MEMO

DATE: April 21, 2015

TO: KCP Work Group

FROM: Ron Buchanan, SC&A

SUBJECT: SC&A's Evaluation and Closure of KCP SEC Matrix Issues 11 and 12; Neutron Dose

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In January 2015, NIOSH provided a response to the Kansas City Plant (KCP) Special Exposure Cohort (SEC) neutron dose issue concerning the use of the neutron-to-photon ratio (n/p) method by stating at the end of Matrix Issue #11, "*After further evaluation, OTIB-24 Estimation of Neutron Dose Rates from Alpha-Neutron Reactions in Uranium and Thorium Compounds, is not appropriate and should not be used to estimate neutron dose at KCP*." Instead, NIOSH has addressed (at the end of Issue 12) the neutron dose issue by applying an annual neutron dose to KCP workers that may have been exposed to neutrons as follows:

> ***NIOSH status for January 20, 2015 WG:*** *As indicated in the previously submitted response to Issues Matrix #11, the neutron sources at the KCP appear to be confined to Ra-Be/Pu-Be sources and neutron generators. The sources produce an average neutron energy of 3.6 MeV (Ra-Be) and 4.2–5.0 MeV (Pu-Be) whereas the neutron generators produced a neutron energy of 14.7 MeV. Typically, NTA film has a neutron energy-response threshold of 0.5 MeV and would be able to detect the neutrons emitted by KCP sources/generators.*
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> *In 1993, an appraisal of Radiation Protection was performed at KCP (SRDB 111275) to evaluate their compliance with DOE Order 5480.11, DOE RadCon Manual, and applicable occupational radiation protection standards and practices. The appraisal found that users of radiation generating equipment were assigned neutron dosimeters, but there had been no measurable neutron doses in three years or on an area dosimeter that had been in a worst-case location for three months. The appraisal indicates that removal of the neutron badges appears to be justified based on the historical information that less than 0.100 rem would be received.*
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> *The sources of neutrons at KCP are essentially the same throughout KCP operations and annual doses are likely less than 0.100 rem (the dosimetry data reviewed from the site confirms that doses greater than 0.100 rem are very infrequent). Since the predominant neutron energy is well above 0.5 MeV, a correction factor (which is applied at other sites with lower energy neutrons) is not needed. The dosimetry records from the site were reviewed and they consisted of 13,745 entries, of which 2,188 had neutron monitoring (35 with recorded positive neutron dose, remaining all had zero recorded neutron dose). Three dosimetry records were greater than 0.100 rem (0.200 rem in 1966, 0.180*

rem in 1988, 0.140 rem in 1970). The 95th percentile dose of the dosimetry records with recorded neutron dose (limited set of 35 records) results in a value of 0.154 rem. To account for unmonitored neutron dose that may have been received, a bounding assignment of 0.154 rem/year neutron could be assigned for unmonitored workers who worked with neutron sources or neutron-generating devices as indicated in the CATI or other available DOL/DOE information. This dose should be assigned using the 2–20 MeV energy range. This approach is an overestimate for unmonitored employees and should be assigned as a constant distribution.

SC&A evaluated the document containing the neutron exposure records at the KCP (*Worker Exposure History* on the K-drive) and NIOSH's January 2015 response and found:

- There were 34 records of positive annual neutron dose (1966–1996), and over 2,000 records of annual neutron dose with zero entries (1965–2010)
- The 34 positive annual neutron recorded doses range from 0.003 rem to 0.200 rem, with all but three readings less than 0.100 rem.
- The top three annual neutron dose readings were 0.140 rem (1970), 0.180 rem (1988), and 0.200 rem (1966).
- The 95th percentile neutron dose was approximately 0.154 rem/year.

In view of this analysis, SC&A found that NIOSH's use of a neutron dose of 0.154 rem/year for KCP workers that may have been exposed to neutrons is reasonable and claimant favorable. SC&A considers the present KCP SEC neutron dose-related issues addressed and the issues have been closed by the Advisory Board.