October 16, 2012

MEMORANDUM TO: Kenneth G. O'Brien, Deputy Director
Division of Reactor Safety
Region III

FROM: Sher Bahadur, Deputy Director ***/RA/***
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

SUBJECT: FINAL RESPONSE TO TASK INTERFACE AGREEMENT 2012-05, PALISADES NUCLEAR PLANT, THERMOLUMINESCENT DOSIMETER (TLD) MAY NOT BE ALIGNED WITH NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) ACCREDITATION

By letter dated February 2, 2012 (Agencywide Documents Access and Management System Accession No. ML12033A089), the U.S. Nuclear Regulatory Commission, Region III Office, requested technical assistance from the Office of Nuclear Reactor Regulation (NRR) in evaluating the Palisades Nuclear Plant practice of using a single TLD badge to measure occupational dose from beta, gamma, and neutron radiations. Region III requested NRR's technical assistance by providing answers to the following Task Interface Agreement questions, as to whether the practice:

1. Is aligned with required NVLAP accreditation;
2. Is allowed by NRC regulation; and
3. Correctly assesses dose to occupational workers.

Based on its review, NRR staff finds that the lack of a beta, gamma, neutron radiation mixture test category in ANSI/HPS Standard N13.11-2009 does not mean that using a single dosimeter in the field to measure all three radiations is a violation of the requirement to use a NVLAP accredited dosimeter processor in 10 CFR 20.1501(c). The licensee's practice of using a single dosimeter to measure all three radiations is in alignment with NVLAP accreditation, and the dosimetry practice the inspector observed at Palisades does not constitute a performance deficiency.

The NRR staff position is documented in the enclosed evaluation.

Enclosure:
As stated

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As stated

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ADAMS Accession No.: ML12268A330 ***no major changes to AHPB input** **NRR-106**

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TASK INTERFACE AGREEMENT 2012-05

PALISADES NUCLEAR PLANT THERMOLUMINESCENT DOSIMETER (TLD) MAY NOT BE ALIGNED WITH NATIONAL VOLUNTARY LABORATORY ACCREDITATION PROGRAM (NVLAP) ACCREDITATION

1.0 INTRODUCTION

By letter dated February 2, 2012 (Agencywide Documents Access and Management System Accession No. ML12033A089), the U.S. Nuclear Regulatory Commission (NRC), Region III Office, requested technical assistance from the Office of Nuclear Reactor Regulation (NRR) in evaluating the Palisades Nuclear Plant (Palisades) practice of using a single TLD badge to measure occupational dose from beta, gamma, and neutron radiations. Region III requested NRR's technical assistance by providing answers to the following Task Interface Agreement questions, as to whether the practice:

1. Is aligned with required NVLAP accreditation;
2. Is allowed by NRC regulation; and
3. Correctly assesses dose to occupational workers.

2.0 BACKGROUND

During the performance of a new Inspection Procedure (IP) (71124.04), a question was identified during the completion of Step 02.02, "External Dosimetry," which states:

> a. National Voluntary Laboratory Accreditation Program Accreditation: Verify that the licensee's personnel dosimeters that require processing are NVLAP accredited. If dosimeters are provided by a vendor, verify the vendor's NVLAP accreditation. Ensure that the approved irradiation test categories for each type of personnel dosimeter used TLD, optically stimulated luminescent (OSL), dietil glycol bisalil carbonate (CR-39), etc. are consistent with the types and energies of the radiation present, and the way that the dosimeter is being used (e.g., to measure deep dose equivalent (DDE), shallow dose equivalent (SDE), or lens dose equivalent (LDE)).

The NRC inspectors identified an issue of whether the licensee's use of personnel monitoring dosimeters was consistent with the NVLAP accreditation program. At the time of the inspection, the NVLAP accreditation for the dosimetry provider used by the licensee included proficiency testing for Photons/Photon mixtures, Betas, Photon/Beta mixtures, and Neutron/Photon mixtures (Test Categories II through V as defined in Table 1a of American National Standards Institute/Health Physics Society [ANSI/HPS] N13.11).

The inspector identified that the licensee used the dosimeters (Harshaw 760 TLDs) provided by their vendor in a manner that could expose a single dosimeter to beta, photon (gamma), and neutron radiations. The inspector questioned whether this licensee practice was a violation of Title 10 of the *Code of Federal Regulations* (10 CFR) Section 20.1501(c) as the NVLAP

accreditation does not include a category for dosimeters exposed to a mixture of beta, gamma, and neutron radiations. Additionally, the inspector noted that the licensee had not demonstrated that they could accurately monitor dose from this mixture of radiations.

In response to the inspector's questions, the licensee performed a special blind spike testing (TID 2011-006) of the Harshaw 760 TLDs (used for the dose of legal record) to determine the adequacy of using a single dosimeter for monitoring beta, gamma, and neutron exposures.

The NRC inspector believes that the four (4)-element TLD design of certain dosimeters, such as the Harshaw 760's and Panasonic 802 dosimeter designs, limits the capability of these dosimeters to distinguish dose from these three types of radiation. The inspector has identified this issue as an Unresolved Item (URI), and Region III has initiated this TIA for NRR's assistance in resolving the issue.

3.0 EVALUATION

General

Licensees are required to provide adequate monitoring of occupational dose by use of individual radiation monitoring devices in accordance with 10 CFR 20.1502(a). In addition, licensees are required to use a NVLAP accredited processor to process and evaluate personnel dosimeters used to demonstrate compliance with the dose limits. Specifically, 10 CFR 20.1501(c) states that:

> All personnel dosimeters (except for direct and indirect reading pocket ionization chambers and those dosimeters used to measure the dose to the extremities) that require processing to determine the radiation dose and that are used by licensees to comply with § 20.1201, with other applicable provisions of this chapter, or with conditions specified in a license must be processed and evaluated by a dosimetry processor-- (1) Holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP) of the National Institute of Standards and Technology [NIST]; and (2) Approved in this accreditation process for the type of radiation or radiations included in the NVLAP program that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored.[1]

The NIST NVLAP dosimetry processor accreditation process, which is made applicable to the NRC through 10 CFR 20.1501(c)(1), is described in the NIST Handbook 150-4, "National Voluntary Laboratory Accreditation Program Ionizing Radiation Dosimetry." NIST Handbook 150-4 adopts the ANSI/HPS Standard N13.11, "Personnel Dosimetry Performance - Criteria for Testing" for whole body dosimeter proficiency test standards.[2] The accreditation is specific to the dosimetry system (type of dosimeter, and dosimeter processing method) and the testing categories passed.

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[1] 10 CFR 20.1501(c)(1)-(2).

[2] NIST Handbook 150-4, National Voluntary Laboratory Accreditation Program, Ionizing Radiation Dosimetry (August 2005), paragraph 5.9.1.

As noted above, 10 CFR 20.1501(c)(2) requires that the dosimeter processor be approved "for the type of radiation or radiations *included in the NVLAP program that most closely approximates* the type of radiation or radiations for which the individual wearing the dosimeter is monitored."[3] As identified by the NRC inspector, there is no NVLAP test category for dosimeters exposed to a mixture of beta, gamma, and neutron radiations. Therefore, a licensee, that is required, in accordance with 10 CFR 20.1502(a), to monitor for SDE or LDE, as well as DDE, and is using a single dosimeter to monitor beta, gamma, and neutron exposures, would have to use a dosimeter processor that is NVLAP accredited in ANSI/HPS Standard N13.11-2009 test Categories IV and V (beta-photon mixtures and neutron-photon mixtures, respectively) to comply with 10 CFR 20.1501(c)(2). As described above, at the time of the inspection, the licensee's dosimetry vendor/processor held a valid NVLAP accreditation, with approvals for Categories IV and V with the Harshaw 760 dosimeters.

Specific Questions

a. Evaluate the licensee's practice of using a single Harshaw 760 TLD to measure dose from three different types of radiation (beta, gamma, and neutron) to determine the accuracy and precision for each radiation type.

Response:

The acceptance criteria and protocol for NVLAP performance testing is given in ANSI/HPS Standard N13.11-2009. The standard specifies accuracy and precision for measuring DDE and SDE from exposure to different radiation mixture categories. The test acceptance criteria are given as a combination of the bias and the precision determined from processing a set of pre-exposed dosimeters, such that:

$$B^2 + S^2 \leq L^2$$

Where B is the average bias in the dosimeter results, normalized to the expected dose; S is the standard deviation of the normalized results; and L is the limit of acceptable performance, given as 0.3 for non-accident DDE and SDE results.

As identified by the NRC inspector, there is no beta, gamma, and neutron mixture category specified in ANSI/HPS Standard N13.11-2009. In response to the NRC inspector's questioning the accuracy and precision of using a single dosimeter to monitor exposures to all three types of radiation, the licensee performed a blind spike testing of the dosimeters in use at the time of the inspection (TID 2011-006). This test was conducted like the NVLAP proficiency test, except that the number of dosimeters in the test group (8) was below the minimum number (15) specified in ANSI/HPS Standard N13.11-2009, and the lower end of the dose range used was below the minimum for the test categories listed in Table 1a of the 2009 standard. Both of these differences have the potential to increase the bias and standard deviation in the measurement results.

The dosimeter processing results given in the licensee's report TID 2011-006, indicate biases of -0.2118 and -0.0753; with standard deviations of 0.1507 and 0.0566 for deep dose and shallow dose, respectively. These result in a $B^2 + S^2$ of 0.068 for deep dose

[3] 10 CFR 20.1501(c)(2) (emphasis added).

readings and a $B^2 + S^2$ of 0.0089 for shallow dose readings, which are both less than, or within, the acceptance criteria ($L^2 = (0.3)^2$) of 0.09. Notwithstanding that there is no NVLAP test category for beta, gamma, and neutron mixtures, and the limitations of the TID 2011-006 test noted above, this data indicates that the licensee's practice of monitoring all three radiations with a single Harshaw 760 dosimeter (as observed by the NRC inspector) meet the NIST approved standard (ANSI/HPS N13.11-2009) for dosimeter accuracy and precision. Therefore, the licensee did provide adequate monitoring and was, at the time of inspection, in compliance with 10 CFR 20.1502(a).

b. Evaluate the practice of using a single TLD in fields or situations with three different types of radiation (beta, gamma, and neutron) to assess dose for DDE; LDE; and SDE.

   Response:

   The NRC inspector correctly identified that this practice is not appropriate for all dosimeters designs. Some TLDs (such as the Panasonic UD 802) have a detector element (TLD chip) under the "beta window" that is sensitive to both betas and neutrons. Exposing such a dosimeter to a mixture of all three radiations can compromise the processor's ability to distinguish between beta and neutron dose. The degree to which this sensitivity impacts the accuracy of the monitoring would have to be evaluated on a case-by-case basis. Note that the Panasonic UD 808A and UD 809A dosimeters, as well as the Harshaw 760 dosimeter, are not subject to this sensitivity as they each use Li-7 (neutron insensitive) TLD elements under the beta window.

   It would be inappropriate for a licensee to use a single Panasonic UD 802 dosimeter (or any dosimeter that has a neutron sensitive chip under the beta window) to measure concurrent beta and neutron radiation exposures. The dosimeter processor could pass the separate Category IV and Category V performance testing without accounting for the inaccuracies possibly introduced by this field practice. However, in such cases where the licensee is using a dosimeter in a way that compromises the processor's ability to distinguish between beta and neutron dose, then the issue is not whether the processor is NVLAP accredited (per 10 CFR 20.1501(c)) for this field practice, but whether the licensee is providing adequate monitoring (e.g., using dosimeters within its specific limitations) as required by 10 CFR 20.1502(a). This is true for any other in-field use practice that can introduce error in the monitoring results (e.g., practices that result in exposures to organic vapors, high levels of heat, or intense light, etc., depending on the specific dosimeter design).

   See the response to question a. above for the impact of measuring beta, gamma, and neutrons on the Harshaw 760 dosimeters in use by the licensee at the time of the inspection.

c. Determine the accuracy and precision of the type of dose assessment protocol when there is a time delay for exposure data and time to dosimetry read date and time (monthly, quarterly, semiannually, and annually).

Response:

The issue of dosimeter fading due to delayed processing is accounted for in the NVLAP processor performance testing. The NRR staff does not see the relevance of the length of monitoring periods and the issue of dosimeter fading, as they pertain to using a single dosimeter for monitoring beta, gamma, and neutron exposures.

d. Determine when this practice is appropriate for demonstrating compliance to10 CFR 20.1501(c).

Response:

As there is no category for the three radiation mixture (beta, gamma, and neutron) in ANSI/HPS Standard N13.11-2009, the categories included in the NVLAP that most closely approximates the type of radiation or radiations for which the individual wearing the dosimeter is monitored, as required by 10 CFR 20.1501(c), are those in NVLAP Test Category IV, for beta-photon mixtures and Category V for neutron-photon mixtures. As discussed in the response to question b. above, if the practice of using a single dosimeter introduces a significant error in the reading, it should be evaluated to determine whether the licensee is providing adequate personnel monitoring required by 10 CFR 20.1502(a). Section 20.1501(c) is not at issue because the licensee used a vendor (processor) who held the appropriate accreditation and was approved in the accreditation process for the type of radiation in the NVLAP program that most closely approximated the type of radiation for which the licensee's workers wearing the dosimeters were monitored.

e. Recommend appropriate communication strategy if this appears to be a generic issue.

Response:

This does not appear to be a generic problem in the industry. Licensees using the Panasonic UD 802 dosimeter for personnel monitoring generally use separate dosimeters for beta-gamma and neutron-gamma exposures.

f. Enhance inspection guidance contained in IP 71124.04 as appropriate to capture the results of this review.

Response:

The wording of the inspection requirement 02.02 (a) in IP 71124.04 should be revised. As discussed above, NVLAP accredits dosimetry processors, not dosimeters. In addition, there is no NVLAP test category for LDE measurements. This inspection requirement will be clarified in a future revision.

4.0 CONCLUSION

Based on its review of TIA 2012-05, the NRR staff finds the following:

1. The lack of a beta, gamma, neutron radiation mixture test category in ANSI/HPS Standard N13.11-2009 does not mean that using a single dosimeter in the field to measure all three radiations is a violation of the requirement to use a NVLAP accredited dosimeter processor in 10 CFR 20.1501(c). The licensee's practice of using a single dosimeter to measure all three radiations is in alignment with NVLAP accreditation. The NVLAP test categories that most closely approximate the type of radiation, or radiations, are Category IV, beta- photon mixtures, and Category V, neutron-photon mixtures. At the time of the inspection, the dosimeter processor held a valid NVLAP accreditation, with approvals for Category IV and V radiation mixtures with the Harshaw 760 dosimeters then in use by the licensee at Palisades.

2. Depending on the dosimeter design, the use of a single dosimeter to monitor for beta, gamma, and neutron exposures could be an issue of whether the licensee is providing adequate monitoring as required by 10 CFR 20.1502(a). However, based on the licensee's test data, the Harshaw 760 dosimeter can be used to monitor the combination of beta, gamma, and neutron exposures within the accepted accuracy for DDE and SDE determinations. Specifically, the dosimetry practice the inspector observed at Palisades (as described in this TIA) does not constitute a performance deficiency.

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Date: October 16, 2012