

INTRODUCTION

The mission of the Oak Ridge National Laboratory (ORNL) is to deliver scientific discoveries and technical breakthroughs for clean energy and global security. As a United States (US) Department of Energy (DOE) facility, ORNL must comply with DOE rules and regulations regarding radioactive materials. The ORNL is host to the two most powerful neutron sources in the world for open research – the Spallation Neutron Source (SNS) and the High-Flux Isotope Reactor (HFIR). All experimental samples will, to some extent, become radioactive; many samples will remain radioactive for extended periods of time. Scientists frequently would like to receive their samples back without the need for a radioactive materials license.

PROBLEM

DOE Rules do not provide levels at which volume-activated radioactive materials are below any level of concern – a so-called “exempt” level. License exempt levels for non-DOE entities may be determined by the Nuclear Regulatory Commission (NRC), by individual States, or by receiving country. Transport exempt levels are determined by the US Department of Transportation (DOT) for internal shipment or by international agreements for exported samples. International transportation also requires understanding of exempt levels of the receiving country (if they exist).

SOLUTION

Determined in advance:

1. Activity for every radionuclide that would keep committed effective dose [E(50)] from intake under reasonable scenarios to under 0.01 mSv.
2. All applicable regulatory limits (USDOT, USNRC, state, and/or receiving country) for receipt as exempt.

For each sample:

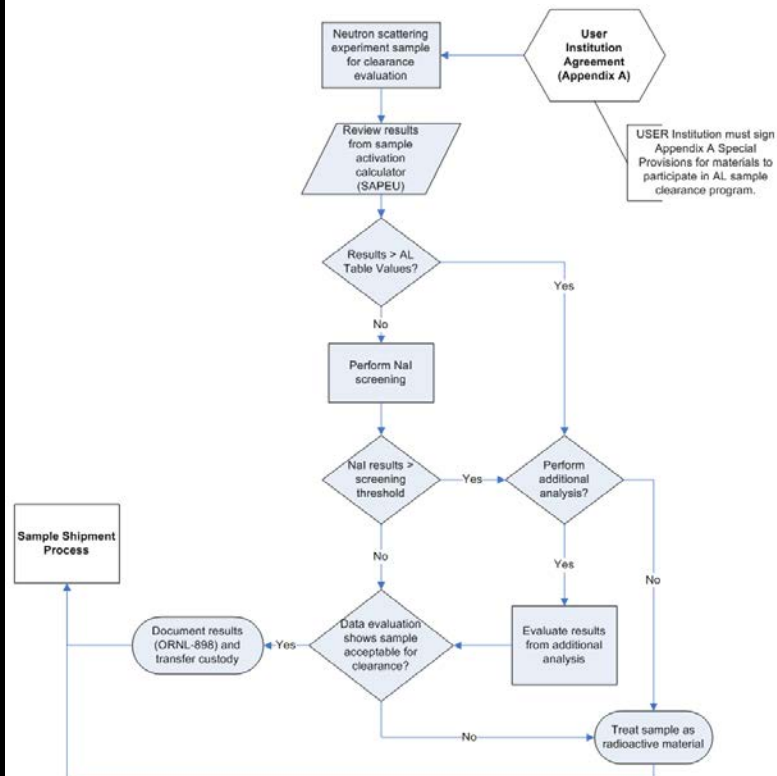
1. Calculate radionuclide content (SAPEU)*
2. Calculate expected count rate on NaI detector
3. Measure actual count rate on NaI detector
4. Investigate any anomalies

Ensure:

1. Each nuclide is below its exempt level, as well as the total content (rule of unity).
2. Receiving entity is responsible for local notifications.

*Sample Activation Program for Easy Use (based on CINDER90 library)

PROCESS



Notes:
 AL = Authorized limits
 NaI = Sodium iodide detector system
 Additional analysis may include holding the sample for decay and re-screening using the NaI system and/or performing more precise radiological measurements such as gamma spectroscopy

INTERNATIONAL CONCERNS

All activities calculated for the US are below those identified in International Atomic Energy Agency (IAEA) *Regulations for the Safe Transport of Radioactive Material*, TS-R-1. Though the values in the IAEA standard are non-binding on countries, they “establish standards of safety which provide an acceptable level of control of the radiation, criticality and thermal hazards to persons, property and the environment that are associated with the transport of radioactive material.” Many countries do not identify their exempt levels (if they exist) where they can easily be found.

CONCLUSIONS

The Authorized Limits process provides a mechanism that recognizes that we must engage with society as we responsibly live with radiation. It uses calculations to determine sample radionuclide content and uses verification by measurement. All applicable regulations of the receiving state or country are considered, as well as required transportation exempt levels and maximum E(50) = 0.01 mSv. The US process requires receiving entity to provide stakeholder notification. The most difficult information to obtain are exempt levels from receiving countries. Scientists are happy to receive minimally radioactive materials back without unnecessary controls.