# <u>Processing or shipping samples back home - how its done at NCNR</u>

## Two general needs

### Shipping sample back home (from NCNR)

### • Form:

– Material Transfer Request (Rm A134, A132, or B100)

### Acquire or dispose of source (a) NIST

- Forms:
  - Proposal to acquire a Radiation Source
  - Proposed change in Utilization of Radiation Source

*How does "Need #1" get solved?* 

## 2<sup>nd</sup> test: Gamma Tool Monitor

- 16in X 16in X 18in (cavity size 4608 in<sup>3</sup>)
- 40keV to > 2MeV Gammas
- 6 plastic scintillation detectors  $4\pi$ shielding w/2 inches Pb
- Sensitivity is in low nCi range, •  ${}^{60}\text{Co} \sim 47\%$  efficient
- $^{137}Cs \sim 27\%$  efficient
- Typically scan is < 7 sec Static or 2in/sec feed-thru using 100 ms time slices



## Health Physics Assessment

### **Possibilities**

- Release for Unrestricted use (not radioactive)
- Release as an Exempt Quantity
- License Transfer
- Many beam samples have short-lived isotopes that significantly decay before transfer



## **General issues of note**

Organic synthesis can have catalytic impurities that activate. Inorganic chemicals can have impurities that activate. Stainless steel sample holders or screws will sometimes activate.

Activation of common sample elements ( $t_{1/2}$  life)

- These activate (& can complicate immediate transfers): Na (15 hrs), Cl (87 days), Br (35 hrs), Si (2.6 hrs), Li (12 years), S (87 days), Ga (varies), Ge (varies), Sn (varies), transition metals in general
- These don't activate, don't activate easily, or decay quickly: K, F, N, O, C, H

Using these will create mixed waste in an activated sample:  $NO_3^-$ ,  $ClO3^-$ ,  $ClO4^-$ , & generally any chemical that is corrosive, reactive, ignitable, toxic, or listed

.....this designation may be important if you retain the sample

## **Carbon nanotubes, two vials** (HFBS)

**Tool Monitor** – clean (individually)

**GM Survey** – clean

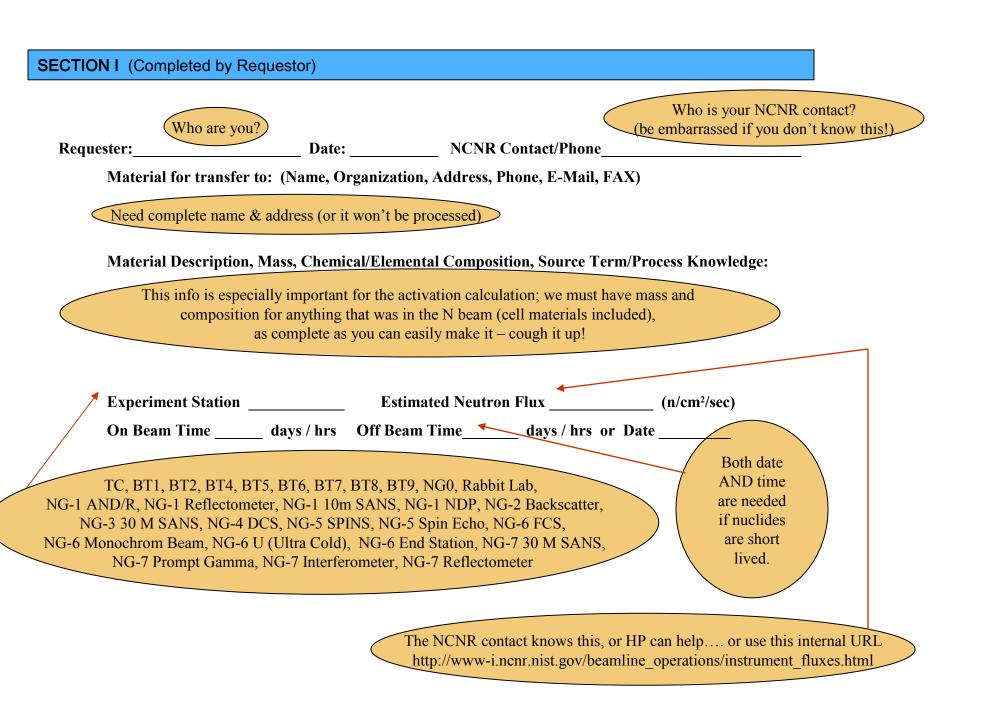
**Smear survey of container – clean Gamma Spectroscopy** – Co-60 (120 Bq and 59 Bq), K-40 (4.4 Bq)

Activation calculation – C slow to activate

Certain commercial equipment, instruments, or materials are identified herein. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the products identified are necessarily the best available for the purpose.

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#### **MATERIALS TRANSFER REQUEST**



**GM Survey** 

**Tool Monitor** 

**Smear survey** removable contamination

Gamma Spectrum Analysis

## 3<sup>rd</sup> test: Contamination Smears

#### β/γ

- 40 mm diameter paper disk (over 100 cm<sup>2</sup>)\*
- Tennelec S5E Counter (Eff ~  $30\% \beta / 2\% \gamma$ )

#### Tritium

ignificant Radionuclides

Not Radioactive Material as defined in US DoT and/or IATA Shipping Regulations

r further information, contact: NIST Health Physics, (301) 975-5810 or E-mail at hp@nist.gov

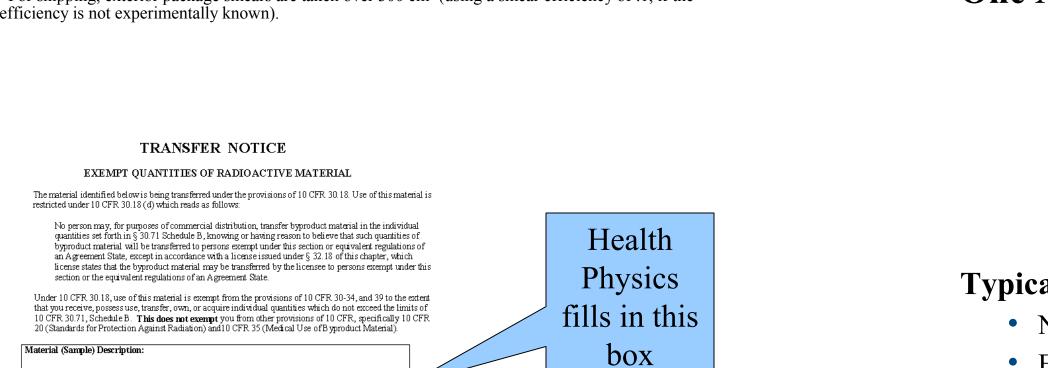
If this material is taken to an organization or entity that is within the scope of a NRC or State license, or the relevant office within that organization of this transfer of exempt quantities of radioactive material

Small Quantity Transfer per 49 CFR 173.4 (Domestic Only)

cility Representative Receiving Material (Name, Phone, E-mail, FAX):

- 40 mm diameter polystyrene disk (over 100 cm<sup>2</sup>)\*
- This technique also responds to  $\alpha$  and other  $\beta$ 's
- Packard Tri-Carb 2500TR Liquid Scintillation Counter (Eff typically ~ 40-52% for T)

\* For shipping, exterior package smears are taken over 300 cm<sup>2</sup> (using a smear efficiency of .1, if the



#### **Typical packages for beam samples:** • Not radioactive for shipping purposes, but still RAM per NRC • Excepted, Limited Quantity • Small Quantity (better package than LQ, for untrained handlers) • Type A • Industrial Package Type 1 (IP-1) • Industrial Package Type 2 (IP-2)

- Normal

Note: If not RAM per DOT, Exempt Quantities may be carried back by scientist

He/she must advise RSO of receiving institution!

\_ Date \_\_\_\_\_

## [(CH<sub>3</sub>)<sub>2</sub>NH<sub>2</sub>]CuCl<sub>3</sub>, 2 g crystal (SPINS, 9 days old)

**Tool Monitor – clean GM Survey of bottle – clean Smear survey of container – clean** Gamma Spectroscopy – Bi-214 (1.1 Bq) a U-238 Series decay product Activation calculation – S-35 (925 Bq)



## Health Physics Assessment

(usually  $1\frac{1}{2}$  -8 hours per sample, depending on work load and complexity)

- quick  $\beta / \gamma$  determination
- sensitive  $\gamma$  determination (better than GM)
- identifies and quantifies  $\gamma$  (better than tool monitor)
- **Activation Analysis** identifies and quantifies  $\beta$

## 1<sup>st</sup> test: Survey

- These give an immediate initial assessment of how to physically handle the sample....if one of these responds, it's definitely radioactive.



## 4<sup>th</sup> test: Gamma Spectrum Analysis

#### Four Ge Gamma Spectrometers

- Three stationary, one portable
- Typical count time  $\sim 1$  hour
- $\sim 100 \text{ keV to } \sim 2 \text{KeV}$
- Assumed geometry affects calculated activity
  - 1. Point source at contact 2. Point source at 8 cm
  - 3. Disk at contact
  - 4. Disk at 8cm

**One X-Ray Spectrometer (SiLi)** 

## Shipping

#### Shipping modes

• Exclusive

## 5<sup>th</sup> test: Activation Analysis

### **Excel<sup>\*</sup>** spreadsheet created at NIST $^{x}A + ^{1}n \rightarrow ^{(x+1)}A$

## **Inputs:**

- Mass of sample
- Elemental mass % of
- Neutron flux
- 4. Time of exposure to a
- 5. Time since exposure
- **Outputs** 
  - Expected products, & their Activities @ variables times

# Overview of shipping

#### **Outgoing:**

- We analyze it, and properly label it.

### Incoming

- track.
- **Approximate %'s of Scientific samples (2004)** Release for Unrestricted Exempt Material, not ra Exempt, Limited Quant Type A

# **Railroad track**

#### **Tool Monitor – omitted**

GM Survey – clean

Smear survey – clean

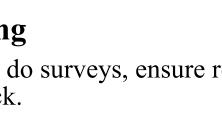
Gamma Spectroscopy (top shield off) – Co-60 (5.1 Bq), K-40 (150 Bq), Bi-214 (9.5 Bq) a U-238 Series decay product

Activation calculation – 1.3E5 Bq Fe-55 (using an estimated upper limit of 3500 grams Fe)

# (**BT-8**, 602 days old)

**Tool Monitor – clean** GM Survey – clean Smear survey – clean Gamma Spectroscopy – Sc-46 (~2.3 Bq) Activation calculation – Si-31 (5.9 Bq @ 1 hour, 0.02 Bq after 22 hours)

## Silicon window, 10mm X 30cm (NG-7 SANS)



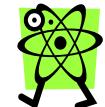




fisotopes	(grams)
	(neutrons/sec-cm <sup>2</sup> )
neutrons	(hours)
to neutrons	(hours)

(µCi)

\* Microsoft ® Excel



• We properly pack "excepted, limited quantity," as well as license-to-license transfers, and make notifications when needed. • Transportation of Exempt Quantity Material usually up to Scientist

• We do surveys, ensure receipt in accordance with our license, and

d use	42% (~97)
adioactive per DOT	52% (~122)
tity	4% (~10)
	2% (~4)