HNF-2207

ALARA Center of Technology - Resource Guide

Prepared for the U.S. Department of Energy

Fluor Daniel Hanford, Inc.
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

Please be aware that all of the Missing Pages in this document were originally blank pages

HNF-2207

ALARA Center of Technology - Resource Guide

L. O. Waggoner

Date Published
February 1998

To Be Presented at
31st Topical Meeting
Health Physics Society
Mobile, Alabama
February 8-12, 1998

To Be Published in
Proceedings

Prepared for the U.S. Department of Energy

Fluor Daniel Hanford, Inc.
P.O. Box 1000
Richland, Washington

Hanford Management and Integration Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

RELEASE AUTHORIZATION

Document Number: HNF-2207

Document Title: ALARA Center of Technology - Resource Guide

This document, reviewed in accordance with DOE Order 1430.1D, "Scientific and Technical Information Management," and DOE G 1430.1D-1, "Guide to the Management of Scientific and Technical Information," does not contain classified or sensitive unclassified information and is:

APPROVED FOR PUBLIC RELEASE

V. L. Birkland 2/5/98

V. L. Birkland
Lockheed Martin Services, Inc.
Document Control/Information Clearance

Reviewed for Applied Technology, Business Sensitive, Classified, Copyrighted, Export Controlled, Patent, Personal/Private, Proprietary, Protected CRADA, Trademark, Unclassified Controlled Nuclear Information.

2/2/98

INFORMATION CLEARANCE FORM

A. Information Category

- [ ] Abstract
- [ ] Journal Article
- [ ] Summary
- [ ] Internet
- [ ] Visual Aid
- [ ] Software
- [ ] Full Paper
- [ ] Report
- [ ] Other Resource Guide

B. Document Number HNF-2207

C. Title

ALARA Center of Technology - Resource Guide

D. Internet Address

E. Required Information

1. Is document potentially Classified? [X] No [ ] Yes (MANDATORY)

R. Ni (per telecon) V.B. 2/2/98
Manager's Signature Required

If Yes ______ [ ] No [ ] Yes Classified
ADC Signature Required

2. Internal Review Required? [X] No [ ] Yes
If Yes, Document Signatures Below

Counsel ______

Program ______

3. References in the Information are Applied Technology [X] No [ ] Yes
Export Controlled Information V.B [X] No [ ] Yes

4. Does Information Contain the Following: (MANDATORY)

a. New or Novel (Patentable) Subject Matter? [X] No [ ] Yes
If "Yes", Disclosure No.: ______

b. Information Received in Confidence, Such as Proprietary and/or Inventions?
[X] No [ ] Yes If "Yes", Affix Appropriate Legends/Notices.

c. Copyrights? [X] No [ ] Yes If "Yes", Attach Permission.

d. Trademarks? [X] No [ ] Yes If "Yes", Identify in Document.

5. Is Information requiring submission to OSTI? [ ] No [X] Yes
If Yes UC- 900 and B&R- ______

6. Release Level? [X] Public [ ] Limited

7. Charge Code MC30E

F. Complete for a Journal Article

1. Title of Journal

G. Complete for a Presentation

1. Title for Conference or Meeting 31st Topic Meeting - Health Physics Society
2. Group Sponsoring Health Physics Society
3. Date of Conference Feb. 8-12, 1998
4. City/State Mobile, AL
5. Will Information be Published in Proceedings? [ ] No [X] Yes
6. Will Material be Handed Out? [ ] No [X] Yes

H. Author/Requestor

Waggoner, Larry O
(Print and Sign)

Responsible Manager

Randolph Ni
(Print and Sign)

I. Reviewers

	Yes	Print	Signature	Public Y/N (If N, complete J)
General Counsel	[X]	J.T. CURTIS	K.M. Ni for JTC	(Y) / N
Office of External Affairs	[X]	S.A. WOODY	Shelia A Woody	(Y) / N
DOE-RL	[X]	reviewed-approved by B. Pangborn V.B. 2/2/98		(Y) / N
Other DOE/RL Counsel	[X]	reviewed-approved by R. SOUTHWORTH V.B. 2/2/98		(Y) / N
Other	[ ]			Y / N

J. If Information Includes Sensitive Information and is not to be released to the Public indicate category below.

- [ ] Applied Technology
- [ ] Protected CRADA
- [ ] Personal/Private
- [ ] Export Controlled
- [ ] Proprietary
- [ ] Procurement-Sensitive
- [ ] Business-Sensitive
- [ ] Patentable
- [ ] Predecisional
- [ ] Other (Specify) ______
- [ ] UCNI

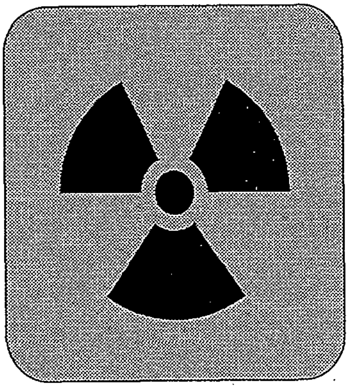
Information Clearance Approval

APPROVED FOR RELEASE
OFFICIAL
V.B
Date 2/5/98

K. If Additional Comments, Please Attach Separate Sheet

Fluor Daniel Hanford Company, Inc *Richland, Washington*

ALARA CENTER OF TECHNOLOGY



RESOURCE-GUIDE

Point of Contact
Larry Waggoner (phone 509-376-0818; Fax 509-376-7717)
Jim O'Connor (phone 509-373-7289)

RELEASE AUTHORIZATION

Document Number:	HNF-2207
Document Title:	ALARA Center of Technology - Resource Guide

This document, reviewed in accordance with DOE Order 1430.1D, "Scientific and Technical Information Management," and DOE G 1430.1D-1, "Guide to the Management of Scientific and Technical Information," does not contain classified or sensitive unclassified information and is:

APPROVED FOR PUBLIC RELEASE

V. L. Birkland 2/5/98

V. L. Birkland
Lockheed Martin Services, Inc.
Document Control/Information Clearance

Reviewed for Applied Technology, Business Sensitive, Classified, Copyrighted, Export Controlled, Patent, Personal/Private, Proprietary, Protected CRADA, Trademark, Unclassified Controlled Nuclear Information.

ALARA RESOURCE GUIDE

Table of Contents

ALARA Tools List

Dose Reduction Techniques

Recommendations Concerning the Reduction in the Use of Respirators

Guidelines for Using the ALARA Management Worksheet

Guidelines for Incorporating Radiological Controls into Technical Work Documents

Radiological Hold Points

Post-ALARA Review Guideline

Glove Bag Familiarization

Actions to Reduce the Number of Skin and Clothing Contaminations

Prevention of Heat Stress During Radiological Work

Mock-up Training

ALARA TOOLS LIST

Revision 4

FLUOR DANIEL HANFORD COMPANY, INC.
ALARA TRAINING CENTER

NOTE:

The information contained in the ALARA Tools Listing does not replace HNF or WHC Control Manuals. In addition, the listing of companies and vendors in this document does not represent an endorsement by the FDH ALARA Program Office. This document has been distributed solely for the purpose of INFORMATION ONLY.

TABLE OF CONTENTS

1.0 PURPOSE AND SCOPE 1

2.0 ENGINEERED CONTROLS 1
- 2.1 HEPA Filtered Portable Ventilation Units and Vacuum Cleaners . . 1
- 2.2 Temporary Shielding 3
- 2.3 Posting in Radiation, High Radiation and Very High Radiation Areas 4
- 2.4 Glove Bags 4
- 2.5 Containment Tents 5
- 2.6 Specialized Bags, Sleeves, and Disposable Surfaces 5
- 2.7 Closed Circuit Television System 6
- 2.8 Communication Systems 6
- 2.9 Vented Hoods and Glove Boxes 6
- 2.10 Special Decontamination Methods 7
- 2.11 Special Tooling 9
- 2.12 Remote Systems And Robotics 9
- 2.13 Computer Programs Related To Radiological Controls 9
- 2.14 Brookhaven National Laboratory Fax Service 10
- 2.15 Wireless And Electronic Dosimetry 10
- 2.16 Scale Modeling 10
- 2.17 Spray Foam 11
- 2.18 Aerosol Generation 11

3.0 ALARA CENTER OF TECHNOLOGY 12

4.0 TRAINING FOR RADIOLOGICAL WORK
- 4.1 Skills and Mockup Training 12
- 4.2 "Virtual Reality" Technology 12

5.0 RADIOLOGICAL WORK PLANNING 13

6.0 GOOD RADIOLOGICAL WORK PRACTICES 16

7.0 VENDORS 21
- 7.1 Specialized Equipment, Services, and Systems 21
- 7.2 Vendors Specializing in Decontamination 24
- 7.3 Shielding Tables 29
- 7.4 "Stores" Material for Use as Temporary Shielding 30

8.0 CONTAINMENT SKETCHES AND STOCK NUMBERS 32
- 8.1 Spare Parts List 32
- 8.2 Poly Bottle Connected To A Catch Containment 34
- 8.3 Catch Containments 36
- 8.4 Type I Glove Bag, FIC Glove Bag 38
- 8.5 Type II: Standard 4" Riser Bag 40
- 8.6 Type IV: Greenaway 42
- 8.7 Type VI Glove Bag: Rulon Glove Bag 44

8.8 Type V 46
8.9 Type VIII: Butch Hall Glove Bag 48
8.10 Type X Glove Bag: Wilder Glove Bag 50
8.11 Type B Containment Frame:
Type II, III, IV, and VI Glove Bag Frame 52
8.12 Type I Containment Tent
(For Non-Ventilated Applications) 54
8.13 Type II Containment Tent
(For Ventilated Applications) 55
8.14 Breather Filter Assemblies 58
8.15 Type I/II Tents 60
8.16 106-C Splash Guard 62

1.0 PURPOSE AND SCOPE

Purpose: To provide a source of information that can be used to assist personnel in the planning, training, and execution of radiological work using the principles of ALARA. This document is not intended to replace HNF or WHC Control Manual requirements.

Scope: The ALARA Tools List provides detailed information on the use and procurement of engineered controls, mockup training guidelines, and good radiological work practices that have been proven to be ALARA.

2.0 ENGINEERED CONTROLS

What is an engineered control? The systematic application of both work practices and engineering principles to tasks that present a risk to the operator and/or environment so that the work can be accomplished in an efficient, controlled, and safe manner consistent with the ALARA principle.

What is the goal of engineered controls? The overall goal is to reduce the need for respirators, confine and minimize the amount of loose surface contamination, reduce radioactive waste, reduce radiation exposure, increase worker efficiency, and in general,comply with the ALARA principle.

The following is a list of those engineered controls and some good radiological work practices that should be used to reduce radiation exposure and limit the spread of contamination. Note: This list is not all-inclusive, but represents some of the practices that personnel use to accomplish radiological work. If you can add more examples of engineered controls to the list, please contact the ALARA Program Office at (509) 376-0818/(509) 373-7289.

2.1 HEPA Filtered Portable Ventilation Units and Vacuum Cleaners

Portable ventilation units and vacuums that are equipped with High Efficiency Particulate Air (HEPA) filters are a proven engineered control that can be used to evacuate air in contaminated work areas. When the suction end of the hose is placed near loose contamination, any airborne contamination that is created during work tends to be sucked into the hose and captured on the HEPA filter rather than spread throughout the work area and into the worker's breathing zone. The use of ventilation can greatly reduce the amount of contamination spread and may reduce/eliminate the need for respiratory protection.

The placement of the ventilation hose end is extremely important. The hose should be positioned so the air is drawn away from the worker. Normally workers are taught to position the hose as close as possible to the work at 90 to 180 degrees from their position. If the hose end is located more than one duct diameter away, it will not be effective in controlling contamination spread. For example: If the hose is 2" in diameter, the hose must be within 2" of the work, preferably, as close as possible.

If a ventilation system is being used to provide negative ventilation for a containment tent,it is important that the placement of the hose in relation to what work is going to accomplished be considered. If the work involves highly contaminated items, you should consider extending the hose into the containment so workers can move it around to the best positions for each phase of the work. It is important to keep the ventilation hose as short and as straight as possible. A screen placed over the end of the hose will prevent large objects from being sucked into the system and plugging the filter.

If the ventilation system is going to be used to remove large amounts of fissionable radioactive materials, contact personnel from Criticality and Radiological Analysis to evaluate the system prior to use. Points-of-Contact is: Joe Estrellado at (509) 376-7490

If the ventilation system is going to be used outside a facility or in a facility which does not have a HEPA filtered stack exhaust (K Basin), a permit may be required to operate the system. Refer questions to (509) 376-8629 or (509) 372-2066.

Prior to the use of any HEPA filtered ventilation system or vacuum cleaner, it must be aerosol tested to insure it is installed correctly and will filter out radioactive material. Portable ventilation units are tested after they're installed and just prior to use. Contact (509) 373-4866 to arrange for aerosol testing and assistance in balancing the ventilation. After the aerosol testing is complete, certification tags are placed on the units to inform personnel that the unit is tested and when that certification expires.

If a vacuum cleaner is going to be used to collect highly contaminated chips or debris, consideration should be given to installing a chip collector in-line so the chips do not plug the vacuum cleaner and make it highly radioactive. These chip collectors can be obtained from Rich Stephenson at (509) 376-0939 or the ALARA Center at (509) 376-0818.

Another innovation that can be used is to install an in-line HEPA filter in the hose so that highly radioactive materials are collected on a filter that can be easily shielded and changed out without effecting the aerosol testing of the main HEPA filter. These in-line HEPA filters can be obtained from different facilities spare parts inventory and adapters made so that the hose can be attached to each end. For example: An in-line HEPA filter was installed near the suction end of a vacuum hose used to clean a ledge inside a reactor vessel. After vacuuming, the in-line filter read 130 R/hr and the vacuum continued to read background. Smear surveys taken on the discharge side of the filter showed no contamination had passed through the filter. Phone (509) 376-0818 for assistance in obtaining these filters.

Some vacuum cleaners can be fitted with controllers so the user can regulate the air flow. This allows the vacuum cleaner to be used to provide negative ventilation in glove bags. The user regulates the air flow so the glove bag bows inward but not enough to damage the bag.

2.2 Temporary Shielding

The use of temporary shielding should be considered for all work in radiation and high radiation areas. Surveys should be taken prior to the start of work in the actual work area and the pathways personnel must travel to get to the work area. An evaluation of the readings should be accomplished to determine how much each source contributes to the general area readings. This evaluation should include how much shielding is required and how it should be installed.

If personnel could come in contact with a "Hot Spot" during work the "Hot Spots" should be either shielded, isolated or eliminated. For example: A hot spot could be screened off so personnel can't get close. This could be done with a metal screen, a herculite/plexiglass panel, metal straps, or other common materials.

Common shielding materials used on site for gamma radiation include steel, lead, water, and concrete. If lead shielding is the best choice, protect the lead so it does not become contaminated or it will have to be treated as "mixed waste" and will be very difficult to store and dispose of later. Shielding materials used for beta radiation include aluminum, rubber matting, and plexiglass which are available in "stores." (See Sections 7.2 and 7.3) Isotopes emitting neutrons are shielded by materials such as water, polyethylene, and plastic which are rich in hydrogen atoms. Note: Before shielding for neutrons, contact Criticality Safety for approval.

Water shields are a type of temporary shielding that are easy to transport and install. Water is added to the containers after they are placed in position. Some containers are tanks that have rigid walls made from metal or plastic while others are bladders that inflate as water is added. The rigid walled containers have a fill connection on the top and a drain valve on the bottom. They are often mounted on wheels so they can be moved around. After the job is finished, the water shield can be drained and removed from the area. If denser shielding is required, the water shields can be filled with sand.

Concrete blocks can be obtained from local concrete companies, e.g., ACME Materials or Central Pre-Mix at low cost. Recently 2' X 2' x 6' "Ecology" blocks, which weigh approximately 3600 pounds, were purchased for $25.00 each. They were used for shielding outside a building in the 300 Area. The company delivered the blocks and installed them for an additional $50.00 per block. Points-of-Contact are Craig Mayfield (509) 545-8510 at Central Pre-Mix and Bill Zigler or Randy Pfliger (509) 946-4131) at ACME Materials.

2.3 Posting in Radiation, High Radiation, and Very High Radiation Areas

Posting the radiation levels in work areas can be an effective tool in reducing radiation exposure. Diagrams or copies of the latest radiation survey are posted near the entrance to these areas. A sign that outlines each worker's responsibilities is also located nearby. This sign can be obtained from "stores" on stock #0037-9100-100. "Hot Spots" within these areas are posted with signs that identify the radiation level and the words "Caution-Hot Spot." These signs are also obtained from "stores" on stock #0037-8100-400. Some facilities are using "Low Dose Standby Area" signs to identify where personnel should stand if there is a momentary delay in their job. These signs are available through vendors.

B Plant has photographed the access control and posting of each of their High Radiation Areas, Fixed Contamination Areas, and areas that utilize Temporary Shielding. This has proven helpful with audits, as well as, identifying locations of these areas to those not totally familiar with their location. The photos show the posting and locking device used at the entrance to each of these areas. Contact Steve Hathaway at (509) 372-0382 for more information.

2.4 Glove Bags

One of the best engineered controls for performing radiological work is the glove bag. Glove bags confine the spread of contamination to a small area and allow the work to be performed by personnel wearing minimum protective clothing. There are several vendors that sell small HEPA filtered ventilators designed for use in a glove bag. A glove bag that has negative ventilation provides a high probability that radiological work can be performed with a minimum chance of spreading contamination. Glove bags can be obtained from several vendors or custom made by the PFP Plastics Shop (509)373-2220. Vendors that sell glove bags to the site include:

Mohawk Industrial & Nuclear Suppliers	(800)394-6825
Nuclear Power Outfitters	(815)455-3777
LANCS Industries	(206)823-6634
G/O Corporation	(504)847-0564
Safety & Supply	(509)735-2905
D. A. Services	(203)285-0808

These vendors have standard design containments on hand that will work for most applications and they will build special order containments based on your sketch. Tank Farms Radiological Control personnel have added glove bags and containments to "spare parts" and are available for all facilities to purchase at Building 2101M, Door 106, in 200E Area. Section 8.0 has several generic design sketches included for reference ideas. Additional information can be obtained by contacting Bob Brown at (509) 372-2932 or Larry Waggoner at (509) 376-0818.

Workers and RCTs who intend to work in a glove bag must be specially trained in order to use the glove bag properly. This training and sketches showing how to use a glove bag are contained in WHC-EP-0749; Radiological Containment Guide.

This guide is available through facility ALARA Committees or the Area Radiological Control Manager--copies may also be obtained from Document Control at (509) 376-5421 or (509) 376-9654. The Hanford Training Center conducts skills training in the use of containments and glove bags. Contact Dan Martini at (509) 372-3720 for information. TWRS Operations is also conducting training on the installation, certification and use of glove bags and containments. 0 Point-of-Contact is Becca Flores at (509) 373-9502.

2.5 Containment Tents

The PFP Plastics Shop and many of the vendors listed in Section 2.4 can provide containment tents. The need for a containment will be identified in the work procedure or RWP. The containment design will depend on many factors such as work to be accomplished, amount of loose contamination/liquid/chemicals expected, type of tooling used, type of temporary services needed, number of personnel involved, how the containment will be supported, number of ante rooms required, and the time required to complete the work. See Section 8.0, for a list of containments and accessories that are available on-site.

2.6 Specialized Bags, Sleeves, and Disposable Surfaces

The PFP Plastics Shop is capable of making many specialty items from plastic materials. During the performance of radiological work, personnel often try to use materials that are off-the-shelf and have difficulty wrapping or enclosing contaminated materials. Rather than risk spreading contamination, it may be desirable to have a special bag, sleeve, or other containment device that is custom-made to fit the component or equipment you're working with.

Examples of these materials include:

a. A reinforced oversized bag that will exactly fit the item you need to contain. This bag could have leather at points where sharp edges will be present, a top that seals with velcro, pockets for containing tags, and absorbent materials attached to the bottom of the bag.

b. A special sleeve that can be used to place a component in so the loose contamination is not spread. This sleeve could be equipped with PVC windows, a HEPA filter, a draw string, and glove sleeves similar to a glove bag.

c. A disposable surface be placed underneath to catch loose contamination when working on a valve or other component. If made by the Plastics Shop, it could be made with grommets in the corners so that it can be securely tied; the edges could be folded around banding material so that it will maintain whatever shape you want it to stay in and a drain could be installed at the low point. This drape or catch containment could be fitted with a fire retardant liner if it will be catching hot metal chips or sparks from grinding operations. (See Sketches 8.2 and 8.3)

2.7 Closed Circuit Television System

The use of the closed circuit TV system can save exposure by allowing personnel to make inspections, perform surveillance, and observe work practices without actually entering high radiation areas. With a VCR connected, the workers can video tape problems in the work area, as well as, make a video tape for future training and historical reference. It is estimated that for each person-rem saved by the use of the system, average dollar savings of $5000.00 is attained. For some applications, the savings may be even higher.

Fortunately, at Hanford we have access to equipment and experienced personnel to assist on the installation and operation of closed circuit television and video systems. Many black and white cameras and TV monitors are now available for use at practically no cost. Some of these cameras zoom, tilt, and pan so an operator can change the position as often as needed. Contact Larry Waggoner at (509) 376-0818 for assistance in obtaining these cameras. If you need something videotaped, contact Videography Services at (509) 376-6960. As the emphasis on exposure reduction increases, the cost savings associated with saving exposure should also increase.

2.8 Communication Systems

In order to better communicate during the performance of radiological work, low power radio systems can be used to allow personnel to converse under adverse conditions, e.g., while wearing a respirator or in noisy work areas. TWRS uses Model #21404 from Radio Shack for pit work in the Tank Farms. The cost is $35.00 for two units. T Plant uses catalog model #21408 (TRC-508), which are about $100.00. The earpiece acts as both a receiver and transmitter and is connected to a small unit worn under the protective clothing.

2.9 Vented Hoods and Glove Boxes

These devices are used to partially or completely enclose the work and use the suction from a HEPA filtered ventilation system to confine the spread of contamination. They are commonly found in many facilities on site. A fume hood's ventilation system can be directly effected by the person standing at the front of the hood. Eddy currents in the air stream can cause contamination to be pulled out of the hood if the ventilation suction points on each side of the work area are obstructed. Specialized training on the use of this equipment is provided by each facility.

2.10 Special Decontamination Methods

A detailed list of vendors that specialize in decontamination chemicals, equipment and services is provided in Section 7.2 of this instruction.

CO_2 Decontamination: In 1994, this technology was evaluated and a contract established to set up a portable facility on site to demonstrate how effective decontamination using carbon dioxide pellets propelled by dry compressed air would be on various types of materials and components. The advantage of this process is that no costly secondary wastes are created. The portable facility was used at B Plant and 222-S Laboratories. The CO_2 unit then moved to the 313 Building (300 Area) for testing on tools and equipment contaminated with Uranium. Results exceeded expectations. B Plant was able to free release assorted hand tools, electric drills, fan blades, metal collars, etc. They also free released a boneyard containing many materials accumulated over the last ten years. Approximately 4500 ft^2 of materials/equipment and 22,000 pounds of lead were decontaminated for 222-S Labs and the Central Waste Complex. A cost savings of over five million dollars was estimated during the period this facility was be on site. Currently, there are several companies that utilize the CO_2 Decon systems.

Dustless Decontamination Systems: These systems combine a high performance vacuum/waste packaging unit in conjunction with pneumatically operated scabblers and needle scalers to decontaminate concrete and steel surfaces. The actual surface material is removed by pistons with tungsten-carbide tipped bits which repeatedly pound and pulverize the surface. Smaller areas are decontaminated by using metal needle scalers. This equipment will remove up to 3/16 inch of material per pass and vacuum the debris into drums. The air continues on through a HEPA filter before being discharged. The EG&G at Rocky Flats has used this system to successfully decontaminate large areas of contaminated concrete. Air samples taken during use showed no airborne contamination. Point-of-Contact is Michael Simmons at (303)966-7574 for EG&G and Patrick Nace, Pentek, Inc. Representative, at (412)262-0725.

Soil Decon Truck (Guzzler): The guzzler truck has a large HEPA filtered vacuum and is used to remove surface materials and soil. The material is sucked into a hose, 3-6 inches in diameter, and collected in a 17 cubic yard container for transportation to a site burial ground for disposal. The system can be modified so that the material is deposited in individual drums instead of the truck mounted container. Point-of-Contact is Mitch Baron at (509) 372-0453. To date, this system has not been used to collect contaminated materials.

Strippable Latex Paint: Several manufacturers sell a strippable latex paint that can be brushed, rolled, or sprayed over radioactive contamination. This paint "fixes" the loose contamination and once it dries, it can be peeled up and most of the contamination is removed with the strips of paint. When sprayed with an air-less sprayer, a thickness of 20 mils works well.

The paint is thick enough to encapsulate the contamination and will normally dry in 6-8 hours. Drying times will vary depending on the thickness of the paint, ventilation, temperature, and weather conditions if the location is outside a facility. The strippable paint is easily removed from large flat areas, walls, painted lagging, etc. It is difficult to remove from armored electrical cabinets/equipment that have ventilation louvers or screens unless these areas are covered. In addition, do not apply the coating to uncovered motor ventilation air passages, open drain funnels, open ends of piping, or other areas where it will difficult to remove. Past experience has shown that the strippable coating does not dry properly on copper or bronze materials. Prior to applying the paint, it is important that personnel walk through the area and identify those areas where the paint should not be applied. Apply the paint per the manufacturer's instructions. When dry, the coating may have to be scored to provide a starting point and then can be peeled and rolled into a ball. The FDH ALARA Program Office has a videotape of the strippable latex being used on actual radiological work. Contact (509 376-0818/(509) 373-7289 to obtain a copy. On large jobs in highly contaminated areas it may be desirable to spray the latex in the work area before work starts, then do the work in reduced protective clothing and remove the strippable paint at the end of the job. This paint is available in "stores" on Stock #524-150-01 (1 gallon) or Stock #524-150-05 (5 gallon).

<u>Chemical Decon Applications:</u> There have been well-publicized success stories about the benefits of decontaminating reactor plant primary systems and major components by injecting different chemicals into the systems. Application of these chemicals on a smaller scale can also be used with positive results. Some commercial utilities have isolated small sections of pipe runs and/or small tanks and injected chemicals directly into these systems. They are then agitated and flushed. This method has shown excellent decontamination factors with relatively little expense.

<u>Hydrolasing Techniques:</u> The high pressure spraying of hot water is an effective way to decontaminate tools and equipment. There are several types of hydrolaser heads/wands available that will get into most crevices of complex equipment. A system in use in the 200 Area is located in a conex box and consists of a stainless steel enclosure and sliding table. Sections of well drilling equipment are placed on the table and pushed into the enclosure. After closing the door, workers spray the item with high pressure heated water. This water is filtered and recirculated so it can be recycled over and over. Hydrolasing has been used at K Basin to decontaminate piping. General area radiation levels have been reduced 40-80% using this method. Point-of-contact is Jerry Kurtz @ (509) 373-3249.

<u>Bead/Sand/Ice Blasting:</u> Other methods that have been used in the nuclear industry are sand, bead, and ice blasting. These methods remove the contaminated surface areas of the object being cleaned using high pressure sand, beads, or ice. These methods are highly successful but create contaminated residue that must be disposed of as radioactive waste.

2.11 Special Tooling

Specially ventilated hand tools are available from several vendors that have a connection for installing a hose from a HEPA filtered vacuum cleaner. As the tool is used, chips and debris that are created are sucked directly into the hose creating an essentially dustless environment. Some vendors sell shrouds that can be attached to the tools you already have such as grinders, sanders, drills, saws-alls, etc., that provide the vacuum hose attachment. The advantage to using tools in conjunction with a vacuum cleaner is that any airborne contamination created by the tool will be sucked away by the vacuum cleaner. A video of these tools in operation is available from the ALARA Program Office at (509)376-0818/(509) 373-7289.

Special tooling for cutting piping is available from several vendors. Normally, this type of tooling mounts on the outside of piping and is operated by a pneumatic motor. It not only cuts the pipe, but also end preps the cut area. This significantly reduces the time to accomplish the cutting and end prep. Other tooling is available that mounts to the inside of the piping for special applications. Contact Radiological Engineering (509) 376-0818 for assistance regarding the use of special tools.

A hydraulic shear (jaws-of-life) has been used to cut up piping jumpers in TWRS underground valve pits and at 100K to remove abandoned piping. The shear quickly cuts the material up to 6" in diameter so that it can be placed into burial boxes. The shear is made by Speedway Hydraulics @ (805) 379-9715.

2.12 Remote Systems and Robotics

There are several remote systems and robotic devices used on site to gather information and work in inaccessible and/or high radiation areas. These systems include small tractor like devices which are used in piping as well as manipulating tools used on cranes. For more information related to use and procurement of these devices contact Hanford Robotics at (509) 376-5215 or Pacific Northwest Robotics at (509) 375-6914.

2.13 Computer Programs Related to Radiological Controls

There are several computer programs that exist on site that can be used by radiological control personnel to make their job easier and more efficient. These programs are:

a. MICROSHIELD - This program can be used to calculate the amount of shielding needed for a particular isotope and determine source strength. Training is available and Jess Greenborg at 376-3482 is a good Point-of-Contact. The program is available through stores (Stock #0072-7050-685).

b. HUDU - This program will let you estimate dose rates downwind in a plume if a radioactive spill occurs outside in the environment.

c. RADDECAY - This program provides a great deal of information about 497 radionuclides. This information includes half-lives, radioactive daughter nuclides, probabilities of decay and the decay product energies for alpha, beta, electrons, positrons, x-ray and gamma photons.

d. ISOSHIELD - This program is similar to MICROSHIELD but requires personnel to have a more extensive knowledge of Health Physics and using complex computer codes.

e. SHARE - This program will let the user identify lessons learned from similar tasks that have occurred at WHC. This program is available as a network application or may be obtained by contacting Julia Hu at (509) 376-1549.

2.14 Brookhaven National Laboratory Fax Service

The Brookhaven National Laboratory (BNL) maintains a fax service that can be accessed by anyone with a fax machine. By calling their number from your fax machine, you can obtain up to seven hundred documents related to ALARA. These documents are prepared by individual DOE, DOD, and commercial nuclear facilities and sent to BNL for incorporation in their data base. The telephone number to call is (516) 344-7361. A recording will give you instructions on how to obtain up to five documents with each phone call. A list of available documents can be obtained during the call or through your facility ALARA Chairperson and/or the ALARA Program Office at (509) 376-0818/(509 373-7289.

2.15 Wireless and Electronic Dosimetry

Radio Transmission Dosimetry Systems have been tested by Tank Farm personnel with mixed results. The system works better inside facilities than it does outside. The system consists of a whole body dosimeter, an extremity dosimeter, and a base station personal computer. The dosimeters send dose information and receive set points and remote alarms from a central base station through a radio communications link. The extremity dosimeter can monitor up to four extremities. At the base station, the dose and dose rate can be read out and alarms reset to provide real time ALARA control. Although not designed to be a survey instrument, the dose rate can be measured from background to 500 R/hr linearly. Another feature is the dosimeters can be set to chirp at intervals as low as every 0.01 mrem so that personnel will have an audio response to tell them when they enter higher radiation fields. Point-of-Contact at Hanford is Robert Ford at (509) 376-8585.

2.16 Scale Modeling

Scale modeling can be an effective ALARA tool to increase efficiency and improve productivity. Reducing the amount of time spent in radiation fields is one of the most direct ways of reducing radiation exposure. An effective approach for minimizing time spent in radiation areas is to construct a physical scale model for planning, training, and orienting workers. The complexity of the model is determined by its intended use.

If the model is to be used for equipment laydown, a simple block model may be sufficient. If it is used to support maintenance activities or personnel training, a detailed model showing components, wiring, piping, ducts, etc., may be required. Facilities that have used models report that it is a very effective tool and much better than listening to verbal descriptions, looking at photographs, or marked-up drawings.

2.17 Spray Foam

Spraying expandable foam into contaminated ventilation ducts that are being removed has proven to be an effective way to seal the ducts and prevent the spread of contamination during removal of the duct. Holes are cut into the top of the duct and workers spray the foam inside. The foams expands to completely fill the space and becomes solid. Point-of-Contact is Rich Hobart at (509) 373-2316. Experiments with cans of spray foam insulation to plug piping has been accomplished with good results. A 1/4 inch hole is drilled into the top of the pipe and the foam sprayed through the opening. This foam expands and becomes a solid plug after 24 hours. The piping can then be cut with less risk of spreading contamination. Several types of foam have been found that are non-hazardous in their dried form. Contact the ALARA Center at (509) 376-0818 or Don Gardner at (509) 373-1867 for a list of these foam products. It is important to use a foam that dries to a non-hazardous material to prevent having to control the removed materials as mixed waste.

2.18 Aerosol Generation (Fogging)

An aerosol generator has been recently used to apply a "fixative" to highly contaminated underground valve pits. A vendor mixes chemicals and then bombards them with sound waves to form an aerosol. This smoke-like material moves slowly down a hose and through an opening in the concrete cover block over the valve pit. The aerosol completely fills the air space in the pit and all surfaces are covered with a sticky fixative. Any airborne contamination present is encapsulated by the aerosol and deposited on the surface. This film covers all the removable contamination and prevents it from spreading when the cover blocks are removed. Work in these highly contaminated pits has been accomplished without any spread of contamination. Smear surveys show the removable contamination is very low, once the fixative has been applied. The fixative washes off easily when sprayed with liquids or rain. Potential uses in the future include ventilation ducts, fume hoods, and process rooms at Plutonium facilities. In addition, a diluted strippable latex decontamination paint could be applied remotely using this technique and then the area entered by personnel who could then strip the coating off, decontaminating the surface. Contact Craig Upchurch at (509) 373-0074 for more information or call the vendor, Encapsulation Technologies at (509) 377-3842.

3.0 ALARA CENTER OF TECHNOLOGY

An ALARA Center of Technology (ACT) has been established in the 200 East Area, at Building 2101M, Room 226. This facility contains examples of operating engineered controls (i.e., containments, glove bags, HEPA ventilation/vacuum cleaners, decontamination techniques, cameras, special tooling, temporary shielding, etc.) used to accomplish radiological work at Hanford and in the nuclear industry.

Generic radiological control classes are offered, as well as, specialized training to fit individual facility needs. Most of the training is hands-on and very intensive. The individual training is enhanced by having working mock-ups available so that workers can learn to apply their skills in simulated work environments. Planners preparing for unique or non-routine jobs are able to tour the facility and see various options available for performing radiological work. A supply of vendor catalogs and video tapes are available for personnel wanting to purchase engineered controls. A computer that has the Search Hanford Accessible Records Electronically (SHARE) program is available to aid personnel in finding lessons learned. Fax Number at the ALARA Center is (509) 376-7717.

4.0 TRAINING FOR RADIOLOGICAL WORK

4.1 Skills and Mockup Training

Complex radiological work performed in high radiation areas or involving work on highly contaminated systems require specialized skills training for workers and RCTs to verify the work practices, procedures, and tooling perform satisfactorily. The "WHC Occupational ALARA Program", WHC-IP-1043, Chapter 5, provides detailed information on Skills and Mockup Training. This manual is in the process of being revised but information can be obtained from Bill Decker at (509) 372-2881.

4.2 "Virtual Reality" Technology

"Virtual Reality" is a technology-mediated illusion of being totally immersed in a three-dimensional environment that you can navigate and manipulate. It's an environment that is created by a computer in which objects appear to occupy space. This "Virtual World" can consist of anything that can be modeled in a computer; it is the "immersive" dimension that gives the user the feeling of being present in a scene and is free to move about.

A Virtual Reality system was created by the Solid Waste Characterization Section and to date has saved many labor-years in "real time" graphics-based modeling and simulation work. Operational training capabilities has greatly improved by providing a "completely safe" environment to perform training and has provided a superior and highly efficient source of information to improve solid waste management activities at Hanford.

This technology is expanding quickly to other facilities and Companies. It is sure to enhance our abilities to train personnel to accomplish radiological work. Point-of-Contact is Ed Mertens at (509) 376-2459.

5.0 RADIOLOGICAL WORK PLANNING

Personnel responsible for planning radiological work need to include the Radiological Control Organization early in the planning process on those jobs that involve work with highly radioactive systems or are located in high radiation areas. Some of the items that should be considered when planning radiological work are:

a. Inspect the work area and list interferences and lagging that must be removed. Is the lagging asbestos? Look at access routes and determine if materials, components, and equipment can be removed and installed as required? Do any components in the area need temporary protective covers to prevent them from being damaged? Is there any staging required to be installed? Is other work scheduled to be done that will interfere with this job?

b. Consider whether temporary shielding should be installed to reduce work area and access route radiation levels. Obtain a copy of the latest work area radiation survey and review with Radiological Control. Request shielding be installed, if required. It may be possible to remove or isolate the sources so personnel can not come in contact with them.

c. Before opening a system, component, or equipment that is radioactively contaminated, try and assess the potential hazards before the job starts as part of the planning process. Determine if this system has been opened at other locations that may provide a clue as to what the contamination levels will be on the inside. If possible, have the system opened at a convenient location to obtain surveys. If liquid samples have been drawn, have them analyzed to determine activity levels. If the system is located in a low background radiation area, request the RCT perform contact surveys on the surfaces to determine radiation levels. Determine if the system has been subjected to high pressures and heat which would tend to create more contamination on internal surfaces. Determine if the system may have residual liquid or residue that will spread contamination upon opening and estimate the quantity. Factor all this information into the work procedure so that it contains the proper radiological work practices for performing this job.

d. Determine whether the posting of the work area will affect the plans for accomplishing the work. Is it a High Radiation Area, Radiation Area, or Confined Space?

e. Determine what services and communications are required to support the work. If the work is to be done in a glove bag or containment tent, make sure it will be installed and certified when work is scheduled to start. If portable HEPA filtered ventilation is going to be used, ensure it meets the requirements of Section 2.1, above.

f. If the work area is contaminated, it should be decontaminated prior to the start of work. The goal of this decontamination should be to remove the gross contamination in order to reduce the possibility of spreading airborne and loose contamination during work. This reduction in removable contamination may also allow RCTs to reduce the required PPE for the job.

g. If the area can't be decontaminated, consider covering the contamination so the amount of removable contamination is reduced. This will reduce the risk involved and may reduce the PPE. Methods to cover the contamination include the use of strippable latex paint, contact paper, plastic sheet and tape.

h. Prefabrication of components should be accomplished in low radiation areas to reduce radiation exposure.

i. Consider the use of special tooling or adapters that can be made to make the work go faster. Does the tooling for this job need to be calibrated or sharpened?

j. Minimize the discomfort of workers. Determine if measures can be taken to regulate the temperature in the work area to 70-80 degrees fahrenheit. Consider installing a reflective heat shield or camouflage netting to reduce work area temperatures. Add temporary lighting, if required to illuminate the work area.

k. Estimate the person-rem required to accomplish the job to determine if enough workers are available. If the job is complex and/or involves work in High Radiation Areas, it may be necessary to assemble a team to review the work procedure and perform a time-motion study for each worker in order to determine an accurate dose estimate.

l. Compare the RWP to the work procedure to assure they compliment each other and are correct. If an ALARA Manager's Worksheet has been prepared, review it to ensure it is correct and take corrective actions as required.

m. Determine if there are any special plant conditions, system isolation or vital services required to prepare the work area for work. Should valves or switches be tagged out to prevent unauthorized operation during work? Is there a need for heat or freeze protection?

n. Determine whether special skills training is required to accomplish the job. It may only be necessary to properly brief personnel at the pre-job briefing and rehearse difficult work steps just prior to performing those steps.

o. Review lessons learned from previous jobs to determine if additional actions need to be taken to prepare for this job. Contact Jim O'Connor at 373-7289 for assistance in obtaining lessons learned from various databases.

p. Consider conducting planning meetings to track preparation of work procedures, materials, tooling, and containments.

q. Assistance is available to personnel who have to plan radiological work from Radiological Engineering and the ALARA Program Office. The latest lessons learned, vendor information, video tapes, and samples of tooling/equipment/ materials used to perform radiological work are available by contacting Bill Decker at (509) 372-2881, Jim O'Connor at (509) 373-7289 or Larry Waggoner at (509) 376-0818.

6.0 GOOD RADIOLOGICAL WORK PRACTICES

The following work practices have been proven to either reduce radiation exposure or limit the spread of contamination:

1. <u>DECONTAMINATE:</u> Before working on a contaminated component, decontaminate the exposed surfaces to reduce contamination levels. During work, continue to wipe down the item from time-to-time to keep the contamination levels low. If wipedowns are ineffective, cover exposed surfaces adjacent to the work area with tape, poly, or damp cloths to cover the contamination. Cover the unneeded parts of tools with tape or plastic so they will be easier to decontaminate and release at the end of a job.

2. <u>LOCALIZED VENTILATION & FIXATIVES:</u> Place a HEPA filtered ventilation suction hose near contaminated work areas so that any airborne contamination is drawn away from the workers. In addition, spray the surrounding areas with water or a fixative from a "spritzer" bottle or garden sprayer to dampen any loose contamination so that it will not spread as easily. A recent test conducted at 100N showed that combining water and Elmer's glue at a 25:1 ratio would dampen the surface and form a film on top of the contamination so that it would not require respraying at frequent intervals. This effectively "fixes" the loose contamination so there is less risk of it becoming airborne. Other facilities have varied the ratio of glue to water depending on the levels of contamination.

3. <u>MINIMIZE "MIXED" WASTE:</u> The amount of "mixed" waste that is created during radiological work can be reduced by evaluating each product and finding substitutes or ways to prevent it from becoming contaminated. List each product used on a particular job and review the Material Safety Data Sheets (MSDS) to determine if it is hazardous material. Look for substitute products that will accomplish the same function that are not hazardous material. If you must use a product, determine how much you need and only take that amount into the work area. Evaluate wrapping the item in plastic or tape to keep it from getting contaminated.

4. <u>HOUSEKEEPING:</u> Housekeeping in Contamination Areas (CA) is very important. If a spill occurs, the cleanup will be much quicker and easier if the area does not contain large amounts of unnecessary materials. As each phase of a job is completed, the individual workers should clean up after themselves.

5. <u>CONTAMINATION AREA BOUNDARIES:</u> Services and equipment that penetrate the boundaries of CAs should be securely tied off and marked so that personnel cannot pull the item into or out of the CA without being surveyed by an RCT.

6. <u>MINIMIZE TOOL CONTAMINATION:</u> Minimize the amounts of materials taken into CAs to reduce radioactive waste and materials that will require decontamination later. Some tools and materials can be

sealed in tape or plastic to prevent them from becoming contaminated and then this covering removed when the item is brought out of the Contamination Area.

7. <u>PREVENT PPE FAILURE:</u> Cover or pad the sharp edges of tools or equipment to prevent injury and reduce the spread of contamination. Wear leather or heavy work gloves when handling tools and equipment that have sharp edges to prevent damage to the worker's PPE and possible contaminated wounds.

8. <u>PREJOB CHECKS:</u> When preparing a glove bag or containment tent for work, ensure the services that connect to the containment are operational. If there is a drain hose to a poly bottle make sure the drain is not plugged and the connections are tight at each end. The poly bottle should be securely tied so it will not tip over and have a HEPA filter installed. If a pump is attached, make sure it is installed correctly and will actually start when turned on. If a vacuum cleaner or ventilation system is installed, make sure the unit is marked with a certification sticker that shows a current aerosol test date for the HEPA filter. If the test date will expire before the job is complete, have it retested or replace the unit. Ventilation systems should have screens over the end of the hose and the system should have been balanced for the job. If the vacuum cleaner system includes a chip collector, inspect the chip collector to make sure all connections are tight.

9. <u>FIXED CONTAMINATION:</u> Many facilities have areas that were contaminated but have been painted over to prevent personnel from spreading loose contamination. The paint "fixes" the contamination so that it is no longer loose. The painting process requires that the first coat be yellow and the following coats be non-yellow. If your facility has these type of painted over areas, make sure the paint is inspected periodically and surveys taken. If the yellow paint starts to appear in high traffic areas, the area needs to be surveyed and repainted.

10. <u>TEMPORARY CONTAINMENT:</u> A PVC cover equipped with glove sleeves and HEPA Filter could be attached to the front face of a ventilated hood to convert the hood into a glove box for work on very highly contaminated items or pressurized samples.

11. <u>AIR SAMPLING DURING WORK:</u> RCTs are required to take portable air samples during work in the worker's breathing zone. Normally, this is defined as within one foot of the worker's head. If the workers move around a lot to perform the work, take the sample in the area that would be representative of the air they would breathe. This would be on the downwind side if the job was outside a facility. It is important not to obstruct the workers while they are performing their job, but at the same time you should try and get sample in the correct location. On most jobs, the air sample filter paper is located in an adapter attached to the end of the sample hose. If the adapter is not used, the filter paper will be located at the air sampler. If a hose is attached to this sampler

some of the airborne particulate may attach themselves to the inside of the sample hose during operation due to the static electrical charge that is present as air flows through the hose. This radioactive material can build up to very high levels of contamination on the internal walls of the hose. If the hose is severely bumped while sampling, the internal contamination could be dislodged into the air stream and be collected on the filter paper all at one time. This could give a false indication that you have an airborne contamination problem. If there is no other choice except to attach a length of hose to the sampler without the adapter, keep the hose length as short as possible and avoid sharp bends. If the hose is bumped during sampling, the RCT should be notified to stop the sampler, reload the filter paper, and restart the air sample.

12. <u>SPURIOUS CAM ALARMS:</u> When working with highly radioactive components or equipment, avoid handling them near Continuous Air Monitors (CAMs) as the radiation may set off the CAM alarm and personnel may think they have a problem with airborne contamination.

13. <u>REDUCE CONTAMINATION SPREAD:</u> Sticky pads are often used in undressing areas to remove dirt from shoe soles. These pads can also be placed next to actual work areas when there is a potential that high levels of contamination could be tracked around, in a Contamination Area (CA). For example: If workers were required to perform work on a radiological system where the possibility for high levels of contamination on their shoe covers was possible, they should consider placing the sticky pads next to the work area to reduce the possibility that the contamination would be tracked in the CA.

14. <u>STAGE TEMPORARY SHIELDING:</u> If the radiation levels could increase during radiological work, consider staging temporary shielding in the work area that can be installed by the workers. For example: This could be lead blankets wrapped in plastic so they don't become contaminated or large mobile shields that can be rolled into position when needed.

15. <u>IMPROVING CONOPS:</u> The K East and West Basins have manned a station with an RCT at the entrance to the controlled areas to provide access control and assist with donning and removal of protective clothing. The purpose of this station is to improve the conduct of radiological work and it is working well.

16. <u>SHIELDED CONTAINERS:</u> When transporting highly radioactive materials such as liquid samples, consideration should be given to using a shielded container that can be either held away from the body or placed on a cart to reduce exposure. If the radioactive material is "fissionable," contact Criticality Safety for approval.

17. **<u>TOOL CRIBS:</u>** The release of complex tooling used on radiological work has become increasingly difficult as the requirements for surveys become more restrictive. Instead of having to dispose of expensive tools as radioactive waste, a few facilities are reevaluating the use of contaminated tool "cribs" to store and reuse tools. After use, the accessible surfaces of the tools are decontaminated and the tool is bagged and transported to the tool crib for storage. Usually, the tool never leaves the controlled area. The next time it's needed, the worker obtains the tool from the tool crib instead of using a new tool.

18. **<u>HANDLING BETA CONTAMINATED MATERIAL:</u>** Surveys and handling of radioactive material which has high beta radiation can result in very high levels of radiation to the hands of the worker or RCT. At T Plant, it was determined the beta radiation exposure can be reduced by 80 percent if thicker vinyl gloves that have lead particles added are worn instead of the normal canvas gloves. Extension tools can also be used to reduce beta exposure.

19. **<u>CLEAN OUT OF VALVE TRANSFER PITS:</u>** Tank Farm valve transfer pits are being cleaned out and decontaminated. Baskets are lowered into the pit and debris is loaded into the basket. Old flexible and non-flexible hose jumpers are sectioned into small lengths using a hydraulic shear and then the pieces are placed into the baskets. When full, the baskets are raised from the pit and placed into waste burial boxes. Once the pit has been cleaned out, high pressure water and chemicals are sprayed into the pit to reduce the contamination and radiation levels. These liquids drain into the underground tank located beneath the transfer pit.

20. **<u>SHARE EQUIPMENT:</u>** Often times equipment from one facility could be used at other facilities to improve radiological work practices. A fume hood that was never used by FMEF was donated to T Plant to be used to decontaminate tools. A portable HEPA filtered ventilation system will be attached to the fume hood to provide negative ventilation. A glove box also obtained from FMEF is being modified so that it can be used by West Tank Farms to decontaminate tooling. Lead shielding on casters was going to be excessed, but other facilities could use the shielding so it was donated.

21. **<u>REDUCE RADIATION DOSE:</u>** Significant reductions in radiation exposure at the PFP were obtained when a concentrated effort was applied to reducing dose. Lead-lined leather gloves were used to handle special nuclear materials. This reduced worker's exposure by 80 percent. Shielded carts were used to transport samples. Leaded plastic panels were applied to the windows of two glove boxes and radiation levels were reduced by a factor of 15. Sludge containers were lined with three layers of lead foil and radiation exposure was reduced by 75 percent. Shielded port covers were installed on the 15" sealout ports of glove boxes and radiation exposure was reduced by 90 percent. TLDs used at the facility were calibrated with the actual neutron energy encountered at PFP. This reduced

the amount of neutron exposure that was being recorded by 50%. Contact Allen Ostby at (509) 373-2564 for detailed information.

22. <u>FAX MACHINES ELIMINATE DOCUMENT RELEASE:</u> At 222-S Labs, it is very difficult to release the large volume of documents that are brought out of the controlled areas. The large volume of documents created meant that an RCT had to spend considerable time surveying each document before it could be released. To make the system more efficient, two telefax machines are being used. A technician in the controlled area faxes the document to the fax machine located just outside the controlled area. This eliminates the need for a survey of the original document and makes the work operations in the lab more efficient. A "black box" was obtained from the vendor do the machines could talk together without having a phone line. Contact Tom Bushaw at (509) 372-0894 for more information.

23. <u>REDUCING BETA AND EXTREMITY DOSE:</u> In some situations, use of leaded gloves and extension tools significantly reduce the beta dose from small, highly radioactive objects or samples. In addition, special sample holders have been constructed using rubber and lucite that enable workers to screw and unscrew bottle caps and reduce extremity dose. These methods are in use at 222-S Laboratory and by Tank Farm Characterization Projects.

7.0 VENDORS

The vendors listed in this section are provided for information only; they are not necessarily endorsed by the FDH ALARA Program Office.

7.1 Specialized Equipment, Services, and Systems

- ARMEX - Long Services Incorporated - Mark Schneider
  8025 10th Avenue South
  Seattle, WA 98108-1335
  PHONE: (206)763-8433 FAX: (206)767-4076

  ARMEX Blast Media for stripping and decontamination. This is utilized in a variety of industries to effectively remove dirt, contamination, chemical scale and paint on surfaces in preparation for maintenance, remediation or painting. ARMEX Blast Media is water soluble and can be applied by site personnel. Plasite 9009 is a protective coating that can be decontaminated and is resistant to radiation.

- Bartlett Services, Incorporated - Jerry Hiatt
  60 Industrial Park Road
  Plymouth Industrial Park
  Plymouth, MA 02360
  PHONE: 1-800-225-0385

  The following are items provided by Bartlett Services: PlasBlast Decontamination System, Portable HEPA Ventilation Systems, Nuclear Mastr-Pumps, STRIPCOAT TLC Strippable Coating, Polymeric Barrier System (PBS).

- Ben Meadows Company
  P.O. Box 80549
  Atlanta, Georgia 30366
  PHONE: 1-800-241-6401 FAX: 1-800-628-2068

  Enduro Measuring Wheel from Rolatype, catalog #103369. Used for measuring distance along rough, outdoor terrain.

- Concrete Cleaning, Incorporated - Mike Connacher
  P.O. Box 1557
  Bend, Oregon 97709
  PHONE: (503)388-2672 FAX: (503)385-8134

  Modified shot blast machines that can remove layers of concrete to varying depths without any visible dust. These machines are electrically operated and travel across the surface to be decontaminated. A hardened steel shot propelled at a high rate of speed abrades the surface of the concrete. The depth of material removed is determined by the rate of speed the machine is traveling and the volume and size of the shot being fed into the blast chamber. The steel shot is recycled and used over until it is pulverized into dust, which then ends up in the waste container with the concrete being removed. Debris is continually vacuumed by a large dust collection system attached to the unit which is HEPA filtered.

- DAI - Dufrane Associates, Incorporated
7 Holly Lane
Avon, CT 06001
PHONE: (203)675-9350

  Special shielding, Radwaste storage, and processing needs.

- ESI - Environmental Scientific, Inc. - Vance Syphers
P.O. Box 13486
Research Triangle Park, NC 27709-3486
PHONE: (203)585-9934 FAX: (203)585-8422

  Various types of decontamination and disposal methods. Liquid absorbents and solidifiers.

- Inflatable Abatement Systems - Phil Olivieri
P.O. Box 507
East Millinocket, ME 04430
PHONE: 1-800-962-2565 FAX (207)746-5795

  Inflatable abatement systems have proven themselves to be one of the industry's fastest, safest, most durable, cost effective approach to tenting. Must see these to appreciate the quality construction and ease of assembly. These have been used on asbestos abatement containments.

- INS - Interstate Nuclear Services - Stephen Hofstatter
295 Parker Street
P.O. Box 51957
Springfield, MA 01151
PHONE: (413)543-6911 FAX: (413)543-6989

  INS on-site services maintains a fleet of mobile process facilities which include laundering units, material decontamination units, and personnel respiratory equipment leasing, cleaning, and testing units. Each is completely self-contained, requiring only INS operator support and simple utility hookups. All designs incorporate recycling systems to minimize secondary waste generation. In addition, INS provides the industry with high quality personnel services, ranging from engineers and technicians to laundry and decontamination labor.

- LANCS Industries Incorporated - Kevin Bylin
12704 NE 124th Street
Kirkland, WA 98034
PHONE: (206)823-6634 FAX: (206)820-6784

  Containment tents, modular hard-sided containments, glove bags and hardware, lead shielding and blankets, protective clothing and accessories, air fed hoods, and more.

- Mid-Columbia Supply
311 West Kennewick Avenue
Kennewick, Wa 99336
PHONE: (509)582-7225

SONIN Pro Combo, ultrasonic measurer, that uses either sound waves or infrared light signals, depending on the distance, to take measurements.

* NOCHAR - Protection Enterprises - Linda Page
  204 NW 101 Street
  Seattle, WA 98177-4914
  PHONE: (509)375-3069 PHONE: (206)783-8233

  Various types of bonding agents that are environmentally safe. Fire retardant materials.

* Non-Destructive Cleaning, Incorporated
  1600 Providence Highway
  Walpole, MA 02081
  PHONE: (508)660-3064 FAX: (508)660-3067

  Non-Destructive Cleaning Inc. provides engineered cleaning systems and facilities that are custom designed to clean the objects of interest and transform the resultant waste into the most economical and environmentally compatible waste form for disposal. Each Non-Destructive Cleaning facility is designed to provide maximum cleaning efficiency through the use of dry ice as its exclusive cleaning medium. Waste material in minimized because no secondary wastes are generated. Non-Destructive Cleaning is the exclusive supplier of the patented NDC cleaning systems and facilities that use dry ice as their exclusive cleaning medium.

* RADCO. - Radiation Attenuating Devices Company, Incorporated
  P.O. Box 1012
  Rockville, Maryland 20800
  PHONE: (301)279-7511

  Shielding

* Secur Tech Company
  5755 Willow Lane
  Lake Oswego, OR 97035-5340
  PHONE: (503)636-6831 FAX: (503)636-9642

  Electronic identification systems; barcoding.

* SKC-West, Inc.
  Fullerton, CA 92631
  PHONE: (714)992-2780

  Detector tubes, sampling pumps, IH sampling media

* Additional vendors and information may be added to this list by sending the additional information to the ALARA Program Office. MSIN: SO-19

7.2 Vendors Specializing in Decontamination

This list of vendors was obtained from the Nuclear News 1994 Buyers Guide.

Specialty Category:

AC	Abrasive Cleaning	HW	High Pressure Water
BM	Barrier Material	NG	Noble Gas Decon Systems
C	Chemicals	PC	Protective Clothing
CD	Chemical Decontamination	PS	Plugs and Seals
CE	Containments	S	Services
CO	Containers	SH	Shielding
CR	Cryogenic Cleaning	SC	Strippable Coatings
CS	Concrete Scabbling	U	Ultrasonics
D	Drainline	UW	Ultra-High Pressure Water
E	Equipment	VB	Vacuum Blasting, Abrasive
EP	Electropolishing	VF	Vibratory Finishing
HF	High Pressure Freon	VS	Ventilation Systems

** <u>NOTE</u>: Some of these decontamination techniques have the potential to increase radioactive air emissions. Contact FDH Regulatory Support at 372-0840 or 376-1271 to determine if an Air Permit is required.

Vendor	Specialty
AARVAL Contact Ted Turbenson (800)328-3361	BM, CD, CE, SH
ABB Combustion Engineering Contact Jay Holbus (203)285-3833	C, E, S, AC
ABESOCO Industries Inc. Contact Art Field (310)327-4920	AC, VB
Accurra Products and Services Contact Mike Butts (360)377-8213	C, CE, PC, S, HS
AECL Technologies Contact B. Deist (301)417-0047	S
Aero Tech Laboratories, Inc. Contact David Dack (201)825-1400	E, PS
ALARA Engineering Contact Wayne Capolupo (508)462-2997	S, AC, HS, HW
Alaron Corporation Contact James Taylor (803)791-9900	S, AC, CD, CS, EP, HS, HW, SC, VB
Alliance, Inc. Contact Manny Irwin (616)637-5915	S, AC, HS, HW, PS, SC
American Ecology Corp Contact Fred Gardner (713)624-1900	S
Apex Technologies Contact Gary Blackburn (813)445-1500	W, S, AC, HW

Vendor	Specialty
Applied Radiological Control Contact La Shell Jahn-Keith (800)241-6575	C, E, S, AC, CD, CS, CR, D, HS, HW, SC, UW, U, VB
ARMEX-Long Services Inc. Contact Mark Schneider (206)763-8433	VB
Associated Bag Company Kathie Kukla (800) 926-6100	PC, SH
Associated Technologies Contact David Estabrook (516)331-2323	E, AC, CR, HW, VF
Atlantic Nuclear Corporation John P. Anderson (617)828-9118	CD, PE, SH
Babcock & Wilcox Nuclear Technologies Contact Bill Warner (804)385-3234	E, S, AC, CD, HS, HW, SC, VB
Bartlett Services, Inc. Contact Jerry Hiatt (800)225-0385	SC, E, VB, VS
Brand Industrial Services Contact Steve Booth (606)325-8845	AC, W, UW, VB
Brand Utility Services Contact John Chiangi (203)767-2156	E, AC, HS, HW, UW
R. Brooks Associates, Inc. Contact John Gay (203)589-4000	S, AC, HS, HW, SC, U
CH_2O International Contact John Eakin (509)452-1006	C,E
Canberra Nuclear Products Group Contact J. Miller (860)238-2351	S
Carboline Co. Contact Jerry Arnold (504)733-3791	SC
Chem-Nuclear Systems Inc. Contact Conrad Cooke (803)256-0450	C, E, S, EP, HF, U, VF
Coastal Network, INC. Contact M. Moyles (508)746-8868	CE, PC
Concrete Cleaning, Inc. Contact Mike Connacher (530)388-2672	VB
Container Products Corporation Contact James Granathan (800) 635-5647	
DDH Nuclear, Inc. Contact Al Holmes (419)225-6244	S, AC, CD, CS, HS, HW, UW, VB

Vendor	Specialty
Decon International Corp Contact John Kowal (412)831-3000	C, E, S, AC, CD, CS, EP, HS, HF, HW, PS, SC, UW, VB, VF
Decon Systems, Inc. Contact Steve McLaughlin (803)243-5350	C, E, CS, HS, HW, SC, UW
Dufrane Associates, Inc. Contact Kenneth Dufrane (860) 675-9350	E, S
Duke Engineering & Services, Inc. Contact E. Abrams (704)382-7766	CD
Electro-sonic Systems, Inc. Contact O. Jackson (904)799-7076	E, S, EP, HW
Environmental Alternatives, Inc. Contact Chris Norton (603) 256-6440	E, S, AC, CS
Environmental Scientific, Inc. Contact Costas Gounarakis (919)941-0847	CD, U
Exploration Products Contact Dennis Medina (800)448-7312	E,S
FQS Environmental Services, Inc. Contact Ed Guthrie (904)260-6856	CR
Framatome USA, Inc. Contact Christian Buchalet (703)527-4747	S, CD, EP
GE Nuclear Energy Contact Steve Barber (408)925-1151	S
Hazard Technology, Inc. Contact David Levinson (800)852-3698	CS, VB
Hilbert Associates, Inc. Contact Steve Miller (518)584-0166	C, E, S, CS, HS, HW, VB
Hot Cell Services Corp. Contact Ron Campbell (206)854-4945	S, AC, CR, EP
Iceblast, Inc. Contact Jerry Blankenship (318)261-0690	CR
ICS International, Ltd. (513)831-8888	CS
Inflatable Abatement Systems Contact Phil Olivieri (800)962-2565	E
International Technology Corp. Contact Jim Mahoney (310)378-9933	S, AC, CD, CS

Vendor	Specialty
Interstate Nuclear Services Contact (413)543-6911	E,S
J & L Protech Corp. Contact Lisa Nicholson (407)722-3303	AC, NG, VB
Klieber and Schultz, Inc. Contact Don Pymm (516)293-6688	C, E, S, AC, EP, HW, VB, VF
LANCS Industries Contact Kevin Bylin (206)823-6634	E
Long Painting Company Contact William Brown (206)763-8050	SC
Master-Lee Decon Services, Inc. Contact Robert Burns (609)654-6161	S, HS, HW
Nelco Manufacturing Corp. Contact Brad Roberts (800)256-3440	E, AC, CD, CS, VB
NFS - Radiation Protection Systems, Inc. Contact Marc Green Leaf (860)434-0660	S, HW, UW
Non-Destructive Cleaning, Inc. Contact Pat Gillis (508)660-3064	E, CR
NSSI/Sources & Services, Inc. Contact R. Gallagher (713)641-0391	C, E, S, CD, EP, HS, HF, HW
NSS Numanco, Inc. Contact Fred Erskine (717)838-8125	E, S, AC, CS, CR, D, HS, HW, PS, SC, UW, VB
Nuclear Associates Contact Harris Targovnik (516)741-6360	C, CD, HS
Nuclear Shielding Supplies, Inc. Contact Tom Hurkett (602)7489362	AC, UW, VB
Pentek Decontamination Products, Inc. Contact Patrick Nace (412)262-0725	C, E, S, CS
Power Products & Services Co. Contact Timothy Montgomery (804)525-8120	E, AC, HW, VB
Power Systems Energy Services, Inc. Contact Steve Tuzik (203)285-4444	C, E, S, AC, HS, HW, SC, UW, U
Protection Enterprises NOCHAR Contact Linda Page (509)375-3069	E
PTS Plant Technical Services Contact Amin Bishara (305)598-0602	E, S, AC, CS, HS, HW, SC, UW

Vendor	Specialty
Quadrex Corp. Contact David Wry (615)482-5532	C, E, S, AC, CD, EP, HS, HW, CS, UW, VB
RADco. Radiation Attenuating Devices Company, Inc. (301)279-7511	E
Radiological & Chemical Technology, Inc. Contact Roger Assay (408)982-0601	EP
RUST Federal Services Contact Denice McMahon (708)409-9100	S, AC, CD, CS
Scientific Ecology Group, Inc. Contact Jim Gibson (615)481-0222	C, E, S, AC, CD, CS, EP, HW, SC, UW, VF
Siemens Power Corp. Contact J. Nordahl (206)453-4300	AC
SKC Inc. Contact Carol Knouse (412)941-9701	E
Uni-Chem Chemicals Contact Carl Post (216)255-4070	C, E, CD, HS
Vectra Technologies, Inc. Contact Ray Fortney (206)874-2235	E, S, CD
WasteChem Corp. Contact John Raymont (713)520-9030	AC, CR, SC

* Additional vendors and information may be added to the table by sending a copy of the table with the additional information marked, to the ALARA Program Office. MSIN: S0-19

7.3 Shielding Tables

SHIELDING

BETA Radiation

Thicknesses of low Z materials in inches, to absorb beta radiation:

Energy (Mev)	Plastic (Lucite)	Concrete	Aluminum
0.5	0.1	0.05	0.05
1.0	0.2	0.1	0.1
2.0	0.3	0.2	0.2
3.0	0.4	0.3	0.3

GAMMA Radiation

Shield material half-value layer, in inches:

Energy (Mev)	Lead	Iron	Concrete (150 lb/ft^3)	Water
0.5	0.2	0.4	1.3	3.0
1.0	0.3	0.6	1.8	3.9
1.5	0.5	0.7	2.3	4.8
2.0	0.6	0.8	2.6	5.5
2.5	0.6	0.9	3.0	6.2

To use half-value layers: Shielded dose rate = unshielded dose rate $(1/2)^n$, where n is the number of half-value layers.

Percentage of 1 Mev Beta Radiation Absorbed by Various Common Materials and Equipment

Materials and Equipment	% Absorbed
Cotton Coveralls	20
Plastic Hoods or Goggles	30
Cotton or rubber gloves	30
Neoprene gloves	50
Paper (0.3 mm)	90
Safety glasses or respirator	90

Range of beta particles in air - Rule of Thumb: Range is about 12 feet/Mev beta energy.

7.4 "Stores" Material for Use as Temporary Shielding

There are many products and materials listed in the "Stores" catalog on "Soft Reporting" that can be used to provide temporary shielding for radioactive materials. The following list is only a small portion of the constantly changing materials available.

a. Beta Shielding-The following thickness of materials will completely attenuate all Beta radiation normally encountered at Hanford:

Aluminum - 0.3 cm or 0.118" Plastic - 0.5 cm or 0.197"
Rubber - 0.7 cm or 0.276"
Note: Plastic, plywood and rubber materials are combustible. Contact facility safety personnel before installation.

Material Info from "Stores" Catalog

Stock No.	UOI	Description	Page No.
0040-5450-025	Sht	Plexiglass; Type-G; 1/16"x 48"x 72" Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5450-050	Sht	Plexiglass; Type-G; 1/8"x 48"x 72"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5450-065	Sht	Plexiglass; Type-G; 3/16"x 48"x 72"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5650-075	Sht	Plexiglass; Type-G; 1/4"x 48"x 72"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5650-100	Sht	Plexiglass; Type-G; 3/8"x 48"x 72"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5650-125	Sht	Plexiglass; Type-G; 1/2"x 48"x 72"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0040-5650-150	Sht	Plexiglass; Type-G; 3/4"x 36" x 60"; Commercial Grade, Clear, Colorless, Masked and Untrimmed	471
0042-3385-100	Rol	Matting, Rubber; Black, Corrugated, size 1/8" Thick x 36" Wide by 25 Yards Long	632
0046-0376-140	Ea	Plate, Type 6061-T6; Aluminum; 1/4"x 24" x 72" ASTM B-209	912
0046-0376-160	Ea	Plate, Type 6061-T6; Aluminum; 3/8"x 24"x 72" ASTM B-209	912
0046-0376-170	Ea	Plate, Type 6061-T6; Aluminum; 1/2"x 24"x 72" ASTM B-209	913
0046-0396-110	Ea	Sheet; Type 6061-T6; Aluminum; 0.125"x 48"x 144";	914
0046-0396-163	Ea	Sheet; Type 6061-T6; Aluminum; 0.063"x 48"x 144";	914
0046-0400-032	Ea	Sheet; Type 1100-H14; Aluminum; 0.032"x 48"x 144";	914
0046-0400-250	Ea	Sheet; Type 100 H14; Aluminum; 0.250"x 48"x 144";	915
0040-5580-050	Sht	Plywood, Exterior, Fire Retardant, 1/2"x 4'x 8'	473
0040-5580-075	Sht	Plywood, Exterior, Fire Retardant, 3/4"x 4'x 8'	473

b. Gamma Shielding-Denser materials which contain large numbers of electrons make the best shielding for Gamma radiation. The thickness of shielding needed to reduce the radiation levels is dependent on the Gamma Photon Energy. For example: 1/2" of lead or 3/4" of steel will reduce radiation from a Co^{60} source to one-half its original value. 2" of lead or 4" of steel will reduce the radiation to 1/10 its original value. If the source of radiation is from Cs^{137}, 1" of lead will reduce the radiation to 1/10 its original value.

Material Info from "Stores" Catalog

Stock No.	UOI	Description	Page No.
0046-1505-140	Ea	Plate; 304L; Stainless Steel; 1/4"x 48"x 120"	913
0046-1505-170	Ea	Plate; 304L; Stainless Steel; 1/2"x 48"x 120"	913
0046-1630-011	Ea	Sheet; 304L; Stainless Steel; 0.120"x 48"x 120"	915
0046-1630-016	Ea	Sheet; 304L; Stainless Steel; 0.060"x 48"x 120"	915
0046-1630-020	Ea	Sheet; 304L; Stainless Steel; 0.036"x 48"x 120"	915
0049-1600-022	Ea	Sheet; 304; Stainless Steel; 0.03125"x 48"x 120"	923
0049-1600-026	Ea	Sheet; 304; Stainless Steel; 0.01875"x 48" 120"	923
0046-8090-140	Ea	Plate; Black; Steel; 1/4"x 48"x 120"	913
0046-8090-170	Ea	Plate; Black; Steel; 1/2"x 48"x 120"	914
0046-8090-190	Ea	Plate; Black; Steel; 3/4"x 48"x 120"	914
0046-8090-210	Ea	Plate; Black; Steel; 1"x 48"x 120"	914
0046-8090-230	Ea	Plate; Black; Steel; 1 1/2"x 48"x 120"	915
0046-8115-100	Ea	Sheet; Carbon Steel; 0.135"x 48"x 120"	916
0046-8115-110	Ea	Sheet; Carbon Steel; 0.1196"x 48"x 120"	916
0046-4940-150	Ea	Lead; Brick; 8"x 4"x 3"	912
0046-4950-100	Lb	Lead; LPG; 50 or 100 lb ingots	912
0046-4990-040	Ea	Lead; Sheets; 1/16"x 48"x 48", 4 lb/ft^2	912
0046-4990-300	Ea	Lead; Sheet; 1/2"x 48"x 48", 30 lb/ft^2	912

c. Neutron Shielding - Materials that contain a lot of hydrogen atoms are the best materials for attenuating neutron radiation. It can take up to 10 inches of water or polyethylene to reduce the neutron radiation by a factor of ten. The "stores" system does not stock materials that are good neutron shields. These will have to be purchased from private vendors. Contact Criticality Safety for review/approval before installing neutron shielding.

8.0 CONTAINMENT SKETCHES AND STOCK NUMBERS

This section focuses on a variety of containment sketches and the associated spare parts inventory stock numbers. R. L. (Bob) Brown can be contacted on (509) 372-2932 for information on the acquisition and stocking of containments.

8.1 Spare Parts List

These items may be obtained at Building 2101M, Door 106 in the 200E Area or by calling (509) 373-1850.

Stock No.	UOI	Description
6175-1610-0590	EA	Poly Bottle, 5 gallon, with second closure plug
6175-1610-0924	EA	Cone Shaped Catch Containment, 12" Diameter
6175-1610-0925	EA	Containment, Flat Bottomed, 18" Diameter
6175-1610-0926	EA	Containment, Mechanical Joint
6175-1610-0927	EA	Containment for 5 gallon Poly Bottle
6175-1610-0928	EA	Containment Tent, Type I (for non-ventilated operations)
6175-1610-0929	EA	Containment Tent, Type II (for ventilated applications)
6175-1610-0930	EA	Containment Tent Floor for Type I and II Tents
6175-1610-0936	EA	Bungee Cord, 1/4" Diameter x 500 feet
6175-1610-1260	EA	Containment Drain Assembly, 1/2"
6175-1610-1720	EA	Poly Bottle Fill and Vent Assembly, 5 gallon
6175-1610-1722	EA	Filter, Canister, 30 CFM**
6175-1610-1724	EA	Filter, Glove Bag, 2 CFM
6175-1610-1726	EA	Filter, Type II Containment tent inlet, 18" x 18" x 1/2"
6175-1610-1930	EA	Frame, for Doghouse Glove Bag
6175-1610-1932	EA	Frame, Type I/II Containment Tent, 1" sch 40 galvanized pipe
6175-1610-1934	EA	Frame, Type B (Type II, III, IV, & VI glove bag)
6175-1610-2230	PR	Glove, 18" rolled cuff, size 11 (for glove bag)
6175-1610-2234	PR	Glove, 15" rolled cuff; size 9
6175-1610-2238	EA	Doghouse Containment
6175-1610-2240	EA	Glove Bag, Type I (FIC)

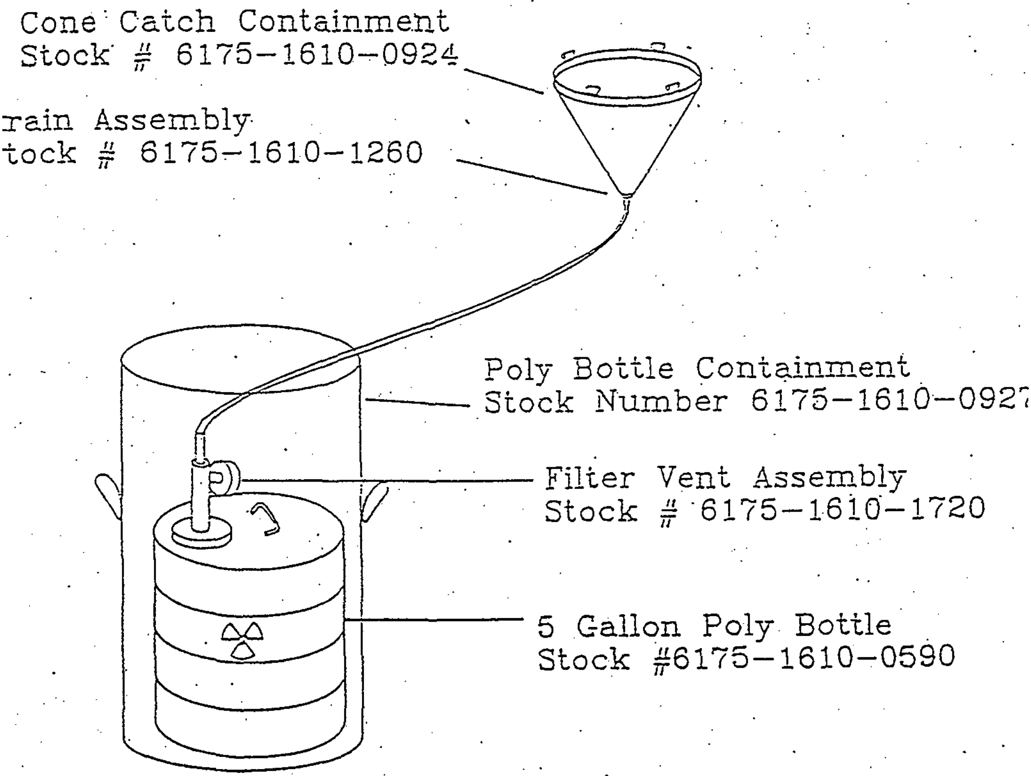
Stock No.	UOI	Description
6175-1610-2241	EA	Glove Bag, Type II (for 4" Riser)
6175-1610-2242	EA	Glove Bag, Type IV (Greenaway)
6175-1610-2243	EA	Glove Bag, Type VI (Rulon)
6175-1610-2244	EA	Glove Bag, Type VIII (Butch Hall)
6175-1610-2245	EA	Glove Bag, Type X (Wilder)
6175-1610-5656	EA	Pump, Hand Siphon
6175-1610-6200	EA	Ring, Glove, 5 1/2" Inside Diameter
6175-1610-6914	RL	Sleeving, 8" diameter x 100', 12 mil, translucent yellow, clear or white
6175-1610-6916	RL	Sleeving, 12" diameter x 50', 12 mil, translucent yellow, clear or white
6175-1610-6918	RL	Sleeving, 24" diameter x 50', 12 mil, translucent yellow, clear, or white
6175-1610-6920	PK	Sleeving, 6" diameter x 100', 8 mil
6175-1610-7440	EA	Tape, G-Flexx Tape, 3" x 20 yards
6175-1610-7442	EA	Tape, G-Flexx Tape, 6" x 20 yards
6175-1610-7760	EA	Tube, Transfer, 6" diameter Rigid PVC

* Additional information may be added to the table by sending a copy of the table with the additional information listed, to the ALARA Program Office. MSIN: S0-19

** 30-40 CFM filters can also be obtained from Lancs Industries (206)823-6634, G/O Corporation (504)847-0564, or Frham Safety Products (615)254-0841.

8.2 Sketch

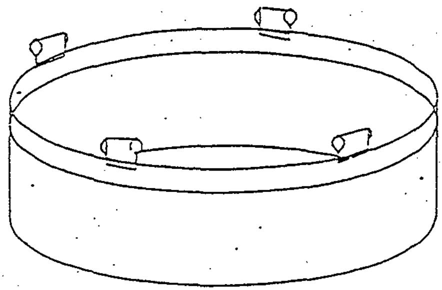
POLY BOTTLE CONNECTED TO A CATCH CONTAINMENT (USED TO COLLECT RADIOACTIVE FLUIDS)



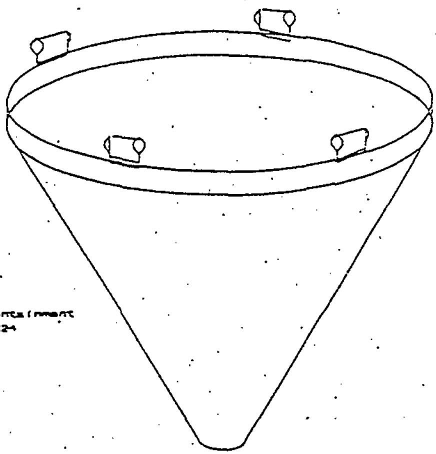
8.3 Sketch

CATCH CONTAINMENTS

(USED TO COLLECT FALLING DEBRIS OR DRIPPAGE FROM RADIOACTIVE SYSTEMS)

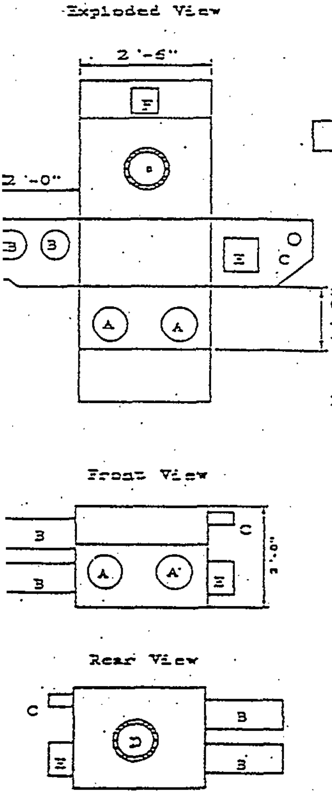


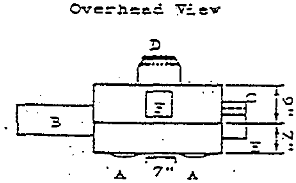
18" Flat Bottomed Catch Containment
Stock # 8175-1810-0525

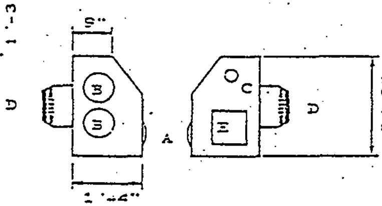


ed Catch Containment
175-1810-0524

8.4 Sketch
TYPE I GLOVE BAG, FIC GLOVE BAG



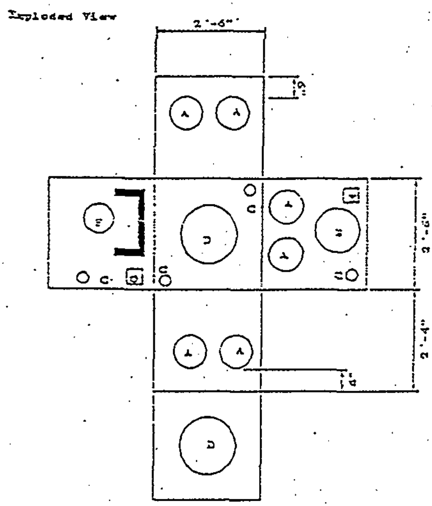


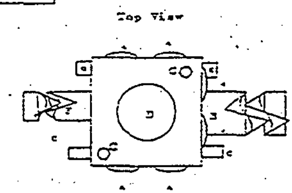


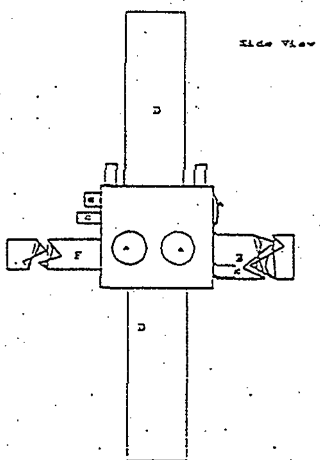
A Glove Ports
B 7" x 18" Service Sleeve
C 3" x 6" Service Sleeve
D 10" x 4" Service Sleeve (with elastic end)
E Passout Box 8" x 8" x 6" with 1" Velcro Seam on inner and outer flaps.
F Foam breather filter assembly, 4" x 4" filter

Revision 3, November 7, 1994.
Stock # 6175-1610-2240

8.5 Sketch
TYPE II: STANDARD 4" RISER BAG





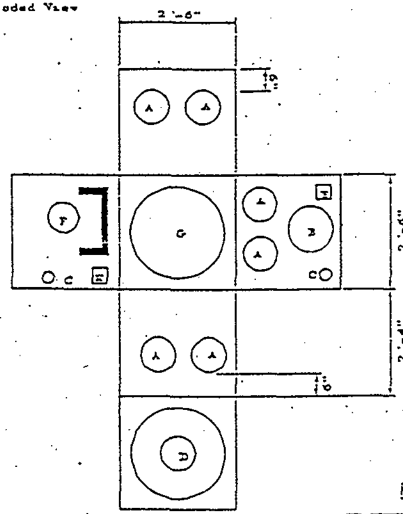


Revision 3, November 7, 1994.
Stock # 6715-1610-2241

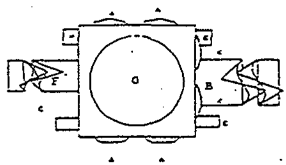
- A Glove Sleeve
- B 12" x 60" Service Sleeve
- C 3" x 4" Service Sleeve
- D 16" x 3' Service Sleeve
- E Passout Box
- F 7" x 60" Service Sleeve
- G Installed Foam Breather Filter, 16" square
- 2" Velcro (Flap is 4" x 16")

8.6 Sketch
TYPE IV: Greenaway

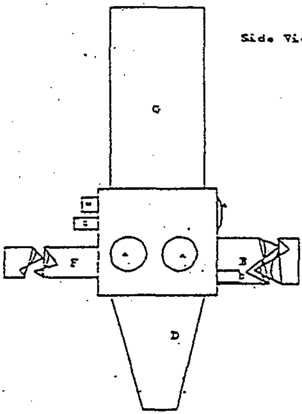
Exploded View



Top View



Side View

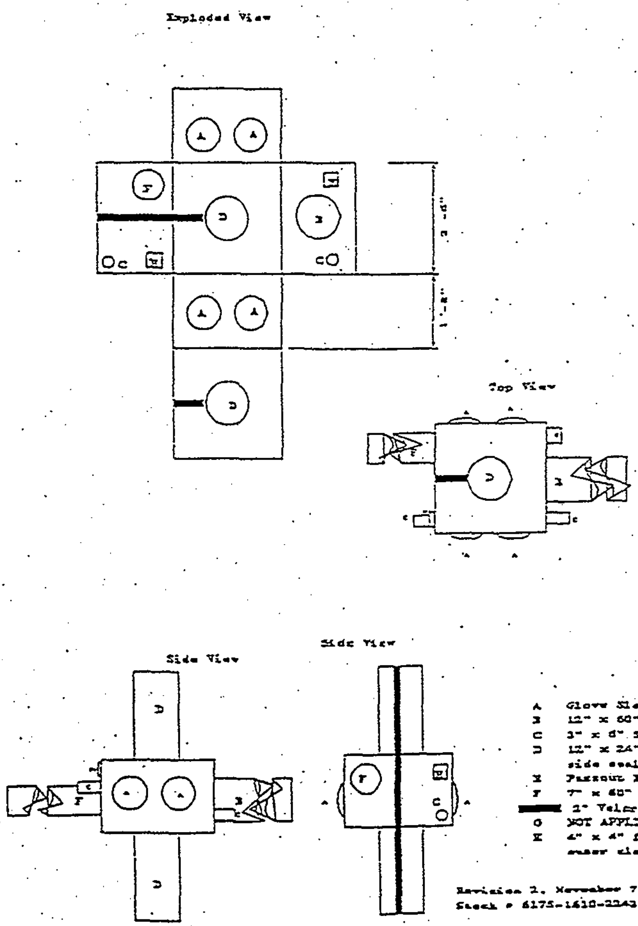


Revision 4, November 7, 1994
Stock # 6175-1610-2242

A Glove Sleeve
B 12" x 60" Service Sleeve
C 3" x 6" Service Sleeve
D 24" Service Sleeve, tapered to 12" at bottom, 30" long
E Passout Box
F 7" x 60" Service Sleeve
▬ 2" Velcro (Flap is 6" x 18")
G 24" x 48" Service Sleeve
H 4" x 4" foam breather filter with outer closure flap

8.7 Sketch

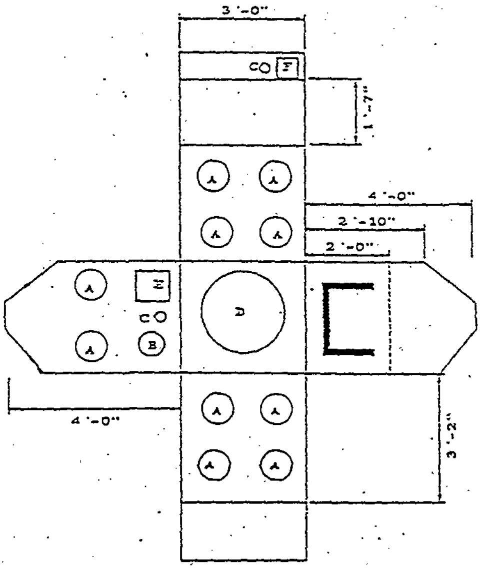
TYPE VI GLOVE BAG: RULON GLOVE BAG

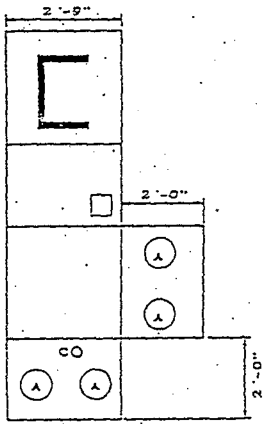


A Glove Sleeve
B 12" x 60" Service Sleeve
C 3" x 6" Service Sleeve
D 12" x 24" sleeves with 2" side seal on velcro
E Passout Box
F 7" x 60" Service Sleeve
▬ 2" Velcro (Flap is 6" x 18")
O NOT APPLICABLE
H 4" x 4" foam breather filter with outer closure flap

Revision 2, November 7, 1994
Stock # 6175-1610-2243

8.8 Sketch
TYPE V



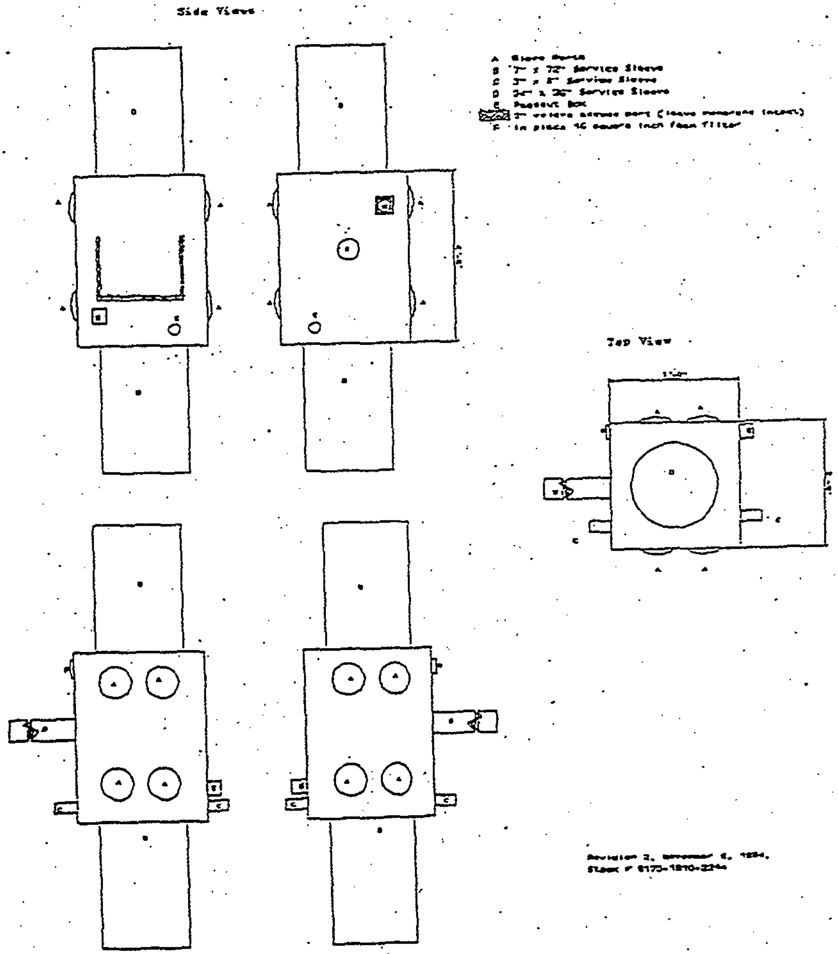


A Glove Sleeves
B 7" x 12" Service Sleeve
C 3" x 6" Service Sleeve
D 21" x 48" Sleeve
E 8" x 8" x 6" Passout Box
F 4" x 4" Breather Filter
▬ 2" Velcro Panel, 18" x 6"

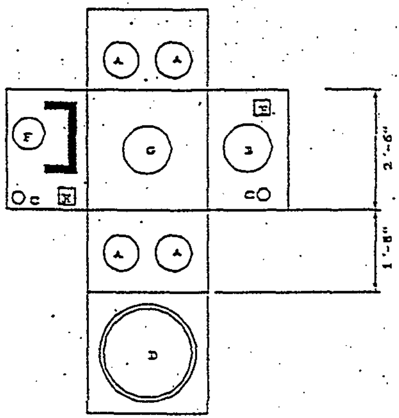
Revision 2
Special Order

8.9 Sketch

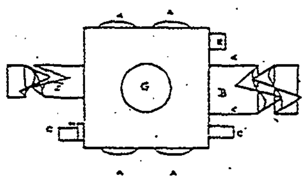
TYPE VIII: BUTCH HALL GLOVE BAG



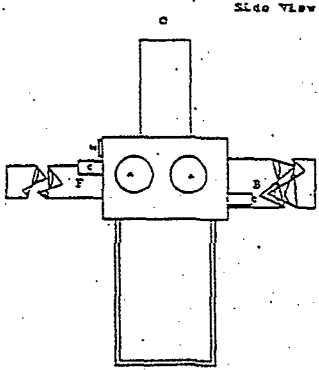
8.10 Sketch
TYPE X GLOVE BAG: WILDER GLOVE BAG



Top View



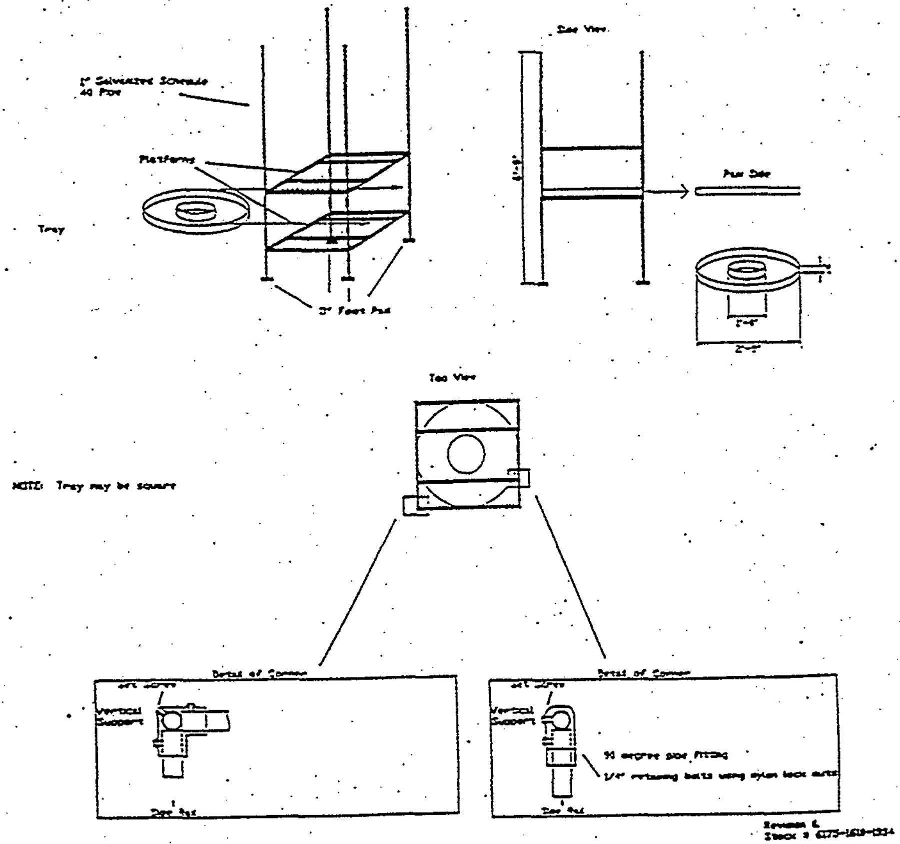
Side View



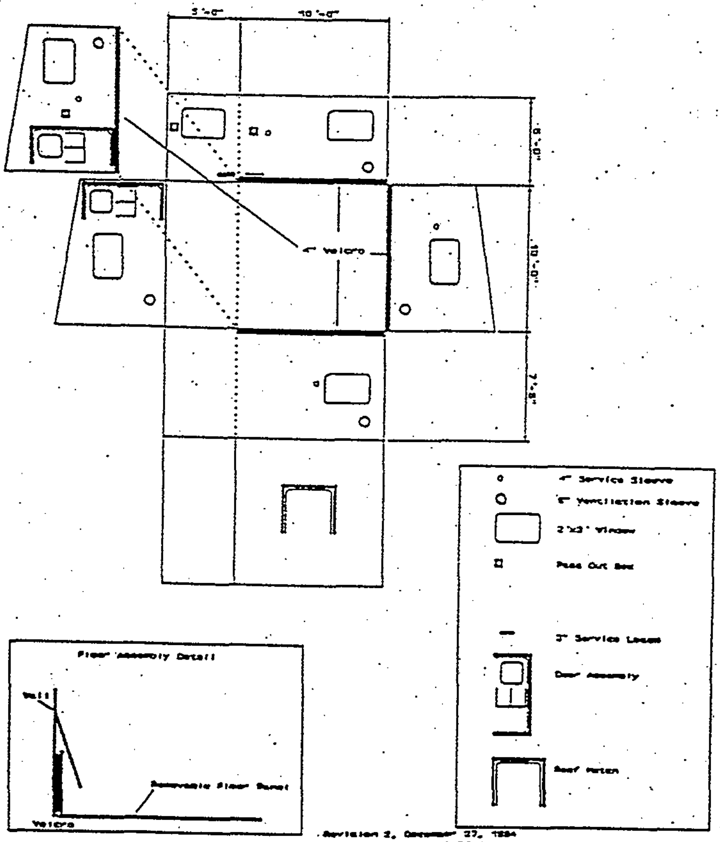
Revision 2. November 7. 1994
Stock # 6175-1810-2245

A Glove Sleeve
B 12" x 60" Service Sleeve
C 3" x 6" Service Sleeve
D Concentric Sleeves, 24" x 36" outer, 22" x 36" inner
E Passout Box
F 7" x 60" Service Sleeve
2" Velcro (Flap is 6" x 18")
G 12" x 24" Service Sleeve
H 4" x 4" foam breather filter with outer closure flap

8.11 Sketch
TYPE B CONTAINMENT FRAME: TYPE II, III, IV, AND VI GLOVE BAG FRAME



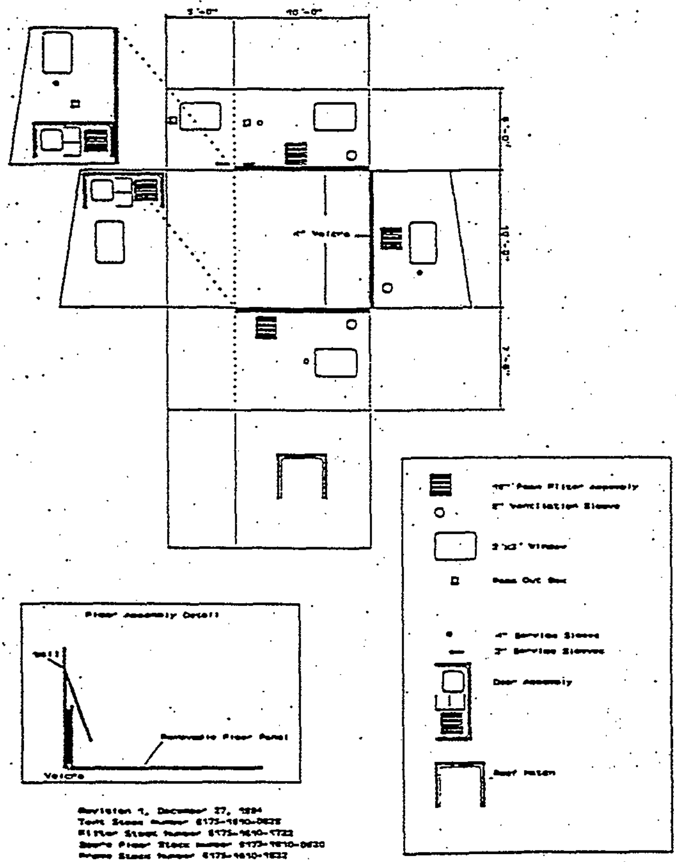
8.12 Sketch
TYPE I CONTAINMENT TENT (FOR NON-VENTILATED APPLICATIONS)



Revision 2, December 27, [illegible]
Tent Stock Number [illegible]
Filter Stock Number [illegible]
Spare Floor Stock Number [illegible]
Frame Stock Number [illegible]

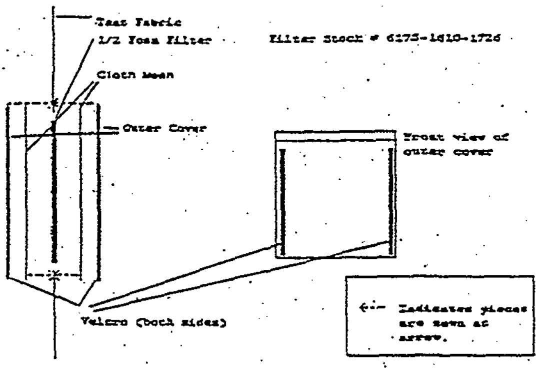
8.13 Sketch

TYPE II CONTAINMENT TENT (FOR VENTILATED APPLICATIONS)

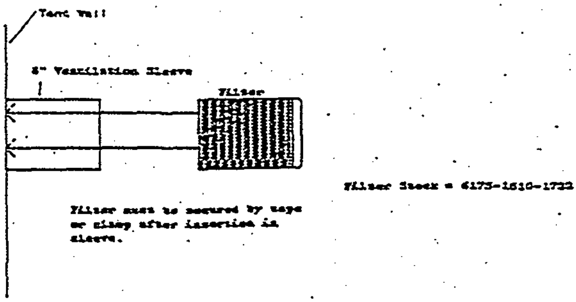


8.14 Sketch
BREATHER FILTER ASSEMBLIES

Breather Filter for Ventilated Tents



Breather Filter for Non-Ventilated Tents

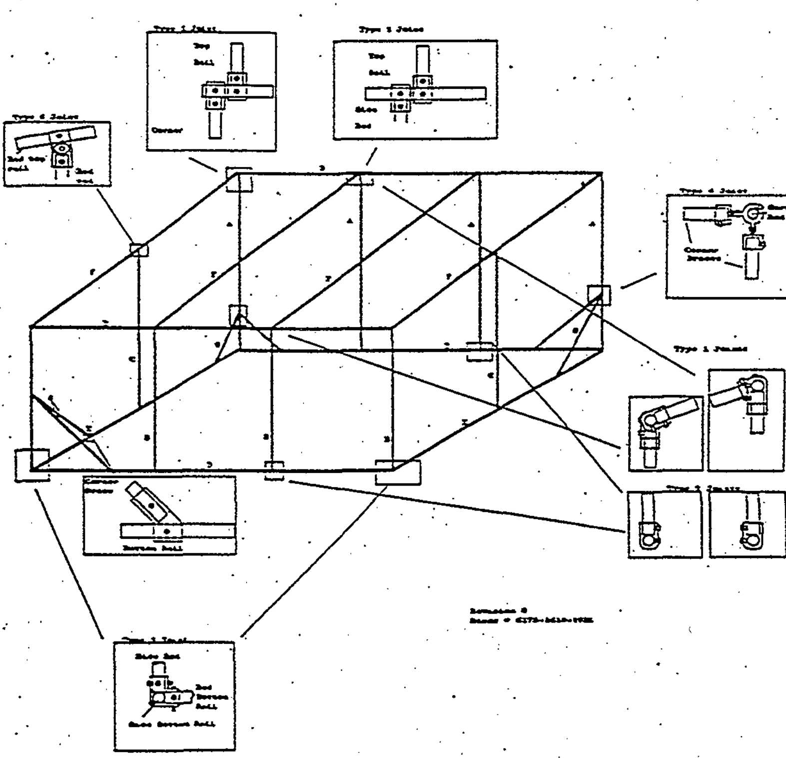


8.15 Sketch
TYPE I/II TENTS

Part	Amount	Name
A	4	7'3" Side Rod (tall)
B	4	6'3" Side Rod (short
C	2	6'10" End Rod
D	4	15' 6" Side Rail
E	2	10'2" End Bottom Rail
F	4	10'4" Top Rail
G	3	4' Corner Brace

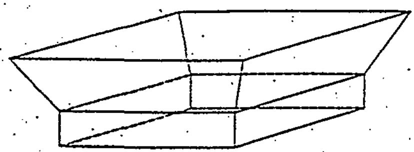
Joint Descriptions/Parts

1.	Angled Roof	Uses two single socket tees
2.	Side/End Bottom	Uses one single socket tee
3.	Bottom Corner	Uses one 90 degree single side outlet tee
4.	Corner Brace (upper)	Uses one corner swivel socket
5.	Corner Brace (lower)	Uses one 30/60 degree single socket tee
6.	End Rod (upper)	Uses one single swivel socket

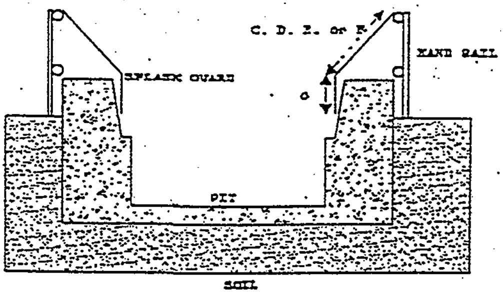


8.16 Sketch
106-C Splash Guard

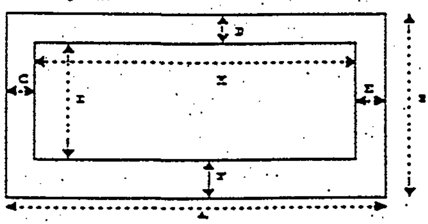
3 Dimensional View



Side View, showing application



Top View



DOSE REDUCTION TECHNIQUES

A. <u>TIME:</u> Reducing the time spent in radiation areas is an effective means of reducing dose. Radiation doses are <u>directly proportional to the time spent in a radiation area.</u> The techniques listed below are effective in reducing the time spent in radiation areas:

<u>NOTE:</u> When working with fissionable materials, special controls and work practices are required. Contact your Criticality Safety Representative during the planning phase to ensure your planned work steps and use of engineered controls are approved for use with fissionable material.

1. Preliminary Planning:

   Involve Radcon early in the planning process to obtain input on radiation/contamination levels and possible ALARA protective measures that can be used.

   Review <u>current</u> surveys of the work area and travel routes.

   Review lessons learned from previous jobs. A database named SHARE (Search Hanford Accessible Records Electronically) is available through Radiological Engineering that scans thousands of lessons learned from all DOE sites. See Paragraph D below.

   Determine what services will be required and coordinate their procurement.

   Determine if a separate disassembly or prefabrication area should be established in a low radiation area.

   Determine if mock-up training is necessary to assure workers can complete the work efficiently

   Obtain necessary spare parts and special tools.

2. Preparation of Radiological Work Procedures

   Complete an ALARA Management Worksheet if the work exceeds the "trigger levels" of WHC-IP-1043, Section 10.

   Walk-down the work area and determine if interferences or insulation have to be removed or temporary covers need to be installed on other components to prevent damage during work.

   Plan access to and exit from the work area.

   Provide for necessary services and communications.

Remove sources of radiation, if practicable. This could include flushing a hot-spot to remove a source or isolating the source so personnel can't get near.

Plan for installation of temporary shielding.

Schedule decontamination work steps at the start of the job and after specific work steps during the job.

Work in lowest radiation levels.

Perform as much work as practicable outside radiation areas.

Consider use of special tools or fixtures that will allow the work to be performed in less time with less skilled workers.

Determine inspection requirements for Radcon and QA.

Determine testing requirements

Delete unnecessary work. If something can be repaired instead of replaced, it may save significant time and dose.

Minimize the discomfort of workers (weather, temperature, lighting, etc.). If work involves kneeling on hard surfaces, consider knee pads or portable pads.

Estimate the person-rem needed to perform the job. This may include a time-motion study of each individual to determine the time spent in the radiation area.

3. Work Practices:

Do the job right <u>the first time</u>. Detailed planning is essential in ensuring that workers are provided the opportunity to be successful.

Brief workers prior to performing radiological work to ensure they understand what it is they are supposed to do, are staged to perform the work, and answer any questions they may have about the work steps and the expectations. This briefing should include the techniques necessary for dose reduction, contamination control, and waste minimization. Using scale models, drawings, photographs, and video tapes are ways to improve these briefings.

Rehearse the critical work steps in a mock-up to ensure the tooling, engineered controls, and the technical work procedure work properly.

Specialized mock-up training may be required to teach workers how to perform work operations in a realistic environment that duplicates the actual work area and conditions. Information on how to conduct mock-up training is available in WHC-IP-1043, Occupational ALARA Program.

Keep unnecessary workers out of the work area. Management tours of the work area are helpful in ensuring the numbers of personnel performing the work are proper and personnel are working in the most efficient manner. The final decision on the number of personnel should be decided at the pre-job briefing.

Use electronic dosimetry to track dose and time in the work area. This dosimetry can be set to alarm if the worker gets into a high radiation field or their total dose is near a preset limit.

Control access to High Radiation Areas so that anyone who has a need to enter must first convince a manager of why the area must be entered and what is going to be gained. If there is no value added, the entry should be denied.

Consider color-coding systems in radiation areas to simplify routine inspections. By marking different components with different colors, it might be possible to reduce the time it takes to locate these components.

Use specialized tooling to speed up work. Use electric or pneumatically powered wrenches for unbolting and rebolting flange connections. Use automatic welding machines to perform critical welds in high radiation areas.

Cutting machines mounted to the outside of piping can be set up quickly and will cut and bevel the pipe for welding in one operation. This simplifies the preparation of the weld area and eliminates the need to grind the end prep.

Use a hydraulically operated shear to cut out abandoned piping quickly if the piping is not going to be replaced. If the piping is going to be replaced, consider installing piping that has removable plugs that allows for the insertion of flexible hydrolazing equipment if it becomes highly radioactive later.

Use engineered and administrative controls to reduce the use of respirators, in order to increase the worker's efficiency and decrease the time in the radiation area. Wear face shields instead of respirators if the concern is to keep the workers from touching their face.

Select protective clothing based on the expected contamination levels, stability and the form the contamination is in. Wearing the proper PPE ensures that contamination will not be spread in the work area or onto workers clothing or skin. This would create problems in recovering from the incident and increase the time workers would have to remain in the work area. Excessive PPE requirements hinder the worker, increase the potential for heat stress and require more time to dress/undress.

On jobs where respiratory protection is required and/or heat stress is a possibility, consider using air-fed hoods instead of full-face respirators. The breathing air helps cool the worker's body and the workers perform more efficiently. Getting certified breathing air takes some effort, but on a long job, the benefits can exceed the effort to install the air system.

Use experienced workers to perform work steps in radiation areas. A dedicated crew of experienced workers can often times perform the work faster than a crew of inexperienced workers.

Video-tape portions of the work on longer jobs to use for training new workers and for historical files/lessons learned.

The two-man rule used for safety often results in two personnel entering a radiation area to accomplish the work that could be done by one person. Consider using cameras to monitor personnel rather than doubling the dose by sending two personnel into the radiation area.

Scaffolding or staging erected in radiation areas takes time and exposure to install and remove. Consider leaving it installed for repetitive work or modify the facility with permanent equipment.

In the past, some facilities monitored the progress of work by counting the number of personnel and the hours spent in the work area. This has resulted in contractors sending a large number of personnel into the work area as soon as the prejob briefing is complete in order to improve their statistics. There is not always work for everyone and sometimes different personnel want to work in the same location.

Digital cameras have been developed that create photo maps of High Radiation Areas. The camera is downloaded into a computer, the images refined, components are labeled, and the high radiation areas are marked. The finished photograph is black and white but the high radiation areas are shown in colors.

B. **DISTANCE:**

1. Distance is the second of the dose control methods and can be more important than time spent in a radiation field. When dealing with a single source, the radiation level drops quickly as you move away from the source. By maintaining distance from the source, the worker can spend more time in the area and receive less dose. The following techniques use "distance" to reduce dose:

In a mixed radiation field where radiation is coming from many different sources, it is important that the workers understand where the sources are and the radiation levels in the work area. Workers should know where the "hot spots" are located as well as low dose "standby areas" where they should move to if the job has a short delay.

Instruct the worker to stay as far away from the radioactive source as possible.

Use remote handling tools when possible. If valves are located in high radiation areas, it may be possible to install remote handwheels that would allow the valves to be operated from low radiation areas.

Use closed circuit television to monitor work areas or components so that personnel can still perform the necessary inspections and over-sight without entering radiation areas. Cameras are available that tilt, pan and zoom in and out. They can be color or black/white and be constructed of radiation hardened materials for use in High Radiation Areas.

If high level radioactive sources or waste have to be moved, consider using wheeled carts or equivalent to allow personnel to perform the movement without getting near the high dose areas.

The type of cutting equipment chosen to cut highly radioactive piping can have a significant effect on radiation dose. Workers have to get close to the piping to install/remove a cut-off machine or to use a port-a-band saw. A german saw or saws-all can be used with the worker positioned farther from the pipe.

Robotics should be considered when performing highly radioactive work in confined spaces in order to reduce dose. Robotic devices and manipulator arms used on-site include tractor devices for inspecting piping, remote arms for handling equipment underwater, and special arms for sampling and monitoring the internals of underground tanks. Micro-robotic devices have been developed that resemble a "bug". These devices can crawl through small pipes and cracks to perform inspections. High dose savings are anticipated.

C. SHIELDING:

1. The types of shielding used to reduce dose rates is dependent on the type of radiation and its energy level. The decision whether to install temporary shielding or not can be complicated in some facilities, therefore, Radcon should be consulted early in the planning phase. An evaluation as to whether to use shielding, which type to use, and all aspects of shielding use has to be completed. Facilities that have an aggressive temporary shielding program have demonstrated the most success in reducing dose. The following techniques use "shielding to reduce dose:

Consider staging temporary shielding near a radiological work area if there is a possibility that highly radioactive waste or components will be encountered during the job. This shielding could be installed quickly to reduce work area dose rates.

When handling highly radioactive samples or sources, thicker protective gloves can be worn which will significantly reduce the beta radiation dose rates. Surveys have shown as much as 80% reduction in extremity dose rates by using the thicker gloves.

When working on radioactive waste tanks or systems, consider leaving water in the system to provide shielding to reduce dose rates.

Some facilities have roll-around shadow shields that can be placed between the hot spot and the worker.

Radiation levels on the outside of glove boxes can be reduced by using lead bricks inside the glove box, leaded plastic for the windows and filling wall cavities with water.

Water shields are tanks that can be positioned near a source and then filled with water. If the tank has a tendency to leak later, the water can be removed and the tank refilled with sand.

Plexiglass, aluminum plate, and rubber matting are "stores" items that can be used effectively to eliminate problems with high levels of beta radiation.

D. **SOURCE REDUCTION:** Source reduction means that if we can keep radiation and contamination levels low, we can perform the work with less risk and limit the spread of contamination. The result should be that workers will spend less time in the work area and not be exposed to high radiation levels. The following techniques of source reduction reduce radiation dose:

Decontaminate the work area to reduce accessible contamination levels and plan for decontamination during the work steps to keep contamination levels low. By decontaminating the work area before the job starts, you may be able to accomplish the work in less PPE.

Cover areas with plastic or tape that are immediately adjacent to the location where high levels of contamination might be present during the job. This will make these areas easier to decontaminate at the end of the job, thereby saving time and exposure.

If the area can't be covered, consider painting the area with strippable latex paint. After the paint dries it can be removed in long strips and this decontaminates the surface. This coating can be applied and the work performed in reduced PPE since it covers up high levels of removable contamination.

Consider the waste stream created during the job. Take actions to separate low-level radioactive waste from mixed waste during the job. By planning for waste minimization, time will be saved in the radiation area.

ALARA protective measures taken to reduce contamination spread often result in reducing the time it takes to perform work steps. Highly radioactive components can be raised into a sleeve to prevent the spread of contamination. This eliminates the time required to decontaminate the area later. Portable HEPA filtered ventilation units or vacuum cleaners that draw a suction close to the source of contamination not only help control contamination spread, but may reduce PPE requirements and decontamination time. Misting the work area with a light water spray or fixative has proven successful in reducing airborne contamination. The use of "sticky pads" in work areas where there is a high probability that contamination will be tracked can reduce contamination spread.

Chemical decontamination of piping systems or components has been used to significantly reduce dose rates. Chemicals are added to the system, allowed to soak and then flushed to a collection facility.

If jobs involve vacuum cleaning high levels of contamination, consider installing a chip collector made from 30 or 55 gallon waste containers in the suction hose to collect the debris. Since the debris is already in the waste container, there is no need to empty the vacuum cleaner. In some facilities, HEPA filters are mounted to the inside of the drum lid so the chip collector will contain all the radioactive particles and prevent the vacuum cleaner from becoming a high radiation source.

If a ventilation hose is placed in the work area to provide negative ventilation, the HEPA filter may become highly contaminated and become a source of high radiation. To prevent this, an in-line HEPA filter can be installed in the suction hose to collect the airborne particles. This filter can be easily shielded and changed when necessary without affecting the aerosol test of the system HEPA filter. At the end of the job, the in-line filter can be disposed in a radioactive waste container and the ventilation system upstream of the filter will not be a radiation source.

Expandable spray foam is being used in ventilation ducts and piping to reduce the possibility of contamination spread during removal. Holes are cut in the tops of the ventilation ducts and the spray foam is added to completely fill the internals of the ducting. Small spray cans are being used to add expandable foam through a small drilled hole at locations where horizontal piping is going to be cut. This forms a plug at the cut location and prevents airborne contamination and spillage during subsequent cutting operations.

Practicing waste minimization in the work area can save time later trying to separate hazardous and radioactive materials. A separate bag or containment sleeve for low-level and mixed waste is an effective method of minimizing waste. Others ways to reduce the amount of mixed waste created include; use substitute materials that are non-hazardous, only take what you need into the work area, and cover hazardous materials so they can be surveyed and released at the end of the job.

"Good housekeeping" throughout the job as well as at the end will significantly reduce the time it takes to recover from a spread of contamination.

An aerosol generator has been recently used to apply a "fixative" to highly contaminated underground pits. A vendor mixes chemicals and then bombards them with sound waves to form an aerosol. This smoke-like material moves slowly down a hose and through an opening in the concrete cover block over the valve pit. The aerosol completely fills the air space in the pit and all surfaces are covered with a sticky fixative. Any airborne contamination present is encapsulated by the aerosol and deposited on the surface. This film covers all the removable contamination and prevents it from spreading when the cover blocks are removed. Work in these highly contaminated pits has been accomplished without any spread of contamination. Smear surveys show the removable contamination is very low, once the fixative has been applied. The fixative washes off easily when sprayed with liquids or rain. Potential uses in the future include ventilation ducts, fume hoods, and process rooms at Plutonium facilities. In addition, a diluted strippable latex decontamination paint could be applied remotely using this technique and then the area entered by personnel who could strip the coating off, decontaminating the surface. Contact Craig Upchurch at (509) 373-0074 for more information.

RECOMMENDATIONS CONCERNING THE REDUCTION IN THE USE OF RESPIRATORS

Respiratory protection is often worn when performing radiological work to prevent the inhalation of airborne radioactive particulate. The DOE Radiological Control Manual, DOE/EH-0256T, emphasizes in Art 316 that:

1. "Engineering controls, including containment of radioactive material at the source wherever practicable, should be the primary method of minimizing airborne radioactivity and internal exposure to workers".

2. "Administrative controls, including access restrictions and the use of specific work practices designed to minimize airborne contamination, should be used as the secondary method to minimize worker internal exposure."

3. "When engineering and administrative controls have been applied and the potential for airborne radioactivity still exists, respiratory protection should be used to limit internal exposures. Use of respiratory..."

4. "The selection of respiratory protection equipment should include consideration of worker safety, comfort and efficiency. The use of positive pressure respiratory protection devices is recommended wherever practical to alleviate fatigue and increase comfort."

Assessments of many of the work practices used in the past have shown that often times respirators are worn when there was little or no attempt to use engineered controls or use work practices that would reduce or eliminate the presence of airborne particulate. Often times respirators would be specified simply to ensure personnel did not contaminate their face by touching it with contaminated gloves. After many years of wearing respiratory equipment many personnel believe it would be difficult to change the workers' mind-set that wearing a respirator ensures you will not take any contamination home with you after work. Many workers insist it is their right to wear respiratory protection.

Studies performed on workers wearing respirators have shown the following results:

a. There is a 25% loss of worker efficiency when wearing a respirator.[1]

b. An average loss of worker efficiency when wearing a respirator was about 20% for most activities and a 40% reduction when wearing the respirator in addition to waterproof outer garments.[2] This added protective equipment effected personnel in two ways:

(1) Alteration of the physical relationship between the workers and their environment - Workers move differently, almost like robots, when wearing respirators.

(2) Deterioration of the physiological condition of the workers - the consequences from conditions which effect the worker's health may be more adverse than being exposed to the radiological conditions.

c. Additional stress on respirator users' was related to eight factors:[3]

(1) Increased breathing resistance
(2) Increased dead air space (worker has to breathe in more oxygen-rich air to replace oxygen deficient air trapped in the mask
(3) Additional weight
(4) Ergonomic concerns (worker enlarges, balance is affected and simple tasks are more difficult)
(5) Restricted vision
(6) Restricted communications
(7) Psychological distress (anxiety level increases)
(8) Physical discomfort

In order to reach the goal of reducing the number of times respirators are used, companies must first increase their ability to use engineered controls to remove any airborne particulate before it reaches the worker's breathing zone. Actions necessary to accomplish this include:

a. Increase the use of HEPA filtered "localized" ventilation to draw airborne particulate away from the worker.

b. Consider purchasing "shrouded" tooling that has an adapter to connect a vacuum cleaner hose directly to the tool.

c. Increase the use of glove bags and teach the workers how to perform work in glove bags.

d. Evaluate spraying work areas with strippable latex decon paint or other "fixants" before starting work to fix high levels of contamination in order to reduce the risks of spreading contamination and possibly reducing the protective clothing requirements for the radioactive work.

d. Revise training to emphasize how to prevent airborne contamination, i.e., use of fixant, "spritzing" area with water, laying damp cloths in the work area, frequent wipedowns of contaminated surfaces, how to position ventilation, etc.

e. Revise work procedures to include detailed radiological control requirements <u>written in the work steps.</u>

Radiological controls personnel can increase the air sampling in the worker's breathing zone to assure the actions taken are sufficient to prove that no airborne contamination is being created during work. If the respiratory equipment has been specified simply to keep the worker from touching his/her face, clear face shields can be worn instead.

If a facility has a "certified" breathing air system or is willing to set up a compressor to provide breathing air, personnel can use air-fed hoods instead of respirators on many of those jobs that require respiratory protection, as long as the length of hose will not restrict the worker's movements. Air-fed hoods are available through several vendors and are cheaper than procuring and laundering respirators. The air-fed hood encloses the worker's head and an inner flap can be tucked inside the protective clothing. The air entering the hood then passes down through the protective clothing and cools the worker's body. A vortex breathing air cooler[4] can be added which will cool the incoming breathing air of up to four workers by up to 50 degrees fahrenheit. This would not only improve the worker's comfort but also eliminates heat stress problems. The air fed hood is popular with workers with long hair, who aren't clean shaven, or need to wear their own eye glasses.

Discussion with radiological control personnel at a commercial nuclear power plant shows they have practically eliminated the use of respirators during maintenance shutdowns. They have expanded the use of engineering controls and established better work practices that reduce the possibility any contamination will become airborne. Workers were briefed in advance on the reasons for reducing the use of respirators and there has been an overwhelming response in favor of using the engineered controls and applying good work practices.

If a company makes the choice to expand the use of engineered controls, modify their training and improve their work procedures they can reduce the number of times workers have to wear respiratory protection. This will involve the commitment of money up front to repair, replace or purchase the proper engineered controls. Once the radiological work can be performed faster and safer without respirators, the companies should recover the money invested.

Convincing the work force they will no longer be required to wear respirators to perform certain jobs will take some effort.[5] The company will need to approach the workers in a way they do not become alienated and willingly accept the need for change. These changes should first be discussed with employee unions or work leaders in order to obtain input on how to disseminate the information to the involved workers. Management and labor will have to work together to plan and analyze the following points:

a. How is the job going to be performed now as opposed to the past?

b. Who should inform the workers of the change?

c. How will this change effect current training and safety policies?

d. How and when the information should be presented?

Because organizations and companies differ in many ways, how this information is presented may vary. However the general approach should be basically the same-Improve the working conditions by reducing the possibility of airborne contamination by using engineering and administrative controls. Train the workforce on methods to use to eliminate airborne contamination. Take extensive surveys in the worker's breathing zone and gradually drop the respiratory requirements when you can prove that no airborne contamination has been detected.

[1] "Respiratory Protection and Worker Efficiency", G. S. Kephart; Radiation Protection Management; Vol II, No. 4, July/Aug 1994

[2] "The effects of Respiratory Protection on Worker Efficiency", R. Lee; Radiation Protection Management, Vol II, No. 5, Sept/Oct 1994

[3] "Combating the Stresses of Respirator Use", E. F. Gee and J. P. Hale; Radiation Protection Management, Vol 6, No. 4, 1989

[4] Automatic Vortex Breathing Air Cooler can be purchased from Innovative Systems, Bremerton, Wa (360) 698-9418

[5] "Workers' Perception of Respirator Use and Internal Dose - A Humanist's Perspective", L. M. Dooley and F. L. Barresi; Radiation Protection Management, Vol II, No. 6, Nov/Dec 1994

GUIDELINES FOR USING THE ALARA MANAGEMENT WORKSHEET

NOTE: The ALARA Management Worksheet is available on Macro WEF043. The form requires you to perform a dose estimate and then evaluate the job to determine if additional ALARA protective measures could be taken to reduce exposure or reduce the spread of contamination. A final dose estimate is then calculated to document any savings of person-rem. This handout amplifies the questions used to evaluate the job and provides suggestions and examples on ALARA protective measures that could be used.

The Hanford Site Trigger levels that shall require formal pre-job radiological ALARA review of nonroutine or complex work activities (HSRCM-1, Article 312.3) are as follows:

- Estimated collective dose for a task projected to exceed **1,000 person-mrem**

- Predicted airborne radioactivity concentrations in excess of the Derived Air Concentration (DAC) or an integrated exposure of **200** DAC

- Work area removable contamination greater than **100 times** the values in DOE/EH-0256T, Rev 1, Radiological Control Manual, Table 2-2

- Entry into areas where whole body dose rates exceed **1 rem/hr** in a work area

- Potential releases of radioactive material to the environment that **meet or exceed DOE 5000.3B reporting criteria (REPLACED BY DOE 232.1)**

In addition, Article 313 of the Hanford Site Radiological Control Manual, HSRCM-1, requires an AMW for Infrequent or First-Time Activities plus senior management and ALARA Committee Review.

What does filling out an AMW do for you?

A. It is the primary documentation to be in compliance with the Hanford Site Radcon Manual and 10 CFR 835.

B. AMW is a tool to help with job planning, document dose estimates and measures taken to reduce exposure. In addition, hazards and potential emergencies are identified and plans can be identified to mitigate these problems.

C. The AMW can be used during the Post ALARA Review to compare actual exposure received to the estimate and verify the planned ALARA protective measures were adequate.

Part I: PRE-JOB INFORMATION

This section is self-explanatory.

Identify what triggered the completion of this AMW:

This list includes a block for each AMW Trigger Level, request by Management or Radiological Control, or for first-time or infrequent work.

Part II: RADIOLOGICAL EXPOSURE ALARA REVIEW

Part IIA: Estimated Person-Hours

This figure represents the total number of hours that workers, HPTs. PICs and Engineers will spend in radiation areas.

Part IIA1: Pre-job Collective Dose Estimate

This figure is calculated by multiplying the number of individuals in each group by the number of hours each individual is in the radiation area times the average dose rate in the radiation area. The final figure is the sum of all the individual person-rem estimates for each organization.

FORMULA: Individual(s) x #Hours x Average Dose Rate = Person-Rem

TOTAL COLLECTIVE DOSE: Total sum of all person-rem

Part IIB Radiological Protective Measures/Considerations

This section requires you to answer five questions concerning the ALARA Protective Measures that reduce radiation dose.

Part III: Contamination Triggered ALARA Review

Part IIIA: Contamination Protective Measures/Considerations

This section requires you to answer seven questions concerning how you control the work area and the ALARA Protective Measures that reduce the spread of contamination.

Part IV: General ALARA Review

This section requires that you answer five general questions that apply to most jobs.

Part IVA: Corrected Person-Hour

This section requires you to recalculate the total number of person-hours spent in radiation areas for workers, HPTs, and engineers after you have determined whether additional ALARA Protective Measures can be used or the number of personnel can be reduced.

Part IVA1: Corrected Pre-job Collective Dose Estimate

This figure is recalculated using the same formula as in Section IIA1 above using the corrected person hours, reduced dose rates, if applicable, and the number of personnel.

Part IVA2: Actual Dose Received

This figure is recorded at the end of the job when the actual dose results are available.

A detailed breakdown of the questions in Sections IIB, IIIA, and IV are included on the Attachment.

Note: Contact your facility Radiological Controls Staff, ALARA committee or the ALARA Program Office at 376-0818 or 372-2881 for assistance in obtaining engineered controls to reduce exposure or limit the spread of contamination.

AMW QUESTIONS

PART IIB . RADIOLOGICAL PROTECTIVE MEASURES/CONSIDERATIONS

A. Can additional or temporary shielding be used to reduce dose rates?

Consideration for using temporary shielding should be given for work in radiation areas. The decision to install temporary shielding will be made by personnel from planning, operations/maintenance and radiological controls, with the approval of Criticality Safety, when required. Radiation exposure to be received in installing the temporary shielding should be balanced against exposure to be saved by the workers. The installation of temporary shielding should normally result in reducing the total person-rem exposure for the job. A potential disadvantage of temporary shielding is that it could interfere with the work and therefore increase the time required to accomplish the job. Consideration should be given to shielding the travel routes to the work area and the areas where services are routed.

Sometimes it may be more beneficial to isolate or remove the source rather than try to shield it. Highly radioactive hot spots that are located near the work area could be wrapped with screen, plastic, plywood, etc., to make it impossible for personnel to get near the source. This would allow the HPTs to establish "stay times" in the area based on a lower accessible radiation levels. If the High Radiation Area is located in a pipe or component, it may be smarter to flush the radioactive material into a collection facility. This gets rid of the source and will reduce the radiation levels in the work area. If the job involves the movement of a highly radioactive source it may be beneficial to use "distance" instead of "shielding" during the period the source is exposed. HPTs should monitor radiation levels and unnecessary personnel should be instructed to move back during this period.

B. What time saving procedures, techniques, training, monitoring, mock-ups, or additional dosimetry will be used?

Time saving procedures could consist of having photographs or video tapes taken to record existing conditions in order to provide better briefings for workers and provide a historical file. Involving radiological control personnel early in the planning process is necessary to avoid delays later in the final job preparations. A planning meeting attended by the appropriate personnel to "brain-storm" a proposed radioactive job is very useful in getting everyone's input early in order to begin preparation of the technical work procedure. Paragraphs 3, 4 and 5 of the "ALARA Tools List" provide additional recommendations on mock up training, work planning and good radiological work practices.

During the walkdown, look at the work area and determine if it should be cleaned up prior to the start of the job. "Good housekeeping" is essential before, during and at job completion to ensure there is ample room to work and all unnecessary materials are removed before a radiological spill occurs. Unnecessary tools, equipment, and materials will complicate the cleanup from a spill and add unnecessary solid waste that has to be processed.

Determine if communications between workers and supervisors could be improved by use of radio systems or closed circuit television. Inexpensive radio systems that can be worn under protective clothing can be purchased. TV cameras and monitors are available through the ALARA Program Office at very little charge. These cameras were formally used to monitor security areas on-site.

Worker comfort can have a significant effect on how long it takes to accomplish the job. If possible, try and use air conditioning, ventilation, heating, etc., to maintain the work area temperatures between 60-80 degrees fahrenheit. Add temporary lighting if existing lighting is poor. If high levels of noise are present, determine if the source of the noise can be secured or moved outside the work area. Consider the use of air-fed hoods and cooled breathing air instead of wearing full-face respirators. This should reduce the potential for a heat stress related problem and the workers will stay in the work area longer.

In plans for access to and exit from the work area, include a convenient and large enough location for donning and removing protective clothing, for briefing personnel prior to entry and for surveying personnel after exit from the work area. When considerable work is to be done in the facility, provide direct access, if possible, from the change room through a controlled passage to the facility work area. Plan the access and exit routes so that personnel do not have to wait in areas where significant radiation levels exist.

In addition, plan in advance for service lines, including lines for air, welding, electrical, ventilation, communications, and consider specifying in the work procedure methods to minimize radiation exposure associated with their installation, maintenance, and removal.

If the work area is located in areas where radiation levels are high, consideration should be given to training on a mock-up if the job involves complex work tasks. The types of mock-ups can vary from small-scale models to full-scale reproductions of the work area to include components, interferences and space limitations. The actual training can consist of lectures, practice on bench-tops or performing the work steps while wearing the protective clothing and using the engineered controls which exactly duplicate the work area conditions. The decision to construct a mock-up and perform training will be a management decision, but the planner will have to determine if this specialized training is required and factor that into the planning process.

The mock-up can also be used to rehearse difficult work steps just prior to entry on the actual job. Tooling can also be operationally tested on the mock-up just prior to use in the work area. For information on mock-up training see WHC-IP-1043, ALARA Program Manual, Chapter 5.

The HPTs will determine if additional supplementary dosimetry is required to record dose to extremities or that will alarm if the radiation levels increase. In some cases it may be required that the workers wear dosimetry that can be remotely read to track their dose when working on highly radioactive components.

C. Can alternatives be employed, such as special tools, ventilation systems, temporary containments, engineered controls?

The ALARA Tools List provides information on the engineered controls that are available on-site to be used to accomplish radioactive work. This includes information about HEPA filtered ventilation/vacuum cleaners, containments, specialized plastic materials, closed circuit television systems, communication systems, vented fume hoods, glove boxes, special decontamination methods, special tools, robotics, software, fax information, electronic dosimetry and scale models. The Tool List also includes sections on training, work planning, work practices, vendors and a list of glove bags and containments that are available in the 200E Area at Bldg 2101M, Door 106 (TWRS Spare Parts, (509) 373-1850.

For certain jobs, the use of special tools or fixtures have made major reductions in radiation exposure through simplification, reduction in time or reduction in mistakes. These tools should be designed, manufactured and tested on a mock-up prior to use in radiation areas. In some cases, use of a special tool can provide less risk of error and can allow a less skilled worker to perform the work. In designing special tools, consideration should be given to ease of decontamination. If special tools require calibration or testing, consider specifying in the work procedure as a prerequisite.

An inventory list should be made for all tools necessary for the job and they should be staged and inventoried just prior to the start of the job. Note: Some tooling may need to be sharpened or calibrated prior to use.

D. How have the number of personnel entering the work area been reduced?

The decision on who is required to be in the work area is probably not up to the planner or other person who is completing the AMW form, but the planner needs to know in order to calculate the exposure estimates. Obviously, there should be no one in the radiation area that doesn't have a need to be there. The use of craft-alignment or cross-trade training can produce significant reductions in the total number of workers exposed and exposure received but, this will have to be approved by management and the worker's union organizations. In any case, the members of the work team should help each other.

In order to maintain personnel exposures at low levels, a large number of skilled workers are sometimes used for a specific high radiation job that could otherwise be performed by a few individuals. In some cases, permitting a few individuals to receive exposures in excess of administrative control levels can result in lower total exposure for the job, because inefficiencies associated with substituting other workers throughout the job would be eliminated. In addition, use of fewer workers would permit more extensive training of these individuals so they can perform the work faster with less chance of making errors. If this appears feasible, the planner or AMW writer should discuss this technique with management personnel to determine what the policy will be for this particular job.

E. List/describe measures employed to control contamination and the generation of airborne radioactivity, as applicable.

Radioactive contamination on surfaces can result from maintenance operations, spills of radioactive liquids/particles or the gradual precipitation of airborne radioactive particulate onto exposed surfaces. The primary reasons for limiting surface contamination is to limit ingestion/inhalation, minimize build-up in the environment and control external radiation exposure if levels of contamination are high.

The use of glove bags, containment tents, drapes, bull pens, wind breaks and air curtains are some of the best methods of controlling the spread of radioactive contamination. The ALARA Tools List provides instructions on how to obtain this equipment as well as other equipment used to collect radioactive liquids. The goal is to confine the spread of contamination to the smallest area when performing radiological work.

The use of HEPA-filtered ventilation systems will also reduce the spread of radioactive contamination as long as it is placed close to the source of contamination and the flowrate is high enough to capture airborne particulate and draw it into the system. Section 3.2 of HNF-CM-4-27 and HNF-SD-OPS-AR-001 will be issued by April, 1997. These documents describe how HEPA filtered vacuum cleaners and portable ventilation systems should be used to control the spread of radioactivity. If the ventilation system is located where it discharges to the environment, without being monitored, a discharge permit approved by state and federal agencies is required before the system can be operated. Questions concerning these systems should be directed to Jeff Luke @ (509)376-8629 or Don Fritz @ (509)372-2066.

Paragraph D of Part IIIB below discusses whether the area can be decontaminated to reduce the risk. If there is a small amount of loose surface contamination, there will be less chance it can become airborne. Decontamination of the work area is an effective means of reducing the potential for airborne contamination. In addition, plastic, tape, strippable latex decon paint or other "fixative" can be applied. A new technology that has been used involves the pumping of an aerosol fixative into highly contaminated work areas prior to entry by workers. The aerosol settles on all surfaces and applies a thin layer of fixative which prevents the contamination from spreading. Surveys taken after the aerosol "fogging" show very low contamination levels. Point-of-contact for this technology is Craig Upchurch at (509)373-0074. Another method that can be used is to lay damp rags in the work area to reduce the possibility that the loose contamination will become airborne during work.

PART IIIA CONTAMINATION PROTECTIVE MEASURES/CONSIDERATIONS

A. Does the work involve posting an area as a Contamination or High Contamination Area?

The work area contamination levels will dictate whether the area is controlled as a Contamination Area, High Contamination Area or an Airborne Radioactivity Area. The protective clothing requirements will be directly effected by how much loose, removable contamination is present and what actions are required for workers to enter the area and perform work. If the work operations involve using highly aggressive tools that will create airborne radioactivity, additional controls will have to be used to control the spread of radioactive particles or the workers will have to wear respiratory protection.

B. What type of floor or wall covering will be used, if applicable?

During the job walkdown, determine the conditions in the work area and decide whether they will have an affect on the job. If the floor of the work area has pipes, valves and other tripping hazards, it might be wise to construct a raised floor to reduce the risks to the worker and allow the job to be performed faster. If the work area is located outside, on uneven ground, you may want level the site before starting work. Often times silver paper or herculite are placed in the work area to cover existing contamination and give the worker a clean place to work. In this way, if the worker tears the protective clothing, there is less risk they will contaminate their skin or clothing. If a containment is used to perform work, you may want to place plywood covered with padding on the floor first. The plywood protects the area underneath the containment and may prevent it from becoming contaminated if the floor is damaged. The padding will make it more comfortable for the workers and make the floor more resistant to tearing if heavy objects or tools are drug across the floor.

The wall areas may become contaminated during work so the area should be protected before work starts. This can be done with plastic materials, construction materials, or the area painted with strippable latex decontamination paint. This saves taking time to decontaminate the area at the end of the job.

C. Should a containment tent or glove bag be used? HEPA filtered?

The decision on whether to use a containment tent or glove bag will depend on several factors. Some of the factors are:

- What is the job scope and what tools will be used?
- Are the workers skilled in using a glove bag?
- Will the work on the job spread radioactivity into the surrounding work area?

The decision on use of HEPA ventilation will depend on whether the ventilation is needed to reduce the spread of radioactivity. If a portable ventilation system is used, the inlet suction must be located close to the work area, otherwise it will have very little effect on collecting airborne radioactivity. If the ventilation system is installed in a containment but only penetrates a short distance into the work area, the ventilation system will be ineffective. If ventilation is installed into a glove bag, it can have a significant effect on airborne particulate. Any tear or puncture of the glove bag during work will may not spread contamination due to the inward flow of air into the glove bag through the hole. WHC-EP-0749, Radiological Containment Guide provides guidance on the selection, procurement, and use of containment tents and glove bags. Copies can be obtained by contacting Document Control at (509)376-5421 or (509)376-9654 or through your area/facility ALARA Chairperson.

D. What decontamination materials are needed?

Review a current contamination survey of the work area to determine the smearable (loose) contamination levels on and near the area to be occupied by the workers and support personnel. If loose contamination levels are high, there may be real advantages to decontaminating the area prior to the start of work. Not only will this reduce the risk of spreading contamination but the protective clothing requirements may be able to be reduced if the contamination levels are lower and the amount of radioactive waste created during the job should be reduced. In addition, consider specifying in the technical work document that the work area should be decontaminated after certain work steps in order to keep these contamination levels low while the job is in progress.

If decontamination is not possible, consider painting the area with a strippable latex decon paint to "fix" the contamination and reduce the amount of contamination that is loose on the surface. This paint can be applied with a paint brush, roller or sprayed. Once applied, it may be possible for the protective clothing requirements to be reduced since there is a reduction in the risk to personnel. At the end of the job, the paint is simply peeled off and most of the loose contamination is removed as part of the residue. Information on where to obtain this paint is included in Section 2.10 of the ALARA Tools List.

Another technique that has been used is to spray the work area with a mixture of water and Elmer's Glue to "fix" the contamination. Mixtures in the ratios of 25:1 and 15:1 have been used successfully to cover the surface with a "slimy" liquid that hardens and becomes tacky. A hand-pump garden sprayer has been used to apply this fixant but it could be also applied with a brush or paint roller. Elmer's glue is available from stores on stock number 0042-0050-007 in one quart cans. Other products that could either be mixed with water or used alone are molten or solid waxes, carbowaxes, organic dyes, epoxy paint films, and polyester resins.

Part IIB, Section E above describes the use of an aerosol to apply a fixant to all accessible surfaces. This has been successful in Tank Farms and is going the be used in other facilities soon.

Other work practices that could be used include "spritzing" the area with water, laying damp rags around the area or covering the nearby areas with plastic and/or tape.

NOTE: For any operations involving fissionable materials at isolated facilities, limited control facilities or fissionable material facilities, consult Criticality Safety personnel for guidance before applying strippable paints or fixatives.

E. What measures have been identified for disposing of radioactive waste?

Facilities are required to minimize the volume of radioactive solid waste generated during radiological work. This is accomplished by minimizing the amount of material generated, segregating materials, decontaminating tools/equipment, reusing contaminated tools/equipment, laundering materials and compressing waste into containers to reduce the volume. The amount of "mixed waste" (hazardous and radioactive) is reduced by looking for non-hazardous substitutes, only using the amount of material you need and taking measures to ensure hazardous materials do not become contaminated. Burial costs for low level radioactive waste is about 10% of what it costs to store mixed or TRU waste. There will be additional costs later when we decide what to do with the mixed and TRU waste. Normally the best place to segregate the waste is in the work area.

Housekeeping in the work area before, during, and after a job will significantly reduce the quantity of materials that have to be disposed as radioactive waste.

F. What methods have been planned to control the spread of contamination? (water spray, fixative, ventilation, etc.)

This question is similar to Part IIB, Sections C and E above. Some of the methods that can be used to confine the spread of contamination include:

- Decontaminate the work area or cover contaminated areas
- Protect clean areas so they don't become contaminated
- Use Glove bags, containment tents, sleeves, etc.
- Use HEPA filtered vacuum cleaners or portable ventilation
- Use chip collectors in-line with vacuum cleaners to collect debris
- Use spray foam inside piping or ventilation ducts
- Provide detailed training to workers on work practices
- Practice "Good Housekeeping"

G. Are the voiding limits of multiple RWPs compatible?

Compare the voiding limits on all RWPs associated with the job to ensure they are compatible.

PART IV GENERAL ALARA REVIEW

A. What phases of the work can be moved to an area with lower radiation levels?

Review a current radiation survey of the work area to determine radiation levels in areas occupied by workers and support personnel. Can the location of the work be moved to another area that has lower exposure? For example: Can the location of where a pipe cut is made on a run of pipe be moved so the worker is in a lower radiation area? Can the components be prefabricated outside a radiation area so that most of the work is done in a lower radiation area? Difficult welds could be made outside the work area and the less difficult welds made in the work area. Evaluate changing the types of welds to reduce exposure. For example: If the procedure requires a butt weld, could the procedure be changed to a socket weld?

B. How can the item or work area be decontaminated to reduce risks?

Part IIB, Section D describes some of the decontamination processes that can be used to reduce the amount of contamination present. For information on additional chemical or mechanical decontamination methods contact the Remedial Action Protection Center at Oak Ridge, TN (423-576-6500 and request a copy of DOE/EM-0142P, Decommissioning Handbook.

C. Describe the lessons learned that were reviewed and incorporated into the work packages, as applicable.

Each planner/scheduler will likely develop his/her own historical file of previous jobs and the lessons learned. In addition, other information is available from Radiological Controls and the ALARA Committee. The Search Hanford Accessible Reports Electronically (SHARE) program is a system anyone can use to retrieve documents related to work that was accomplished at all Hanford facilities. To obtain this information, contact Julia Hu at 376-1549 who will provide the information necessary to put you into the SHARE System. In addition, the lessons learned from the Radiological Controls organization are available from Jim O'Connor at 373-7289. These lessons learned cover problems we have experienced in radiological controls at Hanford and other DOE sites.

D. What existing material, tools, or equipment currently at the job location can be used to complete the job (contaminated materials or tools)?

Some facilities are using contaminated "tool cribs" to store their tooling and equipment that is used often to perform radiological work. In this way, this material is always available and it does not have to be replaced at the completion of each job. When the worker has completed use of a tool, it is wiped down to decontaminate the loose surface external contamination before being placed back into the tool crib. Tools that remain in a contaminated work area are specially marked with yellow or magenta paint so they can be easily identified. Contaminated vacuum cleaners and portable ventilation systems are normally assigned to a facility and do not have to be obtained for each job. You may have to coordinate the use of this equipment in order to have it installed and tested when your job is scheduled to start.

E. Where are the radiological Hold Points included in the technical work document?

Radiological controls that are incorporated into the work procedure fall into two categories. (1) instructions that define how the work is engineered and (2) instructions that specify key actions to be performed during the work. Radiological Hold Points are required to be placed in the left margin of the work procedure on those steps that involve significant radiation exposures, high airborne concentrations or release of radioactivity to the environment. Hold points are also included to ensure surveys or other actions required of HPTs are performed at critical points in the job evolution, e.g., obtaining an air sample during the breach of a radioactive system.

ALARA MANAGEMENT WORKSHEET (AMW)

Work Package No./Procedure	Date	Page 1 of
PART I PRE-JOB · RWP Number	Survey Number	Area/Facility/Location
Job Title/Description of Work:		

Identify what triggered the completion of this AMW:

- [] Estimated dose >1000 person-mrem
- [] Management request
- [] Work area dose rate >1 rem/hr
- [] Radiological Control request
- [] Removable contamination in excess of 100 times Table 2-2 (Go to Part III)
- [] Potential release of radioactive material >DOE 232.1 requirements
- [] Predicted airborne radioactivity in excess of the DAC or integrated exposure of 200 DAC\hrs.
- [] Other ______________________
- [] First time or infrequent activity/Extremity dose

Part II RADIOLOGICAL EXPOSURE ALARA REVIEW	PART IIA Estimated Person-hours	Part IIA1 Pre-job Collective Dose Estimate person-mrem

PART IIB RADIOLOGICAL PROTECTIVE MEASURES/CONSIDERATIONS

A. Can additional or temporary shielding be used to reduce dose rates?
B. What time saving procedures, techniques, training, monitoring, mock ups, or additional dosimetry will be used?
C. Can alternatives be employed, such as special tools, ventilation systems, temporary containments, engineered controls?
D. How have the number of personnel entering the work location been reduced?
E. List\describe measures employed to control contamination and the generation of airborne radioactivity, as applicable?

Part III CONTAMINATION TRIGGERED ALARA REVIEW

PART IIIA CONTAMINATION PROTECTIVE MEASURES/CONSIDERATIONS

A. Does the work involve posting an area as a Contamination or High Contamination Area?
B. What type of floor or wall covering will be used, if applicable?
C. Should a containment tent or glovebag be used? HEPA filtered?
D. What decontamination materials are needed?
E. What measures have been identified for disposing of radioactive waste?
F. What methods have been planned to control the spread of contamination? (water spray, fixative, ventilation, etc.)
G. Are the voiding limits of multiple RWPs compatible?

PART IV GENERAL ALARA REVIEW

A. What phases of the work can be moved to an area with lower exposure levels?
B. How can the item or work area be decontaminated to reduce risks?
C. Describe the lessons learned that were reviewed and incorporated into the work packages, as applicable.
D. What existing material, tools, or equipment currently at the job location can be used to complete the job (contaminated materials or tools)?
E. Where are the radiological hold points included in the technical work document?

PART IVA Corrected Person-Hour	Part IVA1 Corrected Pre-job Collective Dose Estimate person-mrem	Part IVA2 Actual Dose Received person-mrem

Part V AMW REVIEW SIGNATURES		
	AMW PREPARER	Date
	COG\PIC	Date
	ALARA CHAIR	Date

DISTRIBUTION: Original - Work Package
Copies - ALARA Program Office / Facility ALARA Committee Chair

Guidelines for Incorporating Radiological Controls in Technical Work Documents

Radiological Controls that are incorporated into technical work documents (TWDs) fall into two general categories: (1) instructions that define how the work is engineered and (2) instructions that specify key actions to be performed during the work. Instructions in the second category are included to coordinate actions among radiological control and operations/maintenance personnel.

While the TWD specifies some of the radiological controls for the work, it is neither necessary nor desirable that all radiological controls be specified by the TWD. Such a practice would: (1) increase the complexity of the TWD preparation and execution, and (2) unnecessarily delay work in progress to process changes to the TWD when radiological conditions require minor changes to the radiological work practices during the course of the work.

Additionally, such detailed radiological controls are not necessary, because workers are trained/qualified in their "skill-of-the-craft" , supervised and HPTs provide radiological controls oversight of radiological work.

Examples of radiological controls that should <u>not</u> be specified in TWDs include the following:

a. Routine radiological surveys, such as periodic air samples, contamination surveys of items removed from a containment and radiation surveys taken while tagging radioactive material.

b. Routine work practices, such as the work steps to remove a tool from a glove bag.

For most radioactive work, the individual who prepares the TWD should independently incorporate appropriate radiological controls into the procedure. When work is of a unique or highly complex nature and is expected to exceed the trigger levels in Article 312 of Hanford Radiological Control Manual, HSRCM-1 or the work is done infrequently or this is the first-time per Article 313.1, the individual who is preparing the TWD should consult with the facility radiological controls organization for assistance in determining the radiological control requirements and accomplishing a formal pre-job ALARA review. This is best accomplished early in the planning process to avoid delays later and ensure the radiological considerations are factored into how the work is engineered and executed.

As part of preparing the TWD, the author should research the process, facility, room and system to look for historical data and lessons learned. This information should be factored into the preparation of the TWD along with the work scope and actual work activity. For more information concerning electronic databases that contain radiological lessons learned, contact Jim O'Connor at (509) 373-7289, Bill Decker at (509) 372-2881, or Larry Waggoner at (509) 376-0818.

Radiological Control Instructions that Specify How the Work is Engineered:

The TWD should provide the basic instructions but need not reiterate detailed instructions or work practices that are adequately covered by other documents and taught in WHC training programs. Examples showing the types of work steps that should include radiological controls are:

(1) The type of metal removal tool (i.e., grinder, cutting machine, file, etc.) to be used for the work. If the use of different tools is optional, the TWD should specify the preferred technique and the radiological controls required for use of each type of tool.

(2) Use of a radiologically controlled ventilation system or HEPA filtered vacuum cleaner. The work package should include a sketch of the ventilation system and show the flow paths of how air will enter the containment, if installed, and be exhausted. As a prerequisite, the TWD should require an aerosol test by vent/balance personnel and other tests as appropriate, i.e., smoke testing to ensure flow paths are proper or flow rate determinations.

The TWD should include special instructions related to the ventilation system. For example: the TWD might specify the location of the ventilation suction hose just prior to performing work steps that may produce airborne contamination, i.e., grinding, machining, buffing, etc.

(3) Use of radiological tents, glove bags or catch basins. At Hanford, containments are fabricated by the PFP Plastic Shop or procured through private vendors. Some frequently used containments have been placed in TWRS Spare Parts for purchase by all facilities. These containments are installed, certified and removed per WHC-EP-0749, Radiological Containment Guide. The TWD should require the containment or glove bag be certified by Radiological Controls personnel prior to use and at least daily while work is in progress. The step to initially certify the containment should include a Radiological Hold Point.

Special instructions needed to design unique containments should be included in the work package and referenced in the TWD as required. If a radiologically controlled ventilation system is installed, refer to paragraph (2) above.

If the job involves work with fissionable materials, the make-up air is required to enter the containment through HEPA filters or back-flow preventers. Contact the Criticality Safety Representative to approve the design of the system.

Significant changes in the way a containment is used during the steps of a job may require a step in the TWD to ensure it is properly posted and controlled. For example: if the containment is required to be posted as an "Airborne Radioactivity Area" to accomplish grinding, the TWD should include a step to ensure the posting is changed so workers realize that a major change in PPE is required.

(4) Methods to minimize generation of mixed waste when hazardous materials must be used in areas where they will become radioactively contaminated. These instructions should include using minimum quantities, substituting nonhazardous materials and taking measures to prevent them from becoming contaminated, i.e., wrap the container in plastic. Consideration should be given to including instructions to ensure the mixed waste is segregated from other radioactive waste generated during work.

(5) Maximum quantity of radioactive liquid to be expected during work evolutions. Ensure the method used to contain residual liquids or collect larger quantities is covered by the TWD and approved by Criticality Safety, if required. If the work is inside a containment and a drain is required to be installed, ensure the TWD requires the containment to be leak tested as part of the installation process and the drain and associated collection facility are installed properly. Consider adding instructions to minimize the quantities of radioactive liquid waste created, if appropriate.

(6) Performance of decontamination or other actions to remove or "fix" contamination. For example: (1) decontaminate the work area prior to the start of work and periodically during the job; (2) the work area could be painted with strippable latex decon paint or a fixant so there is less removable contamination; (3) "spritz" the work area with water or lay damp rags in the work area to cover the contamination. These actions reduce the risk of spreading contamination and may allow a reduction in PPE by radiological control personnel.

(7) Installation or removal of temporary shielding if not part of another work package. Guidance for the installation and removal of temporary shielding is provided by each area/facility in a local procedure. Consider having temporary shielding installed in the work area and travel paths to the work area. Obtain a recent copy of the work area radiological survey and discuss with the Health Physics Analyst, Senior RCT or Manager.

(8) Installation of temporary personnel barriers around localized high radiation areas to prevent workers from getting near high radiation areas. Also consider flushing "hot spots" to remove the radioactive source.

(9) Installation of protective covers that are installed prior to the start of work to prevent damage to other components which could result in additional work in the radiation area.

(10) Establishing, disestablishing or modifying high or very high radiation or contamination areas.

(11) Special packaging requirements for movement of radioactive tools, material or equipment if different than normal packaging techniques.

(12) Special handling or transfer requirements for disposal of radioactive material or liquid if different than normal handling or transfer techniques.

(13) Use of other types of specialized "engineered controls" such as robotics, cameras, communication systems, special tooling, etc.

<u>Radiological Control Instructions that Specify In-Process or Situational Actions to be Performed by Workers or HPTs.</u>

The following radiological control instructions should be incorporated in TWDs, as applicable, to coordinate specific actions between operations, maintenance and radiological control personnel.

(1) Contamination Control:

(a) Specify when a containment tent, glove bag, catch-basin, etc, should be installed, certified and removed.

(b) Specify contamination surveys whenever conducting operations that have been known to result in or that are expected to result in the spread of radioactive contamination. Examples of such operations include: (1) breaching a radioactive system, (2) removing components or equipment that expose previously inaccessible contaminated surfaces, (3) evolutions that release radioactive or potentially radioactive liquid in the work area, (4) evolutions such as grinding, filing, or machining that have a potential of generating loose surface contamination, (5) prior to removing or opening a glove bag, and (6) changing the posting of a catch-basin contamination area. Note: These examples are not intended to be an all-inclusive list.

(c) Specify fixed radioactive contamination surveys prior to working on surfaces such as the following, if these surfaces were previously exposed or were suspected of being exposed to radioactive liquids or radioactive contamination: (1) painted surfaces, (2) concrete, (3) asphalt, (4) soil, and (5) surfaces with residue to be removed. Note: These examples are not intended to be an all-inclusive list.

2. Exposure Control:

(a) Specify radiation surveys whenever operations are performed that might change radiation levels. Examples of these operations include: (1) installing, removing, or reinstalling temporary shielding, (2) draining, lowering, filling, or increasing the liquid level in tanks containing radioactive liquids or are used for shielding for highly radioactive sources, (3) draining, lowering, filling, or increasing water level inside a radioactive piping system or component, (4) removing highly radioactive components or equipment, and (5) flushing radioactive systems. Note: These examples are not intended to be an all-inclusive list.

(b) Specify the need for radiation surveys when the contact radiation levels on material or equipment removed during work is expected to be high, i.e., >100 mrem/hr.

(c) Specify radiation surveys on HEPA filtered vacuum cleaners or ventilation systems that are used near highly contaminated surfaces or radioactive liquid collection systems that are likely to have an increase in radiation levels during use.

3. Airborne Radioactivity Control:

Specify airborne radioactive contamination surveys during radioactive work that has been known to cause or is expected to cause airborne radioactivity. Examples of such work include the following: (1) initial breaching of a radioactive system if the work is performed in a catch-basin or area that is controlled as a Contamination Area, (2) root pass welding of consumable insert butt welds on radioactive systems, (3) opening and initial entries of confined spaces, tanks or areas that contain radioactive systems, (4) handling radioactive material in a Contamination Area if surface contamination levels are high, and (5) machining or grinding contaminated surfaces outside containments in areas controlled as Contamination Areas.

4. Other Radiological Control Instructions:

(a) Fabrication, installation and/or removal instructions for catch-basins, glove bags and containment tents. These instructions should include special techniques or requirements related to the installation and testing of portable HEPA filtered ventilation systems and temporary radioactive liquid collection facilities.

(b) Special radiation/contamination surveys on grid maps showing the location of survey points if the TWD requires a special survey be recorded for record purposes.

<u>Radiological Inspection Steps in TWDs:</u>

Radiological Hold Points should be incorporated into technical work documents for steps that require action by the Radiological Control Organization to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactivity to the environment. {HSRCM-1, Article 315}

These steps, which require an inspection by radiological control personnel, are required to be signed off before work can proceed. The Hold Point designator is normally placed at those steps where omission or incorrect accomplishment of the step could cause a significant radiological problem. Hold Points may also be included to ensure surveys or other actions required by HPTs are performed at critical points.

A signature block may be used for other applications, such as to verify survey completion, containment installation, survey adequacy or that some other radiological requirement has been met or designated steps taken. Some facilities mark these steps in the TWD as "RC Notes" or "Note" to differentiate between Hold Points.

RADIOLOGICAL HOLD POINTS

Article 315.3 of the HSRCM-1 states "Radiological Hold Points should be incorporated into technical work documents for steps that require action by the Radiological Control Organization to prevent radiation exposures in excess of Administrative Control Levels, high airborne radioactivity concentrations, or the release of radioactivity to the environment."

In order to establish a site-wide consistency on how Radiological Hold Points are used, it is necessary to further define a Radiological Hold Point and provide some examples of how it is used. In addition, guidance is included on actions to be taken if a Radiological Hold Point is missed and work proceeds past the work step.

1.0 DEFINITION: A Radiological Hold Point is a certification signature step in a technical work document which radiological control personnel are required to sign for a specified action *or verification*. Radiological Hold Points are placed at those steps for which omission or incorrect accomplishment of the step could result in a significant radiological problem, i.e., spread high levels of contamination to the environment, create high airborne radioactivity concentrations, or result in high radiation dose to personnel.

Facilities should use the symbol **(HP)** in the left margin of the technical work document to identify these steps and include a signature block at the work step or in an Appendix for the signature, printed name, and date. The action to be signed for should be clearly stated so there is no confusion on what Radiological Control personnel are required to inspect and certify. Such steps shall be signed by radiological control personnel prior to proceeding beyond the work step unless the step specifically states that work is permitted to proceed in parallel. If no such statement is present, work shall not proceed until the work step is signed off. The **(HP)** symbol shall not be used for other purposes.

2.0 GUIDELINES: These guidelines are provided to assist the procedure writer/Radiological Control on whether to add a **(HP)** to the work step. If the work step exceeds these guidelines, add a **(HP)** to the step. Sometimes, the work situation may be unclear and a **(HP)** can be added at the discretion of Radiological Controls personnel if they suspect that contamination and radiation levels may be higher than normal. *The work step should include a clear, concise description of what the RCT is to inspect or action to be performed.*

1. Exposure Control: If high levels of radiation are present or expected, evaluate actions that should be taken to reduce the dose to workers, i.e., temporary shielding, flushing, isolating the workers from the source, and that actions have been taken to track the dose, when required.

    (a) Establishment of special exposure controls when working in radiation fields greater than or equal to *100 mrem/h* beta-gamma @ 30 cm.

    (b) Establishment and removal of high radiation areas where personnel could exceed their Administrative Control Levels.

(c) Identify steps where accessible radiation levels could exceed the limits of the RWP.

2. Potential Release of Radioactive Contamination to the environment: If high levels of contamination are present or suspected, evaluate the engineered controls and work practices used to keep it from spreading, i.e., use of glove bags, containments, ventilation, fixatives, special tools, etc.

   (a) Certification of containment tents, glovebags or other engineered barriers located outside a radiological work facility where leakage could occur and spread contamination greater than the HSRCM-1 Table 2-2 limits.

   (b) Certification of containment tents, glove bags or engineered barriers inside a radiological work facility that could spread contamination greater than one hundred times HSRCM-1, Table 2-2 limits.

   (c) Result in removable contamination levels exceeding the limits of the applicable RWP

3. Airborne Radioactivity Controls: If high levels of airborne contamination will be present, evaluate the engineered controls used to keep it from becoming airborne, i.e., ventilation, fixatives, decontamination, different tools, etc.

   (a) Verification of the adequacy of radiological controls immediately prior to operations that could generate radioactive airborne particulate, i.e., grinding, welding, machining, opening highly contaminated systems, etc., on contaminated surfaces that could exceed concentrations (μCi/cc) >10% of any DAC value."

3.0 ACTIONS REQUIRED IF A RADIOLOGICAL HOLD POINT IS MISSED

If personnel discover that a Radiological Hold Point was missed and the verification signature was not obtained prior to proceeding to the next step, the following actions will be taken:

1. Work will be immediately stopped and the work area placed in a safe condition. The Radiological Control Manager and other appropriate line managers will be informed of the missed sign-off.

2. A Radiological Problem Report (RPR) will be written describing the problem.

3. A critique will be held, if necessary, to gather facts and determine immediate and long-term corrective actions.

4. Those actions needing completion prior to resuming work will be identified and responsible parties assigned.

5. Once the actions are complete, approval will be obtained prior to restarting the job from the Radiological Controls Manager and appropriate line manager.

EXAMPLES OF (HP) SIGN-OFFS:

(1) Exposure Control:

(HP) *Perform radiation survey as the shield plug is removed to ensure RWP limiting condition is not exceeded (100 mrem/h @ riser opening).*

Signature Printed Name Date

NOTE: If RWP Limit is exceeded, stop work, replace the shield plug, and either, obtain revision to the RWP or initiate actions to reduce the radiation levels.

(HP) *Confirm* that temporary shielding has been installed *on the filter housing.*

Signature Printed Name Date

(HP) HPT perform dose rate survey around edge of pit to *ensure* radiation levels are within RWP limiting conditions *(<100 mrem/h* at *waist level).*

Signature Printed Name Date

NOTE: IF LIMITS ARE EXCEEDED, STOP WORK AND REQUEST A REVISION TO THE RWP.

(2) Contamination Control:

(HP) Certify the glove bag *per EP-0749* and *ensure* the drain pump is *installed.*

Signature Printed Name Date

(HP) Perform a contamination survey *to ensure* the fixative has sealed the removable contamination.

Signature Printed Name Date

(HP) *Ensure* that splash guards have been installed for contamination control before cover blocks are removed.

Signature Printed Name Date

(3) Airborne Radioactivity Controls:

(HP) Prior to grinding on the surface, *ensure* the area has been decontaminated, a fixative applied, and/or the contamination covered with plastic or tape.

Signature Printed Name Date

(HP) *Ensure* the portable ventilation system is operating, positioned so it will draw airborne radioactivity away from the worker's breathing zone, and has been leak-tested within last twelve months.

Signature Printed Name Date

(HP) RCT ensure CAM is operational.

Signature Printed Name Date

Post-ALARA Review
Guideline

1. <u>PURPOSE:</u> The purpose of this document is to present recommended guidelines, requirements and responsibilities for debriefing radiological work, preparing debriefing reports, documenting lessons learned and tracking of action items. The use of this instruction is not mandatory, but if it is used, it will assure the Post-ALARA Review is conducted in a manner that will provide the most benefit and document the lessons learned during the job.

2. <u>SCOPE:</u> A formal Post-ALARA Review is required for all non-routine or complex radiological work activities that meet or exceed the trigger levels established in Section 10 of WHC-IP-1043, <u>WHC Occupational ALARA Program.</u> These trigger levels are:

- An actual collective dose equivalent of 5,000 person-mrem or greater
- Actual doses for a task outside the range of +/-25% of pre-job estimates
- Use of the stop radiological work authority
- A task results in a reportable radiological occurrence per DOE 5000.3B reporting criteria **(REPLACED BY DOE 232.1)**
- For identification of significant lessons learned. NOTE: Management may decide to conduct Post-ALARA Reviews to document those actions, tools or techniques that improved job performance or reduced exposure and costs.

3. <u>DISCUSSION:</u> A Post-ALARA Review (PAR) is normally completed by the PIC or cognizant engineer on a standardized form that is then distributed to appropriate personnel. The method chosen to obtain the information necessary to complete the PAR depends on the complexity of the job, use of new technology, and the problems encountered. In most cases, the PAR is completed by the PIC/ Cognizant engineer without assembling a group of personnel. It may be necessary to send a questionnaire to each individual with questions about the job so that each individual can provide input back to the PIC/Cognizant Engineer for incorporation in the PAR. Occasionally, it will be necessary to assemble some of the key personnel in order to document their input into the report. The goal is to record the lessons learned and fix the problems encountered so they are not repeated on future jobs. <u>It is just as important to record what was done right as well as what was done wrong</u>.

A copy of the PAR form can be obtained in the ALARA Program Manual, WHC-IP-1043, <u>Figure 10-2</u>, or <u>macro WEF192</u> on a computer. This form is duplicated as Attachment 1 to this guideline.

If the PIC/Cognizant Engineer needs to obtain input from the workers, HPTs, and planners, the input can be obtained by contacting each person and listing their individual comments. Since this is time-consuming, a better way may be to send each person a questionnaire which requires them to answer several job-related questions. See attachment 2 for an example. After these forms are filled out and returned to the PIC/Cognizant Engineer, the PAR can be completed with the confidence that all key personnel had the opportunity to contribute and the completed PAR documents the problems and lessons learned.

If it is determined that a formal debriefing should be conducted with involved personnel present, the following guidelines may be useful. This debriefing is normally conducted by the PIC and/or the Cognizant Engineer but may be conducted by the Radiological Controls personnel if the main subject or problem areas are directly related to radiological controls. Specific topics of concern which may be addressed at a Post-ALARA Review include, but are not limited to:

- Planning
- Training
- Special Tooling
- Radiological controls, including Radiological Problem Reports (RPRs), Off-Normal Occurrences, control problems and/or the effectiveness of ALARA Protective measures
- Prefabrication
- Technical Work Procedure/RWP
- Quality control
- Cost
- Procedural delays and/or coordination problems
- Analysis of estimated and actual radiation exposures
- Lessons learned/recommendations

4. DISCUSSION:

4.1 To get the most value from the Post-ALARA Review (PAR), it should be conducted soon after the completion of the job while the problems and lessons learned are still fresh in the minds of the workers, HPTs and engineers. A recorder should be selected to take minutes so the important facts presented at the debriefing will not be forgotten. These minutes can be used later by the chairperson to transfer the information to the Post-ALARA Review form.

4.2 Personnel should be notified in advance that a PAR is going to be conducted so they can adequately prepare themselves. This notification should include a summary of the agenda and technical work documents/RWPs to be debriefed. Specific attributes to be discussed should be identified and the chairperson should request applicable work groups be prepared to discuss their areas of expertise. The chairperson should also assure the notification identifies those organizations whose attendance is needed to conduct a proper debriefing. Normally this would include, as a minimum, representatives from engineering, planning, HPTs and crafts.

4.3 Personnel attending the PAR should review related procedures, logbooks, and reports and prepare a list of problems and/or comments to be presented. If possible, these lists should be forwarded to the chairperson in advance to assist in preparing the debriefing report. Attendees should be the personnel who actually performed the work or were closely involved and they should be prepared to discuss the following topics as applicable:

a. Crafts: A summary of the planning, training, special tooling, material prefabrication, operational problems, radiological aspects (e.g., contamination control, radiation exposure, ALARA protective measures, etc), quality control, coordination, and recommendations for improvements.

b. RCTs: Review of RPRs, work practices, assessment of exposure received versus estimate, work area radiation levels and recommendations for improvements.

c. Planners: Review of costs, preplanning, assumptions made versus actual work conditions and recommendations for improvements.

d. PICs/QA: Review of problems encountered, technical work documents and recommendations for improvement.

4.4 At the end of the meeting, the minutes should be read back to the attendees to ensure they are correct. Actions identified during the PAR should be listed in the minutes with estimated completion dates so they can be included in the debriefing report. A representative from each organization having action should sign the minutes to ensure they understand that action must be taken to correct the problems identified.

4.5 The chairperson should take the minutes and any other documents provided and fill out the PAR form. The information needed to complete the blocks of the form are obvious. Once the PAR form is complete, the original should be sent to the ALARA Program Office and copies put into the work package and sent to the ALARA Chairperson. In addition, recommend sending a copy to all attendees with extra copies to the managers of the groups which have actions along with a copy of the minutes. To track the actions, contact the facility Database Administrator or the ALARA Program Office at (509)372-2881 or (509)376-0818.

POST JOB ALARA REVIEW

Work Package/Procedure	RWP No.	Area	Facility	Specific Job Location

Job Title	Job Description

What triggered the completion of this Post Job ALARA Review?

Describe any modifications made to the original work plan to <u>increase</u>, <u>decrease</u>, or <u>change</u> the following:

1. Dosimetry
2. Respiratory Protection
3. Protective Clothing
4. Time/Distance/Shielding
5. Personnel
6. Engineered Control
7. Contamination Control
8. Source Reduction
9. Administrative Controls

Evaluate the effectiveness of the ALARA controls that were implemented. List decontamination factors achieved, installed engineering applications, and administrative controls which attributed to dose reduction.

Describe any deviations from the original scope including any planned ALARA controls that were not implemented and the reasons.

Describe unplanned situations encountered during the job, especially those that caused increased personnel dose.

List Lessons Learned. (Both "Good" and "Improvement Needed" lessons learned are beneficial)

Compare the "actual" collective dose and the estimated pre-job collective dose. List and describe reasons for actual collective dose that is + or - 25% of the pre-job collective dose estimate.

Estimated Prejob Collective Dose	Actual (Postjob) Collective Dose	Corrected Dose Savings/Difference
person-mrem	person-mrem	person-mrem

Potential topics of discussion during the Post Job ALARA Review include:
- [] Planning (good or improvement needed)
- [] Training (met expectations or additional needed)
- [] Special tools ("Did they work?" or "Is there a need for more use of?")
- [] Prefabrication (need more or fully utilized)
- [] Technical Work Procedure/RWP (effective or improvement needed, be specific)
- [] Procedural delay (coordination of crafts, tool or part availability, procedure changes, etc.)
- [] Radiological Controls (RPR, off-normal occurrences, ALARA protective measures)
- [] Quality Controls
- [] Others____

Identify the person performing the Post ALARA Review

COG/PIC	Date
Other	Date
ALARA Chair	Date

Distribution: Original - Work Package Copies - ALARA Program Office, Facility ALARA Committee Chairperson (WEF192)

Comment Sheet

To:

For:

Comments are needed in order to record and document the lessons learned during the radiological work just completed. Rather than try and assemble everyone involved with the job, comment sheets are being distributed in order to obtain input from the workers and HPTs that worked the job. These comment sheets will be combined and form the basis for a Post ALARA Review.

Please answer the questions below that apply to your portion of the job. Both good and bad comments are welcomed and appreciated.

Question	Comments
1. Was the planning for this job adequate? Yes___ No___ If not, what needs to be done to improve the planning for the next job?	
2. Was mock-up or specialized training performed prior to starting the job? Yes___ No___ Was the training adequate? If not, what should be done to improve the training?	
3. Was specialized tooling used to accomplish the job? Yes___ No___ Did it work satisfactorily? What changes should be made to future tooling.	
4. Were the radiological work practices used to accomplish the work steps adequate. Yes___ No___ Was there any spread of contamination that required the job to be stopped in order to decon the area? Yes___ No___ What work practices need to be changed in the future?	

5. Were containments or glove bags used to accomplish the radiological work? Yes__ No__ Describe how they worked and what changes need to be made for future work.	
6. If respirators were required to be worn during the job, is there anything that could have been done differently that would have eliminated the possibility of airborne contamination? Did the respirators cause you to spend more time in the work area and make the job more difficult? Yes No	
7. Were any Radiological Problem Reports, Off-Normal Occurrences written during the job? If so, for what reason?	
8. What measures did you or other personnel use to reduce radiation exposure and control the spread of contamination? Did these measures work? Are there other measures we should take in the future?	
9. Could any of the work been accomplished in lower radiation areas?	
10. Were the steps of the Technical Work Document easy to understand and in the proper sequence. Did the Technical Work Document include the radiological work practices necessary to understand each step and the actions required by the worker?	
11. Were there any procedural delays, job stoppage or coordination problems? If so, what were they? What can be done in the future to eliminate those problems?	

12. Did the prejob briefings cover the things you needed to know to accomplish your portion of the work? If not, how can these briefings be improved?	
13. What lessons learned do you think should be incorporated into future work plans? Please include the good things that were done that should be remembered as well as other lessons that should not be done again. Describe any corrective actions that should be taken to make the job better.	
14. Additional comments or recommendations:	

Please return these comments to ________________________ @ Mail Stop ______ by __________ so they can be incorporated into the Post ALARA Review. Thank you for your input. I will make every effort to assure the lessons learned are documented and distributed to personnel planning future radiological work.

SIGNED____________________

GLOVE BAG FAMILIARIZATION
TRAINING HANDOUT

In order to accomplish radiological work, we use "engineered controls" to reduce our exposure to radiation and prevent the spread of radioactive contamination. Glove bags are one of the engineered controls we use to confine the spread of contamination to the smallest area and enable workers to perform the work without wearing multiple layers of protective clothing and respiratory equipment.

Using a glove bag instead of other types of controls offers several advantages:

- Less radioactive waste will be created
- Less protective clothing will be required
- By confining the contamination to the smallest area, there will be less chance the contamination will be spread
- Using a glove bag can result in significant savings in terms of time, money and person-rem. In tank farms, using a containment tent to accomplish a job costs about $2500.00. The same job in a glove bag costs $250.00

The need for a glove bag should be identified in the technical work document and the RWP. At Hanford, we use the Radiological Containment Guide, WHC-EP-0749, as the source of information about the installation, certification and use of containment tents and glove bags. Copies of this document can be obtained by calling Document Control at (509) 376-5421 or (509) 376-9654.

Appendix A of the Containment Guide describes the process used to select a containment. This process is reproduced in part as Attachment 1 to this handout.

Glove bags can be obtained from several sources. The PFP Plastic Shop has heat sealers available to fabricate containments and glove bags per your sketch. Contact the shop at (509) 373-2220/373-5943 or by fax at (509) 373-3190. Several commercial vendors have provided containments for work on-site for past jobs. These vendors normally have several styles of glove bags on the shelf or will custom build per your sketch. Contact the ALARA Training Center at (509) 376-0818 for a list of phone numbers.

Several glove bags and containment tents that are routinely used for work at tank farms are available through the spare parts warehouse (Bldg 2101M, Door 106 in 200E). These glove bags can be used for many applications besides what they were originally designed for at Tank Farms. In addition, the assessories used in glove bags are also in stock. Contact the ALARA Training Center for assistance at Bldg 2101M, Room 226 or call (509) 376-0818.

Another option that can be used to obtain a containment or glove bag is for the worker to construct his own containment using plastic, herculite, tape, or glue. This has been used on simple jobs but is normally unsatisfactory for complex jobs that have the potential to spread high levels of contamination.

One exception is that FDNW has their own shop at East Tank Farms and routinely fabricates glove bags using sheet herculite, plastic, a sewing machine and glue.

DESIGN CONSIDERATIONS: Appendix A is a checklist that can assist personnel in designing a glove bag. When designing a glove bag or reviewing a vendors design, there are several things to consider:

What work operations will be done in the glove bag?

What tools are going to be used?

How big does the glove bag have to be to accomplish the work?

How much liquid is expected? Is a drain to a collection facility required?

What are the radiation and contamination levels expected?

Is the contamination stable?

What other crafts have to work in the glove bag?

What services are required?

How much space is available in the work area?

What interferences or sharp objects are present in the work area?

Will any chemicals be used that could damage the glove bag?

What type of HEPA filter is needed in the glove bag?

Is a pass out box needed to transfer smears and small tools?

WORK AREA PREPARATIONS: Preparation of the work area is important before the glove bag is installed.

Cover exposed surfaces that will be in the glove bag with tape, plastic, herculite, etc., to keep them from getting contaminated. Don't cover areas that are needed to mount tooling or would interfere with the job.

Remove interferences and lagging in way of the job.

Install temporary shielding and/or protective covers if required.

Install staging to support the glove bag bottom or to tie the glove bag to if there is not sufficient tie-offs located nearby. If the tooling used for the job is heavy or heavy objects will be placed in the bottom of the glove bag, it is important the glove bag not be damaged.

Pad sharp objects that could damage the glove bag during use.

If Caution or Danger Tags are present, ensure they are not covered and are protected from getting contaminated. If component label plates will be covered, determine if temporary label plates should be installed.

If there are components present that could be greater than 150°F, cover these areas with flame retardant materials, as required, to protect the glove bag from coming in contact and becoming damaged.

If the surrounding work area is very complex with many crevices, consider installing sheet plastic or herculite to cover these areas before installing the glove bag. Covering these areas in advance will make it easier for the HPTs to survey and release the area after the job is complete and may prevent having to decontaminate these areas later if a spill occurs during the job.

If lighting in the work area is poor, install temporary lighting or use fluorescent drop lights for illumination.

Consider the need for weather protection, if the glove bag is located outside. In hot weather, the glove bag should be located in a shaded area. In cold weather, heat lamps may be needed to warm the glove bag if temperatures are below 40°F. In addition, protection from wind, rain, snow, etc., is needed.

GLOVE BAG PREPARATIONS: Preparation for installation should be accomplished by personnel who have received training on the guidelines and techniques for installation. These guidelines are outlined in the Radiological Containment Guide and include:

Stage the glove bag and assessories i.e., gloves, HEPA filters, transfer sleeves, etc. outside the radiation or contamination area and install as many of these assessories as possible before entering the work area. Appendix B is a list of containments, glove bags and accessories that are located in the TWRS Spare Parts Warehouse in 200 East (Bldg 2101M, Door 106). There are normally enough of these items in stock to supply TWRS needs and the rest of the contractors.

Install the gloves (size 10 or 11 is recommended) in the correct sleeve and rotate so the thumb is turned slightly inward. **See Attachment 2**

Install HEPA filters near the top of the glove bag. Normally, a 2 CFM filter is installed in a non-ventilated glove bag to allow the glove bag to flex due to small pressure changes that occur when workers use a glove bag. If the glove bag is going to be ventilated with HEPA filtered ventilation or vacuum cleaner, one or more 30-40 CFM filters are needed. Reinspect the filter media after installation to verify it has not been damaged. **See Attachment 3**

Inspect everything for cuts, holes or defects before taking each item into the work area. If the glove bag was stored in a cool area, allow sufficient time for it to warm-up before flexing it so that it will not separate at folds of the material.

While in the staging area, if it is possible to determine where the lowest part of the glove bag will be after installation, install a glove bag drain, if required. If it is not possible to determine the exact location, the drain will have to be installed after the glove bag is installed in the work area. See Attachment 4

Service sleeves installed in the glove bag should only be cut open when needed. Unused service sleeves should be taped securely.

If the glove bag has an access zipper or velcro opening, ensure it works properly. If a transfer box for passing smears and tools is attached, ensure it works properly and is located so it will not restrict visibility.

If the job involves cutting piping with a cutting machine, it may be wise to set up the cutting machine and operate it to ensure it works before installing the glove bag. Any cutting on the outside of the piping would have to be authorized by the work procedure.

<u>GLOVE BAG INSTALLATION:</u> Once all the preliminary outfitting of the glove bag has been completed and all preparations in the work area are complete, take the glove bag to the work area and begin installation.

Tie up the glove bag using elastic cord or thick rubber bands.

Use inside seals when attaching the glove bag to piping whenever possible. See Attachment 5

Presslock or ziplock access tracks should be aligned and properly secured. Apply a strip of tape over the track to provide additional security.

Connect required services and route through service sleeves. Normally only one service per sleeve is allowed. Connect a collection system to the low point drain, if installed. Figure B-6 and B-12 of the Containment Guide shows how to connect this drain and a pump, if needed. Trace the system from the glove bag to its final destination to ensure connections are made up properly.

Tooling that will be used in the glove bag should have its non-critical surfaces covered with tape or plastic to reduce the area that can become contaminated. This will make it easier to get the tooling released at the end of the job.

If the glove bag is going to get highly contaminated during use you should consider laying a piece of plastic or equivalent in the bottom of the glove bag. If it gets highly contaminated, it can be folded and placed in the waste sleeve. This will reduce the amount of decontamination required in the glove bag. Use flame retardant material if grinding will be accomplished or hot metal chips will fall to the bottom of the glove bag.

Testing of the glove bag may be required if liquid is expected or high contamination levels are estimated. This test can be performed using air or water. Page B-16 of the Guide describes the testing methods. If a water test is performed, rather than removing the water at the end of the test, let it flow down the drain tubing and check for leaks. If possible, have the HPT present to witness the test. This will simplify the certification process if the HPT knows there were no leaks found or that any leaks that were found, were corrected. Air tests are normally performed in the shop, not at the worksite.

When the glove bag is installed and all services are operational, a Containment Identification Tag should be signed by the installing craft and tied to the glove bag. See **Attachment 6**. Then contact an HPT to certify the glove bag.

<u>CERTIFICATION:</u> The HPT will inspect the glove bag per the Glove Bag Certification Checklist. See **Attachment 7**. The HPT will sign the Certification Checklist and the Containment Identification Tag. An HPT will recertify the glove bag daily, when in use and sign the appropriate block of the Identification Tag.

<u>WORK OPERATIONS:</u>

During periods when liquids are introduced into the glove bag, ensure there is nothing blocking the low point drain, if installed.

Don't overload the glove bag. Remove waste and unneeded tools promptly. If a vacuum cleaner or ventilation system is installed, ensure it is operating anytime the glove bag is opened.

Wear additional durable protective gloves inside the glove bag when handling objects with sharp edges. This will protect the glove bag gloves and reduce the possibility that a worker could be contaminated and/or injured if a glove is punctured.

In order to prevent tools from damaging the glove bag cover sharp edges or grind off sharp points of the tools.

After using a glove sleeve, leave the glove and sleeve inside the glove bag so that it does not become damaged.

The transfer sleeve should be used to insert or remove items from glove bags when contamination levels are high. **See attachment 8.** Pass out boxes may be used for transferring small items into glove bags when contamination levels are low and <u>permission is obtained from the HPT.</u> The HPT should take surveys after each transfer to ensure contamination is not spread.

If pneumatic tooling is going to be used inside the glove bag, either modify the tool so the air exhausts outside or position the vacuum cleaner or ventilation hose to remove the air being discharged by the tool into the glove bag.

MAINTENANCE OPERATIONS: Workers should be trained to maintain the glove bag during use. These maintenance operations consist of:

Replacing transfer sleeving - See Attachment 9

Replacing damaged gloves - See Attachment 10

Patching holes/tears

Securing the glove bag after work

GLOVE BAG REMOVAL: Recommended sequence that incorporates the following steps is recommended to remove the glove bag without spreading contamination:

Remove tools, material and equipment. Leave the vacuum cleaner or ventilation system, if installed.

Determine if glove bag will be saved for future use

Decontaminate the glove bag to acceptable levels per the HPT or RWP

Spray fixant, if required

HPT signs the Installation Tag - "OK to Remove" plus signature/date

Remove any remaining waste

Conduct prejob briefing and discuss work steps for removal and individual responsibilities

Don required protective clothing

Position large plastic bag underneath the glove bag to catch any contamination that may fall during removal

With the vacuum or ventilation operating, if installed, remove the tape and support cords.

Loosen the glove bag from the top down in slow, deliberate steps and place into the plastic bag. As each new area is uncovered, the HPT should survey. Decontaminate as required before continuing removal.

Secure vacuum/ventilation, if installed

Remove remaining tape/plastic and place into plastic bag

HPT take final survey and decontaminate, as required

Notify PIC when glove bag is removed and area has been returned to its original state

Formal training on glove bags and containment tents can be scheduled through Becca Flores at (509) 373-9502.

Table A-1. Recommended Containments for Specific Work Activities

Removable Contamination Level	Contamination Stability	Operation	Containment Category
<10 times Table 2-2 6	Very Stable 4	Simple Material Movement 5	Very Low Risk Total = 15-20
<100 times Table 2-2 12	Moderately Stable 8	Vigorous Material Movement 10	Low Risk Total = 21-31
>100 times Table 2-2 18	Low Stability 12	Use of power tools in area or manual cutting, shaping or abrading of material 15	Moderate Risk Total = 32-45
		Use of low velocity power tools to cut, shape or abrade material 20	High Risk Total >45
		Use of high velocity power tools to cut, shape or abrade material 25	

Instructions: Select the appropriate block from each of the first three columns. Add numbers from the appropriate block in each column and select the appropriate containment class.

Notes: 1. Removable contamination refers to the DOE Radcon Manual Table 2-2.

2. Containment requirements may be revised up or down based upon general area contamination levels, or dose rates and personnel protection afforded (for example, respirators, ventilation, engineering controls).

3. When contamination levels cannot be verified, either by survey or historical data, the most limiting level for contamination should be used.

4. The values on the chart call for subjective analysis. The Radcon Organization is responsible for making the final determination of the level of containment. This should be done in consultation with the line organization.

CONTAINMENT CATEGORIES

Very Low Risk

This category of tasks has a very low risk of contamination spread. For these work activities no specific containment beyond good work practices would apply. This does not preclude using containment; experience and training of the work force would be the basis for containment selection. In this category, containment might be a damp rag, sleeving, an air curtain, or even a plastic bag.

No certification or work controlling document description of the containment is routinely required for this category of work.

Low Risk

This category of tasks does have a risk of contamination spread, but the risk is low. To keep the risk low, the containment device should be identified in the work controlling document. Examples of devices in this category are catch containments, drip pans, bull pens, sleeving, air curtains, etc.

No certification of the containment is routinely required, but the work package describes the containment device/method.

Moderate Risk

This category of tasks has a moderate risk of contamination spread. Containment for this type of work is usually total enclosure such as heavy sleeving, glove bags, or containment tents. Where total enclosure is not feasible, the application of fixatives or other controls should be used.

The containment method should be called out in the work controlling document and the containment should be certified prior to use.

High Risk

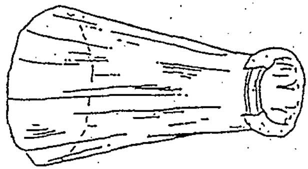
This category of work contains an inherent risk of a contamination spread. Containment should be accomplished by ventilated tents or glove bags, or other means of enclosure used independently or in conjunction with each other.

Certification of the containment device is recommended. The work package must contain a certification checklist for the specific containment used.

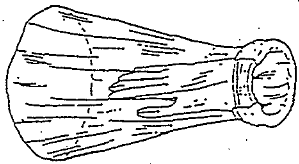
Attachment 2

GLOVE INSTALLATION

1. Insert the end of the sleeve through the ring. Then fold the end of the sleeve out to cover the glove ring.

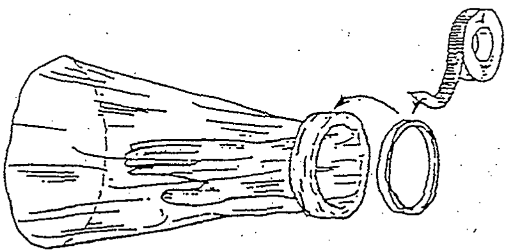


2. Insert the glove into the sleeve in the appropriate working position (thumb rotated slightly inward) and fold the cuff of the glove over the glove ring.



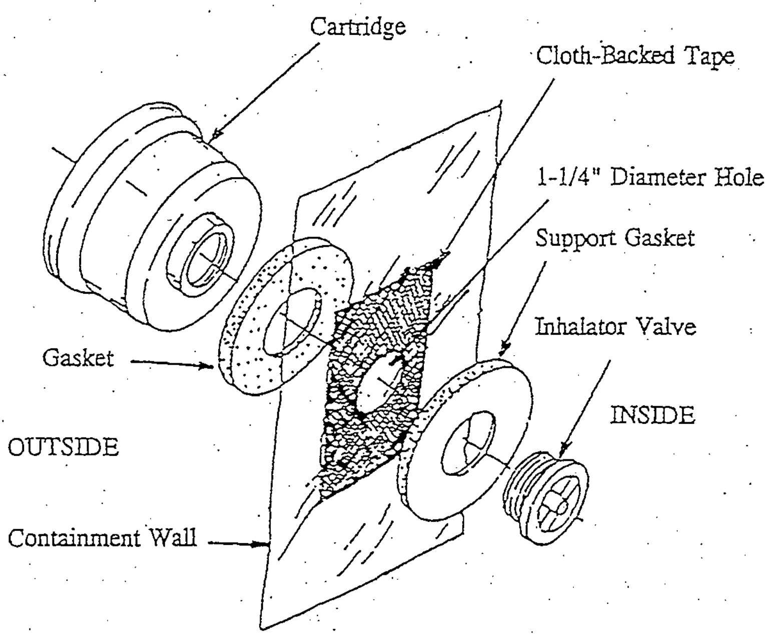
3. Place the rubber ring over glove and sleeve and into the groove in the glove ring.

4. Apply tape over rubber ring.

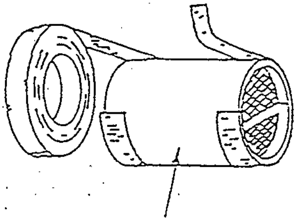


5. Push gloves and sleeves inside the containment.

2 CFM FILTER INSTALLATION



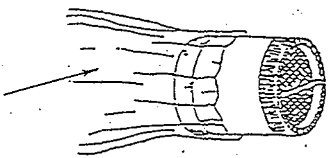
CANISTER FILTER INSTALLATION



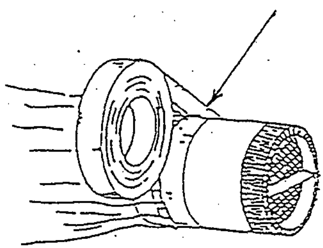
30-40 CFM Filter

1. Check the following:
   - Efficiency test stickers attached.
   - Metal Housing intact and not deformed.
   - Filter elements intact.
2. Install filter in highest practical portion of the containment.
3. Ensure filter does not obstruct
4. Attach tie-off rubber (or elastic) band and cord to metal strap on filter

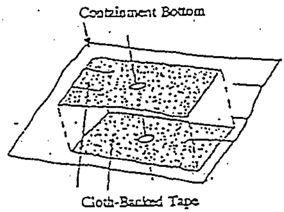
Sleeve



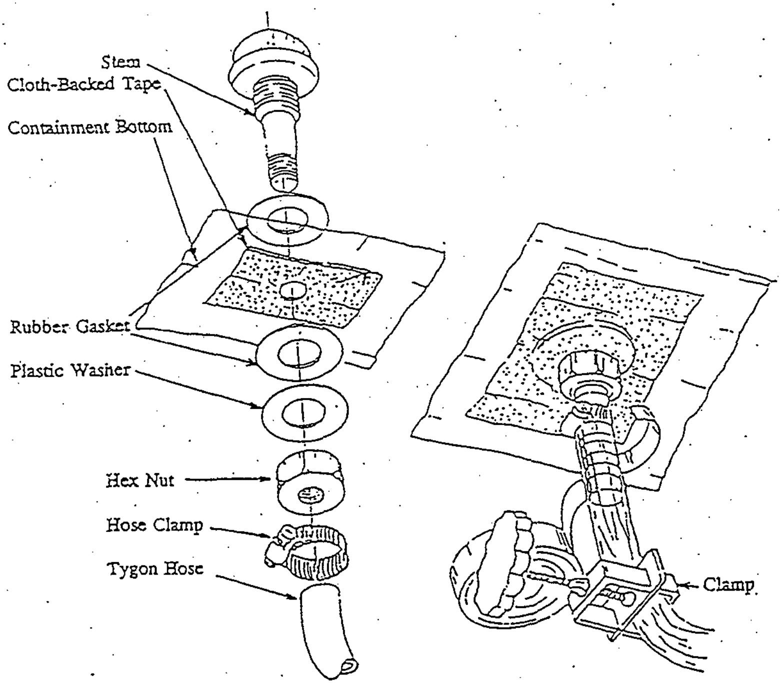
Seal Sleeve to Filter



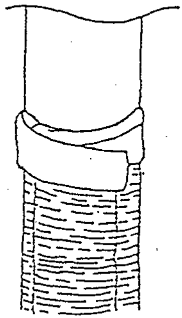
DRAIN FITTING INSTALLATION



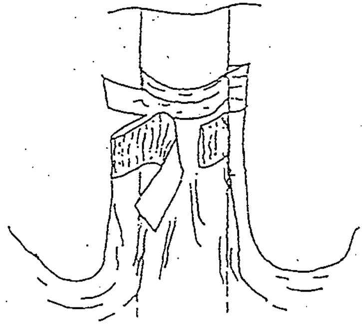
1. Apply cloth-backed tape to an area (approx. 2" X 2") inside and outside the glove bag in the area selected for the drain. Note: This should be at the lowest point at least 1/2" from nearest seam.
2. Cut or punch an appropriate size diameter hole through the tape.
3. Install drain fitting as illustrated.
4. Protect sharp edges of hose clamps with cloth-backed tape.



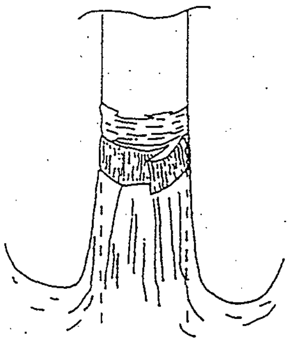
SEALING A GLOVE BAG TO A COMPONENT USING AN "INSIDE" SEAL



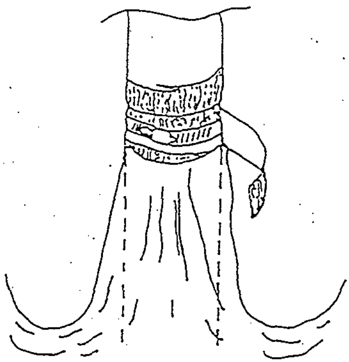
1. Cover piping with cloth backed tape.
2. Apply doublesided tape to cloth backed tape.



3. Attach cloth backed tape to sleeving and double backed tape to make a tight seal.



4. Wrap again with cloth backed tape.



5. Install hose clamp and tape over clamp.

Figure C-3. Containment Identification Tag

Work Package #	
Installed by	Date:
Initial Inspection by	Date:
Record of Routine Inspection	

Date	Time	Signature	Date	Time	Signature

Routine Glove Bag Inspection

1. The glove bag is free of holes, tears, or defects in materials.

2. Components and surfaces inside the glove bag are covered to minimize decontamination.

3. The containment is protected from sharp objects, internal and external.

4. The glove bag and installed service sleeves are properly supported.

5. The gloves are properly attached and free of cracks, splits, or holes.

6. The glove bag seal to the component is adequate and inside seals are used (if possible).

7. The glove bag is properly aligned to allow access to the work.

8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.

9. If a vacuum is used with the glove bag, it is HEPA filtered and has a current efficiency test label.

Figure C-2. Glove Bag Certification Checklist

DATE	LOCATION
WORK PACKAGE #	INSPECTED BY (SIGNATURE)

YES	NO*	N/A*	CRITERIA
			1. The glove bag is free of holes, tears, or defects in materials
			2. Components and surfaces inside the glove bag are covered to minimize decontamination.
			3. The containment is protected from sharp objects, internal and external.
			4. The glove bag and installed service sleeves are properly supported.
			5. The gloves are properly attached and free of cracks, splits, or holes.
			6. The glove bag seal to the component is adequate and inside seals are used (if possible).
			7. The glove bag is properly aligned to allow access to the work.
			8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.
			9. If a vacuum is used with the glove bag, it is HEPA filtered and has a current efficiency test label.
			10. Other
			11. Other
			12. Other

Comments:

* Check-offs in this column must be supported by comments and/or approval signatures; if no criteria are waived or added, approval signatures are not required.

Approval: Health Physics ____________________

Operations ____________________

1. The glove bag is free of holes, tears or defects in materials.

Inspect all seams. Using the thumb, apply moderate pressure to the seam to verify is completely sealed. Inspect the seams where sleeves attach to the glove bag, tug on the sleeves to verify the connection is sealed.

2. Components and surfaces inside the glove bag are covered to minimize decontamination.

Non-essential surfaces that could become contaminated during work should be covered with tape or plastic materials. Glove bags installed on valves or switches should not cover the identification plates, if possible. Notify the PIC to have temporary label plates installed, if required.

3. The containment is protected from sharp objects, internal and external.

Corners of sharp objects outside the glove bag should be padded or taped before the glove bag is installed. In addition, protective covers should be installed on components near the glove bag that could be damaged during work.

4. The glove bag and installed service sleeves are properly supported.

Elastic cord should always be used to support a glove bag so the worker will not damage the bag during work operations. Services passing through the sleeve should be supported independently of the glove bag.

5. The gloves are properly attached and free of cracks, splits or holes.

Ensure the right and left hand gloves are installed in the proper sleeves with the thumb tilted slightly inward.

6. The glove bag seal to the component is adequate and inside seals are used (if possible).

The connection between the glove bag and the componenet is a critical connection that is often made over an irregular surface. Special consideration may be required to ensure this connection remains secure during operation.

7. The glove bag is properly aligned to allow access to the work.

A person working in the glove bag must be able to reach the work. Verify the alignment of the glove bag is such to minimize interference.

8. If a drain is used, it is located in the low point of the glove bag, is unobstructed, and is securely fastened to an appropriate collection system.

If liquids will be deliberately introduced into the glove bag during the job, a "leak test" the glove bag should have been accomplished as part of the installation process. Glove bags containing drain fittings should not have absorbant material in the bag and the drain should be connected to an appropriate collection device.

9. If a vacuum is used with the glove bag, it is HEPA filtered and has a efficiency test label.

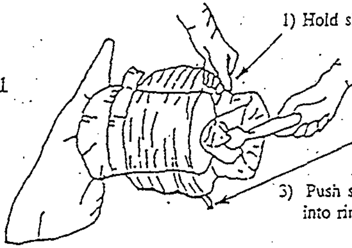
Operate the vacuum cleaner to ensure the glove bag does not collapse during use. A breather filter should be installed to installed to allow make-up air to enter the glove bag when the vacuum cleaner is operated. A tag on the vacuum cleaner should indicate the date of the last efficiency test and its expiration date. If the date will expire before the job is complete, consider retesting the vacuum cleaner now or replace with a different vacuum cleaner.

If pneumatic powered tools will be used in the glove bag determine how the air discharged from the tool will removed from the glove bag. A remote exhaust hose may be able to be attached to the tool or the vacuum cleaner could be operated while the tool is being used.

NOTE: Article 464.6 of Reference (b) requires that a nuclear safety review be performed and documented prior to the use of a vacuum cleaner for <u>fissile material</u>. Recommend this be verify this review has been conducted prior to certifying a glove bag used on a system that contains fissionable materials.

TOOL/ITEM INSERTION INTO A GLOVE BAG

STEP 1

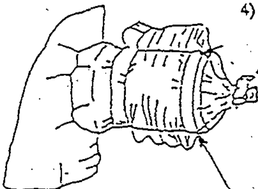


1) Hold sleeving.

2) Remove tape holding sleeve to plastic ring.

3) Push sleeve and tool into ring as shown.

STEP 2

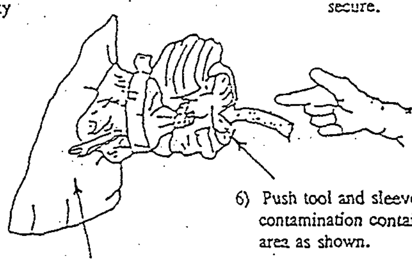


4) After pushing tool and sleeve into ring, gather open end of sleeve and make tape joint securely, as shown.

Sleeve and Ring cut away for clarity

5) Tape sleeve around ring to secure.

STEP 3

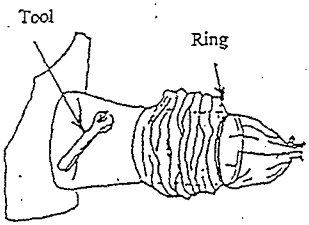


6) Push tool and sleeve into contamination containment area as shown.

7) From inside contamination containment area, make opening in sleeving and remove tool.

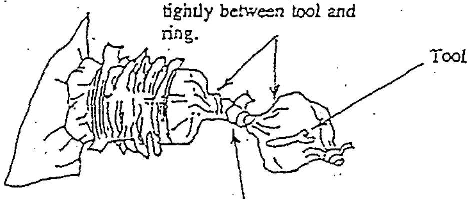
<u>NOTE:</u> After completing item of step 3, disregard cut portion of sleeving, continue as required with next removal or insertion.

TOOL/ITEM REMOVAL FROM A GLOVE BAG



STEP 1 1) Pass tool thru ring into PVC/Poly sleeving.

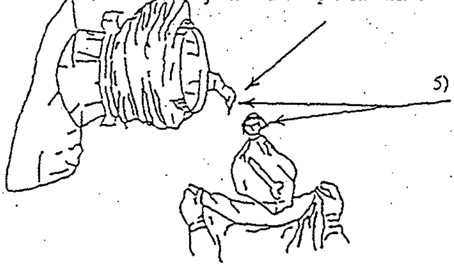
2) Twist PVC/Poly sleeving tightly between tool and ring.



STEP 2

3) Pinch twisted PVC/Poly sleeving and tightly tape.

4) Cut in center of tape joint with sharp instrument.



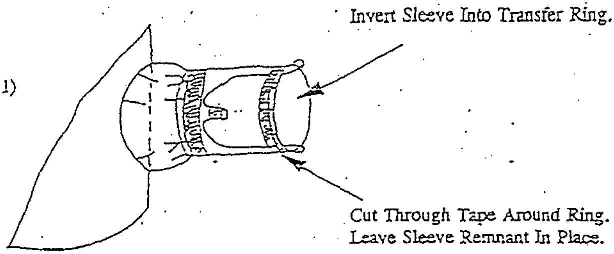
STEP 3

5) Tape over to seal

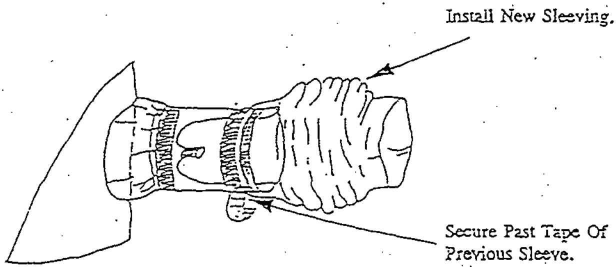
6) Place tool inside of sleeving into poly bag and remove from area.

REPLACE TRANSFER SLEEVE

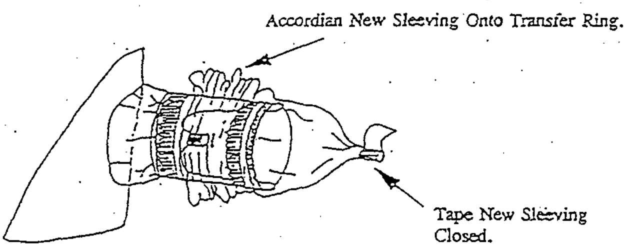
Step 1)



Step 2)

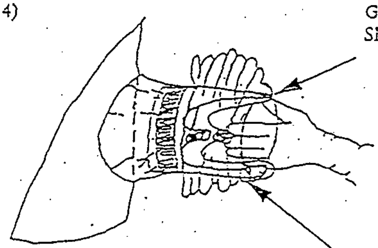


Step 3)

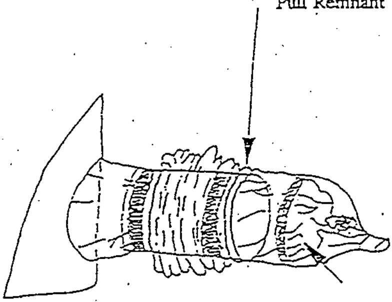


REPLACE TRANSFER SLEEVE (CONTINUED)

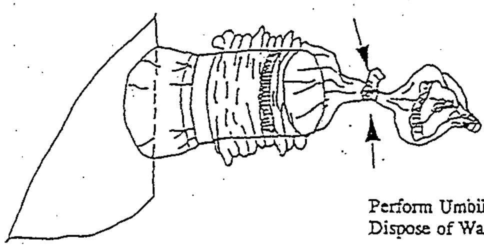
Step 4)



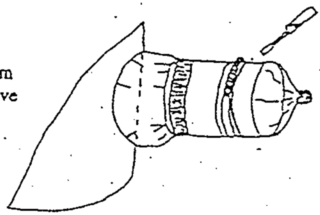
Step 5)



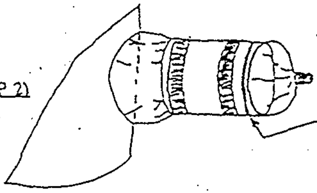
Step 6)



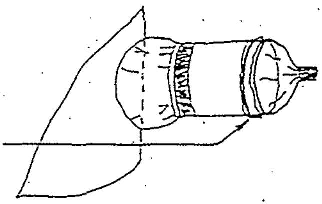
REPLACE TRANSFER SLEEVE (ALTERNATE METHOD)



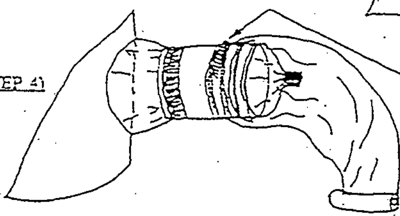
STEP 1) Remove hose clamp/cable ties from the depleted sleeve. Do not remove tape at this time.



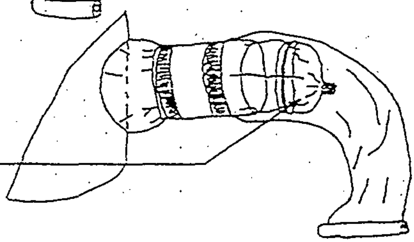
STEP 2) Place a large rubber band near the end of the transfer sleeve to hold it in place.



STEP 3) Untape the transfer sleeve remnant and roll edges over the rubber band.



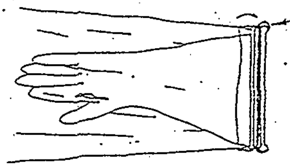
STEP 4) Tape and hose clamp/cable tie the new transfer sleeve to the transfer ring. Cover clamp with tape.



STEP 5) Through the transfer sleeve, grasp and pull the remnant into the new transfer sleeve. Transfer out, umbilical cut, and dispose of remnant.

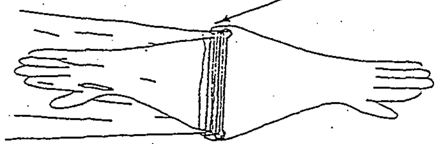
GLOVE REPLACEMENT

Step 1)



Lip of damaged glove rolled to center of glove ring.

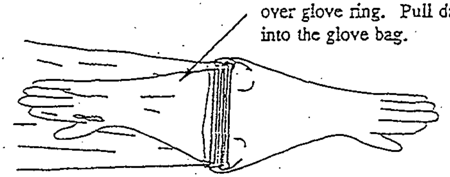
Step 2)



Lip of replacement glove placed over lip of damaged glove and glove ring.

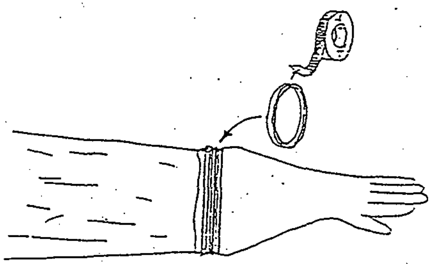
Step 3)

Roll or lift lip of damaged glove over glove ring. Pull damaged glove into the glove bag.



Step 4)

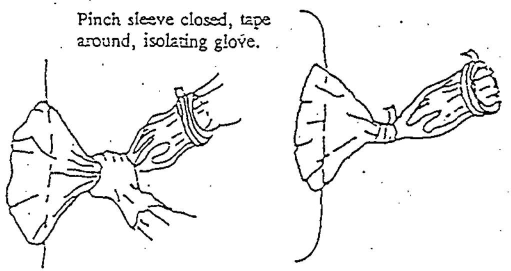
Reinstall the rubber ring and retape new glove into place. Replace the glove and sleeve into the glove bag.



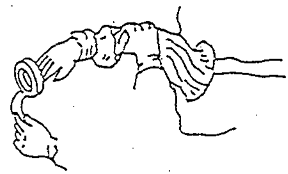
GLOVE REPLACEMENT
(ALTERNATE METHOD)

STEP 1)

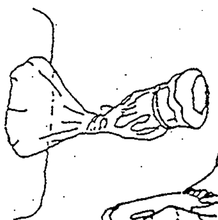
Pinch sleeve closed, tape around, isolating glove.



STEP 2) Remove tape and rubber ring from the sleeve/glove ring.

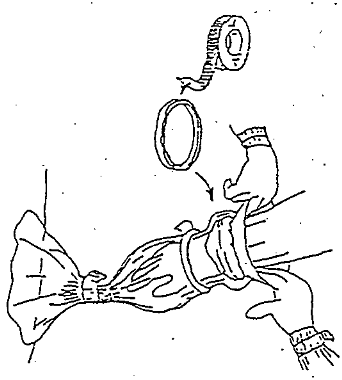


STEP 3)



Over open poly bag, remove the damaged glove, allowing it to fall into the bag.

STEP 4) Insert the new glove into the sleeve. Place the glove lip over the glove ring. Reinstall the rubber ring and retape.



GLOVE BAG DESIGN WORKSHEET

JOB TITLE: ______________________________
WORK FACILITY: ______________________ RWP# ____________
LOCATION OF GLOVE BAG: ______________________________
SKETCH IS/IS NOT ATTACHED. NUMBER REQUIRED: ________ DATE REQUIRED ____________

DESCRIBE WHAT IS GOING TO BE DONE IN THE GLOVE BAG: ____________

____

____

____

____

HOW WILL THE GLOVE BAG BE SUPPORTED? ____________

____

____

____

____

HOW WILL GLOVE BAG BE ATTACHED TO COMPONENT? ____________
WILL TEMPERATURES EXCEED 150 DEGREES FAHRENHEIT ON COMPONENTS? ____________

WILL THE GLOVE BAG HAVE NEGATIVE VENTILATION AND/OR VACUUM CLEANER? ________
MINIMUM SIZE HEPA FILTER REQUIRED IS _____ CFM. SIZE & LOCATION FOR FILTER SLEEVE IS ______________________________

OVERALL DIMENSIONS: ______________________ COLOR ____________
NUMBER OF GLOVE SLEEVES, LOCATION & SIZE GLOVES ____________

____

NUMBER OF PASS SLEEVES, SIZE & LOCATION ____________

____

NUMBER OF SERVICE SLEEVES, SIZE & LOCATION ____________

____

SIZE & LOCATION OF SWIPE BOX ____________

ARE THERE ANY COMPONENTS, I.E. PIPING, THAT PENETRATE THE GLOVE BAG THAT WILL REQUIRE SPECIAL SLEEVES OR SEALING METHODS? ____________

ARE HEAVY TOOLS OR COMPONENTS GOING TO BE PLACED ON THE BOTTOM OF THE GLOVE BAG THAT WILL REQUIRE STAGING UNDERNEATH THE GLOVE BAG TO SUPPORT THE WEIGHT?
______________________ WHO INSTALLS STAGING? ____________

IS TEMPORARY SHIELDING GOING TO BE INSTALLED INSIDE THE GLOVE BAG? ________

DOES GLOVE BAG REQUIRE A VELCRO TOP THAT CAN BE OPENED? _____ SIZE? ________

ARE LIQUIDS EXPECTED? ________ HOW MUCH? ____________
SHOULD GLOVE BAG BE WATER TIGHT? ______ SHOULD LIQUID DRAIN BE ATTACHED? ______
WILL GLOVE BAG BE TESTED WITH WATER PRIOR TO CERTIFICATION? ____________

WHAT CHEMICALS WILL BE USED IN THE GLOVE BAG? ______________________

ARE ANY OF THESE CHEMICALS DETRIMENTAL TO THE MATERIALS THE GLOVE BAG IS MADE FROM? ______________________

ARE THE GLOVE BAG INTERNALS REQUIRED TO MEET GRADE "A" CLEANLINESS REQUIREMENTS? ______________________

SHOULD THE GLOVE BAG CONTAIN INTERNAL POCKETS FOR TOOLS? ______________________
IF SO, WHERE? ______________________

SHOULD LINERS BE INCLUDED TO COVER THE BOTTOM OF THE GLOVE BAG SO THEY CAN BE REMOVED IF THE BAG BECOMES HIGHLY CONTAMINATED? ______________________

IS A CATCH PAN OR DRAPE REQUIRED BELOW THE GLOVE BAG TO CONTAIN ANY SPILLAGE FROM THE BAG? ______________________

WILL LONG TOOLS SUCH AS TORQUE WRENCHES BE USED IN THE GLOVE BAG? ______________________
DOES THE SKETCH INCLUDE SOME PROVISION FOR THIS LONG TOOL? ______________________

NAME: ______________________ PHONE: ______________________

STOCK NUMBERS FOR CONTAINMENTS, GLOVE BAGS, AND THEIR ACCESSORIES

This section focuses on a variety of containments and the associated spare parts inventory stock numbers. R. L. (Bob) Brown can be contacted on 372-2932 for information on the acquisition and stocking of containments.

Spare Parts List

These items may be obtained at Building 2101M, Door 106 in the 200E Area or by calling 373-1850.

Stock No.	UOI	Description
6175-1610-0590	EA	Poly Bottle, 5 gallon, with second closure plug
6175-1610-0924	EA	Cone Shaped Catch Containment, 12" Diameter
6175-1610-0925	EA	Containment, Flat Bottomed, 18" Diameter
6175-1610-0926	EA	Containment, Mechanical Joint
6175-1610-0927	EA	Containment for 5 gallon Poly Bottle
6175-1610-0928	EA	Containment Tent, Type I (for non-ventilated operations)
6175-1610-0929	EA	Containment Tent, Type II (for ventilated applications)
6175-1610-0930	EA	Containment Tent Floor for Type I and II Tents
6175-1610-0936	EA	Bungee Cord, 1/4" Diameter x 500 feet
6175-1610-1260	EA	Containment Drain Assembly, 1/2"
6175-1610-1720	EA	Poly Bottle Fill and Vent Assembly, 5 gallon
6175-1610-1722	EA	Filter, Canister, 30 CFM**
6175-1610-1724	EA	Filter, Glove Bag, 2 CFM
6175-1610-1726	EA	Filter, Type II Containment tent inlet, 18" x 18" x 1/2"
6175-1610-1930	EA	Frame, for Doghouse Glove Bag
6175-1610-1932	EA	Frame, Type I/II Containment Tent, 1" sch 40 galvanized pipe
6175-1610-1934	EA	Frame, Type B (Type II, III, IV, & VI glove bag)
6175-1610-2230	PR	Glove, 18" rolled cuff, size 11 (for glove bag)
6175-1610-2234	PR	Glove, 15" rolled cuff; size 9
6175-1610-2238	EA	Doghouse Containment
6175-1610-2240	EA	Glove Bag, Type I (FIC)

Stock No.	UOI	Description
6175-1610-2241	EA	Glove Bag, Type II (for 4" Riser)
6175-1610-2242	EA	Glove Bag, Type IV (Greenaway)
6175-1610-2243	EA	Glove Bag, Type VI (Rulon)
6175-1610-2244	EA	Glove Bag, Type VIII (Butch Hall)
6175-1610-2245	EA	Glove Bag, Type X (Wilder)
6175-1610-5656	EA	Pump, Hand Siphon
6175-1610-6200	EA	Ring, Glove, 5 1/2" Inside Diameter
6175-1610-6914	RL	Sleeving, 8" diameter x 100', 12 mil, translucent yellow, clear or white
6175-1610-6916	RL	Sleeving, 12" diameter x 50', 12 mil, translucent yellow, clear or white
6175-1610-6918	RL	Sleeving, 24" diameter x 50', 12 mil, translucent yellow, clear, or white
6175-1610-6920	PK	Sleeving, 6" diameter x 100', 8 mil
6175-1610-7440	EA	Tape, G-Flexx Tape, 3" x 20 yards
6175-1610-7442	EA	Tape, G-Flexx Tape, 6" x 20 yards
6175-1610-7760	EA	Tube, Transfer, 6" diameter Rigid PVC

* Additional information may be added to the table by sending a copy of the table with the additional information listed, to the ALARA Program Office. MSIN: S0-19

** 30-40 CFM filters can also be obtained from Lancs Industries (206)823-6634, G/O Corporation (504)847-0564, or Frham Safety Products (615)254-0841.

ACTIONS TO REDUCE THE NUMBER OF SKIN AND CLOTHING CONTAMINATIONS

1.0 PURPOSE

This instruction provides a list of actions that have been proven to reduce the number of skin/clothing contaminations at Nuclear facilities.

2.0 IMPLEMENTATION

1. Control of radioactive contamination can be achieved by using proper radiological work practices and the use of engineered controls to confine the spread of contamination. By controlling contamination, the potential for internal exposure and personnel contamination can be decreased. The radiological training of the individual workers is paramount in having a successful radiological program. In spite of efforts to have no skin or clothing contaminations, they sometimes occur. When this happens, trained personnel need to evaluate what happened and determine what must be done to prevent recurrence.

3.0 ACTIONS TO MINIMIZE SKIN/CLOTHING CONTAMINATIONS

1. Each facility should periodically review their Radiological Problem Reports (RPRs) for trends so action can be taken to fix problems that occur over and over. When skin and clothing contaminations occur it is not always obvious what caused the problem. The following actions reduce skin and clothing contaminations.

1.1 Review records to determine which body locations are experiencing the most incidents of contamination. Efforts may then be concentrated on those specific locations to determine the cause and take the appropriate corrective action.

1.2 Review protective clothing requirements and survey results for several jobs to determine if the requirements listed on the Radiological Work Permit (RWP) were correct.

1.3 A prime source of skin contamination occurs during the removal of PPE. Hurrying or improper removal, especially at lunch time and near the end of the shift, may contribute to this problem. If this is found to be occurring, the workers should be reminded to undress the same way they were trained. Emphasize the importance of following each step of the undressing procedure verbatim, completing each step before going to the next step. Supervisory personnel should be encouraged to monitor the undressing of their workers occasionally to identify problem areas. RPRs should be written to identify personnel who continue to have a problem undressing properly.

1.4 Improper laundering of protective clothing may leave residual contamination which can transfer to the user. Surveys of returned laundry should be increased if it is suspected to be a causal factor. Surveys should be performed prior to removal of laundry bags from the vehicle and results should show <1000 DPM alpha and <10,000 DPM beta-gamma. Laundry above limits should be returned to the vendor and documented on an Radiological Problem Report.

1.5 If a person is found to be contaminated after wearing protective clothing, try and recover his/her protective clothing so that it can be surveyed and inspected for holes, rips and tears. Remove a portion of the contaminated protective clothing for isotopic analysis.

1.6 If personnel are working without respirators and their faces are becoming contaminated, have them wear clear plastic face shields and/or paper masks. This will keep them from touching their face.

1.7 Consider installing "sticky" pads in the undressing areas of controlled areas. This can reduce a number of "false alarms" caused by workers with naturally occurring radioactive isotopes on their shoes. If the RCA contains "Fixed Contamination Areas" (FCAs) which have been painted over, the cause of shoe contamination may be due to deterioration of the outer layers of paint covering the fixed contamination. Normally, yellow paint is applied directly to the area and is followed by one or more layers of non-yellow paint.

3.2 <u>Other actions taken to minimize skin and clothing contaminations include:</u>

1. Retraining radiological workers in contamination control work practices is accomplished by having the workers attend training classes, reading periodic training bulletins and discussions at safety meetings. Consideration should be given to mockup training and/or special skills training for complex radioactive jobs. The mockup training should closely simulate actual conditions in the work area and personnel should wear the same protective clothing. Assessing the work practices used by the workers and RCTs should give a picture of what happens in the work areas.

2. Managers should review contamination control policy guidance with workers to assure the workers understand what's expected? Managers may need to reemphasize worker accountability for radiological and work control requirements and their responsibility to not get contaminated. Poor performance should not be tolerated. Workers must be accountable for their actions.

3. Managers should evaluate what corrective actions are necessary if the cause of the skin/clothing contamination is personnel errors.

4. Evaluate the checklists and polices used to review work procedures and prepare Radiological Work Permits. Assure documents include the proper radiological controls necessary for each work step.

5. Conduct critiques for events and "near misses". Find the "root cause" and identify what corrective actions are necessary. Assign actions and due dates wherever possible.

6. Prejob briefings provide an opportunity to assess the readiness of personnel to perform radiological work. Managers should evaluate the prejob briefings for jobs that have complex radiological controls to determine if workers and RCTs understand the requirements and what is expected of them. The Person-in-Charge (PIC) should ensure each key step of the job is discussed and the steps that could result in a spread of contamination are covered in detail.

7. "Engineered controls" should be used to confine the spread of contamination. The use of containments, glove bags and HEPA filtered ventilation are proven ways to accomplish complex radiological work in a safe manner. Other engineered controls include the use of remote handling equipment, robotics, and specialized decontamination methods to reduce contamination levels. Communication systems and closed circuit television can be used to communicate with the workers and supply them with needed information from the technical work procedures as well as monitor their health and work practices.

8. Managers should evaluate the actual conditions in the work area to determine if changes could be made to reduce the potential for skin and clothing contaminations. Unnecessary materials, tools and equipment could be removed or repositioned to give workers more room. If high levels of loose contamination exist in the work area it should be decontaminated. As the work progresses, it may be necessary to stop work and decontaminate often to keep contamination levels low. The lower the contamination levels, the less chance that contamination will be spread in the work area and on to personnel.

9. Managers need to attend prejob briefings on a frequent basis and enter the actual work areas while jobs are in progress to assess the radiological work practices. Watch the workers undress to see if they're doing it exactly as was taught in Rad Worker II Training. This will assure that workers understand management's commitment to perform the work safely without contaminating the environment or themselves.

10. If the source of the contamination is still a mystery, determine what, if anything, has changed in the work area. Is the ventilation operating at full capacity? Have other systems been shutdown that would cause contamination to migrate?

3.3 <u>When all else fails:</u>

1. Evaluate the type of work. Evaluation of past occurrences revealed that personnel are often contaminated during strenuous work involving flexing, lifting, working on hands/knees, or other physical movements. If the worker sweats profusely, the protective clothing becomes soaking wet and contamination can easily penetrate the layers of protective clothing. Consider increasing the ventilation and regulating the temperature if possible. Look at finding better tools or change the procedure so the job can be performed with less exertion.

2. Study the working conditions. Past occurrences reveal most incidents occurred in hot, humid, or damp conditions. In addition, the work area may be cramped or a confined space and the workers were forced to work for long periods in these conditions. Evaluate changes that would improve the working conditions and replace workers more often so they remain fresh.

3. Evaluate the type of protective clothing being worn. Cloth or water resistant clothing often fails to protect workers during demanding work conditions or activities. Multiple sets of protective clothes or the wearing of impermeable plastic clothing increases the potential that the worker will have heat stress. It may be necessary to decontaminate the work area or cover the contamination with plastic or paper to reduce the risk the worker will become contaminated.

4. Determine the area of the worker's body or clothing that is becoming contaminated. Normally the legs and arms are contaminated more than other areas. On the legs, the knees are contaminated more than other areas. This appears to be caused by prolonged contact with contaminated surfaces, physical work that causes perspiration, and high stress placed on the protective clothing. On the arms, the forearms seem to get contaminated more than other areas. Workers use their forearms to enter small spaces, maneuver tools, lean against surfaces, or otherwise come in contact with contamination. Corrective actions have included rubber-coated or plastic arm sleeves and knees, aprons, and other protective devices.

5. Determine how the contamination is spread. If the contaminated area corresponds to sections of the protective clothing that are perspiration soaked, had prolonged contact with contamination, or there was a rip or tear in the clothing. Frequently, perspiration soaked clothing is completely intact, with no holes or tears.

PREVENTION OF HEAT STRESS DURING RADIOLOGICAL WORK WHC-SA-2922-FP

This instruction provides guidance on actions that can be taken to reduce the possibility of encountering heat stress related injuries during radiological work.

Heat stress is caused by hot environments and the physical demands of work. It is further complicated by protective clothing requirements commonly used to perform radiological work. The resulting physiological strain is reflected in increased sweating, heart rate and body temperature. Uncontrolled exposures to heat stress can lead to decreased performance and increased risk of accidents and heat disorders.

The five most common heat-related disorders are described as follows:

TITLE	CAUSE	TREATMENT
Heat Rash	Caused by obstruction of the sweat glands brought on by chronically wet skin. Symptoms are itchy skin with small red spots and an unusual sensitivity to radiant heat.	To treat, allow intermittent relief from the hot environment. Heat rash can be prevented by keeping the skin clean, and periodically allowing the skin to dry.
Heat Cramps	Caused by profuse sweating and hard work which results in an excessive loss of salts. This results in painful muscle cramps, in legs, arms or abdomen. The cramps may occur during or after exertion.	Massage cramping muscles to obtain relief and give water orally. Prevent heat cramps by adding extra salt* to food.
Heat Syncope (sin-ka-pee)	Occurs when a worker maintains one work posture (e.g., standing or squatting) for too long a time. This allows blood to pool in the legs, away from the head. Standing or sitting up quickly will cause a dizzy feeling("grey out")or a brief fainting spell ("black out"), of less than 30 seconds.	Treat heat syncope by allowing the worker to rest laying down. Administer water or other suitable fluids orally. To prevent or reduce heat syncope, instruct workers to flex their leg muscles several times before moving from a stationary position, and to stand or sit up slowly.

Heat Exhaustion	Often precipitated by heavy sweating, which causes dehydration. If a person is already dehydrated due to an illness (vomiting or diarrhea), the onset of heat exhaustion will be hastened. The symptoms are a general feeling of fatigue or weakness, uncoordinated actions, headache, thirst, and weak pulse.	The treatment is to simply rest in a cool environment. Prevent heat exhaustion by drinking water or other suitable fluids frequently, and by adding salt* to food.
Heat Stroke	This is a life-threatening condition. It may be brought on by a pre-existing illness (e.g., fever or flu), an abnormal intolerance to heat stress, excessive exposure to heat stress, or by drug or alcohol abuse. A person in heat stress will have difficulty recognizing surroundings or people and may exhibit irrational or unexpected behavior. The skin will be dry and convulsions/unconsciousness for periods greater than 30 seconds may also occur.	Treat heat stroke by immediately and aggressively lowering the person's body temperature. This can be accomplished by wetting the skin and clothing and increasing the air flow by using fans, ventilation trunks, or hand fans. Ice packs may also be used if available. Transport the person immediately to an emergency medical facility. Prevent heat stroke by training personnel to recognize the symptoms of heat related disorders in themselves and in others, and by allowing the workers to participate in the determination of heat stress exposures. Workers who maintain a healthy life-style will be less likely to have heat stroke.

* **NOTE:** Lightly salting food at mealtimes is encouraged both as a treatment for and prevention of some heat disorders. Those individuals on salt restricted diets should consult their personal physicians regarding the advisability to heat stress and the supplementing of salt intake. Salt tablets, however, should never be used. In addition to causing stomach irritation, salt tablets retard the absorption of water into the body where it is needed to support adequate blood flow and sweating.

In order to accomplish radiological work in hot environments, it is necessary to manage the work, recognizing the potential for heat stress and take measures to prevent it. Effective management requires that an evaluation be performed to assess the potential for heat stress situations and then use control measures to mitigate the stress. Most facilities have Industrial Safety Professionals/Industrial Hygienists that can help with this evaluation.

Contact the Industrial Hygienist prior to the start of the job to review the work package, environmental heat sources, work demands, and clothing requirements. This review may include a job walkdown and participation in mockup training.

Environmental sources of heat stress include convection, which is reflected in air temperature and air movement; radiant heat, which depends on the temperatures of surrounding walls, equipment and other surfaces; and air humidity, which affects the body's ability to cool by sweat evaporation.

Work demands are divided into three categories. Light work includes instrument repair, supervision, valve lineups, etc. Moderate work is typical of most maintenance tasks and heavy work requires a great deal of physical effort (e.g., continuous shoveling, mopping, installing shielding).

Clothing requirements mostly effect the body's ability to cool by sweat evaporation. Multiple layers of clothing, especially impermeable plastic clothing, significantly reduce the body's ability to evaporate sweat, and therefore cause greater physiological strain.

Planning personnel and the Person-in-Charge (PIC) should review local Safety Standards and Guides when preparing for work that has a high potential for heat stress:

There are two common elements in managing any potential heat stress: training of the individual and the commitment each individual makes to following good health practices.

Training provides individuals with the knowledge required to deal rationally with heat stress. This training is usually repeated periodically and covers subjects such as the sources of heat stress, physiological responses, heat stress hygiene practices, acclimation, recognition, prevention and first aid for heat disorders.

The prejob briefing conducted just before the work starts should include these same key points and a reminder to personnel that if they feel they have the symptoms of heat stress to notify personnel and exit the work area.

The primary method of preventing heat stress is to follow good health practices. This is solely in the hands of exposed workers. Site management has a responsibility to minimize the barriers so that good heat stress practices can be followed, but it is ultimately an **individual responsibility.** Good health practices for workers who will be exposed to a heat stress environment are:

Fluid Intake is needed to replace water lost by sweating. Ideally, water is replaced on a frequent schedule (e.g., 3-4 times per hour). On some radiological jobs, there may be restrictions on drinking to avoid ingestion of radioactive or chemical contaminants. Workers should be encouraged to prehydrate (drink more than usual before the heat exposure), and then to drink additional water afterwards. An ample supply of cold water, fruit juice, Gaterade, etc., should be available for the workers. The use of caffeinated beverages such as coffee, tea, and colas, should be discouraged since these products are natural diuretics that cause increased urine output.

Balanced Diet: Workers should be encouraged to eat a "light" meal before entry to control nauseous feelings. In addition, eating a "light" meal will reduce the amount of blood required for digestion and allow more blood to flow to the surface of the skin for cooling.

Self Determination is both a health practice and an administrative control. The individual worker must understand there are differences among workers for heat tolerance and each individual should stop work and exit the work area at the first symptoms of fatigue, nausea, or other signs of heat disorders.

Life Style relates to the worker's personal activities off-the-job, such as alcohol and drug abuse, and heat exposures outside of the work environment. These activities can greatly effect each worker's ability to perform work in a heat stress environment.

Health Status is the recognition that chronic or acute illness can increase the risk of a heat disorder. Personnel who are sick should not work in a heat stress environment.

Acclimation is frequently considered an administrative control. It recognizes that performance under heat stress conditions improves with successive exposures, and that expectations should be adjusted accordingly. For example: seven to ten successive days of heat exposures lasting at least two hours are required to obtain the most benefits of acclimation. As a rule of thumb, one day of acclimation is lost for every two days that a person is not exposed to heat stress. (The ratio is one-to-one if the absence is due to illness.)

After the job is evaluated by planning personnel and the Industrial Safety/Hygienist, specific actions can be identified that will reduce the probability that heat stress will occur. Priorities should be given to controlling the greatest contributors to heat stress. There are three categories of specific actions: use of engineering controls, administrative controls and personal protection.

Engineering Controls. Permanent and temporary engineering controls are the first consideration. Any mechanical assistance that can reduce work demands will cause a significant reduction in the level of heat stress. For instance, the use of pneumatic powered tooling to remove/replace fasteners reduces the physical work of the user. In terms of effectiveness, engineering controls to reduce metabolism are followed by reductions in air temperature and humidity.

Dilution ventilation and air conditioning can cool the work environment inside a facility or a containment. Ventilation systems can be used to remove smoke and heat from the work area or confined spaces. Air conditioning containment tents is possible but requires a large A/C unit to make up for losses through the non-insulated fabric or metal walls. Normally, the air discharged from the HEPA ventilation blower is cooled by the air conditioner and then a large portion of the discharged air is returned to the containment as "make-up air".

Where radiant heat is a factor, shielding, insulation and decreasing surface radiated heat are possible solutions. The more reflective a surface is (shinier), the lower is its ability to radiate heat to a person. Sometimes work area temperatures can be reduced by covering the work area with white or reflective materials so that it is shaded and sunlight is reflected. If the work is inside a tank or building, a garden hose/sprinkler can be placed on top of the area to cool down the structure and reduce the radiated heat. Water should not be allowed to drain into the work area. Closed circuit TV cameras can be mounted so that personnel outside the work area can observe the workers and look for signs of heat stress. Inexpensive communication systems are available that can be worn under protective clothing and not interfere with the wearing of a respirator. If used, the workers and personnel at the work area boundary could communicate with each other frequently to detect early signs of heat stress.

Administrative Controls. If engineering controls provide only a lessening of the heat stress (not an elimination) or if they are not practical, then administrative controls can be used to reduce the risk of an overexposure to heat stress. Some of these controls are:

Self determination is an acknowledgement that workers may and must terminate a heat stress exposure at the onset of symptoms of a heat related disorder. This is one of the most important factors in managing heat stress.

An environmental "stay time" and/or work/rest regimen can be established for various work steps by reviewing applicable Safety Standards and consulting with the facility Industrial Safety/Hygienist. Table 1 provides a guide for determining the work/rest regimen. The stay time is the maximum time a person may be in the heat stress situation. Personnel should be ordered out of the work area in advance so they can be out of their protective clothing when the stay time expires. They should then be required to rest in a cool location for a minimum time determined by review of Table 1. In addition, at periodic intervals, the PIC and/or other personnel running the job should question each person in the work area to determine (1) if they are experiencing any symptoms of heat disorders, and (2) if they can continue to work. Each person should be asked the questions and a decision made on whether to continue based on the response of each individual.

Recovery allowance and work/rest cycles are designed to allow sufficient recovery from previous heat stress exposures before a subsequent exposure is undertaken. The work/rest regimen observed should be established by the facility Industrial Safety/Hygiene per instructions of the American Conference of Governmental Industrial Hygienists and modified to reflect worker acclimatization, work type and clothing type for "physically fit" workers. See Table 1. The "rest" area selected should be shaded, cooled and preferably indoors. If temperatures are high, a Wet Bulb Globe Thermometer (WBGT) can be installed in the work area by Industrial Safety/Hygiene.

Scheduling hot work to a time of lower heat stress is a commonly recognized control method. Working hot jobs on back shifts when air temperatures are cooler, or scheduling the work to be accomplished in late fall through early spring are examples of this strategy.

Clothing requirements can be reviewed and possibly reduced to lower the potential for heat stress by Radiological Control. This may require areas be decontaminated or covered in order to reduce the possibility of skin/clothing contamination in order to justify the reduction of PPE. The modesty clothing worn under the protective clothing could be specified to be shorts/tee shirt instead of the standard coveralls worn at many facilities. With the concurrence of the Radiological Control Manager, and at worker option, the tee shirt and/or inner hood could be wetted before dressing in protective clothing.

During work, personnel in the work area should use the "buddy" system to observe each other for signs of heat stress. The Person-in-Charge should control the work rate by allowing the workers to set their own pace.

With the assistance of the Industrial Hygienist, commercial equipment is available to monitor body temperature and heart rate. Trained personnel must be on hand to evaluate the readings and determine required actions.

Personal protection in the form of personal cooling and reflective clothing is recommended when the environmental stay time is very short. Personal cooling can consist of circulating air systems or ice garments. One type of circulating air system consists of a compressor capable of supplying large amounts of air at the proper purity for breathing, with or without a vortex cooling device supplied to personnel wearing an air fed hood. The inner bib of the hood is tucked inside the protective coveralls so that air flow is into the hood, over the person's face, down through the coveralls and out through the protective clothing. If used, the vortex cooler can cool the air by up to 50 degrees fahrenheit for up to four personnel. Other companies sell small vortex cooling devices that are attached to the person's belt. If wearing impermeable plastic clothing, the air exhausts around the ankles or through special vents installed in the leg/arm of the plastic clothing. Information on vortex breathing air coolers and special cooling vests that contain pockets for "blue ice strips" are included in attached references. The ice vest weighs about 12 pounds and allows a great deal of worker mobility with typical service times of 1-2 hours. Ice vests do not work well for longer jobs unless the blue ice strips can be changed out after they thaw.

If there is a high potential for heat stress on a particular job and personnel can be continuously observed, consideration should be given to establishing a "Hero" watch at the work area entrance. The Hero watch would be dressed in protective clothing and have the proper dosimetry so he/she could immediately enter the work area to assist personnel if they showed signs of heat stress.

If air supplied respirators are worn, the hose length should be minimized and the hose should not be laid against hot surfaces. Consider insulating the hose with foam pipe insulation and wrapping the outside with white or reflective material. If portable air bottles are used for the breathing air, the bottles could be wrapped in white or reflective material, placed in the shade and sprayed with water.

With the permission of Radiological Control, personnel who are monitored on a bio-assay program and not wearing respirators may be able to drink liquids while in the radiological work area. Follow the instructions of the Radiological Control Technician (RCT). As a minimum these instructions should include: (1) step to a location at the work area boundary designated by the RCT, (2) stop all other airborne contamination producing work, (3) survey the worker's hands and face, changing gloves as necessary, (4) use a closed container approved by the RCT to dispense fluids, and (5) survey any equipment passing over the work area boundary at the completion of drinking. Dispose of drinking cups/utensils after each use. Refilling is normally allowed, but the cup/utensils cannot be left unattended and reused.

Definitions of Terms used in Table 1:

<u>ACGIH</u>: American Conference of Governmental Industrial Hygienists - An organization of professionals in governmental agencies or educational institutions engaged in occupational safety and health programs. ACGIH develops and publishes recommended occupational exposure limits for chemical substances and physical agents.

<u>WBGT</u>: Wet Bulb Globe Temperature - usually determined by Industrial Hygienists using an instrument that compares dry bulb, wet bulb and globe temperature

<u>TLV</u>: Threshold Limit Value - Term used to describe exposure levels that all workers can be exposed day-after-day without adverse effects.

<u>REST</u>: Is a total cessation of work in a shaded environment to allow for cool-down between work periods. Personal protective equipment (PPE) should be removed as required during rest periods.

References:

1. Bernard,T, "Features of Heat Stress Control", 1989; Radiation Protection Management, Vol 6, No 4

2. Carls, D, "Heat Stress Control", Waste Tank Safety Support, Westinghouse-Hanford Company

Products:

1. Automatic Vortex Breathing Air Cooler, Innovative Systems, Bremerton, Wa; 206/698-9418

2. Personal Vortex Cooling Device and Air-Fed Hoods, Lanc's Industries, Kirkland, Wa; 206/823-6634

3. Air-Fed Hoods, Nuclear Power Outfitters, Crystal Lake, IL; 815/455-3777

TABLE 1. Modified ACGIH Guidelines for Heat Stress Protection (for acclimatized workers)[a]

WORK TYPE	CLOTHING TYPE	Percent Ratio of work/rest for each hour based on TLVs in Table			
		100	75/25	50/50[b]	25/75[b]
		TEMPERATURE IN DEGREES FAHRENHEIT			
Light	Street and Summer clothing	86	87	89	90
	Anti-c with modesty clothing[c]	86	87	89	90
	Double anti-c with modesty clothing[c]	83	84	86	87
Moderate	Street and Summer clothing	80	82	85	88
	Anti-c with modesty clothing[c]	80	82	85	88
	Double anti-c with modesty clothing[c]	77	79	82	85
Heavy	Street and Summer clothing	77	78	82	86
	Anti-c with modesty clothing[c]	77	78	82	86
	Double anti-c with modesty clothing[c]	74	75	79	83

a For unacclimated workers performing moderate level of work, reduce the permissible heat exposure TLV by 4.5 degrees fahrenheit, i.e., subtract 4.5 from the WBGT in the Table. If work is inside a containment in direct sunlight during summer months, contact your Industrial Hygienist for guidance.

b For conditions in these columns (50/50 and 25/75), contact the facility Safety Support IH group for increased monitoring. Less stressful conditions (100 and 75/25 percent columns) are usually monitored at less frequent intervals by Safety personnel and the PIC.

c Reduce the permissible heat exposure TLV by 1 degree F for summer clothing under anti-c's. Reduce the permissible heat exposure TLV by 2 degrees F for street clothing under anti-c's. Subtract 1 degree F for use of a respirator (i.e., subtract 1 or 2 degrees from the WGBT in the Table.

* TLV's are estimated for containment work. Use actual WBGT values and clothing types when available.

NOTE: Contact Safety Support personnel for advise when impermeable clothing will be used.

To use this Table, obtain the "Work Area Temperature" and locate the work/rest ratio appropriate for the current WBGT, work load, and clothing taking in to account the notes at the bottom of the Table.

1.0 PURPOSE 1

2.0 SCOPE 1

3.0 DEFINITIONS 1

4.0 RESPONSIBILITIES 1
4.1 ALARA Training 1
4.2 Skills and Mockup Training 3
4.3 ALARA Training Records 6

Figure 5-1. Mock-up Check Sheet 7
Figure 5-2. Mock-up Student Check Sheet 9

1.0 PURPOSE

This procedure identifies the ALARA training requirements necessary for administering and supporting the WHC ALARA Program.

2.0 SCOPE

To identify the ALARA training requirements for WHC personnel responsible for implementing and/or supporting the ALARA Program. This includes personnel who are responsible for planning, preparing, performing, and managing radiological work at WHC.

NOTE: ALARA Training, and subsequent requirements can be met as part of currently established courses, e.g., Hanford General Employee Training (HGET), Rad Worker I, Rad Worker II, and Radiological Control Technician (RCT).

3.0 DEFINITIONS

Specialized Radiological Worker

An individual whose work assignment includes work in nonroutine operations or work in areas with changing radiological conditions.

4.0 RESPONSIBILITIES

4.1 ALARA Training

General Employees

1. Shall be trained in radiation safety before receiving occupational exposure during access to controlled areas. The training frequency shall be consistent with requirements of DOE/EH-0258T-1, and retraining shall be conducted at intervals not to exceed 2 years. Training should contain orientation on the ALARA policy and philosophy and an explanation of its biological basis. [§835.901(a,b)]

Radiological Workers

2. Shall attend training and retraining programs at intervals not to exceed two years. The training should contain the following:

   - Fundamentals of radiation protection
   - Fundamentals of the ALARA process
   - Site and organizational ALARA policy
   - Basic ALARA protective measures (time, distance, shielding, and reduction of radioactive materials)
   - General methods and uses of ventilation, filtration, and containment

- Radiation workers responsibilities to reduce their exposure and the spread of radioactive material
- Procedures to control dose and contamination of radioactive materials that are specific for the type of work
- Significant changes to the occupational ALARA Program
- Lessons learned from radiological occurrences, as applicable (DOE/EH-0256T, Articles 631, 632, and 633).

Specialized Radiological Workers

3. Shall attend specialized radiological worker training, which is required in addition to Rad Worker II for personnel who plan, prepare, and perform jobs that meet the following criteria (HSRCM-1, Article 634):

   - Are nonroutine operations
   - Work in areas with changing radiological conditions
   - Have a potential for high radiological consequences.

   Such jobs may involve special containment devices, the use of mockups, and ALARA considerations and controls.

Radiological Control Technicians

4. Should ensure they are knowledgeable of the requirements and trained to manage their own exposure and the exposure of workers under their concern. This applied training for various ALARA assignments should be directly supervised by a qualified person. They shall attend RCT training, [§835.903], which should include site-specific classroom and hands-on training in the following areas:

   - Procedures for attaining and maintaining exposures ALARA
   - Organizational and site ALARA policy
   - Organizational and site ALARA philosophy
   - Site ALARA organization
   - Their responsibility for ALARA performance goals
   - Advanced protective measures used at the site
   - Responsibilities of RCTs in implementing the site ALARA Program
   - Exposure and contamination controls established for site-specific repetitive activities
   - Proper documentation of the sites ALARA records

- Lessons learned from radiological occurrences, as applicable (DOE/EH-0256T, Article 642).

NOTE: Frequency of retraining shall be consistent with DOE/EH-0258T-1.

Technical/ Radiological Support Personnel

5. To ensure effective participation in implementing the ALARA Program technical and radiological support personnel (e.g., engineers, planners, schedulers, procedure writers) should be trained in the following areas:

   - ALARA principles
   - Basic ALARA techniques
   - Dose reduction and contamination control techniques.

   They should also participate in selected portions of job-specific and specialized training and mock-ups (DOE/EH-0256T, Articles 652-657).

   They should be trained to the level of the workers for whom they plan and prepare radiological work.

6. Specific training for site ALARA Committee members should include courses in the following areas:

   - Risk Evaluation
   - RCM Article 342 training
   - RCM Article 652 training.

   The ALARA Program Office may provide other training as necessary.

7. Specific training for facility ALARA Committee chairpersons will be provided, as necessary, by the ALARA Program Office.

4.2 Skills and Mock-up Training

1. Complex radiological work performed in high radiation areas or involving work on highly contaminated systems require specialized skills training for workers and RCTs to verify the work practices, procedures, and tooling perform satisfactorily.

   Jobs that typically should be considered for mock-up training include:

   a. Work that could involve a significant individual or cumulative dose

   b. Work that can result in the spread of contamination to the environment

   c. First-time, complex work on radiological systems using new tooling and/or techniques
   d. When there is a need to rehearse workers or proof-test a work procedure

e. Work that will result in changing radiological conditions

f. Work, that if mock-up training were accomplished, would significantly reduce the time it takes to complete the job or the numbers of workers required.

2. The degree of training and skills required to accomplish the job should be determined by a technically competent person from the facility. This individual should be selected by plant management to be the authority on whether mock-up training should be accomplished. This individual should obtain input from other organizations, eg., operations, maintenance, engineering, radiological engineering and supervisory personnel from the crafts and RCTs as needed when making this determination. Based on the work scope and the type of training needed, the Site and/or Facility Technical Authority for the radiological functional areas can provide additional input to define the learning objectives and improve the quality of the training.

   a. If it is determined that specialized training using a mock-up is required, the next step will be to determine the type of training necessary to assure the workers and/or RCTs will have the skills necessary to accomplish the work steps. The type of training necessary can be classified using a graded approach:

      (1) Type A: Training can be accomplished by an instructor or technically competent individual using a lecture or conference technique.

      (2) Type B: Hands-on training should be conducted by an instructor or technically competent individual who will demonstrate the use of a tool or equipment and then the workers set up and operate the tool or equipment under his/her direction. This training could be accomplished on a work bench or mock-up. When the workers are familiar with the set-up and operation of the tool, they would set up the tool individually without assistance from the instructor. Only minimal protective clothing or none at all would be used.

      (3) Type C: Training should be accomplished in a full scale mock-up that closely simulates the actual work area, with the same radiological work requirements as the actual job. Personnel will be dressed in the same protective clothing and follow the same steps in the work procedure and RWP.

b. Lesson or training plans should be prepared, as needed, using the existing work procedure and lessons learned from similar work performed in the past.

c. Mockups should be obtained or constructed as required for training. These mockups may consist of a small bench top device or up to a full scale model of the work area including all interferences, services and a full-size containment.

d. Assign key personnel to act as evaluators, if needed.

e. While the mockup is being prepared, the instructor(s), evaluators, and other technical personnel should prepare attribute checklists to be used while the worker is performing the required skills training. These checklists should identify what the trainee has to demonstrate during the skills testing and establish a method to determine pass/fail. See Figures 5.1 and 5.2 for examples of typical attribute checklists that can be used as guides to evaluate specific skills during mock-up training.

f. When the preparations are completed, involved instructors, trainers, and management personnel should evaluate the mock-up, lesson plans, and attribute checklists to determine if they are satisfactory. Figure 5.1 is a guide that can be used to evaluate the adequacy of the mock-up.

g. During the actual conduct of mock-up training, the work conditions should closely simulate the actual work conditions as follows:

   (1) Pre-job briefings should be held exactly as they would on the actual job.

   (2) The requirements of the work procedure should be followed unless it is impractical to perform the work steps using the mock-up. This includes the actions taken at those steps that have Radiological Hold Points.

   (3) If stay times and predetermined dosimeter readings are established for any of the work steps, they should be included in the training. If extremity dosimetry will be required, it should be worn during training.

   (4) If "mixed waste" or wet waste will be created during work, personnel should be expected to minimize it and handle it properly.

   (5) Simulated radiation levels should be posted in the mock-up to familiarize personnel with the actual levels in the work area. This can be accomplished using radiological warning signs and/or "hot

spot" labels. These signs should be clearly marked, such as "For Training Purposes Only."

(6) If liquids will be encountered during the job, the mock-up should contain water to simulate the actual conditions.

(7) Abnormal and or casualty situations should be simulated in order to assess the actions taken by involved personnel.

(8) If the worker does anything during the training that would result in either the gross spread of contamination or a skin/clothing contamination, the training should be stopped and the worker briefed before continuing. If necessary, retrain the worker.

3. After each group of workers and RCTs complete a phase of training, Figure 5-2 should be completed by the evaluator who will make a determination whether the trainees have satisfactorily demonstrated their proficiency and possess the necessary skills required to perform the work. A debriefing should be held with cognizant Engineering, Radiological Control and Operations personnel to document lessons learned during mock-up training and improvements needed before attempting the actual work in a radiological area.

4.3 ALARA Training Records

ALARA training records shall be maintained by the Hanford Training Center. The training records should include documentation on training lesson plans, attendance records, and examinations given to participants during training activities. (HSRCM-1, Article 742)

For information relating to other ALARA records, see Section 11.

Figure 5-1. Mock-up Check Sheet.

The mock-up check sheet process consists of two parts: Part I, Mock-up attributes; and Part II, Mock-up Evaluations.

PART I. MOCK-UP ATTRIBUTES

Mock-up training for:____________________________ Work Procedure __________

MOCK-UP ATTRIBUTES	YES/NO	REMARKS
1. Does the mock-up accurately represent work area conditions, including interferences and lighting?		
2. Are the services installed the same as will be used on the actual job?		
3. Are any containment tents and glove bags the same general design as will be used on the actual job?		
4. Are the tools functionally identical to the tools and equipment that will be used on the actual job?		
5. Are radiation levels posted in the mock-up training area using radiological warning signs and "hot spot" signs as required?		
6. Are contamination levels identified, either on radiological warning signs or on surveys posted at the entrance to the mock-up?		
7. Does the plan for training include simulating an emergency or abnormal condition?		

Evaluator ________________________________ Payroll #_________

PART II. MOCK-UP EVALUATIONS

After mock-up training is complete this evaluation should be performed:

Did the tools and equipment perform satisfactorily? ____________________

Do the engineered controls used to control contamination spread or radiation exposure appear they will work successfully?

Are there other engineered controls that should be considered, such as closed circuit TV systems, communication systems, vacuum cleaners, or special tools?

What lessons learned were identified during the mock-up training?

Does the work procedure or RWP need to be changed to incorporate lessons learned during the training?____________________

Remarks:____________________

Evaluation completed by:________________ Payroll #__________

Figure 5-2. Mock-up Student Check Sheet.

The mock-up student check sheet process consists of two parts: Part I, Training attributes; and Part II, Mock-up Evaluations.

Mock-up Training for:____________________ Work Procedure #______________
Trainees:________________ Payroll #_____ Date _________
Trainees:________________ Payroll #_____ Location ____________
Trainees:________________ Payroll #_____

TRAINING ATTRIBUTES	YES/NO	REMARKS
1. Do the workers/RCTs being evaluated have the basic skills and qualifications needed to perform the work?		
2. Did the trainees participate in a pre-job briefing and do they understand what the requirements are and what is expected of them?		
3. Are the trainees wearing the PPE prescribed for this work step in the RWP?		
4. If a containment tent or glove bag was used, was it installed correctly and used properly?		
5. Were the tools, equipment, and materials needed to perform the work steps staged and ready for use?		
6. During the course of the skills training, did the trainees follow the steps in the work procedure, including the correct actions at any steps with Radiological Hold Points?		
7. If an abnormal or emergency condition was simulated during the training, did the trainees react properly?		
8. Did the trainees use time, distance, and shielding during the training steps to reduce their simulated radiation exposure?		
9. Was the dosimetry used by the trainees the same as will be used on the actual job?		

10. Did the trainees practice good contamination control work practices and "housekeeping"?		
11. Were the work steps performed in a reasonable length of time that would indicate the worker is familiar with the work steps and the work practices associated with each step?		
12. Did the trainees perform any work step incorrectly that would have had a high probability of spreading contamination to their skin, clothing or to the environment?		
13. Did the trainees practice waste minimization techniques?		

In the opinion of the evaluator, do the trainees possess the knowledge and skills needed to perform these work steps properly in the work area?

____

____

____

____

Signed ______________ Payroll # ______________ Date ______________

Forward a copy of this completed form to the employees manager, PIC, and the mock-up training coordinator. Jobs performed in high radiation areas or involving work on highly contaminated systems require specialized skills training for workers and RCTs to verify the work practices, procedures, and tooling perform satisfactorily. The degree of training and skills required to accomplish the job should be determined by personnel from operations, maintenance, engineering, radiological engineering and supervisory personnel from the crafts and RCTs.