



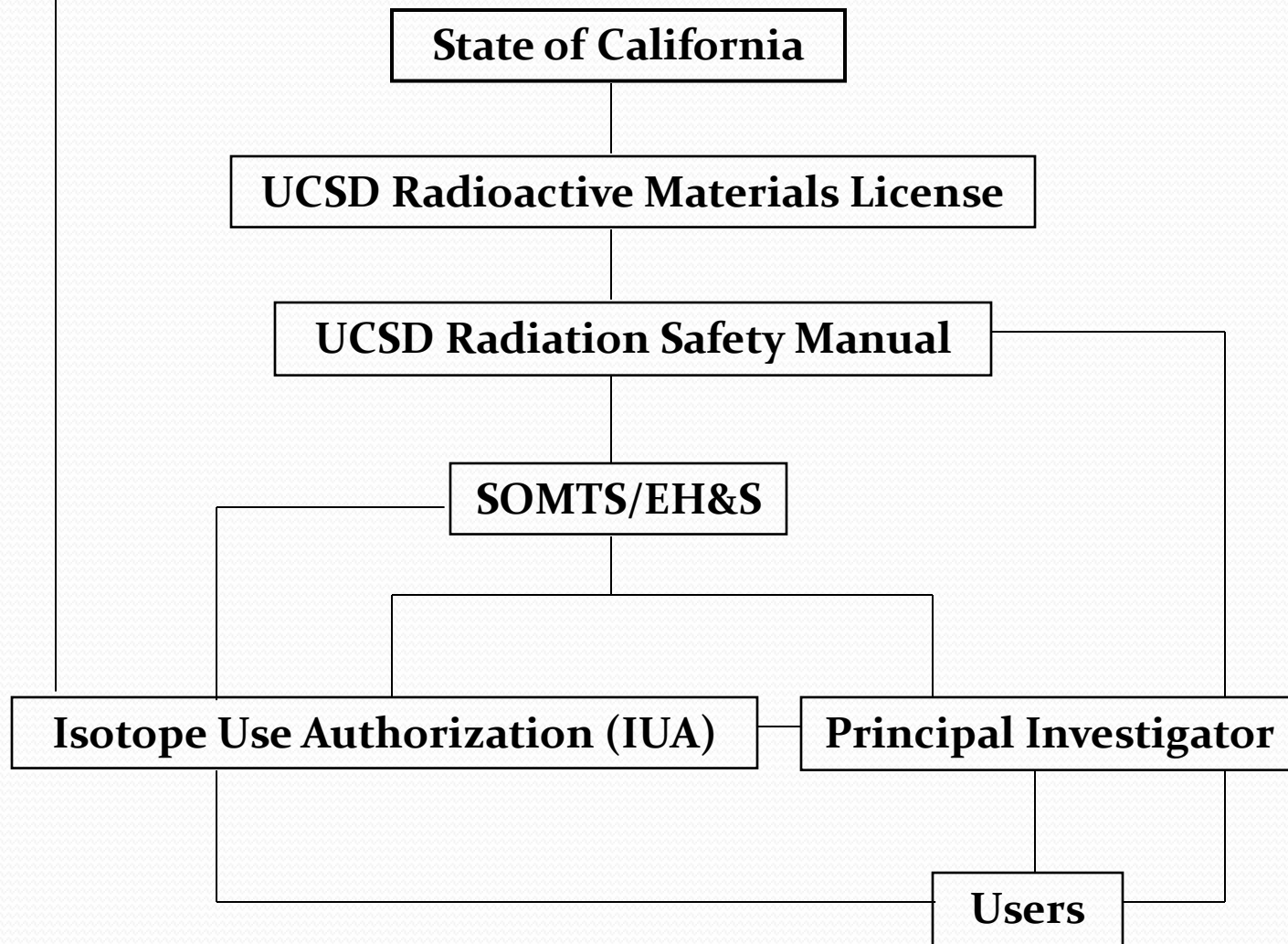
Shipboard Radiation Safety Training

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/
- Please allow ninety days for approval process.
- Have your RSO contact Gary Lain, 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.

^3H –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)

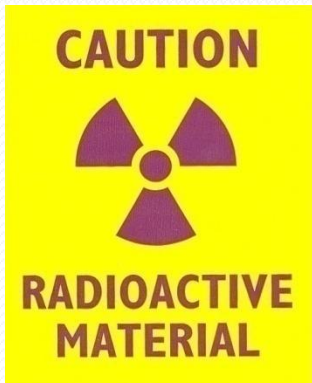
- The calibration date should be current. The instrument should be turned on and battery checked and then a background reading recorded.
- All measurements should be recorded in counts per minute (CPM).
- The probe should be held face down within 1/2 inch of the surface being surveyed, then moved slowly 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]; ICAO --- IATA[International Air Transport Association  
IATA]; IMO --> CFR49[United States CFR 49]; IATA --> CFR49; IAEA --> 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.