Office of Compensation Analysis and Support Program Evaluation Report	Document Number: OCAS-PER-005 Effective Date: 06/09/2006 Revision No. 0
Misinterpreted Application of the External Dose Factor for Hanford Dose Reconstructions	**Page 1 of 5**
Subject Expert: Gregory V. Macievic. PhD **Approval: Signature on File Date: 6/09/2006** **J.W. Neton, Associate Director for Science**	**Supersedes:** **None**

RECORD OF ISSUE/REVISIONS

ISSUE AUTHORIZATION DATE	EFFECTIVE DATE	REV. NO.	DESCRIPTION
06/09/2006	**06/09/2006**	0	New document to evaluate the programmatic effect of the misinterpreted application of the bias factor for Hanford Dose Reconstructions

1.0 Description

On June 29, 2005, an error in the interpretation of the Hanford External Dose Reconstruction Technical Basis Document (TBD)[(1)] was identified by OCAS during the course of dose reconstruction review. Prior to this date, the Hanford External Dose TBD was interpreted by ORAU to indicate that the energy employee's recorded dose was overestimated (bias) from 1944-1994 with bias values varying from 1.01 to 1.27 (Table 1).

Table 1: Hanford Bias Factors

Dosimeter	Period of Use	Bias	Estimated Range
Two-element film	1944 – 1957	1.27	1.13 - 1.60
Multi-element film	1958 – 1971	1.02	0.86 – 1.12
Hanford TLD	1972 - 1983	1.12	1.04 – 1.16
Hanford TLD	1984 – 1994	1.01	0.95 – 1.05
Commercial TLD	1995 - 2003	1.00	0.95 – 1.05

Other portions of the Hanford External TBD however, indicate that the response of the dosimeter changed significantly depending upon the photon energy spectra and could either underestimate or over estimate the true dose. Since the specifics of the exposure scenario would dictate either an over-response or an under-response, and since this information in generally not available, the OCAS TBD reviewers interpreted the Hanford External Dose TBD to conclude a claimant neutral position that no bias factor that reduced the recorded dose would be applied. The ORAU Dose Reconstruction Team came to a different conclusion from the same information and implemented the bias correction factor methodology into the Hanford Best Estimate Dose Reconstruction Tool / Template. This bias factor effectively reduced the recorded dose by the factors listed in Table 1.

It is important to note that not all Hanford cases completed to date have been affected by this misinterpretation. Only cases using the Hanford Best Estimate Dose Reconstruction Tool were affected. As of August 3, 2005, 1184 Hanford cases had been completed, and of these, only 115 (10%) used the best estimate tool which contained the error. The reason for the low number of cases was that the best estimate tool was not implemented until 5/3/2005. Of these 115 cases, 51 were still undergoing internal review and were subsequently returned to the initial dose reconstructor for rework (i.e. removal of the bias factor and recalculation of the external dose). Three cases were modified internally by the OCAS reviewers in the early stages of identifying this problem, thus the bias factor had been removed and the cases did not require further evaluation. An addition 18 cases only had employment in years for which the bias factor was 1.0 and therefore did not require further evaluation. Fourteen cases were compensable claims and, since the bias factor reduced the external dose, correcting the error would only increase the dose and further increase the probability of causation which was already greater than 50%. Thus, these cases also did not require further evaluation. Of the 115 cases, 31 required evaluation for potential impact on the probability of causation calculation. A graphical breakdown of the 115 cases is provided in Figure 1.

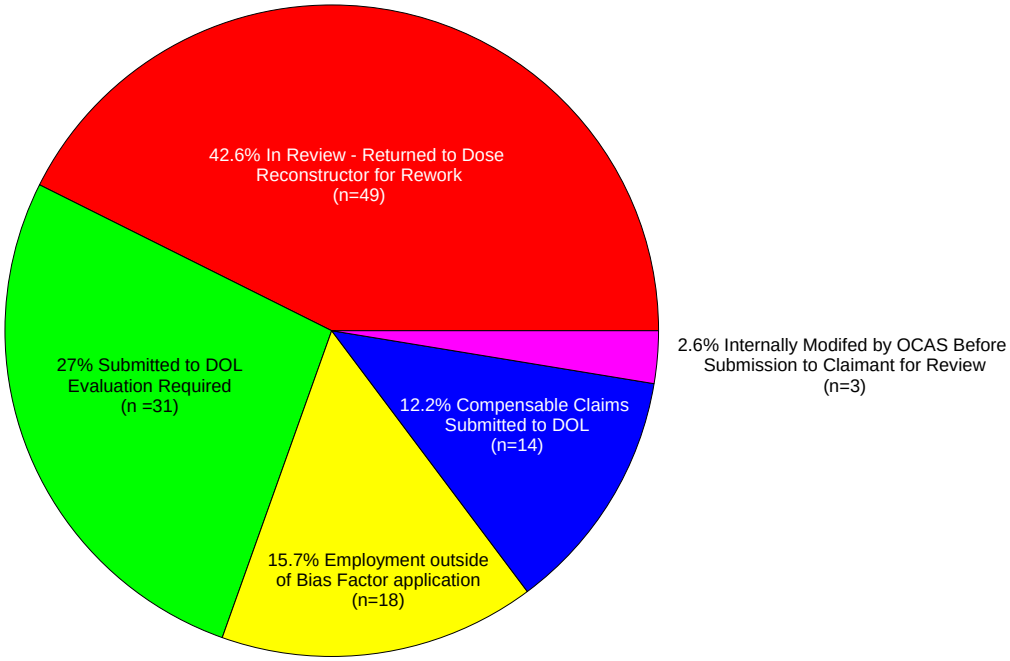

Figure 1: Distribution of Hanford Best Estimate Cases

2.0 Evaluation

2.1 Dose Evaluation

The application of this bias factor effectively reduced the recorded external dose by the values listed in Table 1. Thus, for the period 1944 to 1957, the recorded external doses were inadvertently reduced by 27%. During other time periods the magnitude of the reduction was significantly less, however, in this report all of the reductions have been evaluated. This evaluation, the external dose for each of the 31 cases was recalculated after the bias factor was removed. During the review, one case was found to contain a significant external dose reconstruction error (external dose uncertainty had not been incorporated into the dose reconstruction). Fortunately this case had not gone through the Department of Labor's final adjudication process and had been sent back to OCAS by DOL for rework due to an unrelated error in the initial employment information provided to OCAS. Since this case is currently being reworked, it was excluded from this evaluation. Of the 30 cases evaluated, the maximum increase in external dose was 4698 mrem and the minimum increase in external dose was 78 mrem.

2.2 Probability of Causation Evaluation

Since this magnitude of the dose reduction could have a significant effect on the probability of causation calculations, the probability of causation was recalculated for each cancer. The average increase in the 99th percentile of the probability of causation was 0.83% with a maximum of 2.65%. Figure 2 depicts the probability distribution of the change in PC values for the 30 cases. Table 2 provides a summary of the 30 remaining cases that were revaluated and the individual impact on the PC calculation. Note that all of the PC calculations both original and revised presented in Table 2 used NIOSH-IREP version 5.4.

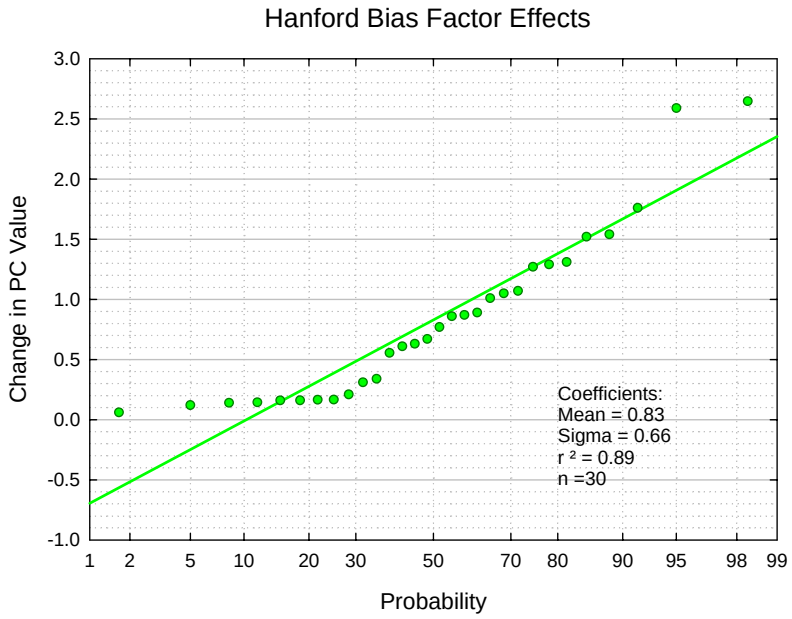

Figure 2: Normal Probability plot of change in the 99th percentile PC value

Table 2: Evaluation Summary of 30 cases submitted to the DOL

#	Cancer Type	Original PC (%)	Revised PC (%)	Change in PC (%)		Dose DR Report (rem)	External % of Total Dose	Original External Dose (rem)	Revised External Dose (rem)	Change in Dose (rem)
1	Bladder	40.69	41.56	0.87		54.360	95.0	51.631	54.067	2.436
2	Bladder	37.79	38.46	0.67		40.754	99.3	40.460	41.843	1.383
3	Bladder & Prostate	37.76	37.93	0.17		21.878	72.7	15.900	16.081	0.181
4	Esophageal	41.00	42.07	1.07		37.748	80.4	30.342	32.631	2.289
5	Esophageal	36.00	36.86	0.86		31.738	95.8	30.398	31.597	1.199
6	Hodgkin's Disease	27.37	28.00	0.63		35.293	89.5	31.593	33.322	1.729
7	Kidney	43.33	43.49	0.16		43.952	95.6	42.009	42.583	0.574
8	Leukemia	36.01	36.13	0.12		14.138	66.5	9.399	9.477	0.078
9	Lung	43.14	43.30	0.16		89.884	19.1	17.158	17.919	0.761
10	Lung	41.09	41.15	0.06		82.534	24.4	20.154	20.907	0.753
11	Lung	42.61	42.82	0.21		49.620	37.8	18.732	19.713	0.981
12	Lung	43.47	43.78	0.31		63.877	38.5	24.580	25.601	1.021
13	Lymphosarcoma	34.89	36.43	1.54		71.245	97.7	69.623	74.321	4.698
14	Malign. Fib. Histiocytoma	29.68	29.84	0.16		15.600	86.5	13.487	13.628	0.141
15	Multiple Cancers	41.80	44.45	2.65		8.551	98.7	8.442	8.717	0.275
16	Multiple Myeloma	28.87	30.14	1.27		53.213	65.7	34.942	38.340	3.398
17	Multiple Myeloma	17.68	18.45	0.77		43.947	60.1	26.420	28.141	1.721
18	Pancreatic	40.89	42.20	1.31		84.992	88.8	75.514	79.817	4.303
19	Prostate	29.65	30.66	1.01		44.701	99.2	44.341	46.242	1.901
20	Prostate	43.34	43.48	0.14		59.429	63.7	37.833	38.252	0.419
21	Prostate	41.66	43.18	1.52		71.822	79.2	56.864	60.473	3.609
22	Prostate	37.64	38.53	0.89		58.088	97.8	56.802	59.002	2.200
23	Prostate & Lymphoma	40.41	41.70	1.29		36.320	97.7	35.479	37.623	2.144
24	Prostate & Renal	39.83	40.38	0.55		22.696	92.5	20.993	21.647	0.654
25	Prostate & Skin Cancers	40.82	40.96	0.14		11.542	98.6	11.382	11.647	0.265
26	Rectum	21.50	22.11	0.61		57.663	81.2	46.838	48.721	1.883
27	Renal	29.40	31.16	1.76		25.169	97.5	24.542	26.826	2.284
28	Stomach	27.35	28.40	1.05		29.904	97.4	29.136	30.826	1.690
29	Thyroid	41.86	44.45	2.59		10.865	78.2	8.494	9.431	0.937
30	Thyroid	42.67	43.01	0.34		5.514	66.1	3.644	3.756	0.112
			Average	0.83						

Although all of the PC values increased as expected, all of the affected cases PC values were still less than 45%. Thus, no special consideration for 10,000 iterations was necessary. The range of the increase in PC was greatly affected by the magnitude of the energy employees original dose and the subsequent change in dose, the type of cancer, and the relative percentage that the external dose contributed to the total organ dose.

3.0 Resolution / Corrective Action

The immediate resolution to this problem was to implement the provisions of the TBD correctly. Thus, the ORAU removed the bias factor from the Hanford Best Estimate Dose Reconstruction Tool and all active claims in review were returned to the ORAU team for rework.

Concurrently, all claims submitted to DOL were reevaluated as described above. Although the external dose increased in each case, the increase in PC value was insufficient to change the compensability decision (i.e. all modified PC values remained less than 45%).

4.0 Summary

An error in interpretation and application of the bias factor information in the Hanford External Dose Reconstruction Technical Basis Document[(1)] resulted in an underestimate of the external dose for certain Hanford claims. Claims that were potentially affected by this error were identified and those that had not already been submitted to the Department of Labor were returned to the ORAU team for rework. The cases that had been submitted to DOL were reevaluated by removing the bias factor, thus developing a revised external dose. The probability of causation (PC) for each of the affected claims was recalculated. This evaluation found that although this error appeared upon discovery to be rather significant, there was no impact on compensation decisions made by the Department of Labor.

5.0 References

1. ORAU Team, Technical Basis Document for the Hanford Site – Occupational External Dosimetry, ORAUT-TKBS-0006-6 Rev 01 (2004).