ENCLOSURE 1

POSITION PAPER

4 pages follow

This position paper relates to a shipping container sent from Prairie Island to Waltz Mill on October 29, 2008. A spot on the container bottom was found to exceed 200 mR/hr. This radiation field above the shipping limit was found to be quite small, indicating that the dose contribution was dominated by a discrete radioactive particle (DRP). Technicians struggled to locate the highest exposure rate, providing anecdotal evidence of the size of the radiation source. To further detail that aspect of the event, four independent survey instruments gave four highly varied readings on the surface of the container:

Instrument	Exposure Rate
GM Teletector	2000 mR/hr
GM Telepole	1630 mR/hr
GM E-600	1089 mR/hr
Ion Chamber RO-2	800 mR/hr

This represented a quandary to what should be recorded as the contact exposure rate. It is important to note that when using various instruments, especially in a scenario of a discrete radioactive particle, the surface exposure rate would be especially difficult to define. But strictly speaking, an ion chamber will always be the most appropriate instrument for the assessment of true dose rate.

From Radiation Detection and Measurement, Third Edition, Glenn F. Knoll, Copyright 2000, John Wiley & Sons, the following represents relevant information with respect to GM and Ion Chamber detectors.

Regarding Geiger-Mueller detectors:

"A common type of survey meter used in gamma-ray monitoring consists of a portable Geiger tube, high-voltage supply, and pulse counting rate meter. The pulse rate is then taken as an indication of the intensity of the gamma-ray exposure. The count rate meter scales are often calibrated in terms of exposure rate units, but under some circumstances these readings can be in error by a factor of 2 or 3 or more.

The difficulty arises from the fact that the count rate from a Geiger tube, in contrast to the measured current from an ion chamber, bears no fundamental relation to the gamma ray exposure rate."

Regarding Ion Chambers:

"One of the most important applications of ion chambers is in the measurement of gamma-ray exposure. An air-filled ion chamber is particularly well-suited for this application because exposure is defined in terms of the amount of ionization charge created in air. Under the proper conditions, a determination of the ionization charge in an air-filled ionization chamber can give an accurate measure of the exposure....."

GM detectors are used for initial shipping surveys for a variety of good reasons:

- They are rugged, inexpensive, lightweight, and easy to calibrate
- GM's have simpler electronics packages
- GM detectors are small, provide for auto-ranging, can have speakers that indicate changing fields, and can be on telescopic poles
- GM's have quick response times (as do most count rate instruments).
- They also have well-known over-responses to low- and high-energy photons. Yet because of their conservatisms, this is very acceptable.

Although not true indicators of actual dose rates, with speakers, small size, telescopic poles, and general over-responses, GM instruments provide the quickest, most efficient, and conservative detection of any radiation fields. With GM detectors, surveyor doses are lower. In addition, shipping survey measurements using GM's are typically higher than the true dose rates. Therefore, any subsequent measurements by other types of instruments would be lower (GM's being conservative).

That presents the most suitable plan for initial shipping surveys; i.e., use conservative survey instrumentation ensuring that instrument differences would not be the cause of a shipment later exceeding a limit; i.e., GM detectors. With that plan in mind, the Conference of Radiation Control Program Directors (CRCPD) developed a set of generic procedures for shipping surveys. The CRCPD E-5 Committee on Radioactive Waste Management wrote very detailed model procedures for all of the agreement state shippers. In these, they state the following: *Any observed radiation survey readings in excess of regulatory limits shall be confirmed using a portable ion chamber instrument.*

The reasons are quite valid and logical. The GM detectors provide quick, easy to perform, conservative measurements. In an event where there would be a question about the true dose rate, ion chambers should be brought in. They would be used only when assessments of the dose rates were necessary, to confirm the true dose rates. The CRCPD procedures recommend this for surface measurements and also for personnel doses (e.g., cab dose rate). It is their goal to measure the true dose rate (risk) when it is necessary. Otherwise, the GM detectors generally provide a conservative set of surveys to manage the processes.

Regulatory Guide 7.3 in its Annex Instrumentation Section describes obtaining the most appropriate instrument for accurate determinations on shipments. For this regulated shipping event, we propose that the ion chamber measurement of surface dose rate be used (i.e., 800 mR/hr). Of the measurements performed, the ion chamber measurement was the most accurate assessment of surface dose rate, and the only one not measured with a count rate instrument. Further, because the dose rate was dominated by a discrete radioactive particle, we believe that the true risk of exposure to the bottom of the container would be better described by the effective dose equivalent (EDE) rate, which would be even lower than the ion chamber reading. Therefore, it is our contention that acceptance of the ion chamber reading as the surface measurement would allow for conservatism in the assessment of the true risk of exposure to this shipping container.

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Attachment to position on Ion Chamber vs. GM Tube Accuracy

The following are a subset of references used while evaluating the accuracy of Ion Chambers vs. GM Tubes for dose rate measurements.

Radiation Detection and Measurement - Third Edition, Glenn F. Knoll, Copyright 2000, John Wiley & Sons, Inc.

REGULATORY GUIDE 7.3, PROCEDURES FOR PICKING UP AND RECEIVING PACKAGES OF RADIOACTIVE MATERIAL, May, 1976

Radiation Instruments by Herman Cember, Copyright 2001 by the Health Physics Society, Medical Physics Pub Corp, Chapter 17, "Everything But The Counting Statistics: Practical Considerations In Instrumentation And Its Selection And Use", Ronald L. Kathren

MARSSIM : NUREG-1575, Rev. 1, EPA 402-R-97-016, Rev. 1, DOE/EH-0624, Rev. 1

ANSI N42.34-2006, American National Standard Performance Criteria for Hand-Held Instruments for the Detection and Identification of Radionuclides