



Proper Care and Handling of Personnel Radiation Monitors

Presented by Walter L. Robinson & Associates

Welcome to the Course!

Welcome to the **Proper Care and Handling of Personnel Radiation Monitors** course.

This course outlines approved procedures for handling, wearing, and storing personnel radiation monitors.

A brief overview of personnel monitoring technology provides a framework for understanding how personnel monitors function and how to handle them.

Beyond just giving recommendations, the course explains why the recommended procedures are necessary.

Course Objectives

After taking the course, you should be able to:

- Describe how to properly care for and handle your personnel radiation monitor.
- Identify the benefits of monitoring exposure with OSL-based personnel radiation monitors.
- Explain why certain procedures must be followed when you are given a personnel radiation monitor.

Personnel Radiation Monitors

A personnel radiation monitor:

- Accurately and reliably records local exposure.
 - ...**It accurately records exposure where it is and only if properly handled and stored.**
- Is assigned to you.
 - ...**YOU are responsible for its proper care and handling.**
- Is always “On.”
 - ...**Improper handling or storage of a personnel monitor makes it impossible to determine your actual exposure level, and in certain cases, can result in criminal prosecution.**

Luxel Badge

What is a Luxel badge?

A personnel monitor that uses $\text{Al}_2\text{O}_3:\text{C}$
(Aluminum-oxide crystal luminescence)

DID YOU KNOW?

A Luxel badge is not a “film badge.”

Why is this important?



Luxel Badge



Luxel Badge

Question: How does a Luxel badge work?

Answer: Optically-Stimulated Luminescence (OSL)

1. The badge is worn and collected for the purpose of measuring exposure.
2. A green-color laser is applied to the crystals contained in the badge.
3. The crystals emit blue-ish light in proportion to radiation exposure.

Capabilities

What advantages do Luxel badges offer?

Luxel badges are:

- Capable of being processed months after exposure
- Able to be reanalyzed
- Capable of detecting neutrons and low energy betas
- Sensitive down to 1 mREM not 10 mREM
- Not subject to directional effects (C-arm)
- **Not** sensitive to light, heat or water

Benefits

Practically speaking, what are the benefits of a Luxel?

The benefits of a Luxel badge are:

- You can drop a Luxel and it won't break.
- A Luxel badge is about \$5, a Pocket Dosimeter is about \$130, and needs a \$130 charger.

Form and Functionality



- Facility name
- Series/department name
- Participant name
- Body location icon

Form and Functionality

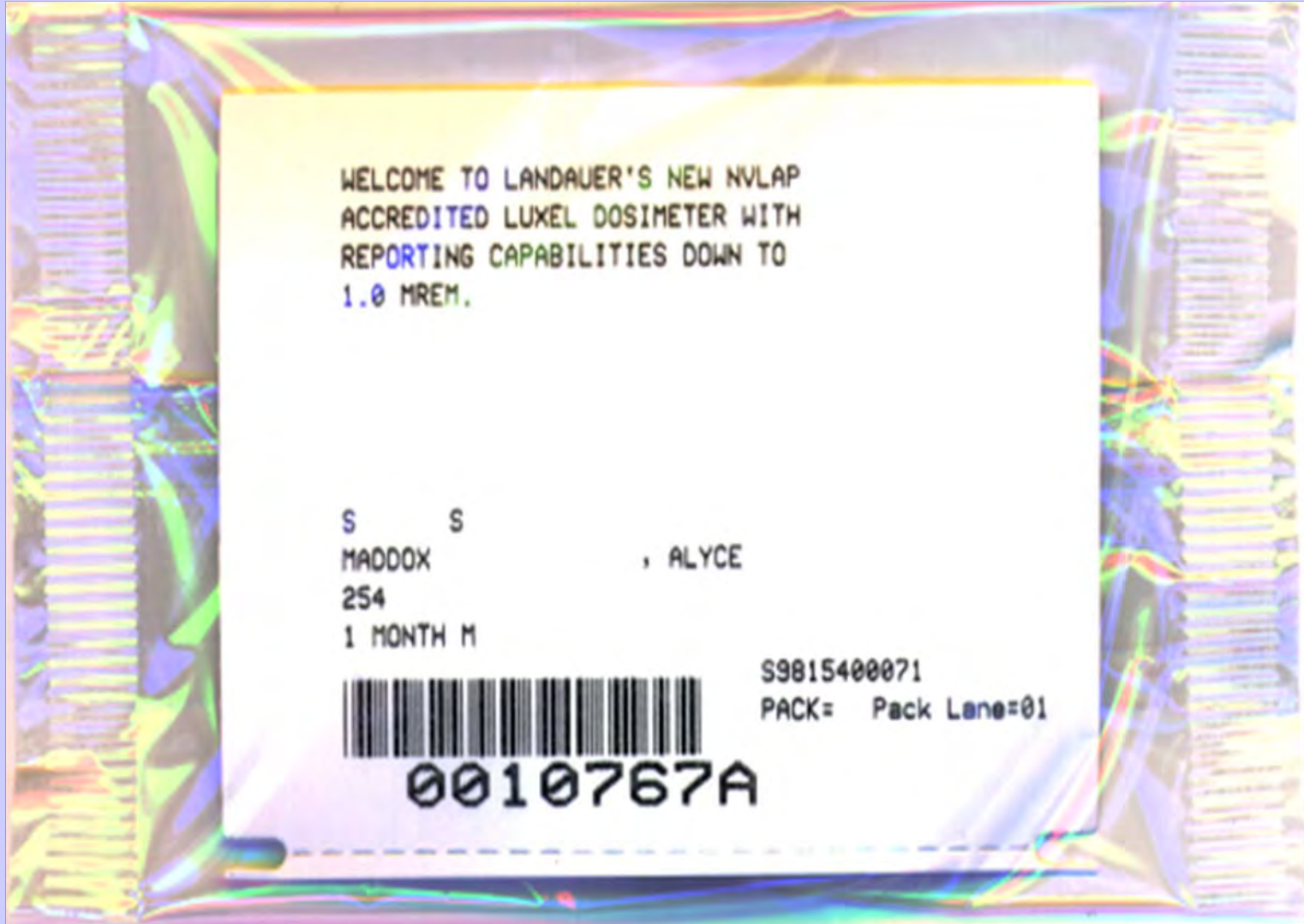


- Account #, series code, participant #
- Dosimeter location
- Wear date
- Barcode
- CR-39, if applicable

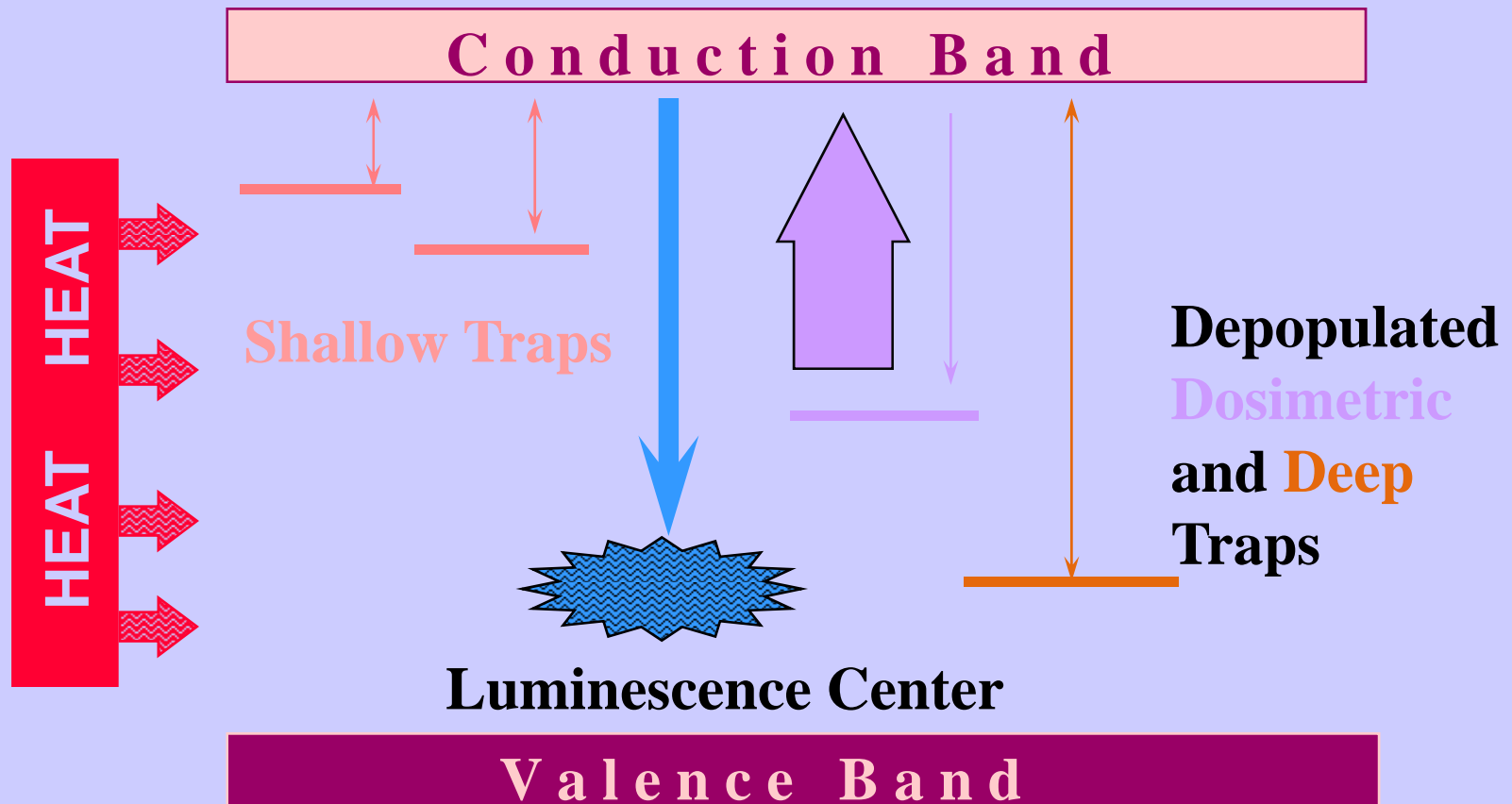
Personal Communicator



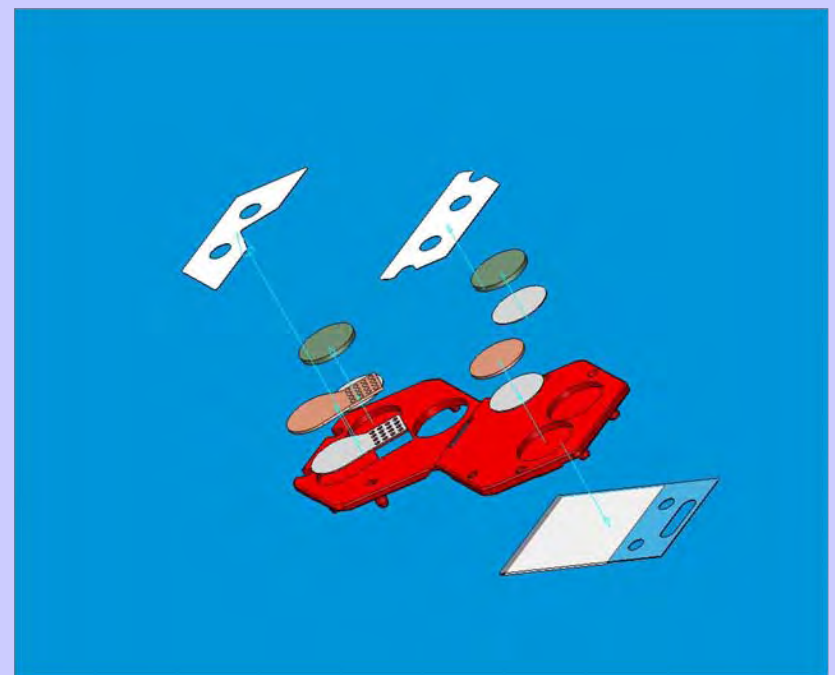
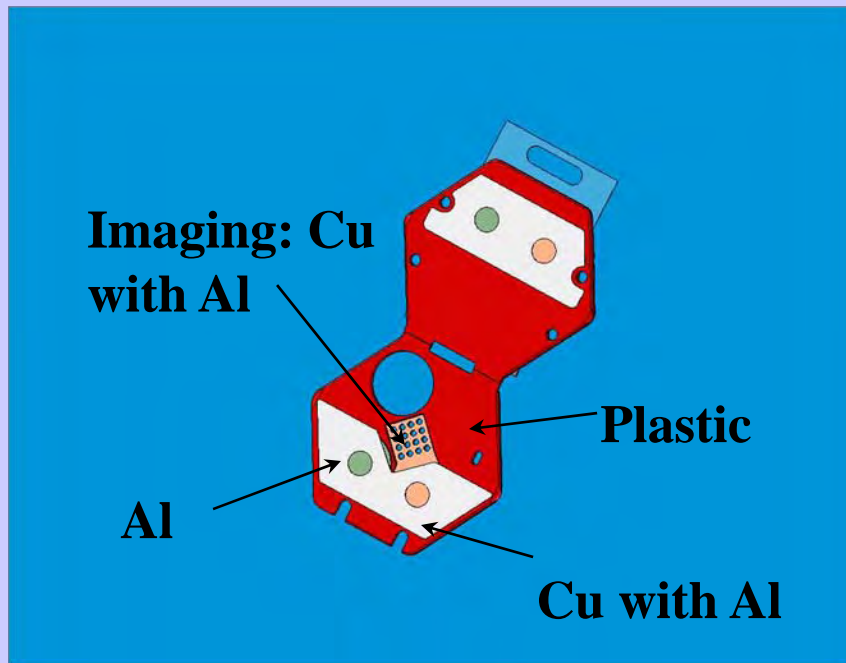
Personal Communicator—Back



Conceptual Energy Diagram



Filter Pack – Luxel +



Al₂O₃ Inside Filter Pack



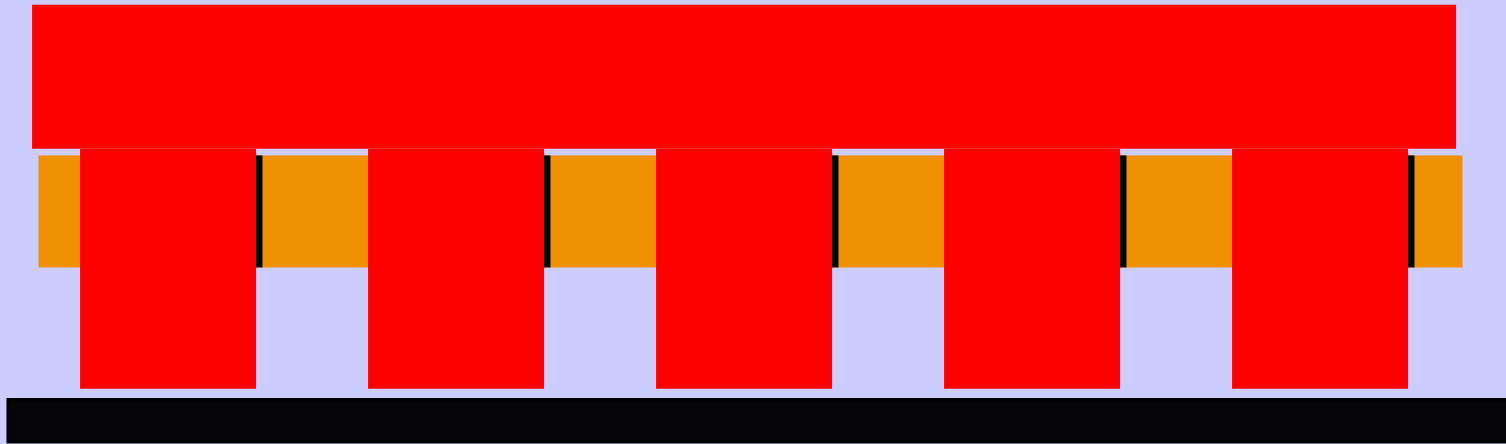
Imaging Capabilities

Luxel Badges have a wide range of imaging capabilities, including the ability to identify:

- Static exposure
- Dynamic exposure
- Contamination
- Partial shielding

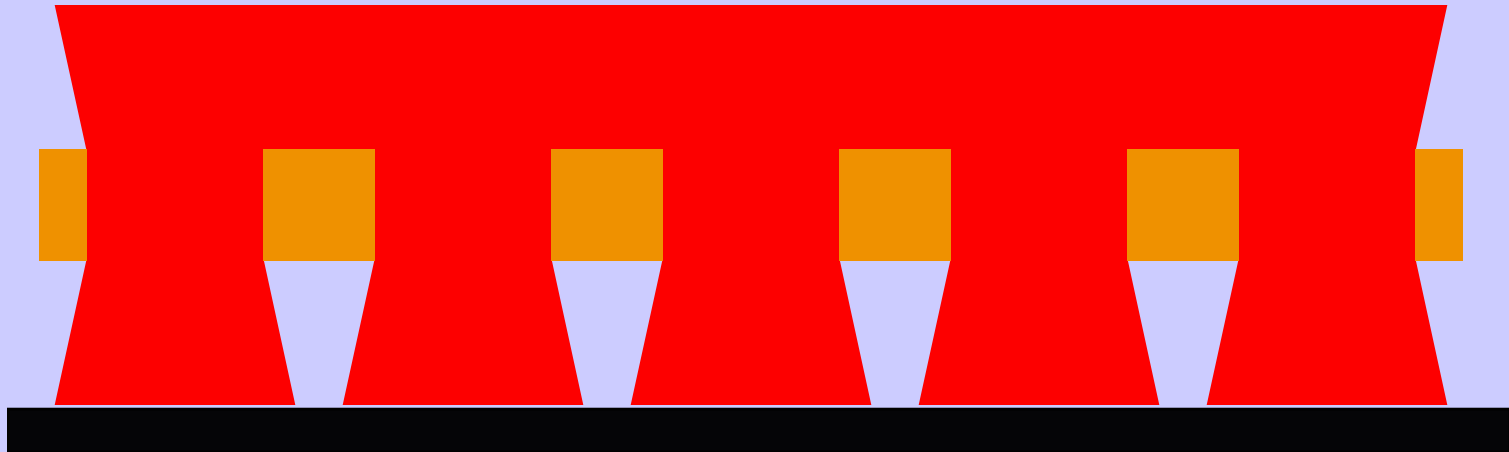
Low Energy - Static

Radiation

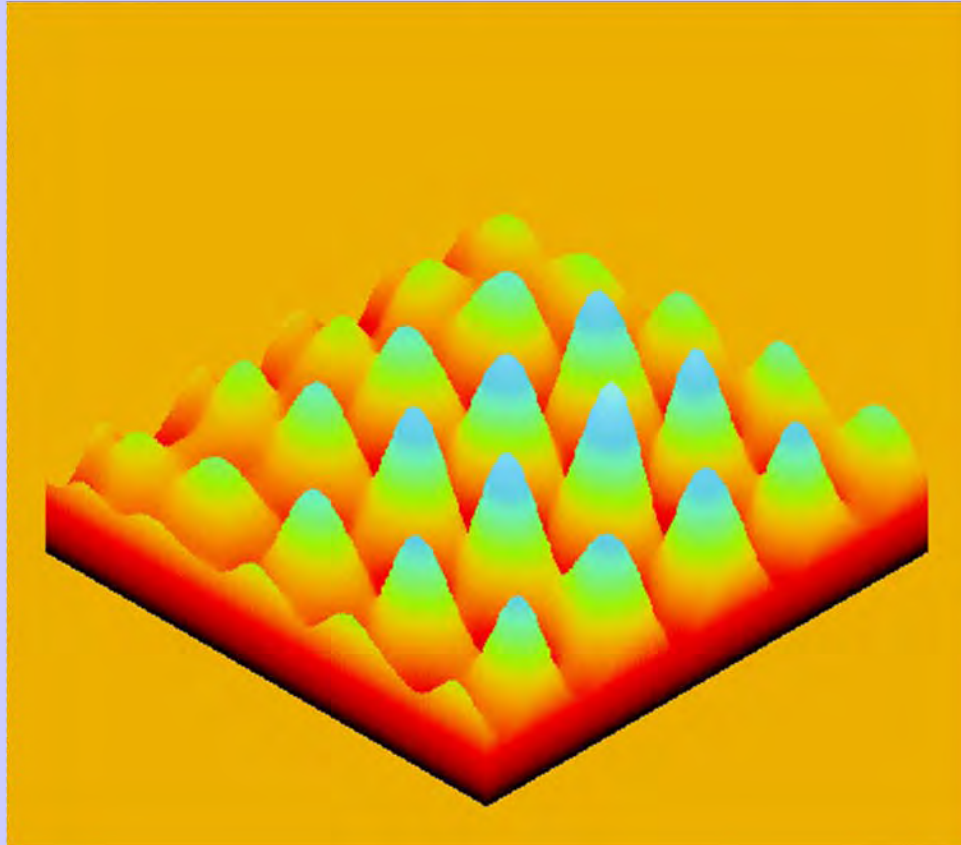


Low Energy - Dynamic

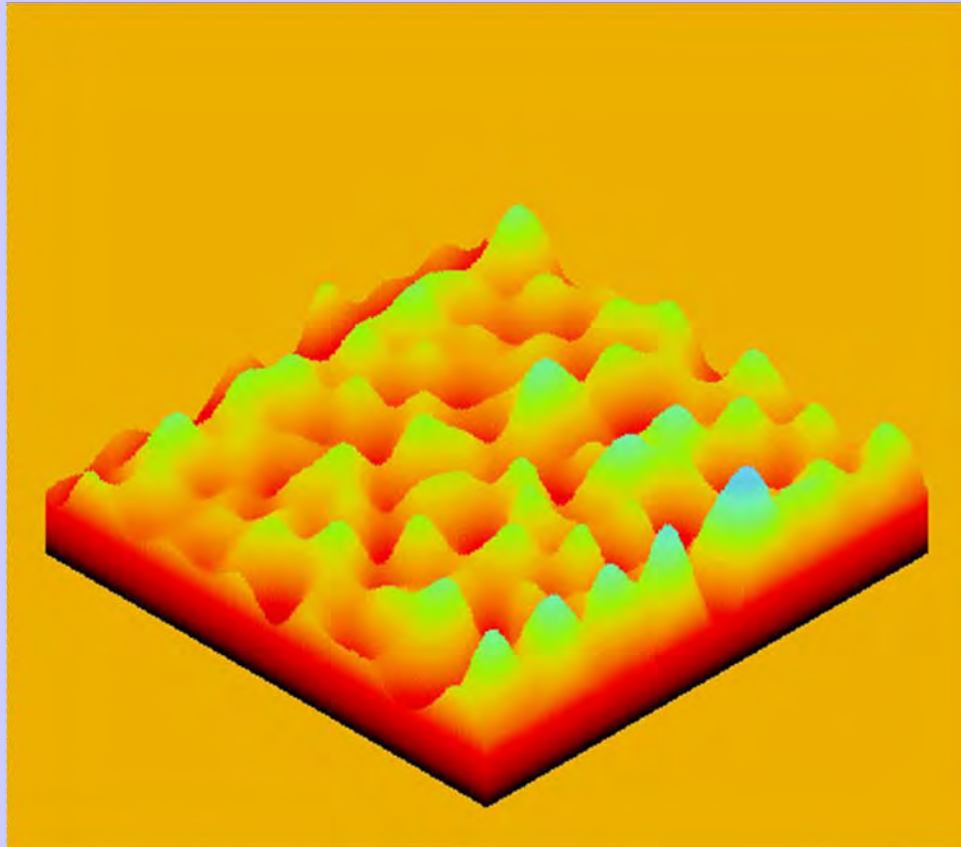
Radiation



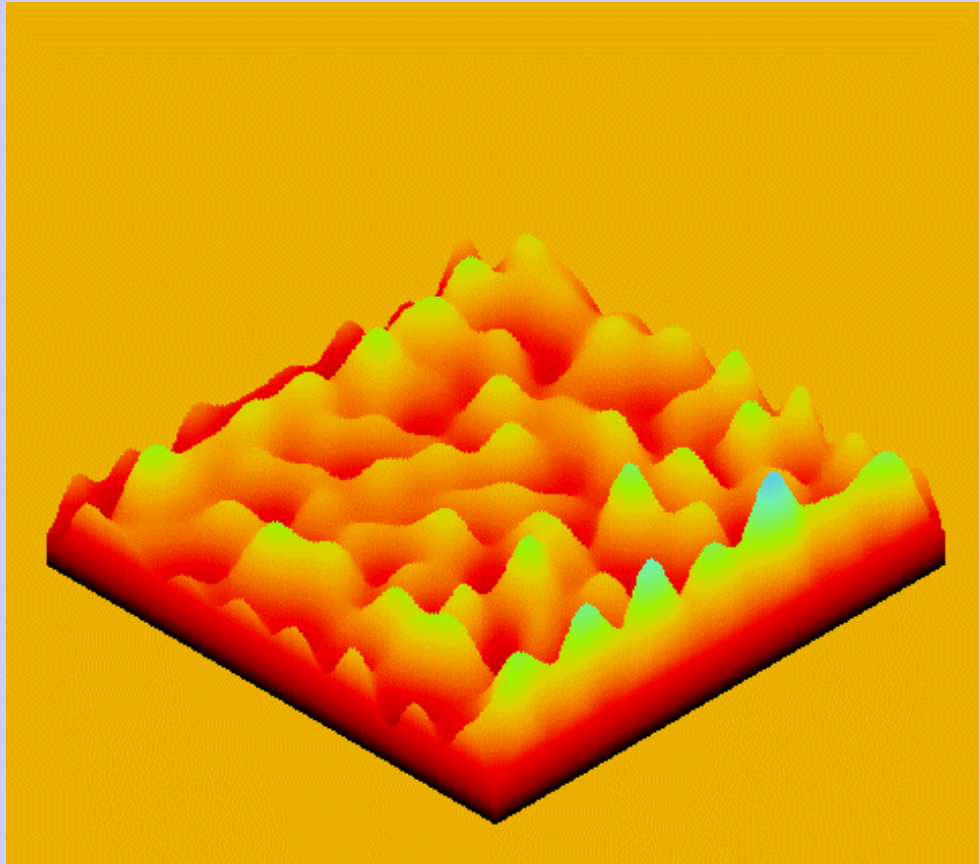
Static Image – M60 – X Ray



Dynamic Image – X Ray

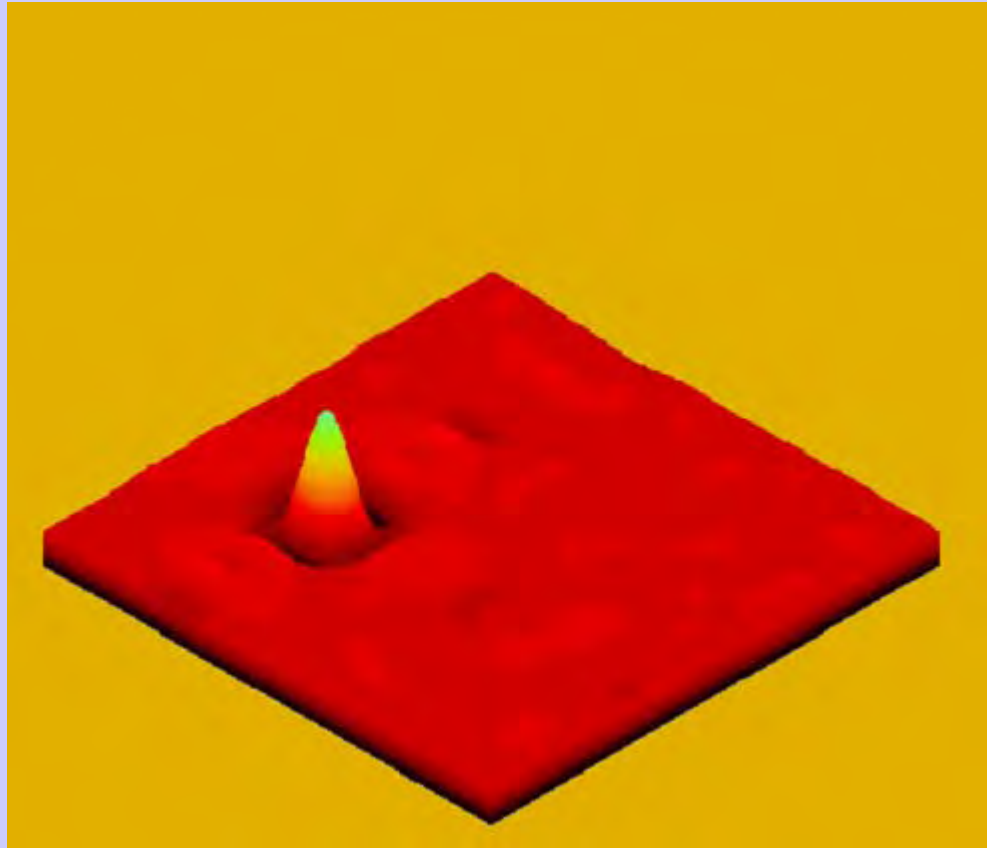


High Energy – Inclusive

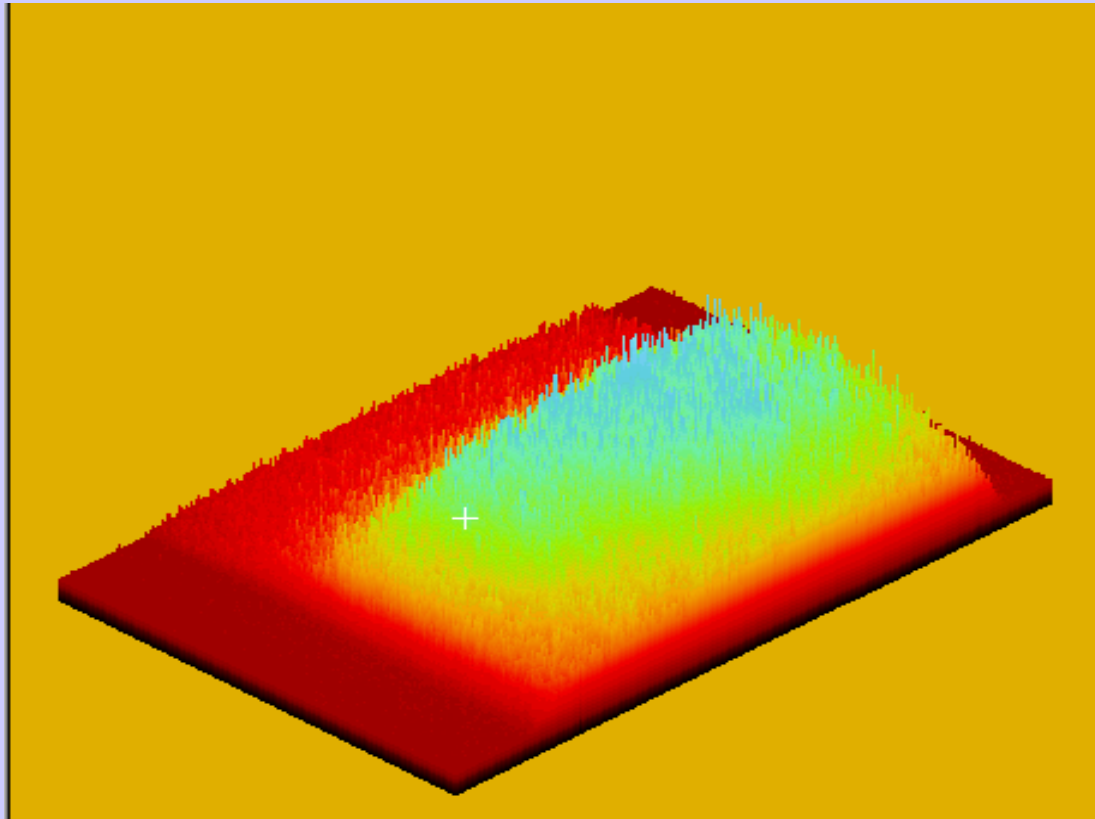


559 mrem

Contamination

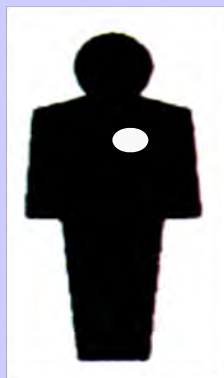


Shielded Exposure

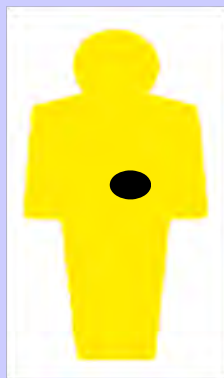


Body Location Icons

- Visual identification for badge placement
- Special visuals:
 - Yellow icon for “yellow belly” – Waist
 - Red icon for “red neck” - Collar



Whole Body



Waist



Collar

Archiving

- All badges archived for 1 year
- “M” dosimeters released from archiving for Al_2O_3 recovery after one year
- Dosimeters with doses greater than 100 mrem are archived indefinitely

What Happens If I Lose A Badge?

- Immediately inform your supervisor, so that they can order a “stat” replacement (1-2 work days).
- If you have misplaced your badge, and then find it in the X-ray room, do not continue to wear it. Take it to your supervisor, and have them reorder a “stat” replacement.
- The badge is to monitor YOUR exposure, not all the exposure in the X-ray room.

What If I Forget My Badge At Home?

- Don't compound the error of taking it home by forgetting to bring it back
- If you do forget to bring it back, inform your supervisor.
- The supervisor will contact the person authorized to get you a pocket dosimeter to monitor your exposure on that day.
- That day's data will NOT be added to your lifetime records history, so try very hard not to forget your badge at home.

Where Should My Badge Be Kept?

- A rack should be provided for all badges to be stored.
- The badge should be picked up each day from this rack, and returned to the rack at the end of your shift.
- Under no circumstances should you leave a badge clipped to a pocket of a lead apron or vest – even if the protective garb has your name on it.
- Someone else might unknowingly pick up your apron and expose YOUR badge, or it may accidentally fall off and get lost by someone else using your lead apron.

Take Responsibility For Your Badge

- It is your responsibility to wear it and to keep it safe from erroneous exposure.
- You should not have another person “change out” your badge each month.
- Everyone must take personal responsibility for their own badge.
- It is a privilege, and sometimes *a requirement* to wear your badge.

Purposely Causing False Exposures

- **Any personnel found to have purposely exposed another person's, or their own badge, to direct or scattered radiation is subject to dismissal, as this is against State laws!**

Who Must Wear A Personnel Monitor ?

- Any person deemed occupationally exposed to >500 mREM of ionizing radiation a year.
- This can be determined by a pocket dosimeter used for a month, or by a badge assignment temporarily for a few months.
- It is completely safe, and also legal in Pennsylvania and Delaware, to work around radiation, but not be monitored directly by a personnel monitor.
- Remember, a personnel monitor cannot keep you safe, only time, distance, and shielding can do that.

The Catch 22

I am often asked how do I know a person's exposures are being kept below 500 mREM per year without monitoring, and therefore the individual need not be badged. If the person in question had never been badged, but others doing similar duties are badged, then the individual would have monitoring for at least three months by badge or for a month or two by pocket dosimeter. If the resulting data was < 40 mREM/month, then the individual would not need to be badged. If the person in question had been badged, say for a few years, and their exposures were always < 500 mREM/yr., then the monitoring could be discontinued, with the caveat that if the person has new job duties that are expected to increase their exposure to radiation significantly, then a pocket dosimeter could/would be worn for a month or two to see if a routine monitoring is appropriate.

Many people are confused by the reason for this attitude, and feel that to remove badges is anti-ALARA and unsafe radiation safety practice. The reason is not to save the institution money (although it will do that). It is to drive the point home to employees that their job is so safe that they can be downgraded in risk and hazard status to “non-occupationally exposed”, thus limiting them to 500 mREM/yr. vs. the previous “occupational exposure” status of the badged person, who is allowed to get 5000 mREM/yr. So the institution is required to keep your exposure 10 times lower than it could with you in the badged status. This is in keeping with the ALARA philosophy, which tries to achieve exposures As Low As Reasonably Achievable. This is the institution’s payback for it’s efforts over the years to reduce radiation exposure so low that badges are no longer required by most staff. To do so is reasonable.

The logic is that if in the period of time that the badge was worn and data recorded, no high exposures occurred, and the near term job duties are not expected to be hazardous by the RSO, then it is logical to expect the personnel will be safe without the badge. If the personnel does get a “higher” exposure without a badge, then the exposure must be reconstructed (with surveys and measurements), and a best estimate given, and recorded along with their other personnel monitoring records.

REMEMBER, a badge will not keep you safe, only Time, Distance, and Shielding can do that.

This policy may be confusing to some, as in the State of Maryland, all personnel working around radiation must be badged regardless of the exposures recorded. This is not so in PA and DE.

Badge Management Responsibilities

- **How long must badge records be kept? – FOREVER!**
- **A new employee must have a monitor, of some type, on their first day of radiation exposure duties.**
- **An exiting employee must be given all their monitoring records on their last day, including an estimate if complete data is not present.**
- **The RSO is the only person who can have badge data changed following a evaluation of incorrectly reported data.**

**These “requirements” are from: PA/DE
BRP, PA Dept. of Health, and JCAH(O).**

Policing Badge Wear

- **So who's job is it to police the wearer of a personnel monitor to wear it? The immediate supervisor is responsible to see that all staff, who are required to wear a badge, do so.**
- **Physicians cannot be forced to wear a badge. If they do not wear a badge, the Radiation Safety Officer should be notified. He/she will have a talk with the physician. If they continue to not use a badge, they may be asked to sign a waiver or responsibility on behalf of the hospital. This issue would be decided at a Radiation Safety Committee Meeting.**

Personnel Monitoring Records

- Reading and understanding your personnel monitoring records is the responsibility of your immediate supervisor.
- Putting exposures in perspective and addressing outliers is the RSO's responsibility.
- The RSO reviews all badge records each month and initials them, then distributes them to the supervisors, who post them for you to see.
- Answers to many questions about badge reports can be found on the flip side (back) of the report

Exposure Report

LANDAUER®

SAMPLE FACILITY
 RADIATION SAFETY OFFICER
 18930 SPRINGFIELD AVENUE
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 Telephone: (708)755-7000 Facsimile: (708)755-7016
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RADIATION DOSIMETRY REPORT

ACCOUNT NO.	SERIES CODE	AWO	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO.
103702	RAD	S12345	7/17/98	7/13/98	5	1

PARTICIPANT NUMBER	NAME			DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW			QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM)			YEAR TO DATE DOSE EQUIVALENT (MREM)			LIFETIME DOSE EQUIVALENT (MREM)			RECORDS FOR YEAR	INCEPTION DATE (MM/YY)	
	ID NUMBER	BIRTH DATE	SEX				DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE	DEEP DDE	EYE LDE	SHALLOW SDE			
FOR MONITORING PERIOD:							6/ 1/1998 - 6/30/1998			QTR 2			1998								
00191			M	P	WHBODY	PN	90	90	90	90	90	90	100	100	100	200	200	200	6	6/80	
						P	60	60	60	60	60	60	70	70	70	170	170	170			
14839			M	P	WHBODY	NF	30	30	30	30	30	30	30	30	30	30	30	30	6	1/90	
16784			M	P	WHBODY	I1	PARTIAL SHIELDING - NO EVALUATION POSSIBLE														
			M	P	COLLAR	P	40	40	40												
			DE1	P	WAIST		M	M	M				M	150	150	370	370	370	6	2/86	
				U	RFINGR		M	40	40	M	40	40		80	80	620	620	620	6	2/86	
00901			F	P	WAIST								30	30	40	100	100	150	6	1/90	
05061			M	P	WHBODY		ABSENT	40	40	40	160	160	160	200	200	200	240	240	240	6	6/80
							CALC														

What is DDE, LDE and SDE?

- The Deep Dose Equivalent (DDE) is an exposure at a few centimeters into your body (Limit: 5000 mREM/yr)
- The Lens Dose Equivalent (LDE) is the exposure to your eyes (Limit: 15,000 mREM/yr)
- The Shallow or Skin Dose Equivalent (SDE) is the exposure to the epidermis of your skin (Limit: 50,000 mREM/yr.)

What is Assigned Dose?

- The assigned dose is the Effective Dose Equivalent Dose (EDE) reported. It can be with two different formulas depending on whether one or two badges are worn with a lead apron.
- If one badge is worn on the collar when a lead apron is routinely worn, the EDE is = $0.3 \times$ collar badge reading.
- If two badges are worn: one badge is worn on the collar outside the lead apron, and one is worn at waist level under the lead apron, the EDE is = $1.5 \times$ waist badge reading + $0.04 \times$ the collar badge reading. This formula usually produces the lowest EDE value.

What is a Baby Badge?

- A second badge, often called a “baby” badge, is usually worn by a pregnant woman (declared in writing) who also is required to wear a lead apron.
- The collar badge and the EDE both overestimate the fetal dose.
- The fetal dose is still about 50% of the waist badge worn under the lead apron, as the fetus is obviously not on the surface of the body.
- The baby badge reading is required to be below 50 mREM/month and <500 mREM during the entire pregnancy to be considered “absolutely safe”.

Congratulations

You have completed The Proper Care and Handling of Personnel Radiation Monitors.

Now you should be able to:

- Describe how to properly care for and handle your personnel radiation monitor.
- Identify the benefits of monitoring exposure with OSL-based personnel radiation monitors.
- Explain why certain procedures must be followed when you are given a personnel radiation monitor.

More Questions?

If you have any other questions about personnel monitoring, feel free to contact your immediate supervisor for answers.

If they can not answer your questions, they will contact a Radiation Physicist such as Walter L. Robinson, who will provide more information.

Walter L. Robinson

Radiation Safety Officer

Consultant Certified Medical Radiation Health & Diagnostic Imaging Physicist