

Radiation Safety for Machine Sources & Radioactive Material Use

NJIT

Mitchell Gayer, MS, MPH
Radiation Safety Officer

Patrick J. McDermott, CHP
RyCon Solutions



Topics

- General Radiation Stuff I have to cover (boring)
- X-ray Machines and Electron Microscopes
 - War Story – Severe Hand Burns, see handout
- Generally Licensed Devices
- Radiation Safety Guide – Online and in progress
- Golden Rules for Use of Radioactive Materials
 - Large Contamination Event at a University

- ANYTHING Else you want
- ANYTHING Mitch Says I forget



Purpose

*The training you are about to see
is intended to increase your
awareness of radioactive
materials and radiation
producing machines here at
NJIT.*



Quiz

- Who is the RSO?



Quiz

- Who is the RSO?
- **Mitchell Gayer, MS, MPH** (“Safety Beard”)



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- Bonus Question: What is his #?



Quiz

- Who is the RSO?
- **Mitchell Gayer, MS, MPH** (“Safety Beard”)
- Bonus Question: What is his #?
- 973-596-3509 (office)



Radiation Safety Officer (RSO)

- Mitch Gayer, MS, MPH
- “The RSO has the authority to immediately stop any operations involving the use of by-product material in which health & safety may be compromised or may result in non-compliance with NRC/NJDEP requirements.”



Agreement State



STATE OF NEW JERSEY
DEPARTMENT OF ENVIRONMENTAL PROTECTION
RADIATION PROTECTION AND RELEASE PREVENTION PROGRAMS
NOTICE TO EMPLOYEES



STANDARDS FOR PROTECTION AGAINST RADIATION

Standards for protection against radiation; Notices, Instructions and Reports to workers; Inspections; Employee Protection

<p><u>Your Employer's Responsibility</u> 1. Any company that conducts activities regulated by the Department of Environmental Protection (DEP) must comply with the DEP's requirements. If a company violates DEP requirements, it may be penalized or have its license revoked. 2. Your employer must post or otherwise make available to you copies of the New Jersey Administrative Code, Title 7, Chapter 28 (NJAC 7:28), licenses, registrations and operating procedures which apply to work you are engaged in, and explain their provisions to you.</p>	<p><u>Your Responsibility As A Worker</u> You should familiarize yourself with those provisions of NJAC 7:28 and the operating procedures which apply to the work in which you are engaged. You should observe these provisions for your own protection and the protection of your co-workers. Should you observe violations of these requirements, you are to report them to the address listed under "Inquiries."</p>	<p><u>Reports on Your Radiation Exposure History</u> 1. NJAC 7:28 requires that your employer provide you with a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in NJAC 7:28-6. This section specifies limits of exposure to radiation and exposure to concentrations of radioactive material in air and water. 2. If you work where personnel monitoring is required, and if you request information on your radiation exposures: (a). Your employer shall advise you annually of your exposure of radiation, and. (b). Your employer shall give you a written report, upon termination of your employment, of your radiation exposures, and any bioassays.</p>	<p><u>Posting Requirement</u> Copies of this notice must be posted where employees working in or frequenting any portion of controlled areas can observe a copy on the way to or from their place of employment.</p> <p><u>Inquiries</u> Inquiries dealing with the matters outlined above are to be made to the Radiation Protection & Release Prevention Program, New Jersey State Department of Environmental Protection, PO Box 415, Trenton, New Jersey 08625-0415</p>
<p><u>What is Covered By The New Jersey Administrative Code, Title 7, Chapter 28 (NJAC 7:28-1 et seq.)</u> 1. Limits on exposure to radiation and radioactive material in controlled areas. 2. Measures to be taken after accidental exposure. 3. Personnel monitoring, survey and equipment; 4. Caution signs, labels, and safety interlock equipment; 5. Related matters.</p>	<p><u>You are Protected From Discrimination (NJSA 34-19-1)</u> Under the "Conscientious Employee Act" an employer cannot discharge, suspend or demote an employee who discloses an activity or practice which he believes to be unlawful.</p> <p><u>How Do You Report a Violation?</u> You should report violations immediately to your supervisor. If you believe that adequate corrective action is not being taken, you may report this to a DEP inspector or the DEP office listed under "Inquiries."</p>	<p><u>Inspections</u> All persons shall afford the Department an opportunity to inspect any sources of radiation and the operation associated with the source of radiation as well as the facilities and premises where the source of radiation is being used or stored (NJAC 7:28-2).</p>	<p><u>Radioactive Materials</u> Phone: (609) 984-5462 Fax: (609) 633-2210</p> <p><u>Radiological Health (X-ray)</u> Phone: (609) 984-5634 Fax: (609) 984-5811</p> <p><u>Call to report incidents involving radioactive materials:</u></p> <p><u>During Business Hours: (609) 984-5462</u></p> <p><u>After Hours: 1-877-WARNDP</u> 1-877-927-6337</p>



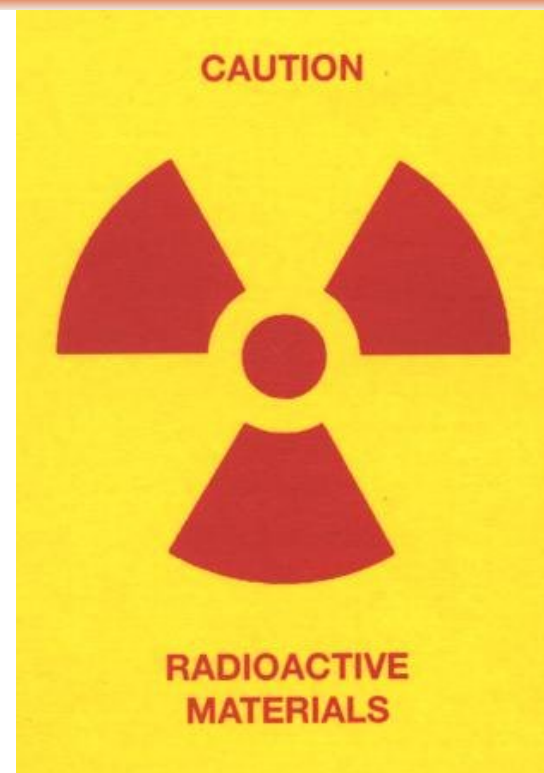
Regulations

- NJDEP “Notice to Employees” Posted throughout facility
- You have the right to see the facility license, as well as the regulations
- You have the right to call the NJDEP if you believe work with licensed materials endangers human health or welfare or the health or welfare of the environment
- You have the right to see your dosimetry records
- Contact the RSO if you have questions or concerns



Posting & Labeling

- All Radioactive material storage and use locations
- Door posting
- Equipment
- Work Areas





Regulations

- Occupational exposure limits
 - Whole body 5,000 mrem/yr
 - Extremity 50,000 mrem/yr
 - Skin 50,000 mrem/yr
 - Declared Pregnant Worker - 500 mrem/yr
- General public limits
 - 100 mrem/yr from licensed activities



Regulations

Declared Pregnancy

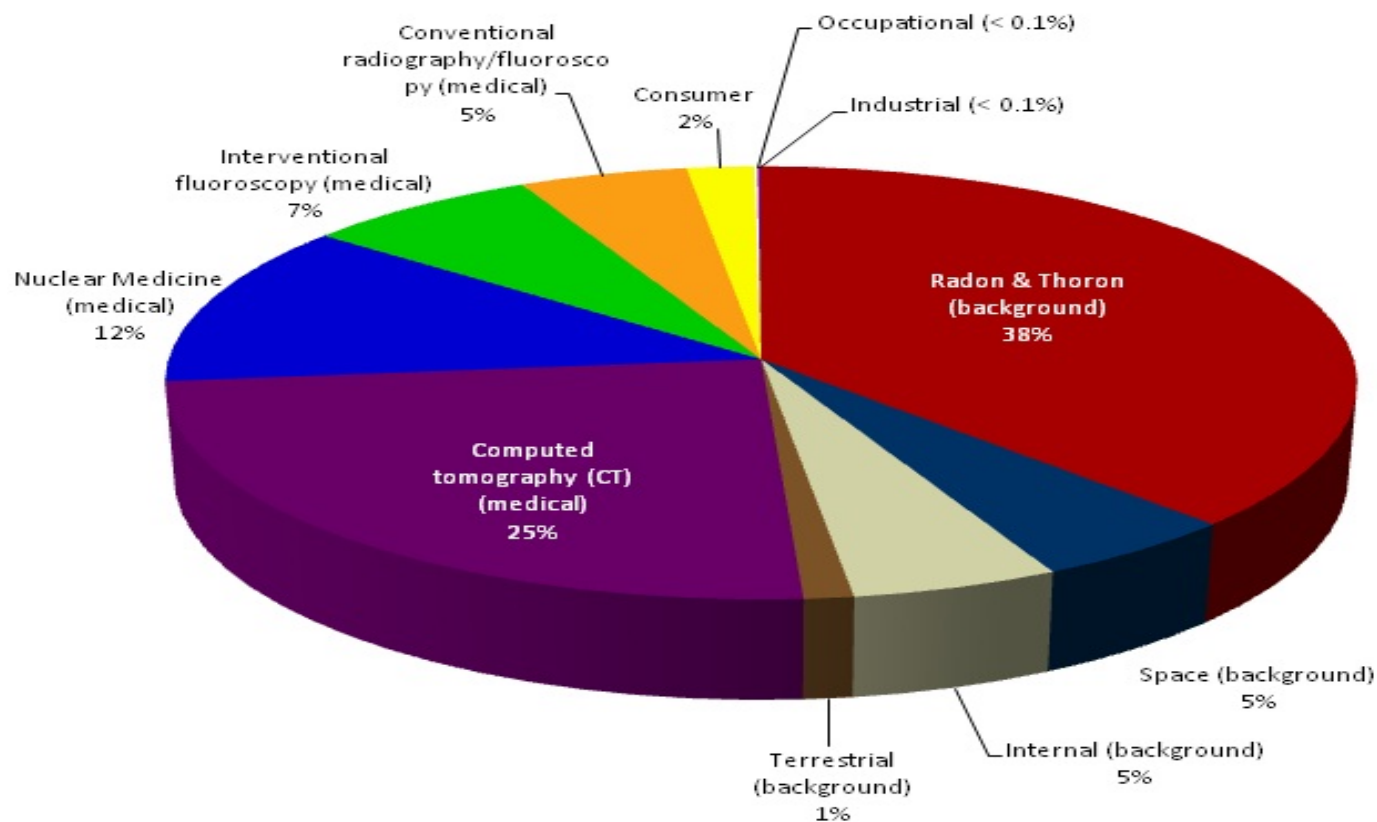
- 10 CFR 20.1208
- Voluntary written declaration to RSO
- Dose to an Embryo/Fetus
 - 500 mrem limit over the gestation period
 - 50 mrem per month





Background Radiation

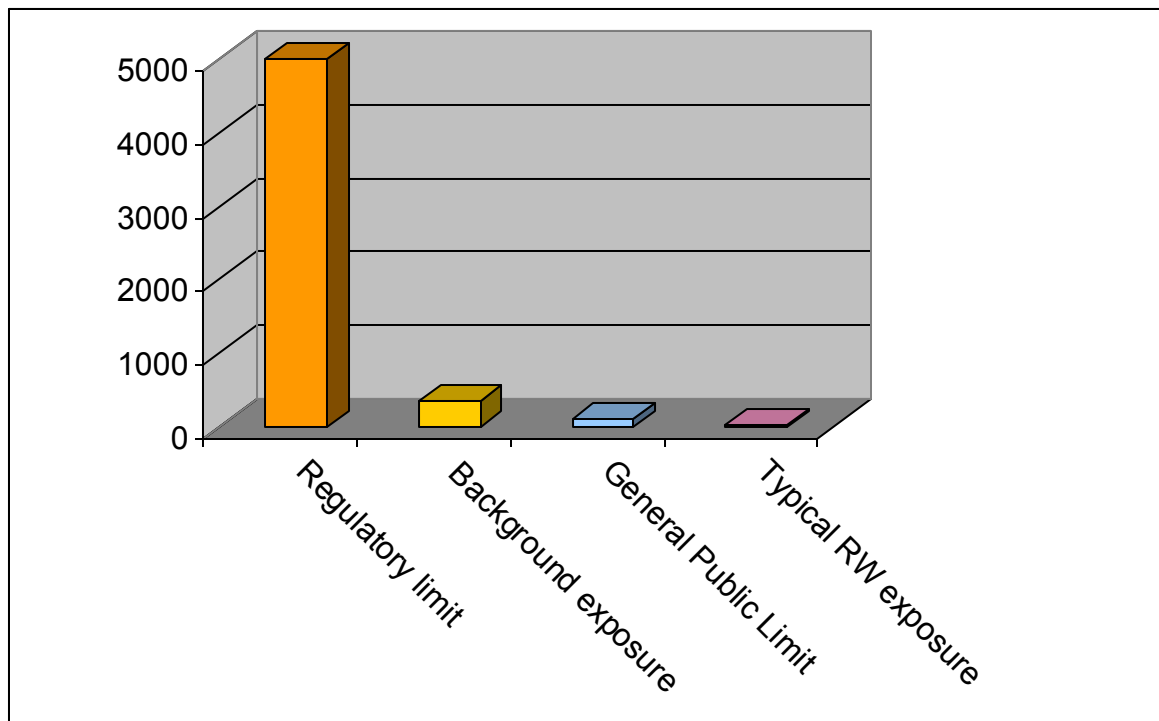
Ionizing Radiation Exposure to the Public



620 mrem/year - US Average



THE MOST IMPORTANT SLIDE!





The Golden Rules

- Survey yourself and your work area before leaving the lab after working with radioactive materials
- Wash your hands!



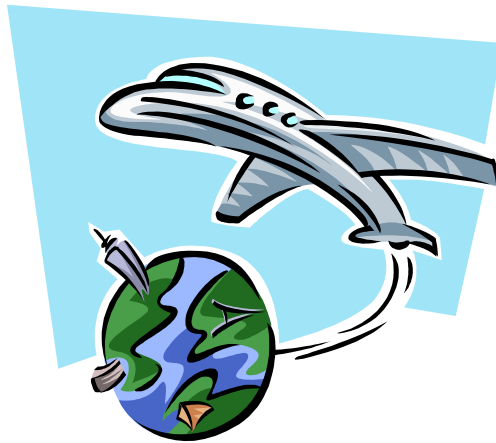
Minimize Exposure

- Time
- Distance
- Shielding
- Contamination Control



Time & Distance

- Time is directly proportional to radiation exposure



Distance

Inverse square law

$$I_f = I_i \times D_f^2 / D_i^2$$



Shielding

- Shielding: Any material or obstruction that absorbs radiation and thus tends to protect personnel or material from the effects of ionizing radiation.





Shielding

Radionuclide	Shielding for Handling	Shielding for Storage
H-3, C-14	NA	NA
P-33, S-35, Ca-45	NA	NA
P-32	0.25"- 0.5" Lucite	0.25"- 0.5" Lucite, Lead as secondary
I-125	0.006" Lead	0.006" Lead
Cr-51	0.25" Lead	Lead Bricks



Contamination Control

- Lab coats (buttoned)
- Double gloves
- Eye protection
- Wash hands post experiment
- Survey, survey, survey





Minimizing Exposure

- Lab Rules
 - No eating, drinking, smoking, gum chewing, application of cosmetics
 - Never pipette by mouth
 - Label RAM items and work area
 - Monitor frequently
 - Monitor at days end
 - Dispose of waste properly





Personnel Monitoring

- Use Them,
- Return Them,
- Report Them Lost.

- Do not, Do not:

- Do not wear during medical exams
- Do not deliberately expose dosimeter to radiation or heat
- Do not share dosimeters





Detection

- Gieger Mueller Tube
 - Beta
 - Beta/gamma
- NaI
 - Gamma
 - High energy beta





Detection





Radioactive Material Postings





Radioactive Material Postings





Radiation Safety Manual

- Good news, NJIT has a radiation safety manual (RSM)
- Bad news, NJIT's RSM is 30 years old and not useful
- EHS has a team led by the RSO, utilizing the assistance of RyCon Solutions... to re-write the RSM and have a draft for review by 7/2017.



Why Provide Training

...Always take the initiative for your own safety....



War Story

- Happened at another prestigious university in NJ
- Could have been anywhere
- Simple lessons... learn from others and don't be the next story!!



Machine Sources

- X-Ray Units
- Electron Microscopes

*Acquisition of
these units requires
prior approval by
RSO*



X-ray Machines

- Survey upon start, after every relocation and after repairs
- Dosimetry
- SOP's (and alignment procedures if applicable)
- 6-month safety checks... documented
 - Warning lights (fail-safe)
 - Shutter or power-supply door interlocks
- Training
- Prevent unauthorized use



Electron Microscopes

- Initial Survey
- Subsequent surveys only after repair or relocation
- Initial Training
- Dosimetry if no empirical evidence to show not a potential radiation hazard
- Prevent unauthorized use



The Actors

- The Regulatory Agency (NJDEP)
 - Enforces Compliance to regulations
 - The NJDEP Bureau of Radiological Health (see website)
- NJIT Management and RSO
 - Complies with regulations
 - Est. Radiation Safety Program
- You (PI, Authorized User, Grad Student)
 - Understand and follow procedures in the Radiation Safety Program











FILTER PAPERS
WEIGHING PAPERS

0 10 20 30 40 50
MICRO R/HR

Thermo
Fluor 420

ON
A
C
D

F





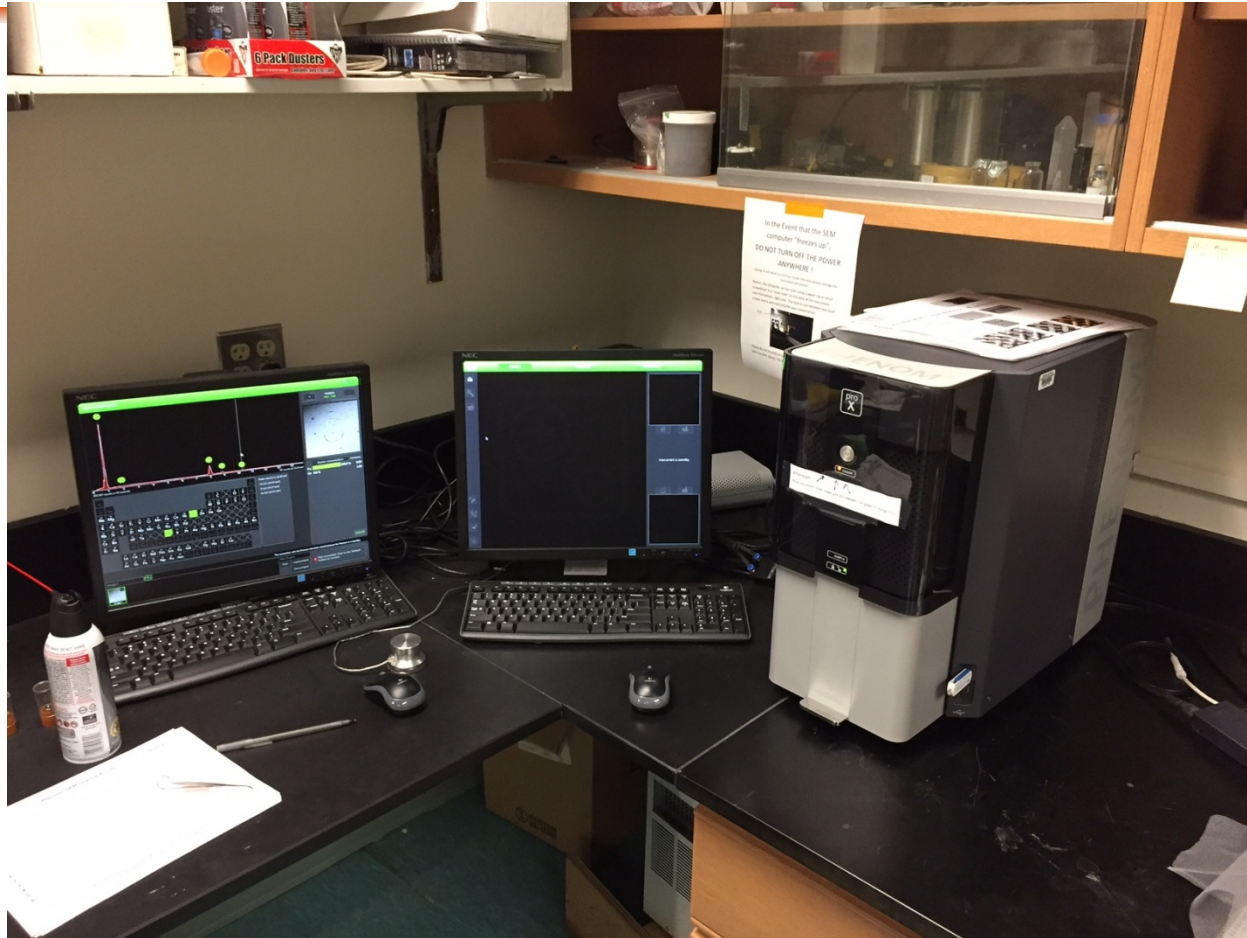


Be on the lookout!

- THIS Is Coming...



This is a mini – SEM!





This isn't a scanner, but a 50 kvP
X-ray unit!



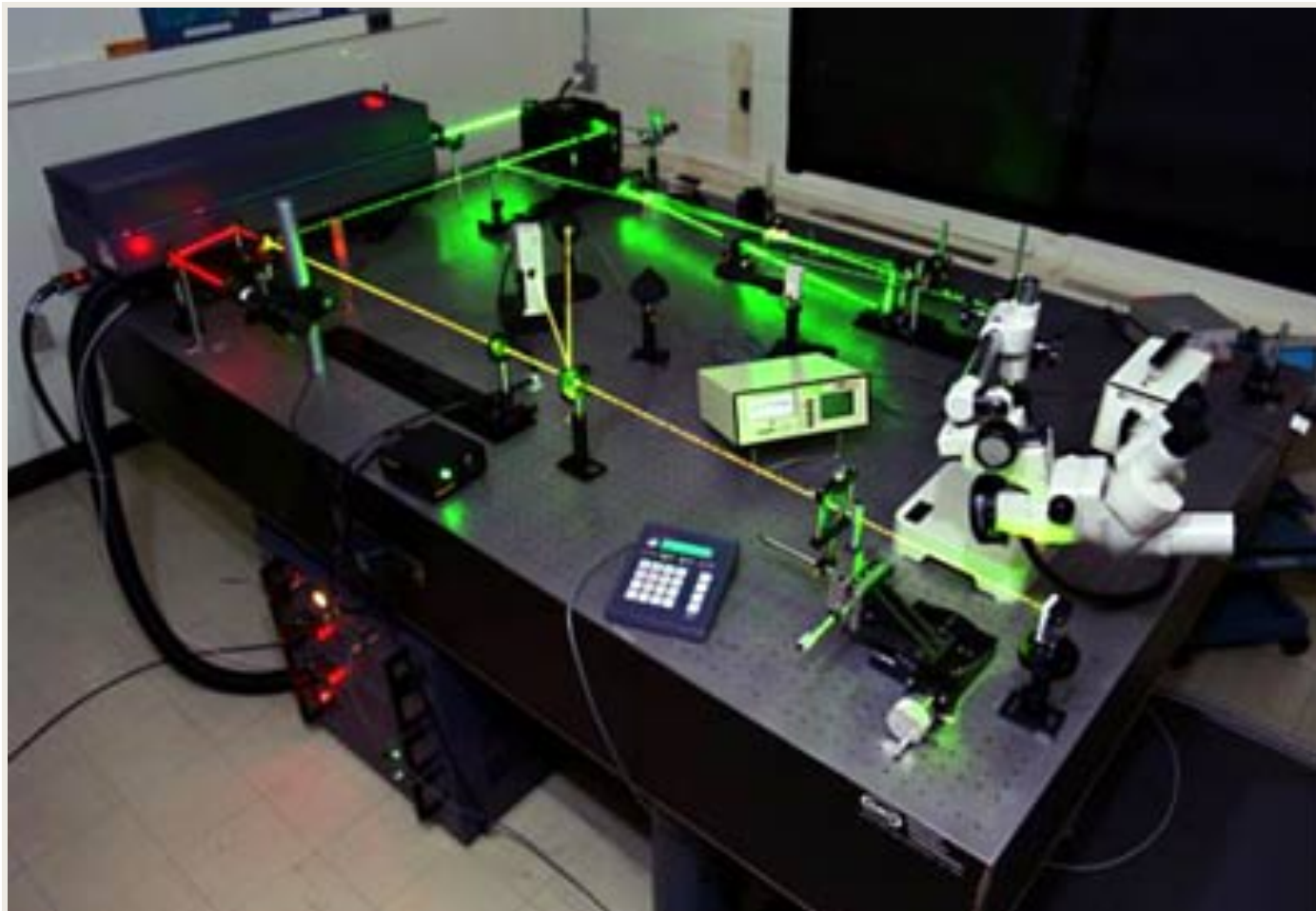


War Story

- 20+ years ago
- Hurry to get experiment done without losing data
- PI gave OK without fully appreciating what was happening
- Ultimately, 2 grad students DID NOT take responsibility for their own safety.
- DIDN'T turn the unit OFF before working!!



Non-Ionizing Radiation





Generally Licensed Devices

- Electron Capture Devices with GC's (ECD's)
- Typically 15 mCi of Ni-63
- Must inventory and leak test every 6-months
- Dispose of properly and inform NJDEP if acquired, disposed, stolen, lost or are leaking (shedding Ni-63)

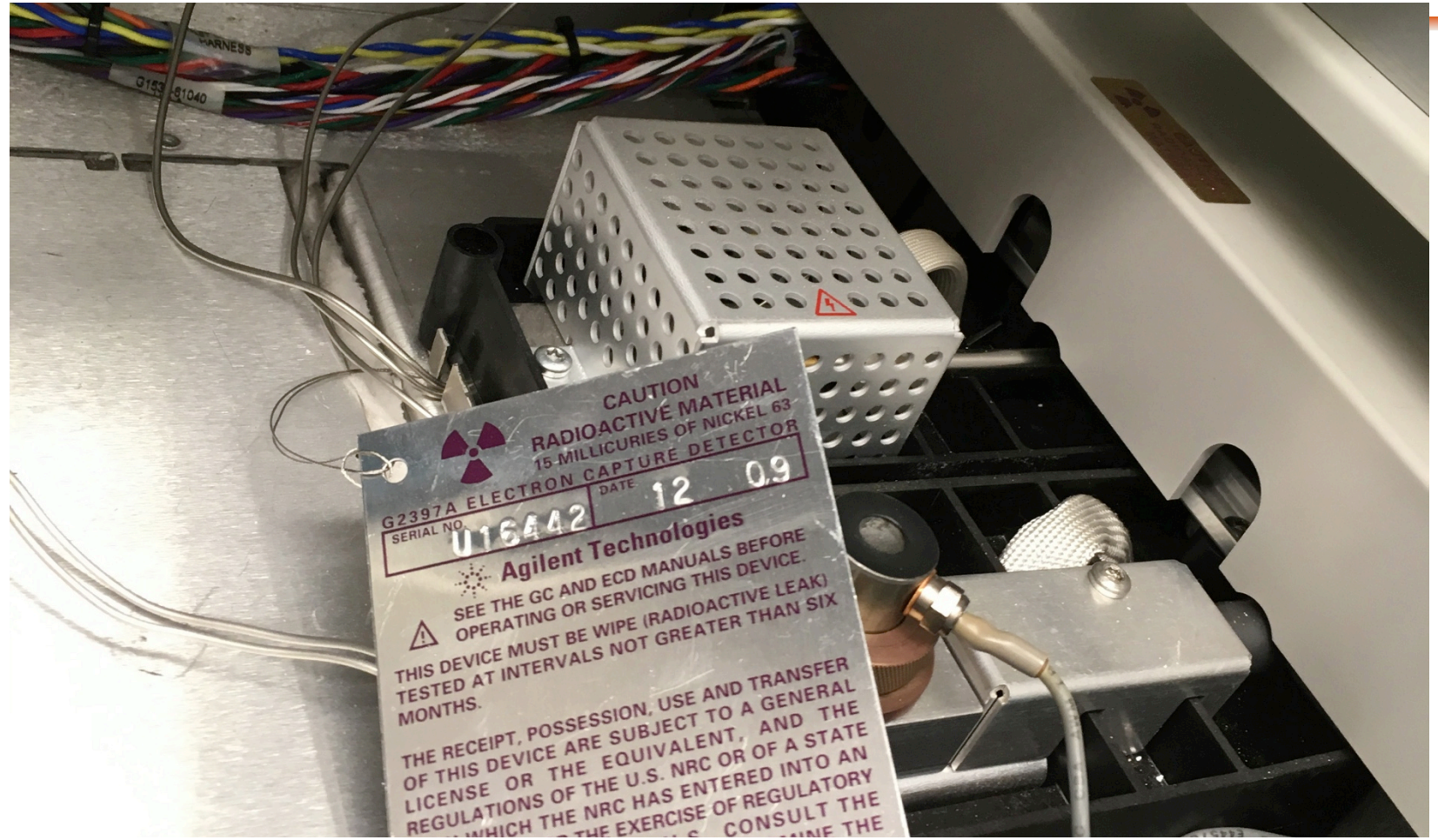


Gas Chromatograph with ECD





ECD





Other GLD's



Smoke Detector

Self Luminous
Exit Sign





Out of Place

Your role in building a safety culture also includes reporting situations that appear unsafe or unusual based on what you have just learned.



Out of Place - trash





Out of Place – disposed equipment





Out of Place – on the loading dock





Out of Place - dumpster





Emergency Response – Contact RSO





Emergency Response



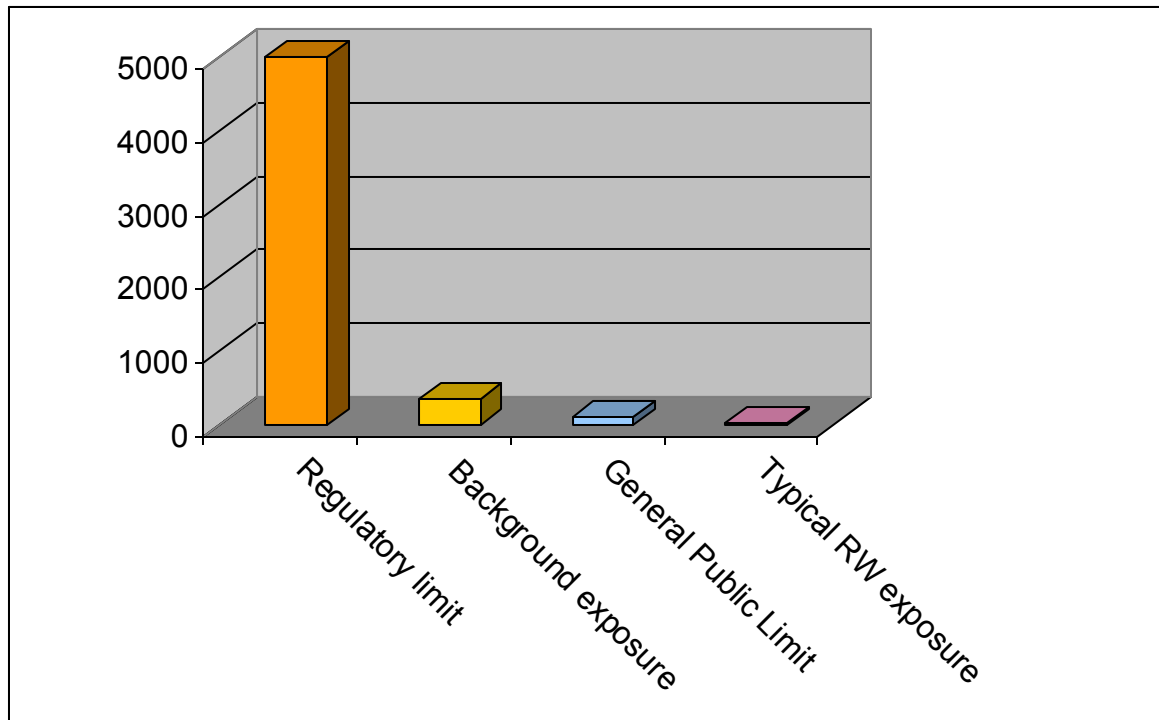


Emergency Response

*...Contact RSO
anytime for guidance
or questions...*



THE MOST IMPORTANT SLIDE!





Don't Forget the Golden Rules

- Survey yourself and your work area before leaving the lab after working with radioactive materials
- Wash your hands!



Closing statements

Contact RSO

- **Mitchell Gayer, MS, MPH**
- 973-596-3509

- RyCon Solutions
 - Patrick J. McDermott, CHP
 - 973-723-5443



Questions?

- This is your training, not mine. Hope it wasn't the most boring hour + of your life...
- ANY QUESTIONS welcome. I do better with radiation safety than meaning of life and politics... but I'll give an honest answer to any honest question.



Questions?

Remember why you do what you do... these are my reasons.