Analysis of Working Conditions, Worker Exposures and Monitoring, 1980 - 1994, Y-12 Plant, Oak Ridge, TN

August 15, 2020

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This document summarizes some working conditions, typical and expected radiological exposures, monitoring practices and compliance with established standards from 1980 through 1994 at the Y-12 Plant, Oak Ridge, TN

Abstract

In support of the SEC250 petition to establish an SEC class for workers at Y-12 Plant, Oak Ridge, TN through 1994, an analysis of working conditions, exposures and monitoring has been prepared in order to establish inconsistencies and errors in data collection, adherence to DOE standards and implementation of adequate practices to properly protect nuclear workers. In order to establish the SEC250 class of workers, it is necessary to highlight institutional practices that resulted in workplace radiological exposures that were not monitored. It is also important to challenge the assumptions used by NIOSH in current dose reconstruction methodology that do not accurately represent the actual experience of the nuclear worker at Y-12, primarily prior to the 1994 shutdown of operations.

Keywords: Y-12 Plant, radiological exposures, radiation monitoring, nuclear worker

The Y-12 Plant began operations in 1943 and since that time work has been conducted there with, "…uranium, thorium, neptunium, and other production materials in various chemical and metal forms, and in many cases, with residual amounts of contaminants from recycled feed (e.g., plutonium, technetium, americium) or daughter products (e.g., radium-224 and radon from arc melting of uranium and thorium). These materials have been variously cast, rolled, shaped, and machined by thousands of workers over five decades using radiation protection practices that evolved intermittently over that timeframe."[1]

There have been differing practices of worker exposure monitoring and data retention employed during historical periods of operations at Y-12; but, for the purposes of this document, it is the period of 1980 through 1994 that is of concern here. There will be references to later periods; but, only for the purpose of clarification.

Sec 1. Discrepancies in Hardcopy and Electronic Files Containing Worker Exposure Data from 1978 through 1991 or later

The Center for Epidemiological Research (CER) was in receipt of electronic files derived from hardcopy records of worker exposure data from Y-12 from 1978 through 1991 or later, for the purpose of epidemiological studies relating to worker exposures. It was found there were discrepancies between the hardcopy radiation records and the electronic files.[2] There was a reconciliation performed; but, it only sampled 210 worker records, which is only 1% of the worker population.[3] Conversely, the Radiation Exposures for DOE and DOE Contractor Employees Annual Report published every year from 1974 depicts a much larger population from which to sample, numbering in the thousands. This would dictate a challenge to the NIOSH statistical analysis to arrive at co-worker assumptions used in dose reconstruction for the unmonitored population.

In 1989, the Department of Energy (DOE) changed procedures and required the summation of external and internal doses. Previous to that time, internal exposure was only assessed against an acceptable value (MPBB) and no reporting was required.[2] However, with the new standards for internal dose, the data found in the electronic copy would not have been adequate for dose assessment and review of the hardcopy data would be required. When this review was conducted, only a small sample of 210 workers was looked at and did not include the data for the whole Y-12 workforce.[3] (See Sec. 6, Change in Methodology for Individual Monitoring Reporting)

There were also data-entry and transposition errors in the electronic files found and while they were stated to have been corrected, as of 1991 this process was still underway and a final evaluation of the fixes has not been published.[3]

Sec 2. Thorium Monitoring Through 1999

"The *in vivo* lung count was the only monitoring technique for monitoring thorium exposure in the body during the Plant's first decades. Thorium lung activity was inferred from ^{228}Ac and/or ^{212}Pb lung activity (Souleyrette 2003). Thorium lung counting was conducted from 1958 to 1984 with routine lung counts, scheduled at approximately 6-month intervals, starting in 1961. (BWXT, 2005)"[4] However, the background levels for ^{212}Pb were too high to read worker levels accurately.

"Whole-body counting was not routinely practiced at Y-12. The primary *in vivo* detection method was chest counting."[4]

"The first record of thorium at Y-12 is from January 1947…It was not until fiscal year 1952 that thorium activity increased significantly…Processing of thorium at Y-12 began in the early 1960s."[5]

"An interview with a former worker indicated that the major activities involving thorium continued through the mid-1970s, after which the demand for thorium components diminished (Personal Communication, 2018e). Another interview indicated that thorium work was still ongoing in 1974 when they were in process quality control (Personal Communication, 2018d). A February 25, 1975 document states: The thorium monitoring program in the arc melt area has been discontinued and added back to monitor for uranium. No changes have been made in the thorium program in the chip and press areas at this time. Tentative plans call for elimination of these area programs around July after complete phase out and decontamination. (Thorium Melt, 1969) Employee interviews indicated that, after the cessation of major thorium operations, thorium processing (including arc melting) continued for:

- refurbishment of parts (through ~1989 time frame) and special projects (through the end of arc melting activities in 1999) (Personal Communication, 2018e).
- development of detector plates (Personal Communication, 2018e)"[6]

In spite of the continuation of thorium ^{232}Th processing at Y-12 through 1999, the routine lung count testing was discontinued in 1984. As late as 2012, machining equipment was found to be contaminated with thorium, returning readings of 240,000dpm/100cm2 fixed plus removable beta and gamma.

Additionally, the test that was used to monitor ^{232}Th did not meet ANSI N42.22 or ANSI N13.30 standards. The test used to monitor ^{230}Th was only developed to meet these standards in 2007. Therefore, it is certain that workers involved in thorium processing after 1984, up until 1999, were not monitored for thorium exposure, neither by lung count nor whole body count; nor by using testing methods that comply with ANSI standards.

Sec 3. Individual Internal Uranium Monitoring and Worker Protections 1943 Through 2000

"Y-12 has a long history of handling large quantities of uranium…chronic uranium uptake is acknowledged for all workers at Y-12, but the implications of this chronic radiation exposure are not addressed... Likewise, the uncertainties in the bioassay techniques and detection limits used to quantify internal dose are significant issues in dose reconstruction."[1]

However, "DOE (and MMES) policy state that facilities should, where feasible, be designed and operated with engineered controls that prevent intakes of radioactive material by workers…Although engineered controls are utilized to limit inhalation of uranium aerosols, low-level chronic inhalation of uranium remains the primary mechanism by which individuals are internally exposed to radioactive material at Y-12. The rates of chronic uranium intake at the Y-12 Plant are maintained As Low As Reasonably Achievable (ALARA), are detectable primarily because of state-of-the-art bioassay methods…Internal dosimetry programs are required at facilities where individuals are likely to receive intakes greater than 2% of DOE limits (100 millirem CEDE), and as such, an internal dosimetry program is required at this facility. These objectives are met by constant air monitoring for uranium activity…and providing bioassay monitoring (which consists of urine analysis, fecal analysis, and lung counting)…DOE Notice N5480.6 mandates the implementation of the DOE Radiological Control (RADCON) Manual…Most of the internal dosimetry program requirements originally presented in DOE 5480.11 have been either included in, or superseded, by DOE N5480.6 (RADCON)… "[7] The 1993 standard of 100 millirem or .1 rem was not met as a threshold to determine worker need for internal monitoring.

Historically, the standard for individual monitoring for intakes of radionuclides has been set by the International Commission on Radiological Protection. ICRP Publication 54, Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation, published in 1988. "It was a companion volume to Publication 30 (ICRP, 1979a,b, 1980, 1981a,b, 1982a,b, 1988a) which gave values of Annual Limits on Intake for radionuclides based on then current modes of the respiratory and gastrointestinal tracts and biokinetic models. Since that time there have been major developments in radiation protection…It has become necessary, therefore, to replace Publication 54 (ICRP, 1988b) with a new document."[9] It was replaced by ICRP Publication 78, Individual Monitoring for Internal Exposure of Workers, Replacement of ICRP Publication 54, published in 1997.

"The general guidance is used to provide detailed numerical information that can be used to design monitoring programmes and interpret results of measurements for some radionuclides selected for their potential importance in occupational exposure…Organizations where there is potential for significant exposures from intakes of radionuclides need to consider carefully their particular working conditions, the physical and chemical nature of the radionuclides handled and to design monitoring programmes that meet their specific needs."[9]

“Individual monitoring for intakes of radioactive material should be used routinely only for workers who are employed in areas that are designated as controlled areas specifically in relation to the control of contamination and in which there are grounds for expecting significant intakes.”[9]

“Experience has shown that it is necessary to give consideration to routine individual monitoring for internal exposure of workers involved in the following operations: (i) the handling of large quantities of gaseous and volatile materials…in large scale production processes…(ii) the processing of plutonium and other transuranic elements…(iii) the processing of thorium ores and the use of thorium and its compounds…(iv) the milling and refining of high grade uranium ores; (v) natural and slightly enriched uranium processing and reactor fuel fabrication; (vi) the production of large quantities of radionuclides, and (vii) the handling of large quantities of iodine-131…”[9]

“…individual monitoring for intakes of radionuclides may be achieved by body activity measurements, excreta monitoring, air sampling with personal air samplers, or a combination of these techniques. The choice of measurement technique will be determined by several factors: the radiation emitted by the radionuclide; the biokinetic behavior of the contaminant; its retention in the body taking account of both biological clearance and radioactive decay, the required frequency of measurements; and the sensitivity, availability, and convenience of the appropriate measurement facilities.”[9]

“…for the processes listed above, if contamination of the workplace occurs frequently, a routine individual monitoring programme would be appropriate.”[9]

"The frequency of measurements within a routine monitoring programme should be chosen so as to reduce the uncertainty arising from the unknown time of intake to an acceptable level."[9]

"ICRP (1964) recommended that the inhalation of soluble uranium of any isotopic composition should not exceed 2.5 mg in any one day. In 1989, the Occupational Safety and Health Administration in the USA (OSHA,1989) recommended a permissible exposure limit…to a daily intake of 0.5 mg."[9]

Based on the absorption pathway of either ingestion or inhalation of uranium with an f_1 value of .002 - .02, many chemical and radiological compounds are found, both soluble and insoluble.

The measurement techniques for uranium of *in vivo* for lung monitoring and radiochemical separation and alpha-spectrometry on biological samples for urine and fecal are adequate for bioassay.

Internal dose monitoring, or bioassay, was not required until 1989 at Y-12[1], at which time soluble testing was began. Prior to this time, bioassay testing was only conducted randomly, usually based on an incident. Also, the detection limits for uranium before 1989 are only established on a provisional basis. The detection limit for plutonium before 1988 "has not yet been identified" (Rich and Chew 2005, p 22). Because no consideration was given to the multiple ingestion pathways through which workers could inadvertently take in radioactive material, the absence of bioassay testing has missed many exposures. However, in 1999, as a result of new ICRP standards, it was found that insoluble and fecal monitoring was also needed.

"Following the recent restart of operations at the Y-12 Plant, the Radiological Control Organization (RCO) observed that the enriched uranium exposures appeared to involve insoluble rather than soluble uranium that presumably characterized earlier Y-12 operations. These observations necessitated changes in the bioassay program, particularly the need for routine fecal sampling. In addition, it was not reasonable to interpret the bioassay data using metabolic parameter value established during earlier Y-12 operations. Thus, the recent urinary and fecal bioassay data were interpreted using the default guidance in Publication 54 of the International Commission on Radiological Protection (ICRP); that is, inhalation of Class Y uranium with an activity median aerodynamic diameter (AMAD) of 1 μm. Faced with apparently new workplace conditions, these actions were appropriate and ensured a cautionary approach to worker protection. As additional bioassay data were accumulated, it became apparent that the data were not consistent with Publication 54."[18]

The standards for which workers received monitoring was not consistent with ICRP standards, in that salaried workers were more closely monitored than hourly workers. Workers that performed the operations outlined in ICRP 78 were not monitored as frequently as salaried or office workers, who did not come in contact with radiological material. Consequently, the bioassay records for salaried workers returned higher values than the hourly workers.

The machinists were required to work in cloth short-sleeved coveralls and without gloves, as wearing long sleeves and gloves was thought to be a safety hazard around rotating equipment. Some hourly workers wore long-sleeved shirts and chemical gloves taped to the long sleeves; but, other hourly workers wore short-sleeved coveralls. Salaried employees and visitors wore lab coats over street clothes. Many of the hourly support workers, like janitors and laborers, were also only given short-sleeved cloth coveralls even though they were assigned to areas where known and unknown radioactive contaminants were present. Most of the shifts that required support workers to be in enriched areas were overtime shifts and dressing requirements were not consistently observed, instead deferring to the production schedule. They were required to handle these contaminants and work closely with that material, potentially breathing or ingesting it. They relied on the immediate employee supervisor to order bioassay testing and many were never bioassayed for their entire terms of employment at Y-12. Machinists could be bioassay monitored based on incident exposure; but, other hourly workers in the same area were not bioassayed unless their supervisor requested it.

Machinists were also required to carry machined enriched, binary and depleted uranium parts of 70 pounds and less because the crane used was for heavier parts. These larger cranes prevented air monitors being placed over the machines and the monitors were placed away from the worker (see Sec 5 Internal Air Monitoring). Many times the size and weight of the part necessitated carrying it close to the body.

Supervisors determined if the employee needed a respirator and was in charge of the respirator cabinet for all hourly workers.

The adoption of DOE Order 5480.11 in 1989 required RadCon and health physics technicians to survey jobs and determine if bioassay was required. But, as is stated further in this report, Y-12 was still not in compliance with this order as late as 1993. The implementation of routine bioassay monitoring for all workers who were at risk would be in line with the ICRP 78 guidelines as stated, "Routine monitoring would only be required in conditions of essentially continuous risk of contamination of the workplace as a result of normal operations."[9] However, this was not done until 1999.

In 2000, when bioassay monitoring for certain designated workers was implemented, there was a policy that stated after three tests were returned above allowable levels, the worker would be removed from their work area for a designated period of time. However, this was not conducted equally across all process areas. Machinists who were working with depleted and binary uranium were not bioassay monitored, even though uranium oxide contamination was found in the work area.

"The NIOSH intake model does not treat the uncertainties inherent in bioassay measurements to detect intakes from urine samples after exposure to Type S uranium, as found in "high-fired" oxides. It also does not address the implication of a 48-hour absence from the workplace by the worker following a weekend before routine urine samples were taken: without an appropriate adjustment, this would lead to underestimation by the TBD model of a factor of 2-4 as a function of lung clearance type."[1] When urine testing was implemented for employees determined to be exposure risks, they were forced to take the urine test kit home on the weekend and return it on Monday.

"…chronic levels of radiation exposure from uranium handling, while recognized, were not seen as a concern and, therefore, not given much attention in the Y-12 dosimetry program…Supervisors were typically given latitude to make decisions regarding which of their workers were provided badging, bioassay and respiratory protection, and how radiation jobs were performed…With the production exigencies of the Cold War, production was often the first priority and workers were kept at their contaminated workstations for almost the entire workday."[1]

Sec 4. External Air Monitoring at Y-12 - 1975 through 1994

"Uranium activity in air was reported beginning in 1975. However, the reported concentration was based on a composite sample taken from all stations with the PAM network.

Two changes in the air monitoring network were noted in 1983. 1) A second monitoring station was established east of Y-12. Samples collected at this station were analyzed for gross α and gross β activity and iodine-131 (131I), along with other radionuclides including fission products (FP), uranium and transuranics (TRU). These concentrations were averaged for all stations in the PAM network. 2) …the establishment of the eleven air monitoring stations in and around the perimeter of Y-12. These stations were established primarily to measure uranium. After 1984, the amount of environmental uranium monitoring increased substantially and this period is the most significant for uranium air monitoring at Y-12…Sampling for radioactive particulates was conducted by passing air continuously through filter papers. These filters were evaluated weekly for gross α and gross β activity. The filters were composited quarterly and were evaluated for four uranium isotopes (234U, 235U, 236U and 238U). Reports from 1988 onward indicate that the filters were analyzed using alpha spectroscopy…The Y-12 perimeter stations were increased to 12 stations beginning in 1985."[12]

"Ambient uranium data for the twelve Y-12 stations included gross α and gross β and activity concentrations (μCi cm-3) for four uranium isotopes (234U, 235U, 236U and 238U). In 1993, the analysis program for radionuclides was revised to obtain total uranium (μg m-3) concentrations and the percentage of ^{235}U. This approach was implemented to better correlate air concentrations with the stack emission data that were measured in terms of uranium mass…data subsequent to, and including 1993, are reported in terms of μg m-3. Since there were no Federal or State regulations, or DOE Orders that required the monitoring of uranium releases, and with the reduction of plant operations, the usefulness of the Y-12 stations was re-evaluated in 1993…processes that resulted in the emission of enriched and depleted uranium were equipped with stack samplers that were reviewed and approved by the Environmental Protection Agency

(EPA) to meet the requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPs) regulations. Therefore, sampling at all but three of the stations (4, 5, and 8) was discontinued after 1994."[12]

"Ambient air monitoring at Y-12 prior to 1983 is insufficient for estimating environmental doses… Given the distance between the main production areas of Y-12 and the locations of these stations (HP-32 and Station 40), it is unlikely that these stations reflect the level of on-site ambient uranium. Consequently, these stations do not present a representative measure of air concentrations at Y-12 and cannot be used to estimate on site doses"[12]

Sec 5. Building Air Monitoring Through 1990

From September 25 through October 20, 1989, a Tiger Team Compliance Assessment of the Department of Energy's' Y-12 Plant was conducted. Air sampling data found the presence of uranium dust in the proximity to a grit blasting machine at the west end of 9204-4. Martin Marietta's Health Physics Department relied exclusively on radiation measurements to determine uranium exposure instead of particulate metal sampling. Consequently, recent reviews of engineering shop controls have determined a broader, more detailed evaluation of other Y-12 operations may be in order. However, systemic evaluation of hazards posed by unguarded machinery, surfaces, platforms and electrical equipment has not received the attention it should. The Y-12 Plant has failed to develop a comprehensive policy for dealing with these types of hazards. Other deficiencies found include confined space entry practices, mechanical hold-off and electrical lockout programs, variances to respirator policy, insufficient resources for implementation and enforcement of safety and health programs, lack of formal implemented policies for health and safety matters, effective oversight of safety and health on construction worksites due to confusion over prime contractor responsibility and overall, a number of construction violations that reflect the lack of safety and health oversight at Y-12. One of the specific recommendations for improvement was to identify operations with potential exposure to particulate uranium and have the exposure characterized through breathing zone sampling for particulate uranium. Of the 25 buildings, housing everything from machining to chemical recovery, to be reviewed by the Tiger Team, only 5 of them had any hygiene sampling performed.[13]

Inside air monitors were not placed in the work area properly using a smoke test, which created a “pig pen effect” where the monitor was placed away from the worker and in dead zones, assuming the worker would generate an aerosol to reach the monitors. This would not read concentrations where higher than expected levels occurred adjacent to the worker. In the process of machining uranium parts, there were daily uranium “chip fires” that generated uranium smoke that the machinist could not avoid inhaling. The usual practice was that a fire had to be large enough to warrant a visit by the fire department before attention would be given to the workers affected. Because of rotating shift workers, periods of days could elapse before those incidents were recorded in the log books for each machine. Policies regarding recording of uranium fires in log books was inconsistent across different buildings. If a machinist were to be in proximity to uranium dust or smoke from a uranium chip fire and their work location was not close enough to the air monitor, this exposure would go unrecorded, particularly when there is no bioassay monitoring available to that worker.

In the absence of bioassay, the air sampling of uranium particle size would be the only way to monitor that workers exposure level. There were no standards for air monitoring until

NUREG 1400, Air Sampling in the Workplace, was published in September, 1993. It established guidelines for the placement of air monitors to represent inhaled air. Prior to this, particle size from a room monitor was the only way to know possible airborne exposures had occurred and workers in that space must then be tested further. “Measured particle size values should be used over a default value of 5 um (as called for by 42 CFR Part 82), particularly at Y-12, where the particle size has been found to range from 1-10 um.[1]

“Another example of a chronic source of “incidental” exposure of Y-12 workers is elevated airborne levels of uranium contamination due to failures of the building exhaust fans or, the incinerator…most of this elevated contamination was due to “backflow of air through the ducts at a time when the exhaust fans were off.”[1]

In the buildings where processes were conducted using radiological material, the procedure for air monitoring was to weekly collect the filter papers from the monitors. Based on testimony of a Utility Operator responsible for recording the readings off those filters, there were certain buildings where the exhaust fans were turned off to reduce the amount of contaminated air reaching the outside. When the air monitor readings for those buildings were recorded, if there were any readings that were above allowed levels, those records were not forwarded to the DOE office in Washington, DC for review. There was a second set of records showing acceptable air level readings in those buildings that were sent off to Washington. At Y-12, the main objective was to reduce incident reports. This was irrespective of worker health and safety.

Sec 6. Change in Methodology for Individual Monitoring Reporting

According to the DOE document DOE-STD-1121-2008, DOE Standard, Internal Dosimetry, October 2013, "10 CFR 835 requires internal dose evaluation programs for assessing intakes of radionuclides and for maintaining adequate worker exposure records…10 CFR 835 explicitly requires adding equivalent dose due to external irradiation to committed effective dose due to irradiation by internal sources."[16]

"Prior to January, 1, 1989, regulations in the DOE did not require computation of E_{50} and $H_{T,50}$ values from bioassay and workplace monitoring data. From January 1, 1989, with the adoption of DOE Order 5480.11, sites were required to assess and record these values. Prior to 1989, records of intakes, if they exist, were likely to be expressed in fractions of a maximum permissible body burden (MPBB)."[16] This order "…specified the uptakes of radionuclides be converted to internal dose and reposted using the AEDE methodology. With the implementation of the RadCon Manual in 1993, the methodology used to calculate and report internal dose was changed from the AEDE to the 50-year CEDE."[17] "There is no simple and straightforward general method to convert MPBB values to E_{50} values. Sites should consider whether it is feasible and cost-effective to attempt to historically reassess doses prior to 1989. The DOE position on prior years' exposures records does not address doses due to intakes prior to 1989 or intakes at non-DOE facilities."[16]

Because whatever amount of exposure data that may exist for the years before 1989 is expressed in "fractions of maximum permissible body burden (MPBB)"[16] and cannot be converted to current E_{50} values, it would be impossible for NIOSH to perform a dose reconstruction as part of a propability of causation(POC) calculation. This would indicate that dose for uranium cannot be bound for the years 1989 and prior at Y-12.

Sec 7. Radionuclides Not Monitored

"The internal dose TBD is incomplete in its review of the historic dose contribution of radioisotopes other than uranium. These radionuclides include ^{3}H, ^{90}Sr, ^{99}Tc, ^{210}Pl, ^{228}Th, ^{232}Th, ^{239}Pu, ^{241}Pu, ^{237}Np, ^{233}U and ^{241}Am…site experts indicated in interviews that radionuclides processed or worked with at the Y-12 plant included ^{3}H, ^{232}U, ^{233}U, ^{237}Np, ^{238}Pu, ^{239}Pu, ^{240}Pu, ^{228}Th, ^{232}Th, and ^{241}Am."[1] Currently, some of these unmonitored doses are added into the dose reconstruction equation; however, the entire list is not included there.

Sec 8. Compliance with DOE Monitoring Standards

In the Occupational Radiation Protection Program (10 CFR 835), issued by the Office of Environment, Health, Safety and Security it is stated, "The requirements given in 10 CFR 835 are matters of law, punishable by civil and criminal penalties. Elements include assessing external and internal doses, workplace monitoring, radiological equipment, and radiation dose reporting. Doses are required to be ALARA (as low as reasonably achievable) and must not exceed the limits given in 10 CFR 835."[10]

In Memorandum for Distribution, Radiological Control Technical Positions Regarding Use of Personal Nuclear Accident Dosimeters and Internal Audits, February 18, 2011, it is stated, "On November 22, 1996, Lockheed Martin Energy Systems (LMES) requested, for the Y-12 facility, an exemption from 10 C.F.R. 835.1304(b)(4), which at the time required "Personal nuclear accident dosimeters worn by all personnel who enter locations in which installed criticality alarm systems are required." The requirement for installed criticality alarm systems was specified in DOE O 420.1A, chapter 2, October 24, 1996, which required installed criticality alarm systems "to cover occupied areas in which the expected dose exceeds 12 rads in free air." The exemption request listed eight locations at the Y-12 facility outside the security fence, which met the requirement for needing an installed criticality alarm system, and accordingly, PNADs for all individual entering those locations. On April 10, 1997, DOE granted an Exemption Decision to LMES to allow the site to establish PNAD zones based on criteria other than that specified in 10 C.F.R. 835.1304(b)(4) and to take advantage of existing physical boundaries and access points, such as security fences. In recognition of this implementation difficulty, on December 23, 1996, DOE published a Notice of Proposed Rulemaking (NOPR) in the Federal Register. The NOPR explained DOE's intent to amend 10 C.F.R. 835. One of the purposes of the amendment was to revise 10 C.F.R. 835.1304 to eliminate confusion regarding the coverage of the personal nuclear accident dosimetry provisions and remove the reference to "all personnel" to provide flexibility in implementing the personal nuclear accident dosimetry provisions. DOE issued a final rule on November 4, 1998, revising the requirement to simply indicate that the nuclear accident dosimetry system must include personal nuclear accident dosimeters. This approach was to allow for flexible implementation on a site- and facility-specific basis."[11]

Upon conducting a review of the implementation plans for DOE Order 5480.11 during April 7-8, 1993, "Senior DOE Oak Ridge Field Office (DOE-ORO) and Martin Marietta Energy Systems (MMES) radiological controls managers stated the opinion that many DOE Radiological Control Manual mandatory requirements are "good management practices" which will not necessarily be implemented at the Y-12 Plant due to insufficient resources. There are numerous instances where Y-12 is not in compliance with DOE Order 5480.11, the DOE Radiological Controls Manual, or consensus standards…The MMES Y-12 Plant Radiation Protection Upgrades Manager stated that the organization and budget to implement the Radiological Control Manual will be severely limited in FY94…Some of the areas in which MMES is farthest from being in full compliance with the requirements of these instructions include contamination control, training and occurrence reporting."[8]

In 1994, when the DOE Order 5480.11 was enacted, many non-ALARA compliant practices were modified, curtailed or eliminated. "Y-12 continued to allow eating, drinking and smoking in radiological areas until 1988-89, and did not practice egress monitoring (DOE 1986, DNFSB 1993)."[1] One practice was to require workers with no current work assignment to gather and wait in a designated area, until their next assignment was determined. These waiting areas were adjacent to actual process areas where uranium machining was and other processes were performed. There were usually coffee pots, donuts and other edibles, as well as, dishes and cutlery, in these waiting areas where they were exposed to uranium and other unidentified particulates that were generated by process work nearby. If there was an area where known radionuclides were present, either by work activity or accidental spillage, the area would be roped off; but, workers were required to access those areas, while awaiting work assignments, on scheduled breaks, etc.

On July 7, 1992, the Defense Nuclear Facilities Safety Board, plus outside experts, issued a report outlining the assessment of the implementation of the Board Recommendations 90-2 and 91-1 for the Y-12 Plant. The report identified numerous deficiencies at Y-12 in the implementation of both of the Recommendations.

The Recommendation 90-2 states that DOE identify the specific standards which it considers apply to the design, construction, operation and decommissioning of defense nuclear facilities, provide its views on the adequacy of the standards and determine the extent to which the standards have been implemented at these facilities. Recommendation 91-1 contained seven specific considerations for the Secretary of Energy.[15]

Several DOE Orders specify a graded approach to operation of the facilities and several impediments to this implementation were apparent. However, Martin Marietta would rank risk-calculated jobs and the “budget line is then drawn”. MMES management stated that it was possible for the points assigned to good business practices to outweigh the points assigned to a significant safety issue and could result in a safety issue not being implemented or addressed. This means different facilities potentially have varying risks to health and safety based on budget.[13]

The Defense Nuclear Facilities Safety Board submitted Recommendation 94-4, Deficiencies in Criticality Safety at Oak Ridge Y-12 Plant, to Victor H. Reis, Assistant Secretary for Defense Programs, on September 27, 1994. In the accompanying staff report, it was stated that, “Although Y-12 has made some improvements over the past two years, activities at the plant still do not comply with DOE Order 5480.19, Conduct of Operations Requirements for DOE Facilities. The DNFSB staff has identified many conduct of operations deficiencies during reviews at Y-12. The DNFSB has pointed out this fact to both DOE Oak Ridge and Martin Marietta Energy Systems (MMES) senior management. Although the Y-12 management appears willing to change the existing operational culture, they clearly have not implemented the changes effectively… The DNFSB staff believes this is a clear indication of an institutional culture that lacks the appropriate level of rigor and formality associated with conduct of operations…Despite the DNFSB Recommendations, site specific reporting requirements, publicly-issued trip reports, and numerous staff reviews…recent events indicate that the personnel at the Oak Ridge Y-12 Plant still have not integrated several fundamental concepts supporting sage operations into their daily routines. These fundamental concepts include providing adequate procedures…, ensuring the workforce is properly trained, expecting compliance with requirements, and conducting nuclear facility operations formally. All these concepts are necessary in a integrated, systems engineering-based health and safety management strategy required of a modern DOE defense nuclear facility”[14]

Sec 9. Records Maintenance Through 2000

Throughout the history of operations at Y-12, the issue of maintenance and availability of employee work records, including payroll, medical, dosimeter, bioassay, building/work assignments, disciplinary and clearances has been problematic. The typical worker may have work assignments that take them to a number of buildings in order to perform a number of tasks on a daily basis. The records that were generated, maintained and stored reflecting this work activity are either non-existent or unavailable due to misfiling, inadequate retrieval systems, security classification or have been destroyed. The Y-12 Plant payroll records were maintained at the central location housed at K-25 and were later moved to a warehouse in Oak Ridge, TN; but, FOIA requests for those records do not include searching that location, only the central archive at the NNSA facility in Albuquerque, NM. The dosimeter records are oftentimes incomplete or inaccurate. Most bioassay testing results that exist are unavailable or nonsensical. The medical records generated by the plant doctors only contained issues that did not reflect poorly on management.

Overall, many of the employees at Y-12 Plant were not given monitoring or protection that would comply with DOE standards. However, being able to accurately reconstruct workers dose exposures is oftentimes made possible by gaining access to the various types of records that are illustrative of the workers activities. The Y-12 Plant management has not prioritized the ability of current and former workers to access their own work records and this lack of documentation has made accurate dose reconstruction impossible.[1] This, then, makes the EEOICPA claimant overly dependent upon dose reconstruction assumptions made by NIOSH. Those assumptions, in most cases, do not resemble, in any credible manner, the actual work experience and therefore, radiological exposures of the claimant, resulting in denied EEOICPA claims for legitimate workplace exposures that are "at least as likely as not" to have caused a workers cancer.

Sec 10. Conclusions

From its inception, the Y-12 Plant has had challenges with –

- Inaccuracy of reporting worker exposure data for epidemiological studies and later dose reconstructions.
- Discontinuation of thorium *in vivo* monitoring after 1984, in spite of continued thorium operations.
- Noncompliance with ICRP standards requiring routine bioassay until 1999.
- Insufficient ambient external air monitoring for estimating site doses prior to 1983.

- Insufficient indoor air sampling until 1993, requiring particle size monitoring.
- No known methodology to convert MPBB to E_{50} after adoption of DOE Order 5480.11 in 1989, making dose reconstruction before 1989 impossible.
- Noncompliance with ALARA, 10 CFR 835, DOE Order 5480.11, DNFSB Recommendations 90-2 and 91-1, ICRP 30, 54 and 78, eventually requiring a cessation of operations from 1994-98.
- Inadequate or non-existent worker monitoring of radionuclides other than uranium.
- Gross lack of worker records.

Therefore, the purpose of this report is to highlight these unacceptable circumstances, with the intent to illustrate to the Advisory Board the current and historical problems that indicate the impossibility of reconstructing dose for uranium or thorium from 1980 through 1994. Based on decades of absent or inconsistent employee monitoring and protections, as well as, falsified, omitted or unavailable records to prove the EEOICPA claimants exposures, it is essential that the Advisory Board establish a class of workers from Y-12 Plant, Oak Ridge, TN, for whom dose reconstruction for uranium and thorium cannot be bound for the years of 1980 through 1994.

Sec 11. References

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Sec 12. Attachments

Martin Marietta Energy Systems, Inc, Memo sent to Dr D.L. Cragle, October 11, 1991, Worker Radiation Exposure Data Used for Epidemiological Studies.

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MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2003
OAK RIDGE, TENNESSEE 37831

October 11, 1991

cc: Fry
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Wing
CERF

Dr. D. L. Cragle
Director, Center for Epidemiologic Research
Oak Ridge Associated Universities
Post Office Box 117
Oak Ridge, Tennessee 37831-0117

Dear Dr. Cragle:

Worker Radiation Exposure Data Used for Epidemiological Studies

It is our understanding that the worker radiation exposure data previously provided to Oak Ridge Associated Universities (ORAU) by Martin Marietta Energy Systems, Inc., and its predecessor, Union Carbide, are being and have been used for epidemiological studies. Recent reviews indicate that this data may not totally or accurately reflect the actual exposure of the individual.

The Department of Energy (DOE) Order addressing worker exposure changed drastically in 1989, by requiring the summation of internal and external doses. Prior to that time, bioassay measurements were not assessed in terms of an internal dose. Results were simply compared with an acceptable value and no action was taken if they were below that level. Reporting of these results was not required.

The Oak Ridge National Laboratory (ORNL) has been reassessing many previous internal exposures in light of the current DOE Order and has found that data stored on the history tapes provided to ORAU may be inadequate for dose assessment. Use of the original hard copies of bioassay results was found to be necessary. Data stored on the history tapes prior to 1989, particularly those associated with internal exposures, were for compliance purposes only and may not be sufficient for dose assessment.

External exposure data on these history tapes have recently been found to contain errors. Incorrect entries and transposed fields were discovered in the data base. Corrections to these problems are currently under way at ORNL, K-25 site, Y-12, and Paducah. Portsmouth does not store their historical data on this tape.

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