UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

July 13, 2009

Mr. Larry Meyer
Site Vice President
FPL Energy Point Beach, LLC
6610 Nuclear Road
Two Rivers, WI 54241

SUBJECT: POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2 – APPLICATION TO USE WEIGHTING FACTORS FOR EXTERNAL EXPOSURE (TAC NOS. MD9417 AND MD9418)

Dear Mr. Meyer:

By the letter dated July 30, 2008 (Agencywide Documents Access and Management System Accession No. ML082140476), FPL Energy Point Beach LLC (the licensee), requested approval by the U.S. Nuclear Regulatory Commission (NRC) for the use of the weighting factors listed in Table 1 in the American National Standards Institute HPS N13.41-1997, "Criteria for Performing Multiple Dosimetry," for external radiation exposures when demonstrating compliance with total effective dose equivalent, based on requirements in Title 10 of the *Code of Federal Regulations*, Part 20, for the Point Beach Nuclear Plant, Units 1 & 2.

On the basis of its review, the NRC staff finds your request acceptable. The enclosed safety evaluation documents the NRC staff's findings.

If you have any questions, please contact Justin Poole, at 301-415-2048.

Sincerely,

Lois M. James, Chief
Plant Licensing Branch III-1
Division of Operating Reactor Licensing
Office of Nuclear Reactor Regulation

Docket Nos. 50-266 and 50-301

Enclosure:
Safety Evaluation

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UNITED STATES
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO APPROVAL TO USE EFFECTIVE DOSE EQUIVALENT

WEIGHTING FACTORS FOR EXTERNAL RADIATION EXPOSURE

FPL ENERGY POINT BEACH, LLC

POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

DOCKET NOS. 50-266 AND 50-301

1.0 INTRODUCTION

By the letter dated July 30, 2008 (Agencywide Documents Access and Management System Accession No. ML082140476), FPL Energy Point Beach LLC (the licensee), requested approval by the U.S. Nuclear Regulatory Commission (NRC) for the use of the weighting factors listed in Table 1 in the American National Standards Institute (ANSI) HPS N13.41-1997, "Criteria for Performing Multiple Dosimetry," for external radiation exposures when demonstrating compliance with total effective dose equivalent (TEDE), based on requirements in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 20, for Point Beach Nuclear Plant, Units 1 & 2. ANSI/HPS N13.41-1997 was approved December 1996 by the ANSI.

The licensee stated that accurate assessment of occupational exposure of workers from external sources of radiation in highly non-uniform radiation fields requires a method for assessing the effective dose equivalent (EDE) and that the use of the proposed weighting factors will improve the accuracy of the licensee's assessment of occupational exposure. Therefore, the effect of granting this request would be to allow the licensee the option to estimate EDE using the weighted external exposure measurements in those cases where it is a more accurate predictor of the risk from occupational radiation exposure.

2.0 REGULATORY EVALUATION

10 CFR 20.1003 defines EDE or H_E as "the sum of the products of the dose equivalent to the organ or tissue (H_T) and the weighting factors (W_T) applicable to each of the body organs or tissues that are irradiated ($H_E = \Sigma W_T H_T$)." 10 CFR 20.1003 defines weighting factor for an organ or tissue (T) as "the proportion of the risk of stochastic effects resulting from irradiation of that organ or tissue to the total risk of stochastic effects when the whole body is irradiated uniformly." For calculating the effective dose equivalent, 10 CFR 20.1003 has a table listing the values of W_T for different organs or tissues. For the whole body value, the table contains a footnote which states "For the purpose of weighting the external whole body dose (for adding it to the internal dose), a single weighting factor, W_T=1.0, has been specified. The use of other

weighting factors for external exposure will be approved on a case-by-case basis until such time as specific guidance is issued." The weighting factors are applicable to the organs and tissues whether the dose results from radiation sources internal or external to the body.

10 CFR 20.1003 defines two components: (1) dose resulting from radioactive sources internal to the body, and (2) dose resulting from sources external to the body. The doses from external and internal exposures are then summed to obtain the total effective dose equivalent (TEDE). Several dose limits (such as those in 20.1201(a)(1)(i) and 20.1301(a)) and other requirements in Part 20 are based on TEDE.

10 CFR 20.1003 defines TEDE as the "sum of the effective dose equivalent (for external exposures) and the committed effective dose equivalent (for internal exposures)." The committed effective dose equivalent is the sum of the products of the dose equivalents to each tissue, from radioactive material taken into the body, integrated over 50 years, and the weighting factor applicable to that tissue.

In most relatively-uniform exposure situations, a single dosimeter, calibrated to measure deep dose equivalent (DDE), worn on the whole body, provides a reasonably accurate estimate of the EDE from external exposures (EDE_{ex}). If the body is not irradiated uniformly, a single dose measurement can not determine the dose to the various organs and tissues for an accurate determination of the EDE_{ex}. To insure a conservative TEDE determination, 10 CFR 20.1201(c) requires that when the external exposure is determined by measurement with an external personal monitoring device, the DDE must be used in place of the EDE_{ex}, unless the EDE_{ex} is determined by a dosimetry method approved by the NRC.

Using DDE in place of EDE_{ex} can be overly conservative in extremely non-uniform irradiations (i.e., when only a small portion of the whole body is irradiated). As discussed in NRC Regulatory Issue Summaries 2002-06 "Evaluating Occupational Dose For Individuals Exposed to NRC-licensed Material and Medical X-rays", 2003-04 "Use of the Effective Dose Equivalent in Place of the Deep Dose Equivalent in Dose Assessments" and 2004-01 "Method for Estimating Effective Dose Equivalent from External Radiation Sources Using Two Dosimeters," the NRC has approved several methods for determining EDE_{ex}.

3.0 TECHNICAL EVALUATION

The NRC staff has reviewed the technical approach for estimating EDE_{ex} provided in ANSI/HPS N13.41-1997. This multiple dosimetry method divides the whole body into seven separate compartments. Each compartment, or combined compartment (since the ANSI /HPS N13.41-1997 allows combining adjacent compartments), is monitored separately. The results of the dose measurement for each compartment are weighted with an associated "compartment factor." The resulting weighted doses are then summed to determine the EDE_{ex} for the whole body.

The compartment factors are listed in Table 1 of the ANSI/HPS N13.41-1997. The factor for each compartment was developed by summing the stochastic weighting factors given in Part 20 for all the organs located within that compartment. For each tissue that reside in more than one compartment (e.g., red bone marrow), the weighting factor was apportioned between the compartments based on the fraction of the total mass of the tissue residing in each, using the information in International Commission on Radiation Protection Publication 23.

Fundamental to the ANSI/HPS N13.41-1997 multiple dosimeter method of determining EDE_{ex}, are the assumptions that: (1) the average dose to the tissues in each compartment can be reasonably measured (with one or more dosimeters), and (2) that the dose distribution across the compartment is sufficiently constant so that this average dose can be applied to each tissue in the compartment. The compartments defined in ANSI/HPS N13.41-1997 are small enough so that under most exposure situations these assumptions are valid and a single determination of DDE in each compartment is sufficient. However, this may not be the case in those unusual situations where a significant dose gradient exists across the compartment (particularly the thorax and abdomen compartments). In these cases, dosimeter placement in each compartment becomes critical to ensuring that the EDE_{ex} is not underestimated.

To ensure that the estimates of EDE_{ex} are conservative, the licensee has stated it will measure the dose to each compartment (and/or combined compartments) by locating the dosimeter, calibrated to DDE, at the highest exposed portion of that compartment. The dosimeter location for each compartment will be subject to the same criteria the licensee currently uses for demonstrating compliance with 10 CFR 20.1201(c).

The licensee has stated that in uniform exposure situations, a single dosimeter placed between the wearer's head and waist, which is consistent with the licensee's current practice, will be used to monitor external exposure. When using the ANSI/HPS N13.41-1997 multiple dosimeter method of determining EDE_{ex}, the licensee has stated that, consistent with their current policy, a single dosimeter will be used to monitor the dose to the combined thorax and abdomen compartments. This combined compartment will be called the chest compartment.

4.0 CONCLUSIONS

The NRC staff concludes that the licensee's proposed method for dose measurement using the multiple dosimetry method to determine EDE_{ex} by applying the weighting factors listed in Table 1 of ANSI/HPS N13.41-1997, as discussed above in Section 3.0 of this report, is consistent with the ANSI/HPS standard and with the requirements of 10 CFR Part 20, and is therefore acceptable for the purposes of demonstrating compliance with the TEDE based requirements in 10 CFR Part 20.

Principal Contributor: R. Pedersen, NRR

Date: July 13, 2009

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Sincerely,

/RA by P. Tam/

Lois M. James, Chief
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Safety Evaluation

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