KANSAS CITY PLANT SPECIAL EXPOSURE COHORT (SEC 210) ISSUES MATRIX

No.	SEC Issue	Post-data capture	NIOSH response
1	**Data Completeness, Legibility, and Accuracy –** SC&A has not found that the completeness and accuracy of the recorded bioassay and external exposure records, as well as the electronic database, has been verified for the KCP. This is especially important because of the lack of general periodic or routine monitoring for KCP workers, and also because of the lack of legibility of some of the records. This issue applies to both bioassays and external dose records.	*a) Prior to the KCP visit, during an analysis of some of the claimant recorded dose files, SC&A found that approximately 50% of the images on NOCTS had questionable readability. Therefore, SC&A evaluated the situation during the KCP visit and found that the original files exist, appear to be legible, and are available for DR if needed. If the dose reconstructor has any problems reading the external or bioassay records, the dose reconstructor can contact the KCP and obtain a legible copy. b) During the KCP visit,* [KCP HP] *agreed to provide NIOSH with a summary of the QA/QC methodology used to audit the transfer of the written external and bioassay records to the electronic database. NIOSH has agreed to provide a copy of that summary to SC&A when it becomes available. SC&A will then evaluate the process.*	The KCP health physicist (HP) was interviewed and questioned by SC&A, Board members and NIOSH regarding this issue at the May 2014 KCP site visit. Photocopied images were shown to interviewers on the HP's computer monitor and it was demonstrated that legible, accurate records are available. Efforts to acquire additional urinalysis records are ongoing. NIOSH has reviewed several documents that indicate urinalysis was performed beginning in 1951, and that those samples were analyzed by LANL. NIOSH has received an example urinalysis from an employee's medical file, and the Team is getting access to the LAHDRA holdings to search for additional records. There are also some other classified urinalyses listings that NIOSH is attempting to capture.
	June 10, 2014 WG: Remaining issue is (b) above; NIOSH will provide a copy of a summary of QA/QC methodology used for transfer of recorded external and bioassay records to electronic database when received from [KCP HP].		
	NIOSH status for January 20, 2015 WG: KCP has not been able to locate documentation of the QA/QC methodology used during the copying of external and bioassay records into the electronic database. However, the raw-data records used to create the database remain available to NIOSH for use on DRs and coworker modeling.		
	ACTION for January 20, 2015 WG: NIOSH committed to provide the WG with a proposed sampling plan for how it intends to validate the electronic database with the raw records for both internal and external dose (the latter is also addressed in matrix issue #9, below). Following WG agreement, NIOSH would conduct the sampling review and provide results.		

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No.	SEC Issue	Post-data capture	NIOSH response
2	**Worker Location, Job Category, and Coworker Model –** Because of the varied historic operations at the KCP, coupled with the lack of specific worker locations and job categories, the application of coworker or generalized technical basis document derived doses could result in incorrect dose assignments. This could involve a relatively large number of workers because in many cases there is a lack of (or illegible) bioassay and/or external dose records. Therefore, the adequacy and completeness of the available data used for the coworker model need to be addressed, along with their applicability to different categories of workers.	*Based on 5/5-8/14 KCP interviews, there were conflicting accounts of how freely workers "on the plant floor" were able to move from one department to another. One interviewee recollected moving from job to job, while another disagreed, noting that the union restricted such movement. Based on past interviews, the organizational codes did not necessarily match the assigned jobs, which could change over time; however, the distinction between operators, supervisors, and administrative staff was seen as clear. There appears to be a clear delineation and access restriction afforded the operating area containing the natural and depleted uranium work (Depts. 20 and 26). While some scanned records on the SRDB are not legible, the original records are readable. Further review warranted to ascertain whether worker location and job category are sufficiently distinguishable for coworker modelling.*	This is primarily a TBD issue and NIOSH is planning a revision to the TBD. The adequacy and completeness of the available data are being addressed in issue 1 above. Interviewees during the May 2014 visit indicated that historic radiological operations were not that varied (e.g. five separate operations), and that personnel movement throughout the radiological facility was limited. A better understanding of these classified operations is desirable; however, NIOSH has not received any new information that thus far appears to conflict with the bounding assumptions documented in the SEC00210 Evaluation Report (ER).
	June 10, 2014 WG: Remaining issue revolves around application of coworker model to KCP worker categories. Additional bioassay records have been requested by NIOSH (as part of medical records) and a future site visit will be scheduled to obtain additional information regarding the adequacy and completeness of available data used for the coworker model, along with applicability to various job categories.		
	NIOSH status for January 20, 2015 WG: After the writing of the ER, NIOSH became aware of additional bioassay monitoring that was performed by Los Alamos for KCP (128346). NIOSH worked with the KCP HP to locate any records of this previously unknown monitoring, and on May 15, 2014, the KCP HP uncovered one such record. Learning from this approach, NIOSH compiled a list of employee names from access lists for the Model Shop and Project Royal. That list of 550 names was submitted to KCP as part of the data request prior to the October 2014 site visit. As a result, additional bioassay records that were filed with medical records were retrieved by NIOSH, and 164 new medical examination and hospital card entries were made to the SRDB. These documents, along with additional information regarding the adequacy and completeness of data used for a coworker model and its applicability to various job categories, were also retrieved and will be incorporated in the next TBD revision.		

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No.	SEC Issue	Post-data capture	NIOSH response
	TBD ISSUE: The WG has combined matrix issues #2 and #3, and agrees that they can be considered TBD issues and moved to the site profile matrix for later review.		
3	**Chronic vs. Acute –** Default chronic pattern of intake used in the uranium coworker model, apparently being applied to most KCP workers, may not be applicable to a large number of them. SC&A's review of actual claims reveals that workers that have legible bioassay records show patterns of excretion rates that indicate that the coworker model may not be necessarily claimant favorable for all workers.	*The operational information obtained during the KCP visit indicates that there was the potential for acute intakes, i.e., not all operations were continuous steady-state production processes. Therefore, this issue remains open as an internal dose reconstruction issue that NIOSH should address. Additionally, the cause of the generally higher bioassay reading for 1960–1961 warrants further investigation.*	This is primarily a TBD issue and NIOSH is planning a revision to the TBD. The ER does not make use of the TBD's coworker model. The TBD 6000 Working Group has also generically addressed these chronic vs. acute coworker model issues.
	June 10, 2014 WG: Work group agreed that question regarding chronic versus acute intake patterns does not represent an SEC issue and can be accommodated by the TBD 6000 model. The issue of unexplained higher bioassay readings in 1960–1961 will be addressed under matrix issue #18, as part of review of KCP incidents. The work group decided to <u>hold matrix issue #3 in abeyance</u> pending further discussion of an internal coworker model for KCP (NIOSH indicates above that it does not make use of TBD's coworker model in the ER) and whether scope of worker category coverage is adequate.		
	TBD ISSUE: The WG has combined matrix issues #2 and #3, and agrees that they can be considered TBD issues and moved to the site profile matrix for later review.		
4	**Super S Uranium –** Type S, high-fired uranium oxide (UO_2) may have been handled at KCP and needs to be addressed in terms of : 1) source term and exposure potential; and 2) how solubility factors will be addressed. [Note: confirmation of Type S uranium would not confound dose estimation – requires explicit acknowledgment in site profile).	*While it was likely that some of the uranium handled at KCP was "high fired," there is no clear evidence of insolubility that would preclude dose reconstruction with sufficient accuracy. Previously addressed by Board for Y-12 and INL; no dose reconstruction concerns concluded. <u>Recommend closure by the work group.</u>*	NIOSH does not need to address a high-fired uranium oxide source-term and exposure potential separately from other KCP uranium work because SC&A has previously agreed with NIOSH that high-fired uranium oxide is adequately bounded by the Type S solubility class (see, *White Paper – SC&A Review of LBNL Issue #3, dated 9/5/12*).

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No.	SEC Issue	Post-data capture	NIOSH response
	June 10, 2014 WG: Work group **closed** this matrix issue.		
5	**Recycled Uranium -** SC&A is aware of the potential for even DU to include recycled uranium once Hanford established its recycling program in the early 1950s. A cursory search of available documents did not reveal explicit mention of KCP as a recipient, but the potential for trace contaminants may exist. Therefore, the potential for exposure to radionuclides from recycled uranium at the KCP needs to be addressed. [Note: confirmation of recycled uranium by itself would not confound dose estimation – issue is explicit acknowledgment as source term).	*It is the standing position of NIOSH to assume the presence of recycled uranium beginning in the mid-1950s and to account for it in dose reconstruction. TBD 6000, for example, addresses recycled uranium in its model calculations. NIOSH will assume recycled uranium was present at KCP and dose reconstruct, accordingly. Recommend closure by the work group.*	TBD-6000 Section 2.3 identifies 1952 as the start of RU availability. The bounding methodology used during uranium work after 1952 includes the exposure contribution from RU nuclides. This was implied by reference in the ER to TBD 6000. [Section 3.1, page 19, discusses how RU is addressed, with Table 3.2 providing the assumed nuclide mix].
	June 10, 2014 WG: Work group **closed** this matrix issue.		
6	**DU After 1971 and During and After 1997 -** The nature and extent of work with depleted uranium after 1971 and again during and after 1997, as well as any intakes that may have resulted, remain to be adequately established.	*An interview conducted during 5/5-8/14 KCP visit, indicates that uranium machining equipment remained in place and was not D&D'd until 1975. Depleted uranium "ballast" parts were used in the KCP telemetry program in the 1980s (and possibly beyond) and show up in KCP waste inventory; not clear if they were fabricated onsite. Further review of "ballast" source term activity warranted.*	NIOSH requests that SC&A be more specific as to the DU work information missing from the ER after 1971 to the end of the evaluated period (12/31/93). NIOSH is not aware of any DU work that is not bounded by the methods documented in the ER. The period after 1993 did not qualify for evaluation.
	June 10, 2014 WG: NIOSH and SC&A to review more information related to DU ballast parts and other potential source terms identified in KCP documentation, e.g., weekly activity reports and SWIMS. [Proposal for ORAUT to send team to KCP to capture these document sets].		

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No.	SEC Issue	Post-data capture	NIOSH response

NIOSH status for January 20, 2015 WG: DU ballasts were not specifically addressed in the ER; therefore, NIOSH was interested to discover if they were machined or if they otherwise introduced a new exposure pathway at KCP. NIOSH consulted the literature to gain an understanding of how DU ballasts may have been used at KCP, and found the following in NUREG 1717, Section 3.17. Counterweights or ballasts made of DU are used for military ballast and counterweight applications. DU counterweights may be used as anti-flutter devices in missile test applications, and have been used in the Trident missile program.

NIOSH collaborated with SC&A and the Board in advance of the October 2014 visit to generate search terms used to locate records related to DU ballast parts and other radioactive source-terms. The site-visit team reviewed these records, retrieved activity reports, SWIMS and other documents that provide detailed information regarding DU ballasts. However, there were no additional source-terms identified beyond those previously discussed in this Issues Matrix.

NIOSH reviewed documents that showed ballast parts ordered from ORNL and procedures for the safe handling and assembling of ballast parts (137064, 128378). NIOSH also reviewed records where DU ballasts appear in KCP's waste stream. It is noteworthy that when the term "ballast" appears in waste records it is with the descriptors "pieces" and or "parts" (e.g. 128402 pp. 45, and 137081), instead of what appears in other known machining processes such as the Mg-Th work where the descriptors include "turnings" and "machining waste" (e.g. 134675, pp. 98).

In light of documents recently reviewed by NIOSH, and classified discussions with Nelson Beard, it is apparent that KCP activities with DU ballasts included only the installation of pieces/parts and not on-site machining. Therefore, NIOSH concludes that the ER's DU bounding methods are also adequate for this additional DU work.

NIOSH and SC&A confirmed to the WG that DU ballast parts were fabricated offsite and would not have presented an exposure potential for workers handling them at KCP. No other DU materials unaddressed by the ER were identified during recent onsite data captures. Accordingly, the work group closed this matrix issue.

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No.	SEC Issue	Post-data capture	NIOSH response
7	**Radioactive Waste -** Further evaluation is warranted in regard to the processes and isotopes contributing to liquid radioactive waste shipments from the Kansas City Plant, the time period during which these activities and shipments occurred, and the potential for unmonitored internal exposures from spills, leaks, cleanup, and routine handling/storage of contaminated drums.	*Several KCP interviews on 5/5-8/14 indicated that DU and MgTh turnings were collected in small barrels with oil, and staged in a "dump room" for disposition. Interviewees did not recall instances of leakage or contamination from these drums or from the waste disposal process, itself. However, LANL documentation indicates instances of leakage upon receipt. Further review is warranted, with a particular focus on whether leakage was limited to uranium.*	NIOSH has reviewed liquid radioactive waste shipment records (e.g. SRDB 123835). More records [Solid Waste Information Management System (SWIMS)] have also been requested (SWIMS example SRDB 123881). NIOSH is not aware of any processes or unmonitored internal exposures from spills, leaks, cleanup and routine handling/storage of contaminated drums that are inadequately bounded with the methodologies described in the ER utilizing models developed with approved TIBs and TBD 6000.
	June 10, 2014 WG: NIOSH and SC&A to review weekly activity reports, SWIMS and available waste disposition records (KCP and LANL) to ascertain radiological waste composition, timeframes and exposure potential. [Proposal for ORAUT to send team to KCP to capture at least first two document sets].		

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No.	SEC Issue	Post-data capture	NIOSH response
	NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 visit to generate search terms used to locate waste disposition records. The site-visit team reviewed these records, retrieved activity reports, SWIMS and other documents that provide detailed information regarding radiological waste composition, timeframes and exposure potential. Because of this recently obtained information and further research, NIOSH has developed a better understanding of KCP's waste types, volumes and disposition methods. Examples include, Department 20 D&D waste shipment information (128412, 128419, 137067, 137033, p. 6 and 137081, p. 14, 137045, p. 24), and that KCP's irradiated waste was created by Sandia (134514, p. 14). NIOSH has also reviewed KCP's Waste Management Implementation Plan (128145, p. 76), and found documents that corroborated information obtained during employee interviews. Specifically, maps and details about waste stored in a converted jet engine test cell, and at the "Red X lot" (128145, pp. 46, 71, 86, 89, 91). Other documents besides the SWIMS that NIOSH found informative included the Radioactive Waste Management Site Plans (128375, 128413, 128414, 128415, and 137045) that provide an annual summary of waste generating activities. For example, they describe the amount of waste generated in cubic feet per year, and document a running total of waste stored on-site. Note: The SRDB Ref. IDs provided are not an all-inclusive listing of the information now available on this topic. Records indicate that KCP's routine waste generation was minimal and that waste shipments were typically made every two years (137081, p. 16). There were many years where a waste shipment was not necessary (137080, p. 5). In fact, there was no waste shipped from June 26, 1974 to 1979 (128375, p. 8 and 137080 p. 31). There are communications to the DOE that describe the amount of low-level radioactive waste generated at KCP as "essentially insignificant" (134675, p. 14). Generation rates at this time were one barrel (134675, p. 96) or 0.283 cubic meters per year (137094, p. 78). NIOSH did observe some years where shipments were not routine and larger, explained by the end of KCP's primary DU machining campaign or the D/20 D&D (e.g. 21 barrels in 1979; 134514, p. 46). As part of this review, NIOSH did not discover any new information that suggests KCP's waste generating and disposition activities presented exposure pathways that were not bounded by the ER's methodology.		

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No.	SEC Issue	Post-data capture	NIOSH response

January 20, 2015 WG: SC&A indicated that the waste generation characterization provided by NIOSH is only true after the early 1970s; hundreds of drums were shipped per year from the late 1950s through early 1970s, particularly during the active DU operational period (1960–1972) (see SRDB 123806, 38160, as detailed below). KCP began shipping radwaste to LANL on 3/29/59 (SRDB 38160). In response to WG's request: Waste composition: DU, "laboratory wastes," including sources, equipment, some Th-232 oxide (SRDB 108241); Timeframes: (SRDB 123806) — based on available manifests located (appear incomplete). Exposure potential: Minor contamination found on trucks and on drums of Jan 1962 shipment of 355 drums from KCP to LASL for burial. No evidence of KCP worker exposure; no evidence of drum contamination (other than isolated) after 1962 incident, following KCP program response to LANL complaints.

SC&A cited a sampling of shipments for a 10-year period:

- 1961: 56 drums + 150 "barrels" classified + 295 "containers" of contaminated/radwaste material
- 1962 **(JAN):** 137 drums (55 gal) + 218 drums (20 gal)*; **(APR):** 99 drums (55 gal) + 69 drums (15 gal); **(MAY)**: 123 drums (55 gal) + 12 drums (15 gal)
- 1964: **(MAY):** 111 + 51 + 55 drums/containers **(AUG):** 112 drums radwaste + 3 boxes
- 1965: 111 drums radwaste
- 1966: 87 + 158 = 245 drums radwaste
- 1967: 124 drums radwaste
- 1968: 60 + 127 = 187 drums of radwaste
- 1969: 2 truckloads of classified/radwaste (17 drums radwaste, classified waste drums)
- 1970: 2 truckloads of classified/radwaste

While SC&A disagrees with the NIOSH characterization of waste shipment frequency and volumes as it applies to 1959–early 1970s, we find that the one major contamination experienced at LASL appears to have been isolated and spurred KCP to take comprehensive actions to eliminate future contamination. No evidence exists that the contamination involved in the one incident led to worker exposure at KCP or LASL. Review of KCP procedures and records for radwaste handling have yet to surface any reports of contamination or exposures.

ACTION: The WG considers this issue open pending additional document searches and worker interviews for information regarding KCP radwaste handling in the 1960s, as well as in the 1980s, with specific attention to whether there existed a radwaste handling group, or whether project personnel handled radwaste during these time periods (names of contact personnel were identified at the WG meeting; it was also mentioned by a former worker present at the WG meeting that personnel handling waste in the 1980s were disqualified from further work because they were deemed illiterate by KCP management).

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No.	SEC Issue	Post-data capture	NIOSH response
8	**Metal Tritides –** It needs to be established the degree to which metal tritides were present and how doses would be reconstructed to account for this potential source of exposure, with particular attention to any incidents that may have occurred (i.e., only one isolated incident?).	*KCP interview of 5/5-8/14 indicates that several types of metal tritides were likely handled at KCP in sealed components. Historically, there appears to be only one instance where a component leaked, resulting in tritium contamination involving erbium tritide in 1987, but with no evidence of intake. Further review is warranted of incident records to confirm no evidence of contamination involving tritium and tritide containing components.*	Interviews conducted during the May 2014 site visit confirmed that the presence of metal tritides at KCP wase solely related to contaminated parts being returned without adequate decontamination. A second occurrence of metal tritide contamination at KCP was described by an interviewee, and records of that occurrence will be reviewed by NIOSH.
	June 10, 2014 WG: NIOSH and SC&A to review weekly activity reports and other information sources to ascertain the frequency and exposure potential for metal tritides at KCP. [Proposal for ORAUT to send team to KCP to capture weekly activity reports].		
	NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 visit to generate search terms used to locate metal tritide records. The site-visit team reviewed these records, retrieved activity reports and other documents that provide detailed information regarding frequency and exposure potential for metal tritides. NIOSH reviewed reports of weapon's test assemblies contaminated with low levels of tritides during testing at Pantex and Sandia. There is a timeline of events and decisions that KCP, Pantex and Sandia undertook to ensure these assemblies were decontaminated prior to their return to KCP (123923, p. 65). Representatives from each site participated in a demonstration of decontamination techniques in April of 1984 at Pantex (123923, p. 40). KCP established an acceptance testing protocol where assemblies were surveyed upon arrival and compared to the shipper's survey results (e.g., 123862, p. 51). Records of these contamination surveys performed by KCP's consultant health physicist (Benjamin Friesen, PhD) are available (e.g., 123862, pp. 69, 88) There are reports of four instances where contamination greater than 100 dpm/100 cm^2 was detected at KCP during acceptance tests in 1985 and 1988 (123862, pp. 30, 97, 143). There are three other events described as unusual occurrences where low-levels of contamination were discovered at KCP from 1987 to 1990 (108267; 128248, p. 8; 128248, p. 15). Because of these three unusual occurrences, the problem was elevated to the attention of the resident authority (senior DOE officials), and a meeting with the Albuquerque and Kansas City Area Managers was held in October of 1990 to discuss the problem (123923, p. 51). After this meeting, KCP, Sandia and Pantex revised their procedures to prevent future occurrences, and NIOSH has not found evidence of additional tritide contamination finds at KCP after these procedural upgrades.		

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No.	SEC Issue	Post-data capture	NIOSH response
	January 20, 2015 WG: SC&A agreed that the exposure potential at KCP to metal tritide contamination was minimal and isolated, with no evidence of worker uptake. Accordingly, the WG <u>closed</u> this issue.		
9	**External Coworker Dose –** Legibility, accuracy, and completeness of the databases (original and electronic) for use in developing a coworker external dose model has not been verified. Preliminary review indicates the lack of legibility and raises questions concerning the completeness of the external dose records	*a) See Issue #1 above concerning QA/QC of transferred data.* *b) To date, neither NIOSH nor SC&A has found the reason for all the recorded external doses for 1969 being zero. During the KCP visit,* [KCP HP] *agreed to try to determine the cause of the records for 1969 being all zero.* [KCP HP] *will contact SC&A if he finds anything.*	The legibility of monitoring records was verified during the May 2014 site visit and NIOSH is satisfied that there are methods available to obtain reliable monitoring results.
	June 10, 2014 WG: SC&A awaiting communication from [KCP HP] regarding status of 1969 records, which may require further follow-up review.		
	NIOSH status for January 20, 2015 WG: NIOSH has located a document that independently confirms a zero dose for 1969 (137215, p. 19). KCP to date has not been able to locate the Eberline reports from 1969, and has been notified that Eberline's successor, Thermo Fisher, does not maintain copies of records as far back as 1969.		
	ACTION for January 20, 2015 WG: The same as for matrix issue #1, with NIOSH to develop and provide a plan on how it will validate the KCP electronic record for external doses with original raw records.		
10	**Non-penetrating Dose -** It appears that there are periods (especially 1950–1963) where the details of non-penetrating exposure, dose, and records are lacking, making it difficult to evaluate non-penetrating doses to workers and for developing a coworker model.	*SC&A's research of KCP claims files indicates that before 1964, there was a column labeled "RADS" that may have been used for recording of the beta dose. However, this has not been addressed in the ER or site profile documents. The relationship between recorded RADS, ROENTGENS, REM, and BETA RAD, as recorded at the KCP, needs to be defined, and how these quantities will be applied during DR (i.e., how will the non-penetrating dose be calculated from the recorded data) to determine if appropriate data were recorded for DR purposes.*	The ER provides a method to place an upper bound on non-penetrating doses with sufficient accuracy. NIOSH is aware of the dosimetry used from 1950 to 1963, and that KCP records show 5,000 entries for non-penetrating doses during this time. NIOSH is satisfied that the maximally exposed work group and work scenario are represented with the available data, and can bound doses to others in the evaluated class with their data.

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No.	SEC Issue	Post-data capture	NIOSH response

June 10, 2014 WG: NIOSH to arrange technical call between Matt Smith, ORAUT, and Ron Buchanan, SC&A, regarding the following specific, outstanding questions, prior to 1964: [Notes from call and subsequent written statement of issue disposition from NIOSH will be needed for work group review].

1) *Is the "Shallow" dose (such as listed in Column F of the SRDB Ref ID#14707) being derived from the values in the "RADS" column of the original data cards?*
2) *Which column in the original data cards is the 'Deep" dose (such as listed in Column D of the SRDB Ref ID#14707) being derived from; the "ROENTGENS" or from the "REM" column of the original data cards?*
3) *For DR purposes, is the non-penetrating dose being determined by NP = (RAD-Deep) dose?*

This clarification is needed because the details of non-penetrating dose assignments are not covered in the TBD or ER.

NIOSH status for January 20, 2015 WG: The technical call between Matt Smith, ORAUT, and Ron Buchanan, SC&A, was conducted on 7/22/14. The notes from that call were sent to the Work Group by Pete Darnell on 7/31/14.

The following Action Item was created during the technical call on 7/22/14:

NIOSH will provide a summary of their analysis of external dose record terms and what data values are used for DR purposes.

The hand-entered film-badge dosimetry data (typically seen prior to 1965) had several columns labeled "RADS," "ROENT." and "REM." After reviewing the derivation of these values and information provided by site personnel, it is determined that the columns can be defined and are used by the Dose Reconstructors as follows:

RADS = Open Window (gamma/x-ray + beta)
ROENT. = Shielded (gamma/x-ray)
REM = RADS + ROENT. NOTE: The REM value is a total of the RADS and ROENT. values and is not used by the dose reconstructor.
Historically, dose reconstructors have been assigning the RAD value for non-penetrating dose. This is a claimant-favorable approach.

NIOSH will also add this analysis of the pre-1965 data to the next revision of the TBD.

TBD ISSUE: The WG agreed that the external dose record terms in question can be clarified and included in an update of the TBD. Accordingly, this issue is moved to the site profile issues matrix.

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No.	SEC Issue	Post-data capture	NIOSH response
11	**N/P issues –** The KCP neutron-to-photon (n/p) ratios as recommended by NIOSH are not technically correct and require additional investigation in order to develop a technically sound approach for dose reconstruction.	*NIOSH's proposed method is not technically correct. This is still an issue that NIOSH needs to address.*	Based on OTIB-024, the n/p ratio for alpha reaction in uranium and thorium would result in n/p ratios less than one; therefore, the ratio stated in the ER is bounding. The KCP Site Profile advises the use of an n/p ratio approach rather than the use of NTA film with a correction factor for neutron dose assignment. The data used to recommend the n/p ratio of one are from the post-NTA film era, as noted in Section 6.4.3 of the Site Profile. The occurrence of positive neutron dose during the post-NTA era is very rare, indicating a low potential for neutron exposure. It is also noted (from Table 4 in the Site Profile) that the same neutron sources were operational during the NTA and post-NTA dosimetry eras; therefore, using the modern data set to recommend an n/p ratio for the earlier era should be valid.
	June 10, 2014 WG: NIOSH agreed that it is not clear what neutron sources were being measured with the NTA film and that OTIB-024 is not an appropriate basis for deriving n/p ratios. NIOSH will review these issues and provide the results of its review to the work group.		

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No.	SEC Issue	Post-data capture	NIOSH response

NIOSH status for January 20, 2015 WG: The SRDB was searched for information related to neutron radiation at Kansas City Plant. The documents located generally corroborated the information provided in the KCP Site Profile, though some neutron sources were found to have arrived at the site earlier than stated in the site profile. Neutron generators were in use at the plant in the Test Laboratory. The sources of neutron radiation are described below:

- A Ra-Be source (20.48 milligrams) was used by Sandia workers while working at KCP January 19–20, 1955. Ra-Be sources typically produce an average neutron energy of 3.6 MeV.
- A Ra-Be source (10 milligrams) was received on July 20, 1962.
- A Pu-Be source was received on May 11, 1964, from General Atomics. This source was unusually strong at 10 Ci. Pu-Be sources typically produce average neutron energy ranging from 4.2–5.0 MeV.
- A Pu-Be source (73 mCi) was used from 1966–2004 for Boron-10 analysis.
- There were several neutron generators used (unable to determine the first period of use, but likely used in 1959). The generators identified were a Kaman Model A-800, A-850 and a GE U5493 (the GE neutron generator was delivered on July 1, 1984, and is assumed to be in use shortly after this time). The neutron energy associated with these generators was 14.7 MeV. It is indicated in 1968 that the maximum weekly exposure is 500 pulses. In 1972, measurements of the external surfaces were performed using a Texas Nuclear Neutron Dosimeter System (Model 9140) and provided the following measurements: Cabinet surface highest reading – 0.062 mrem/700 pulses and Operator Position highest reading – 0.060 mrem/700 pulses. Later, quarterly badge measurements (1990s) taken at 14 and 16 inches from the neutron output indicated the highest average pulse dose of 0.040 mrem/pulse. An additional measurement (location of measurement not provided) indicated a dose of 0.79 mrem/pulse at 10 cm from the Kaman Model A-800 neutron generator.

After further evaluation, OTIB-0024, *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.

January 20, 2015 WG: SC&A noted that while the use of only 3 data points is not desirable, statistically, the fact that 32 positive readings were less than these 3 data points, and there were 2,153 recorded zeros for neutrons, and considering the low potential for exposure to neutrons at the KCP, this is very likely (although not statistically strong) a claimant-favorable method.

ACTION: While SC&A indicated its satisfaction with the methodology proposed, the WG agreed that SC&A should have the opportunity to firsthand review the 35 data points from which neutron dose estimation will be based at KCP. NIOSH will provide (or identify location of) the 35 data points in question to SC&A, with SC&A to report back to the WG and NIOSH its conclusions, including any remaining questions and comments.

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No.	SEC Issue	Post-data capture	NIOSH response
12	**Fading of NTA -** The fading of the NTA film as a function of time, temperature, and humidity has not been addressed, nor were there any correction factors provided. Lower-energy moderated neutrons could have gone undetected, and if detected, would show even more fading as compared to the higher-energy neutrons, such as those used for calibrating the NTA film. Quarterly exchange of NTA film, such as was used at KCP, can result in complete loss of countable track and yield zero dose recordings for low-level and/or low-energy neutron exposures. These factors could be indicative of why there were very few recorded neutron doses, and insufficient data to derive a technically sound n/p value.	*During the KCP visit, records of outside vendor neutron dosimetry were located. Most of the results were recorded as minimum detectable level (M). However, with quarterly exchanges, the fading of NTA film tracks could significantly contribute to positive doses not being recorded. NTA film fading and its impact on DR is still an issue that NIOSH needs to address.*	The NTA film fading is a common issue and has been discussed at multiple sites. A correction factor could be developed for KCP; however, it would take significant research and may not be justifiable since essentially all the neutron doses during the NTA era are "zero." NIOSH will perform dose reconstructions using data from the post-NTA era and will not use the NTA data.
	June 10, 2014 WG: Similar to its response to matrix issue #11, NIOSH will reevaluate what neutron sources were being measured by NTA film and determine whether and what correction factor is appropriate. It is not clear, given this question, whether the "zero" readings are real or not.		

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No.	SEC Issue	Post-data capture	NIOSH response

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.

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 3 years or on an area dosimeter that had been in a worst-case location for 3 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.

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 confirm 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.

January 20, 2015 WG: SC&A agrees that because of the relatively high energy of the neutron sources and the methods in which they were utilized, the potential neutron fields at the KCP would not contain significant doses of low-energy moderated neutrons. Therefore, cut-off response and fading would not be a major issue for NTA film as it would be at reactors or heavily moderated medium-energy neutron sources. Accordingly, this issue was closed by the WG.

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No.	SEC Issue	Post-data capture	NIOSH response
13	**Mg-Th Alloy operations –** In the ER NIOSH identified the Mg-Th operations period as May 1, 1957 through April 30, 1979, as well as a residual period after operations ceased and before D&D. For the operational period, NIOSH proposes to use engineered air concentration limits coupled with ORAUT-OTIB-0070 to bound internal doses. The operations, timeframe, data adequacy/completeness, dose estimation approach, as well as the representativeness of 1970 BZ sampling for null exposure, need to be validated. For the residual period, NIOSH proposes to assume 3E-11 µCi/ml lower air limit and deposition, re-suspension, and depletion models to assign intakes. Thoron dose assumed to be 5.1 WLM/yr coupled with TBD-6000 modeled air concentrations. These assumptions and models need to be evaluated.	*May 5-8, 2014 interview indicates that Mg-Th alloy work commenced as early as 1954. No additional air sampling data were identified. Further review of operational experience (with attention to incident reporting of fires) and dose reconstruction method is warranted.*	NIOSH has reviewed the ER and remains satisfied that the bounding method is feasible. NIOSH is also requesting additional recently located urinalysis records to determine if modification of the bounding method is required.
	June 10, 2014 WG: NIOSH to review SC&A's draft white paper, "*Review of Internal Exposures to Thorium and Its Progeny at the Kansas City Plant During Mg-Th Machining Operations*," when it is issued (8/15/14) and provide response to work group. NIOSH to provide information to verify offsite fabrication of Mg-Th received at KCP. NIOSH has requested medical records that may contain thorium bioassay data.		
	NIOSH status for January 20, 2015 WG: NIOSH used the available information and created a Response Paper to address this issue titled, *Internal Exposures to Thorium and its Progeny at the Kansas City Plant during Mg-Th Machining*.		
	SC&A's comments at January 20, 2015 WG: Although NIOSH made clear that the Mg-Th machining operations at KCP started August 23, 1961, there is contradictory information about the period April 1963–August 1970. On page 8 it is written: "**After March 1963, there is no other KCP documentation of Mg-Th machining at KCP or elsewhere until August 28, 1970**, when these operation were performed in Department 20 and the Model Shop for the Radec program (SRDB 108264, PDF p. 26). **This 1963–1970 time period with no Mg-Th machining** is the same period that DU machining operations were ramping up in Department 20."		

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No.	SEC Issue	Post-data capture	NIOSH response
	On page 10 it is written: "Mg-Th machining operations began in Department 20 (AKA Department 22, Heavy Machining Area) **August 23, 1961 and were only performed in this department until September 21, 1970, when they were moved to the Model Shop**." SC&A believes more information would be important to better define Mg-Th machining operations for the period April 1963–August 1970. If Mg-Th machining operations were performed in the period April 1963–August 28 1970, in which department did those operations take place? On page 8 of NIOSH's paper it is written: **"**This 1963–1970 time period with no Mg-Th machining is the same period that **DU machining operations were ramping up in Department 20.**" In NIOSH's response to item 17 of KCP SEC issues matrix for Jan 20 WG meeting it was written: "**In 1966, as DU machining work was winding down in D/20 (the only orders left were for rings and seal plugs), plans were made to transition to a new project machining polyurethane foam, and to clean D/20 and make it into an open area (123895, p. 132). The Facilities group cleaned, and the Industrial Hygiene group surveyed D/20D and D/217-20D.** Instructions were provided that stated, "…wet wipe all the walls and ceiling and other areas as the entire area walls and ceiling will be repainted, floors stripped and resealed, and equipment requiring decontamination decontaminated. Some of the equipment will go to Department 34C and can be packaged and transported to Department 34C. Some of the equipment will have to be disposed…" (123895, p. 133). Areas were surveyed for alpha contamination, and the nature of the contamination was described as follows: "Contamination is commingled with dust and is easily removed, either with soap and water or by vacuuming. Contamination levels are generally near the "open area" limit with the 'exception of bus ducts and ventilator-diffuser openings" (123895, pp. 141)." While NIOSH and SC&A agree there are no monitoring data after October 1970, SC&A disagrees that there should be reliance on program performance and "environmental working conditions" to lend confidence on the use of the 3E-11 µCi/ml limit as bounding for this later period, and that applying any air monitoring data from Department 20 to the Model Shop location post-1971 would not be necessarily equivalent. **Beyond these questions,** SC&A **agrees** with NIOSH's response to item #3 of its white paper, in that a constant value of 3E-11 µCi/ml, and not the lower value of 1.1E-11 µCi/ml (NBS 69 value for Th-232 based on the lung as critical organ), should be applied, as it is more claimant favorable. **ACTION: SC&A is to complete its review of the NIOSH white paper and provide a formal response to the WG and NIOSH, with joint efforts during the anticipated KCP site visit to find more information regarding the 1966–1970 D20 and 1971–1979 Model Shop Mg-Th operations (for the latter with attention to engineering process controls and a reported laboratory located under the model shop). The sub-issue of most claimant-favorable Th-228/Th-232 proportion (0.19 triple separation or equilibrium) for each cancer organ has been acknowledged as a TBD issue.**	

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No.	SEC Issue	Post-data capture	NIOSH response
14	**Post-1993 monitoring –** Need to validate 1993 cutoff date for ER based on NIOSH finding of "*no apparent, or potentially, inadequately-monitored exposures*," which was based on a review of claims after 10 CFR 835 was implemented.	*SC&A analyzed NIOSH's 4/17/2014 response to this issue and sampled several case files in view of it. To date, SC&A has not located definitive information that dose cannot be reconstructed beyond 1993; however, SC&A recommends that this issue be left open until the other SEC issues are resolved.*	During the petition qualification phase, ORAUT performed a qualitative assessment that considered job titles and work information contained in the CATI. Claim information was reviewed for indications that a specific EE's work duties were not represented by the four worker "exposure categories" presented in the site profile for assignment of dose to unmonitored workers. As stated in petition qualification documentation, dose reconstruction methods and assumptions would be evaluated through 1993, and if subsequent NIOSH evaluation into areas such as decontamination following operations indicated potential inadequately monitored exposures post-1993, NIOSH would extend the evaluation period into the 10 CFR pt. 835-era, as appropriate. Since it was determined by NIOSH that all doses could be estimated with sufficient accuracy through 1993, the evaluation period remained unaltered in the final report. NIOSH is aware that DOE performed a "Radiological Protection Appraisal" of KCP in April 1993, and determined that KCP complied with most of the requirements of the DOE RadCon Manual. The few parts they were not in complete compliance with were not significant in terms of employee monitoring (SRDB 108258). NIOSH is also aware that KCP was actively complying with Article 511 of the Manual and appropriately removing personnel from the monitoring program (SRDB 108258). To illustrate, KCP monitored 59 personnel in 1994 using DOELAP accredited dosimetry, with only two personnel receiving measureable exposures. The two exposures were < 100 mrem TEDE (SRDB 11987).
	June 10, 2014 WG: SC&A to review NIOSH bases for 1993 cutoff date re: SRDB documents cited in response and in other source documents that provide validation of ER statement of "no apparent, or potentially, inadequately monitored exposures" after 1993.		

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No.	SEC Issue	Post-data capture	NIOSH response

NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 visit to generate search terms used to locate records related to implementation of 10 CFR 835. The site-visit team reviewed these records and retrieved documents that provide detailed information regarding the adequacy of KCP's monitoring program after 1993.

NIOSH has reviewed appraisals of the KCP HP program that lead up to the end of the SEC evaluation period.

A September 1990 appraisal conducted by the DOE's Albuquerque Operations Office summarized that, "Implementation of the KCP Health Physics Program and the Radiation Protection Program meets, and in several areas exceeds, the minimum requirements set forth in the applicable DOE Orders, Regulations and Standards. Review of the Radiation Protection Program by the appraisal team revealed a well-designed HP approach to the conduct of radiological operations at the KCP" (128208, p. 16).

In 1990, the DOE Kansas City Area Manager and KCP's president certified that contamination is controlled on site (128240, p. 5), and certified compliance with posting and other requirements of DOE Order 5480.11 and ANSI Standard N2.1 (137035).

In 1990, KCP certified the following appraisal action item as complete: "Revise and in many cases create a viable Radiation Protection Program that meets the requirements of DOE Order 5480.11; implement this program plant-wide" (137036).

KCP's 1990 self-assessment sent to DOE stated, "a health physics action plan has also been prepared which addresses a comprehensive radiation protection program. A radiation-protection program manual has been published and internal procedures issued which require departments to come into compliance with requirements or write action plans to bring them into compliance within 60 days. Basic radiation training has been given to the entire plant population; all radiation sources have been inventoried and sampled for leakage" (137093 p. 24).

A 1991 Health Physics audit performed by Benjamin Friesen, PhD, found that KCP's Radiation Protection Program is based on a policy statement signed and endorsed by the highest KCP management. Based upon this commitment and all relevant DOE, federal and state regulations, the Radiation Protection Program Manual was generated and approved (137086, p. 5).

KCP received DOELAP accreditation in November 1992 (137219). In December 1992, a letter to the DOE reports that although KCP has 140 employees qualified as radiation workers, none of them receive greater than KCP's local control limit (100 mr/yr), and, in fact, the entire site dose for all 140 rad workers combined was 160 mr (128330, p. 13).

In DOE's 1995 review (137091) and in the Radiological Control Manual revision (137139) there is no indication of inadequately monitored exposures occurring at KCP.

Interviews with [KCP HP] did not reveal any difficulties with 10 CFR 835 implementation or indications of inadequately monitored exposures after 1993.

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No.	SEC Issue	Post-data capture	NIOSH response
	January 20, 2015 WG: During the October 2014 site visit, both NIOSH and SC&A reviewed program documentation that addressed this question. All documentation in the years between promulgation of 835 and its implementation at KCP by 1993, indicates a comprehensive approach by KCP and DOE to ensure compliance. This included DOELAP accreditation for KCP in November 1992. An interview with [KCP HP], an HP at KCP during this timeframe, indicated no difficulties with 835 implementation or instances of inadequately monitored exposures after 1993. Accordingly, the WG decided to close this issue.		
15	**Thorium oxide operations –** Need to validate that KCP laboratory operations involving ThO_2 were bench scale in nature, and therefore, had negligible exposure potential.	*DOE inventory review indicates a standing inventory of "non-alloyed" (i.e., non-MgTh) thorium at KCP in the 1970s-1980s. No associated KCP program has yet been identified, or attendant bioassay program and related bioassays. One interviewee from 5/5-8/14 visit recalled a "room devoted to thorium;" that it was in "powder form." However, other interviewees to date do not acknowledge any programmatic activity involving thorium other than MgTh (and formulation of laboratory-scale standards; one interviewee noted that thorium oxide powder was retained for use as an ICAAP standard). Further review is warranted.*	Interviewees were asked about operations involving ThO_2 at the May 2014 site visit and no large-scale operations were identified. The Industrial Hygienist provided additional documents during the May 2014 site visit that NIOSH will review after they are ADC reviewed.
	June 10, 2014 WG: NIOSH and SC&A review of [redacted] documents (may need to be re-requested), weekly activity reports (once available), and other source documents, to identify any additional information regarding presence of thorium oxide at KCP outside of laboratory standard quantities.		
	NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 visit to generate search terms used to locate thorium records. The site-visit team reviewed these records, retrieved activity reports, documents provided by [redacted] and [KCP HP] and other documents that provide detailed information regarding thorium. Thorium inventory information was obtained from the Nuclear Material Management and Safeguard System (NMMSS) database (137786). The information appears to be incomplete, but it is another data point for NIOSH to consider. For example, KCP is said to possess thorium as alloyed metal in kilogram quantities from 1971 to 1976; however, NIOSH has shown that KCP possessed Mg-Th from 1957 to 1979. It may be that NMMSS tracking did not begin until 1971, and that the only Mg-Th present at KCP after 1976 was as waste awaiting disposal.		

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The NMMSS inventory also shows that KCP possessed kilogram quantities of a non-alloyed thorium from 1971 to 1976. The KCP NMMSS custodian was asked for information regarding this material; however, being new to the position, she was unable to offer any insight.

NIOSH has reviewed inventory documents known as AQA Statement of Measurement Methods that cover the time from July 1969 to September 1978. Although these inventories show Mg-Th (2% thorium) quantities starting in 1971 through September 1978, there is no mention of non-alloyed thorium forms, such as thorium oxide. It is possible that laboratory materials were not included in these reports to DOE, if their total site quantities were maintained at less than 500 g (123922, p. 3).

Other documents related to KCP operations with non-alloyed thorium that were recently reviewed by NIOSH include the following.

There is a 1967 proposal to perform thorium electroplating work in Department 34C (D/34C) (137074, p. 56)

In 1977, there was work planning associated with electronic assemblies (film circuit resister arrays for measuring the intensity profile of laser beams) with a thorium fluoride coated copper substrate, supplied by an outside vendor (137074 pp. 25–28).

There is a 1979 waste survey showing 22 cu. ft. of a thorium nitrate (10 µCi Th-232) liquid solution in an absorbent (134675, p. 99). There is also a 1979 Solid Radioactive Waste Data inventory that shows this material (10 µCi Th-232 or 92 nuclide grams) in absorbent, and a waste shipment record that shows it as one gallon of liquid containing 10 µCi Th-232 (137080, p. 58; 134514, pp. 33, 42).

A 1980 inventory of D/185 (old jet engine test cell) shows 1 gallon of thorium nitrate waste that was received a year earlier (134675, p. 223). This material fit into three 55-gallon drums and weighed 274 lbs.

A 1985 Avoid Verbal Orders (AVO) memo from D/541 to D/187 (Material Conservation and Reclamations) that mentions 24 µCi or 500 grams thorium nitrate waste (137045, pp. 5, 95).

1985 investigation report of a 500 g thorium nitrate shipment with no shipping papers stored for 2 months at Receiving, that was shipped to KCP by mistake instead of a facility in Maryland (137074, p. 15).

A document that shows that the Solutions Analysis section of the Materials Evaluation Lab (D/816) and the Minilab (D/61) store less than 200 g of thorium nitrate to "maintain production and critical development support." Wastes in these labs are to be kept in a designated 5-gallon container and sent to Waste Management when full (137074, p. 21).

In 1986, there are 24 µCi (or 220 g nuclide Th-232) listed in SWIMS, and again as thorium nitrate (500 grams) in unclassified waste barrel #5. This is most likely the same material mentioned in the 1985 AVO memo referenced above (137094, pp. 68, 157).

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No.	SEC Issue	Post-data capture	NIOSH response
		A 1986 procurement document that describes thorium nitrate handling controls, including a 500-g site limit before accountability is required. This document also lists an 810 g shipment to LANL as a "chemical reagent" waste (123922, pp. 2, 15). There are 1986 waste handling instructions for thorium nitrate used to make a solution in labs. The lab's "usage is very small," and the solution used contains a very small quantity of thorium nitrate (13.8 g used to make a 0.1 normal solution prior to a "fluorine titration" process). Also listed in the document is shipping information for 0.11 µCi/g or 13-µCi total of Th-232 (137074, pp. 8–13). A 1987 source inventory that shows a 4.77 nCi Th-230 source (128231, p. 6). A 1988 document that describes "research" with solution concentrations of 10 to 100 grams of thorium per liter (1.1 to 11 µCi per liter) and less than 2 liters per day will be generated. This work will be strictly research and development and the anticipated quantities may not exceed 150 lbs/yr (to meet the 10 CFR 40 exemption). The work will be carried out solely in the laboratory and drain disposal is not allowed for thorium used in R&D (137042). There is a 1989 waste container inventory that has an entry for 113 grams or 0.09 µCi thorium oxide, and another for 100 grams or 10 µCi (137092, pp. 25, 26). A 1989 multi-site (Pinellas, Mound, Inhalation Toxicology Research Institute, and KCP) radioisotope report to DOE, lists 12 Ci Th-230 as the maximum allowable to be stored as solid waste in the Main Manufacturing building. The report is a pre-decisional draft and states that it is important to note this information is preliminary data and is subject to change (13225, pp. 7, 14). A 1989 radioactive material inventory states that 20 g per year of thorium is used in D/61 and D/838 (formerly D/816) to make a 0.1 N thorium nitrate solution (128430, p. 42) A 1990 inventory that tracked the following radioactive sources: thorium nitrate for "Solution Analysis" operation; thorium oxide coated tungsten for "XPS" filaments; thorium oxide as a spectrographic standard (128430, p. 18). A 1992 document states that commercially available thorium laboratory reagents are considered non-regulated (128330, p. 9). In December 1992, a letter to the DOE reports an "approximate" amount of 600 g of Th-230 as a compound on a waste inventory (128330, p. 20). A 1993 material safety-data sheet states that the thorium (IV) oxide stored in D/838 was manufactured by Johnson Matthey Cat Chem. (137074 p. 84). At this time, NIOSH is not aware of any other thorium operations at KCP except for weld rods (e.g. 2.5% thorium dioxide; 137074, p. 85). This information, combined with the interviews of former employees, leaves NIOSH convinced that KCP's thorium work can continue to be characterized as small-scale laboratory research.	

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No.	SEC Issue	Post-data capture	NIOSH response
	January 20, 2015 WG: SC&A notes that the NMMSS inventory information has not yet been reconciled with the lack of operational information in onsite documentation located to date. The current NMMSS custodian at KCP is relatively new to the position and has been unable to offer any insight. SC&A deferred to the WG on whether further investigation is warranted; one possibility would be a search of existing Materials Accountability files specific to KCP. **ACTION: SC&A to complete its review of SRDB records identified by NIOSH from the last data capture, and for both NIOSH and SC&A to continue to look for relevant records while conducting onsite searches.**		
16	**Natural Uranium, 1950-1958: Application of TBD-6000** Need to validate proposed application of TBD-6000 methodology to determine if recommended concentrations bound internal doses for workers that had less exposure potential, or were unmonitored, for internal exposures to natural uranium (NU).	*a) SC&A's review of the application of TBD-6000 for the exposure to NU during the period of 1950-1955 at KCP found the approach adopted in the SEC to be scientifically sound and claimant favorable, as long as there were no other radiological operations taking place in the Main Manufacturing Building during this time period. b) SC&A's review of the use of TBD-6000 methodology for unmonitored workers uranium intakes for the 1955-1958 residual time period found the approach adopted in the SEC PER to be scientifically sound and claimant favorable, as long as there were no other radiological operations taking place in the Main Manufacturing Building during this time period.* *SC&A finds that NIOSH's use of TBD-6000 addresses the concerns for uranium exposures.*	Interviewees were asked about access controls and freedom of movement throughout KCP during the May 2014 site visit. NIOSH remains satisfied that the methodology documented in the ER is bounding. The TBD-6000 Working Group has also generically addressed the use of the surrogate modeling used in the ER.
	June 10, 2014 WG: NIOSH to review SC&A's draft white paper, *Review of Internal Exposures to Uranium at the Kansas City Plant Using TBD-6000 and OTIB-0070 as Surrogate Data*, when it is issued (7/25/14) and provide response to the WG. NIOSH to provide "mapping" of historic radiological operations (beginning with "Troxell" map of 1954), which is ongoing, and, if feasible, provide WG with KCP plant radiological maps for 1950s (i.e., Troxell), 1960s, 1970s, and 1980s.		
	NIOSH status for January 20, 2015 WG: SC&A's white paper titled, *Review of Internal Exposures to Uranium at the Kansas City Plant Using TBD-6000 and ORAUT-OTIB-0070 as Surrogate Data*, provides additional rigor to NIOSH's KCP SEC evaluation. SC&A independently affirmed NIOSH's conclusions using analysis not performed by NIOSH who was required to complete the ER within 180 days. [NIOSH does not disagree with SC&A's analysis or conclusions; however, minor comments were provided as clarification for SC&A consideration.]		

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No.	SEC Issue	Post-data capture	NIOSH response
	January 20, 2015 WG: SC&A's original finding was the need to validate the proposed application of TBD-6000 methodology to determine if the recommended concentrations bound internal doses for workers that had less potential, or were unmonitored, for internal exposures to natural uranium. From SC&A's white paper assessment, two conclusions were reached: (1) SC&A's review of the application of TBD-6000 for the exposure to natural uranium for the period 1950–1955 at KCP found the approach adopted in the ER to be scientifically sound and claimant favorable, as long as there were no other radiological operations taking place in the Main Manufacturing Building during this time period; and (2) SC&A's review of the use of TBD-6000 methodology for unmonitored worker uranium intakes for the 1955–1958 residual period was found to be similarly valid under the same conditions. The only additional clarification would be assurance that no other activities were going on in the Main Manufacturing Building from 1955 to 1958, other than machining uranium metal. Regarding the additional clarification questions and comments posed by NIOSH regarding the white paper, SC&A concurs with the suggested changes and clarifications provided, but will provide these specific responses by separate correspondence (e.g., e-mail). SC&A recommended WG closure of this issue, assuming that NIOSH provides the "mapping" of historical radiological operations that was included under this matrix issue (which provides added confirmation that the natural uranium operations were the only radiological activity at the time). **ACTION: NIOSH to forward copies of mapping diagrams of KCP historic radiological operations for review by WG members and SC&A.**		
17	**D&D activities –** Need to validate scope and monitoring status of D&D activities; ER assumes D&D confined to 1984–1986 period and applies assumed air concentration parameter for general employee exposure.	*Interviews have not identified any significant D&D other than that in 1984–1986. Other D&D related activities involved contaminated equipment, e.g., DU machining. No evidence has been found of exposure potential for plant workers during D&D. Further review of weekly activity reports and other sources of operational information is warranted.*	Interviewees were asked about the possibility of other D&D activities by Rockwell International or other contractors during the May 2014 site visit. NIOSH remains satisfied that the ER's description of D&D activities is bounding.
	June 10, 2014 WG: NIOSH and SC&A to review weekly activity reports (when available) and other source documents for further evidence of D&D activities. (Radiological maps from matrix issue #16, above, helpful to view radiological operational changes over time).		

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No.	SEC Issue	Post-data capture	NIOSH response

NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 site visit to generate search terms used to locate D&D records. The site-visit team reviewed these records, retrieved activity reports and other documents that provide detailed information regarding D&D. NIOSH reviewed the following information that describes decontamination activities other than those described in the ER.

In 1964, there are surface contamination survey results with grid drawings of the machining area, and instructions to perform decontamination. It was requested, "all walls, lighting fixtures, piping and other equipment be wet-washed and the walls painted to remove or fix any loose particulate. The area is to be monitored after decontamination" (123895, pp. 11, 32). There are also reports of individual machines decontaminated in1964, 65 (123895, pp. 20, 129, 155, 163).

In 1966, as DU machining work was winding down in D/20 (the only orders left were for rings and seal plugs), plans were made to transition to a new project machining polyurethane foam, and to clean D/20 and make it into an open area (123895, p. 132). The Facilities group cleaned, and the Industrial Hygiene group surveyed D/20D and D/217-20D. Instructions were provided that stated, "…wet wipe all the walls and ceiling and other areas as the entire area walls and ceiling will be repainted, floors stripped and resealed, and equipment requiring decontamination decontaminated. Some of the equipment will go to Department 34C and can be packaged and transported to Department 34C. Some of the equipment will have to be disposed…" (123895, p. 133). Areas were surveyed for alpha contamination, and the nature of the contamination was described as follows: "Contamination is commingled with dust and is easily removed, either with soap and water or by vacuuming. Contamination levels are generally near the "open area" limit with the exception of bus ducts and ventilator-diffuser openings" (123895, p. 141). In 1967, there was a request for improved house keeping in D/34C (123895, pp. 80, 87).

In 1977, there is a decon procedure for DU and beryllium-contaminated equipment that was performed in the Model Shop (137215, p. 23), and in 1978, decontamination and disposal information including surface contamination survey results for equipment and ventilation used with DU operations (137215, p. 3).

As NIOSH continues to review new information, it is apparent that KCP was cognizant of machining area contamination, and undertook less-formal but effective area decontaminations as they transitioned between projects. NIOSH believes that this new information continues to support the general cleanliness of the facility and the ER's bounding methods.

KANSAS CITY PLANT SPECIAL EXPOSURE COHORT (SEC 210) ISSUES MATRIX

No.	SEC Issue	Post-data capture	NIOSH response
	January 20, 2015 WG: SC&A noted that the ER only acknowledges the 1984–1986 D&D performed by Rockwell, but does not address what was likely other D&D activities over the 60+ year plant history, and whether 1984–1986 dose estimating approach is bounding of these other D&Ds. From the June 10, 2014, WG, NIOSH and SC&A were to review weekly activity reports and other source material for further evidence of D&D activities. NIOSH's most recent matrix reflects our joint review that found a number of other instances of D&D activities from the 1960s into the 1970s, involving D&D of operational areas and contaminated equipment. There is also evidence in SRDB 132757 of D&D in KCP area D434-20 in the late 1980s. SC&A believes it is not clear that the Rockwell D&D of 1984–1986 is bounding of all other D&Ds at KCP; it needs to be confirmed that workers performing D&D in these instances were already in a monitoring program. A programmatic basis alone would not be sufficient for bounding purposes. **ACTION: SC&A to clarify possible path forward on what data or information would inform a NIOSH analysis of whether KCP workers in historic D&D activities would have either been already monitored or whose potential exposure would be bound by proposed NIOSH methods at KCP. NIOSH would then determine its approach and propose same to the WG.**		
18	**Accidents, Incidents, and Fires in Worker's Record -** The status of the recording of accidents, incidents, and fires in the worker's records needs to be determined. Specifically, NIOSH needs to establish whether internal intakes and external doses from accidents, incidents, and uranium fires were included in the records NIOSH has available for dose reconstruction or whether they need to be obtained and accounted for separately from the standard recorded intakes and doses. This would include the 1987 erbium tritide and the 1989 Pm-147 incidents, as well as intakes from uranium fires.	*Routine recording of workplace incidents was not identified until "weekly activity reports" were found in microfilm format during 5/5-8/14 KCP visit – a search for all such available reports has been requested. A limited sampling of such weeklies for the mid-1960s found routine reporting of workplace fires, spills, and accidents.*	The KCP HP was asked about the inclusion of dose investigations with monitoring records during the May 2014 site visit. A dose investigation that includes a statement about it being added to an employee's records (SRDB 128233) was shown to the HP and he stated that this was a KCP standard practice. Interviewees were also asked about their recollection of accidents, incidents and fires. NIOSH remains satisfied that the ER's description of D&D activities is bounding. The personnel information in documents pertaining to the 1987 erbium tritide (SRDB 108267) and the 1989 Pm-147 (SRDB 6216) incidents has been reviewed against NOCTS claimant identifiers, and linked to NOCTS claims data as appropriate. The TBD-6000 Working Group has also generically addressed the inclusion of fires and other incidents into exposure models.
	June 10, 2014 WG: NIOSH and SC&A to review weekly activity reports (when available) to better characterize historic accidents, incidents, and fires with radiological exposure implications.		

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No.	SEC Issue	Post-data capture	NIOSH response
	NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 site visit to generate search terms used to locate records related to accidents, incidents and fires. The site-visit team reviewed these records, retrieved activity reports, and other documents that provide detailed information regarding these mishaps. The following reports were reviewed by NIOSH. In 1963, there is a detailed evaluation of KCP's response to a fire in D/22 that resulted from the overheating of an immersion heater. The results of the evaluation indicate that, "there were no internal or external radiation exposures or contamination levels of any significance as a result of this incident" (123895, pp. 45, 48, 66). From 1963 to 1975, there is a folder titled Radiation Incidents containing 153 pages of historical information on radiological incidents. None of the incidents were significant in terms of radiation exposures to large numbers of workers. Most apparent doses from the incidents were reasonably small (128479). In 1976, there was a shipment of Mg-Th received from a vendor without proper shipping papers (137074, p. 30). In 1984, High Dosimeter Readings Investigation where a worker was x-raying parts for flaws got a high reading on his dosimeter (128289). In 1985, an investigation of a worker's high TLD reading and his possible exposure while in D/435 performing NDT activities. TLD readings of 3.561 rem whole body and 11.153 rem to the skin (111496). In 1986, there is a report of a 0.66 rem dose assigned a worker from an x-ray exposure to his dosimeter while working with x-ray beams while using electro curtains on cabinets (123843).		

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No.	SEC Issue	Post-data capture	NIOSH response

In 1989, beta contamination, above limits, was discovered on parts received from Y-12 and identified as DU (137076), and several bottles of krypton-85 gas were shipped to KCP by mistake (137073).

In May 9, 1990, low levels of thallium-204 were found on a source holder case during routine surveys of the waste storage area. This same case was reported to be lost on May 29, 1990, and it was determined that it was likely disposed as waste. The evaluation concluded that since "the case was contaminated with less that 0.06 microcuries of Thallium 204, the case poses no health hazard. Cross contamination and subsequent internal deposition is unlikely, as the contamination had been determined to be firmly affixed to the case" (137118, 137066).

In a 1990 Exposure Investigation, two workers' TLDs read unusual shallow doses of 239 and 148 mrem and no deep doses while working as x-ray film readers. An investigation was conducted with no resolution as to the dose readings. The dosimeter vender was contacted and TMA/Eberline did indicate that they were having trouble distinguishing between low-energy photons and shallow (beta) skin doses. The doses were assigned to the workers (128300).

A 1991 investigation of an unusual beta dose reports that an Electronic Equipment Technician in D/132/134 performed work on "Neutron Testers" using tritium tritides and Ba-133 sources, and received a dose of 60 mrem on his TLD. An investigation ensued and the worker was assigned the dose (128233).

NIOSH to date has not discovered any events at KCP that rise to the level of a discrete incident as described in 42 CFR 83.13(c)(3)(i), or any events that could not be bounded with the ER's methods.

January 20, 2015 WG: SC&A noted that a number of records were found during the October 2014 visit that identify accidents, incidents, and fires at KCP. While weekly activity reports were only located for a narrow range of years (mid 1960s, early 1970s), a folder entitled "Radiation Incidents" documents incidents from 1963–1975. None of these incidents were significant in terms of exposure to large numbers of workers and all could be bounded by NIOSH's DR approach. SC&A deferred to the WG regarding whether closure or additional document searches are warranted.

ACTION: SC&A and NIOSH to continue searching for additional incident reporting during the upcoming KCP site visit; the WG will review NIOSH's SRDB citations provided.

KANSAS CITY PLANT SPECIAL EXPOSURE COHORT (SEC 210) ISSUES MATRIX

No.	SEC Issue	Post-data capture	NIOSH response
19	**Potentially Unmonitored Exposures –** The ER mentions the concerns of a petitioner about potentially unmonitored exposures in Section 7.4.4. However, the response in the ER was that NIOSH has determined it has sufficient information to document potential exposures and bound associated doses. Since these are specific items, it would be appropriate to address the monitoring requirements, impacted workers, and available records associated with each exposure potential to determine dose reconstructability for these potential exposures.	*Inventory review and interviews indicate no plutonium and weapons grade uranium-235 and uranium-233 were present at KCP, except in gram quantities in sealed sources, or as isolated fugitive contamination in returns. External radiation sources, e.g., electron beam welders, accelerators, cesium irradiator, and Electro Curtain, would have been monitored through film and TLD badges. Potential tritium exposure will be addressed as a separate issue. Further review of operational records and incident reports is warranted.*	The concerns of a petitioner about potentially unmonitored exposures were listed in the ER as follows: "Many surface and airborne uranium isotopes, plutonium, tritium, weapons grade uranium-235, uranium-233, neutrons and other ionizing radiation from industrial X-ray gauging devices, electron beam welders, neutron generators, neutron plutonium-beryllium sources, accelerators, cesium irradiator, medical X-ray, and Electro Curtain". NIOSH addressed exposures to the evaluated class from many of the listed sources throughout the ER. Those items not addressed in the ER such as weapons grade uranium-235 were omitted because there is no indication that they were on site. NIOSH has questioned former employees and searched SRDB documents for information regarding all of the petitioner's concerns; however, only verified exposures are addressed in the ER.
	June 10, 2014 WG: With tritium as the only source term either not discounted or not addressed adequately by NIOSH, the work group **closed** this matrix issue, deferring to matrix issue #20 to address the question of tritium as a potential exposure source at KCP.		

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No.	SEC Issue	Post-data capture	NIOSH response
20	***NEW ISSUE:*** **TRITIUM**	*During its May 2014 KCP site visit, SC&A identified the availability of KCP site "weekly activities" reports that were compiled internally by Bendix and preserved on microfilm. In its preliminary review of one such roll, weeklies for mid-1964 highlighted the start of a heretofore unknown tritium bottling operation where bulk quantities of tritium (obtained from Sandia) were rebottled into 4 ounce quantities for a yet unknown use. This early review also found that these reports contained considerable information on accidents and incidents, as well as operational status.* *Recommend that the WG open a new issue and further review continue.*	NIOSH has been made aware of "Weekly Activity" documents obtained during the May 2014 visit that indicate KCP performed an operation where tritium water was transferred from one-gallon polyethylene bottles to 4-ounce bottles. These documents indicate that KCP obtained procedures from Sandia to perform urinalysis and that KCP was "set-up" to handle tritium water (equipment operating satisfactorily and calibrated) before they received the first (8) gallon shipment in August 1964. This water was received from Sandia and certified at 226 µCi/l. There are also indications within these reports that KCP ordered (7) additional gallons of tritium water in November of 1964. NIOSH also recently reviewed a document (SRDB 128438 pdf 3) that seems to indicate KCP handled or prepared a tritiated phosphor within an exhaust hood, utilizing safe handling precautions. This document indicates this work occurred prior to October 1968. NIOSH will continue to request and review documents that address KCP's tritium operations.
	June 10, 2014 WG: NIOSH and SC&A to review weekly activity reports (when available), and other source documents, to ascertain nature of operation, potential worker exposure, and timeframes involved.		
	NIOSH status for January 20, 2015 WG: NIOSH collaborated with SC&A and the Board in advance of the October 2014 site visit to generate search terms used to locate tritium records. The site-visit team reviewed these records, retrieved activity reports and other documents that provide detailed information regarding tritium operations. NIOSH used the available information and created a White Paper titled *Tritium at the Kansas City Plant*.		

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No.	SEC Issue	Post-data capture	NIOSH response
		January 20, 2015 WG: SC&A reviewed NIOSH white paper and found that it had more fully characterized historic tritium operations at KCP. However, the lack of specific information regarding source terms, operational conditions, and workplace measurements makes it difficult to bound potential worker doses without use of broad assumptions, no matter how scientifically founded. It is also not clear which KCP workers were involved in these operations. **ACTION: NIOSH to update white paper with new information on organic tritium source term; both NIOSH and SC&A to continue looking for any new documentation regarding tritium operations at KCP during the next site visit.**	