UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
WASHINGTON, D.C. 20555-0001

August 22, 2003

NRC INFORMATION NOTICE 2003-12: PROBLEMS INVOLVED IN MONITORING DOSE TO THE HANDS RESULTING FROM THE HANDLING OF RADIOPHARMACEUTICALS

Addressees:

All holders of 10 CFR Parts 32, 33, and 35 licenses.

Purpose:

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert licensees of potential difficulties that may be encountered when monitoring doses to the hands of workers involved in handling radiopharmaceuticals. This IN describes some of these difficulties, the work that is being conducted to resolve them, and interim guidance that NRC will adopt pending completion of this work. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in the IN are not NRC requirements; therefore, no specific action nor written response is required.

Background:

Handling of radiopharmaceuticals contained in syringes, vials, and other vessels exposes the workers' hands to radiation doses that may, in the course of a year, approach a significant fraction of the regulatory limit on the shallow dose equivalent (SDE), which is the limit that normally applies to such exposures. The practice has been, for many years, to monitor these doses using ring dosimeters worn on one or more fingers of one or both hands, depending on the details of the activity that produces the exposure. The highest ring dosimeter reading is normally considered to provide a measure of the SDE received, and is used to show compliance with the applicable dose limit.

During the past year or so, NRC inspectors have focused attention on this practice, and have concluded that, at least in some cases, the dosimeters may be underestimating the doses they are supposed to be measuring. This conclusion was reached because the dose that must be assessed for the worker is the dose at the location of the highest exposure on the extremity. When handling radiopharmaceuticals, it may happen that the location of the highest exposure is not the same as the location of the ring dosimeter, in which case the dosimeter will underestimate that dose. This is particularly true when handling radioactive materials with the fingertips, thus creating a sharp dose gradient between the location of highest exposure, which

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is likely to be at the fingertip, and the location of the dosimeter, which is normally at the base of the finger. Under these conditions, the dosimeter may not provide a sufficiently accurate measure of the SDE for purposes of showing compliance, and a correction factor may be warranted, in such cases, to adjust the dosimeter reading.

In response to these findings, some licensees have undertaken some measurements in an attempt to estimate the value of such a correction factor. It is clear that this factor will vary depending on the details of the handling activities, and this has been confirmed by the measurements. The results obtained by the licensees, as well as those published in the professional literature, showed factors ranging from very close to 1 up to 2, or in some cases, higher values, with an average of roughly 1.2 - 1.4. These factors were estimated using the ratio of the dose measured at the fingertip to that measured by the ring badge. Based on these results and other considerations, some licensees have concluded that their activities are such that their dose measurements do not require a correction factor or, in effect, that the appropriate factor for them is 1.

This situation has been complicated by the change in the SDE limit, which became effective in June 2002. The SDE limit has remained numerically the same, namely 0.5 Sv (50 rem) per year to the extremities. However, whereas the old rule required that the dose be averaged over an area of 1 $cm^2$ of skin, the new rule requires that the dose be averaged over a skin area of 10 $cm^2$ (10 CFR 20.1201(c)). The effect of this change has been two-fold. For uniform, or nearly uniform, exposures, over the extremity, the effect is negligible. However, for situations involving high dose gradients, which is the case when handling radioactive materials with the fingertips, the new rule results in an assessed dose that may be lower than would have been assessed under the old rule, the extent of the reduction depending on the details of the exposure. This in turn means that any correction factor that may have been applied to the ring badge reading under the old rule is most likely to be closer to 1 under the revised rule.

The second effect of the rule change is that it now defines the limit in terms of a quantity that is not directly measurable, without specialized measurement techniques, under conditions of high dose gradients. Under the old rule, measuring the dose at the point of highest exposure, such as at the fingertips, by placing a dosimeter at that location, provided a fairly good approximation of the dose averaged over an area of 1 $cm^2$, even in the presence of a high dose gradient. However, such a measurement does not provide a good estimate of the dose averaged over an area of 10 $cm^2$. The required dose must now be measured using special measurement techniques, or calculated. Such measurements or calculations enable estimation of any correction factors that should be used with finger ring dosimeters, to permit reasonably accurate estimation of the required SDE. It should be noted that this is not an unusual situation in applied dosimetry, but only one that is made somewhat more than usually difficult because of the relatively large area over which the dose must be averaged.

Discussion:

NRC and the radiopharmaceutical industry are currently conducting studies and measurements designed to provide estimates of the appropriate correction factors that should be used with ring dosimeters to enable accurate assessment of the SDE. It is expected, as a result of the revised SDE limit, that these correction factors will be close to unity, but may be sufficiently different to warrant their routine use in assessing the SDE. Until this work is completed, and licensees are notified of its results and conclusions, NRC will accept the reading of the finger ring dosimeter, without application of a geometry correction factor, as being sufficiently

accurate to provide a direct indication of the SDE received by the worker provided the ring dosimeter is worn on the finger that is expected to receive the highest dose. NRC will reconsider this approach, and licensees will be notified of the new guidance, when the ongoing work to resolve this matter is completed. In the interim, licensees are reminded of the regulatory requirement to keep doses As Low As is Reasonably Achievable (ALARA) to ensure that, even if the appropriate correction factor is found to be higher than 1, the worker will nevertheless be adequately protected, and the SDE limit will not be exceeded.

This notice requires no specific action nor written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate regional office.

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Attachments:
1. List of recently issued NMSS Information Notices
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| 2003-10 | Criticality Monitoring System Degradation at BWX Technologies, Inc., Nuclear Products Division, Lynchburg, VA | 08/04/2003 | All U.S. Nuclear Regulatory Commission (NRC) licensees authorized to possess a critical mass of special nuclear material. |
| 2003-09 | Source Positioning Errors and System Malfunctions During Administration of Intravascular Brachtherapy | 07/16/2003 | All medical licensees. |
| 2002-31, Sup 1 | Potentially Defective $UF_6$ Cylinder Valves (1-inch) | 03/24/2003 | All U.S. Nuclear Regulatory Commission (NRC) licensees authorized to possess and use source material and/or special nuclear material for heating, emptying, filling, or shipping 30- and 48-inch cylinders of uranium hexafluoride ($UF_6$). |
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| 2002-35 | Changes to 10 CFR Parts 71 and 72 Quality Assurance Programs | 12/20/2002 | All holders of 10 CFR Part 71 quality assurance program approvals and all 10 CFR Part 72 licensees and certificate holders |

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| Information Notice No. | Subject | Date of Issuance | Issued to |
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| 2003-11 | Leakage Found on Bottom-Mounted Instrumentation Nozzles | 08/13/2003 | All holders of operating license or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor. |
| 2003-10 | Criticality Monitoring System Degradation at BWX Technologies, Inc., Nuclear Products Division, Lynchburg, VA | 08/04/2003 | All U.S. Nuclear Regulatory Commission (NRC) licensees authorized to possess a critical mass of special nuclear material. |
| 2002-26, Sup 1 | Additional Failure of Steam Dryer after a Recent Power Uprate | 07/21/2003 | All holders of operating license or construction permits for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor. |
| 2003-09 | Source Positioning Errors and System Malfunctions During Administration of Intravascular Brachtherapy | 07/16/2003 | All medical licensees. |
| 2003-08 | Potential Flooding Through Unsealed Concrete Floor Cracks | 06/25/2003 | All holders of operating licenses or construction permits for nuclear power reactors. |
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