Draft

SC&A'S ISSUES MATRIX FOR THE BROOKHAVEN NATIONAL LABORATORY SITE PROFILE TECHNICAL BASIS DOCUMENT

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Brookhaven National Laboratory Site Profile Issues Matrix

This matrix contains a list of the issues (formally titled Findings in the site profile review) that SC&A identified in Rev. 00 of the Brookhaven National Laboratory (BNL) technical basis document (TBD) ORAUT-TKBS-0048 (ORAUT 2006), with status update considering the recent Rev. 01 edition of ORAUT-TKBS-0048 (ORAUT 2010) and Rev. 02 edition of ORAUT-TKBS-0048 (ORAUT 2013). Two SECs presently exist for BNL; one for the period January 1, 1947, through December 31, 1979, and one for the period January 1, 1980, through December 31, 1993.

This site profile issues matrix is based on assessments of the following:

- The BNL TBD ORAUT-TKBS-0048, Rev. 00, August 30, 2006 (ORAUT 2006)
- SC&A's September 2009 review of the BNL site profile ORAUT-TKBS-0048, Rev. 00, August 30, 2006 (SC&A 2009)
- The NIOSH SEC-00113 Evaluation Report dated September 29, 2009 (NIOSH 2009)
- The BNL TBD ORAUT-TKBS-0048, Rev. 01, April 26, 2010 (ORAUT 2010)
- The NIOSH SEC-00196 Evaluation Report dated January 5, 2012 (NIOSH 2012)
- The BNL TBD ORAUT-TKBS-0048, Rev. 02, February 7, 2013 (ORAUT 2013), which will be referred to in this evaluation as the "revised TBD."

Note that March 2013 updates to this issues matrix appear in blue text, except for any additions to the reference list, and May 2013 updates appear in red text.

Finding 1: Bioassay Monitoring Not Adequately Established
ORAUT-TKBS-0048 (ORAUT 2006) does not provide sufficient information to determine which workers were monitored for what radionuclides and what criteria were used to select workers for special, routine, and spot bioassay monitoring. To perform an adequate dose reconstruction, the dose reconstructor needs to know who, when, and why workers were bioassayed at a given DOE site. This information allows the dose reconstructor to determine if the worker should have been monitored, and prompts the dose reconstructor to search for such records, if applicable (especially important because of the lack of a centralized record system at BNL). Although bioassays for some radionuclides were conducted for some workers at BNL throughout the laboratory's operating history, sufficient documentation of written procedures and requirements for bioassays is not apparent before the 1990s; this leaves 40 years of uncertainty concerning bioassay requirements.
SC&A's February 2012 update: The SECs negate this concern through 1993. *SC&A needs to determine if this issue is still applicable after 1993.*
NIOSH Response: Bioassay records are sufficiently complete for DR after 1993.
SC&A's March 2013 update: While addressing the SEC issues, it was found that analyses of the bioassay records and cases indicate that bioassay records are sufficiently complete for DR after 1993. Resolution of the SEC issue addressed this site profile issue.
Work Group Actions: SEC issue resolution accepted by WG on phone conference call of March 6, 2013.
Board Action: SEC issue resolution accepted at Advisory Board meeting of March 12, 2013.

Finding 2: Records of Bioassay Monitoring Not Centralized or Knowingly Complete
The site profile does not address the issue of the completeness and accessibility of the bioassay records. There were numerous bioassay data recording systems and filing methods at BNL. Many of these earlier records are still located in various departments, making it difficult (as confirmed by current BNL health physics personnel) for BNL to properly and completely respond to NIOSH requests for bioassay records to be used for dose reconstruction. It is not currently known by BNL health physics personnel if all the hardcopy records have been located, are legible, and are accessible for dose reconstruction. As various departments were formed and supplanted, and as department heads came and left BNL, the hardcopy records may have survived, or they may have been destroyed or removed from the site. There is presently no method available to determine if all the records for a given employee are available for dose reconstruction purposes, particularly before the records were centrally stored in electronic databases.
SC&A's February 2012 update: The SECs negate this concern through 1993. *SC&A needs to determine if this issue is still applicable after 1993.*
NIOSH Response: Bioassay records are sufficiently complete for DR after 1993.
SC&A's March 2013 update: While addressing the SEC issues, it was found that analyses of the bioassay records and cases indicate that bioassay records are sufficiently complete for DR after 1993. Resolution of the SEC issue addressed this site profile issue.
Work Group Actions: SEC issue resolution accepted by WG on phone conference call of March 6, 2013.
Board Action: SEC issue resolution accepted at Advisory Board meeting of March 12, 2013.

Finding 3: Minimum Detectable Activity and Uncertainty Values Not Sufficiently Defined
Minimum detectable activity (MDA) is mentioned several times in Section 5 of the site profile (ORAUT 2006), and a list of whole-body counter (WBC) MDA values is provided in Table 5-3, pp. 78–79, for the years 1999 through 2005. Additionally, urinalysis MDA values for some of the common radioisotopes found at BNL are listed in Table 5-3, pg. 80, mainly for 1999–2006. Therefore, a reasonable amount of MDA information for common radioisotopes is provided for 1999–2006. However, what is lacking is a comprehensive listing of urinalysis and WBC MDA values for the 1940s–1990s, such as is found in other NIOSH site profiles. Additionally, uncertainty values are not provided, and are apparently not available, for most of the bioassay reporting period from the 1950s–1990s.
SC&A's February 2012 update: The SECs negate this concern through 1993. *However, this issue is still pertinent for the period 1994–1998 for many of the radioisotopes.*
NIOSH Response: MDA values updated in Section 5 of Rev. 02 of the TBD.
SC&A's March 2013 update: SC&A evaluated the revised TBD and found that additional MDA data for some of the major radionuclides had been added to cover the period of interest (1994–1998), with expanded coverage of radionuclides and time periods in general. This issue has been satisfactorily addressed.
Work Group Meeting:
Board Action:

Finding 4: Radionuclide Characteristics Not Sufficiently Known
Unfortunately, as stated in Section 5.10 of the site profile (ORAUT 2006), specific *solubility data*, *particle size*, and *activity fractions* are not known, or are not available, for most facilities at BNL. Table 5-5 lists a few of the activity fractions, presumed to have come from stack emission data. However, stack emissions are not always a good indicator of the types of radioisotopes present, or their concentrations, in the worker's breathing zone (this also applies to Table 2-2). Interviews with BNL workers indicate that Tables 2-2 and 2-3 do not correctly reflect the historic radioisotopes present at some of the BNL facilities. Without appropriate characterization of workplace exposures, the adequacy and completeness of the internal and external monitoring programs come into question and may result in a less than favorable organ dose reconstruction. In addition, workplace specific *monitoring data* and/or *source term data* do not appear to be available.
SC&A's February 2012 update: The SECs negate this concern through 1993. *However, this issue is still pertinent after 1993.*
NIOSH Response: Additional information in Rev. 02 of the TBD.
SC&A's March 2013 update: SC&A evaluated the revised TBD and found no major additional data concerning this issue; however, the revised TBD instructs the dose reconstructor to use the most claimant-favorable solubility, particle size, etc.; this would be claimant favorable and resolves the issue.
Work Group Action:
Board Action:

Finding 5: No Internal Coworker Dose Database Available
The site profile (ORAUT 2006) does not address internal coworker dose data. In view of the issues with the lack of a coordinated, consistent bioassay program and the problems with the availability of historic bioassay records, it would be advantageous to have a viable coworker database to use to assign unmonitored dose. Unfortunately, the lack of a routine and comprehensive bioassay program before the 1990s may make it difficult to create an adequate coworker internal dose table for the dose reconstructor to bridge monitoring or recordkeeping gaps for sporadically monitored workers, monitored workers whose complete records are not available, and for unmonitored workers who should have been monitored.
SC&A's February 2012 update: The SECs negate this concern through 1993. *However, this issue is still pertinent after 1993.*
NIOSH Response: NIOSH does not intend to develop an internal coworker model.
SC&A's March 2013 update: This issue was resolved in SEC issue #12. A coworker internal model is not presently needed, because internal dose monitoring and records have been deemed complete for DR purposes after the SEC period ending in 1993. Resolution of the SEC issue addressed this site profile issue.
Work Group Actions: SEC issue resolution accepted by WG on phone conference call of March 6, 2013.
Board Action: SEC issue resolution accepted at Advisory Board meeting of March 12, 2013.

Finding 6: NTA Threshold Response Not Sufficiently Investigated
The threshold energy of NTA film and the amount of dose not registered due to this limitation is important in neutron dosimetry. NTA film decreases in response starting at neutron energies below 1 MeV, and is almost completely insensitive to neutrons below 0.5 MeV; therefore, radiation fields containing an appreciable percentage of the total dose equivalent due to neutrons below 1 MeV must be evaluated carefully, with attention given to the missed dose resulting from this threshold affect. The site profile does not specifically address the subject of the NTA film threshold. The site profile should address this issue and make clear and technically sound recommendations to compensate for the incomplete neutron doses as recorded by NTA film and contained in the dose of record.
SC&A's February 2012 update: *SC&A needs to determine if the revised TBD provides additional information that could be applied to this issue.*
NIOSH Response: Section 6.10 expanded to cover this issue in 2013 TBD revision.
SC&A's March 2013 update: This issue was generally covered in SEC Issues #1–#3; however, recent review of several BNL documents containing neutron dose equivalent (D.E.) measurements as a function of neutron energy (Preisig 1995, Ref ID 22845 pdf. 26–32) indicates that the D.E. under 0.5 MeV could range from 25% to 50% of the total dose at the Alternating Gradient Synchrotron (AGS), and one measurement shows that NTA film would only register <2% of the total neutron D.E. (Xie 1986, Ref ID 121356, pdf. 53). Phillips states in a BNL document (Phillips 1974, Ref ID 22429, pdf. 17–21) that PuBe (4.5 MeV) neutron sources were used for fast neutron calibration, and that the calibration for neutrons of average energy of 1 MeV was 20 mrem per tack per 25 fields, and 10 mrem for 4.5 MeV neutrons (PuBe), a difference of a factor of 2. Table 6-5 in the revised TBD lists a significant portion of the neutron energy in the 0.1–2 MeV range, indicating part of the dose is below the 0.5 MeV threshold of NTA film, and below the average neutron energy of the calibration source of PuBe (4.5 MeV). ***Therefore, it should be determined if the recorded neutron doses for workers exposed to moderated lower-energy neutrons were too low because of the threshold of NTA film, or how/if this was accounted for.***
NIOSH's April 30, 2013, Response to SC&A's March 2013 update: NIOSH agrees that an adjustment factor is needed to address the NTA energy threshold. NIOSH proposes to use NTA film and calibration data from the AGS facility to develop the adjustment factor. The AGS facility represents the largest and best characterized source of potential neutron exposure at BNL in the post-SEC period. The factor will be developed and incorporated into the next revision of the site profile.
SC&A's May 2013 update: SC&A will need to review NIOSH's recommended solution when it becomes available.
Work Group Actions:
Board Action:

Finding 7: NTA Track Fading Not Covered in the Site Profile (ORAUT 2006)
The magnitude of the proton recoil tracks in NTA film resulting from neutron interactions depends on the energy of the interacting neutron. Lower-energy neutrons cause less dense proton recoil tracks; these tracks fade more rapidly with time than heavier tracks caused by more energetic recoil protons resulting from energetic neutrons (i.e., 0.5–1.0 MeV neutrons in the workplace versus 4 MeV neutrons from a calibration source). The site profile did not directly address NTA film track fading, provide evidence that it was not a problem at BNL, or describe any procedure necessary to compensate for it.
SC&A's February 2012 update: *SC&A needs to determine if the revised TBD provides additional information that could be applied to this issue.*
NIOSH Response: Section 6.10 expanded to cover this issue in the 2013 TBD revision.
SC&A's March 2013 update: This issue has been satisfactorily addressed in SEC Issue #1, in that the latest revised TBD recommends a fading factor of 1.81 be applied to the recorded neutron dose measured by NTA film processed at BNL before 1985. After the processing was outsourced to Landauer during 1985–1995, SC&A found that the vendor did calibrate the NTA film at the beginning of the exchange cycle and read them at the end of the cycle; therefore, incorporating fading in the calibration cycle as if the whole dose was received on the first day of exposure (NIOSH 2011), which is claimant favorable. This issue has been resolved.
Work Group Meeting:
Board Action:

Finding 8: NTA/TLD/Lexan/CR-39 Problems
The problems associated with the NTA film threshold and track fading initiated a search for other neutron dosimeters; among those tested and selected for use at BNL were the TLD, CR-39, and Lexan neutron dosimeters. However, these neutron dosimeters were not without their own shortcomings. There were issues with NTA film, CR-39, and Lexan neutron dose readings, and even the gamma-muon readings. None of the detectors appeared to establish a long-term "gold standard" to which results could be compared. During the 1980s and 1990s, a number of issues were ongoing between BNL and their dosimetry vendor, Landauer. The BNL site profile does not cite these dosimetry problems, if they were solved, or make any recommendations on the use of the neutron dose records, given the concerns and uncertainties associated with these issues.
SC&A's February 2012 update: *SC&A needs to determine if the revised TBD provides additional information that could be applied to this issue.*
NIOSH Response:
SC&A's March 2013 update: This issue was covered in SEC Issue #3, where it was found from the documents reviewed to date that the highest of the neutron readings were recorded. Therefore, SC&A has no further comments on this issue and considers it resolved.
Work Group Actions:
Board Action:

Finding 9: Potential Exposures at Accelerators Not Sufficiently Covered
High-energy accelerators, such as the many diverse types operated at BNL during its 60-year history, present the standard health physics problems, as well as emergent new challenges, typically unique to each type of new accelerator. There are many situations at high-energy accelerators that have the potential for unconventional exposures leading to unrecorded or under-recorded doses. The present BNL site profile does not address the unique dosimetry problems associated with high-energy accelerators, if the dosimetry systems were adequate during the startup periods, or if the dosimetry systems were sufficiently encompassing to accommodate operational changes. Nor does the site profile discuss adjustment factors for neutron doses, and if they are needed to compensate for the limitations of the dosimetry systems used as a function of time at different accelerator facilities.
SC&A's February 2012 update: *SC&A needs to determine if the revised TBD provides additional information that could be applied to this issue.*
NIOSH Response: Updated facility information in Section 2 of the revised TBD.
SC&A's March 2013 update: This issue was incorporated into SEC Issue #4. Which was satisfactorily addressed as follows: The original issue was that even if the highest dose value was recorded, this does not mean that the highest dose value correctly represented the dose received for all exposure situations. According to several BNL articles (such as Xie & Rohrig 1985 and Kahnhauser 2011), there were issues concerning the ability of the BNL neutron dosimetry system to register all the neutron D.E. because of the energy response range of the various neutron dosimeters. In a few instances, SC&A found locations where a portion of the neutron D.E. may result from neutron with energies greater than 20 MeV (such as 50% of the D.E. at 2 out of the 15 exposure areas characterized using Bonner spheres around the AGS in a memorandum by Xie & Rohrig 1985). However, considering that a conservative relative biological effectiveness (RBE) [or Quality Factor (QF)] of 10 was used at BNL for determining neutron dose at all times (when the measured QF was approximately 5), and that an energy employee would only spend a small fraction of time in the vicinity of such an exposure area, additional adjustment factors applied to all neutron dose records would be excessively conservative and not warranted. Additionally, special precautions and dosimetry were in place when personnel worked in the beam areas. SC&A considers this issue resolved.
Work Group Actions:
Board Action:

Finding 10: External Coworker Dose Data Not Addressed
Section 6 of the site profile (ORAUT 2006) does not address or provide any coworker data for use in assigning doses to workers who should have been monitored, but were not. Coworker data are needed in cases where the worker had the potential to receive greater than environmental doses, but by the criteria at the time, the individual was not considered a radiation worker and, therefore, was not badged, or the monitoring results cannot be located.
SC&A's February 2012 update: Although some of the information has changed in the revised TBD, there appear to be no significant changes concerning this issue; *therefore, this issue is still pertinent.*
NIOSH Response: Average worker external doses included in revised TBD of 2013.
SC&A's March 2013 update: SC&A evaluated the revised TBD and found that the information and data on pages 82–83, with the table of coworker data for 1947–2010 (which values were derived using a claimant-favorable method), along with the evaluation of external dose records, provide for resolution of this issue.
Work Group Actions:
Board Action:

Finding 11: Incidents and Unanticipated Events Not Addressed
The site profile (ORAUT 2006) does not sufficiently address incidents or unusual events that could affect external dose reconstruction. Some examples of incidents were found in the BNL documents; however, the site profile itself did not address such incidents for their implications to dose reconstruction, and whether the doses of record were correct under these exposure conditions. Likewise, specific environmental-related incidents and releases and their impact on onsite occupational doses to unmonitored workers are not addressed.
SC&A's February 2012 update: Although some of the information has changed in the revised TBD, there appear to be no significant changes concerning this issue; *therefore, this issue is still pertinent.*
NIOSH Response:
SC&A's March 2013 update: SC&A reviewed the revised TBD and found some increased coverage of incidents in Section 2.0. Information gathered during the evaluations of the two BNL SECs, including potential exposures and intakes, and external/internal dose records indicates that this issue has been satisfactorily addressed.
Work Group Actions:
Board Action:

Finding 12: Potential Environment Exposures from Igloo Area Not Addressed
Nothing is mentioned in Section 4 of the site profile (ORAUT 2006) concerning the Igloo storage area in the Hazardous Waste Management Facility (HWMF) and its impact on localized environmental doses. Averaged site parameter yearly readings, and other readings inside the BNL site, may not reflect the true environmental doses received by unmonitored workers who spent any significant time in the areas outside the Igloo or other hazardous waste facility areas.
SC&A's February 2012 update: Although some of the information has changed in the revised TBD, there appear to be no significant changes concerning this issue; *therefore, this issue is still pertinent.*
NIOSH Response: Additional information concerning the Igloo has been included in the revised TBD.
SC&A's March 2013 update: SC&A evaluated the revised TBD and found that this issue is satisfactorily addressed in Section 4.4.1, where additional environmental monitoring information (including the Igloo and HWMF) was provided. This issue has been resolved.
Work Group Actions:
Board Action:

Finding 13: The Site Profile has Inadequately Characterized the Number and Types of X-rays Received by BNL Employees in Early Years
The site profile (pg. 50) (ORAUT 2006) states that BNL had machines capable of photofluoroscopic/fluoroscopic exams in 1951 and 1960, but on page 50, it is concluded that only the diagnostic unit was used for routine exams, and on page 52, it is stated that it seems unlikely that the greater dose units were used for routine exams. These potential exposures were not further addressed in the site profile. It references Brodsky 1964 as one of its reasons to conclude that only the diagnostic unit was used routinely for examinations. However, Sunderman (1947) summarized the health program used for BNL employees in September 1947. Sunderman recommended that employees of BNL be observed medically (1) upon hire at BNL, (2) routinely for employees requiring health maintenance, (3) when employees become sick or injured, and (4) when employees terminated. Candidates for employment were to receive "fluororoentgenograms of the chest, AP and LAT roentgenograms of the spine, and roentgenogram of one forearm." During Health Maintenance exams of employees, an annual fluororoentgenogram of the chest was completed.
SC&A's February 2012 update: There have been some changes in this area in the revised TBD (ORAUT 2010); *therefore, SC&A needs to determine if the revised TBD provides additional information that could be applied to this issue.*
NIOSH Response: Revisions in Section 3 of the TBD address these issues. List of cases to support x-ray exam assumptions provided by e-mail of March 5, 2013 (NIOSH 2013).
SC&A's March 2013 update: Finding #13, Item #1, concerning Table 3-1 has been satisfactorily addressed in the revised TBD. Finding #13, Item #2: SC&A reviewed the revised TBD and the types of medical x-rays performed in the 20 cases provided by NIOSH and concluded that PFG, PA, and LAT exams are sufficiently covered in the revised TBD, and that other views, such as spinal and forearm exams, were not indicated in the records, except some that were illness- or injury-related. Therefore, this item is completed. Finding #13, Item #3, concerning Tables 3-2 and 3-3, has been addressed in the revised TBD, ***but the 2013 TBD edition still does not contain any information in the text of the TBD related to purpose, use, or derivation of Table 3-4 on page 52.***
NIOSH's April 30, 2013, response to SC&A's March 2013 update to Finding #13, Item #3: Table 3-4 on Page 52 simply shows the current skin dose guidance. It serves to document the basis for skin doses to particular areas of skin found in Table 3-5 on page 53. The TBD will be revised to add information that explains the purpose of the information in Table 3-4.
SC&A's May 2013 update: SC&A agrees with this course of action and has no further issue with this finding.
Work Group Actions:
Board Action:

References:

Brodsky, A., 1964. Minutes of a meeting (no title) held on June 29, 1964 between A. Brodsky of BNL and Paul Klevin of the Atomic Energy Commission. Brookhaven National Laboratory, Upton, New York. SRDB Ref ID: 17344.

Kahnhauser 2011. ORAU Team Dose Reconstruction Project from NIOSH Data Request, H. Kahnhauser to Dr. Falco, March 6, 2011. SRDB Ref ID: 93609.

NIOSH 2009. *SEC Petition Evaluation Report, Petition SEC-00113*, Rev. 0. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. September 29, 2009.

NIOSH 2011. Telephone Interview between Landauer Personnel and M.H. Chew personnel, July 27, 2011. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. SRDB Ref ID: 100347.

NIOSH 2012. *SEC Petition Evaluation Report, Petition SEC-00196*, Rev. 0. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. January 5, 2012.

NIOSH 2013. E-mail to members of the BNL Work Group from by Grady Calhoun (NIOSH), Subject: *RE: BNL TBD issues*. National Institute for Occupational Safety and Health, Office of Compensation Analysis and Support, Cincinnati, Ohio. March 05, 2013.

ORAUT 2006. *Technical Basis Document for the Brookhaven National Laboratory*, ORAUT-TKBS-0048, Rev. 00, Oak Ridge Associated Universities Team, Cincinnati, Ohio. August 30, 2006.

ORAUT 2010. *Technical Basis Document for the Brookhaven National Laboratory*, ORAUT-TKBS-0048, Rev. 01, Oak Ridge Associated Universities Team, Cincinnati, Ohio. April 26, 2010.

ORAUT 2013. *Technical Basis Document for the Brookhaven National Laboratory*, ORAUT-TKBS-0048, Rev. 02, Oak Ridge Associated Universities Team, Cincinnati, Ohio. February 7, 2013.

Phillips, L. F., 1974. *Personnel Dosimetry*, Associated Universities, Brookhaven National Laboratory, Upton, New York, May. SRDB Ref ID: 22429.

Preisig, J. R., 1995. "1995 Alternating Fradient Synchrotron (AGS) Bonner Multisphere Spectrometry and Carbon-11 Detector Results," memorandum to E. Lessard and H. Kahnuhauser, Associated Universities, Brookhaven National Laboratory, Upton, New York, July 24. SRDB Ref ID: 22845.

SC&A 2009. *Review of the NIOSH Site Profile for the Brookhaven National Laboratory,* ORAUT-TKBS-0048, Rev. 00, 2006. SCA-TR-TASK1-0001. SC&A, Inc., Vienna, Virginia, and Saliant, Inc., Jefferson, Maryland. September 2009.

Sunderman, F.W., M.D., 1947. *Health Program for Employees of the Brookhaven National Laboratory*, Brookhaven National Laboratory, Upton, New York. August 27, 1947. SRDB Ref ID 55277.

Xie, Y., and N. Rohrig, 1985. BNL Memorandum from Xie and Rohrig to Malinowski, T. of BNL. *Bonner sphere neutron measurements at the AGS*. November 22, 1985. Brookhaven National Laboratory, Upton, New York. SRDB Ref ID: 50833.

Xie, Y. R., 1986. "Neutron Measurements in JSW and 60" Cyclotron Maze Area," memorandum to D. Schlyer, Associated Universities, Brookhaven National Laboratory, Upton, New York, March 17. SRDB Ref ID: 121356.