



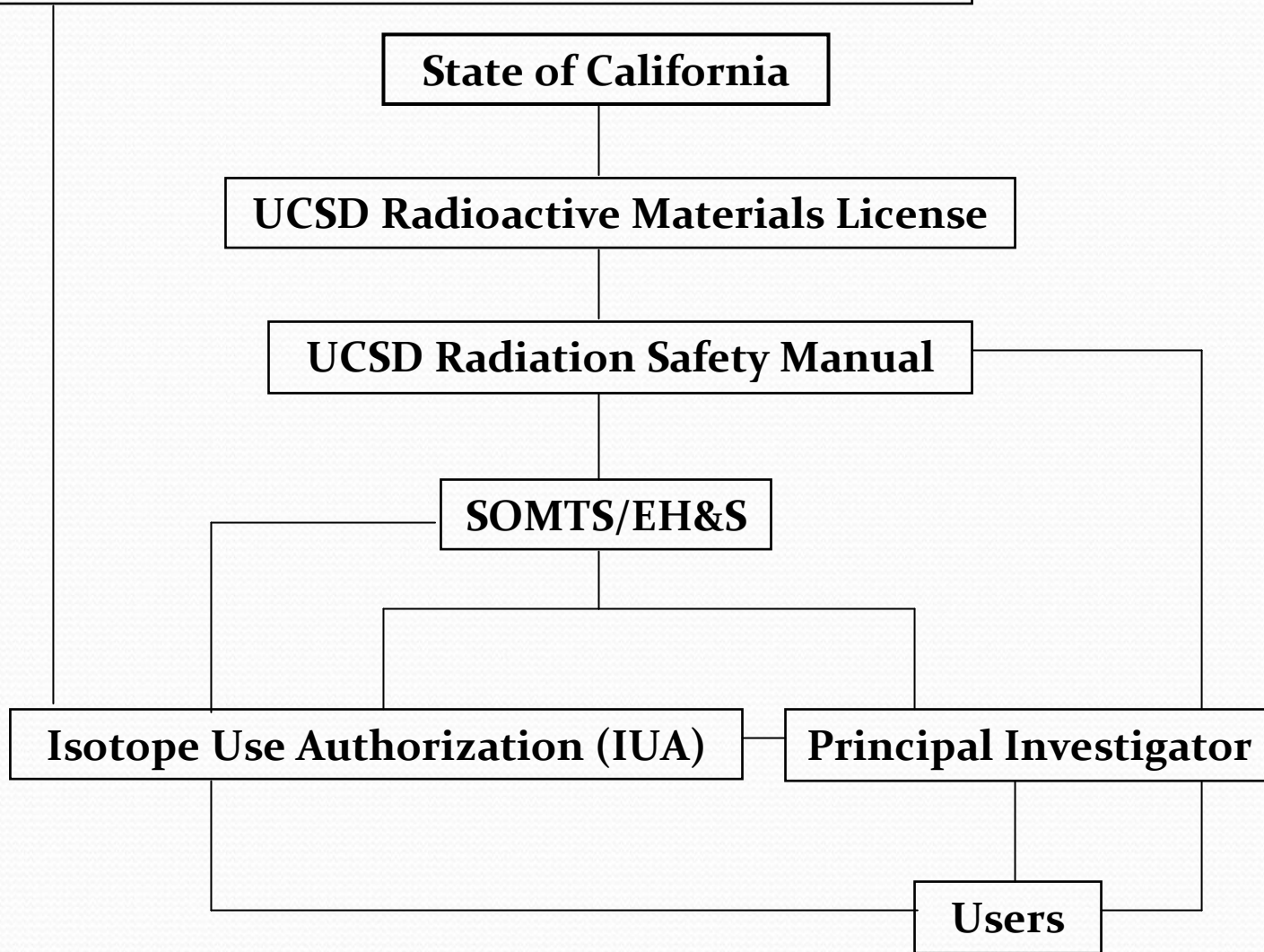
# Shipboard Radiation Safety Training

Scripps Institution of Oceanography  
University of California, San Diego

# Training Goals

- To familiarize science parties with the unique circumstances associated with isotope use on research vessels.
- To educate isotope users as to their responsibilities under the applicable regulations.
- To provide resources toward the isotope use application process at SIO.

# Nuclear Regulatory Commission (NRC) Form 241



# SIO Isotope Use Committee

- Isotope Use Applications can be downloaded at SIO website:
- [http://shipsked.ucsd.edu/Schedules/Instructions\\_For\\_Scientists/](http://shipsked.ucsd.edu/Schedules/Instructions_For_Scientists/)
- Please allow ninety days for approval process.
- Have your RSO contact Gary Lain, [dlain@ucsd.edu](mailto:dlain@ucsd.edu), to facilitate approval.
- Online forms are in development.

# What is Radioactivity?

- Radioactivity is the process by which unstable (radioactive) atoms decay by emitting ionizing energy.
- Radioactive material is any material containing unstable (radioactive) atoms that emit ionizing radiation (alpha, beta, gamma or neutron radiation).
- Even when the radioactive material is properly contained, it still emits radiation and may be hazardous.

# Radioactive Contamination

- Radioactive contamination is radioactive material in an unwanted place.
- Radioactive atoms cannot be neutralized, sterilized, or killed in order to make them non-radioactive.
- The material containing the radioactive atoms must be removed from the person or object.

# SWAB Surveys

- SWAB surveys, as per UNOLS requirements, are conducted after each unstable isotope cruise both by the Miami Tritium Lab and internally by SIO—background levels are maintained.

# Radioisotopes Used On SIO Ships

- Ni-63 (sealed source)
- H-3
- C-14
  
- Radioisotopes must remain in the Isotope van; control boundaries (van entrance) must be observed, shoe covers removed before exit.



# Nickle-63 (Sealed Source in ECD's)

- Sealed sources are regulated as radioactive materials and should be shipped and handled as such.
- An application to SIO's Isotope Use Committee is required.
- Sources are due for leak testing every six months: test certifications should not expire during a cruise.

# $^3\text{H}$ – Tritium

- Relatively short 12.3 year half-life (the half-life of a radioisotope describes how long it takes for half of the atoms in a given mass to decay).
- Low energy beta emitter (5.7 keV).
- Removable contamination can only be detected using a liquid scintillation counter.
- Safety glasses, lab coat and gloves are required.
- Shielding is not required.

# LSC for Tritium Monitoring



# Wipe Surveys

You are required to perform weekly and final wipe surveys of the isotope van.

## How to perform a wipe survey:

- Whatman filter paper works well for this procedure.
- Using gloved hands and multiple pieces of filter paper; successively wipe one hundred square centimeters of area at a time (one hundred square centimeters is about equal to the area of a dollar bill).
- Place the individual pieces of filter paper into liquid scintillation vials; load the vials into the sample racks.
- Using the correct protocol, which will vary according to LSC, count the vials.
- A background sample (blank) should be included first and any wipe which reads greater than 3 times the background sample must be considered contaminated; the area must be decontaminated according to protocol and re-wiped/re-counted. Windex is a good decontaminant.
- Save and document all survey results; please return to Gary Lain.



# Carbon-14

- 5730 year half-life.
- Detected with Geiger Counter (beta counter) from 4 to 6 cm in air.
- Not considered an external radiation hazard.
- Shielding is not required.
- Safety glasses, lab coat and gloves are required.
- Some carbon labelled compounds may penetrate intact skin and gloves.
- Critical organs for carbon can be either the bone or fat depending on the compound.

# Using the Geiger-Mueller Meter (AKA: GM meter or Survey meter)

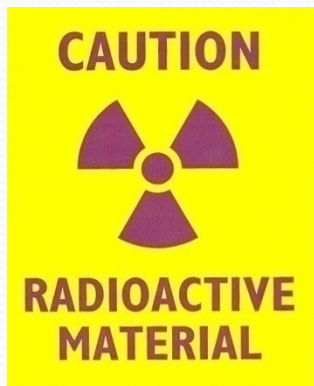
- The calibration date should be current. The instrument should be turned on and battery checked and then a background reading recorded.
- All measurements should be recorded in counts per minute (CPM).
- The probe should be held face down within 1/2 inch of the surface being surveyed, then moved slowly over the area at a rate of about 1-2 inches per second.
- If the area is not contaminated the reading you get should be less than 3 times on average the background reading you recorded.
- Any reading higher than 3 times background is considered contaminated and must be documented, and then decontaminated and re-surveyed.
- Survey yourself as well as the work area.

# Isotope User Responsibilities

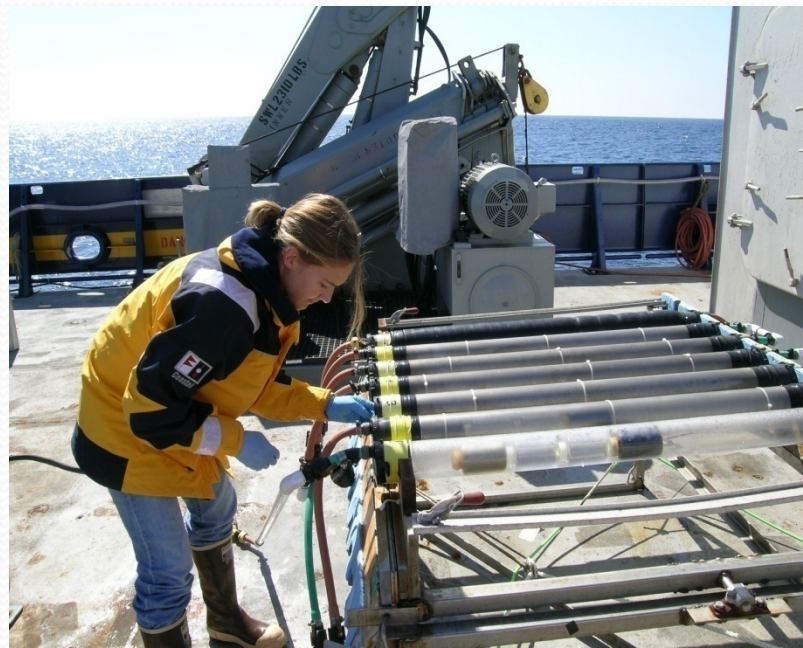
- Survey isotope van weekly and decontaminate if needed; post survey results in log.
- Use trays and absorbent paper/bench coat.
- Store liquids with secondary containment.
- Label containers, storage and use areas.
- Do not eat, drink, smoke, store food or apply cosmetics in the isotope van.
- Wear protective clothing and gloves.

# Posting/Labeling

- Post all radioactive materials use areas (including isotope van entrance).
- Label refrigerators and freezers.
- Label containers, tubes, racks, pipettes--anything coming in contact with radioactive material.







# Radioactive Waste Guidelines

- **Isotope** – start a separate waste stream for each isotope: H-3, C14, etc.
- **Liquid** – separate all solids from the liquid waste. Use a carboy and secondary containment drum as supplied by SIO.
- **Solids** – keep all liquids out of the solid waste, use waste drum with plastic liner.
- **Gels** - double bag using clear plastic bags.
- **Sharps** – use a puncture-proof (sharps) container.
- **Stock Vials** - double bag and store in freezer/refrigerator.
- **Animals** - wrap in Bench-cote, double bag, store in freezer.
- **LSC Vials** – cardboard crate or double bag.
- No radioactive trash in regular trashcans.
- No radioactive liquid waste down the drain.
- Minimize non-radioactive materials in radioactive trash.
- Science party should package waste.
- Waste issues should be part of isotope use plan and coordinated with Gary Lain.

# Radioactive Waste Storage

- Keep outside surface of waste containers free of contamination.
- All radioactive wastes must be retained inside the radioisotope isolation van.
- No wastes may be stored on the deck of the ship without prior approval.
- No liquid or solid waste goes over the side of the ship into the environment.

# Spills

- Accidents happen.
- Failing to follow the plan outlined below may result in a long decontamination procedure and a major disruption to your schedule, and the schedules of others on the ship.

## The Plan

- **Stop Moving** – Call for help and a survey meter
- **Warn others** – To stay out of area
- **Isolate the area** – Isolate the spill – Locate spill using a survey meter
- **Minimize exposure** – Decontaminate

Assume spills are going to happen and plan for them by assembling a spill kit in advance with all the items you may need to control and clean a spill.

# Personnel Decontamination

If the researcher is wearing protective equipment, decontamination may be as simple as removing their lab coat, gloves, etc.

- Remove contaminated clothing - double bag and hold for decay or discard.
- If skin is contaminated begin decontamination procedures using mild soap and water (avoid aggressive washing and rubbing that breaks the skin).
- Continue washing until decontamination to background is attained.
- Survey meter or wipes should be used to monitor progress.
- Double bag all supplies used to decontaminate and hold for discard.
- Notify: Resident Marine Technician, Chief Scientist, Gary Lain at SIO.
- Document the event in the isotope van log.

# Special notes when using radioactivity

- Never touch your face.
- Constantly monitor your gloves.
- Don't touch phones, refrigerator handles without monitoring the gloves.
- Be aware of everything that might get contaminated.
- Monitor the bench, floor and yourself after all radioactivity has been put away.
- Every item that becomes contaminated must be marked "Caution Radioactive Materials."
- Radioisotope, including waste, stays in the rad van!

# Dangerous Good Shipping

- Radioactive materials are regulated as are
- 50% are permitted in cargo or passenger aircraft
- 30% are restricted to cargo aircraft only
- 20% are restricted from transport by air
- Nearly anything non-radioactive can go by ship
- A few are restricted from transport by any mode.

# Transportation of Dangerous Goods, Radioactive and Otherwise

United Nations Committee of Experts Recommendations on  
Transport of Dangerous Goods

**COE**

International Maritime  
Organization

**IMO**

International Civil Aviation  
Organization

**ICAO**

International Atomic Energy  
Agency

**IAEA**

International Air Transport Association

**IATA**

United States CFR 49

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graph TD; COE[United Nations Committee of Experts Recommendations on Transport of Dangerous Goods  
COE] --- IMO[International Maritime Organization  
IMO]; COE --- ICAO[International Civil Aviation Organization  
ICAO]; COE --- IAEA[International Atomic Energy Agency  
IAEA]; IMO --> CFR49[United States CFR 49]; ICAO --> CFR49; IAEA --> CFR49; ICAO --> IATA[International Air Transport Association  
IATA]; IATA --> CFR49;
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## For the system to work, shippers must...

- Classify and identify
- Package and secure
- Mark
- Label
- Provide proper documentation
- Provide Emergency Response information
- Keep training current
- Maintain records

# Communication is the Key

- Proper shipping Name
- Hazard Class or Division (1-9)
- United Nations Identification Number
- Packing Group Number
- Hazard Labels
- Handling Labels

Radioactive materials are in a class by themselves (Class 7).



# In Conclusion...

- Radioisotope use applications must be submitted 90 days in advance to SIO.
- Contact Gary Lain for assistance with the application process and related matters.
- Radioisotope must stay in the isotope van, please observe the control boundary.
- Your health and safety comes first.