Technical Support for the Advisory Board on Radiation and Worker Health Review of NIOSH Dose Reconstruction Program

Volume 1: Technical Proposal
Request for Proposal (RFP) 2003-N-00768

Submitted to:

Centers for Disease Control and Prevention
Acquisition and Assistance Field Branch
Attention: RFP 2003-N-00768
P.O. Box 18070, 626 Cochrans Mill Road
Pittsburgh, PA 15236-0070

Submitted by:

SC&A, Inc.
6858 Old Dominion Drive
McLean, VA 22101

June 2, 2003

Information Required by Solicitation Clause L.3(c)(2)

(i) Solicitation Number: 2003-N-00768

(ii) Offeror:

SC&A, Inc.
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Suite 301
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703-893-6600, fax 703-821-8236
http://www.scainc.com

(iii) Required Statement:

SC&A takes no exception to any of the terms, conditions, and provisions included in the solicitation. Pricing is given in the cost proposals for each of the Sample Tasks.

(iv) Authorized Negotiators:

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(v) Name, Title and Signature of person authorized to sign the proposal:

Sanford Cohen, President _____ Date _____

EXECUTIVE SUMMARY

S. Cohen & Associates (SC&A) has assembled a team which is uniquely qualified to provide technical support to the Advisory Board on Radiation and Worker Health Review (the Board) as part of the National Institute for Occupational Safety and Health's Dose Reconstruction Program. For the purposes of this proposal we have teamed with and with . In keeping with the Government's commitment to assist small and disadvantaged businesses, we have also made arrangements to bring on a qualified 8(a) subcontractor, , upon contract award.

Three attributes of the SC&A team separate us from our competition. First, our team offers *depth of expertise*. For the past 21 years, SC&A has been in the forefront of the radiation protection community. Our company President, Sanford Cohen, has dedicated his professional career to the radiological sciences. A nuclear engineer by training, Dr. Cohen founded SC&A in 1981. The company specializes in the assessment of radiation and radioactive materials in the workplace and environment and its associated risks to workers and the public health. We can provide expertise in radiological dose and risk assessment, dose reconstruction, environmental restoration and waste management, radiation sciences, health and safety analysis, public outreach, geographical information systems, and information management. SC&A is well known within the radiation protection community and is respected for its objectivity, scientific expertise, and communication abilities.

, SC&A's proposed Project Manager, has a Ph.D. in health physics, is certified by the American Board of Health Physics, and has over 30 years experience in providing health physics consulting services. He has completed numerous risk assessments for several Government and private sector clients and has been involved with historical dose reconstruction projects involving the people of the Republic of the Marshall Islands and the Idaho National Engineering and Environmental Laboratory (INEEL).

As a company, SC&A maintains a staff of highly qualified, technically skilled professionals. More than 70 percent of SC&A's professional staff have earned advanced degrees—approximately one-third at the Ph.D. level. The majority of staff members have 15 to 25 years of experience in solving complex scientific and technical problems. Many of our professionals are radiobiologists, radioecologists, environmental scientists, engineers, health physicists, chemists, and physicists. Other scientific disciplines include hydrogeology, metallurgy, geography, biology, epidemiology, toxicology, computer science, mathematics, and statistics. To complement our technical staff, SC&A also offers expertise in policy analysis, economics, law, communications, information management, and public outreach and education.

SC&A's corporate headquarters is located in McLean, Virginia with regional offices in Montgomery, Alabama, and St. Louis, Missouri. We also maintain a full service radiological laboratory, allowing us to empirically evaluate radiological issues.

, and its principal, , have unique expertise, experience, and capabilities to perform key tasks identified in the solicitation, particularly those related to Department of Energy (DOE) and Atomic Weapons Employer (AWE) site profiles, worker

profiles, and SEC reviews. and its associates have years of advanced health physics experience, both at DOE and in the commercial sector. Senior associates, such as and , are intimately familiar with historic dosimetry programs at DOE and AWE sites, and are knowledgeable of worker dose histories and operations throughout the 60-year history of these sites. Mr. , during his notable Federal government career at DOE, was a pioneer in identifying past radiation program deficiencies with respect to dosimetry and record-keeping practices, program management, and policy and standards, and identifying needed improvements.

offers extensive experience in radiological survey and personnel dosimetry programs, primarily for facilities associated with the National Institutes of Health. In addition, can provide expertise in radiological training, communication, and outreach, should such services be required on this project.

Second, the SC&A team offers *vast Federal contracts experience.* Throughout its history, SC&A has administered a number of large, multi-million dollar/multi-year, task-order contracts requiring multiple subcontractors, formal quality assurance/quality control programs, and their attendant management and auditing systems. SC&A's principal client is the Federal government, although we have conducted projects for State environmental agencies and private sector clients. About 80 percent of SC&A's contracts, valued at more than $250 million, have been large task-order contracts for the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the Nuclear Regulatory Commission (NRC). These contracts have encompassed more than 500 work assignments dealing with a broad range of health physics and radiological issues. Other clients have included the Defense Nuclear Facilities Safety Board (DNFSB), the Department of Justice, and the Congressional Office of Technology Assessment. Based on this experience, SC&A has developed the tools and the know how to manage large task order contracts, including comprehensive quality assurance and quality control plans, as well as document and software controls that have passed EPA and NRC audits.

Both and have actively supported Federal agencies, including the National Institutes of Health, the U.S. Forest Service, and the Federal Emergency Management Agency, as well as private clients such as Johns Hopkins University and the Federation of American Scientists.

The third attribute of the SC&A team is perhaps the most significant. *The team has neither an actual nor perceived conflict of interest with respect to DOE.* While most other radiological consulting companies have provided direct services to DOE and the nuclear utility industry, SC&A made a decision early in its existence to devote its resources to supporting those government agencies that regulate DOE and the nuclear industry. Thus, we have been very selective in our assignments and have implemented stringent conflict of interest standards within the company.

With these standards in mind, we disclose here that the SC&A laboratory is performing radiological analyses of environmental samples collected at DOE sites by DOE contractors. However, we do not believe this work will in any way present a conflict to the Board. In addition, none of the SC&A team has past or current contracts with NIOSH or its dose

reconstruction contractors. Therefore, we are confident that our team is free of any actual or perceived conflict of interest.

It is our understanding that the primary role of the contractor on this project is to assist the Board in its efforts to advise the President on guidelines pertaining to Section 3623(c) of the Energy Employees Occupational Illness Compensation Program Act of 2000, particularly in terms of dose reconstruction and the allocation of risk. The contractor will be expected to review dose reconstructions performed by NIOSH, review Special Exposure Cohort (SEC) petitions, review worker and site profile databases, and provide a broad range of ad hoc technical support to the Board as required. The SC&A team's approach to the work required by the Board will draw upon the three attributes described above.

Much of the work done by SC&A and its other team members is similar in many respects to the proposed statement of work. SC&A has performed numerous health physics and nuclear safety investigations for the DNFSB regarding the safe operations of DOE facilities and has provided extensive health physics consulting support to NRC, the Atomic Industrial Forum, the Electric Power Research Institute, universities, and private sector clients. SC&A conducted the Phase I study of the INEEL dose reconstruction for CDC and is currently reconstructing the atmospheric source terms and associated doses to the public associated with historical operations at INEEL. In addition, SC&A has been leading the effort in support of the government of the Republic of the Marshall Islands to reconstruct the historical thyroid and whole body doses for the people of Rongelap and Utrik Atolls in the Marshall Islands.

Figure ES-1 presents the proposed organization chart for this project. We are proposing a management structure that includes both a Project Manager, , and a Deputy Project Manager, . This management construct best leverages the unusual qualifications of these two individuals and will offer an energy and synergism to the project that few companies can rival. As an experienced Certified Health Physicist, can provide the technical oversight necessary to a project of this complexity. His understanding of radiation dose assessment techniques and his experience in dose reconstruction exercises makes him the ideal Project Manager. In addition, is the Senior Vice President of SC&A and has over 15 years of experience in managing large task-order contracts for government agencies. Complementing 's technical expertise will be 's unparalleled familiarity with DOE and AWE facilities. has over 20 years of experience with DOE, including serving as Deputy Assistant Secretary for Health and Safety. Together, and possess the knowledge and expertise necessary to direct any task orders issued by the Advisory Board.

The project team consists of nine key individuals (designated by an asterisk in Exhibit ES-1) that will be dedicated to the project and will serve as the project management team. These nine individuals will be supported by 24 highly specialized experts in various disciplines critical to the mission of the contract. As Task Order Request Packages (TORPs) arrive at SC&A, this team will prepare comprehensive technical and cost proposals and will assign staff to review teams based on the specific requirements of each case. Depending on the case and the complexity of the review (e.g., basic versus advanced reviews versus blind dose reconstructions), a review team

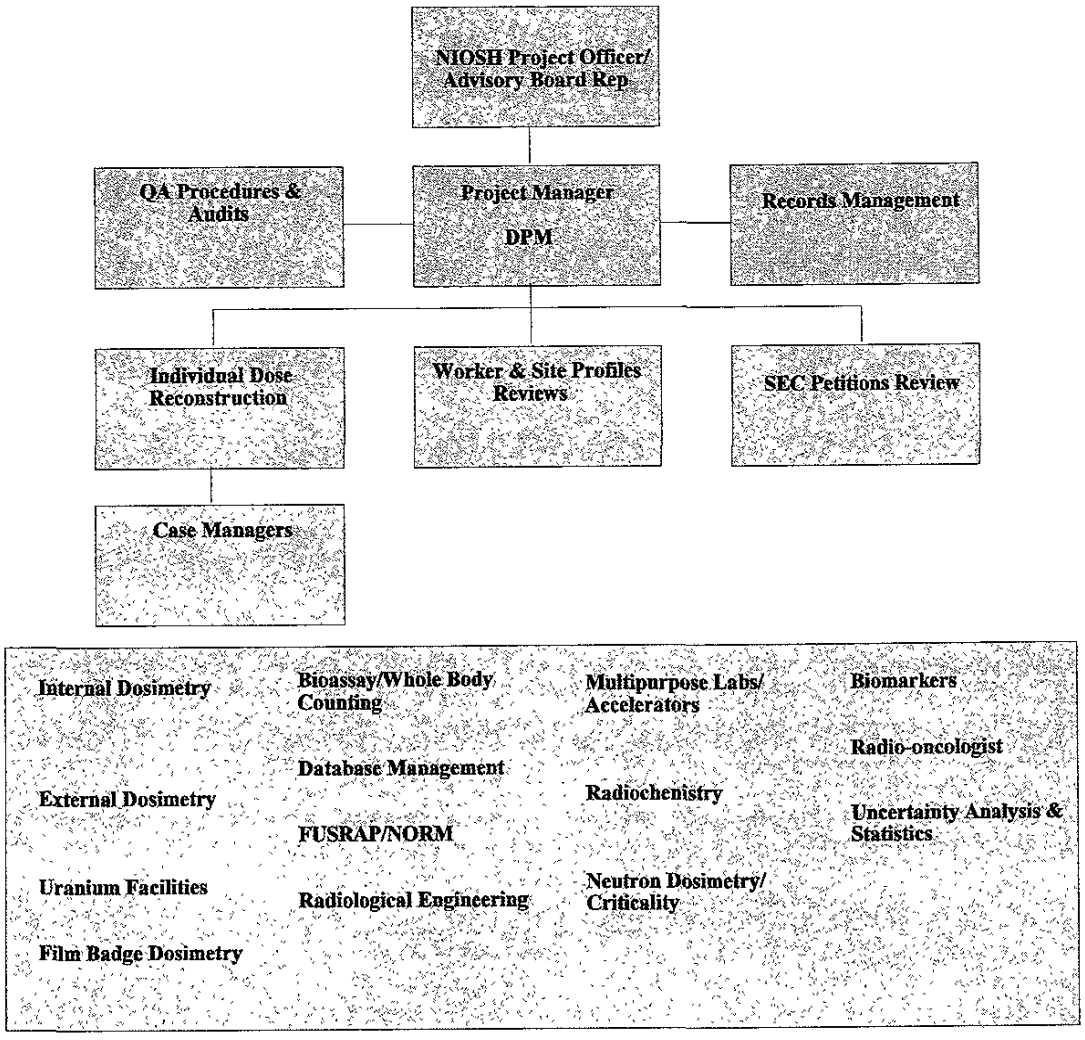

Exhibit ES-1. Organizational Chart
(* indicates key personnel)

might consist of only one or two persons or it might consist of several individuals working under the direction of a Case Manager. In forming these teams, we will draw from the specialized technical resources identified in Exhibit ES-1. All work will be performed under a highly structured and transparent quality assurance/quality control and documentation process, which includes audit forms and checklists that correspond to the requirements of Part 81 of Title 42 of the *U.S. Code of Federal Regulations* (CFR), "Probability of Causation," 42 CFR 82, "Dose Reconstruction," 42 CFR 83, "Special Exposure Cohorts," OCAS-IG-001, "External Dose Reconstruction and Implementation Guideline," and OCAS-IG-002, "Internal Dose Reconstruction and Implementation Guideline."

Under this organization, Drs. will be responsible for ensuring that all basic and advanced reviews and blind dose reconstructions are performed in a fair and consistent manner, are well-grounded in the best available scientific knowledge, and give the benefit of the

doubt to the claimant. They will either serve as case managers themselves or direct reviews performed by other case managers. In Exhibit ES-1, we have identified three case managers, but any member of the project team can serve as a case manager, depending on the nature of the case.

Because of their familiarity with DOE and AWE facilities, worker profile and site profile reviews will be performed by , which will also support Drs. in advanced reviews and blind dose reconstructions. SEC petition reviews will be performed under the direction of . is known not only for his expertise in nuclear engineering, but also as an advocate for worker rights. We believe that his presence on the SC&A team will enhance the credibility of our findings with the SEC applicants.

For basic reviews, the emphasis will be placed on ensuring that dose reconstructions were performed in accordance with 42 CFR 82, as well as NIOSH procedures and guidelines, using a hierarchy of methods (i.e., highest priority given to complete and adequate dosimetry records and, lacking adequate dosimetry records, falling back to co-worker records and, lacking that, falling back to area dosimeters, etc.). Basic reviews will evaluate (1) the data collection process, (2) the claimant interview, (3) external and internal dose reconstruction, and (4) relevant NIOSH procedures and methods. If the dose reconstruction utilized worker profile and site profile databases, the basic reviews will also review those portions of the databases used to perform the dose reconstructions. Our basic and advanced reviews will be performed in accordance with the review procedures provided in Appendix C of this proposal.

Advanced reviews will go beyond the basic reviews in that they will require a much more extensive assessment of the data collection process performed on behalf of the case. We will critically review the records upon which the dose reconstructions were performed for completeness and adequacy, and will compare them with the claimant interview forms and with the worker profile and site profile databases. For the important contributors to exposure, we will draw upon the highly specialized expertise of the members of the project team (i.e., neutron dosimetry, criticality dosimetry, uranium and TRU internal dosimetry and bioassay, film badge dosimetry). Our objective for both basic and advanced reviews will be to assess the consistency and reasonableness of the assumptions and determine whether patterns emerge which reveal fundamental flaws or systematic biases in the dose reconstruction process.

For blind dose reconstructions and advanced reviews, we will employ the entire administrative record, perhaps visit with DOE and DOE contractor personnel, if needed, and perform supplemental interviews, if needed and if authorized by the Board. In the case of blind dose reconstructions, unlike basic and advanced reviews, we assume that we will not have access to the dose reconstruction or IREP input/output prepared by NIOSH.

Finally, we assume that we may be called upon to review worker and site profile databases and perform special studies as requested by the Board. It is for this reason that we have assembled a large, highly experienced project team. With the SC&A team, the Board can be assured of a contractor who is dedicated to the pursuit of information, technical and scientific integrity, and high standards of quality. This will be an important contract to SC&A, and it will receive the timely attention of senior management. The resources assembled for this proposal are among the best in the world and can be relied upon to recognize, understand, and meet the substantial challenges of conducting reviews and audits that will withstand the most intense scientific scrutiny and be accepted by the claimants as fair and unbiased. In addition, the three attributes of the SC&A team—depth of expertise, vast Federal contracts experience, and no conflict of interest—make us the best possible choice to fulfill the requirements of this proposal. The project team stands ready to assist the Board in any way possible.

Unique Qualifications

- SC&A staff represent some of the most experienced and nationally recognized experts in health physics and internal and external dosimetry.
- SC&A has vast experience in managing large task-order contracts, particularly those dealing with radiological issues.
- SC&A has extensive experience in historical document retrieval for the purposes of dose reconstruction.
- SC&A has a corporate Quality Management Plan and Standard Operating Procedures that meet ANSI and EPA requirements.
- By teaming with , we bring to the project extensive knowledge of the DOE complex and AWE facilities and its historical practices.
- By teaming with , we bring to the project a vast amount of hands-on experience in radiation protection practices.

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LIST OF EXHIBITS

1.0 UNDERSTANDING THE PURPOSE AND OBJECTIVES

Exhibit 1-1 graphically presents our understanding of the overall statutory/regulatory framework within which this contract will be implemented. Within this framework, compensation is provided to covered employees via two administrative categories of procedures: (1) those that are used if the individual is a member of a Special Exposure Cohort (SEC), and (2) those that are based on a dose reconstruction and an assessment of probability of causation (PC) and are used, in part, to determine whether compensation is warranted. The former process requires appropriate filings and administrative determinations, but does not require a dose reconstruction. The latter process also requires appropriate filings and administrative determinations, but will include dose reconstructions and an assessment of PC. This proposal of work is concerned primarily with the latter category of claimants.

Potential claimants file Forms EE-1, 2, 3, 4, and 7, as applicable, along with a narrative medical report, with the U.S. Department of Labor (DOL). The DOL, as lead agency, authorizes the Department of Energy (DOE) to compile all applicable records. The DOL also authorizes the National Institute for Occupational Safety and Health (NIOSH) to begin the dose reconstruction process. The reconstructed doses are provided to the DOL, along with documentation, in a form appropriate for input to the computer code, Interactive RadioEpidemiological Program (IREP). The output of IREP is used to support the adjudication process for claimant compensation. Within this process, Section 3624 of the Energy Employees Occupational Illness Compensation Program Act (EEOICPA) requires: (1) the formation of the Advisory Board on Radiation and Worker Health, (2) the President to make appointments to the Board, including its chairman, and (3) the Board to advise the President on guidelines pertaining to Section 3623(c) of the EEOICPA (i.e., dose reconstruction and the allocation of risk), evaluate the validity of the reconstructed doses, and evaluate other related matters. It is our understanding that the primary role of the contractor on this project is to assist the Board in reviewing the dose reconstructions performed in support of adjudicated claims and their accompanying administrative records.

Section 3626 of the Act also requires the Board to advise the President whether there are classes of employees at any DOE facility that should be treated as members of an SEC. In fulfilling these responsibilities, the Board will be required to make certain radiological determinations regarding the records and exposures experienced by that cohort. The Board will also be called upon to review SEC petitions filed under Part 83 of Title 42 of the *U.S. Code of Federal Regulations* (CFR), "Special Exposure Cohort." It is our understanding that the contractor will be required to assist the Board in fulfilling its mission on matters related to SEC petitions. SEC petition reviews could require a substantial level of effort and the services of highly specialized, technically diverse, and experienced personnel. In addition, this work will need to be performed simultaneously with basic and advanced reviews, and perhaps blind dose reconstructions. It is for this reason that we have formed a large, technically diverse team. In addition, we are prepared to expand upon the resources of the team members or add new team members, as needed. This can be accomplished by drawing from the existing resources within our team, adding new associates, or bringing aboard new subcontractors. SC&A is very experienced in efficiently responding to surges of unique and highly specialized work under task order contracts.

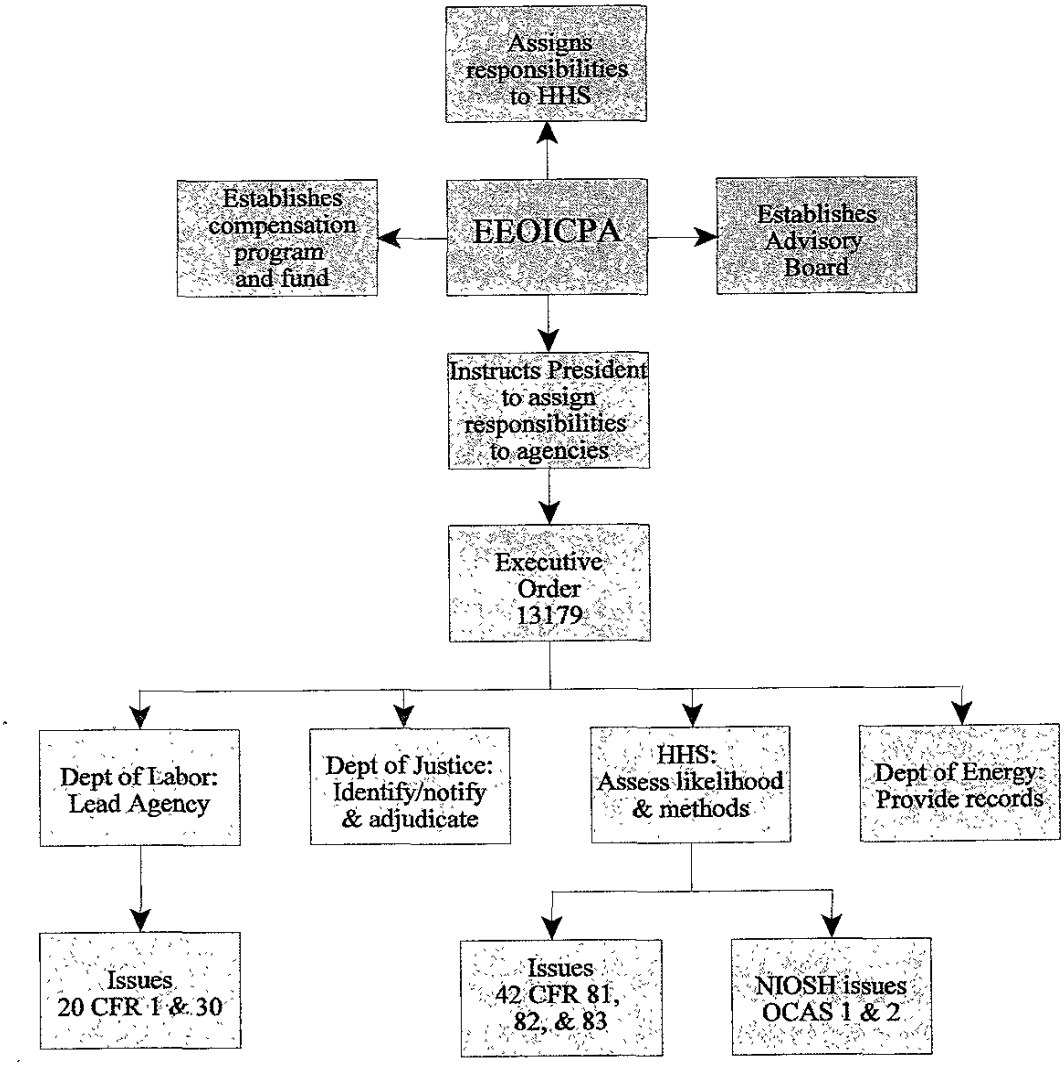


Exhibit 1-1. EEOICPA Regulatory Framework

It is SC&A's understanding that NIOSH currently has approximately 12,000 claims in its possession that require dose reconstructions. New claims are referred to NIOSH by the DOL at a rate of about 200 per week. These dose reconstructions are being performed by NIOSH, with the assistance of its contractors, in accordance with the requirements set forth in 42 CFR Part 82, "Dose Reconstruction," and the guidelines provided in OCAS-IG-001, "External Dose Reconstruction Implementation Guide," and OCAS-IG-002, "Internal Dose Reconstruction Implementation Guide." The results of these dose reconstructions, along with other claimant information delineated in 42 CFR Part 81.5, are being used by the DOL as input into IREP to derive the probability that a claimant's radiogenic cancer, as delineated in 42 CFR Part 81, was

caused by exposure to radiation received by the claimant during the course of performing his or her duties at a DOE facility or Atomic Weapons Employer (AWE) facility as listed in the *Federal Register*, Volume 66, Number 112, page 31218, June 11, 2001, and as revised in subsequent notices. In accordance with 42 CFR Part 82, the results of these probability-of-causation calculations, as derived using IREP, are used by the DOL for determining whether the individual with cancer is found "at least as likely as not" to have sustained the cancer from work-related exposures to ionizing radiation.

We understand that the reconstruction of doses is concerned with the dose delivered to particular organs over specific time periods and not the total effective dose commitment. In addition, "missed dose" is of particular concern to a dose reconstruction. As such, this program differs in many important ways from the dose assessments performed for the purpose of demonstrating compliance with radiation protection standards.

SC&A understands that a critical factor affecting how doses are reconstructed is the amount of time available to adjudicate the claims. The claimants, because of their medical conditions, are especially entitled to a speedy resolution of their claims. In response to the EEOICPA, the dose reconstruction process is not a research project, as it is for many of the offsite dose reconstructions being performed by the Centers for Disease Control and Prevention (CDC). Under the NIOSH program, a delicate balance must be struck between efficacy and precision. A high level of precision, when not required to support an adjudicated decision, will only unnecessarily delay the decision-making process. SC&A believes that implementing dose reconstructions with a full appreciation of this balance is critical to the success of this project. This overarching principle applies to the dose reconstructions performed by NIOSH, the reviews of the dose reconstructions that will be performed on this project on behalf of the Advisory Board, and the review of SEC petitions. Nevertheless, the dose reconstructions and reviews of SEC petitions must be fair, consistent, and well grounded in the best scientific knowledge. They must also give the benefit of the doubt to the claimant.

It is SC&A's understanding that our role on this project is to assist the Advisory Board in the fulfillment of its mission under Section 3624 of the EEOICPA, specifically Section (b)(2), which states, "The Board shall advise the President on the scientific validity and quality of dose estimation and reconstruction efforts being performed for purposes of the compensation program." In addition, our role is to assist the Board in fulfillment of its mission under Section 3626 of the EEOICPA (and draft 42 CFR Part 83) related to the review of SEC petitions.

In formulating our concept of operations for this project, we struggled with the degree to which we, as consultants to the Advisory Board, will comment on the validity of any given adjudicated decision. Unless specifically requested by the Board, we believe that such commentary goes well beyond our mandate. It is our understanding that we are not part of an appeals process. We are simply to help the Board probe technical issues, to reveal and gain insight into areas where the dose reconstructions may have had problems, and to seek out possible systematic errors or biases in the way in which the doses are reconstructed. We believe we can best serve the Board by being a source of highly credible analysts that, in the end, will provide confidence to all

concerned that the decisions being made under the Act are fair, consistent, and well grounded in the best scientific knowledge, and that they give the benefit of the doubt to the claimant.

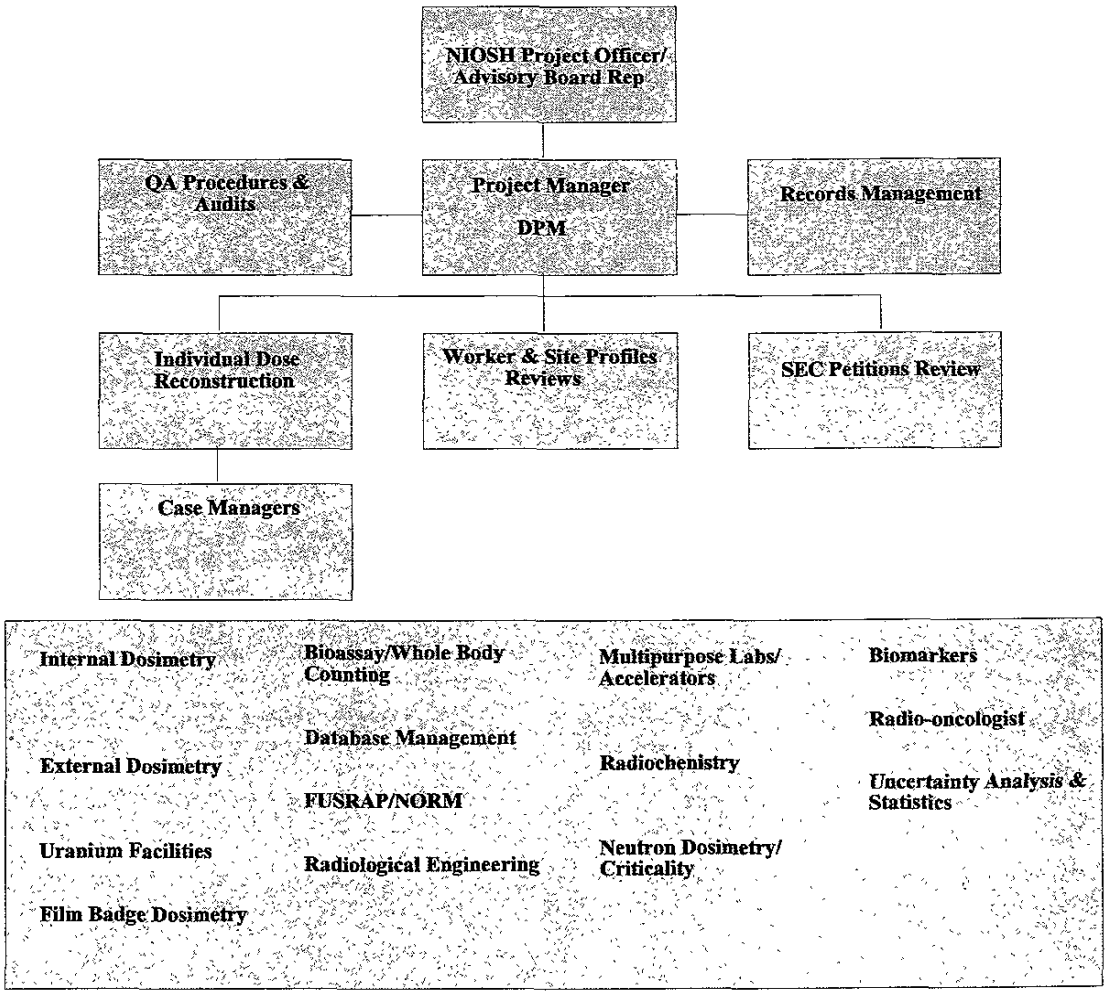
2.0 MANAGEMENT APPROACH

2.1 Project Organization

SC&A has assembled a large, highly responsive team to address the multi-disciplinary areas of the statement of work (SOW). Exhibit 2-1 shows the overall organizational structure of the project. The individuals designated with asterisks (*) are the program management team and the key individuals on the project. A total of nine key personnel are proposed. These individuals will not be replaced without written approval of the Contract Manager. These individuals are prepared to commit at least half time, and, for most individuals, full time to this project for its entire duration. Each key person has a back up. The individuals on the bottom of the chart, many of whom are nationally and internationally recognized experts on internal and external dosimetry, bioassay, radiation protection, and other specialized technical areas, serve as resources to the project management team on specific task orders, cases, and Special Exposure Cohort (SEC) petition reviews. Section 4 of this proposal presents biosketches of each of the key individuals on the project, along with statements addressing their level of commitment. Appendix A presents complete resumes of all individuals on the project team. Appendix B presents signed statements by each member of the project team disclosing any potential, actual, or perceived conflict of interest issues.

As prime contractor for the proposed effort, SC&A will oversee and manage all project activities and carry out all work, relying on the company's 21-plus years of Federal contracting experience to ensure maximum performance within budgetary and contractual limitations. SC&A has a history of close working relationships with its clients and subcontractors on Federal contracts which will enhance our ability to communicate effectively and resolve issues that may arise in the performance of this contract. The SC&A team will be managed by , who is the Senior Vice President of SC&A, and Mr. , who will serve as Deputy Project Manager. Dr. is eminently qualified to oversee the proposed effort. He has the authority necessary to fulfill the requirements of this contract and to complete task orders on schedule and within budget. Dr. has over 30 years experience as a consultant to the Federal government in the area of radiation protection and has managed numerous major (multi-year, multi-million dollar) contracts for Federal agencies, including the Environmental Protection Agency (EPA), Nuclear Regulatory Commission (NRC), and the Centers for Disease Control (CDC). In addition, Dr. has been fully certified by the American Board of Health Physics since 1976.

As Project Manager, Dr. will exercise project fiscal control and bear ultimate responsibility for ensuring that all technical contractual obligations are fully satisfied in a timely manner. Dr. has a reputation among his clients for providing efficient service within budget estimates, while maintaining a proactive approach to problem resolution. Should, for any reason, Dr. become unavailable to the project, the President and CEO of SC&A, Dr. Sanford Cohen, will assume project management responsibilities. Dr. Cohen has a Ph.D. in Nuclear Engineering and has over 35 years experience in managing large, complex government task order contracts concerned with radiological engineering and radiation dose assessment issues.



We have assigned as Deputy Project Manager working alongside Dr. on every aspect of this project. We elected to take this approach because is intimately familiar with DOE and AWE facilities as a result of his 21 years of experience with DOE in the area of health and safety oversight of DOE programs. 's understanding of DOE and AWE sites, coupled with qualifications in health physics and experience managing large Government task order contracts, creates an extremely powerful project management team.

Dr. will be responsible for maintaining quality and configuration control over all standard operating procedures (SOPs) used on the project Section 3 presents the technical approach and review/auditing procedures that will be used on the project) and for QA audits verifying and documenting that all work is being performed and documented in accordance with approved procedures. His internal audits of SC&A's task orders will also ensure that areas for which deviations from the SOPs are needed and implemented are documented (in accordance with the SOPs) and that, if necessary, revisions to the SOPs to accommodate lessons learned are

made. Dr. has over 20 years experience in assessing, integrating, and implementing diverse new technologies; managing departments; and directing specialists with advanced degrees in projects and programs, ranging from small studies to billion dollar, first-of-a-kind, mega-projects for commercial companies, electric utilities, government agencies, and universities. He was formerly Manager and Chief Engineer of Nuclear Engineering, responsible for personnel and technical direction of all nuclear engineering activities, for a major architectural/engineering firm.

Ms. will serve as the project's Records Management specialist. Ms. has served as records management specialist at SC&A for the past 13 years and was responsible for health physics records management at GPU Nuclear for 10 years. She will be the central repository for all documents and records received from the Project Officer pertaining to all Task Order Request Packages (TORPs), all project procedures, all project deliverables, and all internal and external correspondence. She will establish a hard copy and electronic filing system that will maintain the confidentiality of information, while still making it accessible to authorized individuals in accordance with project SOPs.

Dr. and Dr. will serve as the co-lead dose reconstruction reviewers. Dr. has extensive experience in dose reconstruction in the Marshall Islands and served as the Radiation Protection Manager at GPU Nuclear during the cleanup of Three Mile Island Nuclear Generating Station Unit 2. As a result, he is intimately familiar with external and internal dosimetry issues associated with complex health physics operations. Dr. is an internationally recognized expert on internal dosimetry. Drs. will be directly responsible for all dose reconstruction reviews and blind dose reconstruction performed on this project, ensuring that any individual assigned to perform dose reconstruction reviews and blind dose reconstructions does so in accordance with the SOPs, and that deviations from the SOPs receive the proper review, approval, and documentation.

Messrs. and and will serve as Case Managers. Because of the large number of basic and advanced reviews required by this project, we have elected to designate at least three Case Managers to the project reporting directly to Drs. . Additional Case Managers will be assigned as the number of cases increase. In many cases, a single person may be able to manage more than one case; while in others, such as advanced reviews and blind dose reconstructions, one person may only be able to manage a single case at a time. We believe strongly in the concept of a "Case Manager," because it helps to ensure accountability and transparency for each case.

will wear two hats on this project. In addition to his role as Deputy Project Manager, he will serve as lead reviewer of worker and site profiles. As explained earlier, has extensive knowledge of the health and safety issues at DOE and AWE facilities, and is therefore especially well qualified to provide independent reviews of worker and site profiles, as directed by the Board. served as DOE's Deputy Assistant Secretary for Health and Safety and is intimately familiar with DOE operations and radiation protection practices across the DOE complex. He will also support the Case Managers in the performance of both basic and advanced reviews and blind dose reconstructions, where worker

and site profiles are critical to the dose reconstructions. He will also be available to support SEC Petition reviews. will be assisted by Mr. and Dr. . Both Mr. and Dr. have over 30 years experience, a large portion of which consisted of working with on matters related to ES&H at DOE facilities.

will serve as lead SEC petition reviewer. is an expert in nuclear engineering and also a nationally recognized advocate for worker rights. He will be responsible for overseeing SEC petition reviews, with the assistance of other members of the project team as required, to ensure that the reviews are performed in accordance with procedures prepared specifically for this project (see Section 3), and that deviations from the SOPs receive the proper review, approval, and documentation. In this capacity, can draw upon any member of the project team.

Drs. and , both of whom are recognized experts in statistics and uncertainty analysis, will serve as a resource to the other key individuals on the project in matters pertaining to statistics and uncertainty analysis. Their primary responsibility will be to review the distributions of the parameters used as input to IREP based on the information provided in the administrative record. Since the ultimate objective of dose reconstruction is to construct distributions characterizing the uncertainty in the doses experienced by the claimants and which serve as input to IREP, we believe that every case review must be reviewed by Dr. or Dr.

The other members of the SC&A team are critical to the success of the project because of their specialized expertise in each of the technical areas of this project. They will be called upon by the Case Managers as required to ensure a complete and quality audit of each case and SEC petition.

2.2 Flow of Work

The project calls for the performance of 70 Basic Reviews, 70 Advanced Reviews, 10 Blind Reviews, 5 Worker Profile Reviews, and 5 Site Profile Reviews in the first year of this task order contract. We assume that Example Tasks 1 and 2 are representative of the types of TORPs that will be issued periodically by the Project Officer. This type of project is best managed and performed using a matrix organization consisting of Case Managers, who are responsible for one or more cases, and a team of technical specialists who will work on one or more cases, under the direction of the Case Managers, depending on the technical requirements of the case. Any person in the organization chart provided in Exhibit 2-1 could serve as a Case Manager, depending on the nature of the task, and any person on the team could also be assigned specific technical responsibilities on a case.

We struggled with identifying the scope, schedule, level of effort, and staffing required for a basic review, advanced review, or a blind dose reconstruction for obvious reasons—until we see the administrative record for a given case, such estimates would be highly speculative. We prepared very detailed checklists (see Appendix C) to be used as we systematically perform and document our basic and advanced reviews. Inspection of the checklists reveals that a basic

review, and especially an advanced review or a blind dose reconstruction, could require a considerable level of effort. Because we expect that the level of effort required for each case that comprises a TORP can vary widely, we have elected to begin the process of preparing technical and cost proposals by first sorting the cases into two categories: those requiring a relatively large level of effort with several staff members, and those that could be performed by a single individual in a relatively short period of time.

Notwithstanding uncertainties in the scope of a given review, we also understand that we must make the best estimates we can in the scope, schedule, and resources required, given the limited information currently available to us. We believe that the basic reviews of many cases could be performed by a single person in a matter of a few days. However, some basic reviews may require several technical specialists and a week or more to complete. We believe that all advanced reviews will require a minimum of a three-person team, including the Case Manager, and several weeks to complete.

The functional areas that will be performed in a basic review will include dose reconstruction reviews and claimant interview record reviews (according to the checklists in Appendix C). But it is our understanding that, if the dose reconstruction for a given case also required the utilization of worker and site profile information, even our basic reviews will require us to review at least a portion of the worker profile and site profile databases.

We believe that advanced reviews, using our procedures in Appendix C, will be much more extensive than the basic reviews because they will require ensuring that all sources of potentially relevant information and records were considered. This could include meetings with site personnel and cross-checking the claimant interview questionnaire with the data used for the dose reconstruction and with the worker profile and site profile databases. If authorized by the Board, advanced reviews and blind dose reconstructions may require meetings with site personnel,[1] requests for additional information, and perhaps supplemental claimant interviews (again, if authorized by the Board and if approved by the claimant or the claimant's representative). We will likely also review co-worker records and interview co-workers, especially if dosimetry records are deficient.

Such reviews certainly sound like they could easily grow into very large efforts, and, in theory, they can. However, at the same time, as stated earlier, these reviews are not research projects. Our objective is not to reconstruct highly precise and complete historical doses. Rather, our goal is to perform reviews that will identify areas in which the method used to reconstruct the doses (1) may have errors or systematic biases, and/or (2) could have resulted in substantively errant reconstructed doses. We believe that, on average, each team will be able to complete a basic review and deliver its work product to the Board within one week from the date of authorization to proceed. However, some cases may require a somewhat longer period of time. For advanced reviews and blind dose reconstructions, we believe that we will be able to deliver our work

[1] We understand, based on our review of the pre- proposal conference meeting minutes, that visits to DOE sites will not be necessary, but offsite meetings with key DOE and DOE contractor personnel may be required as part of advanced reviews and blind dose reconstructions.

product to the Board within four weeks from authorization to proceed. In cases in which the review reveals unresolved data inconsistencies, questionable assumptions, calculational errors, or similar discrepancies, it may be beneficial and expeditious to develop a working relationship with the original authors of the dose reconstructions that we are requested to review.

It is our expectation that the first few basic and advanced reviews will require more time to complete because we will be on a learning curve. However, as we become more familiar with worker and site profiles, our efficiency will continually increase and the level of effort and time required to perform basic, advanced, and blind dose reconstructions will continually decrease.

Assuming each advanced review and blind dose reconstruction will require a three-person team and four weeks to complete (not all team members will be devoted to each review for the entire duration of the review), and given that our project team consists of 35 individuals, SC&A will be able to form as many as 10 teams to readily meet the solicitation requirements of 70 Basic Reviews, 70 Advanced Reviews, 10 Blind Reviews, 5 Worker Profile Reviews, and 5 Site Profile Reviews during the first year, including tasks related to worker profile and site profile reviews, SEC petition reviews, and other ad hoc investigations. We have assembled a large team with the specific objective of providing the ability to handle widely varying work loads and highly diverse cases, some of which may require very unique and specialized expertise.

Dr. and Mr. will interact directly with the Case Managers on technical progress and issues pertaining to their specific work products. The Case Managers will be responsible for their respective cases, including planning, scheduling, and cost control, as well as the technical quality of the deliverables. They will be accountable to the Project Manager for ensuring the timely and cost-effective preparation of high-quality deliverables. More specifically, the Case Managers will be responsible for the following:

- Supervising all work performed by the staff assigned to their cases
- Ensuring that work is performed in conformance with project SOPs and quality assurance (QA) requirements
- Reporting the status of assigned work to the Project Manager

2.3 Procedures and Training

All reviews and audits performed on the project will be performed and documented in accordance with SOPs for auditing external and internal dose reconstructions, worker profiles, claimant interviews, site profiles, and SEC petitions (see Section 3). Each of the key members of the project team and each Case Manager will be trained in the use of these procedures at SC&A's expense.

2.4 SC&A Methodology to Ensure Completion of Tasks

2.4.1 Management of Complex, Multi-Task and Multi-Disciplinary Contracts

SC&A has a wealth of experience managing complex, multi-task, and multi-disciplinary contracts. Over its 22-year history, SC&A has managed more than 20 such contracts, involving complex subject matter and numerous and simultaneous task orders (often more than 25 at a time), requiring teams of staff comprised of scientists, health physicists, regulatory specialists, engineers, and public outreach and communications specialists. Many of these contracts have been managed by SC&A's proposed Project Manager, Dr. . For this effort, SC&A has assembled a team capable of responding to the technical requirements encompassed by the SOW. However, should additional or more diverse specialized expertise be required, SC&A's active list of Associates could be utilized. Or, if an unanticipated work requirement should arise, SC&A is willing to subcontract outside of the team assembled for the purposes of this proposal. (SC&A has established procedures for competitive procurement of new subcontractors.) A gap in existing expertise should be recognizable very early in the performance of a task order (most likely at the work plan development phase), thus allowing sufficient time for SC&A to respond. SC&A will implement the following procedures to ensure effective management of the contract SOW areas.

Review and Distribution of Task Orders in a Timely Manner

SC&A has time-tested procedures to ensure the timely review and distribution of task orders. The following procedures will be performed within 14 calendar days after receipt of a TORP:

- When the Project Manager receives a TORP from the Project Officer, he will first review it for Organizational Conflict of Interest (OCI), assess its requirements for resources with the key members of the team, and then determine how best to meet the requirements of the TORP, without impacting the resources available for ongoing tasks. At this point in the process, the Project Manager, in consultation with the Deputy Project Manager, will make a first attempt at sorting the tasks into categories regarding scope and level of effort.

- After the allocation of SC&A resources has been established, the Project Manager will select the Case Managers, who will perform or oversee the performance of the specific cases that comprise the TORP.

- If necessary, the SC&A Project Manager, Deputy Project Manager, and Case Managers will contact the Project Officer or his designee to clarify any issues that are unclear in the TORP and to gain a more complete understanding of the scope of work. After that interaction (which may be in person or by telephone), the Project Manager, in consultation with the Deputy Project Manager and the designated Case Managers, will commence preparation of the technical and cost proposal for the TORP.

At no time will SC&A delay the initiation of TORPs. Work will commence when the technical and cost proposal for the TORP is approved and SC&A receives notice to proceed.

Tracking Progress of Cases and Task Orders

Once the TORP is approved, a Task Order will be issued. The Project Manager will oversee the Task Order in accordance with established management, QA, and information system requirements. Technical and administrative communications will be maintained within the SC&A team and with the Project Officer by the SC&A Project Manager, Deputy Project Manager and/or Case Managers, under the cognizance and direction of the Project Manager.

The level of effort for each participant on each case and on the overall Task Order will be stated in the technical and cost proposal for the associated TORP, and each participant will be informed of the scope of the effort and the estimate made for his/her time on the project. Moreover, the performance of each participant will be judged in part by his/her satisfaction of the commitment made to and performance on the project. Each participant's actual level of effort will be monitored carefully each month through the job-cost reports by the Case Manager and the Project Manager, who will hold conferences to discuss issues, problems, and potential solutions related to the project as needed, but at least weekly.

There are three basic stages to the successful tracking and controlling of contracts involving multiple task orders and multiple cases and/or subtasks within each task order: (1) defining the cases and/or subtasks comprising the task order; (2) entering and analyzing the activity data for each task order, case, and subtask (cost and performance measures); and (3) updating and reporting these data. These activities can be more easily accomplished with the aid of modern software packages, and SC&A will use its existing automated Project Management System (PMS) and Management Information System (MIS) programs.

Cost Projection Accuracy

One of the most important lessons learned in previous task order contracts was the need to develop a comprehensive MIS and supporting databases to assist in cost projection and management. The system that SC&A has developed for use on earlier task order contracts supports invoices and monthly progress and projection reports. Moreover, the system is extremely valuable in tracking and controlling cost and schedule performance for individual task orders at both the task, case, and subtask level. It is supported by input data from the SC&A accounting system. A separate database is used to track subcontractor hours and costs.

SC&A has proven systems and procedures in place for cost control. At the time a task order is issued, SC&A assigns a job identifier to the project. If necessary, an identifier is assigned to each case and/or subtask within the task order. Uniquely identified time sheets are routinely issued in advance to each employee. Time sheets, Associate invoices, and subcontractor invoices are received and posted on a monthly basis. Individuals working on a project charge their time each day to the appropriate job identifiers. For quick-response task orders, charges are obtained by the Case Managers weekly or even daily, if required for budget control. Project charges on

time sheets and Associate invoices are certified by the individual and reviewed by the Case Managers, the Project Manager, and the accounting department. Other direct costs (ODCs), after being checked for correct authorization, are processed in the same way. Subcontractors follow similar procedures.

This system of reporting and approving contract expenditures is used to produce a Cost Management Report for comparison to the Cost Plan. The Cost Management Report is used for project monitoring and control to determine accrued costs for the current reporting period, to forecast accrued costs for subsequent reporting periods, and to anticipate total costs for project completion.

The Cost Plan provides a baseline for measuring cost variance on a contract and basic information for projecting costs and re-budgeting, if necessary. It also addresses each specific task order, case, subtask, project phase, or any other work elements required by the contract, since planning and reporting by elements of cost may be required, in addition to planning and reporting by elements of work.

The Project Manager checks the costs against the Cost Plan to ensure that the work is proceeding within budget. Weekly informal review meetings (by telephone, if necessary) are held among the Project Manager, Deputy Project Manager, the Case Managers, and technical staff to discuss technical progress and expenditure rates in order to keep these two aspects of the project in balance. Potential problem areas are flagged so that they can be dealt with at the earliest possible stage to minimize the impact on the project. At least one of the weekly meetings each month includes a formal review of progress and budget.

Using either the accounting system or the MIS, SC&A will be able to provide the NIOSH Project Officer or Contracting Officer with any kind of *ad hoc* report or cost projection. Although the complete range of such requests may vary, listed below are some of the ad hoc reports requested and provided under previous contracts:

- Estimates of costs and hours to complete near the end of the period of performance
- Reconciliation of booked versus billed costs for a contract as a whole or for a specific task order
- Schedules of ODCs by cost element
- Labor costs and ODCs by cost element for specific subcontractors under specific task orders, cases, and/or subtask
- List of task orders with ODC costs greater than a specified percentage of total estimated cost

Finally, SC&A has in place an approved Government Property Control System which will govern the management of any government-furnished property under this contract.

2.4.2 Subcontractor Management

As the prime contractor, SC&A will be responsible for overall project management. SC&A's ability to manage, control, and ensure the performance of subcontractors is demonstrated by the very substantial experience that SC&A has amassed in utilizing subcontractors in the performance of work for the Federal government over the past 22 years. In the case of task orders with substantial subcontractor participation, SC&A exercises rigorous oversight of subcontractor work, closely monitoring costs and deliverables. Subcontractors are held to tight adherence with deliverable schedules. SC&A Case Managers will participate in all subcontractor meetings with NIOSH and the Advisory Board, and directions will come directly from SC&A.

SC&A will have a subcontract with each team subcontractor. The subcontracts will contain our standard terms and conditions and any particular clauses required by our contract with CDC. SC&A's Contracts Manager, in consultation with the Program Manager, will be responsible for ensuring that the subcontractors follow contract requirements.

The management of the subcontractors is the responsibility of SC&A's Project Manager, Dr. . He will regularly interface with the Subcontractor Project Managers. The Subcontractor Project Manager serves several roles. He or she will be responsible for the subcontractor's performance in completing work assignments under the contract; in this capacity, the Subcontractor Project Manager will serve as the "point person" for the subcontractor company. The Subcontractor Project Manager will also serve as a technical specialist on work assignments. and will serve as the Subcontractor Project Managers for and , respectively. , President of , Inc., our 8(a), woman-owned business subcontractor, will serve as the Subcontractor Project Manager for .

The previous discussion applies to subcontractors who are already on the SC&A team. However, for work requiring a specialty niche contractor, SC&A would search for the capabilities required and solicit proposals from qualified firms. A sole-source award will be made if the requirement is not excessively large and it is clear that, by virtue of location and capabilities, a particular offeror is eminently qualified to perform the work. In this case, a cost proposal will be solicited from the offeror and a subcontract negotiated and submitted to the Contracting Officer for approval (if a level-of-effort (LOE) subcontract is negotiated—consent is not required from the Contracting Officer if the subcontract is under $25,000 and is fixed price). If a sole-source award is not appropriate, a competition of a few (probably three) firms will be held over a short time period. Proposals would be evaluated and a subcontract awarded to the firm that offers the most advantageous proposal to the Government, considering both technical and cost factors. If consent is required, the subcontract would be submitted to the NIOSH Contracting Officer prior to its execution by SC&A.

The management of a large contingent of subcontractors is not a new venture for SC&A. We have successfully managed as many as 68 subcontractors on a previous LOE contract for EPA. Where required, we obtained consent from the Contracting Officer prior to placement, and the subcontracted work was performed within the labor hour and cost limitations of the approved subcontractors. With very few exceptions, subcontractor costs on individual work assignments were maintained within the limitations of their original cost estimates.

2.4.3 Problem Resolution

It is SC&A standard operating procedure to prepare a work plan for every task order received from its clients. Potential problems or schedule slippages arising from each task order assigned by NIOSH will therefore be identified during the development of the technical and cost proposal in response to a TORP. Thus, if anticipated problems should arise during the performance of a Task Order, potential strategies will be available to deal with them. Of course, it is difficult to predict the precise nature of a future problem. However, the intimate involvement of the Project Manager, Deputy Project Manager, and Case Managers in all aspects of the work, from early development of the work plan through completion of each case and Task Order, offers the Advisory Board the confidence that problem areas will be identified as early as possible and resolved promptly.

In addition, this proposal envisions a strong commitment on the part of the Project Manager, the Deputy Project Manager, and the Case Managers, who will meet frequently with the Project Officer and Advisory Board members. SC&A believes in keeping its clients informed of any potential problems and implementing safeguards early in the process. When a schedule delay is unavoidable, the SC&A Project Manager will work with the Project Officer and Advisory Board to minimize the impact of any delay on the overall project goals.

Changes in Program Direction

The proposed Project Manager has considerable experience with changes in program direction. Recently, Dr. demonstrated the capability to address change in an SC&A contract with NRC (NRC-04-01-049, Technical Basis Information for Clearance of Materials and Equipment; NRC Project Officer Dr. Carl Feldman). The project scope and schedule of this contract were modified on two separate occasions to accommodate the changing demands of the project. SC&A's ability to recognize changing client needs, access appropriate and highly specialized staff through Associate arrangements, and select subcontractors who supplement SC&A skills renders us more than able to respond to changes in program direction both quickly and efficiently. Should a concern arise that a change may be needed in program direction, the Case Manager will immediately inform the Project Manager, Deputy Project Manager, and the Project Officer and/or Advisory Board representative. The issue will be discussed, and SC&A will either continue work while the issue is being resolved or stop work until the issue is resolved.

Responding to Increased Workloads

Because of the depth of SC&A's personnel resources in a broad range of disciplines, increased and widely fluctuating work loads will not pose a problem. There is a sufficiently large staff to fill the case load requirements as estimated in the solicitation. The total number of available and qualified personnel employed by SC&A provides a large margin of comfort. SC&A's previous contracts with the Government demonstrate the Company's ability to absorb increased and widely fluctuating work loads.

2.4.4 Flexibility of the SC&A Organization

SC&A was initiated as, and has continued to evolve into, one of the most flexible and responsive organizations in the professional services market. SC&A's staffing structure of full-time and part-time employees, as well as Associates, provides us with a resource pool that can be easily expanded or contracted depending on the volume of work or the schedule required to complete a project. The Company's simple corporate management structure ensures that problem solving is tackled expediently and efficiently, as described above. SC&A's flexibility and responsiveness is also evidenced in our ability to provide quick turnaround support.

During its 22-year history, SC&A has provided services to the Government through more than 250 contracts, many of which were accomplished through task order type contracts. Many of these task orders required quick turnaround response, which in some cases translated into 24-hour turnaround. The majority of these tasks have involved activities similar to those required under the SOW (i.e., dose assessments). In all cases, SC&A was able to respond to these quick turnaround requests simply and efficiently, due to the Company's resource pool consisting of SC&A staff and Associates and the resources of subcontractors. For this effort, the SC&A team is proposing a fixed staff of 35 individuals who will be formulated into review teams assigned to each case and will work under the direction of a Case Manager. Staff can be mobilized effortlessly and will be available within hours of a request for a quick turnaround task.

As a minority owner and member of the Board of Directors of SC&A, the proposed Project Manager, Dr. , has the authority to obtain resources as needed. Upon receipt of a request for quick turnaround support, Dr. will immediately contact the Project Officer and/or Advisory Board representative to define or clarify the objectives of the task and provide a preliminary estimate of the resources necessary to complete the work in the specified time frame. He will then work with the Deputy Project Manager, Case Managers, and other team members to identify the existing workload and to assess the need for extra staff or equipment. Should extra resources be necessary, Dr. will arrange for their timely provision. These resources will then be made available to the Case Manager (or Task Manager, if the activity does not involve a case) to complete the activity. Dr. will monitor the activity throughout its performance and will adjust resources as necessary to ensure that the schedule is met. It is not uncommon for SC&A to handle more than one quick turnaround project at a time by using these procedures.

2.5 Quality Control Procedures

SC&A strictly adheres to a time-tested corporate Quality Management Plan (QMP) and implementing procedures. For the past three years, SC&A has been performing work on several NRC contracts under project-specific Quality Assurance Project Plans (QAPPs) approved by the Office of Nuclear Regulatory Research of the NRC.[2]

SC&A's corporate QMP mandates the use of the American National Standard Institute's ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs," which is a national consensus document that sets forth mandatory specifications and nonmandatory guidelines for the planning, implementation, and assessment of a quality system for programs involving environmental data collection and environmental technology. SC&A's QMP, developed in October 1997, specifies the requirements, responsibilities, and guidance pertaining to total quality management and is intended, to the extent practical, to adopt verbatim the language of ANSI/ASQC E4-1994. Therefore, SC&A considers the QMP to be an over-arching blueprint for conducting quality work. A copy of this QMP is available for review upon request.

As discussed in detail in the example tasks, and provided in Section 3 and Appendix C of this proposal, SC&A has prepared a detailed set of SOPs and checklists for the basic and advanced review of cases and SEC petitions. The procedures are tied to the Office of Compensation Analysis and Support (OCAS) guidelines for dose reconstruction for external and internal exposures, and the requirements set forth in 42 CFR Parts 82 and 83. These procedures constitute SC&A's draft project-specific QAPP. Specifically, the QAPP and associated SOPs document that following has been done:

- The task's technical and quality objectives are identified and agreed upon.
- Activities affecting the achievement of the quality objectives are identified and, via SOPs, conducted in a controlled manner.
- SOPs implementing quality requirements are identified and in place prior to the start of work.
- The intended measurements or data acquisition methods are appropriate for achieving task objectives; the assessment procedures are sufficient for confirming that data of the type and quality needed and expected are obtained; and that any limitations on the use of the data can be identified and documented.

[2] NRC-04-01-049, Technical Basis Information for Clearance of Materials and Equipment, NRC Project Officer Dr. Carl Feldman and NRC-04-01-065, Technical Assistance in Finalizing NUREG-1640, NRC Project Officer Dr. Robert Meck.

2.6 Conflict of Interest Management

SC&A is fully aware of the conflict of interest (COI) issues on this contract. SC&A can state unequivocally that we comply with the Board's OCI prerequisites, which are listed in Section M.1 of the solicitation, as follows:

- **SC&A, its team members, and the proposed key personnel are not currently performing any work for NIOSH, ORAU, or ORAU's primary teaming partners, and if SC&A is a successful bidder, will not perform any such work during the period of performance of the contract.**

- **If SC&A is a successful bidder on this contract, neither SC&A, its teaming partners, nor any of the key personnel on the contract will bid on any work for NIOSH, ORAU, or ORAU's teaming partners.**

- **None of the proposed personnel have served as an expert witness (including non testifying witness) at any time in the past in any litigation defending worker compensation or other radiation-related claims on behalf of DOE, a DOE contractor, an Atomic Weapons Employer, or an AWE contractor.**

- **None of the proposed personnel are currently working on the NIOSH Dose Reconstruction Contract (Contract Number 200-2002-00593).**

Since its founding in 1981, SC&A has been a prime contractor to many of the Federal regulatory agencies concerned with health and safety relating to occupational and environmental radiation. These include EPA, NRC, the Defense Nuclear Facility Safety Board (DNFSB), and CDC. The OCI requirements imposed on us for the work for these regulatory agencies have been stringent. For example, all seven of our large mission contracts with the EPA Office of Air and Radiation, as well as our prime contract with the DNFSB, restricted our work for DOE and its contractors. Moreover, SC&A has had 13 prime contracts with NRC, all of which have restricted our work for NRC licensees, including Atomic Weapons Employers (AWEs). Many of our Federal contracts have required formal OCI plans addressing search criteria for potential conflict of interest: OCI avoidance, mitigation, and neutralization; OCI documentation; OCI training; subcontractor OCI; and employee conflict of interest.

Section 2.6.1 contains a discussion of the work history of SC&A and its team members, and additionally describes the background of each key individual on the project and includes a disclosure statement with respect to potential conflicts of interest relating to work for DOE, DOE contractors, AWEs, and AWE contractors. Section 2.6.2 discusses SC&A's OCI plan. COI forms were completed and signed by each member of the project team and are provided in Appendix B. The forms provide a description of the work, the time period in which the work was performed, and an identification of the organization for whom the work was performed.

The draft OCI plan presented in Exhibit 2-2 is preliminary in the sense that SC&A will work with the Advisory Board to develop a systematic, comprehensive plan to ensure that neither

SC&A, its team members, nor the individuals working on the contract become involved in any COI situations as they might relate to the proposed work. Thus, our plan will be finalized after it is approved by the Advisory Board.

The Administrator of our OCI Plan will be Ms. Laurie Loomis. Ms. Loomis is Certified as a Professional Contracts Manager and a Federal Contracts Manager by the National Contract Management Association, and has 12 years of experience in government contracting. She is Manager of SC&A's Administrative Services Division and reports to Dr. Sanford Cohen, the President of SC&A. As an employee-owner of SC&A and the Contracts Manager, Ms. Loomis will have a profound interest in ensuring the absence of conflict of interest. She is also the most knowledgeable individual at SC&A about the extent and detail of each of our contracts. She will work with the Advisory Board in finalizing SC&A's OCI plan and keeping it current, and will manage the plan internally. She will ensure that all team members and individuals working on the project are trained in the provisions of the plan and comply with its procedures. She will be responsible for obtaining and filing evaluator certifications, and will work with Dr. Cohen in identifying any potential conflicts of interest and reporting them immediately to the Advisory Board.

It is important to point out that SC&A is a relatively small, tightly managed firm with a history of strict compliance with COI constraints quite similar to those envisioned under this proposed work for the Advisory Board. Our top management is acutely aware of these constraints, and will work closely with the Board to ensure that conflicts of interest are avoided. SC&A will also be mindful that team members who are performing extensive nondosimetry work for DOE or DOE contractors may pose a perception concern for claimants. Such tasks will be judged on a case-by-case basis to determine whether the nature of the work would lead to such perceptions.

2.6.1 Work History

By virtue of our work for Federal regulatory agencies described in Section 5, any work for DOE and DOE contractors has been severely curtailed. SC&A has never held a DOE prime contract. However, we do perform laboratory analysis services for DOE offices and contractors in our Southeastern Environmental Laboratory located in Montgomery, AL. Samples potentially containing very low levels of environmental contamination are shipped to the laboratory for analysis of radionuclide content. Our longest running contract for these services is with the Kaiser Hill Company (KH 020512), who is responsible for the remediation of the Rocky Flats Plant. We have provided these services for approximately six years. For approximately two years, we have held similar contracts with Bechtel Nevada Corporation (Subcontract No. 30025), who operates the Nevada Test Site, and Westinghouse Savannah River Company (AC17824N and AC23323N), operator of the Savannah River Site (SRS). Additionally, in January, 2003, SC&A's Southeastern Environmental Laboratory received an order from DOE's Golden Field Office to analyze 12 samples. **None of this work is concerned with radiation dosimetry, nor is it related in any way to any of the elements of the scope of work of the subject solicitation. Therefore, our laboratory work for DOE contractors is not in conflict with the proposed work for the Advisory Board.**

SC&A has only one nonlaboratory project with a DOE contractor. This contract is with the S.M. Stoller Corporation (SMS-SCA1002), who is a subcontractor to Portage Environmental Inc., who in turn is a prime contractor to the DOE Carlsbad Area Office. The work, which is to conduct field quality assurance audits of the nondestructive assay of transuranic waste prior to its shipment to the Waste Isolation Pilot Plant (WIPP), involves only one SC&A individual. The work has been ongoing for approximately two and one-half years (prior to this year under subcontract to Portage Environmental Inc.). **This work is not concerned with radiation dosimetry, nor is it related in any way to any of the elements of the scope of work of the subject solicitation. Therefore, it is not in conflict with the proposed work for the Advisory Board.**

SC&A has performed some work for DOE contractors in the past, and for completeness, the following describes all of this work performed over the past 10 years:

- In 2001, under subcontract with Argonne National Laboratory, SC&A assisted in the evaluation of a radiation monitoring system for the transborder detection of radioactive materials (under a DOE prime contract).

- In 2000, under subcontract with CH2M HILL, SC&A performed a statistical analysis of contamination around the Hanford Tanks.

- In 1999 and 2000, under subcontract with Walcoff, Inc., SC&A evaluated the environmental impact of nuclear power plant operation.

- In 1999, SC&A received a small subcontract with Lockheed Martin Idaho Technologies Company to reimburse us for allowing them the use of a low-signature cart that we had designed for nonintrusive UXO data collection, and to provide technical assistance related to the use of the cart.

- From 1995 through 1998, under subcontract with the Consortium for Risk Evaluation and Stakeholder Participation (a university grant), SC&A evaluated methods for risk assessment applicable to DOE sites.

- In 1997, under subcontract with Raytheon Engineers and Constructors, SC&A performed environmental analysis support to the West Valley Demonstration Project.

- In 1996, under subcontract with Brookhaven National Laboratory, SC&A evaluated decision-support software (EPA prime contract).

- From 1995 to 1997, under a subcontract with the Environmental Evaluation Group (EEG), SC&A reviewed certain safety features of the WIPP. Although EEG receives its funding from the DOE, it is an independent watchdog group.

- In 1995, under subcontract with SAIC, SC&A evaluated the potential of treatment technology for soils at FUSRAP sites.

- In 1995, under subcontract with Brookhaven National Laboratory, SC&A developed an Arctic Information System that applied to Siberian Russia (under an EPA prime contract).

- From 1992 to 1994, under subcontract with Analytical Services Inc., SC&A reviewed environmental impact statements for the DOE Office of NEPA Compliance.

- In 1993, under subcontract with Battelle Pacific Northwest Laboratories, SC&A performed tasks related to environmental management support.

- In 1993, under subcontract with Roy F. Weston Corporation, SC&A provided environmental consulting assistance in connection with the Yucca Mountain high-level nuclear waste repository.

Since none of this work is concerned with radiation dosimetry nor with any of the elements of the scope of work of the subject solicitation, it does not constitute a conflict with the proposed work for the Advisory Board. Moreover, only one small project (for Argonne National Laboratory) was performed within the last two years.

SC&A has also searched its records to identify any work performed for AWEs and AWE contractors,[3] searching its contracts' records against the list of AWEs given in the *Federal Register* on December 27, 2002. SC&A identified the following AWEs for which work was performed over the past 10 years:

- SC&A is currently providing, and has provided on several occasions, environmental support to General Electric Corporation, none of which is related to atomic energy or radioactivity.

- In 1997, under subcontract with Raytheon Engineers and Constructors, SC&A performed environmental analysis support to the West Valley Demonstration Project (this was also listed above under work performed for DOE contractors).

[3] Please note that SC&A used its best efforts to identify AWE contractors for which it has performed work. In particular, SC&A believes that it has identified all instances of its work over the past 10 years performed for AWEs using contractual vehicles with AWE contractors. However, SC&A does not certify that it has identified all of its work for AWE contractors, since the list of all AWE contractors is not available, to the best of SC&A's knowledge. Moreover, SC&A does not believe that the Advisory Board is necessarily interested in work for AWE contractors unless the work is related to AWEs.

- From 1994 through 1996, under contract with the Continental Minerals Processing Division of Alcoa, SC&A performed a radiological characterization of zirconia sands.

Since none of this work is concerned with radiation dosimetry nor with any of the elements of the scope of work of the subject solicitation, it does not constitute a conflict with the proposed work for the Advisory Board.

Finally, SC&A has never performed work under contract with NIOSH, ORAU, or the ORAU primary teaming partners (performing under Contract #200-2002-00593).

2.6.1.1 Subcontractor Work History

During preparation of this proposal, subcontractors and their personnel were asked to review their work histories with respect to their work for DOE, DOE contractors, AWEs, AWE contractors, NIOSH, Oak Ridge Associated Universities (ORAU), and ORAU primary teaming partners. They also certified that they will not bid or perform any work for NIOSH, ORAU, or any of ORAU's primary teaming partners while performing work under this contract. Their signed certifications are provided in Appendix B; summaries of this information are provided below.

, *Inc.*

, Inc., being a relatively new small business (incorporated in 2001), has had no contracts with Federal agencies including DOE and its operating contractors. It has one active contract, with Johns Hopkins University, in support of biodefense activities at the Center for Civilian Biodefense Strategies. 's first government contract proposal will be as a subcontractor member of the SC&A bid team.

, Inc., has never performed any work for NIOSH, ORAU, or a company teamed with ORAU on NIOSH Contract No. 200-2002-00593, including through subcontracts.

, Inc. has never held contracts to provide expert witnesses (including non-testifying witness) in any litigation defending worker compensation or other radiation-related claims on behalf of DOE, a DOE contractor, an AWE, or an AWE contractor.

, Inc. has never performed work for DOE, a DOE contractor, an AWE, or an AWE contractor, including through subcontracts.

, Inc. has never worked at a DOE or AWE site under contract to DOE, a DOE contractor, an AWE, or an AWE contractor, including through subcontracts.

, Inc. has no current or past history of contracts or financial relationships that would result in any actual or perceived conflict of interest under this contract.

, does business as
which is identified earlier in this proposal as . Neither nor has performed any work for NIOSH, ORAU, or a company teamed with ORAU on NIOSH Contract No. 200-2002-00593, including through subcontracts.

Neither nor has provided staff to serve as an expert witness (including non-testifying witness) in any litigation defending worker compensation or other radiation-related claims on behalf of DOE, a DOE contractor, an AWE, or an AWE contractor.

Neither nor holds any DOE prime contracts at this time. However, has provided radiation safety-related training services for DOE facilities and contractors. These services are listed below:

- presented a 5-day training course entitled "Practical Tools for Response to Nuclear Terrorism," from May 19-23, 2003, under contract to EG&G Technical Services. The content of the course included radiation detection instruments and their use, and the understanding of how to respond to a nuclear terrorism event. The course was presented at the DOE Emergency Operation Training Academy in Albuquerque, NM, and most of the attendees were members of DOE's emergency response program.

- presented a 5-day training class entitled "Advanced Concepts in Health Physics," from April 16-20, 2001, under contract to Westinghouse Savannah River. The course covered radioactivity, regulations, instruments, internal and external dosimetry, statistics, waste, and transportation. The purpose of the course was to prepare participants for successful completion of professional certification examinations.

- provided a 1-day training course entitled "Radiation Safety Seminar" for the West Valley Nuclear Services Company, Inc., on October 22, 1997. The course covered basic principles of radioactivity, radioactive waste classification, shipping regulations, and public health and safety considerations. It did not cover radiation dosimetry. The course was conducted as part of a cooperative agreement between DOE and the Seneca Nation of Indians to increase understanding of environmental and human health, and to protect the cultural history of the Seneca community.

This work was not related to any of the elements of the scope of work of the subject solicitation. Therefore, it is not in conflict with the proposed work for the Advisory Board.

Neither has a current or past history of contracts or financial relationships that would result in any actual or perceived conflict of interest under this contract.

, Inc. will participate in this contract as a small, disadvantaged business subcontractor. has never performed any work for NIOSH, ORAU, or a company teamed with ORAU on NIOSH Contract No. 200-2002-00593, including through subcontracts.

, Inc. has never provided staff to serve as an expert witness (including non-testifying witness) in any litigation defending worker compensation or other radiation-related claims on behalf of DOE, a DOE contractor, an AWE, or an AWE contractor.

, Inc. does not hold any DOE prime contracts at this time. However, and its principal, , have provided radiation-related training and other services for DOE facilities and contractors. These services are listed below:

- provided a trainer for the Rocky Flats Environmental Technology Site (RFETS) Plutonium Stabilization and Packaging System project. This project, performed in 2000 under subcontract to BNFL, Inc., and Safe Sites of Colorado, did not involve any radiation dosimetry.

- served as an environmental scientist for Jacobs Engineering Group at the Weldon Spring Site in Missouri between 1986 and 1988. This work did not involve any radiation dosimetry.

- served as the Health and Safety Manager for Bendix Field Engineering at DOE's Grand Junction facility in Colorado in 1983 and 1984. This job included radiation dosimetry for personnel.

In addition, was an employee of Rockwell International at the RFETS between 1978 and 1980.

This work was not related to any of the elements of the scope of work of the subject solicitation. Therefore, it is not in conflict with the proposed work for the Advisory Board.

, Inc. has no current or past history of contracts or financial relationships that would result in any actual or perceived conflict of interest under this contract.

2.6.1.2 Key Personnel Work History

Key personnel were also asked to review their work histories with respect to their work for DOE, DOE contractors, AWEs, AWE contractors, NIOSH, ORAU, and ORAU primary teaming partners. They also certified that they will not bid or perform any work for NIOSH, ORAU, or any of ORAU's primary teaming partners while performing work under this contract. Their signed certifications are provided in Appendix B; summaries of this information are provided below.

2.6.2 Conflict of Interest Plan

We have chosen to modify SC&A's current OCI plan to reflect the provisions of this proposed work. Exhibit 2-2 presents this draft plan. In addition, Exhibit 2-3 presents the Conflict of Interest Certification that SC&A required each potential team member to sign prior to developing this proposal. Actual signed copies of this certification for each team member proposed are included in Appendix B.

Exhibit 2-2. SC&A Organizational Conflict of Interest Plan

PROPOSED ORGANIZATIONAL CONFLICT OF INTEREST PLAN FOR
CONTRACT RESULTING FROM CDC SOLICITATION NUMBER 2003-N-00768

Exhibit 2-2. SC&A Organizational Conflict of Interest Plan (continued)

[1] This conflict of interest plan will flow down to team members in their subcontracts.

Exhibit 2-2. SC&A Organizational Conflict of Interest Plan (continued)

Exhibit 2-2. SC&A Organizational Conflict of Interest Plan (continued)

Exhibit 2-2. SC&A Organizational Conflict of Interest Plan (continued)

Exhibit 2-3. Conflict of Interest Certification

TEAM MEMBER AND INDIVIDUAL CONFLICT OF INTEREST CERTIFICATION
CONTRACT RESULTING FROM CDC SOLICITATION NUMBER 2003-N-00768

Exhibit 2-3. Conflict of Interest Certification (continued)

Additional Certification for Teaming Partners and Key Personnel

I understand that my participation on this contract means that I will not be permitted to bid or perform any work for NIOSH, ORAU, or any of ORAU's primary teaming partners while performing work under this contract.

_____
Individual Name or Company Name

_____
Signature

_____
Date

2.7 Confidentiality and Security Provisions

SC&A fully understands the importance of protecting personal, proprietary, and other sensitive information to which we may have access under this contract. We have reviewed the provisions contained in HHSAR 352.224-70, Confidentiality of Information; FAR 52.224-1, Privacy Act Notification; 52.224-2, Privacy Act; and 52.239-1, Privacy or Security Safeguards, and are prepared to comply fully with all the requirements contained in these clauses.

Privacy Act

We will ensure that all individuals working on this contract with access to data protected by the Privacy Act are aware of the restriction on disclosure of records maintained on individuals and the conditions that must be met in order for disclosure to be permissible under the Privacy Act, Section 552a(b)(1)–(12). In addition, upon contract award, SC&A will establish procedures and policies with respect to (1) accounting for certain disclosures, (2) access to records, (3) relevant agency requirements, and (4) relevant agency rules.

Confidentiality of Information

In addition to the requirements of the Privacy Act, we understand that we will be subject to compliance with the provisions of HHSAR 352.224-70. We will obtain written consent from any individual, institution, or organization prior to disclosing confidential/proprietary information or data about that individual, institution, or organization. We will also provide the Contracting Officer with written advance notice of at least 45 days in the event that we intend to release findings of studies or research which have the possibility of adverse effects on the Agency. Finally, if we are unsure of the proper handling of material or information under this contract, or if the material in question is subject to the Privacy Act or is confidential information under HHSAR 352.224-70, we will obtain a written determination from the Contracting Officer prior to releasing, disclosing, disseminating, or publishing such information or material.

Security Safeguards

In the event that we develop or implement safeguards under this contract, we will not publish or disclose these safeguards without the prior written consent of the Contracting Officer. We agree to cooperate with the Government should it be necessary to carry out a program of inspection to safeguard against threats and hazards to the security, integrity, and confidentiality of Government data, and in this instance will provide the Government access to our facilities, installations, technical capabilities, operations, documentation, records, and databases. We understand that under this contract, should it become evident to either the Government or SC&A that existing safeguards have ceased to function, it will be the obligation of the discovering party to bring the situation to the attention of the other party.

All of our obligations under this section will flow down to our subcontractors at any tier.

3.0 TECHNICAL APPROACH[1]

This section describes our technical approach to performing basic and advanced case reviews, blind dose reconstructions, and Special Exposure Cohort (SEC) petition reviews. In addition, our approaches to performing reviews of worker-profile and site-profile databases, independent of the review of specific cases, and ad hoc reports are also described. Imbedded in the discussions are anticipated major problem areas, together with recommended approaches for their resolution. The section concludes with "Special Topics," which highlights those issues and technical strategies that we believe are worth noting, especially with regard to internal dosimetry.

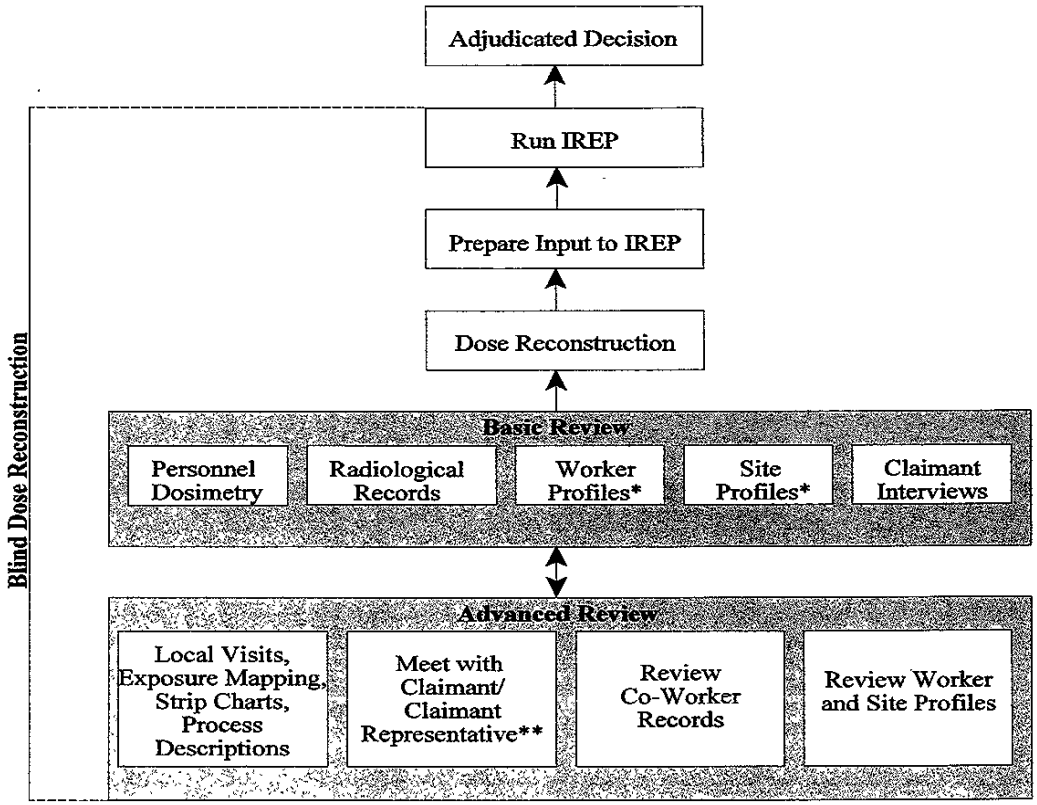
3.1 Concept of Operations

SC&A is proposing a highly structured, transparent, and well-documented approach to reviewing dose reconstructions and SEC petitions. Exhibit 3-1 presents our understanding of the interrelationships between the various tasks that comprise the review of dose reconstructions. Our technical approach to the project assumes that, whether the Task Order Request Package (TORP) requires a basic or advanced review, or a blind dose reconstruction, the administrative record and other pertinent technical material, in hard copy and/or electronic form, will accompany the TORP. These records, and any other information provided by NIOSH or uncovered as a result of our investigations, will be loaded into our relational database, which will be designed to be compatible and consistent with the relational database being employed by NIOSH.

In brief, for *Basic Reviews*, the focus of attention will be on the relevant portions of the administrative record and ensuring the completeness and internal consistency of the dose reconstruction, interview record, and, to the extent applicable to the basic review, NIOSH worker and site profiles. Primary attention will be given to the appropriateness of any assumptions that were used in the determination of dose as well as the completeness and internal consistency of the NIOSH dose reconstruction with Office of Compensation Analysis and Support (OCAS) guidelines in support of the dose reconstruction and the adjudicated decision.

Advanced Reviews will evaluate the entire administrative record and review pertinent worker and site profiles, seek out primary records (original log books, work permits, strip chart recorders, etc.), co-worker records, and supplemental information obtained from the claimant and co-workers (if authorized by the Board) as required to verify the dose reconstruction in those areas that could have a significant impact on the dose estimates and adjudicated decision. In order to perform advanced reviews in a manageable time period, advanced reviews will be limited to those exposure settings and occurrences that have the potential to significantly influence the ability to reconstruct doses and the resulting adjudicated decision. Nevertheless, during the

[1] This section, which describes our technical approach to the project, and Volumes 2 and 3 of the proposal which describe our technical approach to the two example tasks, cover many of the same points. We tried to avoid repetition. As such, we request that the committee reviewing our technical approach to this project consider Section 3.0 of Volume 1 of the proposal, as well as Volumes 2 and 3 in their entirety. Taken together, this information will offer the review panel a solid understanding of how we would approach tasks issued under this contract.



* Worker-profile and site-profile reviews will be part of the basic review only if they were used in the preparation of the original dose reconstruction prepared by NIOSH; otherwise they will be limited to advanced reviews or stand-alone tasks authorized under a Task Order.
**We recognize that direct conversations with claimants may not be authorized.

Exhibit 3-1. Interrelationships of Activities

course of advanced reviews, all findings will be documented, regardless of their importance to a particular dose reconstruction and adjudicated decision. We believe such findings may have relevance to the review of other claims and to the overall dose reconstruction process. *Blind Reviews* will be similar to advanced reviews, with the exception that the review team will not have access to the dose reconstruction, IREP input, and resulting adjudicated decision. Instead, blind reviews will include the performance of our own dose reconstruction and IREP calculations. The outcome of the blind review will then be compared to the dose reconstruction and IREP input/output resulting from NIOSH's investigations.

3.2 Preparation of Technical and Cost Proposals in Response to Task Order Request Packages

Upon delivery to SC&A, all TORPs will be logged in, date stamped, assigned a Task Order number, and placed into the dedicated project file which will be maintained under lock and key pursuant to SC&A's records management procedures (see Section 2.1). As a means of tracking

performance of each case or task comprising the TORP, the TORP will be subdivided into individual cases and/or tasks, and, as required by each case, may be further subdivided into lower-tier tasks, such as external and internal dose-reconstruction review, worker profile review, interview record review, and site profile review. Filing and tracking the cost and performance of each TORP will be performed under the following work breakdown structure:

Tier 1: Task Order Number
- Tier 2: Case Number
  - Tier 3: Dose Reconstruction
  - Tier 3: Worker Profile
  - Tier 3: Interviews
  - Tier 3: Site Profile
- Tier 2: SEC Petition Review
- Tier 2: Worker Profile Review
- Tier 2: Site Profile Review
- Tier 2: Ad Hoc Investigations

Using a relational database, we will be able to sort according to site (e.g., Hanford, Savannah River, etc.), category of site (e.g., FUSRAP site, uranium processing facilities, etc.) category of exposure (e.g., external gamma, plutonium inhalation, etc.), or any other parameter that may serve the Advisory Board's purposes.

While the TORP filing system is being set up, each key member of the project team (see Section 2.1) will receive copies of the TORP for initial inspection with respect to scope, schedule, resource requirements, and conflict of interest (COI) issues. A meeting will be held among the key members of the project team to discuss the TORP and any supporting records and documentation provided with it. The meeting will be designed to accomplish the following objectives:

- Identify questions and concerns to be discussed with the Project Officer and/or Advisory Board representatives. If acceptable to the Project Officer and the Board, it may also be useful to begin discussions at this time with the NIOSH contractors who prepared the dose reconstructions.

- Identify the Case Managers and/or Task Managers and assemble the teams for performing the work required by each case or task contained in the TORP.

- Prepare a schedule for completion and delivery of the technical and cost proposal. Under the direction of the Project Manager, a comprehensive technical and cost proposal will be prepared that meets the requirements of Section H.20 of the solicitation and that will be delivered to the Project Officer within 14 calendar days of receiving the TORP. The first step in the preparation of the technical and cost proposals for both basic and advanced reviews is to inspect the input and output of the IREP computer run for each case. Case Managers will then be selected based on either their familiarity with the site or category of the site and/or special technical issues associated with the exposures (e.g., the case is limited to

reviewing the dose reconstruction of a person who experienced internal exposures to inhaled plutonium and the associated bioassay data). The administrative records provided with the cases will be used to define the qualifications of the Case Managers and technical specialists who will be assigned to each case.

For basic reviews, it may only be necessary to assign a single individual to perform the review. However, for advanced reviews and blind dose reconstructions, a minimum of three individuals will be assigned to each case. As required by the TORP, these individuals will have the following assigned functions: Dose Reconstruction Reviewer (perhaps separated into internal and external doses), Worker Profile Reviewer, Interview Records Reviewer, and Site Profile Reviewer. One of these individuals will also be the designated Case Manager. We recognize that some of the basic reviews will not require access to the NIOSH worker profile or site profile database; however, we will be prepared to review these sources of information as required to complete the basic or advanced reviews, or blind dose reconstructions. The individuals assigned to each case can draw upon any of the other specialists on the project team. The teams will be assembled using the following criteria:

- Familiarity with the site
- Familiarity with the health physics issues at the site
- Ongoing case commitments
- Consistency of team makeup

In general, for basic reviews, the Case Manager will likely be a health physicist with specialized expertise in the primary types of exposure of concern (e.g., external exposure versus inhalation of plutonium) and the associated dosimetric records. For advanced reviews, the Case Manager could be an appropriately qualified health physicist or an individual with in-depth experience with the site or types of operations responsible for the exposures.

3.3 Procedures for Performing Basic and Advanced Reviews

Following approval of the technical and cost proposal, the Government will issue a Task Order and work will commence. For basic and advanced reviews, the individuals comprising each of the teams assigned to each case will review the IREP input and results to determine technical areas of emphasis (e.g., acute versus chronic exposures, external gamma or neutron exposures, internal exposures and radionuclides of concern, etc.) that are the primary drivers for the outcome of the IREP calculations. Based on this initial review, additional specialty resources (see Section 2-1, the charts and biosketches in Section 4, and the resumes in Appendix A) will be drawn upon as needed to perform the review. The review of each case will then commence under the direction of its assigned Case Manager.

Each case will be reviewed by the team assigned to the case, and, depending on the complexity of the case, review responsibilities may be divided into internal and external dose reconstruction reviews (which will include a review of the claimant interview record). In addition, for some basic reviews and all advanced reviews, the review process will also include worker and site profile reviews, as required by the technical proposal and Task Order. If several cases are from the same site, there may be efficiencies we can incorporate into the process by assigning a single

individual to perform the worker and site profile reviews for those cases. However, for complex sites, where operations were highly diverse in space and time, such as at several major Federal facilities, the supporting worker profile and site profile reviews may be highly unique to the operations associated with the particular worker, or category of worker, and the specific campaign at the site at a given point in time.

As described in greater detail in the example tasks, as our team becomes more familiar with worker and site profiles for specific sites and categories of operations, Case Managers and team members will be assigned to each new case in a manner that takes advantage of the experience and knowledge gained by previous reviews. As such, we expect that we will become increasingly efficient in performing both basic and advanced reviews as we acquire experience. However, it is important to note that we will be beginning this process with individuals who already have a great deal of experience and knowledge of the operations and exposure histories of many of the DOE sites (e.g., see the biosketches of
).

The following sections describe the checklist and procedures for performing external and internal dosimetry reviews, worker profile reviews, claimant interview reviews, and site profile reviews. The checklists are extensive, and, in most cases, only those portions of the checklists that apply to a particular case will need to be completed in detail.

During the review process, there will be a great deal of interaction among the review team members in order to evaluate and ensure internal consistency and compatibility of the dosimetric information with the worker profile information, the claimant interview information, and with the site (or event[2]) profile. We suggest that, throughout this process, SC&A have an opportunity to obtain clarifications and discuss our preliminary findings with Advisory Board representatives, and, if acceptable to the Advisory Board, with the original authors of the dose reconstructions. In addition, as work proceeds, should we uncover substantial errors or deficiencies in a dose reconstruction, we will immediately contact the Advisory Board representatives, and not wait until our reports are completed and delivered. We hope to establish a very close and cooperative relationship with the Board members and seek their counsel throughout the review process.

Accompanying each item in the checklist will be a narrative explaining our findings. The level of detail of the review will differ between the basic and advanced reviews. Blind dose reconstructions will be performed in a similar manner as the advanced reviews, except the review team will not have access to the IREP input and output prepared by NIOSH. In this way, our team will perform an independent dose reconstruction, the results of which can be compared to the results provided in the administrative record.

[2] For some cases, a major contributor to exposure may have been a transient or accidental release, referred to here as an "event," which will require a more focused historical reconstruction of the exposure setting than what would normally be contained in a site profile, where exposures occurred as a result of routine operations.

3.3.1 External and Internal Dosimetry Review Procedure and Checklists

The basic and advanced individual dose reconstruction review processes will each utilize a checklist for conducting the technical reviews. The checklists are provided in Appendix C. The checklists are designed to satisfy the basic level and additional advanced level review elements specified by the NIOSH Advisory Board Dose Reconstruction Working Group. The checklists allow the basic/advanced review process to be conducted in a systematic, consistent, efficient, and transparent manner. They will also serve as a means of tracking and formally documenting the individual steps of the audit process. When the audit is completed, the information collected in the checklist will be entered into a database in a format that is compatible with Microsoft SQL 2000. All records/documents collected and used in the audit process that were not included in the case file will be duplicated and provided to NIOSH.

The basic individual dose reconstruction checklist is structured to evaluate the following five areas of review: (1) data collection process, (2) interview/claimant documentation, (3) external dose reconstruction process, (4) internal dose reconstruction process, and (5) applicable portions of NIOSH procedures and methodologies associated with the reconstruction of dose for each individual case . When an advanced dose reconstruction audit is requested, a second checklist will be completed, which incorporates elements that will provide for a more extensive review of the data gathering, work-history interview, and external/internal dose reconstruction processes. These checklists are designed to take into account all requirements established in the *U.S. Code of Federal Regulations* (CFR) Title 42, Part 82, and follow guidelines provided in the External and Internal Dose Reconstruction Implementation Guidelines (OCAS-IG-001 and OCAS-IG-002, respectively), as well as other relevant technical documents. However, it is recognized that, due to the variety of conditions associated with each individual's exposure scenario, these checklists may not be all inclusive. The intent of the checklists is to provide the auditor with a roadmap to evaluate the dose reconstruction process in a stepwise, thorough, and reasonable manner.

3.3.2 Claimant Interview Review Procedure and Checklist

The claimants, their family members, and co-workers play a key role in the dose reconstruction process, especially for the advanced reviews. In general, basic reviews will be limited to a review of the completed questionnaire and the degree to which that information was appropriately incorporated into the dose reconstruction. Advanced reviews will go beyond a simple checking of the questionnaires. Work history interviews will be assessed for their effectiveness and, in the cases involving survivors, will evaluate whether a reasonable effort was made to follow up on information provided by the claimant (i.e., contacting co-workers and tracking down historical records). Advanced reviews may also include approved follow-up interviews.

For each claim, NIOSH will conduct a voluntary interview with the claimants or their survivors which will allow them to collect detailed information concerning the claimant's employment history, work environment, and radiation monitoring history. All of this information, which will be contained in the structured interview forms used by NIOSH, should be considered by NIOSH when performing the dose reconstruction, and should be consistent with the information gathered by NIOSH from the DOE/Atomic Weapons Employer (AWE) personnel and site-monitoring

records. The following describes our approach to basic and advanced claimant-interview reviews, including the checklist in Appendix C that includes elements addressing the NIOSH questionnaire. This will be used to evaluate the completeness of the NIOSH questionnaire and to compare the information provided by the claimant or survivor during the interview with the other information in the administrative record.

The audit of worker and family interviews will include (1) specific elements relating to the use of each worker interview that is audited in the process of dose reconstruction, and (2) general elements relating to the methodological aspects of the relationship of interviews to dose reconstruction.

Specific Elements

The audit of every worker interview will be closely coordinated in each case with the various elements of the overall audit of the dose reconstruction for that worker. Specifically, the audit will involve:

- Determining whether the elements of the worker interview regarding frequency of film badge changes, the components and frequency of various types of monitoring of internal burdens of radionuclides, and the monitoring of the general air in the work environment have been checked against the facility profiles for the period in question and against the dose records of the worker.

- Checking how the discrepancies between the worker's account, the dose records, and facility profiles have been dealt with in regard to the estimation of the uncertainties in the dose estimates from particular radionuclides.

Depending on the results of the dose reconstruction, highly specific "forensic health physics" follow-up inquiries may be required. For instance, a worker job description might include sitting astride uranium metal ingots to stamp serial numbers on them (as was the practice at Fernald). The film badge doses could seriously underestimate external exposure to the gonads, and hence the total effective dose equivalent (TEDE), and misrepresent the doses to specific organs of interest. As another example, the time at which urine samples are taken may influence the concentration of uranium in the urine. For instance, Monday morning urine samples taken after coffee would tend to reduce reported concentrations relative to actual averages. In addition, depending on the solubility of the compound, Monday morning urine or feces samples may also result in an underestimate of doses. Such practices could distort dose estimates, especially if samples were taken infrequently. Other important questions include: (1) Did the worker collect 24-hour excreta samples or just an aliquot? and (2) Was the worker under medication (diuretics, for example, may affect the excreted activity and other drugs may affect the analytical processing of the samples)? Worker interviews will be used as a way of checking on the completeness of specific aspects of workers' dose records and to help focus follow-up inquiries to find records that may be missing or misplaced and which could be critical to the dose reconstruction and the resulting PC calculations. The audit will include an evaluation of the adequacy of such efforts deriving from worker interviews.

General Elements

When a sufficient number of worker interviews and records have been audited for specific facilities or processes (such as uranium chemical processing or machining, plutonium processing or machining, etc.), a check will be made about whether and how the worker interview data have been used in conjunction with facility profiles. Consistent worker testimony about the frequency of badge use or internal monitoring, for instance, could lead to discovery of gaps in facility documentation. Hence, worker interview data can be pooled to provide insight into the quality of and uncertainties in dose estimates for specific facilities or processes. The audit will examine whether the worker interview data have been used to the extent possible to improve the quality of dose estimates for groups of people who worked in specific processes or places.

When the audits of worker interviews and dose records from a sufficient number of different facilities and processes are complete, worker interviews can then be used to determine the adequacy of dose records across the nuclear weapons complex as a whole for specific time periods and processes.

This pooling of worker interview and dose data will allow an analysis of possible patterns in the discrepancies between worker accounts and dose data at specific facilities and over the entire complex. The dose reconstruction methodology will be audited to determine whether the worker interview and records have adequately taken these patterns into account in order to improve dose estimates, and possibly to develop correction factors to dose estimates, in case they are warranted.

Examples of Importance of the Interview Process

Example 1. Thorium-232 Processing

Thorium was processed at a number of facilities, such as the Simonds Saw & Steel Co., Lockport, NY (a FUSRAP site) and at the Fernald plant. The following quote from the study performed for *USA Today* about this (and two other sites) is illustrative of the importance of the interviews. This quote is about Simonds Saw & Steel:

> *Thorium processing operations may have taken as little as one week and possibly much longer.[3] Based on available data, it is not possible for us to estimate the total number of full time equivalent days for which the thorium milling operation was conducted. We have therefore calculated thorium doses corresponding to*

[3] The study was unable to make a reasonable estimate of the number of days for which thorium was processed. Hence, there is a corresponding uncertainty concerning worker exposures to thorium. The lowest estimate of working time was one week of full time work for thorium processing based on a comparison with uranium processing rates. The thorium throughput per hour would be about 40 percent of the uranium throughput per hour due to the difference in mill sizes (10 inches versus 16 inches, yielding a cross-sectional area ratio of about 40 percent). A June 8, 1953, document indicates that thorium processing rates may have been somewhere between roughly 1,000 pounds and 4,000 pounds per day, assuming that all work indicated in a month's period was done in a single full working day. On this basis, the total thorium processing time can be estimated to be between 10 and 40 working days—that is, 2 to 8 weeks. [Survey of Accounting Control over Source and Fissionable Material, Simonds Saw and Steel Company, Lockport, New York, with cover letter dated June 8, 1954.]

one week of full time work. Bone surface doses over a one-week exposure period would range from about 400 rem to almost 2,500 rem, depending on working conditions and thorium solubility. We do not have a basis on which to select a mix of solubilities based on the available data. If the work was carried out for several weeks, then the dose estimates would be correspondingly higher.

Overall, it appears that exposures to specific workers who worked on thorium may have been severe. We have not been able to assess cumulative thorium exposures in a manner similar to uranium since we lack even minimally adequate air concentration data over the requisite period of time. Our estimate of thorium exposures corresponding to one week's work indicates that, for some workers, thorium exposures may have been comparable to and perhaps greater than uranium exposures. Finally, if some workers worked on both uranium and thorium, those exposures would be additive.

The dose estimates above were made from workplace air concentration data. Worker interviews regarding the amount of time for which thorium was processed could be critical in cases like this to make an estimate of the dose, since the documentation for this was not contained in the facility profile that was available to the dose reconstruction personnel.

Example 2. Recycled Uranium

Recycled uranium was processed at a number of facilities (both DOE-owned and FUSRAP). Trace transuranic radionuclides (Pu-239/240, Np-237) can make a significant contribution to the worker dose. However, the levels of transuranics in recycled uranium varied by orders of magnitude, ranging from levels which would play no significant role in the dose to important contributors to dose. A crucial parameter in determining this would be the stage of processing at which the worker handled the uranium. For instance, plutonium concentrations at Paducah were higher at the fluorination tower relative to several other places and steps of processing. Specific job descriptions are therefore very crucial, since plant air monitoring data and biological measurement data usually do not contain radionuclide-specific information. Similarly, information on whether respirators were used is also important.

In light of the above, estimating the contribution of transuranics in recycled uranium processing is typically very difficult and involves carefully combining worker interviews, worker monitoring records, plant air monitoring data, and production data in facility profiles. Auditing worker interviews to determine whether they had adequately covered the worker's history with recycled uranium could be a critical component of individual dose audits at many DOE and FUSRAP sites. Coordinating facility profile and worker interview data across facilities may also be insightful. For example, recycled uranium at Fernald came from Paducah.

Audit Interview Forms

Besides the specifics of the audit, discussed above, we will also review the interview forms for adequacy as applicable to a particular case. Some gaps that may hinder complete elicitation of potentially important information from workers could include the following:

- The NIOSH questionnaire does not address food in the work place. Workers often ate in contaminated places and may have stored their food in contaminated places.

- There is no question about handling of badges. This could affect badge readings.

- The questions about badges imply that a worker would have worn only one badge (except to the extent that one question asks what part of the body the badge was worn). At Fernald, some workers had wrist badges, and some workers may also have worn ring badges.

- The reference to monitoring of "breath" is too vague to elicit data on breathing zone air contamination measurements. Many workers wore these portable air samplers. The interview form asks the question about monitoring "breath" in the context of biological monitoring, such as occurs after an inhalation of radionuclides. This may cause a worker to miss mentioning breathing zone measurements, which are not biological measurements, as such. Breathing zone data could be crucial in determining internal dose in some cases, especially where biological monitoring documentation is missing, as may be the case for many workers at FUSRAP facilities.

- The questions may not reveal the specific ways in which the particular worker may have come into contact with radioactive material. As is clear from the example of workers who stamped uranium ingots at Fernald (formally called the Feed Materials Production Center during the period of production, 1951–1989) noted above, it is necessary to go into the physical details of how a worker processed radioactive materials or handled them in considerable depth.

- The only question about neutrons relates to neutron-generating facilities. This omits neutrons from spontaneous fission of various isotopes, notably Pu-240, as, for instance, in Pantex igloos.

Audit Form Review Checklist

In order to facilitate and standardize the documentation of our reviews, the forms presented in Appendix C will be used, in part, to explicitly evaluate the thoroughness of the completed NIOSH questionnaires.

3.4 Procedures for Worker Profile Reviews

SC&A will review selected worker profiles from NIOSH's database to ascertain the quality and completeness of that database to support individual dose reconstruction. These reviews can be performed as part of the review of a given case, or as a stand-alone Task Order requested by the Advisory Board and authorized by the Project Officer. To accomplish these twin objectives, SC&A will address the following questions: (1) Are the data of sufficient quality and reliability to be used as a means to estimate dose when individual dose records are inadequate or not complete? (2) Have all relevant dose records with personal identifiers, such as plant records, monitoring data, memorandums, electronic databases, and accident and occurrence reports, been included? (3) Has there been sufficient characterization of historic radiation protection programs in place, including personnel monitoring requirements, protective equipment practices, dosimetric techniques and equipment in use, and procedural enforcement history?

3.4.1 Quality and Reliability of the Database

The quality and reliability of the database will be a function of the number of data points available for a particular job category, the facility process location or time period, and the consistency of the data entered in comparison with the original source information. As the worker profiles are populated with data from DOE sites, some searchable fields will contain more data than others, as will some facilities, and locations and time periods within facilities. "Missing data" will be apparent for certain operations and time periods due to any one of the following reasons:

- Lack of personnel monitoring data (dosimeter not assigned or not processed)
- Inadequate monitoring techniques
- Errors in transcribing dosimetry readings to official reports, historic dosimetry practices that ignored certain exposure sources (e.g., radon, low-energy photon, neutron), etc.

One important issue is the quality and reliability of electronic dose-record databases submitted by DOE for a site or facility. Unless these submitted databases have been verified from a quality assurance standpoint against the original source records at the site, they cannot be considered fully reliable. In its September 2000 Exposure Assessment report for the Paducah Gaseous Diffusion Plant, a review team consisting of DOE, University of Utah, and the Paper, Allied Industrial, Chemical and Energy Workers (PACE) International Union found a number of instances where the data on the "official" Paducah electronic historic worker dose database did not encompass all dosimetry records over the history of the plant.

At Paducah, the aforementioned exposure assessment found that the following limitations existed for personal external radiation exposure measurements, uranium urinalyses, and whole-body counting in the electronic database.

- While early health physics reports indicate that limited in-vitro bioassay monitoring for transuranics was conducted, there are no urinalysis data in the electronic databases prior to 1989.

- The historical urinalysis databases did not indicate the type of sampling (routine, special, etc.) or the solubility class of material being monitored.

- The databases have not been verified against any of the original records.

- The databases have not had any quality assurance/quality control evaluations.

- The databases are not complete; for example, it was determined that at least some elevated data from exposures as a result of incidents and accidents were not included in the electronic database. The database may contain data-entry errors.

- Some of the units used in the database are not clearly documented.

- Not all department numbers found in the health physics reports could be correlated with the department numbers recorded in the electronic databases.

The evaluation team in this case concluded that, "based on the above, the databases should not be used at this time to estimate individual worker doses."

As the NIOSH worker profiles will initially consist of many of these historic site electronic databases, SC&A intends to do sufficient "sampling" quality verification checks to assure that their reliability can support application to individual dose estimation. This will be accomplished by identifying the original source data and comparing them with the submitted electronic or hard copy data used in selected worker profiles. The degree and nature of potential "missing doses" will be determined as a means to ascertain the representativeness and usability of profile data. As dose reconstructions proceed over time and reconstructed individual doses are added to the database, the representativeness of the database will steadily improve, aided by these quality verification reviews.

3.4.2 Completeness of Records Incorporated

Each DOE site, if not facility, has a unique operational, radiological, and managerial history. While DOE and its predecessor agencies (Manhattan Engineering District, Atomic Energy Commission, Energy Research and Development Administration) issued directives governing radiation protection standards, dosimetry and record keeping in the early decades (1940s–1980s) were typically general and left to individual contractor interpretation and implementation. To gauge the completeness of records reflected in the NIOSH worker profile, SC&A will verify the "universe" of radiological data having identifiers for a particular facility or site, and compare that data with what is entered in the selected profile.

For this review, it will be essential to identify what monitoring was conducted for different types of radiation, for what worker categories and time periods, and in what form and condition the

source records exist. For many sites, source records, such as old dosimeter readouts, microfiche urinalysis results, and incident reports with estimated exposures can be located through deliberate inquiry and onsite searching. In other instances, databases have been compiled in the past as part of broader worker dose surveys, epidemiological studies, or summary radiation dose reporting. It needs to be ascertained that all such databases have accessible identifiers. Some summary reports, such as the Radiation Exposure Information Reporting System (REIRS), have originating identifiers that are maintained by the project manager.

To determine the completeness of records available to the NIOSH worker profile, it may be necessary to make inquiries of workers and records management personnel at some sites. The purpose of these inquiries is to identify the possible availability of records (with identifiers) based on recollections of programs, incidents, or procedures where monitoring may have taken place, and where corresponding records may have been maintained. In the early years, these are often at the facility or operations level and may not have been compiled in formal radiation dose records. SC&A will make inquiries to independently verify that the profile is complete from this standpoint.

3.4.3 Characterization of Historic Radiation Protection and Dosimetric Practices

Another issue is whether the appropriate caveats and limitations of the profile data are reflected. Each site radiation dosimetry program had a unique history and technical evolution. Some sites have conducted retrospective dose reconstructions to develop a reliable historic worker dose database and have reflected the limitations and qualifications associated with the dose values cited for individuals. Others have simply collected and reproduced available dose records without any effort to acknowledge or compensate for the inadequacies or incompleteness of the resulting database. Tritium and neutron doses were included and recorded for the first time at varying times at different sites. Urinalysis policy and recording thresholds vary widely as a function of radionuclide, operation, and site. Certain radiological source terms, such as trace contaminants in process streams, were not measured routinely, and what exposure records exist can be found in operational reports estimating doses to workers on a particular process line. SC&A will review the historic status of site radiation records for selected worker profiles and ascertain whether the dose information provided is consistent with them.

3.5 Reviewing Site Profiles

SC&A will review selected site profiles as determined first by NIOSH direction, and second by relevant aspects of site profiles associated with cases undergoing advanced dose reconstruction review (the latter will provide a two-for-one economy of work that will support both sampling objectives).

The NIOSH site profile database is designed to support the conduct of individual dose reconstructions by compiling data other than dosimetric information, such as that related to facility operations and processes over time, radiological source term characterization, chemical and physical forms of the radionuclides, historic workplace conditions and practices, and incidents and accidents involving potential exposures. SC&A will evaluate the quality and

completeness of this information to ascertain the adequacy of the information contained in the NIOSH site profiles.

SC&A will identify and evaluate the approach taken in compiling the site profiles through a comprehensive process of (1) independently identifying the selected site's operational history, (2) conducting an "exposure mapping" exercise to identify historic work processes and worker categories, (3) reviewing all relevant data sources, such as occurrence reports, inspection documentation, safety analyses, etc., and (4) interviewing worker representatives, worker advocacy groups, and other individuals having knowledge or expertise on site operational or radiological history.

3.5.1 Reviewing Site Operational History

For many DOE and AWE sites, reliable dosimetry records may be lacking, particularly for workers from the 1940s through 1960s. In these instances, historic operational information that includes the nature of operations, radiological source terms in use, process material concentrations, and location and time periods of worker activities may be the only data available for dose estimations. Such information can be extracted from historic records and documentation being collected by (or accessible from) DOE, including operational records, material inventories, safety and health inspections and assessments, occurrence reports, and routine memoranda and facility reports. This possible source of information will be surveyed at the DOE site or AWE records collection point to ascertain whether the site profiles adequately reflect at least the following information, where feasible:

- Operational processes over time, including improvements, upgrades, modifications and terminations *(important because worker exposures are often higher during major process changes).*
- Historic radiological inventory, source terms, and movement through facility ("mass balance") to include feed material, products, and byproduct and waste streams.
- Any unplanned events, including radiological over-exposures, contaminations, releases, spills, criticality incidents, and unusual occurrences.
- Changes in contractor management and attendant changes in safety policies, procedures, and practices *(important because new contractors import new radiation protection programs).*
- Applicable standard operating procedures, memoranda, directives or recorded practices governing onsite management of radioactive materials and processes.
- Actual historic operational practices established by first hand accounts (e.g., worker representatives, site "experts," etc.) *(important because actual facility practices often varied from official procedures).*

- Historic radiation protection programs in place, including personnel monitoring requirements, protective equipment practices, dosimetric techniques and equipment in use, and procedural enforcement history *(important to determine whether and to what degree the dosimetry program reflected actual potential exposures possible, given source terms involved).*

- Worker rosters with identifiers, work assignments and location, as well as summary of work histories sufficient to determine what categories of workers were assigned to what type and locations of radiological work.

It would be useful to have data on the number of monitored workers, number of workers with doses higher than the minimum detectable levels, average measurable recorded doses, minimum detection levels, and whether doses below the detection limit were recorded as zero. Even better would be to have data on the number of workers in specified dose ranges.

The foregoing information will be used in a comparative manner to ascertain whether the site profiles are complete in how they characterize, from a historic standpoint at a particular site, what radiological materials were present and in what concentrations and chemical forms; what worker groups may have been in proximity with sources of exposure and whether certain activities or unplanned events may have made such exposure likely; and what administrative procedures, operational practices, protective equipment use, and facility conditions may have influenced the likelihood of such exposure. The quality of the profile will be evaluated by what can be termed "exposure mapping."

3.5.2 Conducting "Exposure Mapping"

Exposure mapping will be used to evaluate the extent to which the profile provides information that can characterize the potential radiation exposure to which workers may have been exposed in specific work activities and locations or time periods at the site in question. Sources of information include published site reports, memoranda, area monitoring data, process descriptions, and general worker exposure summary information. Higher activity radiological sources in the facility's process streams will be linked to those worker categories and locations where potential exposure levels were highest.

An example of the types of published information that can provide historical site information that can be very helpful in preparing and reviewing site profiles is "Exposure Assessment Project at the Paducah Gaseous Diffusion Plant," prepared by PACE and the University of Utah on behalf of the DOE Office of Environment, Safety, and Health (September 2000). Table 7-3 from that report is one example of the outcome of an historical exposure mapping for the Paducah Gaseous Diffusion Plant. This type of information can be compiled for virtually any site, and can be extremely valuable in a blind dose reconstruction and in an advanced review of a NIOSH dose reconstruction.

3.5.3 Reviewing Relevant Data Sources

SC&A will determine whether the NIOSH dose reconstruction contractor appropriately identified, evaluated, and incorporated all relevant data sources by comparing the extent to which such information is present in the profile with what can be identified via an independent review of such sources of information. Data sources that will be scanned include the following:

- Department of Energy
  - Field Offices
  - Operating contractors
  - Institutional histories
  - Inspector General files
  - Headquarters and field oversight reports
  - Radiation exposure assessments
- Atomic Weapons Establishment
- Centers for Disease Control
- Nuclear Regulatory Commission
- Environmental Protection Agency
- General Accounting Office
- Defense Nuclear Facilities Safety Board
- Congressional Hearing Records
- State environmental and safety regulatory agencies
- National Academy of Science
- Administrative/court records
- *Department of Defense*
- Environmental Measurements Laboratory (formerly the Health and Safety Laboratory)
- Workers compensation records
- Worker and public advocacy groups
- Historic records in private hands

It is anticipated that a baseline of relevant information contained in these and other data sources will be established at the onset, facilitating subsequent comparisons with site profile information.

3.5.4 Interviewing Sources of Site Knowledge

SC&A, as necessary, will conduct one-on-one or group interviews with selected sources, including worker representatives, worker advocacy organizations, individuals with site "expertise" due to past employment or familiarity with operational history, and others who can verify the adequacy of site profile information that has been collected by the NIOSH contractor. Interviews will be conducted where convenient for these groups, including near the actual site in question. Lines of inquiry would include the following:

- How did actual radiation protection practice compare with documented policy and procedures?

- Were there instances of obvious "missed dose," e.g., not wearing or improperly wearing dosimeters, non-recording of dose, etc.?

- Were there any incidents involving potential radiation exposure, whether reported or unreported?
- Were there special work activities or facility modifications which constituted process changes that increased radiation exposure potential?
- Were workers concerned about past exposure or radiation protection practices? How did management respond and what, if any, changes occurred in onsite practice?
- Did workers wear protective equipment, as required?
- Were radiological jobs planned for exposure minimization (e.g., ALARA)?
- What was the general housekeeping in the facility; was radiological contamination common during the history of the facility?
- Were there special feed materials introduced or contaminants of concern identified from which radiation exposures may have resulted?
- Were there certain work activities at the facility that were considered "hotter" jobs from the standpoint of potential radiation exposure?
- Were safety procedures followed literally and did management assure that they were enforced uniformly?
- In terms of conduct of operation, were workers permitted to smoke, eat, or drink in control areas? Was protective clothing and equipment worn in these areas; was egress monitoring conducted?
- Were negative or "zero" doses recorded on periodic dosimetric records despite known exposure to significant radiation sources?
- Were records and other documentation of radiation exposure discarded or retained by management?
- Were there cases of over-exposed film and how were they treated?

The information extracted from these interviews will be used to ascertain the completeness and representation of that in the NIOSH site profiles.

3.6 Blind Dose Reconstruction

A great deal of information, procedures, and guidelines are provided throughout this proposal that demonstrate how we will go about performing basic and advanced reviews, worker profile reviews, and site profile reviews. Given this as background, suffice it to say that our procedures

for performing blind reviews will be in accord with OCAS-IG-001 and OCAS-IG-002, with all the qualifiers for ensuring quality that are described in depth in the other sections of this proposal. Upon completion of each blind review, the work products will receive the same independent advanced review audits as performed for NIOSH dose reconstructions as a form of quality assurance documentation.

3.6.1 Internal Dosimetry Procedures and Software.

For internal exposures, the document OCAS-IG-002 recommends for dose reconstruction purposes the use of the International Commission on Radiological Protection's (ICRP) most recent biokinetic and dosimetric models. Bioassay measurements, when available and reliable, should be used as a basis for relevant dose calculations. The interpretation of monitoring bioassay results, using ICRP models, requires the derivation and use of intake retention functions (describing body and organ contents) and excretion functions (describing activity in excreta), as a function of time following intake. Once the intake is estimated, the committed effective dose and the annual/committed organ dose are calculated by multiplying the intake by the appropriate dose coefficient.

As the models describing the uptake, distribution, and retention of radionuclides taken into the body are complex, the interpretation of bioassay data requires the use of a computational code that is based on the recommendations of the ICRP. Publication 78 of the ICRP [*Individual Monitoring for Internal Exposure of Workers*, Annals of the ICRP 27 (3-4), Pergamon, 1997.] gives limited information on the interpretation of bioassay data for selected radionuclides, for selected times after an acute intake and some graphical information on chronic intakes. We will use NIOSH guidelines to perform blind reconstructions, and NIOSH-recommended software. If the Task Order does not specify particular software, we will use a computational code that uses the ICRP's most recent biokinetic and dosimetric models. There are few computer codes that utilize the new ICRP models. Most of them are not commercially available, were developed by ICRP members, and are used in their home institutions. The ICRP does not recommend the use of any particular software. The one we will use, if agreed by the Task Order, was developed by ICRP members and was officially adopted by the International Atomic Energy Agency (IAEA), for use in Latin America in its program for Harmonization of Internal Dosimetry Programs, involving 10 countries in Latin America. This software has been benchmarked against ICRP 78 for all radionuclides and all times contained in the publication and reproduces ICRP 78 graphs for chronic intakes. It has all features necessary to reconstruct occupational radiation dose from internally deposited radionuclides as specified in OCAS-IG-002.

This software accepts input information on various types of measurements, e.g., urine, feces, lung, thyroid, bone, whole body, etc. Urine activities may be given as 24-hour excretion rates or on a per liter excretion rate. If given on a per liter basis, unless otherwise specified, a nominal excretion rate of 1400 milliliters (ml(of urine per day will be used. Fecal excretion activities may also be given as 24-hour excretion or on a per gram or per gram of fecal ash basis. Unless otherwise specified, the nominal excretion rate of the ICRP reference man will be used. The software accepts inhalation of gases and particles, ingestion, and injection as routes of entry. It accepts inputs on information on the elements or compounds, such as number of radionuclides available for intake (item 4.2, OCAS-IG-02), physical-chemical characteristics of the compound

(AMAD or absorption parameters) and choice between default and specific values (items 4.3 and 4.4, OCAS-IG-02). Radioactive progeny that grow in after an intake of a parent radionuclide are treated as recommended by the ICRP. Generally, it is assumed that the biokinetic behavior of the decay products is the same as that of the parent nuclide. However, in the biokinetic models for tellurium, lead, radium, thorium and uranium, separate systemic biokinetics are applied to the parent and its decay products, as specified in ICRP 71. An input for the intake of progeny is available, in an optional basis, with chosen equilibrium factors (item 4.2.3, OCAS-IG-02). This feature is very important when decay products are used to assess intakes of the parent.

The software calculates excretion rates and accumulation of radioactive material per unit intake in all organs described in ICRP current models for single intakes, chronic intakes, and exposures during a certain period of time. Thus, it is possible for all those scenarios to produce annual doses, committed doses until date of diagnosis of cancer or throughout the individual's entire employment, for all organs and tissues described by ICRP models as specified in OCAS-IG-02, as well as 50-year committed doses. In addition to calculating organ doses for the most probable intake scenarios, results from all those scenarios may be easily and rapidly compared, as required in items 6.1 and 6.2 of OCAS-IG-02.

When detailed dose reconstruction is required, a special feature, workers' chronic intakes (x days a week, y hours per day, and w days of vacation—for example, 5 days per week, 8 hours per day exposure, 2 days weekend and 20 days vacation) may be used. The workers' pattern of exposure takes into account the smaller activity excreted after a weekend or after a non-working period, typical of certain compounds. In some cases, as for example ^{131}I, the urinary excretion functions diminish by orders of magnitude within a few days, and therefore the choice of the time pattern of intake can influence the assessed dose by that same order of magnitude.

The information on the working history is very important. For long-lived nuclides, the amount present in the body and the amount excreted depends on the time the individual has been exposed. Following a chronic intake of 1 Bq per day of type S ^{232}Th, 5 days a week, its concentration in the lungs after 20 years of work is expected to increase by a factor of 4.4 in relation to the concentration after one year of work, for both AMAD 5 micron and 1 micron. On the other hand, the concentration excreted in the feces is supposed to be constant throughout that time period.

The software accepts the input of a series of data points from bioassay results collected at different times after intake and determines the best estimate of an intake using a least squares fit, maximum likelihood fit, or Bayesian approach. Thus, multiple data points may be used to estimate the actual intake, as specified in item 5.1 of OCAS-IG-02. The software will also determine the best estimate of an intake from information on different monitoring techniques, e.g. urine, fecal, and in vivo monitoring. The simultaneous use of multiple data from different monitoring techniques may be used as a tool to infer the route(s) of intake and the date(s) of intake and in refining preliminary estimates of intake (items 4.1.2 , 5.1 and 6.5 of OCAS-IG-02).

If bioassay data are not adequate to evaluate the individual's internal dose, workplace monitoring data will be used, if available, as specified in item 5.2 of OCAS-IG-02. All recommendations in item 5.2 will be followed to determine the concentration of the radionuclide in the breathing zone

and to estimate the workers' intake. If physical-chemical characteristics of the aerosol are not known, ICRP default parameters will be used. Organ doses will be calculated using ICRP CD-ROM, *The ICRP Database of Dose Coefficients: Workers and Members of the Public*, Version 2.01, Elsevier Science Ltd., 1998.

The same applies to the estimation of doses using information on the source term, as specified in item 5.3 of OCAS-IG-02. The software used for calculating organ doses from bioassay measurement may also be used for calculating organ doses from calculated intakes. It will be used to calculate doses when the use of specific absorption factors from lungs to blood is necessary (item 4.3 of OCAS-IG-02).

The software is thus a very efficient tool to perform blind reviews of internal doses in accordance with OCAS-IG-02. All guidelines contained in the document will be followed: the ICRP models; the collection of data for the individual case; the calculation of the dose to the organ or tissue of interest, including the correlation of ICD-9 Codes to ICRP Models; the collection of work area data; the collection of the individual dosimetry data; the preliminary dose estimates and the detailed dose estimates that include the estimate of the date of intake; the estimation of the uncertainty in the internal dose calculation; the treatment of missed doses; and the estimation of radon and progeny doses. All information given in the examples for item 8.0 will be used.

3.6.2 Dose Per Unit Measured Activity in the Body or in the Excreta: A Tool to Minimize Uncertainties

When multiple data points from bioassay monitoring collected at different times after intake or resulting from different bioassay monitoring methods are used to estimate the dose, the fitting procedure chosen for the analysis is very important. In a recent intercomparison among the most recently developed software that utilizes the most current ICRP models, a discrepancy was noted related to the different methods of fitting to calculate the best estimate of the intake and dose. The second reason for the discrepancy was due to the level of expertise and the choice made by the user on "reasonable" assumptions such as particle sizes; choice of solubility types as exemplified in item 4.3 of OCAS-IG-02; treatment of rogue data, as exemplified in item 5.1 of OCAS-IG-02; weight given to some bioassay results or to a particular bioassay method; etc. ["Review of Methods and Computer Codes for Bioassay Data Interpretation," E.Ansoborlo, P.Bérard, M. Bailey, V. Berkovski, A. Birchall, F. Fry, R. Guilmette, G. Miller, N. Ishigure, J. Lipsztein, and D.Nosske, presented at the Workshop on Intakes of Radionuclides, Oxford, UK, 2002, which will be published in 2003 in "Radiation Protection Dosimetry."] Thus, we should not be surprised if we find different dose estimates from the same data, unless very specific instructions are given in the Task Order. Alternatively, these issues could be addressed as part of the uncertainty analysis in the reconstructed doses.

Tabulations and graphs of dose per unit-measured activity (in the body or in excreta) at specified times after intake will be used. The variable dose per unit measured bioassay quantity is obtained using the most recent published ICRP dosimetric and metabolic models. Those tabulations and graphs are very helpful in determination of the best estimate of a dose (organ dose or effective dose) from results collected at different times, or from different monitoring techniques, e.g., urine, fecal, and direct measurements data. For example, for some

radionuclides, graphs of doses as a function of lung absorption Type and AMAD reveal "areas of invariance," i.e., time periods where the assessment of dose is relatively insensitive to assumptions made about lung absorption Types and AMAD. Thus, in dose reconstruction analysis, when AMAD and/or lung absorption Types are not known or are poorly defined, the use of monitoring data, if available, in the period of time corresponding to the invariance area, can minimize parameter uncertainties.

Those graphs are also useful for assigning a weight to multiple bioassay results, e.g., using the criteria of weighting data according to sensitivity in relation to dose calculations. The weight to multiple bioassay result will also depend on the specific organ for which dose is calculated, e.g., urine is best correlated to systemic organs. These correlations are also well visualized in the mentioned graphs.

The graphs may be used for defining the uncertainties related to an unknown or poorly defined model parameter. The graphs of dose per unit measured activity also provide a tool to rapidly compare doses derived from the same data set of bioassay results, using different assumptions. Thus, the choice of the hypothesis that leads to the greatest dose is easily visualized and determined.

3.6.3 Basic Approach to External Dose Reconstruction Reviews

For external dose radiation exposure, OCAS-IG-001 provides guidance on the methods of dose reconstruction. The procedures for blind reviews will be exactly the ones specified in OCAS-IG-001. As specified in this document, the three groups of workers who require dose reconstruction are: workers who were not monitored, workers who were monitored inadequately, and workers whose monitoring records are incomplete or missing.

Among the workers that were monitored inadequately, special technical attention will be given to the results from individual monitoring done in early times, when the sensitivity and accuracy of the dosimeters were inadequate as compared to modern standards (items 1.1.3, 2.2.1 and 2.3.1,OCAS-IG-001). We anticipate considerable uncertainties in the evaluation of low energy photon dose, mixed photon field evaluation, electron dosimetry and neutron dosimetry.

For the Dosimeter Photon Dose (item 2.1.1.2), the evaluation of external photon doses using film dosimetry is straightforward for photon energies above 250 keV. In this region, the energy dependence of the film emulsion is quite low. It was, and still is, usual to perform the calibration of the dosimetric system using only a high-energy source of photons (above 250 keV). Unless the dosimetric system was characterized and calibrated for low energy photons, the evaluation of external dose due to exposure to, for example, the plutonium isotopes, will be compromised. The review of the individual monitoring reported doses for plutonium workers will include, where possible, an evaluation of the calibration, evaluation, and dose reporting procedures. For example, if the dose due to 17 keV photons was evaluated using the net optical density under the lead filter, and not through the "open window dose" the lower limit of detection will be much higher than 30 millirem (mrem), and probably closer to 500 mrem. This would increase the "missing dose" for these cases.

In the cases in which a worker handled, in the same monitoring period, two or more radionuclides that emit both high and low photon energies, the evaluation of the external photon dose using photographic dosimetry becomes more difficult. For early dosimetric systems, it is possible that only the high energy or only the low energy component of the dose was reported. Again, if the calibration, evaluation, and dose reporting procedures are available, the uncertainty in the dose estimates may be assessed. With the advent of LiF TLD monitoring systems, this problem no longer exists due to the lower energy dependence of LiF.

To evaluate the organ dose, it is necessary to discriminate the energy spectrum of the photon field into the three energy bands established in OCAS-IG-001. The evaluation of dose through film dosimetry or TLDs normally requires the previous evaluation of the average energy of the photon field that is being measured. This energy is, however, not always reported together with the dose. In these cases, it is necessary to determine the radionuclide or radionuclides the worker handled over the monitoring period to determine the relevant energy spectrum. The determination of the relative distribution using the site relative inventory or the review of historical operations is recommended in item 2.1.1.2 of OCAS-IG-001.

As for the neutron dose (item 2.2, OCAS-IG-001), even today, neutron dosimetry is subject to large uncertainties. The main problem is that film and TLD neutron dosimeters have a large energy dependence, together with the fact that the energy range of neutron fields is huge (a few eVs to many MeVs—around seven orders of magnitude). The dosimeter may be typically calibrated for one energy spectrum, and to the others a "calibration factor" was applied. Even today, an uncertainty of + 100% and - 50% for any neutron dose, would be considered an "acceptable result." All procedures recommended in item 2.2 of OCAS-IG-001 will be followed. The OCAS-IG-001 document defines five energy ranges for neutron fields. The establishment of the neutron field energy spectrum is therefore important for the calculation of the organ dose. All data available will be carefully analyzed. All sources of complementary data will be used, for example, neutron energy spectrum studies made at a number of work places using Bonner Spheres and published in the literature. These studies might even be applied to early dates if conditions remained the same. Another example is the use of the ratio of neutron to gamma dose in workplace situations for which it has been well-established. Also, when TLD techniques were used to determine the neutron dose, the photon dose was also evaluated and should have been recorded. In these cases, the ratio can serve as an estimate of the missing neutron dose for cases when the neutron source geometry and the laboratory moderation are relatively unchanged and where only the photon dose was evaluated and recorded.

For electron dose reconstruction using film dosimeter records (item 2.3.1, OCAS-IG-001), it is important to determine whether the worker was also exposed to low energy (15 - 25 keV) photon fields, as these can leave an image similar to an electron irradiation on film dosimeters. Although the calibration process and energy dependence of the film emulsion lead to uncertainties in the electron dose evaluation process, the main source of uncertainty is due to the short range of electrons in air and clothing and the irradiation geometry. For example, consider a worker doing decontamination work and directly handling a source of beta-gamma radiation. The electron dose registered on the thorax dosimeter would be quite low, and the electron dose to the skin of the thorax could be considered zero due to the shielding of the worker's clothing. However, the electron dose to the hands would be much greater, and, unless reliable extremity

dosimetry was provided, a better estimate of the electron dose may be obtained through source term investigations.

For the Photon Dose Reconstruction from a Source Term (item 3.1.3, OCAS-IG-001), it is advisable to use a computer program, as specified in item 3.1.3.2, OCAS-IG-001. We will use NIOSH recommended software. If the Task Order does not specify particular software, we will use a program that uses a voxel phantom to simulate the human body and the Monte Carlo technique to provide the organ doses for external photon fields in the energy range of 15 keV - 2 MeV. The program simulates the source of the radiation, which can be of a complex geometry, and the shielding, which can include many layers of different material. Using the Monte Carlo technique, self-shielding and build-up are taken into account. The use of voxel phantoms is the most modern accepted technique for the simulation of the whole body and is derived from whole body magnetic resonance image (MRI) scan. The program reports the absorbed dose to each organ and tissue relevant to the calculation of the effective dose as defined in ICRP 60. Ground sources or cloud sources may be simulated. The phantom may be placed in a standing, sitting, lying, or other geometry in relation to the source. Although the program simulates multi-energy photon emission and integrates the dose in each relevant tissue over all energies, it can also be used to determine the Hp(10) dose and the photon energy spectrum arriving at the voxel phantom, and therefore permit the application of the Dose Conversion Factors tabled in Appendix B of OCAS-IG-001. The software may be applied to find the "worst case geometry."

There are few programs that have all characteristics described above. They are currently used in different laboratories, but most of them are not commercially available. We will use software that has been extensively benchmarked against other Monte Carlo programs for simple geometries, and against physical phantoms with TLDs for more complex geometries. However, this will only be done with the approval of the Task Order. All guidelines contained in document OCAS-IG-001 will be used.

Currently, we are inclined to derive the effective dose and organ dose using anthropomorphic phantoms with the specified ICRP tissues and organs and the radiation transport code, MCNP4C. Modified (to include the esophagus and skin) versions of the Pacific Northwest National Loaboratory male and female MIRD-like anthropomorphic phantom will be used for the calculations. These modified phantoms are similar to the Adam and Eva phantoms developed in 1982 at Germany's National Research Center for Environment and Health, GSF.

The anthropomorphic phantoms consist of three principal sections: an elliptical cylinder representing the arms, torso and hips; two truncated circular cones representing the two legs and feet; and an elliptical cylinder representing the neck region and lower portion of the head, which is topped by half an ellipsoid. The gonads and eyes are specified. The arms are not separated from the torso, and minor appendages such as fingers, feet, ears, chin and nose are omitted. Internal organs are approximated by simple mathematical equations describing the average shapes and sizes.

Each internal organ is considered to be homogeneous in composition and density. Different compositions and densities are used for the lungs, skeleton, and the total body minus the skeleton

and lungs. The breasts and esophagus have the same composition as the total body minus the skeleton and lungs, with different densities.

The red bone marrow (RBM), a very important tissue to consider, is difficult to represent mathematically due to the intricate mixture of RBM and bone in the skeleton. In this analysis, the composition of the skeleton will be regarded as a homogeneous mixture of true bone and marrow. The RBM will be assumed to absorb energy per gram as efficiently as the bone. The dose to the RBM will be determined by taking the sum of the percentages of RBM found in the different bones. These values are available in MIRD Pamphlet No. 5.

The source type, energy, and geometry (volume, planar, point, etc.) will be modeled from available information. Conservative approximations will be assumed if information regarding the source geometry is unavailable. The most conservative irradiation geometry (usually AP-PA depending on source type and energy) as well as the most likely irradiation geometry will be used for the calculations.

The organ doses will be calculated in the phantom using the energy deposition tally in MCNP4C. Once all of the organ doses are known, the effective dose can also be calculated using the appropriate ICRP tissue and radiation weighting factors.

3.7 Special Exposure Cohort Petition Reviews

The SEC is a specific group of employees defined by Congress in the Energy Employees Occupational Illness Compensation Program Act (EEOICPA) who are eligible for compensation under this Act. They are defined by the proposed rule 42 CFR 83 as follows:

> *. . .employees of DOE, DOE contractors or subcontractors, or Atomic Weapons Employers (AWEs) who worked an aggregate of at least 250 days before February 1, 1992 at a gaseous diffusion plant in (1) Paducah, KY, (2) Portsmouth, OH, or (3) Oak Ridge, TN and who were monitored using dosimetry badges or worked in a job that had exposures comparable to a job that is or was monitored using dosimetry badges; or (4) employees of DOE or DOE contractors or subcontractors employed before January 1, 1974 on Amchitka Island, AK and exposed to ionizing radiation in the performance of duty related to the Long Shot, Milrow, or Cannikin underground nuclear tests.*

If any of these employees had or has been diagnosed with one of 22 specified cancers, then they or their survivors will receive a "lump sum payment of $150,000 and prospective medical benefits" as compensation for illness which resulted from these radiation exposures. These individuals are automatically eligible for compensation and do not have to undergo dose reconstruction under 42 CFR 82 in order to determine PC of their cancers. Proposed rule 42 CFR 83, "Procedures for Designating Classes of Employees as Members of the Special Exposure Cohort under the Energy Employees Occupational Illness Compensation Program Act of 2000: Notice of Proposed Rulemaking," describes the petition process that is being developed for the addition of employees of other DOE facilities and AWEs to the SEC. Addition to the SEC

depends primarily on the ability of NIOSH to perform a dose reconstruction under 42 CFR 82. The EEOICPA states that a class of employees may be considered part of the Cohort if:

> *HHS determines that (1) it is not feasible to estimate with sufficient accuracy the radiation dose that the class received; and (2) there is a reasonable likelihood that such radiation dose may have endangered the health of members of the class.*

Individuals or groups seeking to be added to the SEC must submit a petition to the DOL. Categories of petitions are described in 42 CFR 83 as follows:

> *(1) Petitions from claimants in which NIOSH has already determined that a dose reconstruction cannot be completed under 42 CFR 82. These petitioners only need to cite this decision in their petitions, since NIOSH has already compiled an administrative record for this class of employees. The petitioners are not required to provide any additional information. These petitions are considered the highest priority;*
>
> *(2) Petitions from employees who have not submitted a claim for dose reconstruction under 42 CFR 82. These petitions are considered the second highest priority;*
>
> *(3) Petitions from claimants who are currently waiting for results from dose reconstruction under 42 CFR 82. These petitions are considered low priority.*

The EEOICPA indicates that the Advisory Board will independently review a small sample of petitions evaluated by NIOSH. These audits will allow the Board to oversee the work being done by NIOSH. As prescribed by the proposed SEC rule and guided by the Board, the basis for a worker to be considered a member of a class of workers for purposes of this sampling review would include (but not be limited to):

- Range of uncertainty in doses for the workers for which data are available. This will include factors such as missing and faulty data, measurement uncertainties, and incomplete data. For example, at Fernald, group doses have been calculated with low uncertainty, but the same data indicate uncertainties that are very large for individual workers. A review would include an evaluation of the statistical procedures by which the best dose estimate is assigned to a worker who does not have any or adequate data for a reliable dose reconstruction to be done.

- How closely job descriptions fit the actual work done by workers. In some cases, workers had particular job designations, but in practice performed other duties as well.

- Degree to which facility reviews show that the particular worker consistently performed the work described for which relatively reliable dose reconstruction cases are available.

- Time period for which data are available compared to the period for which the worker in question worked a particular job.

- Whether a worker also performed other jobs that are not typical of those who are members of a group for whom dose data are available.

- Solubility information regarding the chemical form of radionuclides to which a particular worker or group of workers were exposed.

- How frequently bioassay data were taken for individual workers or for workers belonging to the group from which dose for an individual might be imputed.

- When, how much, and in what form, recycled uranium was processed or present, and whether data exist from which the transuranic and fission product contamination of the recycled uranium can be determined or reasonably inferred.

- Handling of film badges and use of correction factors.

The checklist presented in Exhibit 3-2 provides a systematic review of the above considerations and other specific information that SC&A proposes to use in performing these reviews. However, **this checklist is simply a guideline** and may not contain all of these elements that can and may be used for an audit. Each petition, and the information required for its review, will be considered on a case-by-case basis. A "Comments" section is provided in the checklist if the auditor chooses to elaborate or describe information which is not contained in the checklist.

The need to combine both a systematic review of criteria, such as that contained in the checklist, with expert judgment of the radiological dosimetry and operation history of a facility can be illustrated at any number of DOE sites.

For example, at Fernald, "blowouts" occurred in furnaces at Fernald, where UF_4 was reduced to U metal. Workers present during blowouts or who were given the job of cleanup immediately afterwards (if they were from the production area) might be in a different subcategory than the other production workers in this area. Witness information can be useful not only in determining unusual accidents, but also for determining accidents and process upsets that were not so unusual, but nonetheless not part of the planned normal production process. Another example of this kind of problem would be uranium chip fires, which were prevalent at a number of DOE sites handling uranium metal.

At Los Alamos TA-33 (Tritium Facility), workers frequently lacked respirator protection while working in tritium-contaminated atmospheres. When significant exposures occurred, some workers would expedite urinary excretion by consuming large amounts of liquids; others would delay routine bioassay monitoring. Exposure would vary by the particular job being performed, the individual worker's work practice, and ventilation present in the work area at the time. The only area monitoring was an area tritium alarm set at relatively high activity levels. A determination of the ability to reconstruct these doses would hinge on a combination of witness interviews, historic area alarming data, and available dose records, and a judgment on their

adequacy, given the inherent difficulty of establishing routine tritium exposure and what internal residence times can be assumed.

For an SEC evaluation, the circumstances at Paducah Gaseous Diffusion plant exemplify how "missed dose" must be ascertained and evaluated. A number of sources of missed dose existed that made it less feasible to estimate individual worker doses, including:

- A lack of documentation. At Paducah, this included doses that were never recorded, may have been discarded, or records that could not be located after an extensive search.

- A failure to monitor the exposure. There were numerous examples at Paducah during the history of the plant where the potential for radiological exposure may have existed, but was not monitored, or not adequately monitored.

- A failure to recognize an opportunity for a radiological exposure. For example, at Paducah, it was assumed that nearly all uranium ingested or inhaled was soluble and quickly excreted from the body without harm or long-term effects. In fact, aerosols of insoluble uranium compounds were generated in a number of work areas.

- Lack of sensitivity of the radiation monitoring or bioassay techniques. For example, a worker who had been exposed to elevated airborne concentrations of "poorly soluble" uranium was given in vivo radiation monitoring and determined to be below standard detection limits for the site, when, in fact, the determined lung burden was equivalent to a "significant internal deposition" according to corporate radiation protection criteria.

- Movement of workers between job assignments and between facilities without any documentation or changes in dosimetry to reflect differences in radiation source terms. It was also obvious that, over time, buildings were used for different purposes and the potential for worker radiation exposure was not recognized.

The above contributory sources of inadequate, missing, or inaccurate dose records illustrates the need to systematically review the dosimetric history, operational practice, and management policy over the lifetime of the plant for which an SEC petition has been received, and to assure through sampling that this probing is thorough.

The checklist in Exhibit 3-2 is divided into three sections. The first two sections allow the auditor to review the information provided by the petitioner. The last section allows the auditor to review the work performed by NIOSH during the petition evaluations. The first section, "SEC eligibility criteria," presents the conditions which must be met, by law, in order to qualify as a member of the SEC. The second section, "Petition requirements," presents information which 42 CFR 83 states must be included in the petition in order to perform a complete evaluation. The third section, "Information gathered by NIOSH," is a list of sources described in 42 CFR 83 that

may be used by NIOSH during its evaluation. NIOSH is responsible for collecting all relevant information in order to accurately and fairly evaluate petitions for SEC. By definition, addition to the SEC depends on NIOSH's ability to do a dose reconstruction, therefore the auditor must be able to decide if NIOSH exhausted all of the information sources and elements that make up an accurate dose reconstruction. In most cases, performing an audit on an SEC petition evaluation must also involve an audit of the dose reconstruction (see the Dose Reconstruction Review Checklist).

These completed forms will be filed in hard copy and electronic form under our records management system, and auditable under our quality control/quality assurance program. All audit findings are documented on the forms, and traceable back to the auditor and the documents upon which the audit review was performed.

Exhibit 3-2. SEC Petition Audit Report and Checklist

SEC PETITION AUDIT REPORT

Page____of____

Audit Number:	**Petition Number:**	**Date:**
Auditor(s):		
Audit Record Summary (Describe below what records you examined, to whom you submitted them, the conclusions you arrived at, and how you arrived at them):		
List of documents reviewed:		
List of new documents identified: (Attach a copy of all documents not included in the original administrative record to this report.)		
List of person(s) interviewed: (Attach a copy of the interview documentation to this report.)		
Audit conclusions: Agree/disagree (Note: Attach all audit checklists and supporting documents.)	Agree:_____(Initials) Additional comments should be entered in the 'Summary' below.	Disagree_____(Initials) If petition evaluation is rejected, complete next section.
Provide a summary discussion of the reasons for disagreeing with the petition evaluation: (Attach all calculations, notes, reports, etc., used in your conclusions.)		
General Comments:		
Signature of Auditor(s):		
Area of Review:		
Date:		

Exhibit 3-2. SEC Petition Audit Report and Checklist (continued)

SEC PETITION REVIEW CHECKLIST

Audit Number:	Petition Number:	Date:	Page ___ of ___
Auditors/ Area of Review:			
Person(s) who performed SEC petition evaluation and/or dose reconstruction:			

Description	Yes/No/NA	Comments	Initials
SEC ELIGIBILITY CRITERIA Sentences or phases in quotations are items taken directly from 42 CFR 83. Must be able to answer **yes** to one or more parts of the following questions in order to qualify for SEC.			
1. Are the class of employees represented by the petition present or former employees of "Department of Energy (DOE), DOE contractor or subcontractor, or an Atomic Weapons Employer (AWE)"?			
2. Is the petitioner:			
(a) a member of the class of employees?			
(b) "a surviving spouse, child, parent, grandchild or grandparent" of an employee?			
(c) "one or more labor organizations representing or formerly having represented DOE, DOE contractors, or subcontractors, or AWE employees"?			
(d) "one or more individuals or entities authorized in writing by one or more DOE, DOE contractor or subcontractor, or AWE employee"?			
3. Have one or more members of the class of employees been diagnosed with one or more of the following cancers:			
(a) "Leukemia (other than chronic lymphocytic leukemia) provided that the onset of the disease was at least two years after initial occupational exposure"?			
(b) "Lung cancer (other than in situ lung cancer that is discovered during or after a post mortem exam"?			
(c) "Bone cancer"?			
(d) "Renal cancers"?			
(e) "The following diseases, provided onset was at least 5 years after first exposure:			
(i) "Multiple myeloma"?			
(ii) "Lymphomas (other then Hodgkin's Disease)"?			

Exhibit 3-2. SEC Petition Audit Report and Checklist (continued)

SEC PETITION REVIEW CHECKLIST
continued

Description	Yes/No/NA	Comments	Initials
(iii) "Primary cancer of the:			
(A) Thyroid?			
(B) Male or female breast?			
(C) Esophagus?			
(D) Stomach?			
(E) Pharynx?			
(F) Small intestine?			
(G) Pancreas?			
(H) Bile ducts?			
(I) Gall bladder?			
(J) Salivary gland?			
(K) Urinary bladder?			
(L) Brain?			
(M) Colon?			
(N) Ovary?			
(O) Liver (except if cirrhosis or hepatitis B is indicated)"?			
4. Has the petitioner provided proof of the cancer diagnosis (e.g., physician's letter, post-mortem exam results)? Note: Proof of diagnosis is not discussed in 42 CFR 83, but it may be important for the purposes of evaluation.			
PETITION REQUIREMENTS Sentences or phases in quotations are items taken directly from 42 CFR 83. Does the petition indicate or contain:			
1. "The DOE or AWE facility at which the class worked"?			
2. "The location or locations at the facility covered by the petition (e.g., building, technical area)?"			
3. "The job titles and/or job duties of the class members?"			
4. "The period of employment relevant to the petition?"			
5. "Identification of an exposure incident that was unmonitored, unrecorded, or inadequately monitored or recorded?" Some examples include:			
(i) Records or confirmation from NIOSH or DOE that the exposure incident occurred?			
(ii) "Medical evidence that one or more members of the class may have incurred a high-level radiation dose from the incident, such as a depressed white blood cell count associated with radiation exposure or the application of chelation therapy"?			
(iii) "Confirmation by affidavit from two employees who witnessed the incident, providing this evidence is consistent with other information available to HHS?"			

Exhibit 3-2. SEC Petition Audit Report and Checklist (continued)

SEC PETITION REVIEW CHECKLIST
continued

Description	Yes/No/NA	Comments	Initials
6. "A description of the petitioner's basis for believing records and information available are inadequate to estimate the radiation doses incurred by members of the proposed class of employees with sufficient accuracy?" Some examples include:			
(i) "Documentation or statements provided by affidavit indicating that radiation exposures and doses to members of the proposed class were not monitored, either through personal or area monitoring"?			
(ii) "Documentation or statements provided by affidavit indicating that radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed"?			
(iii) "A report published by a scientific government agency or published in a peer-reviewed scientific journal that identifies dosimetry and related information that are unavailable for estimating the radiation doses of employees"?			
INFORMATION GATHERED BY NIOSH Sentences or phases in quotations are items taken directly from 42 CFR 83. Does the administrative record contain information (or indicate attempts to obtain information) from the following sources?			
1. Records and information from DOE and AWE facilities?			
2. "Potential members of the class and their survivors?"			
3. "Labor organizations who represent or represented employees at the facility during the relevant time period?"			
4. "Managers, radiation safety officials, and other witnesses present during the relevant period at the facility"?			
5. "NIOSH records from epidemiological research on DOE populations and records from dose reconstructions conducted under 42 CFR 82"?			
6. "Records from research, dose reconstructions, medical screening programs, and other related activities conducted to evaluate the health and/or radiation exposures of employees of DOE, DOE contractors or subcontractors, and the AWEs"?			

Exhibit 3-2. SEC Petition Audit Report and Checklist (continued)

SEC PETITION REVIEW CHECKLIST
continued

Description	Yes/No/NA	Comments	Initials
TYPES OF INFORMATION USED IN DOSE RECONSTRUCTION Taken directly from 42 CFR 82.14. This is simply a guideline. Each case is different and not all of the types of information listed below may be necessary.			
1. "Subject and employment information:"			
(a) "gender"			
(b) "date of birth"			
(c) "DOE and/or AWE employment history:			
(i) job title held by year			
(ii) work location (site names, building numbers, technical areas, duration of relevant employment)"			
2. "Worker monitoring data":			
(a) "external dosimetry data (film badge, TLD, neutron dosimeters)"			
(b) "pocket ionization chamber data"			
3. "Internal dosimetry data:"			
(a) "urinalysis results"			
(b) "fecal sample results"			
(c) "in vivo measurements results"			
(d) "incident investigation reports"			
(e) "breath radon and/or thoron results"			
(f) "nasal smear results"			
(g) "external contamination measurements"			
(h) "other measurement results applicable to internal dosimetry"			
4. "Monitoring program data"			
(a) "analytical methods used for bioassay analyses"			
(b) "performance characteristics of dosimeters for different radiation types"			
(c) "historical detection limits for bioassay samples and dosimeter badges"			
(d) "bioassay sample and dosimeter collection/exchange frequencies"			
(e) "documentation of record keeping practices used to record data and/or administratively assign dose"			
(f) "other information to characterize the monitoring program results"			

Exhibit 3-2. SEC Petition Audit Report and Checklist (continued)

SEC PETITION REVIEW CHECKLIST
continued

Description	Yes/No/NA	Comments	Initials
5. "Workplace monitoring data"			
(a) "surface contamination surveys"			
(b) "general area air sampling results"			
(c) "breathing zone air sampling results"			
(d) "radon and/or thoron monitoring results"			
(e) "area radiation survey measurements (beta, gamma and neutron)"			
(f) "fixed location dosimeter results (beta, gamma, and neutron)"			
(g) "other workplace monitoring results"			
6. "Workplace characterization data"			
(a) "information on the external exposure environment:			
(i) radiation type (gamma, X-ray, proton, neutron, beta, other charged particles)			
(ii) radiation energy spectrum			
(iii) uniformity of exposure (whole body vs. partial body exposure)			
(iv) irradiation geometry"			
(b) "information on work-required medical screening x-rays"			
(c) "other information useful for characterizing workplace radiation exposures"			
7. "Information characterizing internal exposures"			
(a) "radionuclides and associated chemical forms"			
(b) "results of particle size distribution studies"			
(c) "respiratory protection practices'			
(d) "other information useful for characterizing internal exposures"			
8. "Process descriptions for each work location"			
(a) "general description of the process"			
(b) "characterization of the source term (radionuclide and its quantity)"			
(c) "extent of encapsulation"			
(d) "methods of containment"			
(e) "other information to assess potential for irradiation by source or airborne dispersion of radioactive material"			

3.8 Special Topics

The following presents a list and brief description of special technical topics that our team will be prepared to address. Section 3.6 on Blind Dose Reconstruction also addresses many special topics, especially those related to internal dosimetry.

3.8.1 Special Attention to Historical Bioassays and Dose Reconstructions

Historic bioassay surveillance data in workers have been evaluated at times by dosimetrists and epidemiologists in order to reconstruct the extent of occupationally received past exposures to one or more internally absorbed radionuclide-contaminants. Before those early data could be employed in a meaningful interpretive manner, however, various essential defining characteristics should have been addressed. For example, how technically accurate and precise were the measurements, and to what extent were they representative of their associated exposure events? Within this basic concept, we will endeavor to determine the extent to which statistical confidence was attached to the archival surveillance data; consider any algorithm that may have been employed for translation of older information into more current representations of exposures; examine those programs for evaluating error terms which were attached to each of the individual bioassay values; and consider how the original sample collection protocols were considered for their effect on the final estimation of the time-course and magnitude of related exposure(s).

To accomplish these aims, the approach that will be taken in this review can be represented as falling into each of three major categories: (1) the statistical representation of analytical accuracy and precision, (2) those factors accounting for the sample collection variability, and (3) the biological considerations for estimating the physiological dose and significance. In the first category, it will be necessary to statistically propagate the uncertainties associated with each of the procedural steps (e.g., chemical and plating recoveries, detection efficiency, etc.), as well as to consider the myriad of other factors that make up the statistical counting error (e.g., background variability, sample size, counting time, etc.). In addition, other sources of uncertainty, such as the specificity of the analysis for the contaminant in question and individual analytical procedural steps (e.g., plating problems resulting in unwarranted alpha particle absorption), should be defined quantitatively. All of these considerations become particularly significant when procedures entailing no tracer isotope (as frequently encountered in some of the early methodologies) had been employed.

The second category that will be considered, i.e., the sample collection variability, includes factors such as the magnitude, time, and frequency of the bioassay sample collection (important, for example, to the extent defined by the changing pH of a standing urine sample, container–wall "plateout," magnitude of the "retention" parameter viz. effective half-life), as well as other time-related collection factors that are relevant to the exposure scenario.

Finally, attempts at quantifying the above considerations for final radiological dose calculation necessarily invokes knowledge of the physical absorption along with the uncertainties attached to the magnitude of each of the metabolic transfer factors and deposition parameters of the considered contaminant.

3.8.2 Use of Specific Values of the Human Respiratory Tract Model (HRTM) Parameters

A great deal of attention is currently being given to the appropriate choice of the absorption parameters in performing internal dose calculations. For example, though particle sizes have been considered important since the issuance of ICRP 30, concern regarding specific absorption parameters and their effect on bioassay is new. This issue is given particular attention in the recently published "Guide for the Practical Application of the ICRP Human Respiratory Tract Model," Annals of the ICRP, Supporting Guidance No. 3, Volume 32, No. 1-2, 2002, ISN 0146-6453, Pergamon Press, 2003.

In this document, guidance is given on applying the HRTM in situations that require specific information on the characterization of radioactive aerosols and gases, and on determining absorption rates from lungs to the blood. The information contained in this document is a very important update on the ICRP 66, 68,78, (56, 67, 69) series, and should be used in the interpretation of bioassay data and when it is desirable to obtain better dose assessments. Examples are given illustrating the application of the HRTM in a range of situations. The document analyzes how specific information on particle-size distribution, particle density, absorption to blood, nose or mouth breathing, and distribution of time between sleep, sitting, and light/heavy exercises affects the effective doses and the interpretation of bioassay measurements (urine, feces, lungs). In general, bioassay measurements change much more than effective doses, as the characteristics of the inhaled material change. So it may well be particularly important to use specific information to assess intakes from measurements on workers.

In the reconstruction of doses we may use material-related parameters that result in a better assessment of the dose. When particle-size distribution is unknown, and available data are not sufficient for determining the particle size, dose should be calculated using "dose per measured quantities" (urine excretion, feces excretion, lung, or body measurements). The quantity "dose/measured quantity" is more robust in relation to particle sizes than the quantity "intake/measured quantity," although they come from the same ICRP models and the former value is obtained by multiplying the last one by the quantity dose coefficient per unit intake. Specific absorption factors, describing the rate of absorption from lungs to blood, should be used for compounds described in this document and when a more refined dose reconstruction analysis is required.

In any particular situation, the actual values of many of the parameters will inevitably be different from the reference values. There can be circumstances in which it is feasible and desirable to obtain a more accurate, or more reliable assessment of intake or dose, by using information specific to the situation. Typically, this is likely to be the case when assessing doses retrospectively, i.e., when the intake has already taken place, or when intakes are currently taking place or are likely to take place in the near future.

In general, a "closer look" at absorption parameters generally reveals that the default values used to derive the generic dose conversion factors are overly conservative. This creates a dilemma for this project in that it is our intent to err on the side of the claimant. As such, our audits will identify such issues as they arise, solely for the purpose of providing a complete record of our review, but this does not necessarily mean that NIOSH was incorrect in using the more conservative default values in their assessments. In cases in which the reconstructed doses are

based on dose conversion factors that are clearly conservative based on the records, but the doses are still found to be low, we will provide documentation of this fact.

Sometimes the opposite occurs and the use of specific factors gives a higher dose than using default parameters. In the ICRP technical document, several examples are cited where the use of the specific absorption factors from lung to blood gives a higher dose than when assigning the default absorption type. All examples are related to effective doses, but the same applies with organ doses. In cases in which there is reason to believe that the physical and chemical composition of the inhaled or ingested material is such that the doses may be higher than reported, this finding will be reported and given special attention with regard to its implications not only to the dose reconstruction under investigation, but also to other related dose reconstructions.

3.8.3 Intercomparisons of Bioassay Results among Different Laboratories

Recent intercomparisons have revealed that different laboratories can obtain different estimates of intakes and doses when provided with the same bioassay data. In these exercises, in which the participants had largely used ICRP models, differences in dose assessments of up to five orders of magnitude had been reported. The differences were largely due to assumptions regarding absorption fractions and retention models. [IAEA, "Intercomparison and Biokinetic Model Validation of Radionuclide Intake Assessment," IAEA-TECDOC-1071, 1999; H. Doerfel, A. Andrasi, M.R. Bailey, A. Birchall., C.M. Castellani, C. Hurtgen, N. Jarvis, L. Johansson, B. LeGuen, G. Tarroni,. "Third European Intercomparison Exercise on Internal Dose Assessment: Results of a Research Pprogramme in the Framework of the EULEP/EURADOS Action Group," FZKA 6457, Forschungszentrum Karlsruhe, 2000.] Such findings are very disturbing, but indicate how much the choice made by the internal dosimetry expert on "reasonable assumptions" for missing information can affect the interpretation of bioassay results.

3.8.4 Dose per Unit Measurement for Dose Reconstruction

Graphs of committed effective dose per unit measured activity (in the body or in excreta) versus times after intake, as a function of lung absorption Type and AMAD, reveal "areas of invariance," i.e., time periods where the assessment of dose is relatively insensitive to assumptions made about lung absorption Types and AMAD. Thus, in dose-reconstruction analysis, when AMAD and/or lung absorption Types are not known or are poorly defined, the use of monitoring data, if available, in the period of time corresponding to the invariance area can minimize parameter uncertainties in modeling. The effective dose per unit measured activity also provides a tool to compare bioassay methods in relation to uncertainties in dose calculations as a function of differences in lung absorption parameters for specific compounds. These data are useful when choosing a bioassay method, when assigning a weight to multiple bioassay results, and when defining the uncertainties related to an unknown or poorly known lung absorption parameter.

3.8.5 Upcoming Developments with ICRP Internal Dosimetry

Though the current ICRP models have been adopted for use by NIOSH, ICRP is continually re-evaluating their recommendations and models. Dr. will keep the Board appraised of

these developments, so that they can be given appropriate consideration as the Board fulfills its mandate. New developments that are worth mentioning include:

- HAT - The new model for the Human Alimentary Tract, in substitution to the ICRP 30 GI Tract Model, is in its final draft. It is probably going to be released in early 2004. The new HAT model will be used in the future by ICRP in substitution for the ICRP 30 model.

- Publication of a new document, *Occupational Intakes of Radionuclides: Dose Assessment and Monitoring* (Revision of Publications 30, 54, 68, 78). The new document will contain revisions of the systemic models; most of the models will be recycling models for easier bioassay interpretation. Whenever information is available, physiologically based models will be recommended.

- In relation to inhalation, information relating to absorption rates from the lungs to the blood for important compounds will be recommended and other compounds will be assigned to the three absorptions: Types F, M, S. In addition, the gender-specific doses will be calculated using realistic computational models (phantoms), derived from medical images, with organ sizes consistent with the new reference person (ICRP 89, 2002).

- A review of individual monitoring methods and programs, as well as interpretation of bioassay results, will be given. A review of sources of uncertainty in the estimate of intakes and doses will be included. A technical document on Interpretation of Bioassay Monitoring will be published at the same time as the main document.

- The biokinetic models for radionuclide contaminated wounds, which are being developed by the National Council on Radiation Protection (NCRP), will be reviewed by the ICRP and possibly be adopted.

- A complete review of tritium compounds biokinetics is being performed and a complete review of radon dosimetry is expected in the near future.

3.8.6 Additional Issues Related to Internal Dose Reconstruction

The reconstruction of internal dose is frequently complex, highly individualized, and defined by variables that are largely unknown. Even when credible bioassay data exist, estimates of internal dose(s) may, nevertheless, require process knowledge and professional judgment regarding the applicability of standard dose models in terms of the assigned chemical form, solubility, exposure pathway(s) for a radio-contaminant, etc. Among the variables that may profoundly affect the uncertainty of internal dose estimates are the following:

- Time of Uptake. Whole-body counting (WBC) and/or in-vitro bioassay data are of limited value if the "day(s) of uptake" is not known. This uncertainty is particularly problematic if the WBC/bioassay is one that is termed routine (i.e., conducted annually/periodically or upon termination). To assist in narrowing the window of exposure to a most probable time period, the reviewer must consider

all available data that may include incident reports, radiation surveys, radiation work permits (RWPs), co-worker exposure data, etc.

- Individualize Parameters. Dose models generally are based on reference-person physiological and lifestyle parameters. For some radionuclides, individual-specific parameters may profoundly alter estimates of dose. For example, the amount of dietary intake of non-radioactive iodine inversely affects the blood-to-thyroid transfer fraction (i.e., f_2 value) of radioiodine. Because dietary intake of iodine varies greatly by geographic location as well as over time, f_2 values can reasonably be expected to vary from less than 0.2 to as much as 0.8 on the basis of dietary intakes. Equally, the uptake of iodine and its retention/excretions may also be affected by underlying thyroid conditions/pathologies.

- Use of Air Monitoring Data as Surrogate for Bioassay Data. When internal exposures are based on air-monitoring data, the largest source of uncertainty to a calculated dose comes from the difference in concentration(s) in air inhaled by the worker versus the air sampled. When air is sampled in close proximity to a specific worker (as is the case for breathing-zone apparatus), potential differences are minimized. Of concern, however, are air monitoring data that are based on hard-wired, permanently installed continuous air monitors (CAMs). For example, a glove-box worker exposed in close proximity to a pinhole release of plutonium may be breathing air concentration(s) that are one to two orders of magnitude higher than air concentration(s) sampled by the CAM that may be 20 to 30 feet removed from the source.

3.8.7 Selected Issues Related to External Dose Reconstruction

- Personnel Dosimeters/Field Survey Instruments. Contributing to the uncertainty of derived dose estimates based on personnel dosimeters (film/TLD) are many factors. For some factors, considerable data exist that allow for corrections to be made that minimize their contribution to uncertainty. For example, a substantial body of data exists that defines the energy dependence of various film emulsions used in personnel dosimeters over time.

  A major factor contributing to uncertainty of personnel dosimeter and field survey data is the method of their calibration conditions approximate to exposure conditions of the wearer. Common variables involving calibration include selection of the radiation source, source-to-dosimeter/instrument geometry, use of a phantom, etc. A significant but frequently poorly defined variable is the difference in source geometry between the calibration of the dosimeter/survey instrument and the radiation field to which a monitored individual was exposed. In many instances, this involves the calibration to a point source and the monitored exposure to a complex radiation field that may include (1) multiple independent sources, (2) an infinite planar source, (3) isotropic (2π) source, or (4) an instantaneous exposure (one side only) from a point source (i.e., prompt neutron/gamma exposure from a nuclear weapon test).

3.8.8 Selection of Reasonable Assumptions

Due to the importance of ensuring that assumptions used to estimate doses are fair, consistent, and scientifically grounded, a special topic that must be re-emphasized is the need to compare all available data (i.e., worker profile data, site profile data, work history interview, claimant documentation, etc.) and evaluate them for consistency and reasonableness. Data comparisons should not be limited to information available for an individual case, but when applicable, should also include comparisons between similar cases.

3.8.9 Auditor's Assessment of a Case Significantly Differs with NIOSH's Dose Reconstruction Results

There may be cases during the basic, advanced, or blind review where the auditor identifies new information or uncovers inappropriate/unreasonable assumptions, calculational errors, inconsistencies in data, etc., that will substantially increase the dose and potentially change the outcome of a denied claim. When it appears that the auditor's findings could result in a PC of greater than 50 percent, it is recommended that the auditor(s) have an opportunity to present this case to the Advisory Board for further review.

4.0 PERSONNEL, FACILITIES, AND EQUIPMENT

4.1 Personnel

Exhibit 4-1 presents an overview of the relevant experience of key members of the project team. Following Exhibit 4-1, biosketches are provided that describe the role of each key person on the project, his or her relevant project experience, and their availability to the project. Appendix A presents complete resumes for each member of the team. Though we have assigned specific responsibilities to each individual on the project, it is worth noting that most personnel have experience in several of the technical specialty areas required for this project. A specific number of hours proposed for each key person has not been given here, as there is no way to know this without knowing the tasks which might be issued under the contract. However, work hour allocations and schedules are provided for the sample tasks.

Name, Title, Anticipated Level of Effort (key personnel only)	Educational Background	Years of Relevant	Rad, Chem.	Familiar with Specific DOE/AWE Facilities	Availability
Key Personnel					
SC&A, Inc.					

Name, Title, Anticipated Level of Effort (key personnel only)	Educational Background	Years of Relevant	Rad. Chem.	Familiar with Specific DOE/AWE Facilities	Availability

Name, Title, Anticipated Level of Effort (key personnel only)	Educational Background	Years of Relevant	Rad. Chem.	Familiar with Specific DOE/AWE Facilities	Availability

Name, Title, Anticipated Level of Effort (key personnel only)	Educational Background	Years of Relevant Work Experience			Availability
			Rad. Chem.	Familiar with Specific DOE/AWE Facilities	

4.2.1 Office and Electronic Communications Facilities

SC&A maintains its corporate headquarters in 4,200 square feet of prime office space located on Old Dominion Drive in McLean, Virginia. This office has a 15-workstation 10/100 RJ-45 LAN, allowing SC&A employees to work together and communicate effectively with clients and subcontractors. The LAN operates using Windows NT 4.0 and Linux servers, and utilizes Send Mail for electronic mail. Automated tape backup systems safeguard the network. Each workstation has access to full-time, real-time, full-service direct connectivity over the LAN to the Internet via our dedicated DSL line. This ensures reliable access to global Internet resources, as well as providing the capability for communication and file transfer with remote staff, subcontractors, and clients. Physical resources include a conference room complete with audiovisual equipment. The building has a multi-level security system with card reader access entry.

SC&A's Southeastern Environmental Laboratory is located in Montgomery, Alabama and specializes in the analysis of radionuclides in environmental media. It is fully equipped with modern, industry-standard radiochemical and radiometric equipment and is organized according to nationally and internationally accepted radioanalytical and treatment processing principles. A

significant inventory of factory-calibrated field sampling devices and health and safety equipment is maintained at the laboratory. This inventory includes a full complement of radiation survey equipment, including alpha scintillation probes, beta/gamma survey meters, and gamma scintillation probes. The laboratory is pre-qualified with the U.S. Army Industrial Operations Command under the category of "Characterization and Verification." The laboratory holds a radioactive materials license (No. 1150) with the Office of Radiation Control in the Alabama Department of Public Health and is certified in several other states to characterize radioactive waste.

SC&A also operates a regional office in St. Louis, Missouri, which provides quality assurance and auditing services.

4.2.2 Graphic and Reproduction Facilities

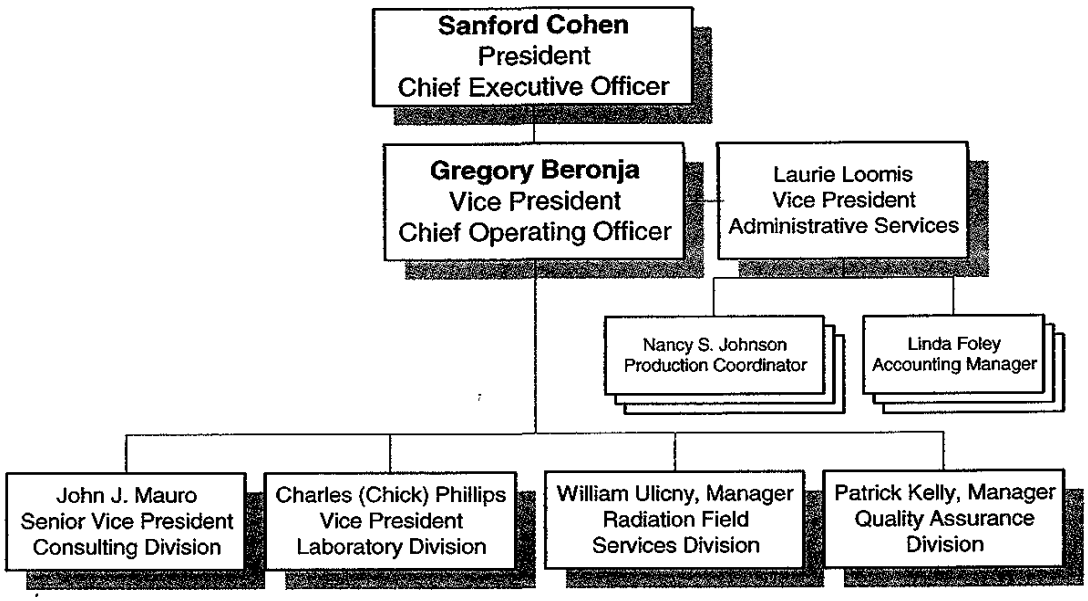
SC&A's production department creates a wide range of documents, presentations, and exhibit materials. Our word processing and graphics capabilities include state-of-the-art desktop publishing software, enabling us to create high-quality documents in a variety of formats. Using graphics software such as Adobe Illustrator, Adobe PhotoShop, Microsoft PowerPoint, Aldus PageMaker, Claris Draw, Corel Draw, and T/Maker ClickArt, SC&A staff are also able to illustrate documents and create effective presentation and exhibit materials.

The McLean office of SC&A is equipped with two Canon ImageRunner 550 reproduction machines, one of which is networked for access from the individual workstations. These high-volume copiers produce high-quality copies at rates of up to 83 copies per minute and are used for reproduction of technical reports, manuals, and handbooks. They are equipped with automatic feed and sorters, and can produce double-sided copies. Both machines are maintained by factory-trained technicians and are serviced regularly. SC&A maintains a full complement of laser and inkjet color and black-and-white printers.

5.0 CORPORATE EXPERIENCE

SC&A currently has approximately 30 employees and approximately 100 associates. More than 75 percent of SC&A's professional staff have advanced degrees. The majority have 15 to 25 years experience solving scientific and technical problems and implementing solutions to radiation and radiation-related issues. SC&A personnel are primarily engineers, health physicists, chemists, and physicists. The engineering staff is composed of nuclear, chemical, and environmental professionals, many with professional registration. About one-fourth of the health physics staff are Certified Health Physicists, and almost all the chemists are radiochemists. Other disciplines include computer science, metallurgy, and hydrology. The following presents SC&A's corporate organizational chart.

SC&A Organizational Chart



Since its founding, SC&A has provided primarily radiological consulting services to Federal agencies under large, task order, cost plus fixed fee contracts. Our principal clients have been and continue to be the CDC, the NRC, the EPA (particularly ORIA/EPA), and the Republic of the Marshall Islands (RMI). We have also held large contracts with the DNFSB and the Congressional Office of Technology Assessment (OTA). The important point is that our primary business is providing the highest quality radiological consulting services to Federal agencies, especially agencies that provide independent regulatory oversight to the DOE and its contractors. From the perspective of being qualified for providing the services required by this contract, and still being free of any real or perceived conflict of interest, SC&A is in a very unique position. The only significant amount of work that we perform for DOE is laboratory services for some DOE contractors, and we do no work for NIOSH.

Our private sector work has been limited primarily to the radiological characterization of contaminated sites and providing heath physics oversight and closeout surveys. We have also assisted many NRC licensees in obtaining and maintaining their NRC licensees. In its more than 20 years of existence, SC&A has performed work on approximately 225 contracts, including more than 1,000 tasks for its clients.

5.1 Radiological Assessment Support to the NRC and the Nuclear Power Industry

SC&A has held 17 contracts with the NRC, either as a prime contractor or subcontractor, since 1981. Six of these contracts were completed or initiated within the past five years. Under these contracts, SC&A fulfilled dozens of task orders, with support requirements spanning the entire spectrum of assistance requested under this solicitation.

SC&A evaluated the impact of NRC-initiated multi-plant actions on worker radiation exposures. A list of multi-plant actions potentially resulting in occupational radiation exposures was compiled from the NRC "orange book" for the period 1979 through 1983. This list was supplemented by the relevant I&E Bulletins over the same time period. The next step was to divide the operating reactors into classes, based on distinguishing parameters, and to select representative plants from each of the classes.

Occupational radiation exposure data were obtained from the Radiation Work Permits at ten representative plants for tasks corresponding to the NRC multi-plant actions. The exposures from these representative plants were used to estimate the total exposures at light water-cooled reactors. The results were presented in a form which illustrates the contribution of dose from NRC-initiated multi-plant actions to total worker dose. The report was published as AIF/NESP-033, Occupational Radiation Exposure Implications of NRC-Initiated Multi-Plant Actions, March 1986.

In the early 1980s, the nuclear energy industry employed an increasing number of non-permanent radiation workers at nuclear power plants, variously referred to as "temporary" or "transient" workers. Little was known about these workers, aside from their radiation exposures, which were alleged to be higher, on the average, than those of permanent station employees. SC&A conducted a study to characterize the non-permanent radiation workers at nuclear power plants. The workforce was subdivided into permanent station employees, non-station utility employees, temporary station utility employees, permanent contractor employees, and temporary contractor employees. For each category of workers, data were collected on numbers of individuals by craft, age, sex, geographical origin, duration of employment, and radiation exposure. Additionally, radiation exposures were evaluated by specific job, including steam generator repair, control rod drive maintenance, decontamination, and waste management. Finally, the training in radiation safety was assessed for both permanent and temporary workers.

In evaluating the job-specific radiation exposures, it was necessary to disaggregate radiation work permits by worker category. Although this task was simplified at some plants through the use of automated databases, tedious reviews were necessary at other plants. In total, one to three years of exposure data were obtained for 15 units at nine stations operated by six utilities. The work was published as a report entitled, "Characterization of the Temporary Radiation Work

Force at U.S. Nuclear Power Plants," AIF/NESP-028, May 1984. This experience has many similarities to the development of worker and site profiles.

SC&A developed for the nuclear power industry methods for predicting worker doses. The objective was to determine how accurate are current state-of-the-art estimates, and to develop a method which improves the accuracy of these estimates. Initially, using data collected from representative nuclear power plants, estimated doses were compared with actual doses in an attempt to explain the reasons for discrepancies. The results of these comparisons were used to guide the development of a method to improve the accuracy of these estimates.

The developed method comprises three building blocks--an overall logic, checklists, and worksheets. A logic diagram guides the estimator through a series of steps, each of which involves the completion of a checklist or worksheet. The checklist systematically solicits the information needed to prepare the estimate, including appropriate adjustment factors. The worksheets are used to organize information and perform calculations needed to construct the dose estimate. The final report described the application of the method to the engineering design process, and presented a sample problem which illustrates its application.

The report was published as AIF/NESP-039, Estimating Doses in Nuclear Facilities with Emphasis on the Design Process, January 1987. The method was also programmed for implementation on a desk-top computer. The program is contained on a floppy disk included with the program description in NUMARC/NESP-001, DOSES: A System for the Personal Computer to Estimate Radiation Exposure at Nuclear Facilities.

Though these investigations were performed on behalf of NRC and its licensees many years ago, the experience and lessons learned have applicability to historical exposures experienced by workers at DOE and AWE facilities at that time.

SC&A is currently supporting NRC's effort to develop the technical basis for a rulemaking establishing residual radioactivity contamination standards for the clearance of materials and equipment from licensed facilities. SC&A is characterizing the quantities and radiological composition of materials and equipment that may be affected by the rule, and supporting the development of cost models for use in determining material dispositions for the collective dose/risk assessment and the cost/benefit analysis portion of the Regulatory Impact Analysis.

As part of the characterization investigations, SC&A was instrumental in the development of a database characterizing the quantities, types, and radionuclide composition of systems, facilities, and equipment for more than 11,000 facilities in a number of industrial and government sectors. SC&A is currently working on two follow-on contracts. The first is to finalize NUREG-1640, entitled "Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities," for the Office of Nuclear Regulatory Research. NUREG-1640 contains methods for translation of concentrations of radioactivity in or on certain metals and concrete into radiation doses as a result of decontamination and survey of these materials. SC&A is performing an analysis of individual dose assessments for the clearance of materials and equipment, resolving public comments on NUREG-1640, and preparing the manuscripts and other materials for final publication. Under the second contract, SC&A is providing technical assistance for both

individual and collective dose assessments to determine the radiological impacts of alternatives for the clearance of materials and equipment. Both projects involve the development of Monte Carlo-based multimedia dose assessment models for evaluating individual and collective doses to workers and the public, including formal assessment of uncertainties and variabilities. The models make extensive use of ICRP methodologies for performing internal and external exposures.

5.2 Defense Nuclear Facilities Safety Board Support

SC&A was a technical support contractor to the DNFSB from 1993 through 1997. DNFSB was established by Congress in 1989 as an independent agency to provide advice and recommendations to the Secretary of Energy on public health and safety at DOE defense nuclear facilities. Fourteen tasks were ordered during the four years that SC&A held the contract. (DNFSB eventually brought the work in-house.)

SC&A developed a Standard Review Guide (SRG) on Radiological Training under the DNFSB contract, which was intended to be the first of a series of guides that would comprehensively relate to radiological protection. SC&A also reviewed several implementation guides under the DOE rule on occupational radiation protection, 10 CFR Part 835, and compared them with applicable commercial and government standards, assessing their technical content with the guidance that has been given to commercial utilities. The lessons learned from these programs provide insight into the strengths and limitations of historic DOE radiation protection programs vis-à-vis NRC regulated programs.

It is important to note that all of these investigations that SC&A performed for our Government clients required auditable QA/QC programs performed under fully documented pre-approved Quality Management Plans and Quality Assurance project procedures which implemented those plans for each project. Our documentation had to be complete, transparent, and was audited by our clients on numerous occasions. During your review of our past performance on these projects, you will have an opportunity to judge the responsiveness and quality of our work.

5.3 Dose Reconstruction Support to Centers for Disease Control

In January 1990, the Secretaries of the Departments of Energy (DOE) and Health and Human Services (DHHS) signed a Memorandum of Understanding (MOU) transferring to DHHS responsibility and funding for studies of chemical and radionuclide releases from DOE nuclear facilities, and of potential exposures and health effects to the surrounding population. The primary purpose of this transfer of responsibility was to avoid any perceived or actual conflict of interest associated with DOE performing the historical dose evaluations for facilities for which it has operational responsibility.

Under the authority of the MOU, the Radiation Studies Branch (RSB) of the CDC began its independent investigations into the historical doses at the INEEL in 1992. The first phase of these investigations began with the retrieval of approximately 15,000 boxes of records and the creation of a bibliographic database containing titles and abstracts of reports, records, and documents pertinent to the historical operations, radionuclide emissions, and radiation exposure

of members of the public on and offsite since the commencement of operations in 1949. This bibliographic database was designed to facilitate research into the historical non-occupational exposures at INEEL. Based on this experience, SC&A understands the challenges associated with the retrieval of critical historical records related to dose reconstruction.

On June 21, 2002, CDC authorized SC&A, in cooperation with SENES Oak Ridge, to proceed with a research project that included:

- Calculation of the chronic and episodic airborne radionuclide releases from the Idaho Chemical Processing Plant (ICPP) for the years 1957, 1958, and 1959, from the criticality accident that occurred in October 1959, and from the series of 31 Initial Engine Tests of the Aircraft Nuclear Propulsion Program (ANP).

- Determination of the historical doses to members of the public both on and offsite from these releases.

The project also involves the search for additional records as required for the above research and adding them to the bibliographic database, attending meetings of the INEEL Health Effects Subcommittee (a Federal Advisory Committee), and preparing fact sheets regarding the project and our findings. The results of this research are to be used by CDC to determine the need for follow-up investigations into the potential impact of these radiation doses on public health.

5.4 Dose Reconstruction Support to the Republic of the Marshall Islands

SC&A provided technical support to the Office of the Public Advocate, Central Government, and the Local Government Councils of Enewetak, Bikini, Rongelap, and Utrik Atolls of the Republic of the Marshall Islands in matters relating to the resettlement of the northern atolls and public health and land claims compensation due to radioactive contamination and radiation exposures resulting from nuclear weapons testing in the Central Pacific. These services included the following:

- Evaluate the current and future, and actual and potential, radiation doses and radiological health risks to the critical population groups and the average members of the populations of the northern atolls of the Marshall Islands from radionuclides in the environment due to nuclear weapons testing.

  The evaluations used existing data (supplemented in some cases by confirmatory sampling and analyses) characterizing the radionuclide concentrations in soil, foods, air, and water to develop three-dimensional representations of the contamination profiles on the islands. Radiation doses and health risks were then derived using the methodologies recommended by the EPA and site specific information regarding diets, living habits, and environmental transfer constants on the islands.

- Compare these radiation doses and health risks to the applicable radiation protection standards.

  The standards included the 15 mrem/yr EDE above background standard adopted by the EPA and by the RMI for the cleanup of sites contaminated with radioactive materials. SC&A also evaluated the doses against the 25 mrem/yr and 100 mrem/yr standards set forth in NRC regulations and recommended by the NCRP and ICRP.

- Derive soil cleanup levels.

  This involved determining the combined average concentrations of Cs-137, Sr-90, Pu-239/240, and Am-241 in soil in survey units, considering depth of contamination, that provide a level of assurance that the resettled populations and/or the existing populations on each island will not receive exposures in excess of the EPA cleanup criteria of 15 mrem/yr above background to the reasonable maximally exposed individual for all pathways of exposure.

- Evaluate the costs and effectiveness of a broad range of alternative strategies for the remediation of the islands to the EPA cleanup criteria.

  The remediation strategies include the no action alternative, natural attenuation with monitoring (including whole body counting, urinalysis, and environmental radiological surveillance), food avoidance, island avoidance, soil removal, application of soil additives to suppress the uptake of radionuclides by plants (including the application of potassium and the application of clay-like additives to soil), soil washing, and phytoremediation. Due to the location of the islands and the unique environmental settings, cost analysis for each remediation strategy required unit cost information unique to the Marshall Islands.

- Reconstruction of the historical radiation exposures and associated health risks to the people of the Marshall Islands from fallout from nuclear weapons testing.

  This work involved the review of hundreds of recently declassified documents characterizing bioassay data, film badge readings, radiation survey readings, aerial survey overflight readings, fallout patterns, and the observed clinical effects of fallout on the populations of the northern atolls. The dose reconstructions included derivation of the doses to the average members of the populations and members of the critical population groups each year from 1946 to the present. These dose reconstructions were then compared to the applicable radiation protection standards at the time for the purpose of assessing compensable "loss of use" claims. SC&A also derived the time integrated collective doses to the populations in support of claims compensation for adverse impacts on public health. This involved monetizing the detriment caused by the exposures using a broad range of methods adopted by the EPA, NRC, and other agencies for monetizing health detriment.

This particular task, which lasted two years at a cost of about $500,000, required retrieval and in depth review of hundreds of recently declassified documents, which included data logs, telegraph communications, redacted documents, hand written reports, very old overflight radiological surveys, film badge readings, results of radiological surveys performed using primitive and poorly calibrated instrumentation, and the review of bioassay data that was sparse, used primitive techniques, and was contradictory. We visited remote atolls of the Marshall Islands and spent extensive periods of time (weeks) interviewing these people to elicit their personal experience and recollection of events that took place almost 50 years ago. This experience is invaluable in terms of the lessons learned with regard to what it means to reconstruct historical doses under difficult situations.

As a result of this work, we believe we have uncovered major discrepancies between the whole body, thyroid, and GI tract doses experienced by the Marshallese as compared to the doses reported by the Government at that time and to this day. The people of the Marshall Islands have learned to trust us to objectively report our findings and defend our work before government tribunals and the DOE. We believe that, in providing these services, we have not only earned the respect of the people of the Marshall Islands, but also our counterparts at the DOE and the various independent consultants that have been reviewing our work. The two key individuals that were responsible for this work, Drs. , are key individuals on this proposed project for the Advisory Board.

- Performance of MARSSIM radiological surveys for selected northern atolls for the purpose of determining whether remediation is required or to certify that the islands comply with the cleanup criteria.

  This involved sending a survey team to collect samples of soil, water, and food items on the Island of Ailuk. The samples were analyzed at SC&A's laboratory in Montgomery, Alabama and in the RMI laboratory in Majuro. Before analyzing the samples in the Majuro lab, SC&A refurbished the lab, and installed and calibrated new counting equipment. As part of the project, SC&A trained six Marshallese in field sampling procedures and worked closely with Marshallese laboratory personnel in performing sample analyses at the Majuro lab.

- Evaluation of the northern atolls for PCB contamination.

  Concern was expressed by the people of Enewetak and Bikini that their atolls may have also been contaminated with PCBs resulting from the facilities constructed on Enewetak and the ships that were sunk in the lagoon of Bikini atoll. SC&A collected soil, lagoon sediment, and fish and analyzed the samples for a broad range of PCB congeners and trace heavy metals.

Our scope of work included defending our analyses before the Nuclear Claims Tribunal for claims amounting to over $1 billion. On four separate occasions, SC&A consultants participated

in extensive hearings (each lasting about 2 weeks), where the results of our work were presented and litigated. Our support to the People of the Marshall Islands also included participation in periodic meetings with the DOE and the Department of the Interior. At these meetings, SC&A presented the findings of our investigations, reviewed the work performed by DOE on behalf of the Marshall Islands, suggested new areas of inquiry, and assisted in the drafting of memoranda of understanding between the Republic of the Marshall Islands and the U.S. Government.

Our work involved numerous visits to Majuro, the capital of the Marshall Islands, and the outer islands to obtain information and present our results to the people of the northern atolls, the President and his Cabinet, the Senators representing the atolls, and before the Nitijela (the Parliament).

5.5 Dose Assessment Support to the Environmental Protection Agency

SC&A has supported EPA/ORIA in many of its rulemaking efforts related to the nuclear power industry and related radiation programs, including a multi-task contract. These efforts involved the recycling of radioactive scrap metal (RSM), cleanup criteria for sites contaminated with radioactivity, 40 CFR Part 197 regulations for Yucca Mountain, disposal of low-activity radioactive waste, and drinking water protective action guidelines. SC&A investigated the technical issues associated with the rules and compiled the information into formats required by the regulatory process, including Technical Support Documents (TSDs), Background Information Documents (BIDs), Regulatory Impact Analyses (RIAs), Environmental Impact Statements (EISs) and Regulatory Issues Papers.

SC&A prepared the radiological dose assessment guidance provided in EPA's "Risk Assessment Guidance - Human Health Evaluation Manual," which is EPA's guidance for deriving DCGLs, along with "Guidance for the Development of Derived Concentration Guideline Levels for Radionuclides in Soils: Technical Background Document," prepared for the EPA ORIA, Contract No. 68D20155, Work Assignment 5-23, EPA Work Assignment Manager Michael Boyd, September 30, 1997.

SC&A support included helping establish the framework and overall EPA strategy for rulemaking; evaluating the legal and regulatory framework within which rules would be promulgated; considering the scope and alternative forms of rules; generating factors involved in implementation of rules; and analyzing precedents established by EPA and other Federal and state agencies. Once information on the rules or guidance was published, SC&A supported EPA in managing, evaluating, and responding to comments.

For example, SC&A prepared a comprehensive multi-volume Background Information Document for the Agency's proposed rule regarding the recycling of radioactive scrap metal (RSM) cleared from nuclear facilities. The investigations (1) compiled an inventory of DOE's existing RSM and predicted the quantity of material that would be generated through DOE's decontamination and decommissioning (D&D) program, (2) performed a cost/benefit analysis for all of DOE's recycle options, and (3) assessed the impacts on certain sensitive industries of recycling metals with residual levels of radioactivity.

SC&A was a prime contractor to EPA ORIA over a 15-year period (1986 to 2000). EPA 402-B-02-001 (October 2002) lists over 700 reports published by ORIA. SC&A was a principal contributor to many of those reports dealing with radiological issues. Noteworthy among those reports include:

- Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), 402-R-97-016
- Environmental Characteristics of EPA, NRC, and DOE Sites Contaminated with Radioactive Substances, 402-R-93-011, March 1993
- Computer Models Used to Support Cleanup Decision Making at Hazardous and Radioactive Waste Sites, 402-R-93-005, March 1993
- Risk Assessment Guidance for Superfund (RAGS): Part A (Volume 1 - Human Health Evaluation Manual), 540-1-89-002, December 1989
- Radiation Site Cleanup Regulations: Technical Support Document for the Development of Radionuclide Cleanup Levels for Soil, 402-R-96-011, Volumes A, B, C, D
- Radiation Exposure and Risk Assessment Manual (RERAM), 402-R-96-016
- Background Information Document to Support NESHAPS Rulemaking on Nuclear Power Reactors, 402-R-94-015
- Fact Sheet: Computer Models Used to Support Cleanup Decision Making at Hazardous and Radioactive Waste Sites, 540-F-94-022
- Fact Sheet: Environmental Characteristics of EPA, NRC, and DOE Sites Contaminated with Radioactive Substances, 540-F-94-023
- Fact Sheet: Environmental Pathway Models – Ground-Water Modeling in Support of Remedial Decision Making at Sites Contaminated with Radioactive Material, 540-F-94-024
- Fact Sheet: A Technical Guide to Ground-Water Model Selection at Sites Contaminated with Radioactive Substances, 540-F-94-025
- A Technical Guide to Ground-Water Model Selection at Sites Contaminated with Radioactive Substances, 402-R-94-012 (prepared as a cooperative effort by EPA, the NRC Office of Nuclear Material Safety and Safeguards, and the DOE Office of Environmental Restoration)
- Evaluating Technical Capabilities of Groundwater Models Used to Support the Cleanup of Low-Level Radioactive Waste Sites, 402-R-93-010

- NESHAPS Background Information Document on Rulemaking for NRC and Agreement State Licensees other than Nuclear Power Reactors, 430-R-92-011

- Radiation and Mixed Waste Incineration Background Information Document, 520/1-91-010

5.6 Selected Private Sector Experience

Starting with the most recent, the following presents brief descriptions of SC&A's experience in deriving cleanup standards using a broad range of dosimetric models and designing and implementing facility and site characterization and closeout surveys for the private sector. All field work is performed by SC&A personnel, using SC&A equipment, and all laboratory work is performed by SC&A's radiological laboratory.

New Jersey Industrial Sites

SC&A is currently involved with five New Jersey sites that are contaminated with radioactivity, including U-238, Th-232, Ra-226, and tritium. SC&A's role involves site investigation, waste characterization and disposal, radiation health and safety, field procedures, oversight functions, and assisting in the development and negotiations with NJDEP for site-specific cleanup criteria. The New Jersey sites are located in Teterboro, Hopewell, Lodi, Riverton, and Sayreville. SC&A has derived DCGLs for both commercial/industrial and residential uses of the sites and designed and implemented the MARSSIM site characterization and closeout survey programs.

Curtis Bay FUSRAP Site in Baltimore, MD

SC&A served as consultant and radiological subcontractor to EA Engineering (under a contract with the Army Corps of Engineers) to provide health physics oversight, site characterization services, and the preparation of the baseline risk assessment of Building 23 (a large five-story industrial building) and the Radioactive Waste Disposal Area (a seven-acre site used for waste disposal) contaminated with residual levels of Th-232 and U-238 series radionuclides. The work included the collection and analysis of wipe samples, air particulate samples, measurement of direct gamma exposure rates, radon emanation analyses, and the collection and analysis of soil samples. SC&A also monitored workers for external exposure (TLDs) and inhalation exposures (breathing zone samplers and low volume air samplers). All work was performed by SC&A field technicians and health physics personnel, under the direction of a Certified Health Physicist. All samples were analyzed by SC&A's radiological laboratory. All data were compiled and reviewed under SC&A's data verification procedures and Quality Assurance Project Plan. The data are being used to evaluate compliance with the established radiation protection standards, the ARARs, and to support MARSSIM evaluations.

Regulatory Approval of a Removal Action

SC&A completed a removal action for the U.S. Army Corps of Engineers (Baltimore District under contract with Foster Wheeler Environmental Corp.) for the cleanup of the 26th Street Disposal Site located at the Edgewood Area, Aberdeen Proving Ground, MD (Contract No.

DACA31-94-D-0020). The project included the segregation and removal of 611 cubic yards of waste containing elevated levels of radioactivity (depleted and natural uranium, cobalt-60, strontium-90, cesium-137, radium-226, and thorium-232, among others), UXO, surety agents, and hazardous waste. All waste was characterized, deposited into containers, and shipped to Envirocare for disposal. The work was conducted under a license and oversight of the NRC, Maryland Department of Environmental Conservation, and DOD's Directorate of Safety, Health and Environment. The project was audited by the NRC twice and once by the Maryland Department of the Environment; the agencies did not issue any citations.

Upon completion of all remedial activities, SC&A implemented a final site characterization survey and prepared a closure report to support an application to the NRC for unrestricted release. The NRC conducted an independent radiological survey of the site via ORISE. The survey included *in situ* measurements and soil sampling and analysis. The NRC authorized the release of the site for unrestricted use on June 22, 1998.

5.7 Dose Assessment Experience

Since its incorporation in 1981, SC&A has performed over 500 studies which required the assessment of the radiation doses associated with radionuclides in the workplace and the environment. In the process, SC&A has either used or reviewed virtually every radiological dose assessment model developed and has also developed its own models for specific purposes. The following outlines the range of SC&A's dose assessment experience:

- Dose/Risk Assessments in Support of Site Cleanup

  SC&A studies pertaining to dose/risk assessments in support of site cleanup include:

  - The development of guidelines and regulations pertaining to the cleanup and assessment of sites and facilities contaminated with radioactive and mixed waste.

  - The performance of baseline risk assessments at several sites, including Weldon Springs, Kerr McGee, and Maxey Flats.

  - The evaluation of the costs and benefits of cleanup technologies.

  - The review of the dose/risk assessments and the models and data used to perform the risk assessments at several sites, including waste management units at Savannah River, Oak Ridge, Paducah, Fernald, Mound, and Los Alamos.

  - A comprehensive dose/risk assessment of sites throughout the country containing elevated levels of naturally occurring radionuclides.

- Dose/risk assessments for contaminated soil, aquifers, and buildings at major DOE facilities as part of SC&A's support to EPA in the development of a site cleanup rule.

- Dose/risk assessment of residual radioactivity and cleanup needs for the Republic of the Marshall Islands.

• Mixed Waste Studies

Most of the studies described above involved the evaluation of both radioactive and chemically hazardous waste. However, several SC&A studies were directed specifically at mixed waste and mixed waste risk assessment. One of the more challenging risk assessment projects was the development of a mixed waste Hazard Ranking System (HRS), which was incorporated into the HRS in revised 40 CFR 300.

• Airborne Pathways Risk Assessment and Source Term Characterization

These studies include:

- Radiological dose/risk assessments of airborne emissions from hundreds of facilities throughout the United States, including DOE facilities, in support of the radionuclide NESHAPS rulemaking.

- Inspection of several DOE facilities for compliance with the radionuclide NESHAPS. Although this did not involve the performance of risk assessments, SC&A did gather data pertinent to developing the source term for risk assessments.

- The performance of radiological impact assessments as part of NEPA documentation.

- Phase 1 of the dose reconstruction project of the Idaho National Engineering Laboratory (INEL) for the CDC. The project involved gathering, reviewing, abstracting, and creating a bibliographic database for all reports, records, and data pertinent to the performance of a dose reconstruction at INEL.

- Reconstruction of the airborne emissions and radiation exposures associated with INEL operations.

• Aquatic (Surface Water) Pathways Dose/Risk Assessment

In addition to the assessment of surface water pathways performed in support of RI/FS reviews, SC&A performed several special risk assessments studies specifically for the surface water pathways, including:

- Dose/risk assessments in support of the development of Protective Action Guides and Derived Response Levels for the water pathways.

- Dose/risk assessments of the discharge of produced water (water containing elevated levels of naturally occurring radionuclides) from coastal and offshore oil and gas drilling platforms in the Gulf of Mexico.

- Dose/risk assessments in support of the drinking water standards.

- Assessments of the radiosensitivity of aquatic organisms.

• Review and Development of Multimedia Models and Computer Codes for Use in Risk Assessment

Support in the development of regulations and guidelines for the EPA required extensive model review and development, including:

- The review of 25 multimedia models for possible use in support of the soil cleanup rule. This resulted in the selection and use of RESRAD, PRESTO, and HHEM Part B.

- The verification and validation of AIRDOS-EPA for use in support of the radionuclide NESHAPS.

- The development of guidance on the selection and use of groundwater flow and transport models for use in support of remedial decision making at radioactively contaminated sites.

- Participation in multimedia model evaluation for the DOE Programmatic Environmental Impact Statement (PEIS) for the DOE Environmental Restoration program.

- Development of computer codes to supplement existing codes for assessing the doses and risks to workers and the public from recycling and site cleanup.

• Decontamination/Decommissioning/Recycling Studies

Both the NRC and EPA are engaged in the promulgation of regulations pertaining to the decommissioning of structures and the possible recycling of metal and concrete. SC&A has performed several worker and public health dose/risk assessment studies for both agencies in support of these rulemakings.

- High-Level Waste Studies

  SC&A performed numerous studies for EPA on the risks associated with the management of high-level radioactive waste (HLW). These studies included:

  - Waste characterization.
  - The review of performance assessment models.
  - Uncertainty analysis.
  - The evaluation of release and exposure scenarios, their probabilities, and the associated radionuclide releases to the accessible environment.
  - Waste transportation studies.

- Uranium Mill Tailings

  In addition to the NORM risk assessments, SC&A performed several studies in support of the uranium mill tailings standards. These studies included the modeling of the risks from radon, dust suspension, direct radiation, and the contamination of groundwater.

- Low-level Radioactive Waste (LLW)

  SC&A assisted the EPA in the promulgation of 40 CFR 193. This work involved revising PRESTO to reflect updated waste characteristics, site characteristics, and disposal technologies. SC&A has also performed risk assessments in support of the siting of LLW storage facilities for NRC licensees.

- Radiation Worker Dose/Risk Assessment

  SC&A performed several worker radiation dose studies in support of:

  - The revised 10 CFR 20 for the NRC.
  - Worker training requirements for the NRC.
  - Radiation protection guidelines for EPA workers.
  - Health physics consulting for NRC licensees.
  - ALARA studies for NUMARC and AIF.
  - Dose/risks to workers due to site cleanup at numerous NORM sites.

- Safety Analysis and Emergency Planning

  Except for the HLW studies, the above studies are oriented toward exposures associated with normal, as opposed to transient or accident, conditions. Accidents or severe external events can be the limiting scenario for the risks to workers, the

public, and the environment. SC&A has performed a number of accident analyses, including:

- Special studies of DOE facility safety for DNFSB.
- Nuclear power plant safety analyses for the NRC and the Congressional OTA.
- Accident analyses in support of the development of Protective Action Guides for the EPA.
- Chernobyl studies for EPA.
- Criticality evaluations related to both LLW and HLW management.
- Criticality evaluations of the October 16, 1959 criticality accident at INEL.

• Data Collection, Analysis, and Evaluation

SC&A performed several studies pertaining to the collection of data for use in dose/risk assessment and regulatory compliance. The studies included:

- The development of guidance for data collection for use in risk assessments for EPA.
- Guidance on evaluating the usability of data for risk assessment for EPA.
- The review of data gathered by others at numerous DOE and non-DOE sites.
- The collection of field data from numerous sites for use in dose/risk assessments and site closeout.
- The collection of license termination data from the Nuclear Energy Institute (NEI), EPRI, and ORISE in support of NRC clearance investigations.
- Collection and analysis of environmental samples collected from the Republic of the Marshall Islands.

• Cleanup Technologies

In addition to the review of technologies performed for OTA and EPA, SC&A has developed a soil washing system for EPA for sites containing large volumes of soil contaminated with slightly elevated levels of naturally occurring

radionuclides. The studies included an evaluation of the worker and public health risks associated with the technology.

- Database Management and GIS Systems

  SC&A has developed several large database management systems and GIS systems in support of the performance of dose/risk assessment/management and outreach programs.

- Outreach Programs

  Many of the risk assessment programs performed by SC&A have had large public outreach components, which included the coordination of local and national workshops, the preparation of newsletters, information booklets, and videos. In addition, SC&A interacts with the Federal Advisory Committee for the INEEL dose reconstruction.

- Epidemiologic Studies

  SC&A performed pilot epidemiologic studies for:

  - Workers at commercial nuclear power plants for EPRI.
  - Indoor radon for EPA.

- Dose/Risk Assessments in Support of Policy Decision making

  SC&A performed nationwide screening studies to aid:

  - The EPA Office of Policy, Planning and Evaluation to set national priorities.
  - The NRC to evaluate nuclear power plant license renewal and clearance.
  - The Nuclear Safety Oversight Committee to establish a nationwide approach to safety.
  - The OTA to evaluate nationwide cleanup strategies.
  - The EPA to evaluate radon mitigation strategies.

APPENDIX B

CONFLICT OF INTEREST FORMS

APPENDIX C

DOSE RECONSTRUCTION AUDIT CHECKLISTS

APPENDIX C
DOSE RECONSTRUCTION AUDIT REPORT

Audit Number:	**Claim Number:**	**Date:**
Auditor(s)/Area of Review:		

Audit Record Summary (Describe below what records you examined, person contacted/interviewed, what conclusions were drawn, and how you arrived at your conclusions):		
List the type of records reviewed (e.g., administrative record):		
List of persons contacted/interviewed:		
List of new documents identified: (Attach a copy of all documents not included in the original dose reconstruction to this report.)		
Audit Conclusions: Agree/Disagree (Note: Attach all audit checklists and supporting documents.)	Agree: _____ (Initial) Include any additional comments in 'General Comments' below.	Disagree: _____ (Initial) Additional discussion should be provided in the next section.
Provide a summary discussion of reasons for disagreeing with the dose reconstruction results: (Attach all calculations, notes, reports, etc. used in your conclusions.)		
General Comments:		

Signature of Auditor(s):	Area of Review:	Date:

REVIEW CHECKLIST

Audit Number:	Claim Number:	Date:	Page of

Auditor(s)/Area of Review:

Dose Reconstruction Analysis(s)/Area of Dose Reconstruction (External/Internal):

Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
	A. DATA COLLECTION REVIEW PROCESS			
A.1	**Data Collection: Evaluate whether NIOSH received all requested data for the DOE or AWE site from any relevant data source or repository.** (Note: Follow protocols established in Volume 2, Section 3 of the proposal.)			
A.1.1	Did NIOSH receive all requested data for the DOE or AWE site from any relevant data source (i.e., site/worker profile data from sources such as DOE/AWE, CDC, DNFSB, Congressional Records, etc.)?			
A.2	**Adequacy of Data: Evaluate whether the data used by NIOSH for the case was adequate to make a determination with regard to probability of causation.** (Note: Follow protocols establish in Volume 2, Section 3 of proposal. Determining adequacy of data may require that the entire basic review checklist be completed first.)			
A.2.1	Is there sufficient data (such as individual monitoring, workplace monitoring, workplace characterization, process description, co-worker monitoring) for calculating/ interpolating/extrapolating external doses for all periods of exposure, including monitored, missing, and unmonitored periods?			
A.2.2	Is there sufficient information (such as co-worker comparison data, area monitoring data, instrument calibration, monitoring practice procedures, etc.) to determine if the quality of data used for determining POC is adequate?			

BASIC INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
B. WORK HISTORY INTERVIEW AND CLAIMANT DOCUMENTATION REVIEW PROCESS				
B.1	**Interview/Claimant Documentation: Evaluate whether NIOSH appropriately addressed all of the reported work history and events represented by the claimant including but not limited to (a) incidents or occurrences, (b) actual monitoring practices, (c) personal protection practices, and (d) work practices.**			
B.1.1	Did NIOSH compare the dates of employment at all applicable facilities provided by the claimant to those reported by DOE/Contractor or AWE site records?			
B.1.2	Did NIOSH compare the locations of employment throughout the work history as declared by the claimant to those reported by DOE/Contractor or AWE site records?			
B.1.3	Did NIOSH review site profile data/facility records to identify radiation incidents (such as contamination or over-exposures) declared by the claimant?			
B.1.4	Did NIOSH compare radiation monitoring practices (such as monitoring frequency, bioassay monitoring programs, etc.) as described by claimant to facility monitoring procedures/records?			
B.1.5	Were facility records associated with personal protection practices (e.g., the use of shielding, glove boxes, respirators, etc.) compared to those described by claimant?			
B.1.6	Did NIOSH compare work practices as described by the claimant to site profile data/facility records?			
B.1.7	Did NIOSH review worker/facility data to identify work-required medical screening x-rays records declared by the claimant?			

BASIC INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
B.2 Data Consistency: Assure that interview information is consistent with data used for dose estimate.				
B.2.1	Is there consistency between the dates of employment at all applicable facilities provided by the claimant and the DOE/Contractor or AWE site records?			
B.2.2	Is there consistency between the locations of employment throughout the work history as declared by the claimant and the DOE/Contractor or AWE site records?			
B.2.3	Is there consistency between facility records and radiation incidents identified by claimant?			
B.2.4	Is there consistency between radiation monitoring practices described by claimant and site radiological monitoring protocols?			
B.2.5	Is there consistency between personnel protection practices described by claimant and site profile data?			
B.2.6	Is there consistency between claimant's description of work practices and facility procedures/records?			

BASIC INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C. EXTERNAL DOSE REVIEW PROCESS				
C.1	**External Dose Estimate Assumptions: Evaluate whether all assumptions used in the external dose determination are appropriate for a remedial compensation program and determine whether, if, and to what extent the benefit of the doubt was resolved in favor of the claimant.** (Parenthetical number represents the section within the "External Dose Reconstruction Implementation Guideline" (OCAS-IG-001) that provides detailed methodology for conducting the appropriate portion of the dose reconstruction.)			
C.1.1	Are assumptions used in the initial dose assessment (rough estimate of exposure) for determining whether the case falls into a very low or very high potential exposure category appropriate? (§1.4)			
C.1.2	Are assumptions used in the initial dose assessment conservative (claimant friendly)?			
C.1.3 C.1.3a	Photon Dose Reconstruction Using Monitoring Data: Are assumptions used in the determination of photon dose/photon energies using monitoring data (i.e., dosimeters) appropriate? (§2.1.1)			
C.1.3.b	Are assumptions used in determining dosimeter dose uncertainty associated with photon exposure appropriate? (§2.1.1.3)			
C.1.3.c	Are assumptions used to determine dose for incomplete/missing photon monitoring records appropriate? (§2.1.2)			
C.1.3.d	Are assumptions used in calculating uncertainty associated with incomplete/missed photon monitoring dose appropriate? (§2.1.2.4)			
C.1.3.e	Are assumptions used in the determination of the occupational medical dose component of photon dose/photon energies appropriate? (§2.1.3)			

BASIC INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
Audit Number:	**Claim Number:**	**Date:**	**Page of**

Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.3.f	Are assumptions used in determining uncertainty associated with the occupational medical dose component of photon dose/photon energies appropriate? (§2.1.3.3)			
C.1.3.g	Are assumptions used in the calculation of the environmental dose component of photon dose appropriate? (§2.1.4)			
C.1.3.h	Are assumptions used in determining uncertainty for the environmental dose component of the photon dose calculation appropriate? (§2.1.4.3)			
C.1.3.i	Are conservative (claimant friendly) assumptions used in the determination of photon dose/photon energies, when monitoring records were available?			
C.1.3.j	Are conservative (claimant friendly) assumptions used to determine uncertainty associated with photon dose, when monitoring records were available?			
C.1.4 C.1.4.a	Photon Dose Reconstruction With NO Monitoring Data: Are assumptions incorporated in the reconstruction of photon dose using co-worker data appropriate? (§3.1.1)			
C.1.4.b	Are assumptions for the uncertainty analysis associated with reconstructing photon dose using co-worker data appropriate? (§2.1.1.3)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.4.c	Are assumptions incorporated in the reconstruction of photon dose using survey data appropriate? (§3.1.2)			
C.1.4.d	Are assumptions for determining uncertainty associated with reconstructing photon dose using survey data appropriate? (§3.1.2.3)			
C.1.4.e	Are assumptions incorporated in the reconstruction of photon dose using source term data appropriate? (§3.1.3)			
C.1.4.f	Are assumptions for the uncertainty analysis associated with reconstructing photon dose using source term data appropriate? (§3.1.3.3)			
C.1.4.g	Are assumptions incorporated in the reconstruction of photon dose using control limits appropriate? (§3.1.4)			
C.1.4.h	Are assumptions for determining uncertainty associated with reconstruction photon dose using control limits appropriate? (§3.1.4.3)			
C.1.4.i	Are conservative (claimant friendly) assumptions used for reconstruction of photon dose, when no monitoring data were available?			
C.1.4.j	Are conservative (claimant friendly) assumptions used in the determination of certainty associated with the reconstruction photon dose, when no monitoring data were available?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.5 C.1.5.a	Photon Dose Conversion to Organ Dose: Are assumptions used to convert monitored photon dose to organ dose appropriate? (§4.1.1)			
C.1.5.b	Are assumptions used to covert survey/source term data associated with photon dose to organ dose appropriate? (§4.1.2)			
C.1.5.c	Are assumptions used in the energy simplification of ICRP 74 dose conversion factors for input into NIOSH-IREP appropriate? (§4.1.3)			
C.1.5.d	Are assumptions regarding uncertainty associated with the energy simplification process appropriate? (§4.5.1)			
C.1.5.e	Are conservative (claimant friendly) assumptions used in the conversion of photon dose to organ dose?			
C.1.5.f	Are conservative (claimant friendly) assumptions used in determining the uncertainty resulting from the energy simplification process?			
C.1.6 C.1.6.a	Neutron Dose Reconstruction Using Monitoring Data: Are assumptions used in the determination of neutron dose/neutron energy using personal monitoring data (dosimeters) appropriate? (§2.2.1)			
C.1.6.b	Are assumptions used in the determination of uncertainty associated with neutron personal monitoring data appropriate? (§2.2.1.3)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.6.c	Are assumptions used to determine dose associated with incomplete/missing neutron monitoring data and associated neutron energies appropriate? (§2.2.2)			
C.1.6.d	Are assumptions used in determining uncertainty associated with incomplete/missed neutron monitoring dose appropriate? (§2.2.2.4)			
C.1.6.e	Are conservative (claimant friendly) assumptions used in the calculation of neutron dose/neutron energies using monitoring data?			
C.1.6.f	Are conservative (claimant friendly) assumptions used in determining uncertainty associated with neutron monitoring dose?			
C.1.7 C.1.7.a	Neutron Dose Reconstruction With **NO** Monitoring Data: Are assumptions incorporated in the reconstruction of neutron dose using co-worker data appropriate? (§3.2.1)			
C.1.7.b	Are assumptions for the uncertainty analysis associated with reconstructing neutron dose using co-worker data appropriate? (§2.2.1.3)			
C.1.7.c	Are assumptions incorporated in the reconstruction of neutron dose using survey data appropriate? (§3.2.2)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.7.d	Are assumptions for determining uncertainty associated with reconstructing neutron dose using survey data appropriate (§3.2.2.3)			
C.1.7.e	Are assumptions incorporated in the reconstruction of neutron dose using source term data appropriate? (§3.2.3)			
C.1.7.f	Are assumptions for the uncertainty analysis associated with reconstructing neutron dose using source term data appropriate? (§3.2.3.3)			
C.1.7.g	Are conservative (claimant friendly) assumptions used for reconstruction of neutron dose, when no monitoring data were available?			
C.1.7.h	Are conservative (claimant friendly) assumptions used in the determination of certainty associated with the reconstruction neutron dose, when no monitoring data were available?			
C.1.8 C.1.8.a	Neutron Dose Conversion to Organ Dose: Are assumptions used to convert area monitoring data associated with neutron dose to organ dose appropriate? (§4.2.1)			
C.1.8.b	Are assumptions used to convert personal monitoring data associated with neutron dose to organ dose appropriate? (§4.2.2)			
C.1.8.c	Are conservative (claimant friendly) assumptions used to convert neutron dose to organ dose?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.9.a	Electron Dose Reconstruction Using Monitoring Data: Are assumptions used in the calculation of electron dose using dosimeters appropriate? (§2.3.1)			
C.1.9.b	Are assumptions used in the uncertainty analysis for the beta dosimetry results appropriate? (§2.3.1.3)			
C.1.9.c	Are assumptions used to calculate dose for incomplete/missing electron monitoring records appropriate? (§2.3.2)			
C.1.9.d	Are assumptions used in determining the uncertainty associated with incomplete/missed electron monitoring dose appropriate? (§2.3.2.3)			
C.1.9.e	Are assumptions used in the dose calculation from skin contamination appropriate? (§2.3.3.2.2)			
C.1.9.f	Are assumptions used in determining uncertainty associated with the calculation of dose from skin contamination appropriate? (§2.3.3.3)			
C.1.9.g	Are assumptions used in calculating dose from electron exposure and associated uncertainty conservative (claimant friendly)?			
C.1.10 C.1.10.a	Electron Dose Reconstruction With **NO** Monitoring Data: Are assumptions incorporated in the reconstruction of electron dose using co-worker data appropriate? (§3.3.1)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.10.b	Are assumptions for the uncertainty analysis associated with reconstructing electron dose using co-worker data appropriate? (§2.2.1.3)			
C.1.10.c	Are assumptions incorporated in the reconstruction of electron dose using survey data appropriate? (§3.3.2)			
C.1.10.d	Are assumptions for determining uncertainty associated with reconstructing electron dose using survey data appropriate (§3.3.2.3)			
C.1.10.e	Are assumptions incorporated in the reconstruction of electron dose using source term data appropriate? (§3.3.3)			
C.1.10.f	Are assumptions for the uncertainty analysis associated with reconstructing electron dose using source term data appropriate? (§3.3.3.3)			
C.1.10.g	Are assumptions incorporated in the reconstruction of electron dose to non-routine radiological workers using radiological control limits appropriate? (§3.3.4)			
C.1.10.h	Are assumptions for the uncertainty associated with reconstructing electron dose using radiological control limits appropriate?			
C.1.10.i	Are conservative (claimant friendly) assumptions used for reconstruction of electron dose, when no monitoring data were available?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.10.j	Are conservative (claimant friendly) assumptions used in the determination of certainty associated with the reconstruction electron dose, when no monitoring data were available?			
C.1.11 C.1.11.a	Electron Dose Conversion to Organ Dose: Are assumptions used to convert electron dose to organ dose appropriate? (§4.3)			
C.1.11.b	Are assumptions used to convert electron dose to organ dose conservative (claimant friendly)?			
C.1.11.c	Dose Conversion Factors Based on Exposure Geometry: Are assumptions used to determine the most credible geometries for dosimeter and missed dose appropriate? (§4.4.1)			
C.1.11.d	Do assumptions used in determining geometries associated with dosimetry and missed dose give the benefit of doubt to the claimant?			
C.1.11.e	Are assumptions used to determine exposure geometry uncertainty associated with specific job functions appropriate? (§4.5.2)			
C.1.11.f	Do assumptions used in determining uncertainty associated with exposure geometries for specific tasks give the benefit of doubt to the claimant?			
C.1.11.g	Are assumptions used to determine the most credible geometry for occupational medical exposure appropriate? (§4.4.2)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.1.11.h	Do assumptions used in determining occupational medical exposure geometry give the benefit of doubt to the claimant?			
C.1.11.i	Are assumptions used to determine the most credible geometry for environmental exposure appropriate? (§4.4.3)			
C.1.11.j	Do assumptions used in determining environmental exposure geometry give the benefit of doubt to the claimant?			
C.2	**External Dose Calculations: Verify external dose calculations are appropriate for purposes of determination of POC using NIOSH-IREP.** (Parenthetical number represents the section within the "External Dose Reconstruction Implementation Guideline" (OCAS-IG-001) that provides detailed methodology for conducting the appropriate portion of the dose reconstruction.)			
C.2.1	Are calculations in the initial dose assessment (i.e., rough estimate of exposure) for determining whether the case falls into a very low or very high potential exposure category appropriate and correct? (§1.4)			
C.2.2 C.2.2.a	Photon Dose Reconstruction Using Monitoring Data: Are calculations of photon dose using monitoring data (i.e., dosimeters) appropriate and correct? (§2.1.1)			
C.2.2.b	Are calculations of dosimeter dose uncertainty associated with photon exposure appropriate and correct? (§2.1.1.3)			
C.2.2.c	Are calculations of dose for incomplete/ missing photon monitoring records appropriate and correct? (§2.1.2)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.2.2.d	Are calculations of uncertainty associated with incomplete/missed photon monitoring dose appropriate and correct? (§2.1.2.4)			
C.2.2.e	Are calculations associated with the occupational medical dose component of photon dose appropriate and correct? (§2.1.3)			
C.2.2.f	Are calculations of uncertainty associated with the occupational medical dose component of photon dose appropriate and correct? (§2.1.3.3)			
C.2.2.g	Are calculations associated with the environmental dose component of photon dose appropriate and correct? (§2.1.4)			
C.2.2.h	Are calculations of uncertainty for the environmental dose component of photon dose appropriate and correct? (§2.1.4.3)			
C.2.3 C.2.3.a	<u>Photon Dose Reconstruction With **NO** Monitoring Data</u>: Are calculations of reconstructed photon dose using co-worker data appropriate and correct? (§3.1.1)			
C.2.3.b	Are calculations of uncertainty associated with reconstructed photon dose using co-worker data appropriate and correct? (§2.1.1.3)			
C.2.3.c	Are calculations of reconstructed photon dose using survey data appropriate and correct? (§3.1.2)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.2.3.d	Are calculations of uncertainty associated with reconstructed photon dose using survey data appropriate and correct? (§3.1.2.3)			
C.2.3.e	Are calculations of reconstructed photon dose using source term data appropriate and correct? (§3.1.3)			
C.2.3.f	Are calculations of uncertainty associated with reconstructed photon dose using source term data appropriate and correct? (§3.1.3.3)			
C.2.3.g	Are calculations of reconstructed photon dose using control limits appropriate and correct? (§3.1.4)			
C.2.3.h	Are calculations of uncertainty associated with reconstructed photon dose using control limits appropriate and correct? (§3.1.4.3)			
C.2.4 C.2.4.a	Photon Dose Conversion to Organ Dose: Are calculations for converting monitored photon dose to organ dose appropriate and correct? (§4.1.1)			
C.2.4.b	Are calculations for converting survey/source term data associated with photon dose to organ dose appropriate and correct? (§4.1.2)			
C.2.4.c	Are calculations used in the energy simplification of ICRP 74 dose conversion factors for input into NIOSH-IREP appropriate and correct? (§4.1.3)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.2.4.d	Are calculations of uncertainty associated with the energy simplification process appropriate and correct? (§4.5.1)			
C.2.5 C.2.5.a	Neutron Dose Reconstruction Using Monitoring Data: Are calculations of neutron dose using personal monitoring data (dosimeters) appropriate and correct? (§2.2.1)			
C.2.5.b	Are calculations of uncertainty associated with neutron personal monitoring data appropriate and correct? (§2.2.1.3)			
C.2.5.c	Are calculations of dose associated with incomplete/missing neutron monitoring data appropriate and correct? (§2.2.2)			
C.2.5.d	Are calculations of uncertainty associated with incomplete/missed neutron monitoring dose appropriate and correct? (§2.2.2.4)			
C.2.6 C.2.6.a	Neutron Dose Reconstruction With NO Monitoring Data: Are calculations of reconstructed neutron dose using co-worker data appropriate and correct? (§3.2.1)			
C.2.6.b	Are calculations of uncertainty associated with reconstructed neutron dose using co-worker data appropriate and correct? (§2.2.1.3)			
C.2.6.c	Are calculations of reconstructed neutron dose using survey data appropriate and correct? (§3.2.2)			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
C.2.6.d	Are calculations of uncertainty associated with reconstructed neutron dose using survey data appropriate and correct? (§3.2.2.3)			
C.2.6.e	Are calculations of reconstructed neutron dose using source term data appropriate and correct? (§3.2.3)			
C.2.6.f	Are calculations of uncertainty associated with reconstructed neutron dose using source term data appropriate and correct? (§3.2.3.3)			
C.2.7 C.2.7.a	Neutron Dose Conversion to Organ Dose: Are calculations for converting area monitoring data associated with neutron dose to organ dose appropriate and correct? (§4.2.1)			
C.2.7.b	Are calculations for converting personal monitoring data associated with neutron dose to organ dose appropriate and correct? (§4.2.2)			
C.2.8 C.2.8.a	Electron Dose Reconstruction Using Monitoring Data: Are calculations of electron dose using dosimeters appropriate and correct? (§2.3.1)			
C.2.8.b	Are calculations of uncertainty for the beta dosimetry results appropriate and correct? (§2.3.1.3)			
C.2.8.c	Are calculations of dose for incomplete/ missing electron monitoring records appropriate and correct? (§2.3.2)			

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C.2.8.d	Are calculations of uncertainty associated with incomplete/missed electron monitoring dose appropriate and correct? (§2.3.2.3)			
C.2.8.e	Are dose calculations of skin contamination appropriate and correct? (§2.3.3.2.2)			
C.2.8.f	Are calculations of uncertainty associated with the dose from skin contamination appropriate and correct? (§2.3.3.3)			
C.2.9 C.2.9.a	Electron Dose Reconstruction With **NO** Monitoring Data: Are calculations of reconstructed electron dose using co-worker data appropriate and correct? (§3.3.1)			
C.2.9.b	Are calculations of uncertainty associated with reconstructed electron dose using co-worker data appropriate and correct? (§2.2.1.3)			
C.2.9.c	Are calculations of reconstructed electron dose using survey data appropriate and correct? (§3.3.2)			
C.2.9.d	Are calculations of uncertainty associated with reconstructed electron dose using survey data appropriate and correct? (§3.3.2.3)			
C.2.9.e	Are calculations of reconstructed electron dose using source term data appropriate and correct? (§3.3.3)			

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C.2.9.f	Are calculations of uncertainty associated with reconstructed electron dose using source term data appropriate and correct? (§3.3.3.3)			
C.2.9.g	Are calculations of reconstructed electron dose to non-routine radiological workers using radiological control limits appropriate and correct? (§3.3.4)			
C.2.9.h	Are calculations of uncertainty associated with reconstructed electron dose using radiological control limits appropriate and correct?			
C.2.10	Electron Dose Conversion to Organ Dose: Are calculations for converting electron dose to organ dose appropriate and correct? (§4.3)			
C.2.11 C.2.11.a	Annual Organ Dose and Distribution: Are annual organ dose calculations for photon energies <30 keV appropriate and correct? (§5.1.1)			
C.2.11.b	Are uncertainty distributions for annual organ doses associated with photon energies <30 keV appropriate and correct? (§5.1.2)			
C.2.11.c	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for photon energies <30 keV? (§5.2)			
C.2.11.d	Are annual organ dose calculations for photon energies between 30 and 250 keV appropriate and correct? (§5.1.2)			

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C.2.11.e	Are uncertainty calculations for annual organ doses associated with photon energies between 30 keV and 250 keV appropriate and correct? (§5.1.2)			
C.2.11.f	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for photon energies between 30 keV and 250 keV? (§5.2)			
C.2.11.g	Are annual organ dose calculations for photon energies >250 keV appropriate and correct? (§5.1.1)			
C.2.11.h	Are uncertainty calculations for annual organ doses associated with photon energies >250 keV appropriate and correct? (§5.1.2)			
C.2.11.i	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for photon energies >250 keV? (§5.2)			
C.2.11.j	Are annual organ dose calculations for neutron energies <10 keV appropriate and correct? (§5.1.1)			
C.2.11.k	Are uncertainty calculations for annual organ doses associated with neutron energies <10 keV appropriate and correct? (§5.1.2)			
C.2.11.l	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for neutron energies <10 keV? (§5.2)			

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C.2.11.m	Are annual organ dose calculations for neutron energies between 10 and 100 keV appropriate and correct? (§5.1.1)			
C.2.11.n	Are uncertainty calculations for annual organ doses associated with neutron energies between 10 keV and 100 keV appropriate and correct? (§5.1.2)			
C.2.11.o	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for neutron energies between 10 keV and 100 keV? (§5.2)			
C.2.11.p	Are annual organ dose calculations for neutron energies between 0.1 and 2.0 MeV appropriate and correct? (§5.1.1)			
C.2.11.q	Are uncertainty calculations for annual organ doses associated with neutron energies between 0.1 and 2.0 MeV appropriate and correct? (§5.1.2)			
C.2.11.r	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for neutron energies between 0.1 and 2.0 MeV? (§5.2)			
C.2.11.s	Are annual organ dose calculations for neutron energies between 2.0 and 20.0 MeV appropriate and correct? (§5.1.1)			
C.2.11.t	Are uncertainty distributions for annual organ doses associated with neutron energies between 2.0 MeV and 20.0 MeV appropriate and correct? (§5.1.2)			

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C.2.11.u	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for neutron energies between 2.0 MeV and 20.0 MeV? (§5.2)			
C.2.11.v	Are annual organ dose calculations for neutron energies > 20.0 MeV appropriate and correct? (§5.1.1)			
C.2.11.w	Are uncertainty calculations for organ doses associated with neutron energies >20.0 MeV appropriate and correct? (§5.1.2)			
C.2.11.x	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for neutron energies >20.0 MeV? (§5.2)			
C.2.11.y	Are organ/tissue dose calculations for electron energies >14 keV appropriate and correct? (§5.1.1)			
C.2.11.z	Are uncertainty calculations for organ/tissue dose associated with electron energies >14 keV appropriate and correct? (§5.1.2)			
C.2.11.aa	Has an appropriate total organ dose distribution been determined (normal versus lognormal distribution) for electron energies >14 keV? (§5.2)			

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C.3 <u>Consistency of External Dose Data</u>: Evaluate whether data were consistent with site radiological monitoring protocols of the time period and determine whether the protocols were adequate for monitoring the external exposure.				
C.3.1	Are external dosimetry data (e.g., monitoring periods, detection limits, etc.) consistent with site radiological monitoring protocols/procedures?			
C.3.2	Were external dosimetry monitoring protocols adequate for assessing external exposure?			
C.3.3	Are external dose estimates based on workplace monitoring data (e.g., surveys, air sampling, fixed location dosimeters) consistent with site workplace monitoring practices/procedures?			
C.3.4	Were site workplace monitoring protocols adequate for assessing external exposure?			
C.3.5	Are assessments of environmental dose consistent with area monitoring procedures/protocols at the site?			
C.3.6	Were environmental dose monitoring protocols adequate for assessing the environmental exposure?			

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C.4 <u>Missing/Unmonitored External Dose</u>: Evaluate the treatment of 'missed external dose' and/or 'unmonitored external dose' if relevant to the case.				
C.4.1	Are 'missed/unmonitored' external photon doses reconstructed in accordance with 42 CFR §82.16 and §82.17 and using guidelines and hierarchy of data established in Section 3.1 of OCAS-IG-001?			
C.4.2	Are data adequate for employing commonly used practices/techniques/professional judgments in estimating 'missed/unmonitored' external photon doses?			
C.4.3	Are 'missed/unmonitored' neutron doses reconstructed in accordance with 42 CFR §82.16 and §82.17 and using guidelines and hierarchy of data established in Section 3.2 of OCAS-IG-001?			
C.4.4	Are data adequate for employing commonly used practices/techniques/professional judgments in estimating 'missed/unmonitored' neutron doses?			
C.4.5	Are 'missed/unmonitored' electron doses reconstructed in accordance with 42 CFR §82.16 and §82.17 and using guidelines and hierarchy of data established in Section 3.3 of OCAS-IG-001?			
C.4.6	Are data adequate for employing commonly used practices/techniques/professional judgments in estimating 'missed/unmonitored' electron exposures?			

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D. INTERNAL DOSE REVIEW PROCESS				
D.1	**Internal Dose Estimate Assumptions: Determine whether all assumptions used in the internal dose determination are appropriate for a remedial compensation program and determine whether, if, and to what extent the benefit of the doubt was resolved in favor of the claimant.** (Parenthetical number represents the section within the "Internal Dose Reconstruction Implementation Guideline" (OCAS-IG-002) that provides detailed methodology for conducting the appropriate portion of the dose reconstruction.)			
D.1.1 D.1.1.a	Preliminary Internal Dose Estimate Efficiency Process: Are assumptions used in the preliminary internal dose efficiency process for determining whether the case falls into a 'clearly high' or 'clearly low' category appropriate? (§6.0)			
D.1.1.b	Are assumptions used to modify the preliminary internal dose estimate efficiency process appropriate for including the case in a 'clearly high' or 'clearly low' category? (§6.3 and §6.5)			
D.1.1.c	Are assumptions used in the preliminary internal dose estimate efficiency process conservative (claimant friendly)?			
D.1.2 D.1.2.a	Preliminary Internal Dose Estimate - Low Dose Potential: Are assumptions used in the recalculation of bioassay values for each radionuclide for which the claimant was monitored appropriate? (§6.1.2)			
D.1.2.b	Are assumptions used in the selection of all potential solubility classes for each radionuclide for which the claimant was monitored appropriate? (§6.1.3)			

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D.1.2.c	Are assumptions for determining the highest intake associated with each potential solubility class that will produce a predicted bioassay value equal to at least one of the recalculated bioassay values from step §6.1.2 appropriate? (§6.1.4)			
D.1.2.d	Are assumptions used to determine the highest intake (using a constant chronic exposure period) that will produce a predicted bioassay value equal to at least one of the recalculated bioassay values from step §6.1.2 for each potential solubility class appropriate? (§6.1.5)			
D.1.2.e	Are assumptions used in the determination of a scenario for each radionuclide for which the claimant was monitored that produces the highest 50-year committed dose to the organ or concern appropriate? (§6.1.7)			
D.1.2.f	Are assumptions used to determine annual doses to the organ of concern using the scenario selected in step §6.1.7 for each radionuclide for which the claimant was monitored appropriate? (§6.1.8)			
D.1.2.g	When the preliminary PC results in ≥50%, are assumptions used in the refinement of internal estimates appropriate? (§6.1.14 A-D and §6.5)			
D.1.2.h	Are all assumptions used in the 'low dose' preliminary internal dose estimate conservative (claimant friendly)?			

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D.1.3 D.1.3.a	Preliminary Dose Estimate - High Dose Potential: Are assumptions for the selection of radionuclides that will deliver the most dose per unit intake or one with the highest bioassay results appropriate? (§6.2.1)			
D.1.3.b	Is the assumption used to determine the date for an inhalation appropriate? (§6.2.2)			
D.1.3.c	Are assumptions associated with the selection of all potential solubility classes appropriate? (§6.2.3)			
D.1.3.d	Are assumptions used to determine the highest intake for each potential solubility class that will not exceed any of the measured bioassay values appropriate? (§6.2.4)			
D.1.3.e	If the acute scenario does not produce a realistic curve, are assumptions used in finding a more reasonable scenario appropriate? (§6.2.5)			
D.1.3.f	Are assumptions used to determine the scenario that produces the lowest 50-year committed dose to the organ of concern appropriate? (§6.2.7)			
D.1.3.g	Are assumptions used to determine the annual doses to the organ of concern appropriate? (§6.2.8)			
D.1.3.h	When the PC calculation results in <50%, are assumptions used in the refinement of internal dose estimates appropriate? (§6.2.11 A-G and §6.5)			

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D.1.3.i	Are all assumptions used in the 'high dose' preliminary internal dose estimate conservative (claimant friendly)?			
D.1.4 D.1.4.a	Detailed Internal Dose Reconstruction - Key Initial Considerations: Are assumptions used to determine the date of uptake(s) appropriate? (§7.1)			
D.1.4.b	Are assumptions used to determine the route of entry of applicable radionuclides into the body appropriate? (§4.1)			
D.1.4.c	Are assumptions used in the selection of applicable solubility class(es) for each radionuclide appropriate? (§4.3)			
D.1.4.d	Are assumptions used to determine whether the exposure was chronic or acute appropriate?			
D.1.4.e	Are assumptions used to determine particle size of all inhaled radionuclides appropriate? (§4.4)			
D.1.4.f	Are assumptions used to select the applicable ICRP biokinetic model for each radionuclide appropriate? (§2.0)			
D.1.4.g	If more than one ICD code describes organs associated with only one region calculated by ICRP models, are assumptions in the calculation of organ dose appropriate? (§3.1.1)			

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D.1.4.h	If one ICD code describes organs associated with more than one region calculated by ICRP models, are assumptions in the selection of ICRP region and associated organ dose appropriate? (§3.1.1)			
D.1.4.i	When an organ of interest is not included in the ICRP metabolic model, are assumptions for assigning dose to that organ appropriate? (§3.1.1)			
D.1.4.j	If an ICD code describes a type of lymphatic cancer, are assumptions for assigning organ dose appropriate? (§3.1.1)			
D.1.5 D.1.5.a	Internal Dose Reconstruction Considerations Associated with Bioassay Measurements: Are assumptions used to determine the quantity of each radionuclide for each intake based on bioassay measurement data appropriate? (see example §8.5)			
D.1.5.b	Are assumptions of uncertainty associated with the quantities of each radionuclide for each intake based on bioassay measurement data appropriate? (§7.2)			
D.1.5.c	Are assumptions regarding the capability of the bioassay program in detecting all potential radionuclides of concern appropriate? (§5.1)			
D.1.5.d	Are assumptions regarding the validity of positive results (i.e., determination of a false positive result) appropriate? (§5.1)			

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D.1.5.e	Are assumptions used to determine missed internal dose associated with bioassay measurements below detection limits appropriate? (§7.3 and §8.3)			
D.1.5.f	Are assumptions used to estimate internal dose when there are gaps in bioassay measurements appropriate? (§6.3)			
D.1.5.g	Are assumptions used in the reconstruction of internal dose using co-worker data appropriate? (§5.1)			
D.1.5.h	Are assumptions used to reconstruct internal dose using bioassay measurements conservative (claimant friendly)?			
D.1.6 D.1.6.a	<u>Internal Dose Reconstruction Considerations Associated with Workplace Monitoring Data</u>: Are assumptions used to determine the radionuclide(s) of concern for each intake using workplace monitoring data (e.g., air samples, contamination surveys, etc.) appropriate? (§5.2)			
D.1.6.b	Are assumptions used to estimate the concentration of each radionuclide in the breathing zone using workplace monitoring data (e.g., air samples, contamination surveys, etc.) appropriate? (§5.2)			
D.1.6.c	Are assumptions regarding the use of respirators and respiratory protection factors appropriate? (§5.2)			
D.1.6.d	Are assumptions regarding the effectiveness of the respirator program (i.e., whether a qualitative fit test was performed and whether the respirator was worn during the time of intake) appropriate? (§5.2)			

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D.1.6.e	Are assumptions used to compare, confirm, or validate internal dose estimates based on workplace monitoring with any other supporting information sources appropriate? (§5.2)			
D.1.6.f	Are assumptions used to estimate internal dose using workplace monitoring data conservative (claimant friendly)?			
D.1.6.g	Are assumptions associated with uncertainty surrounding the estimated intake quantity using workplace monitoring data conservative (claimant friendly)?			
D.1.7 D.1.7.a	Internal Dose Reconstruction Considerations Associated with Source Term Data: Are assumptions used to determine the radionuclide(s) of concern for each intake using source term data (e.g., type of material in area or handled) appropriate? (§5.3)			
D.1.7.b	Are assumptions used to determine the concentration of each radionuclide in the breathing zone using source term data (e.g., dispersible quantity of material, resuspension factors, etc.) appropriate? (§5.3)			
D.1.7.c	Are assumptions used to compare, confirm, or validate internal dose estimates based source term data with any other supporting information sources appropriate? (§5.3)			
D.1.7.d	Are assumptions used to estimate internal dose using workplace monitoring data conservative (claimant friendly)?			

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D.1.7.e	Are assumptions associated with uncertainty surrounding the estimated intake quantity using workplace monitoring data conservative (claimant friendly)?			
D.1.8 D.1.8.a	Occupational Radon Exposure: Are assumptions used to determine dose from occupational radon exposure appropriate?			
D.1.8.b	Are assumptions associated with uncertainty surrounding the radon dose estimate appropriate?			
D.1.8.c	Are assumptions used to determine dose from occupational radon exposure conservative (claimant friendly)?			
D.1.8.d	Are assumptions used to assess the uncertainty surrounding the occupational radon dose conservative (claimant friendly)?			

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D.2	**Internal Dose Calculations: Verify internal dose calculations are appropriate for purposes of determination of POC.** (Parenthetical number represents the section within the "Internal Dose Reconstruction Implementation Guideline" (OCAS-IG-002) that provides detailed methodology for conducting the appropriate portion of the dose reconstruction.)			
D.2.1 D.2.1.a	Preliminary Internal Dose Estimate - Low Dose Potential: Are recalculations of bioassay values appropriate and correct? (§6.1.2)			
D.2.1.b	Are calculations for determining the highest intake associated with each potential solubility class that will produce a predicted bioassay value equal to at least one of the recalculated bioassay values from step §6.1.2 appropriate and correct? (§6.1.4)			
D.2.1.c	Are calculations for determining the highest intake (using a constant chronic exposure period) that will produce a predicted bioassay value equal to at least one of the recalculated bioassay values from step §6.1.2 for each potential solubility class appropriate and correct? (§6.1.5)			
D.2.1.d	Are calculations for determining a scenario (for each radionuclide for which the claimant was monitored) that produces the highest 50-year committed dose to the organ of concern appropriate and correct? (§6.1.7)			
D.2.1.e	Are calculations for determining annual doses to the organ of concern using the scenario selected in step §6.1.7 (for each radionuclide for which the claimant was monitored) appropriate and correct? (§6.1.8)			

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D.2.1.f	When the preliminary PC results in ≥50%, are calculations used in the refinement of internal estimates appropriate and correct? (§6.1.14 A-D and §6.5)			
D.2.2 D.2.2.a	Preliminary Internal Dose Estimate - High Dose Potential: Are calculations for determining the highest intake for each potential solubility class that will not exceed any of the measured bioassay values appropriate and correct? (§6.2.4)			
D.2.2.b	If the acute scenario does not produce a realistic curve, are calculations used in finding a more reasonable scenario appropriate? (§6.2.5)			
D.2.2.c	Are calculations for determining the scenario that produces the lowest 50-year committed dose to the organ of concern appropriate and correct? (§6.2.7)			
D.2.2.d	Are calculations for determining the annual internal doses to the organ of concern appropriate and correct? (§6.2.8)			
D.2.2.e	When the PC calculation results in <50%, are calculations to refine internal dose estimates appropriate and correct? (§6.2.11 A-G and §6.5)			
D.2.3 D.2.3.a	Detailed Internal Dose Reconstruction: Are calculations for determining the quantity of each radionuclide for each intake based on bioassay measurement data appropriate and correct? (see example §8.5)			

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D.2.3.b	Are uncertainty calculations associated with the quantities of each radionuclide for each intake based on bioassay measurement data appropriate and correct? (§7.2 and §8.7)			
D.2.3.c	Are calculations for determining missed internal dose associated with bioassay measurements below detection limits appropriate and correct? (§7.3)			
D.2.3.d	Are calculations for estimating internal dose when there are gaps in bioassay measurements appropriate and correct? (§6.3)			
D.2.3.e	Are calculations for reconstructed internal dose using co-worker data appropriate and correct? (§5.1)			
D.2.3.f	Are uncertainty calculations associated with the reconstruction of internal dose using co-worker data appropriate and correct?			
D.2.3.g	Are calculations to estimate the concentration of each radionuclide in the breathing zone using workplace monitoring data (e.g., air samples, contamination surveys, etc.) appropriate and correct? (§5.2)			
D.2.3.h	Are calculations to estimate internal dose using workplace monitoring data appropriate and correct?			
D.2.3.i	Are uncertainty calculations associated with estimating intake quantities using workplace monitoring data appropriate and correct?			

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D.2.3.j	Are calculations to determine the concentration of each radionuclide in the breathing zone using source term data (e.g., dispersible quantity of material, resuspension factors, etc.) appropriate and correct? (§5.3)			
D.2.3.k	Are calculations to estimate internal dose using workplace monitoring data appropriate and correct?			
D.2.3.l	Are uncertainty calculations associated with the estimated intake quantity using workplace monitoring data appropriate and correct?			
D.2.3.m	Are calculations to determine dose from occupational radon exposure appropriate and correct? (§7.4)			
D.2.3.n	Are uncertainty calculations associated with occupational radon exposure appropriate and correct? (§7.4)			
D.2.4	Are all internal dose calculations performed in accordance with 42 CFR §82.18?			

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D.3 Consistency of Internal Dose Data: Evaluate whether data were consistent with site radiological monitoring protocols of the time period and determine whether the protocols were adequate for monitoring the internal exposure.				
D.3.1	Are internal bioassay measurement data (e.g., types of bioassay, detection limits, etc.) consistent with site radiological monitoring protocols/procedures of the time?			
D.3.2	Were internal bioassay monitoring programs adequate for assessing internal exposure?			
D.3.3	Are the frequencies and types of workplace sampling and surveys (e.g., air sampling, contamination surveys) consistent with site workplace monitoring practices/procedures of the time?			
D.3.4	Were site workplace monitoring protocols adequate for assessing internal exposure?			
D.3.5	Is the use of respirators consistent with protocols defined in the respiratory protection program of the time?			

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D.4 Missing/Unmonitored Internal Dose: Evaluate the treatment of 'missed internal dose' and/or 'unmonitored internal dose' if relevant to the case.				
D.4.1	Are 'missed/unmonitored' internal doses reconstructed in accordance with 42 CFR §82.16 and using guidelines established in OCAS-IG-002?			
D.4.2	Are the types of information used to substitute/supplement 'missed/unmonitored' internal doses reconstructed in accordance with specifications in 42 CFR §82.17 and using *guidance in* OCAS-IG-002?			
D.4.3	Were all relevant factors surrounding the claimant's exposure scenario (e.g., distance from source, work activities, etc.) properly taken into account when evaluating 'missed/unmonitored' internal dose?			
D.4.4	Was the bioassay program at the time considered when selecting the most appropriate method for estimating 'missed/unmonitored' *internal dose*?			
D.4.5	Are data adequate for employing commonly used practices/techniques/professional judgments in estimating 'missed/unmonitored' internal doses?			

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E. NIOSH PROCEDURE/METHODOLOGY REVIEW PROCESS				
E.1 Review of NIOSH Methods and/or Procedures: The review of each dose reconstruction shall include an evaluation of all relevant portions of the methods and/or procedures used by NIOSH.				
E.1.1 E.1.1a	External Dose Technical Basis Documents/Methods: Are the technical basis documents used in reconstructing external radiation doses adequate and appropriate?			
E.1.1b	Are methods for estimating 'missed,' 'incomplete,' and/or 'unmonitored' external dose adequate and appropriate?			
E.1.1.c	Are statistical approaches developed for multiple external dose reconstructions appropriate?			
E.1.1.d	Are procedures used for determining whether data is sufficient to make a reasonable external dose estimate appropriate?			
E.1.1.e	Are methods/procedures used for substituting external exposure information for unavailable or incomplete information adequate and appropriate?			
E.1.1.f	Are methods for estimating uncertainty in dose associated with external dose reconstructions on a facility and time specific basis appropriate?			
E.1.1.g	Are appropriate methodologies used to resolve uncertainty estimates associated with external dose in favor of the claimant?			

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E.1.1.h	Are methods and/or statistical software used for determining uncertainty distributions surrounding external organ dose adequate and appropriate?			
E.1.2 E.1.2.a	Internal Dose Technical Basis Documents/Methods: Are the technical basis documents (e.g., ICRP reports, etc.) used in reconstructing internal radiation doses adequate and appropriate?			
E.1.2.b	Are methods for estimating 'missed,' 'incomplete,' and/or 'unmonitored' internal dose adequate and appropriate?			
E.1.2.c	Are statistical approaches developed for multiple internal dose reconstructions appropriate?			
E.1.2.d	Are procedures used for determining whether data is sufficient to make a reasonable internal dose estimate appropriate?			
E.1.2.e	Are methods/procedures used for substituting internal exposure data for unavailable or incomplete information adequate and appropriate?			
E.1.2.f	Are methods for estimating uncertainty in dose associated with internal dose reconstructions on a facility and time specific basis appropriate?			
E.1.2.g	Are appropriate methodologies used to resolve uncertainty estimates associated with internal dose in favor of the claimant?			

BASIC INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
E.1.3 E.1.3.a	Work History Interview: Are procedures used for work history phone interview adequate and appropriate?			
E.1.3.b	Is the questionnaire used for the work history phone interview adequate, appropriate, and complete?			
E.1.4 E.1.4.a	Evaluation of Contractor: Are NIOSH methods, procedures, and performance analyses used to evaluate, analyze and validate all steps of the contractor's dose reconstruction process appropriate?			
E.1.4.b	Are NIOSH methods, procedures, and performance analyses for evaluating, analyzing and validating the contractor's tracking system for each step of the dose reconstruction process appropriate?			
E.1.4.c	Are NIOSH's performance analyses conducted on a frequency to adequately monitoring contractor progress?			
E.1.4.d	Are NIOSH's methods and procedures adequate to ensure any data inconsistencies/conflicts are resolved in an appropriate manner?			

ADVANCED INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST

(Note: The Basic Individual Dose Reconstruction Review checklist should be completed prior to the Advanced Review)

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Auditor(s)/Area of Review:

Dose Reconstruction Analysts(s)/Area of Dose Reconstruction (External/Internal):

Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
	F. ADDITIONAL DATA GATHERING REVIEWS			
F.1	**<u>Review of Entire Administrative Record</u>: Review the entire administrative record to evaluate if relevant information exists which was not considered by NIOSH.**			
F.1.1	Does the administrative record contain data that are relevant to the reconstruction of external dose, which were not considered by NIOSH?			
F.1.2	Does the administrative record contain data that are relevant to the reconstruction of internal dose, which were not considered by NIOSH?			
F.1.3	Does the administrative record contain data that could be used to evaluate the completeness and adequacy of individual monitoring data, which were not considered by NIOSH?			
F.1.4	Does the administrative record contain data that could be used to evaluate the completeness and adequacy of monitoring programs, which were not considered by NIOSH?			
F.1.5	Does the administrative record contain data that could be used to reconcile discrepancies or uncertainties associated with any aspect of the dose reconstruction, which were not considered by NIOSH?			
F.2	**<u>Review of the Site Profile</u>: Review the relevant aspects of the Site Profile as they apply to the individual case and evaluate the adequacy and completeness of the site profile and evaluate whether the information from the site profile is consistent with the information used for the individual dose estimate.**			

ADVANCED INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
F.2.1	Are data in the Site Profile related to facility operations and processes, which are applicable to the claimant's case, adequate and complete?			
F.2.2	Are data in the Site Profile related to radiological source term characterization, which are applicable to the claimant's case, adequate and complete?			
F.2.3	Are data in the Site Profile related to workplace conditions and monitoring practices, which are applicable to the claimant's case, adequate and complete?			
F.2.4	Are data in the Site Profile related to incidents/accidents involving radiological exposures, which are applicable to the claimant's case, adequate and complete?			
F.2.5	Are relevant Site Profile data consistent with information used to reconstruct external dose?			
F.2.6	Are relevant Site Profile data consistent with information used to reconstruct internal dose?			

ADVANCED INDIVIDUAL DOSE RECONSTRUCTION REVIEW CHECKLIST			
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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
F.3	**Review of All Relevant Sources of Data: Evaluate whether, to the extent practicable, all relevant sources of data (e.g., DOE, AWE, CDC, EML, NRC, EPA, External Health and Safety Regulators, GAO, DNFSB, Congressional Hearing Records, other research program, research publications, publication regarding the history of the DOE complex, or administrative/court records) were identified, evaluated and where appropriate, included within the Site Profile database and, where appropriate, were used in the assessment of the individual dose reconstruction case.**			
F.3.1	Has a thorough search been conducted to identify all potentially relevant sources of data as they apply to the individual dose reconstruction case? (Note: This may require conducting interviews with employees, employee representatives, site 'experts,' etc.)			
F.3.2	Have relevant data identified in the literature search been evaluated and, where appropriate, included in the Site Profile database?			
F.3.3	Have relevant data identified in the literature search been used in the assessment of the individual dose reconstruction, where appropriate?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
G. ADDITIONAL INTERVIEW AND CLAIMANT DOCUMENTATION REVIEWS				
G.1	**Interview/Claimant Documentation Review: Evaluate the effectiveness of the phone interview in ascertaining relevant work history information.**			
G.1.1	Was the phone interview effective in confirming applicable elements of the employment history as included in the claims package provided by DOL?			
G.1.2	Was the phone interview effective in identifying any relevant information on employment history that may have been omitted?			
G.1.3	Was the phone interview effective in confirming or supplementing monitoring data provided in the initial radiation exposure record?			
G.1.4	Was the phone interview effective in identifying undocumented radiation exposures as a result of work tasks, production processes, radiological protection and monitoring practices, and/or incidents?			
G.1.5	Was the phone interview effective in identifying co-workers and/or other witnesses who could potentially supplement or confirm radiation exposure information and/or work experiences in behalf of the covered worker?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
G.2 <u>Adequacy of Research for Co-Workers/Historical Records</u>: Evaluate whether, for the cases involving survivors, there has been an adequate effort to research co-located workers and other historical records to characterize the individual's work history.				
G.2.1	Does it appear that there was an adequate effort to identify, locate, and contact co-worker, supervisors, and/or any other individuals identified by the claimant who could provide data that would supplement/confirm the dose reconstruction?			
G.2.2	Does it appear that there was an adequate effort to research historical records to characterize the work history, radiation incidents, and other relevant information provided by the claimant?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
H. ADDITIONAL EXTERNAL DOSE RECONSTRUCTION REVIEWS				
H.1	**Consistency of Data: Evaluate whether the external dose estimate is consistent with relevant radiological information within the NIOSH site profile.**			
H.1.1	Is there reasonable consistency between assumptions used to estimate external dose and process information (e.g., radionuclides and quantities present and processed) provided in the Site Profile?			
H.1.2	Is there reasonable consistency between assumptions used to estimate external dose and routine radiation monitoring practices identified in the Site Profile?			
H.1.3	Is there reasonable consistency between assumptions used to estimate external dose and routine protective measures used at the site (e.g., glove boxes, shielding, etc.) identified in the Site Profile?			
H.2	**Comparison of Case Information: Compare case information and assumptions associated with external dose with relevant co-worker case information and assumptions associated with external dose for consistency.**			
H.2.1	Is there consistency between monitoring data used to calculate external dose for the covered worker and monitoring data used to calculate external dose for a relevant co-worker case?			
H.2.2	Is there consistency between assumptions used to reconstruct unmonitored external dose for the covered worker and assumptions used to reconstruct unmonitored external dose for a relevant co-worker case?			

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Area of Review	Description of Technical Elements of Review	Yes/No/ NA	Comments	Initials
I. ADDITIONAL INTERNAL DOSE RECONSTRUCTION REVIEWS				
I.1	**Consistency of Data: Evaluate whether the inter dose estimate is consistent with relevant radiological information within the NIOSH site profile (e.g., air monitoring, wipe data are consistent with bioassay results).**			
I.1.1	Is there reasonable consistency between assumptions used to estimate internal dose and process information (e.g., radionuclides and quantities present and processed, production processes) provided in the Site Profile?			
I.1.2	Is there reasonable consistency between assumptions used to estimate internal dose and routine radiation monitoring practices (e.g., air monitoring, contamination surveys, etc.) identified in the Site Profile?			
I.1.3	Is there reasonable consistency between assumptions used to estimate internal dose and routine protective measures (e.g., respirators, ventilation, etc.) identified in the Site Profile?			
I.2	**Comparison of Case Information: Compare case information and assumptions associated with internal dose with relevant co-worker case information and assumptions associated with internal dose for consistency.**			
I.2.1	Is there consistency between monitoring data used to calculate internal dose for the covered worker and monitoring data used to calculate internal dose for a relevant co-worker case?			
I.2.2	Is there consistency between assumptions used to reconstruct unmonitored internal dose for the covered worker and assumptions used to reconstruct unmonitored internal dose for a relevant co-worker case?			