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Materials Inspection Branch
Division of Nuclear Materials Safety
U.S. Nuclear Regulatory Commission, Region III
2443 Warrenville Road, Suite 210
Lisle, IL 60532-4352

Subject: Reply to Notice of Violation – Manchester University and
NRC Routine Inspection Report No. 03008302/2013001 (DNMS)

Dear Tamara Bloomer,

This note describes our completion of the three corrective actions suggested and also how we are addressing the root cause and contributing factor that led to our violations.

1) Calibrating our survey instruments. On March 4, 2013 we mailed two of our survey meters to the Ohio EMA Radiological Calibration Laboratory, 1296 Kinnear Road, Columbus, OH 43212 c/o Rob Stone, for calibration. The calibrated instruments returned here on March 13. The new batteries were removed to preserve their life when the monitors are not in use.

2) Developing leak testing procedures. On March 7, 2013 our previous procedure for leak testing for Am-241 was edited for use with our calibrated Cs-137 sample and multi-channel analyzer along with our 2 x 2-inch NaI(Tl) detector. Attached as an addendum is our leak test procedure. A description of the procedure is on our neutron generator along with a record of leak tests.

3) Conducting leak testing: On March 7, 2013 a leak test was conducted. No leak was detected and the minimum detectable signal was determined to be 0.015 nC.

The root cause of our violations was our infrequent use of our neutron howitzer. To address that cause, we have written three original experiments designed to be used this Spring (2013) for the Advanced Laboratory class. These experiments are designed to serve as the basis of convenient spin-offs experiments in other laboratories such as Modern Physics Laboratory, taught during the Fall 2013 school year, and General Physics Laboratory, taught every semester.

The contributing factor that led to our violations was a lack of organization and oversight from the Radiation Safety Officer, Dr. Dwight Beery. To address that cause, Dr. Beery will place the future dates of leak tests in his daily PLAN computer program and yearly Memo. The leak testing procedure will be placed on the neutron generator itself, rather

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than having it filed in the same room in one of many file folders.

Sincerely,

A handwritten signature in black ink, appearing to read 'Christer Watson'.

Dr. Christer Watson
Assistant Radiation Safety Officer
Manchester University
604 East College Avenue
North Manchester, IN 46962

Leak Test Procedure

Equipment Used: Paper towel and gamma-ray spectrometer (a NaI(Tl) detector) with a multi-channel analyzer (MCA).

1) The MCA is calibrated using a Cs-137 calibrated source. The Cs-137 source is placed directly in front of the 2 x 2-inch NaI(Tl) detector and a spectrum is recorded for 60 seconds. The area of the 661.6-keV gamma-ray peak is measured using the MCA. For example, on 7 Mar 2013, we used the calibrated 638 nCi \pm 5% activity to get net count of 64,669 CPM \pm 0.4%.

2) The leak test is begun by taking a ~100 sq cm paper towel sample from the outside of the plastic sample holder in a horizontal port of the 5 curie neutron generator. It is taped to the center of the 2 x 2 inch NaI(Tl) detector. A 30-minute spectrum is taken. For example, on 7 Mar 2013, we counted, from channel 38 to channel 58, 4,773 counts in 30-minutes. The standard deviation σ of this count = $\sqrt{4773}$ = 69.1 counts in 30-minutes or 2.30 CPM so 3σ = 6.90 CPM to be more conservative. No hint of a peak was seen.

3) Our wipe test for Am-241 has a different decay scheme and photon energy to measure. Our 2 x 2-inch NaI(Tl) detector detects Am-241 59.5-keV gammas with (10/0.92) times the efficiency of the 638 nCi* Cs-137 66.1-keV gamma photons. Also, 36% of Am-241 decays lead to 59.5-keV photons, while 85.1% of Cs-137 decays lead to 661.6-keV photons. Since the 661.6-keV photons photopeak lead to a detection of 64,669 CPM \pm 2%, we can estimate the Am-241 minimum detectable activity as:

$$\text{MDA} = 638 \text{ nCi} (0.92/10) (85.1/36) (6.90/64,669) = \mathbf{0.015 \text{ nCi}}$$

These assumptions are summarized in the following table:

	<u>Calibrated activity</u>	<u>E(keV)</u>	<u>relative efficiency</u>	<u>decay %</u>	<u>Measured Area</u>
Cs-137	638 nCi	661.6	0.92	85.1	64,669
Am-241	-----	59.5	10	36	$3\sigma = 6.90$