Office of Compensation Analysis and Support Program Evaluation Plan	Document Number: OCAS-PEP-008 Effective Date: 12/7/06 Revision No. 0
Modification of NIOSH-IREP lung cancer risk model: impact of "combined" lung model on non-compensable lung cancer claims	Page 1 of 5
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ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
12/7/06	12/7/06	0	New document to evaluate the modification of the NIOSH-IREP lung cancer model on previously competed cases

1.0 Description

The NIOSH-IREP lung cancer risk model, labeled "Lung (162)" in NIOSH-IREP, calculates the probability of causation (PC) for cancers of the lung, trachea, or bronchus. NIOSH modified this risk model on February 28, 2006 via the implementation of NIOSH-IREP Version 5.5. Version 5.5 and Version 5.5.1, which superseded v5.5 on May 16, 2006, are programmed with a "combined" lung cancer risk model. The combined model consists of two alternative lung risk models: the lung model used in NIOSH-IREP v5.4 and earlier versions, plus the lung model used in NIH-IREP, a separate IREP software program maintained by the National Cancer Institute (NCI). NCI revised the NIH-IREP lung model in 2003 based on updated analyses (1, 2) of Japanese atomic bomb survivor cohort data, including the application of new assumptions about the interaction between cigarette smoking and lung cancer. (The revised NIH-IREP lung model is the model that was added to NIOSH-IREP.) For each cancer of the lung, trachea, or bronchus, NIOSH-IREP now calculates separately the PC value produced by each of the two different lung cancer risk models and reports the higher PC at the upper 99th percentile credibility limit as the PC value of record for the claim.

In the revised NIH lung cancer model, risk is adjusted for age at exposure and age at diagnosis. The NIOSH lung model does not adjust for these age-dependent factors. Further, the NIH lung model relies less on a multiplicative interaction than the NIOSH model in accounting for the interaction between cigarette smoking and lung cancer. Consequently, the same claim inputs can

produce different PC values for some exposure profiles for claimants with lung cancer. The NIH lung model is generally more favorable to smokers than the NIOSH lung model, whereas the NIOSH lung model is generally more favorable to non-smokers than the NIH lung model. Other potential effects on PC (age and gender-related, for example) vary according to the circumstances of each case and are more difficult to predict. (3)

NIOSH-IREP v5.5 and v5.5.1 also incorporate a bias correction factor for random errors in dosimetry for "never smokers" who were exposed to radon. Due to a programming oversight, this correction had been omitted for "never smokers" and was applied only to smokers in earlier versions of NIOSH-IREP. NIOSH-IREP v5.5 corrected this error.

The risk model modifications described above can result in no lower PC value for the same set of claim inputs than had been calculated under previous versions of NIOSH-IREP (versions 5.4 and earlier). This change was adopted based, in part, on recommendations from outside experts and was endorsed by the Advisory Board on Radiation and Worker Health (ABRWH). Again, the modifications pertain only to the "Lung (162)" risk model and apply only to cancers of the lung, trachea, or bronchus.

2.0 Preliminary Issue Evaluation

In accordance with the lung cancer risk model changes described above, non-compensable lung cancer claims completed under older versions of NIOSH-IREP were eligible for evaluation. Since the potential effect on PC values for individual lung cancer claims was not fully predictable, the decision was made to evaluate all previously non-compensable lung cancer claims completed under NIOSH-IREP versions 5.4 and earlier (versions in operation prior to February 28, 2006, the date the combined lung cancer risk model was first implemented). The ORAU team researched the NIOSH/OCAS claims database and identified 920 such non-compensable claims (PC<50% at the upper 99th percentile credibility limit). For claims that had been reworked due to DOL returns, only the most recent revision of each such claim was considered.

This preliminary evaluation consisted of running each of the 920 identified claims in NIOSH-IREP v5.5.1, which includes the "combined lung model" first introduced on 2/28/06, to determine the effect on PC outcomes. Of the 920 claims, 729 were "single cancer" claims. That is, only one cancer (primary or secondary) was reported for each claim and the applicable NIOSH-IREP risk model was "Lung (162)." The remaining 191 claims were "multiple cancer" claims, in which two or more cancers (primary and/or secondary) were reported for each claim and the "Lung (162)" model was used for at least one of the cancers.

As displayed in Table 1, this preliminary evaluation revealed a PC increase for 95 of the 920 identified claims. As would be expected, the alternative NIH lung cancer risk model produced the higher PC value for the vast majority (91, or 95.8%) of the 95 affected claims. Of these 91

claims, 70 were single cancer claims and 21 were multiple cancer claims. However, the 21 multiple cancer claims included 28 separate lung cancers. Thus, the total number of lung cancers among all claims for which the NIH lung model produced a higher PC (versus the NIOSH lung model) was 98. The mean and median increase in PC produced by the NIH lung model versus the NIOSH model for the 98 lung cancers was 1.87 and 1.30 percentage points, respectively (range = 0.02 to12.58 percentage points). The NIH lung model produced a *lower* PC value at the upper 99th percentile credibility limit than the NIOSH lung model for 829 (90.1%) of the 920 previously non-compensable claims.

Of the 95 claims with increased PC values, there were only 4 claims in which the NIOSH v5.51 lung model produced a higher PC than the NIOSH lung model used in earlier versions of NIOSH-IREP (v5.4 and earlier). Because the smoking history associated with each of these 4 claims was "Never Smoked" and because each claim included radon exposure, the PC increases can be attributed to the bias correction factor for random errors in dosimetry for non-smokers exposed to radon (see Section 1.0). The PC increases due to the bias correction factor for the 4 affected claims were 1.01, 5.23, 5.29, and 6.47 percentage points (mean increase = 4.50; median = 5.26).

PC values at the upper 99th percentile credibility limit showed an increase in 73 (10.0%) of the 729 "single cancer" claims and in 22 (11.5%) of the 191 "multiple cancer" claims for, as noted above, a total of 95 (10.3%) of the 920 identified lung claims. The new PC values for 84 (88.4%) of the 95 claims remained below 45% and require no further evaluation. However, 11 (11.6%) of the 95 claims had a new PC value of 45% or higher and will require further review. Each of the 11 claims with a new PC ≥45% will require a rework and/or 30 IREP runs at 10,000 iterations to establish the average (arithmetic mean) PC value. Since 4 of these 11 claims have more than one cancer, 30 IREP runs will be required for each cancer (i.e., including cancers other than lung) for each of the 4 claims.

Table 1: Effect of NIOSH-IREP v5.5x "combined" lung cancer risk model on probability of causation (PC) values at the upper 99th percentile credibility limit (results of preliminary evaluation of all non-compensable lung cancer claims originally completed under NIOSH-IREP versions 5.4 and earlier)

Type of Claim	Number of Claims	No PC Increase	PC Increase	Increase Due to NIH Lung Model	Increase Due to Bias Correction Factor	New PC <45%	New PC = 45 - 49.99%	New PC ≥ 50%
Single cancer	729	656	73	70	3	66	3	4
Multiple cancers	191	169	22	21	1	18	4	0
Totals	**920**	**825**	**95**	**91**	**4**	**84**	**7**	**4**

3.0 Plan for Resolution or Corrective Action

Of the 920 lung cancer claims identified for this preliminary evaluation, the "combined" lung cancer risk model used in NIOSH-IREP v5.5.1 produced no PC increase in 825 claims. Of the 95 claims with an increased PC value at the upper 99th percentile credibility limit, the new PC for 84 of the 95 claims remained below 45% and will require no further evaluation. Thus, the evaluation is considered complete for a total of 909 (825 + 84) of the 920 evaluated claims.

For the remaining 11 claims in which the new PC increased to 45% or higher, further evaluation is necessary. Each of the 11 claims (7 "single cancer" claims and 4 "multiple cancer" claims) will be subjected to 30 IREP runs for each cancer to determine the arithmetic mean PC value for each claim. For the 4 "multiple cancer" claims, 30 runs will be performed for each cancer, both lung and non-lung, in order to establish arithmetic mean PC values for use in the multiple primary cancer equation. DOL will be notified of each claim for which a rework is needed. After the evaluation has been finalized, a Program Evaluation Report (PER) will be issued[a] and an itemized list of claims will be provided to DOL that will display claim-specific evaluation results.

Finally, upon completion of the PER, a notation will be added to the administrative record of each of the 920 evaluated claims indicating that the claim has been evaluated and reporting the effect, if any, upon PC as a result of the new combined lung model. Each notation will include the following form, appropriately annotated relevant to the effect on the claim:

NIOSH has determined that the application of the PER referenced above to this dose reconstruction would be to:

☐ Increase the probability of causation at the 99th percentile from <50% to ≥50%, therefore the claim has been reworked.

☐ Increase the probability of causation at the 99th percentile, but the resulting probability of causation would still be <50%, therefore no change is warranted at this time. Should this dose reconstruction be re-opened in the future, this change will be applied.

☐ Decrease the probability of causation at the 99th percentile. Since this dose reconstruction currently has a probability of causation less than 50%, no change is

[a] In accordance with PR-008, *Preparation of Program Evaluation Reports and Program Evaluation Plans*, the final evaluation will be issued as a Program Evaluation Report (PER). The PER will include the information contained in this PEP and the results of the final analysis of all cases that were evaluated.

warranted at this time. Should this dose reconstruction be re-opened in the future, this change will be applied.

4.0 References

1) Pierce DA, Sharp GB, Mabuchi K: Joint effects of radiation and smoking on lung cancer risk among atomic bomb survivors. Radiation Research 159: 511-520, 2003.

2) Land CE and Pierce DA. Likelihood profile for parameter alpha used in computation of statistical uncertainty for ERR/Sv in NIH-IREP lung cancer model. Personal communication from Charles Land (NIH/NCI) to NIOSH, February 3, 2004.

3) Apostoaei AI and Trabalka JR, SENES Oak Ridge, Inc. Differences in the estimation of lung cancer risk between NIOSH-IREP and NIH-IREP. September 20, 2004.