous air samples is 100ft³ (2,832 liters).
 - * Continuous samples represent the concentrations during the relatively long period of sampling time and are used to estimate average concentrations.
 - * Continuous samples are not normally used where airborne concentrations are expected to vary significantly during the time period of interest.
- (b) Either grab or continuous samples may be representative of areas where airborne concentrations are not expected to vary significantly over a time period of interest.

6.5 Sampling and Analysis for Radioactive Noble Gases

6.5.1 Obtain a 500 ml marinelli beaker.

- 6.5.1.1 Ensure the beaker is free of contamination or that a background count of the beaker has been performed.
- 6.5.1.2 Ensure petcocks are free to be opened/closed.
- 6.5.1.3 Fill the beaker with de-ionized water, if available, or tap water, if not and replace the top.

6.5.2 At the sample location:

6.5.2.1 Remove the marinelli beaker top and pour the water from the beaker.

6.5.2.2 Replace top securely.

6.5.2.3 Ensure petcocks are closed.

6.5.3 The chamber is to be analyzed for gamma isotopic as soon as possible after sampling to minimize error due to noble gas loss by diffusion or decay.

6.5.4 Perform Step 6.7.4.8 (a)(b) of this procedure when noble gas isotopic results exceed 10% of the DAC value.

6.6 Sampling and Analysis for Radioiodines

6.6.1 Obtain a low volume air sampler with a particulate filter and charcoal cartridge arrangement.

6.6.2 At the sampling location(s):

6.6.2.1 Start the air sampler.

6.6.2.2 Sample time should be such that a minimum volume of 100ft³ (2,832 liters).

6.6.2.3 At the end of the sampling period, stop the sampler.

6.6.2.4 Send the filter/and charcoal cartridge for gamma isotopic analysis.

6.6.2.5 Request results of the analysis are expressed in $\mu\text{Ci/ml}$ and percent DAC.

6.6.3 Perform Step 6.7.4.8 (a)(b) of this procedure when radioiodine results exceed 10% of the DAC value.

6.7 Sampling and Analysis for Tritium or Carbon 14

6.7.1 Obtain sample pump and tritium bubbler sampling system.

6.7.1.1 Sampling pump.

6.7.1.2 Midget bubbler, with 25 mls of demineralized water.

6.7.1.3 Filter to remove particulate material from air sample.

- 6.7.1.4 Assemble sampling system with filter upstream of bubbler and bubbler upstream of pump.
- 6.7.2 At sampling location:
 - 6.7.2.1 Start the pump; and if flow rate is adjustable, adjust flow rate as indicated on the sampling pump or for a gentle bubbling action in bubbler.
 - 6.7.2.1 bubbler.
 - 6.7.2.2 Sample time should be such that a minimum air volume of 10 liters (0.35 ft³) is sampled.
 - 6.7.2.3 Send the sample to an approved laboratory for analysis.
 - 6.7.2.4 Request a liquid scintillation analysis for Tritium and/or C-14.
 - 6.7.2.5 The results of the analysis are expressed in $\mu\text{Ci/ml}$ and percent DAC.
- 6.7.3 Perform Step 6.7.4.8 (a)(b) of this procedure when Tritium or Carbon-14 results exceed 10% of the DAC value.

6.8 Sampling and Analysis for Radioactive Particulate Material

- 6.8.1 Obtain the air sampler and filter(s) to be used.
 - 6.8.1.1 The filter is to be a F&J FP-47 (Low Volume) and F&J FP-4.0 (High Volume) particulate filter, or filter of equivalent efficiency and characteristics.
 - NOTE: If the sampling head is designed for both a particulate filter and a charcoal cartridge and the sample is for particulate only, a dummy or spacer charcoal cartridge may be required to be inserted into the sampling head to ensure proper fit of the particulate filter and to duplicate calibration conditions. Refer to the samplers calibration documentation for applicability. High volume air samplers shall not be used with the spacer cartridge.
 - 6.8.1.2 Install the filter in the sampling head with the "fuzzy side" facing outward.
- 6.8.2 At the sampling location:
 - 6.8.2.1 Select flow rate and determine time required for the needed volume of air.
 - (a) High volume 150ft³.

(b) Low volume 100ft³.

6.8.2.2 Start the air sampler.

6.8.2.3 At the end of the sampling period, stop the sampler.

NOTE: In the event the required volume of the air sample cannot be taken, the sample, regardless of volume, is still valid.

6.8.2.4 Remove the filter at a designated location, and identify and package the sample.

6.8.3 Particulate Sampling Techniques

6.8.3.1 Grab samples are taken with a high volume sampler. The minimum volume required for grab samples using a high volume sampler is 150ft³ (4,248 liters).

- (a) Grab samples represent the concentrations during the relatively short period of sampling time and may be useful to estimate peak concentrations if this type of data is required.
- (b) Continuous samples are normally taken with low volume air samplers due to the long run times involved. The minimum volume for continuous air samples is 100ft³ (2,832 liters).
- (c) Continuous samples represent the concentrations during the relatively long period of sampling time and are used to estimate average concentrations.
- (d) Continuous samples are not normally used where airborne concentrations are expected to vary significantly during the time period of interest.

6.8.3.2 Lapel Sampling

- (a) Attach the sampling apparatus to the user's hip or waist with a belt.
- (b) The sample head is secured in the "lapel" area.
- (c) Secure the tubing and sample head with tape and/or clips.
- (d) At the sampling location turn the sampling pump on.

- (e) Complete Form ATGF-035 with the following information:
- * Name of Wearer and SS#
 - * Sampler ID#
 - * Date/Time On
 - * Flow Rate CFM/LPM
- (f) At the end of the sampling period turn the sampling pump off.
- (g) Complete Form ATGF-035 with the following information:
- * Date/Time Off
 - * Total Volume Ft³/Liters
- (h) The Health Physics Technician shall ensure that the worker being issued the sampler is instructed as to follow the requirements below:
- * Refrain from tampering with the pump or the sample head.
 - * Leave the work area if the sampler fails, and note stop time.
 - * Contact an HP representative for assistance at completion of work.

NOTE: Due to the low volume of lapel breathing zone air samples, the Minimum Detectable Activity on gross counting equipment is usually insufficient to determine 10 % DAC for unknown isotopes for screening purposes. In the event it is desired to screen these breathing zone samples, a high volume air sample may be placed within 2 feet of the most restrictive breathing zone (highest expected concentration). This sample may be used to screen the lapel samples.

6.8.3.3 Air particulate samples are to be analyzed as a minimum for gross alpha and beta-gamma counting using a Ludlum Model-2929 Dual Channel Scaler or equivalent.

6.8.3.4 Air particulate samples should be initially counted within fifteen (15) minutes of the end of the sampling period.

6.8.3.5 Air particulate samples shall be counted for a period of five minutes.

6.8.4 Air Sample Analysis of Particulate Filters

6.8.4.1 Upon completion of sampling, use Form ATGF-030 and perform the sample analysis in the order of steps on the ATGF-030.

6.8.4.2 Place the air sample filter inside the sampling tray with the "fuzzy" side facing up towards the detector.

NOTE: If a high volume air sample filter is to be counted, using a hole punch, cut out the center portion of the filter and place the cut out portion of the filter in the sampling tray with the "fuzzy" side facing up towards the detector.

6.8.4.3 Count the sample for a five minute period.

6.8.4.4 Upon completion of the counting period calculate and record the alpha activity (unless no alpha counts are present) then calculate the beta activity using the instructions on Form ATGF-030.

NOTE: The following Criteria may be used when evaluating air sample results.

- (a) Contamination levels and physical characteristics.
- (b) Work activities in the area/resuspension probability.
- (c) Historical data/isotopic information.
- (d) Background air sample data.

6.8.4.5 If the calculated air activity does not exceed 10% of the DAC value of the radionuclide(s) of concern, no further analysis is required and the sample may be discarded at the discretion of Health Physics Supervision.

6.8.4.6 If the calculated air activity exceeds 10% of the DAC value of the radionuclide(s) of concern.

- (a) Report this information to Health Physics supervision immediately.

- (b) Allow the sample to decay for a 3 hour period (if feasible) and recount the sample in accordance with the instructions on Form ATGF-030 and Steps 6.7.4.2 thru 6.7.4.4 of this procedure.
- 6.8.4.7 Following the 3 hour decay period, if the calculated air activity does not exceed 10% of the DAC value of the radionuclide(s) of concern, no further analysis is required and the sample may be discarded at the discretion of Health Physics Supervision.
- 6.8.4.8 If the calculated air activity exceeds 10% of the DAC value of the radionuclide(s) of concern.
- (a) Report this information to Health Physics supervision immediately.
 - (b) Consideration should be given to isotopic analysis and area access restriction/posting in accordance with Reference 3.1.3.
 - (c) Allow the sample to decay for a 20 hour period (if feasible) and recount the sample in accordance with the instructions on Form ATGF-030 and Steps 6.7.4.2 thru 6.7.4.4 of this procedure.
- 6.8.4.9 Following the 20 hour decay period, if the calculated air activity does not exceed 10% of the DAC value of the radionuclide(s) of concern, no further analysis is required and the sample may be discarded at the discretion of Health Physics Supervision.
- 6.8.4.10 If the calculated air activity exceeds 10% of the DAC value of the radionuclide(s) of concern.
- (a) Report this information to Health Physics supervision immediately.
 - (b) Consideration should be given to isotopic analysis and area access restriction/posting in accordance with Reference 3.1.3.

6.9 Documentation

- 6.9.1 Air samples shall be documented using a Air Sample Data and Analysis Report (ATGF-030) with the appropriate supporting documentation attached.
- 6.9.1.1 An isotopic printout from the laboratory performing the analysis of the sample(s).
 - 6.9.1.2 Air Sample Identification Record. (ATGF-048).

- 6.9.2 At the Health Physics Supervisors discretion, air sample filters may be preserved and archived after analysis if the results are to be used for the calculation of DAC-hrs and lead to the assignment of dose.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 7.1 Form ATGF-048, Air Sample Identification Record
- 7.2 Form ATGF-030, Air Sample Data and Analysis
- 7.3 Form ATGF-035, Personal Air Monitoring Log
- 7.4 Isotopic Printouts

7 FORMS

- 8.1 Form ATGF-048, Air Sample Identification Record
- 8.2 Form ATGF-030, Air Sample Data and Analysis
- 8.3 Form ATGF-035, Personal Air Monitoring Log

INSTRUCTION 3: Calculate the alpha and beta-gamma MDA values:

$$\text{MDA } \mu\text{Ci/ml} = \frac{2.71 + 3.29 \sqrt{R_B t_{S+B} (1 + t_{S+B} / t_B)}}{2.22E6 \cdot E \cdot V \cdot t_{S+B}}$$

where: V = Sample Volume in ml
 E = Counter Efficiency
 R_B = Background Count Rate (cpm)
 t_{S+B} = Sample Counting Time (min)
 t_B = Background Counting Time (min)

Alpha MDA = _____ Beta-Gamma MDA = _____

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 4: Upon completion of the end of sampling period, perform the initial count of the sample within 15 minutes:

Time Counted	Gross Counts	Count Period	Gross CR	Bkgrnd CR	Net CR	CF	EFF. $\frac{\text{cpm}}{\text{dpm}}$	$\frac{\text{dpm}}{\mu\text{Ci}}$	Activity
	cts	min	cpm	cpm	cpm	.67		2.22E+6	μCi
	cts	min	cpm	cpm	cpm	.95		2.22E+6	μCi

Technician Performing Initial Count: _____ Date: _____

INSTRUCTION 5: Calculate the Total Sample Volume:

$$\frac{\text{Total Sample Run Time}}{\text{minutes}} \times \left(\frac{\text{Sample Average Flow Rate}}{\text{cfm} \times 2.83E+4 \text{ or } \text{lpm} \times 1.0E+3} \right) = \frac{\text{Total Volume}}{\text{ml}}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 6: Determine the Initial Airborne Concentration:

$$\alpha \text{ } \mu\text{Ci} \times \text{FR} \div \text{Volume (ml)} = \text{Initial Activity } \mu\text{Ci/ml } \alpha$$

$$\beta\gamma \text{ } \mu\text{Ci} \times \text{FR} \div \text{Volume (ml)} = \text{Initial Activity } \mu\text{Ci/ml } \beta\gamma$$

= Filter Ratio (4" Filters = 3.0) (2" Filters = 1.0)

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 7: If either the Alpha/Beta-Gamma activity exceeds 10% of the DAC value of the known radionuclide(s) of concern, then a recount of the sample is required after a 3 hour decay period to allow the short lived Radon daughters to decay.

Time Counted	Gross Counts	Count Period	Gross CR	Bkgrnd CR	Net CR	CF	EFF. $\frac{\text{cpm}}{\text{dpm}}$	$\frac{\text{dpm}}{\mu\text{Ci}}$	Activity
		+	=	-	=	±	±	±	=
α	cts	min	cpm	cpm	cpm	.67		2.22E+ 6	μCi
$\beta\gamma$	cts	min	cpm	cpm	cpm	.95		2.22E+ 6	μCi

Technician Performing 3 Hour Count: _____ Date: _____

INSTRUCTION 8: Determine the airborne concentration following 3 Hr. decay and utilizing volume data in Instruction 5:

3 Hr. Decayed Activity	Volume	3 Hr. Decayed Activity
α _____ μCi X FR	_____ ml	= _____ $\mu\text{Ci/ml}$ α
$\beta\gamma$ _____ μCi X FR	_____ ml	= _____ $\mu\text{Ci/ml}$ $\beta\gamma$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 9: Determine the half-life of the radionuclide(s) using the following formula:

$$T_{1/2} \text{ (min)} = \frac{- .693 (t)}{\ln \frac{\text{Final Activity}}{\text{Initial Activity}}}$$

t = elapsed time between counts in minutes

$t_{1/2} \alpha$ = _____

$t_{1/2} \beta\gamma$ = _____

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 10: If either the Alpha/Beta-Gamma activity exceeds 10% of the DAC value of the known radionuclide(s) of concern following the 3 hour decay, then a 20 hour decay count of the sample is required to remove the Thoron component of the sample.

INSTRUCTION 11: Decay sample for 20 hours and then recount the sample:

Time Counted	Gross Counts	Count Period	Gross CR	Bkgrnd CR	Net CR	CF	EFF. $\frac{\text{cpm}}{\text{dpm}}$	$\frac{\text{dpm}}{\mu\text{Ci}}$	Activity
α	cts	min	cpm	cpm	cpm	.67		2.22E+6	μCi
$\beta\gamma$	cts	min	cpm	cpm	cpm	.95		2.22E+6	μCi

Technician Performing 20 Hour Count: _____ Date: _____

INSTRUCTION 12: Using the 3 hour and the 20 hour activity, determine the long-lived activity due to alpha:

$$A_{LL}^{\alpha} = \frac{A_{20}^{\alpha} - A_3^{\alpha} (e^{-0.0655(\Delta T)})}{1 - e^{-0.0655(\Delta T)}}$$

where:

- A_{LL}^{α} = long-lived activity which emits alpha
- A_{20}^{α} = 20 hour decayed activity due to alpha
- A_3^{α} = 3 hour decayed activity due to alpha
- 0.0655 = Pb-212 decay constant; since Bi-212 is in transient equilibrium with the Pb-212 and Po-212 is in secular equilibrium with the Bi-212, it is also Po-212's decay constant.
- ΔT = elapsed time between the 3 hour decay period midpoint and the 20 hour decay period midpoint in hours

$$\begin{aligned} \alpha A_{LL} \mu\text{Ci} &= \frac{A_{20} \mu\text{Ci} - A_3 \mu\text{Ci} (e^{-0.0655 \text{ (hrs)}})}{1 - e^{-0.0655 \text{ (hrs)}}} \\ &= \frac{\mu\text{Ci} - \mu\text{Ci} (e^{-0.0655 \text{ (-) hrs}})}{1 - e^{-0.0655 \text{ () hrs}}} \\ &= \text{_____} \mu\text{Ci} \end{aligned}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 13: Using the value of alpha long-lived activity from Instruction 12, calculate the beta long-lived activity:

$$\beta A_{LL} \mu\text{Ci} = (\alpha A_{LL} \mu\text{Ci}) (0.67)$$

where 0.67 is:

Nuclide	T $\frac{1}{2}$	Ci	Emission	Yield	Energy
Th-232	1.4E+ 10 yr.	1.	Alpha	100%	4.01 Mev
Ra-228	5.75 yr.	.9446	Beta	100%	0.05 Mev
Ac-228	6.13 hr.	.9446	Beta	100%	2.11 Mev
Th-228	1.91 yr.	.9171	Alpha	100%	5.4 Mev
Ra-224	3.62 day	.9169	Alpha	100%	5.5 Mev
Rn-220	55 sec.	.9169	Alpha	100%	6.3 Mev
Po-216	0.15 sec.	.9169	Alpha	100%	6.8 Mev
Pb-212	10.6 hr.	.9169	Beta	100%	0.6 Mev
Bi-212	60.6 min	.9169	Beta	100%	2.25 Mev

$$\begin{aligned} \text{Total long-lived alpha activity} &= 1 + .917 + .917 = 2.83 && \frac{1.89}{2.83} = 0.67 \\ \text{Total long-lived beta activity} &= .945 + .945 = 1.89 && \end{aligned}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 14: Calculated the long-lived activity concentrations from the values determined in Instructions 12 and 13:

$$\frac{A_{LL}^{\alpha} \mu\text{Ci}}{\text{volume}} = \text{_____} \mu\text{Ci/ml } [A_{LL}^{\alpha}]$$

$$\frac{A_{LL}^{\beta} \mu\text{Ci}}{\text{volume}} = \text{_____} \mu\text{Ci/ml } [A_{LL}^{\beta}]$$

If: $[A_{LL}^{\alpha}] > 1\text{E-}13 \mu\text{Ci/ml}$

$[A_{LL}^{\beta}] > 2\text{E-}10 \mu\text{Ci/ml}$

- Then:
- o Report this to the HP Supervisor Immediately
 - o Post the area as Airborne Radioactivity Area
 - o Calculate and record DAC Hours for the affected individuals
 - o Send the sample out for an isotopic analysis

Technician Performing Calculation: _____ Date: _____

HP Supervisor Review: _____ Date: _____

ALLIED TECHNOLOGY GROUP FIELD OPERATIONS
HEALTH PHYSICS OPERATING PROCEDURE

DAC HOUR TRACKING

Allied Technology Group, Inc.
47375 Fremont Blvd.
Fremont, California 94538

Prepared by:

Daniel Spicuzza

Allied Technology Group, Inc.

PROCEDURE/PLAN APPROVAL PAGE

This procedure: HP-OP-011, DAC HOUR TRACKING, has been reviewed and approved by the following:

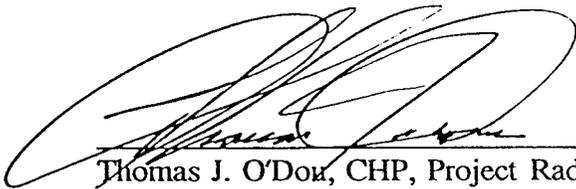
APPROVAL SIGNATURES:



William G. Haney, Project Director

4/12/95

Date



Thomas J. O'Don, CHP, Project Radiation Safety
Officer, HP Technical Support

4/12/95

Date

REVISION RECORD INDICATING
LATEST DOCUMENT REVISION

Procedure Number: HP-OP-011

Title: DAC HOUR TRACKING

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DAC-HOUR TRACKING

1.0 SCOPE

This procedure applies to all individual accounting of DAC-HRs accrued by Allied Technology Group, Inc. (ATG) personnel on field projects.

2.0 PURPOSE

The purpose of this procedure is to provide standardization of the documentation and management of data from the assessment of airborne radioactivity concentrations used for personnel protection.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 Respiratory Protection Program for A.T.G.
- 3.1.2 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.3 10 CFR 20, Standards for Protection Against Radiation
- 3.1.4 HP-OP-010, Air Sampling and Analysis
- 3.1.5 RP-OP-001, Selection and Use of Respiratory Protection Equipment

3.2 Definitions

- 3.2.1 **ALI (Annual Limit of Intake)** - Value of intake of a given radionuclide in a year by the reference man that would result in a committed effective dose equivalent H_{E50} of 5 rems (0.05Sv) or a committed dose equivalent H_{T50} of 50 rems (0.5Sv) to any individual organ or tissue. (ALI values for intake by ingestion and by inhalation of selected radionuclides are given in References 3.1.2 and 3.1.3.)
- 3.2.2 **DAC (Derived Air Concentration)** - The concentration of a given radionuclide in air which, if breathed by the reference man for a working year of 2,000 hours under conditions of light work (inhalation rate 1.2m³ of air per hour), results in an intake of one ALI. DAC values can be found in References 3.1.2 and 3.1.3.
- 3.2.3 **DAC-Hour** - The product of the concentration of radioactive material in air (expressed as a fraction or multiple of the derived air concentration for each radionuclide) and the time of exposure to that nuclide, in hours. A facility may take 2,000 DAC-hours to represent one ALI.

4.0 PRECAUTIONS, LIMITATIONS

4.1 Precautions

- 4.1.1 Health Physics shall determine if an individual has received DAC-HRs at another facility prior to receiving any internal exposure at A.T.G. project sites. An effective dose equivalent or committed dose equivalent, recorded as legal dose on NRC Form-4 (or equivalent) accounting for internal exposure is acceptable. If the effective or committed dose equivalent has not been determined due to the other facility using Maximum Permissible Concentration values, the prior MPC-HR total for the year from the other facility shall be obtained and used to determine the annual effective dose and committed 50 year dose equivalent. If this data is not available, the ATG Corporate Health Physicist or his/her designee should prepare an estimate based upon bioassay data and the ATG baseline bioassay.
- 4.1.2 Use the DAC values listed in References 3.1.2 and 3.1.3 unless otherwise directed by Health Physics Supervision.

4.2 Limitations

- 4.2.1 The most restrictive (lower numeric quantity) value for DAC shall be used, unless the specific form of the material is known, in which case the actual DAC for that form shall be used.

5.0 RESPONSIBILITIES AND QUALIFICATIONS

5.1 Responsibilities

- 5.1.1 ATG Radiological Field Operations Manager(Project Manager) shall be responsible for:
- 5.1.1.1 Implementation of this procedure.
 - 5.1.1.2 Periodic reviews of adherence to the requirements of this procedure.
 - 5.1.1.3 Ensure Health Physics Technicians are qualified by training and experience to perform the requirements of this procedure.
- 5.1.2 Health Physics Supervisors shall be responsible for:
- 5.1.2.1 Assignment of Health Physics Technicians performing this procedure.
 - 5.1.2.2 Reviewing and approving documentation generated by the use of this procedure.

- 5.1.2.3 The transfer of reviewed form ATGF-032, Individual DAC-HR Accounting, to the permanent project files on a DAILY basis.
 - 5.1.2.4 Ensuring all DAC-HR records are sent to the designated ATG office for exposure record updates.
 - 5.1.2.5 Notifying the ATG Corporate Health Physicist or his/her designee if an individual exceeds 10 DAC-HRs in any one week.
- 5.1.3 Health Physics Technicians shall be responsible for:
- 5.1.3.1 Performance of the requirements of this procedure.
 - 5.1.3.2 Adherence to other procedures referenced.
 - 5.1.3.3 Completing all required records and submitting them to the Health Physics Supervisor for review and approval.
 - 5.1.3.4 Immediately notifying the Health Physics Supervisor of any worker who exceeds the limit of 10 DAC-HRs in any one week.
- 5.1.4 Employees shall be responsible for:
- 5.1.4.1 Notifying Health Physics prior to the start of any work under an RWP requiring respiratory protection.
 - 5.1.4.2 Notifying Health Physics prior to entering any areas posted: "Airborne Radioactivity Area."

5.2 Qualifications

- 5.2.1 Health Physics Technicians shall be qualified in accordance with the requirements of ANSI 3.1-1987 to perform air monitoring and subsequent calculations.
- 5.2.2 Health Physics Technicians shall be qualified in accordance with procedures in the operation of equipment required to perform air monitoring.
- 5.2.3 Junior Health Physics/Decontamination Technicians shall perform air sampling and counting only under direct supervision of a Health Physics Technician meeting the requirements of Sections 5.2.1 and 5.2.2 of this procedure.

6.0 PROCEDURE

6.1 Prerequisites

6.1.1 DAC-HRs will be documented and maintained if:

- 6.1.1.1 The individual is exposed to airborne radioactivity greater than the amount equal to 10% of the DAC value for specified isotopes.
- 6.1.1.2 There is a possibility that the individual could receive during the year 10% of the ALI.
- 6.1.1.3 the individual has received internal exposure at another location, such as a power reactor during the current year, and that exposure is recorded as part of the annual effective dose equivalent or 50 year committed dose equivalent.

6.1.2 Once assessment of an individual's DAC-HRs has been commenced, all assessments to exposure to airborne radioactive material will be included, as follows:

- 6.1.2.1 Upon receipt of the isotopic printout, determine the Lung Retention Class (LRC) for the identified isotopes (DAILY, WEEKLY, or YEARLY) if the specific form is known (oxide, etc.) from Table 2 of Reference 3.1.2 or Appendix B of Reference 3.1.3. In the event a radionuclide has two LRCs, use the one with the most restrictive DAC value unless the chemical form of the isotope is known, in which case, the actual LRC is used.
- 6.1.2.2 For mixtures in which there are isotopes at values less than 10% of the DAC value, the isotope may be disregarded if the total of the disregarded isotopes is less than 30% of the total for the mixture. If the total of the disregarded isotopes is greater than 30% of the total for the mixture, the radionuclide with the largest percent DAC should be included first. If the remaining disregarded radionuclides are less than 30% of the new total for the mixture, no further action is required. If the remaining total of disregarded radionuclides is still greater than 30% of the new total for the mixture, include the next highest disregarded isotope in the mixture, and so on, until the <30% value is met.
- 6.1.2.3 Use ATGF-033 to determine and record the DAC value for each isotope from the sample.
- 6.1.2.4 In the event DAC's are determined using alpha-beta counting systems (Model 2929 or equivalent), the most restrictive DAC value shall be used for the job site's radionuclide(s) of concern to calculate the number of DAC's:

- (a) Calculate and record the DAC-HRs in accordance with Section 6.3 of this procedure.
 - (b) Note in the "Comments" section of the ATGF-032
 - * The chemical symbol (Th, Pu, etc.) of the site's radionuclide(s) of concern.
- to indicate that the DAC-HRs were calculated from gross counting system analysis.
- (c) When isotopic results are obtained, correct the entry to reflect the actual DAC-HRs.
 - (d) Line through all the information of the chemical symbol entry and note in the "Comments" section "Up" to indicate the DAC-HRs were updated by isotopic analysis and corrected.

- 6.1.3 The gamma spectroscopy system may calculate the DAC value and report results on the printout in DACs or %DAC. If so, use this value to calculate DAC-HRs.
- 6.1.4 DAC-HR data will be recorded on the Individual DAC-HR Accounting Form (ATGF-032), and a running total shall be retained for the duration of the project and/or year.
- 6.1.5 The Health Physics Supervisor shall review ATGF-032 and forward to the permanent project file on a DAILY basis.
- 6.1.6 The designated ATG office shall update the individual's exposure record at the end of the project and/or year.

6.2 General

- 6.2.1 The designated Health Physics Technician at each job site will complete an Individual DAC-HR Accounting Form, ATGF-032, for any worker required to have DAC-HRs recorded. These forms will be maintained by the site's Health Physics Supervisor and turned into the designated ATG office at the completion of the project and/or year to update the individual's exposure record.

6.3 DAC-HR Calculation

- 6.3.1 Obtain data from Form ATGF-030, Air Sample Data and Analysis, and ATGF-001, Radiological Survey Report. Air sample data is obtained in accordance with Reference 3.1.4.

- * Percent DAC (see Step 6.1.2)
- * Time of Exposure (expressed in hours)

6.3.2 Calculate DAC-HRs using the following equation:

$$\frac{\% \text{ DAC} \times \text{Time of Exposure}}{100 \%} = \text{DAC-HRs}$$

For Example:

$$\% \text{ DAC} = 200$$

$$\text{Time of Exposure} = 8 \text{ hours}$$

$$\frac{200 \% \text{ DAC} \times 8 \text{ HRs}}{100 \%} = 16 \text{ DAC-HRs}$$

Calculate for each isotope requiring documentation.

6.3.3 If respiratory protection is worn, the respirator's protection factor (PF) shall be used to calculate the DAC-HRs.

$$\frac{\% \text{ DAC}}{100 \% \text{ PF}} \times \text{Time of Exposure} = \text{DAC-HRs}$$

6.3.4 Document DAC-HRs on Form ATGF-032 with the following information:

- * RWP #
- * ATGS #
- * Project/Location
- * Calculate Running Total

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

7.1 Form ATGF-032, Individual DAC-HR Accounting

7.2 Form ATGF-033, DAC Determination

8.0 FORMS

8.1 Form ATGF-032, Individual DAC-HR Accounting

8.2 Form ATGF-033, DAC Determination

8.3 Form ATGF-001, Radiological Survey Report (see Reference 3.1.4)

8.4 Form ATGF-030, Air Sample Data and Analysis (see Reference 3.1.4)

INSTRUCTION 3: Calculate the alpha and beta-gamma MDA values:

$$\text{MDA } \frac{\mu\text{Ci}}{\text{ml}} = \frac{2.71 + 3.29 \sqrt{R_B t_{S+B} (1 + t_{S+B} / t_B)}}{2.22E6 \cdot E \cdot V \cdot t_{S+B}}$$

where: V = Sample Volume in ml
 E = Counter Efficiency
 R_B = Background Count Rate (cpm)
 t_{S+B} = Sample Counting Time (min)
 t_B = Background Counting Time (min)

Alpha MDA = _____ Beta-Gamma MDA = _____

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 4: Upon completion of the end of sampling period, perform the initial count of the sample within 15 minutes:

Time Counted	Gross Counts	Count Period	Gross CR	Bkgrnd CR	Net CR	CF	EFF. $\frac{\text{cpm}}{\text{dpm}}$	$\frac{\text{dpm}}{\mu\text{Ci}}$	Activity
	cts	min	cpm	cpm	cpm	.67		2.22E+6	μCi
	cts	min	cpm	cpm	cpm	.95		2.22E+6	μCi

Technician Performing Initial Count: _____ Date: _____

INSTRUCTION 5: Calculate the Total Sample Volume:

$$\frac{\text{Total Sample Run Time}}{\text{minutes}} \times \left(\frac{\text{Sample Average Flow Rate}}{\text{cfm}} \times 2.83E+4 \text{ or } \frac{\text{Sample Average Flow Rate}}{\text{1pm}} \times 1.0E+3 \right) = \frac{\text{Total Volume}}{\text{ml}}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 6: Determine the Initial Airborne Concentration:

$$\begin{aligned} \alpha \text{ } \underline{\hspace{2cm}} \mu\text{Ci} \times \text{FR} \div \underline{\hspace{2cm}} \text{ml} &= \underline{\hspace{2cm}} \mu\text{Ci/ml } \alpha \\ \beta\gamma \text{ } \underline{\hspace{2cm}} \mu\text{Ci} \times \text{FR} \div \underline{\hspace{2cm}} \text{ml} &= \underline{\hspace{2cm}} \mu\text{Ci/ml } \beta\gamma \end{aligned}$$

FR = Filter Ratio (4" Filters = 3.0) (2" Filters = 1.0)

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 7: If either the Alpha/Beta-Gamma activity exceeds 10% of the DAC value of the known radionuclide(s) of concern, then a recount of the sample is required after a 3 hour decay period to allow the short lived Radon daughters to decay.

Time Counted	Gross Counts	Count Period +	Gross CR =	Bkgrnd CR -	Net CR =	CF ÷	EFF. cpm dpm ÷	dpm μCi +	Activity =
α	cts	min	cpm	cpm	cpm	.67		2.22E+ 6	μCi
βγ	cts	min	cpm	cpm	cpm	.95		2.22E+ 6	μCi

Technician Performing 3 Hour Count: _____ Date: _____

INSTRUCTION 8: Determine the airborne concentration following 3 Hr. decay and utilizing volume data in Instruction 5:

3 Hr. Decayed Activity	Volume	3 Hr. Decayed Activity
α _____ μCi X FR	÷ _____ ml	= _____ μCi/ml α
βγ _____ μCi X FR	÷ _____ ml	= _____ μCi/ml βγ

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 9: Determine the half-life of the radionuclide(s) using the following formula:

$$T_{1/2} \text{ (min)} = \frac{- .693 (t)}{\ln \frac{\text{Final Activity}}{\text{Initial Activity}}}$$

t = elapsed time between counts in minutes

t_{1/2} α = _____

t_{1/2} βγ = _____

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 10: If either the Alpha/Beta-Gamma activity exceeds 10% of the DAC value of the known radionuclide(s) of concern following the 3 hour decay, then a 20 hour decay count of the sample is required to remove the Thoron component of the sample.

INSTRUCTION 11: Decay sample for 20 hours and then recount the sample:

Time Counted	Gross Counts	Count Period	Gross CR	Bkgrnd CR	Net CR	CF	EFF. cpm dpm	dpm μCi	Activity
α	cts	min	cpm	cpm	cpm	.67		2.22E+6	μCi
βγ	cts	min	cpm	cpm	cpm	.95		2.22E+6	μCi

Technician Performing 20 Hour Count: _____ Date: _____

INSTRUCTION 12: Using the 3 hour and the 20 hour activity, determine the long-lived activity due to alpha:

$$A_{LL}^{\alpha} = \frac{A_{20}^{\alpha} - A_3^{\alpha} (e^{-0.0655(\Delta T)})}{1 - e^{-0.0655(\Delta T)}}$$

where:

- A_{LL}^{α} = long-lived activity which emits alpha
- A_{20}^{α} = 20 hour decayed activity due to alpha
- A_3^{α} = 3 hour decayed activity due to alpha
- 0.0655 = Pb-212 decay constant; since Bi-212 is in transient equilibrium with the Pb-212 and Po-212 is in secular equilibrium with the Bi-212, it is also Po-212's decay constant.
- ΔT = elapsed time between the 3 hour decay period midpoint and the 20 hour decay period midpoint in hours

$$\begin{aligned} \alpha A_{LL} \mu\text{Ci} &= \frac{A_{20} \mu\text{Ci} - A_3 \mu\text{Ci} (e^{-0.0655 (\text{hrs})})}{1 - e^{-0.0655 (\text{hrs})}} \\ &= \frac{\mu\text{Ci} - \mu\text{Ci} (e^{-0.0655 (\text{hrs})})}{1 - e^{-0.0655 (\text{hrs})}} \\ &= \text{_____} \mu\text{Ci} \end{aligned}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 13: Using the value of alpha long-lived activity from Instruction 12, calculate the beta long-lived activity:

$$\beta A_{LL} \mu\text{Ci} = (\alpha A_{LL} \mu\text{Ci}) (0.67)$$

where 0.67 is:

Nuclide	T $\frac{1}{2}$	Ci	Emission	Yield	Energy
Th-232	1.4E+ 10 yr.	1.	Alpha	100%	4.01 Mev
Ra-228	5.75 yr.	.9446	Beta	100%	0.05 Mev
Ac-228	6.13 hr.	.9446	Beta	100%	2.11 Mev
Th-228	1.91 yr.	.9171	Alpha	100%	5.4 Mev
Ra-224	3.62 day	.9169	Alpha	100%	5.5 Mev
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Po-216	0.15 sec.	.9169	Alpha	100%	6.8 Mev
Pb-212	10.6 hr.	.9169	Beta	100%	0.6 Mev
Bi-212	60.6 min	.9169	Beta	100%	2.25 Mev

$$\begin{aligned} \text{Total long-lived alpha activity} &= 1 + .917 + .917 = 2.83 && \frac{1.89}{2.83} = 0.67 \\ \text{Total long-lived beta activity} &= .945 + .945 = 1.89 && \end{aligned}$$

Technician Performing Calculation: _____ Date: _____

INSTRUCTION 14: Calculated the long-lived activity concentrations from the values determined in Instructions 12 and 13:

$$\frac{A_{LL}^{\alpha} \mu\text{Ci}}{\text{volume}} = \text{_____} \mu\text{Ci/ml} [A_{LL}^{\alpha}]$$

$$\frac{A_{LL}^{\beta} \mu\text{Ci}}{\text{volume}} = \text{_____} \mu\text{Ci/ml} [A_{LL}^{\beta}]$$

If: $[A_{LL}^{\alpha}] > 1\text{E-}13 \mu\text{Ci/ml}$

$[A_{LL}^{\beta}] > 2\text{E-}10 \mu\text{Ci/ml}$

- Then:
- o Report this to the HP Supervisor Immediately
 - o Post the area as Airborne Radioactivity Area
 - o Calculate and record DAC Hours for the affected individuals
 - o Send the sample out for an isotopic analysis

Technician Performing Calculation: _____ Date: _____

HP Supervisor Review: _____ Date: _____

ALLIED TECHNOLOGY GROUP FIELD OPERATIONS
HEALTH PHYSICS OPERATING PROCEDURE

ATG ALARA PROGRAM

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PROCEDURE/PLAN APPROVAL PAGE

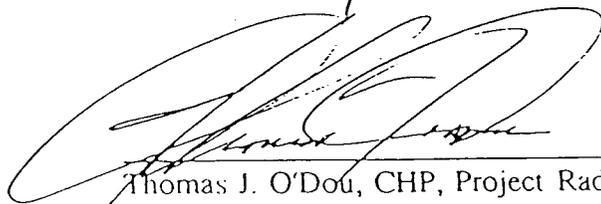
This procedure, HP-OP-012 has been reviewed and approved by the following.

APPROVAL SIGNATURES:



William G. Haney, Project Director

4/12/95
Date



Thomas J. O'Dou, CHP, Project Radiation Safety
Officer, HP Technical Support

4/12/95
Date

**REVISION RECORD INDICATING
LATEST DOCUMENT REVISION**

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ATG ALARA PROGRAM

1.0 SCOPE

Maintaining radiation exposures As Low As Reasonably Achievable (ALARA) based upon cost vs. benefit analysis in relation to strict compliance with the requirements of DOE Order 5480.11 and the U.S. NRC Regulatory Guide 8.8. The ALARA program applies to all Allied Technology Group, Inc. (ATG) personnel on field operations.

2.0 PURPOSE

The purpose of this procedure is to implement ALARA commitments. This procedure and subordinate operating procedures satisfy the requirements of DOE Order 5480.11 and are consistent with the ALARA principles and requirements in applicable NRC Regulations, including 10 CFR 20.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 DOE Order 5480.11, Radiation Protection for Occupational Workers
- 3.1.2 10 CFR 20, Standards for Protection Against Radiation
- 3.1.3 Respiratory Protection Program for ATG.
- 3.1.4 USNRC Regulatory Guide 8.8, Information Relevant to Ensuring that Occupational Radiation Exposures Will Be As Low As Reasonably Achievable
- 3.1.5 HP-OP-004, Issue and Use of Radiation Work Permits
- 3.1.6 HP-OP-001, Radiation and Contamination Survey Techniques
- 3.1.7 HP-OP-005, Control of Radioactive Material

3.2 Definitions

- 3.2.1 **AS LOW AS REASONABLY ACHIEVABLE (ALARA)** - An approach to radiation protection to control or manage exposure (both individual and collective to the workforce and general public) as low as social, technical, economic, practical, and policy considerations permit. ALARA is not a dose limit, but a process, which has the objective to ensure dose to all exposed people is as far below applicable limits as reasonably achievable.
- 3.2.2 **ALARA GOAL** - Any radiation dose poses some risk, therefore goals are set to maintain individual and thereby, collective dose As Low As Reasonably Achievable to minimize that risk.

- 3.2.3 **BENEFIT** - The total exposure savings of implementing an ALARA engineering objective. A comparative monetary value is \$5,000 per man-rem.
- 3.2.4 **CHRONIC EXPOSURE** - Small repeated doses received over a long period of time.
- 3.2.5 **ACUTE EXPOSURE** - A large dose received in a short period of time, i.e., less than one day.
- 3.2.6 **COLLECTIVE DOSE** - The total cumulative dose for all personnel involved in a specific project recorded in man-Rem.
- 3.2.7 **COST** - The total monetary value of resources such as "labor and materials" to accomplish an ALARA engineering objective.
- 3.2.8 **DOSE EQUIVALENT (H)**- The product of absorbed dose (D) in rads in tissue, a quality factor (Q), and other modifying factors (N). Dose equivalent (H) is expressed in units of Rem (or Sievert). $DQN=H$
- 3.2.9 **EFFECTIVE DOSE EQUIVALENT (H_E)**- The sum over specified tissues of the products of the dose equivalent in a tissue (H_t) and the weighing factor (W_t) for that tissue, i.e., $H_E = \sum H_t W_t$. The effective dose equivalent is expressed in units of Rem (or Sievert).
- 3.2.10 **RADIATION WORK PERMIT (RWP)** - A document which provides guidelines to specify protective radiological measures within the scope of the work. The RWP also documents existing radiological conditions, work scope and radiological limitations.

4.0 PRECAUTIONS, LIMITATIONS

The ALARA program is measured with the benefit of reductions in individual and/or collective exposures to workers and/or the general public. While ALARA has no limitation other than the derived benefit vs. actual cost, the application of ALARA techniques need individual consideration for the safety and comfort of the worker.

4.1 **Shielding**

- 4.1.1 Shielding composed of high density materials should be handled carefully. Injury may result from improper handling of heavy shielding material.
- 4.1.2 Shielding should be inspected frequently to ensure its original configuration is maintained and should be surveyed periodically.
- 4.1.3 Shielding should not impede work evolutions. The exposure saved by shielding may be spent by longer work periods.
- 4.1.4 Shielding should be installed based upon seismic considerations.

- 4.1.5 Lead is classified as a hazardous material due to its toxicity. Precautions for handling lead should be exercised during use.
- 4.1.6 Shielding should be evaluated for weight considerations. Shielding may damage or destroy equipment if load limits of supports are exceeded.
- 4.1.7 Shielding should be protected by plastic wrapping when used in loose contamination areas.
- 4.1.8 Radioactive sources should be stored in shielded containers and kept shielded at all other times practical during use.
- 4.1.9 Shielding should be evaluated for compatibility with the area in which it is to be used. For example, lead shot should not be used in areas where loose materials may cause damage to equipment.
- 4.1.10 Temporary shielding is particularly effective against small, localized hot spots and should be used when possible.
- 4.1.11 Consider the installation of permanent shielding. The estimated exposure for installing the shielding must be weighed against the expected exposure reduction.
- 4.1.12 Many different types of shielding are available for use. Consider the following:
 - 4.1.12.1 Lead blankets, bricks, sheets, matting, lead glass.
 - 4.1.12.2 Water.
 - 4.1.12.3 Plastic and wood materials.
 - 4.1.12.4 Aluminum.
 - 4.1.12.5 Cement concrete blocks.

4.2 Remote Handling Devices

- 4.2.1 Remote handling devices should be used by personnel familiar with their operation. Loss of control of highly radioactive material may occur if handling devices are used improperly.
- 4.2.2 Remote handling devices should be inspected prior to use and periodically to ensure they are in good condition.
- 4.2.3 Care should be exercised to prevent cross contaminating handling devices.

- 4.2.4 Cranes used to remotely handle radioactive material shall be operated ONLY by qualified operators.

4.3 Temporary Confinements/Containments

- 4.3.1 Temporary confinements/containments used to limit the spread of contamination should be constructed of fire proof or fire retardant materials.
- 4.3.2 If the possibility of system leakage exists inside temporary confinements/containments, an appropriate drainage path to radioactive drain collecting systems should be installed; use berms in areas where no drains are available.
- 4.3.3 Air quality in temporary confinements/containments should be evaluated frequently for habitability and levels of contaminants.
- 4.3.4 When ventilation systems are used with temporary confinements/containments, it is important to balance the supply and exhaust air flows to prevent damage to the confinement/containment.
- 4.3.5 Temporary confinements/containments used outside should be constructed to withstand adverse environmental conditions. It is particularly important to provide roof drainage in the event of rain.
- 4.3.6 Temporary confinements/containments should be constructed with clear plastic windows to allow outside personnel to view activities inside the confinement / containment. This is important in the event of an incapacitating injury to personnel inside the confinement/containment.

4.4 Worker Comfort

- 4.4.1 The comfort of the worker is extremely important to the ALARA philosophy. Job performance is directly proportional to the degree of comfort a worker feels.
- 4.4.2 Bubble hoods should be used instead of airline full face respirators when possible.
- 4.4.3 The minimum amount of protective clothing required should be determined and only this amount should be used.
- 4.4.4 The time a worker wears a full face respirator shall be limited according to the provisions of Reference 3.1.3. Frequent breaks and maximum total work periods should be observed.
- 4.4.5 Heat stress should be considered and monitored during work. Counter measures should be used to reduce this possibility (e.g., fluid intake, staytimes, or ice vest, etc.).
- 4.4.6 Awkward working positions should be avoided when possible.

- 4.4.7 Unsafe conditions are a distraction to workers. Unsafe conditions should be removed/corrected from a work area.
- 4.4.8 Good lighting is essential to worker comfort. A brightly lighted work area is important to the psychological well being of a worker. A brightly lighted work area should be considered whenever possible.
- 4.4.9 Low dose areas should be designated in work areas where personnel may take rest breaks without removing protective clothing/equipment.
- 4.4.10 Methods to adjust humidity and temperature in the work area should be considered.
- 4.4.11 It is comforting to workers to know they are being watched and help is immediately available in the event of an emergency. An outside person(s) shall ALWAYS be available to assist workers inside radiologically significant (high radiation, high contamination, airborne, confined spaces, etc.) areas.

4.5 Communications

- 4.5.1 Headphones and microphone systems should be considered.
- 4.5.2 Hand signals should be understood by all personnel before starting work.
- 4.5.3 A preplanned reliable communication system shall be employed. Poor communication results in more exposure.
- 4.5.4 A reliable two-way communication system shall be required when personnel are working in areas where:
 - 4.5.4.1 Time keeping is in effect.
 - 4.5.4.2 General area exposure rates require constant communication.
 - 4.5.4.3 Line of sight cannot be maintained in confined spaces.
 - 4.5.4.4 Frequent monitoring is required.
 - 4.5.4.5 Communication is required to meet an ALARA commitment.

4.6 Decontamination

- 4.6.1 Consider decontaminating the work area, or equipment prior to the commencement of work. In addition to exposure reduction due to the removal of the contamination, decontamination may allow work crews to forego protective clothing and/or respirators thereby increasing their productivity and reducing their exposure.

4.6.2 The estimated exposure for decontamination tasks shall be weighed against the expected exposure savings.

4.7 Removal of Sources or Relocation of Work

4.7.1 Consider flushing systems, piping, tanks, valves, etc prior to commencement of work. Consider removing unused equipment in the work area, if equipment is a radiation source. Consider storage of radiological sources in another area.

4.7.2 Consider moving the equipment that is to be worked on to an area with lower radiation levels.

4.8 Improve Access

4.8.1 Consider the improvement of access to work areas by the installation of scaffolding, removal of interferences, establishing different access control points.

4.8.2 Care should be exercised in the location of control points. Personnel should not be required to remain in a radiation area while awaiting their turn at the step-off-pad.

4.9 Special Tools and Fixtures

4.9.1 Consider obtaining or fabricating and using special tools or fixtures:

4.9.1.1 Tools, such as a long handled retriever can significantly reduce dose.

4.9.1.2 Fixtures, such as a temporary confinement/containment with forced ventilation through HEPA filters should be considered for contamination control when applicable.

4.10 Mock-Up Exercises

4.10.1 Consider mock-ups or dry runs to make certain each individual is familiar with their roll in the operation. Mock-up exercises can also help identify problems and solutions with little or no exposure.

5.0 RESPONSIBILITIES

5.1 The ATG Radiological Field Operations Manager (Project Manager) shall be responsible for:

5.1.1 Implementation of this procedure.

5.1.2 Periodic reviews of adherence to the requirements of this procedure.

5.1.3 Promoting the ALARA philosophy.

- 5.1.4 While maintaining ALARA principles, shall ensure the use of respiratory protection will be reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source.
- 5.1.5 Implementing ALARA through Radiation Work Permits in full compliance with the ATG ALARA Program including all goals and procedures.

5.2 The Health Physics Supervisor shall be responsible for:

- 5.2.1 Reviewing work environments, procedures, and equipment to maintain work crew exposure consistent with the ATG ALARA Program goals, procedures, and with applicable RWPS.
- 5.2.2 Actively promoting the ALARA philosophy by establishing high standards for the performance of radiological controls. These standards and management expectations should be frequently communicated to the work force.
- 5.2.3 While maintaining ALARA principles, ensure the use of respiratory protection is reduced to the minimum practicable by implementing engineering controls and work practices to contain radioactivity at the source.
- 5.2.4 Monitoring subordinate's year-to-date radiation exposures.
- 5.2.5 Establishing working conditions that encourage improved radiological controls. This includes temperature, humidity, and lighting as well as the more difficult consideration of accessibility. Work conditions should be considered in planning work.

5.3 ATG Personnel shall be responsible to:

- 5.3.1 Review work environments, procedures, and equipment to maintain work crew exposure consistent with the ATG ALARA Program goals, procedures, and with applicable RWPS.
- 5.3.2 Maintain their own exposures ALARA consistent with the ATG ALARA program, goals, procedures, and with the applicable RWPs.
- 5.3.3 Make suggestions to improve the ALARA program.
- 5.3.4 Follow all procedures and work instructions.
- 5.3.5 Attend and participate in ALARA briefings.
- 5.3.6 Obey promptly "stop work" and "evacuate" instructions of Health Physics.
- 5.3.7 Keep track of his/her individual radiation dose and avoid exceeding dose control levels and limits.

- 5.3.8 Wear dosimetry as required by procedures, RWPs, or Health Physics instructions.
- 5.3.9 Remain in as low a dose rate area as practical to accomplish work.
- 5.3.10 Leave radiation areas or airborne radioactivity areas when not working, and use "low dose waiting areas" when designated.
- 5.3.11 NO SMOKING, EATING, DRINKING OR CHEWING in controlled areas, or bring open containers of smoking, eating, drinking, or chewing materials into controlled areas.
- 5.3.12 Wear protective clothing and respirators whenever required by signs, RWP's, Health Physics personnel, procedures. and instructions.
- 5.3.13 Remove protective clothing and respirators properly to minimize the spread of contamination.
- 5.3.14 Minimize the spread of a known or possible radioactive/hazardous material spill and notify Health Physics promptly.
- 5.3.15 Avoid unnecessary contact with contaminated surfaces.
- 5.3.16 Limit the amount of material requiring decontamination or disposal as radioactive waste.
- 5.3.17 Place contaminated tools, equipment, and solid waste on disposable surfaces (for example, sheet plastic) when not in use, and inside plastic bags when work is finished.
- 5.3.18 Control the amount of materials brought into radiologically controlled areas to minimize radioactive waste.
- 5.3.19 Report unsafe or non compliance situations promptly.
- 5.3.20 Report the presence of treated or open wounds to Health Physics before work in areas where radioactive/hazardous contamination exists, and exit immediately if a wound occurs while in such an area.
- 5.3.21 Report prior or concurrent occupational radiation exposure.
- 5.3.22 Report known or suspected pregnancy to Health Physics promptly.

6.0 ALARA PROCEDURE

Considerations provided in Section 6.1 insure that when dealing with possible radiation exposure to personnel the review of these considerations play a major roll in preparing all individuals in the practices of ALARA. ALARA considerations, once approved, become requirements of the RWP.

6.1 ALARA Considerations

6.1.1 An ALARA Considerations Form (ATGF-024) shall be completed by the Health Physics Planner/Supervisor or ALARA designee for every job specific RWP where the following conditions are anticipated:

- 6.1.1.1 High Radiation/Very High Radiation Area entry.
- 6.1.1.2 A potential radiation exposure > 50 mRem individual whole body or > 500 mRem collective whole body exposure.
- 6.1.1.3 High Contamination or Hot Particle controls.
- 6.1.1.4 Use of temporary shielding.
- 6.1.1.5 When required by another procedure.
- 6.1.1.6 Respiratory protection usage or when measures are taken in lieu of respiratory protection, e.g. DAC hour tracking, glove bag, etc.

6.1.2 Extended RWPs shall have ATGF-024 forms completed for specific tasks which qualify under Section 6.1.1.

6.1.3 The ATGF-024, shall be reviewed and approved in accordance with the following:

ESTIMATED WHOLE BODY EXPOSURE*		REQUIRED APPROVAL
INDIVIDUAL	COLLECTIVE	
> 50 mRem but < 500 mRem	> 500 mRem but < 5000 mRem	Health Physics Supervisor
> 500 mRem but < 1000 mRem	> 5,000 mRem but < 10,000 mRem	Health Physics Supervisor RFO Manager (Project Manager)
> 1,000 mRem	> 10,000 mRem	Health Physics Supervisor RFO Manager (Project Manager) ATG Corporate Health Physicist

* Internal and/or External Exposure

6.1.4 The ATGF-024 Form shall be attached to the RWP and become part of the RWP package.

6.1.5 The ATGF-024 form shall be closed out by the Health Physics Supervisor/Planner or ALARA designee in conjunction with its corresponding RWP or at the completion of a specific task for extended RWPs.

6.1.5.1 Enter the total post-job dose estimate in Section IIB of the ATGF-024 form. Designate where dose information is from; i.e., RWP Sign-in Sheet, TLD, etc.

6.1.5.2 If the post-job estimate exceeds the pre-job estimate the ALARA designee or Health Physics Supervisor shall be notified.

6.1.5.3 The ATGF-024 shall be submitted with the RWP package and retained in the permanent project file.

6.2 ALARA Training

6.2.1 All ATG personnel involved in radiological related activities shall receive training in the ALARA principle and ATG's ALARA policies. This training shall be implemented on a job by job basis and documented on Form ATGF-027 Training Attendance Record.

6.3 ALARA Pre-Job Planning

6.3.1 ALARA pre-job planning should be included in the initiation of the work plan and RWPs where the possibility of meeting Section 6.1.1 specifications are anticipated. The intent of ALARA Pre-Job planning is to provide an objective view of the proposed activity that may not be readily apparent to the author. ALARA Pre-Job planning should consider the following:

6.3.1.1 A specific description of the job (including location).

6.3.1.2 The original dose equivalent estimate for completing the job.

6.3.1.3 Resources required (equipment, supplies and personnel).

6.3.1.4 Radiological conditions.

6.3.1.5 Identify persons performing work.

6.3.1.6 Job assignments.

6.3.1.7 Training requirements, mock-up, dry run.

6.3.1.8 Time required to complete the job.

6.3.1.9 Consideration of exposure reduction techniques.

6.3.1.10 Consideration of the RWP requirements.

6.3.1.11 Any special or unusual hazards.

6.3.1.12 Current radiation effective dose equivalent (available status).

6.3.1.13 Other qualifications (Example-current respirator use, medical, etc.).

6.4 Pre-Job Briefing

6.4.1 The Pre-job briefing shall attempt to insure that all individuals involved in a specific task are working toward a common goal and are aware of radiological conditions and methods of minimizing exposure.

6.5 Post Job Review

6.5.1 The ALARA Coordinator/Health Physics Supervisor or designee should conduct a debriefing meeting upon conclusion of jobs involving collective dose equivalent of greater than 100 person mRem. Debriefings should include the following:

- 6.5.1.1 Identification of any problems encountered and the resolution of the problem.
- 6.5.1.2 Suggestions for improving the future performance of similar tasks, including techniques for further reducing exposures.
- 6.5.1.3 Comparison of the actual dose equivalent to the estimated dose equivalent.

6.6 ALARA Reports

6.6.1 The ALARA reports and associated forms should be completed in accordance with the provisions of this procedure.

7.0 RECORDS

The following records will be generated and retained in the permanent project file as a result of using this procedure.

- 7.1 ATGF-024, ALARA Considerations Form
- 7.2 ATGF-025, Pre-Job Briefing Checklist (IH/Safety)
- 7.3 ATGF-026, Pre-Job Briefing Checklist (Health Physics)
- 7.4 ATGF-027, Training Attendance Record

8.0 FORMS

- 8.1 ATGF-024, ALARA Considerations Form
- 8.2 ATGF-025, Pre-Job Briefing Checklist (IH/Safety)
- 8.3 ATGF-026, Pre-Job Briefing Checklist (Health Physics)
- 8.4 ATGF-027, Training Attendance Record

ALARA CONSIDERATIONS

SECTION I: GENERAL INFORMATION

PROJECT:	RWP #:
JOB LOCATION:	START DATE:
PROJECT MANAGER:	END DATE:
JOB DESCRIPTION:	

SECTION II: PERSON-REM ESTIMATE (Total)

TASK No. & TITLE	ESTIMATE PERSON-HOURS	EFF. DOSE EQUIVALENT RATE (rem/hr)	ESTIMATE PERSON-REM

SECTION II - B: POST AND PRE-JOB DOSE ESTIMATES

Total Estimate (Pre-Job) Person-Rem:	Entered By:	Date:
Total Estimate (Post-Job) Person-Rem:	Entered By:	Date:

SECTION III: EXTERNAL RADIOLOGICAL CONTROLS

ALARA RECOMMENDATIONS	YES	NO	N/A	REMARKS
Decontamination				
Flushing/Filling				
Temporary Shielding				
Pre-Job Meeting				
Special Training (Mock-Up)				
Stay Time				
Post Low Dose Areas				
Other (Specify)				
CONTROLS IN LIEU of RESPIRATORS				
Respiratory Protective Devices				
Full Face Particulate				
Supplied Air				
Self Contained Breathing Apparatus				
Other (Specify)				

ALARA CONSIDERATIONS - (continued)

SECTION IV: INTERNAL RADIOLOGICAL CONTROLS				
CONTROLS IN LIEU of RESPIRATORS	YES	NO	N/A	REMARKS
Ventilation				
Decontamination				
Containments				
Relocation of Work				
Stay Time (DAC-Hours)				
Total Estimate (Pre-Job) Person-Rem:	Entered By:			Date:
Total Estimate (Post-Job) Person-Rem:	Entered By:			Date:

Prepared By: _____ Date: _____

Approved By: _____ Date: _____

Additional Approvals Required: YES NO (If YES, See below)

REQUIRED APPROVALS			
RWP#:		Total Person-Rem Estimates	
Job Description:		Individual:	mrem
		Collective:	mrem
> 500 mRem INDIVIDUAL or > 5,000 mRem COLLECTIVE			
	NAME	SIGNATURE	DATE
Health Physics Supervisor			
RFO/Project Manager			
> 1,000 mRem INDIVIDUAL or > 10,000 mRem COLLECTIVE			
Health Physics Supervisor			
RFO/Project Manager			
ATG Corp. Health Physicist			

**PRE-JOB BRIEFING CHECKLIST
(Industrial Hygiene/Safety)**

A briefing is required for every job. Each of the following topics must be included in the briefing.

1. SAFETY REQUIREMENTS			
All Industrial Safety Hazards discussed, such as:			
	Yes	No	N/A
Confined Spaces			
Adequate Lighting			
Toxic or Explosive Gases			
IDLH			
Excessive Heat			
Housekeeping			
Hearing Protection:			
Hardhats:			
O ₂ Analyzer:			
Safety Glasses:			
Gloves: Type:			
Fire Protection			
Organic Vapor Monitor:			
Foot Protection			
Explosive/Combustible Gas Monitor:			
2. WORK AREA HAZARDS:			
A.			
B.			
C.			
D.			
E.			
F.			
3. OTHER SAFETY REQUIREMENTS and/or SAFETY EQUIPMENT:			
A.			
B.			
C.			
D.			
E.			
F.			
4. JOB SPECIFIC DISCUSSION:			
A.			
B.			
C.			
D.			
E.			
F.			
Briefing Conducted By (Print / Sign)	Date / Time		

**PRE-JOB BRIEFING CHECKLIST
(Health Physics)**

1. Identify Stop Work Authority:			
2. HP Coverage (Intermittent, continuous):			
3. Exposure Limitation/Goal:			
4. Conditions Expected (per RWP):			
Radiation	Contamination	Airborne	Neutron
Hot Particles	Potential Changes (debris, line-ups, opening systems, etc.)		
5. Review:	Yes	No	N/A
Protective Clothing?			
Respiratory Protection?			
Special Dosimetry?			
Air Sampling?			
Laydown Areas Set Up?			
Keys Available?			
Control Point?			
Communications Established?			
6. Special Instructions (per RWP)			
7. Radiological Hold Points: Identify criterion for each point:			
8. ALARA Considerations (shielding, decon, hot spots, low dose areas, etc.):			
A.			
B.			
C.			
9. Job Specific Discussion			
10. Turnover Frequency (every shift, day, etc):			
Must cover these topics:			
ALL WORKERS MUST SIGN ATTACHED TRAINING ATTENDANCE FORM ATGF-027.			
Health Physics Supervisor Review:			
Briefing Conducted By (Print / Sign)			Date / Time

ALLIED TECHNOLOGY GROUP FIELD OPERATIONS
HEALTH PHYSICS OPERATING PROCEDURE

USE OF FILTER TYPE RESPIRATORS

Allied Technology Group, Inc.
47375 Fremont Blvd.
Fremont, California 94538

Prepared by

D. Spicuzza

Allied Technology Group, Inc.

PROCEDURE/PLAN APPROVAL PAGE

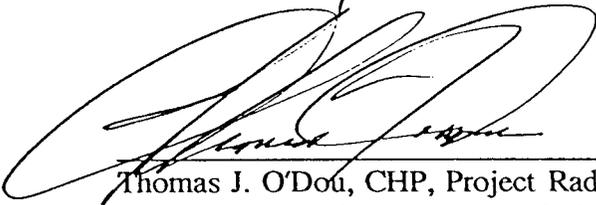
This procedure: RP-OP-002 - USE OF FILTER TYPE RESPIRATORS has been reviewed and approved by the following:

APPROVAL SIGNATURES:



William G. Haney, Project Director

4/12/95
Date



Thomas J. O'Dou, CHP, Project Radiation Safety
Officer, HP Technical Support

4/12/95
Date

**REVISION RECORD INDICATING
LATEST DOCUMENT REVISION**

Procedure Number: RP-OP-002

Title: Use of Filter Type Respirators

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Rev. No.	Date

CURRENT REVISION	
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USE OF FILTER TYPE RESPIRATORS

1.0 SCOPE

This document establishes procedural requirements for the operation of the air-purifying, filter-type respiratory protection devices approved for use by A.T.G. personnel based upon the provisions of the Respiratory Protection Program for Allied Technology Group, Inc. (ATG). This document applies to any qualified respirator user who may be required to use this type of device for a specific task and/or to the personnel assigned to respiratory protection duties.

2.0 PURPOSE

This document describes the proper fitting and operation of the filter-type respirator and provides specific maintenance instructions for the makes of filter-type respirators available to ATG personnel on field projects.

3.0 REFERENCES AND DEFINITIONS

3.1 References

- 3.1.1 Respiratory Protection Program for A.T.G.
- 3.1.2 HP-OP-004, Issue and Use of Radiation Work Permits (RWPs)
- 3.1.3 RP-OP-001, Selection and Use of Respiratory Protection Equipment
- 3.1.4 Mine Safety Appliances (MSA) - Ultra-Twin Respirator Instruction and Approval Manual
- 3.1.5 North - 7600 series, Air Purifying Respirator Using 7600-8a Full Facepiece Operating and Maintenance Manual
- 3.1.6 3M - 7800/Easi-Air Full Facepiece Instruction Manual
- 3.1.7 HP-OP-003, Release of Materials from Controlled Areas

3.2 Definitions

- 3.2.1 **Air-Purifying Respirator** - A respiratory protection system that removes particulate or gaseous contaminants from the ambient air. The purification of the air is accomplished by mechanically filtering out particulate contaminants with fibrous media or by removing contaminating gases and vapors by activated media. The motive force for passage of contaminated air through the air-purifying media is

provided by the wearer's breathing. During inhalation, the facepiece is under negative pressure.

- 3.2.2 **"Bag Out"** - A reference to the process whereby a contaminated item is slowly and carefully placed into a transport container to remove the item from a contaminated area. "Bag Out" requires the worker in a work area to place the contaminated item into a clean plastic bag held by a worker outside the contaminated area. The worker outside the contaminated area holds the clean bag so that the outside of the bag does not touch any contaminated surface. The bag containing the contaminated item is then sealed to prevent contamination from escaping the bag. The contaminated item can now be transported without spread of activity.
- 3.2.3 **Negative Pressure Respirator** - A respiratory protection system where a negative pressure is created in the facepiece during inhalation.

4.0 **PRECAUTIONS, LIMITATIONS**

4.1 **Precautions**

- 4.1.1 Any user of a filter type respirator shall be a qualified respirator user. This requires medical approval and training to use specific respirators.
- 4.1.2 A respirator shall NOT be used unless equipped with the appropriate cartridge for the work environment as specified by the RWP.
- 4.1.3 A filter type respirator does NOT supply respirable air; A filter type respirator shall NOT be used in an environment which may be immediately dangerous to life and health (IDLH) or in atmospheres containing less than 19.5% oxygen.
- 4.1.4 This procedure shall be implemented in accordance with the requirements of Reference 3.1.1 and Reference 3.1.3.

4.2 **Limitations**

- 4.2.1 The respirator shall always be donned in a non-contaminated or non airborne area.
- 4.2.2 The respirator shall always be removed in a non-airborne area, unless it is restricting the flow of breathing air to the user, then the user shall immediately exit the area.
- 4.2.3 Only NIOSH certified respiratory protection equipment shall be used.
- 4.2.4 While using the respirator in a contaminated or airborne area, the user shall not loosen the headstraps, pull the respirator from the face or in any way breach the facepiece to face seal.

- 4.2.5 All O-rings and gaskets used in air-purifying filter type respirators shall be replaced at least once a year.
- 4.2.6 Individuals approved to use specific respiratory protection devices shall use ONLY those devices; An individual with a medical limitation regarding the use of a filter type respirator shall strictly observe such limitations.
- 4.2.7 No air-purifying respirator shall be used for protection against gas or contaminants with poor warning properties (odor, taste or irritation).

5.0 RESPONSIBILITIES

- 5.1 ATG Radiological Field Operations Manager or Project Manager shall be responsible for:
 - 5.1.1 Implementation of this procedure.
 - 5.1.2 Periodic reviews of the adherence of personnel to the requirements of this procedure.
 - 5.1.3 Ensuring by training and experience Health Physics Technicians are qualified to perform the requirements of this procedure.
 - 5.1.4 Reviewing and recommending procedures for operation and maintenance of respiratory protection devices.
- 5.2 Health Physics Supervisor shall be responsible to:
 - 5.2.1 Performs periodic surveillance of the use and maintenance of the respiratory protection equipment.
 - 5.2.2 Maintain inventory of respiratory protection equipment locations and users.
 - 5.2.3 Ensure the Health Physics Technician providing job coverage and personnel using respiratory protection equipment are qualified respirator users.
- 5.3 Health Physics Technician shall be responsible for:
 - 5.3.1 Performing periodic surveillance of the use and maintenance of the respiratory protection equipment.
 - 5.3.2 Ensuring the personnel using respiratory protection equipment are qualified respirator users.
 - 5.3.3 Reporting incidents of respirator use non-compliance and incidents of respirator failure to Health Physics Supervision.

- 5.4 Qualified Respirator Users shall be responsible to:
 - 5.4.1 Prevent damage to respiratory protection equipment.
 - 5.4.2 ALWAYS inspect their respirator BEFORE AND AFTER each use in accordance with the provisions of this procedure.
 - 5.4.3 IMMEDIATELY exit the work area and report any malfunction of a respiratory protection device to the Health Physics Technician or the IH/Safety Technician providing job coverage.
 - 5.4.4 IMMEDIATELY exit the work area and report any undue physical or psychological distress to the Health Physics Technician providing the job coverage.
- 5.5 Respiratory Protection Technician (A Collateral Health Physics function) shall:
 - 5.5.1 Perform scheduled and as-needed maintenance on the air-purifying, filter type respirator systems.
 - 5.5.2 Maintain a back-up inventory of spare parts for repair or replacement purposes.
 - 5.5.3 Maintain records of all repairs/replacement of parts for filter type respirator systems.
- 5.6 IH (Industrial Hygiene)/Safety Technicians shall:
 - 5.6.1 Sample for hazardous materials and/or decontaminate all respiratory protection equipment as necessary BEFORE the equipment is returned to RESPIRATORY PROTECTION for re-certification for use.
 - 5.6.2 Be a qualified respirator user if he/she provides job coverage.
 - 5.6.3 Report incidents of respirator use non-compliance and incidents of respirator failure to Health Physics Supervision.

6.0 PROCEDURE

6.1 Proper Donning of Air-Purifying Filter Type Respirators

- 6.1.1 An inspection to include the following shall be performed before donning the respirator:
 - 6.1.1.1 Inspect the headstraps to see that they still have their elasticity. Inspect for cracks and tears and make sure all buckles are in place and working properly.

- 6.1.1.2 Inspect the facepiece for foreign matter, cracks, tears or holes. Inspect the shape of the face-piece for possible distortion that may occur from improper storage and make sure that the mask material is flexible, not stiff.
- 6.1.1.3 Inspect inhalation, exhalation valves seating surfaces for scratches and other damage that may interfere with the sealing surfaces.
- 6.1.1.4 Inspect cartridges for dents, scratches or other damage particularly the sealing surfaces.
- 6.1.1.5 Inspect o-rings, gaskets etc. Ensure all are in proper place and not damaged.

WARNING: DO NOT USE A RESPIRATOR THAT HAS NOT BEEN INSPECTED BEFORE USE. IT IS THE RESPONSIBILITY OF EVERY RESPIRATOR USER TO INSPECT HIS/HER RESPIRATOR BEFORE AND AFTER EACH USE.

6.1.2 The respirator shall be donned by the following steps:

WARNING: ALL RESPIRATOR USERS MUST BE MEDICALLY QUALIFIED TO WEAR A RESPIRATOR, A QUALIFIED USER, FIT TEST WITHIN THE LAST SIX MONTHS, AND CLEAN SHAVEN PRIOR TO DONNING A RESPIRATOR.

- 6.1.2.1 Prepare the respirator for donning by adjusting the headstraps to their full outward position and placing over the facepiece.
- 6.1.2.2 Put on the facepiece by placing the facepiece snug against the face and pulling the headstrap harness up and over the head until the harness is centered at the rear of the head, and the chin is fitted into the chin cup.
- 6.1.2.3 Make certain the facepiece is centered on the face, and no hair is interfering with the face seal area. Pull both lower headstraps at the same time towards the rear.
- 6.1.2.4 Tighten the two upper headstraps.
- 6.1.2.5 Tighten the top forehead headstrap.

6.1.3 A satisfactory fit shall be determined by the following fitting tests:

- 6.1.3.1 Negative Pressure Fit Check
 - (a) Place the palms of the hands over the openings in the filter

cartridges and inhale. If the facepiece collapses slightly and no air leaks between the facepiece and the face are detected, a good fit has been obtained.

- (b) If air leaks are detected, reposition the facepiece on the face and/or re-adjust the tension of the head harness bands and repeat the negative pressure check until a tight seal is obtained.

6.1.3.2 Positive Pressure Fit Check

- (a) Use the palm of your hand to close the openings in the exhalation valve port and simultaneously exhale. If the facepiece bulges slightly and no air leaks between the facepiece and face are detected, a good fit has been obtained.
- (b) If air is detected to be leaking out between the facepiece and the face, reposition the facepiece on the face and/or re-adjust the tension of the head harness bands to eliminate the leakage. This check must be repeated until a tight seal of the facepiece is obtained.

6.1.4 If both tests indicated a tight seal of the facepiece to the face, the user shall be ready to enter the environment for which the respirator is intended. **THE RESPIRATOR SHALL PASS BOTH FIT CHECKS BEFORE THE RESPIRATOR IS USED.** The respirator will not furnish protection unless ALL inhaled air is drawn through suitable cartridges or filters.

6.2 Operation of Air Purifying Type Respirators

6.2.1 The operation of the air purifying type respirators shall be implemented under the provisions of Reference 3.1.1 and Reference 3.1.3.

WARNING: RESPIRATOR USERS SHALL LEAVE AREAS WHERE RESPIRATOR USE IS REQUIRED IMMEDIATELY IN CASE OF EQUIPMENT MALFUNCTION, UNDUE PHYSICAL OR PSYCHO-LOGICAL DISTRESS, PROCEDURAL OR COMMUNICATION FAILURE, SIGNIFICANT DETERIORATION OF OPERATIONAL CONDITIONS OR ANY OTHER CONDITION THAT MIGHT REQUIRE SUCH RELIEF.

6.3 Removal and Disposal of the Air Purifying Filter Type Respirator

6.3.1 Exit the work area to a non-airborne area. Do not exit the contaminated area prior to removing the respirator and protective clothing.

- 6.3.2 The respirator shall be removed according to the following steps:
- 6.3.2.1 The user shall grasp the base of the respirator with both hands. Do NOT hold the cartridge receptacles.
 - 6.3.2.2 Leaning forward, and holding the respirator with both hands, the user shall lift the respirator slowly out and away from the face.
 - 6.3.2.3 As the headstraps come loose over the head, the arms shall be extended out and away from the body. This is to lessen the risk of spreading loose contamination which may be present on the respirator external surfaces.
 - 6.3.2.4 Inspect the respirator after removal to ascertain that respirator was in proper working condition during the entire duration of the job. If the respirator is satisfactory, proceed to 6.3.2.5. If not, IMMEDIATELY notify the Health Physics or IH/Safety Technician providing job coverage.
 - 6.3.2.5 Respiratory protection equipment used to perform RWP-governed work shall be "bagged out" of the work area into a small "RAD" bag and sealed. The Health Physics Technician providing job coverage shall survey the respirator in accordance with the provisions of Reference 3.1.7.

CAUTION: Respiratory Protection equipment used to perform RWP-governed work shall be sampled for hazardous/radioactive materials and/or decontaminated as necessary BEFORE the return of the equipment to ATG Respiratory Protection.

6.4 Maintenance of the Air Purifying, Filter Type Respirator

- 6.4.1 Only trained technicians assigned to Respiratory Protection shall perform periodic maintenance on ATG respiratory protection systems.
- 6.4.2 All repairs/replacement of parts for ATG respiratory systems shall be documented on form ATGF-019.
- 6.4.3 The NORTH 7600-8A is an air purifying, negative pressure, filter type respiratory system which includes a full facepiece assembly and a pair of air-purifying filter elements to provide respiratory protection against hazardous vapors, gases and/or particulate matter, depending upon the filter elements used.
 - 6.4.3.1 The maintenance of the NORTH 7600-8A air-purifying, filter type respirator shall be implemented in accordance with Reference 3.1.5.

- 6.4.3.2 The NIOSH/MSHA approval and all NORTH warranties for this respirator shall be nullified if other than NORTH replacement parts are used.
- 6.4.3.3 Periodic Maintenance for the NORTH 7600-8A respirator system shall be performed as follows:
- (a) Inspect headstraps and clips for abuse. Check all elastomer and rubber parts for pliability and signs of deterioration.
 - (b) Unscrew and remove exhalation valve guard, valve and seat.
 - (c) Remove the threaded plastic flange which held the exhalation valve seat from the inside of the oral/nasal cup.
 - (d) Remove oral/nasal cup assembly by pulling it from mask.
 - (e) Unscrew the nut retaining the speaker diaphragm and remove the diaphragm and O-ring. Inspect the O-ring for damage, replace if necessary.
 - (f) Remove the speaker adapter and gasket from the facepiece by unscrewing the nut on the outside. Inspect the gasket for damage, replace if necessary.
 - (g) Remove the cartridge connectors and their grommets from the facepiece. Inspect grommets for damage, replace if necessary.
 - (h) Visually inspect the exhalation valve for damage, if necessary, replace.
 - (i) Check oral/nasal cup and inhalation valves for distortion and completeness; if necessary, replace.
 - (j) Inspect the lens for scratches and defects. Replace, if necessary.
 - (k) Reassemble the facepiece. Make certain all O-rings and gaskets are in place.
 - (l) Visually inspect the respirator; ascertain correct reassembly.
 - (m) Document all repairs or replacement of parts on form ATGF-019.

- 6.4.4 The MSA ULTRA-TWIN is an air-purifying, negative pressure, filter type respiratory system which consists of a full facepiece assembly and a pair of air-purifying filter cartridges to provide respiratory protection against hazardous vapors, gases and/or particulate matter, depending on the cartridge used.
- 6.4.4.1 The maintenance of the MSA ULTRA-TWIN air-purifying, filter type respirator shall be implemented in accordance with Reference 3.1.4.
- 6.4.4.2 The NIOSH/MSHA approval and all MSA warranties for this respirator shall be nullified if other than MSA replacement parts are used.
- 6.4.4.3 Periodic Maintenance for the MSA ULTRA-TWIN respiratory system shall be performed as follows:
- (a) Inspect headstraps, buckles and harness for abuse. Check all silicone and rubber parts for pliability and signs of deterioration.
 - (b) Pop off the exhalation valve cover, pull the exhalation flapper valve out. Inspect the exhalation valve body. Replace, if necessary.
 - (c) Loosen the clamp holding the speaker diaphragm housing in place. Pull the speaking diaphragm housing loose from the mask assembly. Inspect the O-ring, retainer ring and the speaking diaphragm. Replace, if necessary.
 - (d) Inspect cartridge receptacles and cartridge receptacle gaskets. Unscrew cartridge receptacles from the inhalation valve seat. Replace cartridge receptacle gaskets, if necessary.
 - (e) Press inhalation valve seat out through the front of the facepiece. Inspect the inhalation valves and the inhalation valve seat. Replace, if necessary.
 - (f) Inspect the lens for scratches and defects. Remove by loosening the two screws holding the lens ring and replace, if necessary.
 - (g) Reassemble the facepiece. Make certain O-rings and gaskets are in place.
 - (h) Visually inspect the respirator; ascertain correct assembly.
 - (i) Document all repairs/replacement of parts on form ATGF-019.

- 6.4.5 The 3M 7800 Easi-Air is an air-purifying, negative pressure, filter type respiratory protection system which consists of a full facepiece assembly and a pair of air-purifying cartridges to provide respiratory protection against hazardous vapors, gases and/or particulate matter, depending on the filter cartridges used.
- 6.4.5.1 The maintenance of the 3M 7800 Easi-Air respirator shall be implemented in accordance with Reference 3.1.6.
- 6.4.5.2 The NIOSH/MSHA approval and all 3M warranties for this respirator shall be nullified if other than 3M replacement parts are used.
- 6.4.5.3 Periodic maintenance of the 3M 7800 Easi-Air respirator shall be performed as follows:
- (a) Inspect the headstraps and retainers for abuse. Check all elastomer parts for pliability and signs of deterioration.
 - (b) Loosen and remove the metal restraining strap on the exhalation valve/speaker diaphragm assembly; unscrew the assembly restraint and remove.
 - (c) Remove the oral/nasal cup assembly by pulling it from the mask.
 - (d) Inspect the O-ring and exhalation valve; replace, if necessary.
 - (e) Unscrew the cartridge holders from the facepiece. Inspect the cartridge gaskets and the interior gaskets. Replace, if necessary.
 - (f) Check the oral/nasal cup and inhalation valves for distortion and completeness. Replace, if necessary.
 - (g) Inspect the lens for scratches and defects. Replace, if necessary.
 - (h) Reassemble the facepiece. Make certain all O-rings and gaskets are in place.
 - (i) Visually inspect the respirator. Ascertain correct assembly.
 - (j) Document all repairs or replacement of parts on form ATGF-019.
- 6.4.6 If it is necessary to remove a respirator from service, the technician assigned to Respiratory Protection shall complete form ATGF-019, Section I and Section IV.

7.0 **RECORDS**

The following records will be generated and retained in the permanent project file as a result of using this procedure.

7.1 ATGF-019, Respirator Evaluation/Repair Report

8.0 **FORMS**

8.1 ATGF-019, Respirator Evaluation/Repair Report

RESPIRATOR EVALUATION/REPAIR REPORT

Section I				
1. Device/Type:		2. Specified Evaluation	Sat	Unsat
A. Date		A. Straps, Suspension		
B. Evaluator(s)		B. Facepiece Material		
C. Manufacturer		C. Facepiece Integrity		
D. Model		D. Cartridge Gaskets		
E. Cartridge No.		E. Integrity -Inhale-Exhale (valves/seals)		
F. NIOSH approval		F. Speaking Diaphragm		
G. I.D. Number		G. Lens		
		H. Clamps/Connectors		
All mechanical parts (regulators, warning devices, etc.) evaluated in Section II.				
Section II - Testing (For mechanical parts: complete Section I, Part 1)				
1. Evaluation performed in accordance with procedure/documents:				
2. Test Parameters:				
3. Testing Results:				
Section III - Repair				
1. Item Repaired or replaced:				
2. Technician			3. Date	
Section IV - Comments				
Comments:				
Respirator Suitable for Issue: <input type="checkbox"/> Yes <input type="checkbox"/> No				
Respirator Removed from Service: <input type="checkbox"/> Yes <input type="checkbox"/> No				
Technician:			Date	
Reviewed by:			Date	