

John Mauro, PhD, CHP
Senior Vice President
S. Cohen & Associates

Testimony
Before the Committee on Resources
United States House of Representatives

Hearing on The United States Nuclear Legacy in the Marshall Islands:
Consideration of Issues Relating to the Changed Circumstances Petition
May 25, 2005

STATEMENT BY JOHN MAURO BEFORE THE COMMITTEE ON RESOURCES
REGARDING THE REPUBLIC OF THE MARSHALL ISLANDS' PETITION FOR
CHANGED CIRCUMSTANCES

This statement was prepared by Dr. John Mauro as an employee of S. Cohen & Associates (SC&A, Inc.) of McLean, Virginia. On October 16, 1998, SC&A was retained by the Enewetak/Ujelang Local Government Council ("the Council") of the Republic of the Marshall Islands to assist the Council with respect to radiological issues concerning the remediation, restoration, and resettlement of Enewetak Atoll. This was the beginning of a long and productive relationship with the people and the leadership of the Republic of the Marshall Islands, which continues to this day.

I am here today to help the Committee on Resources and the Committee on International Relations Subcommittee on Asia and the Pacific achieve a deeper understanding of the facts associated with several complex scientific/regulatory issues addressed in the Petition for Changed Circumstances filed by the Government of the Republic of the Marshall Islands with the President of the United States Senate and the Speaker of the United States House of Representatives on September 11, 2000 ("the Petition").

Along with Dr. Hans Behling, also with SC&A, I contributed to portions of the Petition dealing with certain scientific issues that represent a change in circumstances that must be carefully considered by the Committee. However, two reports have been prepared in support of these proceedings that take issue with many of the findings that Dr. Behling and I present in the Petition. These reports are entitled "Congressional Research Service Report for Congress," dated March 14, 2005, and a report prepared by the Administration entitled "Report Evaluating the Request of the Government of the Republic of the Marshall Islands presented to the Congress of the United States of America Regarding Changed Circumstances Arising from U.S. Nuclear Testing in the Marshall Islands pursuant to Article IX of the Nuclear Claims Settlement Approved by Congress in Public Law 99-239," dated November 2004. The purpose of my statement today is to demonstrate that many of the scientific findings and regulatory positions

articulated in those reports are incomplete and/or incorrect, which brings into question the major conclusion of the Administration's report that "the Marshall Islands' request does not qualify as changed circumstances...." In the discussion that follows, I will refer to these reports as the CRS Report and the Administration's Report.

The Petition identifies a number of changed circumstances. I will limit my statement to those changed circumstances dealing with what I will refer to as "incomplete estimates of dose" associated with the BRAVO test and "changes in radiation protection and cleanup standards." I hope to demonstrate that, without a doubt, at the time of the enactment of the Compact of Free Association between the United States and the Marshall Islands, there was only a limited understanding of the extent of the health impacts of weapons testing in the Marshall Islands, nor had anyone anticipated the magnitude of the changes in the radiation protection standards and cleanup criteria that would occur over the subsequent 15 years. These two facts have substantial cost implications that go to the very heart of the reasons why changed circumstances provisions were incorporated into Article IX of the Section 177 Settlement Agreement. The CRS Report and the Administration's Report either disagree with our position regarding these matters, avoid discussion of some of these issues, or attempt to diminish the importance of these issues. I hope to demonstrate where the CRS Report and the Administration's Report are deficient with regard to these matters and convince the Committee that there have been substantial changed circumstances due to incomplete estimates of dose and changes in radiation protection and cleanup criteria.

Incomplete Estimates of Dose

SC&A has prepared three reports on behalf of the People of the Marshall Islands that describe in detail the historical doses associated with weapons testing in the Marshall Islands (SC&A 2000a; SC&A 2002a; and SC&A 2002b). Using many of the same historical reports and records compiled and used by the Atomic Energy Commission (AEC) and the Department of Energy (DOE) and its contractors, along with a large number of reports that were only recently declassified at that time, we derived doses to the people of the Northern Atolls associated with the BRAVO test that are significantly higher than those derived by the government and its contractors. Specifically, we believe that the whole-body doses associated with the BRAVO test were about two times higher, that the thyroid doses were many times higher, and that the previous dose reconstructions neglected to consider the very large doses that were delivered to the lining of the gastrointestinal tract due to the ingestion of short-lived radionuclides immediately following the test.

With respect to whole-body dose, the following is a reproduction of Table 1 (page 24) of the

Administration’s Report:

Tble 1. Comparison of Whole-Body Dose (rad) from BRAVO fallout by various reports and investigators.

Location	Sondhaus and Bond (1955)	Breslin and Cassidy (1955)	JCAE (1957)	Peterson (1981)	Lessard (1985)	Behling et al. (2000)
Rongelap	175	180 R	170	110	190	410
Ailinginae	69	60 R	75	24	110	215

The estimates by Breslin and Cassidy are either in roentgen (R) or dose to air (r); estimates in whole body dose (rad) would be approximately 0.88 times the reported value.

In coming to its conclusions regarding who is right and who is wrong, the Administration’s Report simply states that “the weight of expert opinion remains in favor of an average external dose about one half those estimated by Behling.” The fact is that all of the authors, except Behling et al., made certain assumptions or neglected certain exposure pathways that either missed important doses or neglected to give the benefit of the doubt to the people of the Marshall Islands. Specifically, the other studies neglected the dose from the passing plume, neglected the whole-body dose from fallout that deposited directly on the persons’ skin and clothing, did not consider the unique exposure geometry associated with fallout, and made assumptions regarding the time of arrival of the plume and the duration of fallout that did not give the benefit of the doubt to the people of the Marshall Islands. These oversights and errors are discussed in detail in the SC&A reports. However, the most egregious error made by the other authors is that they all neglected the hematological clinical data collected from Rongelap evacuees that showed that the whole-body doses were, more likely than not, about twice the values estimated by the government and its contractors. The authors of the CRS Report and the Administration’s report do not even attempt to address these critical facts.

SC&A 2002a and 2002c reviewed the clinical and hematological data reported by the U.S. physicians who attended the exposed population groups of Rongelap, Ailinginae, and Utrik as the most informative data for dose estimates. The results of these reviews are critical of the dose reconstructions performed by the government, as the following paragraphs explain.

In instances when radiation dosimetry is unavailable, many investigators have used the clinical hematological dose-response as a biological dosimeter that may then be used as a prognostic tool. The medical team at Kwajalein stated their concurrence regarding the dosimetric value of clinical hematological data in the following statements (Cronkite et al. 1956):

Since it is generally agreed that the degree of change in the formed elements of the blood is the most useful clinical index of the severity of radiation damage, peripheral blood changes were relied upon as a major aid in evaluating the degree of radiation injury in each exposed individual. In addition, changes in the mean blood counts of the exposed groups were followed closely to aid in evaluating the changing status and probable prognosis of the exposed groups...

Clinical changes that develop in the blood following acute exposure are most evident in select cells that include lymphocytes, neutrophils, and platelets. Among persons exposed on Rongelap, 42, or approximately 50% of exposed individuals, had neutrophil counts below 2,000 at some time during the observation period, and 10% had counts below 1,000. In their report, Cronkite et al. (1956) concluded the following:

Some indications of severity of exposure can be gleaned from a comparison of minimum individual counts in Japanese groups in which fatalities occurred. In general, a significant number of deaths was encountered only in individuals whose neutrophile count fell below 1000 . . .

*. . . By this criteria, then, the effective dose received by the Rongelap people approached the lethal range.**

On the basis of these conclusions, Cronkite et al. (1956) also had doubts about the accuracy of the assigned dose, as given in the following statements:

The high initial incidence of nausea, vomiting and diarrhea in the high-exposure Marshallese group, and the profound neutrophile and platelet count depression indicated a greater effect that might have been expected from 175 R . . . As indicated in Chapter IV . . . and from the degree of leukocyte depression it is possible to estimate the dose at which a small incidence of mortality would have resulted without treatment. [Emphasis added.]

In summary, SC&A's revised estimated dose of approximately 400 R to the maximally exposed Group 1 Rongelapese is, therefore, fully consistent with the opinions expressed by the medical doctors who treated the BRAVO-exposed population groups. In addition to the above-stated benefit of medical intervention, perhaps a more compelling reason that explains the absence of mortality is the fact that the exposure experienced from fallout was not instantaneous but corresponded to a protracted exposure period of more than two days. Animal studies have shown that under similar protracted exposure conditions, the mid-lethal dose is increased to between 550 to 650 R.

With respect to the doses to the thyroid gland, the disagreement between the SC&A reports and the reports prepared by the government and its contractors is equally profound. The CRS Report and Administration's Report address the follow-up clinical investigations of the incidence of thyroid cancer in the Marshall Islands, but are silent on the validity of SC&A's position regarding the thyroid doses experienced by the people of the northern atolls following the BRAVO test. Using the same data compiled by government contractors, SC&A has determined that the various government reports significantly underestimated the doses to the thyroid gland. The underestimates are due to (1) neglecting extensive evidence that, due to

* Note: When the radiation dose is instantaneous (as was the case for Japanese A-bomb victims) or is delivered in a very short time period, a mid-lethal dose of about 450 R is generally assumed.

relatively low amounts of stable iodine in their diets, the uptake of radioiodine by the people of the Marshall Islands is likely to have been several times higher than assumed by the government, (2) neglecting evidence that the size of the thyroid gland of the people of the Marshall Islands is smaller than assumed by the government, (3) failure to properly account for the daily urinary volume excretion fractions in deriving radioiodine intakes, (4) failure to account for thyroid dose due to skin contamination, (5) underestimate of the whole-body dose, which contributes to the thyroid dose, and (6) failure to give the benefit of the doubt to the Rongelap evacuees regarding questions pertaining to the time urine samples were collected and the time radioisotopic analysis of urine was performed. As is the case for whole-body exposures, the final proof that the thyroid gland doses were significantly underestimated by the government comes from clinical data that demonstrate that, in order for the people of Rongelap to have experienced the amount of thyroid damage observed, the radiation doses to the thyroid gland had to have been much higher than those estimated by the government. In fact, the BEIR III and BIER V Committees (NAS 1980 and 1990), the National Academy of Sciences (DCPA 1973) and others (Larsen et al. 1978, Conrad and Bustad at 1969 Conference) expressed disbelief that such severe thyroid disorders could have resulted from the relatively low thyroid doses estimated by the government. It was not until the investigations reported in SC&A 2000a and 2002a that the reasons behind these apparent incongruities between the government's reconstructed thyroid doses and the observed clinical effects on the thyroid glands of the people of the northern atolls were explained.

There were many other oversights in the government's reports related to internal doses from the ingestion of radionuclides that are described in SC&A 2002 a and b. However, by far, the greatest of these oversights was neglecting the dose to the intestinal mucosa from short-lived, highly insoluble radionuclides that were ingested by the people of Rongelap immediately following the arrival of the BRAVO plume and prior to their evacuation. We estimated that the doses to the intestinal mucosa were hundreds of rem. These dose estimates were recently confirmed in a paper by Moeller and Sun 2002. This issue is not mentioned in the CRS Report or the Administration's Report.

What does all this mean with regard to changed circumstances? In my opinion, it means that many errors and oversights were made by the government in assessing the health impacts of weapons testing at the time of the Section 177 Settlement Agreement. As such, explicit consideration must be given to this new information in achieving an equitable resolution regarding this aspect of the Petition.

Changes in Radiation Protection and Cleanup Standards

SC&A has prepared a number of reports addressing the cleanup needs and associated costs for several of the northern atolls, including Enewetak (SC&A 1999a), Bikini (SC&A 1999b), Rongelap (SC&A 2000b), and Utrik (SC&A 2002c). These reports were litigated before the

Nuclear Claims Tribunal and some have been ruled upon by the Tribunal.**

SC&A's reports included the following:

1. An evaluation of the potential radiation doses and radiological health risks to the current populations on the atolls and the populations that may resettle many of the atolls in the future due to residual contamination in the soil, food, and water on the atolls. The results of the evaluations were compared to the radiation protection criteria used in the U.S. for cleanup of sites contaminated with radioactive material, and adopted by the Nuclear Claims Tribunal for use by the Republic of the Marshall Islands; and
2. An evaluation of the costs associated with the remediation of the islands to the U.S. cleanup criteria using a broad range of alternative strategies. The evaluations included recommended remediation strategies for each atoll and their associated costs.

The results of these recommendations represent a changed circumstance because the cleanup criteria and cleanup costs determined by SC&A and ruled upon by the Tribunal were not adequately understood at the time of the Section 177 Settlement Agreement. Hence, by definition, the rulings of the Nuclear Claims Tribunal can be considered a changed circumstance.

The CRS Report and the Administration's Report take exception to SC&A's findings and recommendations, and the rulings of the Nuclear Claims Tribunal, for reasons that I believe are not related to scientific issues, but are more appropriately categorized as regulatory issues. I believe the authors of the CRS Report and the Administration's Report would agree with the radiological data we used in our analyses, because the data were compiled by government contractors and have undergone extensive quality assurance and peer review. I believe the authors of the CRS Report and the Administration's Report would also agree with the methods employed in our reports for performing cost analyses of alternative cleanup strategies, because the unit costs that we used were based on data and reports prepared by the Bikini Atoll Rehabilitation Committee (BARC), which was established at the request of Congress (House Report 99-450) to report independently on the feasibility and cost of rehabilitating Bikini Atoll. I also believe that, if the authors of the CRS Report and the Administration's Report agreed that the regulations and guidance promulgated by the U.S. Environmental Protection Agency are applicable to cleanup decision-making in the Marshall Islands, they would agree with the results and conclusions of our work and the findings of the Tribunal. However, throughout the CRS Report and the Administration's Report, the authors take exception to the use of EPA criteria and

**It is noteworthy that none of these reports are cited in either the CRS Report or the Administration's Report. It is also important to note that our work would not have been possible without the excellent work and incredible amount of data compiled by Lawrence Livermore National Laboratory (LLNL) under the direction of Dr. William Robison, and by the Nationwide Radiological Study (NWRS), under the direction of Dr. Steven Simon. We have reviewed their work in detail, performed independent walk-over surveys of many of the islands on several atolls, collected and analyzed samples of soil and food on Utrik and Ailuk, and have come up with virtually identical results.

guidance as the basis for cleanup decision-making in the Marshall Islands. Therefore, this is a matter that is more appropriately addressed by the Nuclear Claims Tribunal. However, in my opinion, if the Marshall Islands were a State within the U.S., there is little doubt that cleanup of the northern atolls would be required to meet the same criteria that are used to clean up sites contaminated with radioactive material in the U.S.

Notwithstanding one's opinion regarding the appropriate criteria and methodologies that should be employed in determining the types and costs of cleanup of the current levels of residual radioactivity in the Marshall Islands, there is absolutely no doubt that the regulations governing radiation protection of the public and the criteria for cleanup of sites contaminated with radioactive material in the United States have changed dramatically since the Section 177 Settlement Agreement was established. Rather than repeat these changes here, I would refer the Committee to Appendix D of the Petition.

In conclusion, it is noteworthy that the amount of radioactive material in soil, food, and water of the Marshall Islands has not increased since the establishment of the Section 177 Settlement Agreement. In fact, the amount of radioactive material in the environment has declined somewhat due to primarily radioactive decay. However, since the establishment of the Section 177 Settlement Agreement, we have gained a more complete understanding of the radiation exposures and potential health impacts that were experienced by the people of the Marshall Islands due to weapons testing. These exposures and their potential health consequences are much larger than previously believed. In addition, subsequent to the establishment of the Section 177 Settlement Agreement, the radiation protection standards for members of the public and the cleanup criteria for sites contaminated with radioactive material changed dramatically. The standards are a lot more protective now than they were at the time of the Agreement. I believe that these represent changed circumstances that could have a direct bearing on the cost of medical care and certainly greatly increase the cost of remediation.

References:

1969 Conference, "Proceedings of the Second Interdisciplinary Conference on Selected Effects of General War Volume II," Upton, A.C., and Brues, A.M. Co-Chairmen, DASA 2019-2, 1969.

Cronkite, E.P., Bond, V.P., and Dunham, C.L., 1956, "Some Effects of Ionizing Radiation on Human Beings: A Report on the Marshallese and Americans Accidentally Exposed to Radiation From Fallout and a Discussion of Radiation Injury in the Human Being," U.S. Atomic Energy Commission, Washington, D.C.

DCPA 1973, "Response to DCPA Questions on Fallout," DCPA Research Report No. 20, Defense Civil Preparedness Agency.

Larsen, P.R. et al., 1978, "Thyroid Hypofunction Appearing as a Delayed Manifestation of Accidental Exposure to Radioactive Fallout in a Marshallese Population," Late Biological Effects of Ionizing Radiation, International Atomic Energy Agency, Vienna, 1978.

Moeller, D. and Sun, C. 2002, "Absorbed Doses to the Stomach Walls and Colon of the Residents of Rongelap and Utrik Atolls due to their Initial Three-Day Intake of Radioactive Fallout from the BRAVO Detonation, Presented at the 47th Annual meeting of the Health Physics Society, June 16-20, 2002.

NAS 1980, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," BEIR III, National Academy of Sciences, Committee on the Biological Effects of Ionizing Radiation, Washington, D.C., 1980.

NAS 1990, "The Effects on Populations of Exposure to Low Levels of Ionizing Radiation," BEIR V, National Academy of Sciences, Committee on the Biological Effects of Ionizing Radiation, Washington, D.C., 1990.

SC&A 1999a, "Part 1 - Regarding the Potential Radiation Doses and Health Risks to a Resettled Population of Enewetak Atoll and an Evaluation of the Costs and Effectiveness of Alternative Strategies for Reducing the Doses and Risks," Prepared by John Mauro, Hans Behling, and Robert Anigstein of S. Cohen & Associates, March 23, 1999.

SC&A 1999b, "Statement Before the Nuclear Claims Tribunal Regarding the Potential Radiation Doses and Health Risks to a Resettled Population of Bikini Atoll and an Evaluation of the Costs and Effectiveness of Alternative Strategies for Reducing the Doses and Risks," Prepared by John Mauro, Hans Behling, and Robert Anigstein of S. Cohen & Associates, September 10, 1999.

SC&A 2000a, "Reassessment of Acute Radiation Doses Associated with BRAVO Fallout," Prepared by Hans Behling, John Mauro, and Kathleen Behling of S. Cohen & Associates for William Graham, Public Advocate, Nuclear Claims Tribunal, Republic of the Marshall Islands, May 2000.

SC&A 2000b, "Statement Before the Nuclear Claims Tribunal Regarding the Potential Radiation Doses and Health Risks to a Resettled Population of Rongelap Atoll, Rongerik Atoll, and Ailinginae Atoll and an Evaluation of the Costs and Effectiveness of Alternative Strategies for Reducing the Doses and Risks," Prepared by John Mauro, Hans Behling, and Robert Anigstein of S. Cohen Associates, August 2000.

SC&A 2002a, "Final Report - Reassessment of Acute Radiation Doses Associated with BRAVO Fallout at Utrik Atoll," Prepared by Hans Behling, John Mauro, and Kathleen Behling of S. Cohen Associates for Utrik Local Government Council, Republic of the Marshall Islands, May 2002

SC&A 2002b, "Radiation Exposures Associated with the U.S. Nuclear Testing Program for Twenty Atolls/Islands in the Republic of the Marshall Islands," Prepared by Hans Behling, John Mauro, Nicole Briggs, and Kathleen Behling of S. Cohen Associates for William Graham, Public Advocate, Nuclear Claims Tribunal, Republic of the Marshall Islands, May 2002.

SC&A 2002c, "Final Report - Statement Before the Nuclear Claims Tribunal Regarding the Potential Radiation Doses and Health Risks to a Resettled Population of Utrik, Taka, Bikar, and Taongi Atolls and an Evaluation of the Costs and Effectiveness of Alternative Strategies for Reducing the Doses and Risks," Prepared by John Mauro and Hans Behling of S. Cohen Associates, January 2002.

JOHN J. MAURO
209 Ueland Road
Red Bank, New Jersey 07701
732-530-0104
jmauro@scainc.com

Certified Health Physicist
Commissioner of Radiation Protection for the State of New Jersey

Education

- Ph.D. Health Physics, New York University Medical Center - Institute of Environmental Medicine, 1973
- M.S. Health Physics, New York University, 1970
- B.S. Biochemistry and Bacteriology, Long Island University, 1967 (Magna Cum Laude)

Summary of Experience (references for all projects and clients will be provided on request)

Dr. Mauro has a Ph.D. in Health Physics from New York University Medical Center (1973) and is certified by the American Board of Health Physics (since 1976). Dr. Mauro is Manager of SC&A's Consulting Division and is the company's Senior Vice-President. Dr. Mauro was recently appointed by the Governor and confirmed by the State Senate as a Commissioner of Radiation Protection for the State of New Jersey.

For the first 13 years of his career, Dr. Mauro served as the Director of Radiological Assessment and Health Physics Department of EBASCO Services Incorporated. In that capacity, he prepared and defended the in-plant and offsite radiological evaluations for the Environmental Reports and Safety Analysis Reports for 10 commercial nuclear power plants. His specific responsibilities included engineering, radiological, and health physics evaluations related to liquid and gaseous radwaste treatment systems; radionuclide inventories in plant systems and airborne within buildings; source terms during routine operations and following postulated accidents; occupational exposures; environmental pathway modeling and the assessment of exposures to the "maximum individual" and the general public during routine operations and in support of emergency planning; health risk assessments using the BEIR models; the preparation of radiological environmental technical specifications (RETS) and offsite dose calculation manual (ODCM) in accord with NUREG-0472, 0473, and 0133; purchasing, installing, and calibrating equipment for an environmental radiological laboratory; the design and implementation of environmental radiological surveillance programs; emergency planning; radiological and toxic chemical post-accident habitability studies; and decontamination and decommissioning studies. Responsible for the preparation, documentation, and defense of all analyses and licensing documents in these technical areas. He defended his work before the NRC, EPA Science Advisory Board, the Atomic Safety and Licensing Board (ASLB), the Advisory Committee on Reactor Safeguards (ACRS), and state NPDES hearings.

After leaving EBASCO in 1986, Dr. Mauro joined Roy F. Weston, Inc as a Project Director, where he was responsible for radon investigations under a contract with the Commonwealth of Pennsylvania.

In 1988, Dr. Mauro joined SC&A as its first full time employee. Dr. Mauro is currently a Senior Vice President with SC&A, manager of the Consulting Division, and a member of SC&A's Board of Directors. Since joining SC&A, Dr. Mauro's principal responsibilities were as a health physics consultant to the EPA Office of Radiation and Indoor Air (formerly the Office of Radiation Programs). He has also provided health physics consulting services to the Congressional Office of Technology Assessment, several offices within the Nuclear Regulatory Commission, the Defense Nuclear Facilities Safety Board, the Centers for Disease Control and Prevention, the Occupational Safety and Health Administration, the Republic of the Marshall Islands, several state agencies, and the National Institute of Occupational Safety and Health. Dr. Mauro's entire career, which spans almost 35 years, has been dedicated to the protection of workers, the public, and the environment to the potential harmful effect of ionizing radiation.

Dr. Mauro has recently received extensive training by the Office of Domestic Preparedness, the Federal Emergency Management Agency, and the Health Physics Society on emergency planning and training of first responders for planning for and responding to a radiological incident, including acts of radiological terrorism. He has given numerous awareness training sessions to first responders and other interested person on this subject.

The following lists many of the specific projects where Dr. Mauro served as either a principal investigator or project manager.

Professional Experience

1988-present SC&A, INC.

Senior Vice President. Responsible for the overall direction and management of the Consulting Division. Areas of specialization include health physics, radioecology, regulatory analysis, and the assessment of the fate and effects of radionuclides in the workplace and the environment. These services have been provided for the following clients and projects:

- Project Manger for a large task order contract with the Office of Radiation and Indoor Air of the Environmental Protection Agency. Responsibilities include oversight of investigations into the fate and effects of radioactive materials in the environment and technologies for their cleanup.
- Expert consultant to the law firm of Venable LLP in Washington, DC on matters related to the assessment of the radiation doses and health risks to workers occupationally exposed to radiation and radioactive materials.
- Consultant to the Centers for Disease Control and Prevention on matters related to homeland security. Technical support includes (1) the evaluation of equipment

and instrumentation commonly found in the nuclear medicine departments of hospitals for use as whole body counters following a radiological incident and (2) the identification of interdiction levels for non-edible agricultural products

- Consultant to the Department of Interior on matters related to the assessment of radioecological impacts under the Natural Resources Damages Assessment provisions of CERCLA
- Consultant to the EPA Office of Radiation and Indoor Air on the development of recovery and re-entry Protective Action Guides for use in planning for and responding to nuclear and radiological incidents
- Consultant to the BOMARC Restoration Advisory Board (McGuire Air Force Base, New Jersey) regarding the potential health impacts associated with the BOMARC missile accident on June 7, 1960. Work involved reconstructing the source term, atmospheric transport and deposition, and exposure of first responders and members of the public due to the acute and chronic exposures associated with the release of Pu-239 and Am-241 during the explosion and fire.
- Consultant to Magnesium Elektronics, Inc., Flemington, N.J. (a zirconium processing facility) on matters related to the disposition of waste water, containing slightly elevated levels of radionuclides, shipped from MEI to the Trenton POTW, and the disposition of byproduct material for beneficial reuse.
- Consultant to NL Industries on matters related to the cleanup of a site containing elevated levels of naturally occurring radionuclides.
- Consultant to Honeywell on matters related to the cleanup of a site containing elevated levels of naturally occurring radionuclides.
- Project Manager for the performance of independent reviews and audits of dose reconstructions performed by the National Institute of Occupational Safety and Health (NIOSH). NIOSH is currently performing dose reconstructions on behalf of former workers at DOE facilities and Atomic Weapons Employers who have contracted cancer and claim that their cancers are due to radiation exposures experienced as radiation workers. The reviews and audits are being performed by SC&A on behalf of the NIOSH Advisory Board for Worker Health.
- Consultant to the Nuclear Regulatory Commission on matters related to the decommissioning plans and license termination process for NRC licensees. Technical support consists primarily of the derivation of site-specific derived concentration guideline levels (DCGLs) using RESRAD.
- Task Manager for the Centers for Disease Control and Prevention (CDC) for the reconstruction of the airborne radionuclide source terms and onsite and offsite

doses from the Idaho National Engineering and Environmental Laboratory (NEEL) during the late 1950s.

- Consultant to the Department of Labor, Occupational Safety and Health Administration (OSHA) in matters related to planning for and responding to radiological incidents.
- Consultant to the Centers for Disease Control and Prevention (CDC) in matters related to the role of CDC on the Advisory Team in planning for and responding to radiological incidents.
- Project Manager and Principal Investigator for preparing technical background information in support of a possible rulemaking by the U.S. Nuclear Regulatory Commission for the clearance of material from regulatory control at nuclear facilities in the U.S.
- Consultant to the Republic of the Marshall Islands on matters related to the public health exposures and risks to fallout radionuclides in the environment and strategies and costs for cleanup.
- Consultant to the Army Corp of Engineers (through a subcontract with EA Engineering) on matters related to the characterization and cleanup of the W.R. Grace FUSRAP facility in Baltimore, MD.
- Project Manager and Principal Investigator for preparing technical background information in support of a possible rulemaking by the U.S. Nuclear Regulatory Commission for the clearance of material from regulatory control at nuclear facilities in the U.S.
- Consultant to the State of Washington, Department of Ecology (under subcontract to Tetra Tech) for the review of “Draft Work Plan for Screening Level Risk Assessment for the RPP-WTP,” March 1, 2000. This is the work plan prepared by BNFL for the assessment of the health risks associated with the vitrification of high-level waste in the Hanford tanks.
- Consultant to the Consortium for Risk Evaluation with Stakeholder Participation. Services included a review of DOE Management Evaluation Programs and the use of Risk Data Sheets (RDSs) for relating the DOE EM budget to risk.
- Project Manager for the NRC licensee and Federal facilities dose/risk assessment and cost benefit analyses used in support of the EPA radionuclide rulemaking for the recycling of scrap metal from nuclear facilities (for EPA).
- Principal Investigator for the review of the RODs and removal actions implemented at NPL sites contaminated with radioactive materials (for EPA).

- Consultant to DOE on the review of multimedia computer models for use in the assessment of waste streams at DOE facilities. The assessment supported the preparation of the Programmatic Impact Statement for the Environmental Restoration Program.
- Project Director for Phase 1 of the INEL dose reconstruction project (for CDC), which involved the identification, retrieval, and review of documents pertinent to characterizing the waste streams from INEL.
- Project Manager and Principal Investigator for the evaluation of groundwater flow and transport modeling needs in support of remedial decisionmaking (joint EPA/DOE/NRC project).
- Project Manager for a focused radiological risk assessment for private residences and schools in the West Chicago area contaminated with radium and thorium (for EPA Region V).
- Project Manager for the performance of the quantitative uncertainty analysis of releases and doses to the public from releases from DOE- and NRC-licensed facilities. The assessment was performed in support of the Background Information Document (BID): Proposed NESHAPS for Radionuclides (for EPA).
- Project Manager and Principal Investigator for the risk assessment of the Maxey Flats Disposal Site (for EPA Region IV).
- Supported the Office of Technology Assessment in the preparation of “Complex Cleanup.” The project required the evaluation of technologies for the characterization and remediation of DOE NPL sites (for OTA).
- Project Director for the development of a database characterizing all Class-A low-level waste generated in the United States from 1986 to 1990 (for NRC).

1986-1988 ROY F. WESTON, INC.

Project Director and Manager of the Radiological Assessment Department. Served as Principal Investigator for Performance Assessment and Permitting low-level radioactive waste management for the Pennsylvania Department of Environmental Resources/Bureau of Radiation Protection. Served as Project Director for PADER the Radon Remediation Research and Demonstration Project which remediated 130 homes and elevated levels of radon in the Reading Prong area of Pennsylvania.

1973-1986 EBASCO SERVICES, INC.

Director of Radiological Assessment and Health Physics Department. Prepared and defended the in-plant and offsite radiological evaluations for the Environmental Reports and Safety Analysis Reports for 10 commercial nuclear power plants. Provided a broad range of consulting services in the areas of high-

level waste and low-level waste management, R&D, emergency planning, fusion technology (TOKAMAK), radiological and hazardous chemical risk assessments, FUSRAP sites, and Superfund Sites.

Specific responsibilities included engineering, radiological, and health physics evaluations related to liquid and gaseous radwaste treatment systems; radionuclide inventories in plant systems and airborne within buildings; source terms during routine operations and following postulated accidents; occupational exposures; environmental pathway modeling and the assessment of exposures to the “maximum individual” and the general public during routine operations and in support of emergency planning; health risk assessments using the BEIR 3 models; the preparation of radiological environmental technical specifications (RETS) and offsite dose calculation manual (ODCM) in accord with NUREG-0472, 0473, and 0133; purchasing, installing, and calibrating equipment for an environmental radiological laboratory; the design and implementation of environmental radiological surveillance programs; emergency planning; radiological and toxic chemical post-accident habitability studies; and decontamination and decommissioning studies. Responsible for the preparation, documentation, and defense of all analyses and licensing documents in these technical areas. Defended work before the NRC, EPA Science Advisory Board, the Atomic Safety and Licensing Board (ASLB), the Advisory Committee on Reactor Safeguards (ACRS), and state NPDES hearings.

1970-1973 NEW YORK UNIVERSITY MEDICAL CENTER
Research Assistant. Performed radiological studies of the lower Hudson River estuary.

Professional Affiliations and Accomplishments

Commissioner of Radiation Protection for the State of New Jersey
Certified by the American Board of Health Physics
Member of the Health Physics Society
Elected to the Optimates Society (1967)
Alvin Gruder Memorial Award for Excellence in Biological Sciences (1967)
Founders Day Award for Ph.D. Thesis (1973)

Selected Publications

“A review of radiocesium in aquatic biota.” Presented at the Health Physics Society Annual Meeting, Las Vegas, Nevada, June 12-16, 1972, with M.E. Wrenn.

“Numerical criteria for in-plant as low as is reasonably achievable.” Proceedings of the 9th Mid-Year Topical Symposium of the Health Physics Society, 1976, with J. Porrovecchio.

“Evaluation of Environmental Dosimetry Models for Applicability to Possible Radioactive Waste Repository Discharges,” Y/OWI/SUB-77/45705, 1977, with D. Michlewicz and A. Letizia.

“Comparison of Gaseous Effluent Standards for Nuclear and Fossil Fuel Power Production Facilities,” proceedings of the December Annual Meeting of the American Nuclear Society, 1978.

“A Real Time Computer Program for Offsite Radiological Impact Assessment,” presented at the Annual Meeting of the American Nuclear Society. TANSO 34-1-899, 1980.

“Effects of Containment Purge on the Consequences of a Loss of Coolant Accident,” presented at the Annual Meeting of the American Nuclear Society. TANSO 34-1-899, 1980, with R. Bhatia and G. Martin.

“Radiocesium Transport into Reservoir Bottom Sediments - Licensing Approach,” presented at the Annual Meeting of the American Nuclear Society. TANSO 34-1-899, 1980, with S. Marschke.

“Deployment Concepts for Real Time Environmental Dosimetry Systems,” presented at the Annual Meeting of the Health Physics Society, 1981, with D. Michlewicz.

“Dealing with Uncertainties in Examining Safety Goals for Nuclear Power Plants,” in NUREG/CP-0027, proceedings of the International Meeting on Thermal Reactor Safety, 1982, with W.R. Rish.

“Survey of Chemical and Radiological Indices Evaluating Toxicity,” National Low-Level Radioactive Waste Management Program. DOE/LLW-17T. March 1983, with S. Schaffer, J. Ryniker, and J. Roetzer.

“Dose Projection for Nuclear Emergency Response on a Microcomputer,” published in Computer Applications in Health Physics, proceedings of the Health Physics Mid-Year Topical Meeting, Pasco, Washington. February 5-9, 1984, with E. Vold and D. Michlewicz.

“Application of Probabilistic Techniques to Dose and Risk Assessment,” performed by EPA in Support of 40 CFR 191, submitted for publication, with S. Schaffer, W.R. Rish and J. Parry.

“The Environmental Consequences of Higher Fuel Burnup,” AIF/NESP-032. June 1985.

“Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual,” Chapter 10, EPA/540/1-89/002, December 1989. Co-author, with L. Ralston and D. Dunning.

“Baseline Risk Assessment of the Maxey Flats Disposal Site,” with D. Kluesner and M. Nawar. Accepted for publication in Waste Management '92.

“Environmental Pathway Models - Ground Water Modeling in Support of Remedial Decision-Making at Sites Contaminated with Radioactive Material,” EPA 402-R-93-009, March 1993.

“Radiation Site Cleanup Regulations: Technical Support Document for the Development of Radionuclide Cleanup Levels for Soil - Review Draft,” EPA 402-R-96-011, September 1994.

“Technical Basis for EPA's Proposed Regulation on the Cleanup of Sites Contaminated with Radioactivity,” with A. B. Wolbarst et al., Health Physics Vol. 71 (5), 644 - 660, November 1996.

“Model for Estimating Population Impacts Averted through the Remediation of Contaminated Soil,” Health Physics, 75(1):67, July 1998, with A.B. Wolbarst, et al.

“Human-Made Ionizing Radiation and Radioactivity: Sources, Levels, and Effects,” Chapter 15 of Environmental Toxicants, edited by Morton Lippman, second edition, John Wiley & Sons, Inc., 2000.

“Sites in the United States Contaminated with Radioactivity,” with A.B. Wolbarst, et. al., Health Physics, 77(3), 247-260, September 1999.

“Evaluation of Alternative Remediation Strategies for the Cleanup of Enewetak Atoll of the Republic of the Marshall Islands,” with Hans Behling, submitted for presentation to the Society for Risk Analysis, June 2000.

Mauro, J. “Radioecological Screening Levels (RESLs) for Terrestrial Plants,” Health Physics, Vol 84, (6): 774-783, June 2003.

Co-author of “Radiological Assessments for Clearance of Materials from Nuclear Facilities,” NUREG-1640, June 2003. Prepared for the Office of Nuclear Regulatory Research of the U.S. Nuclear Regulatory Commission.

Co-Author of “Radiological Incident Awareness Training for First responders - The First Four Hours,” Accepted for publication in “Operational Radiation Safety.”