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TENNESSEE
HEALTH STUDIES AGREEMENT

Annual Report for Year ⁵
January 1, 199~~6~~, to December 31, 199~~6~~

An Agreement Between the Tennessee Department of Health and
the U.S. Department of Energy

Submitted May 1997

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Oak Ridge Health Studies Agreement

Annual Project Report Grant Year 1996

The Tennessee Department of Health (TDH) has completed the fifth full year of the Oak Ridge Health Studies Agreement grant. This report summarizes the accomplishments and concerns of the State for the period January 1, 1996, to December 31, 1996. The Health Studies project overall is progressing well and target dates are being reached with very few problems. Eight major categories of work under the grant are described below. Each description provides a discussion of the progress made during this grant year, concerns, budget status, and scheduling.

Dose Reconstruction:

The focus of work during the fourth grant year was the actual work on the dose reconstruction. The contractors presented the first iteration of the dose and health risk analysis for radioiodine releases, Task 1, *Investigation of Radioiodine from Radioactive Lanthanum Processing*; refinements of methods and calculations continued throughout 1996. The investigators for Task 2, *Investigation of Mercury Releases from Lithium Enrichment*, completed the Level I screen of potential health risks from mercury emissions, and continued the refinement of the analyses for ventilation systems in key buildings, ridge effects with air modeling, the speciation of mercury compounds, and other refinements of the source term. The investigation team presented the results of the screening level analysis and the first iteration of the dose and health risk analysis for PCBs, Task 3, *Investigation of Releases of PCBs from Oak Ridge Facilities*; the team, also, presented the results of a fish productivity study for East Fork Poplar Creek. The investigators for Task 4, *Investigation of Releases of Radionuclides from White Oak Creek to the Clinch River*, continued to evaluate the quantities of radionuclides released from White Oak Creek and to refine the modeling for the fate and transport of the radionuclides. Investigations are continuing to lessen the uncertainty of the dose and health risk analyses. The search for documents for Task 5, *Plan to Perform a Systematic Document Search* is continuing according to schedule. The investigators for Task 6, *Investigation of the Quality of Historical Uranium Effluent Monitoring at Oak Ridge Facilities*, presented the preliminary source term and health risk screening results and continued to refine the source term. The work on Task 7, *Additional Screening of Materials Not Evaluated in the Dose Reconstruction Feasibility Study*, slowed down somewhat because of the cap on spending. One meeting was held with contractors, State staff, DOE staff, and LMES staff who hold security clearances to discuss the availability of classified information relevant to screening of certain materials of potential concern. ChemRisk's 4th Quarterly Report, for October through December 1996 is included in Attachment 1.

During 1996, TDH staff, contractors, and staff of DOE and LMES worked together to clarify the security plan. We all agree on the intent and the protocols to be followed.

Registries:

Will be sent under separate cover.

Public Communications and Education:

In 1996, TDH requested that the Agency for Toxic Substances and Disease Registry provide physician education in the Oak Ridge area about low level cyanide poisoning and the urine thiocyanate test in particular. Dr. Lorne Garretson of Emory University presented a grand rounds at the Oak Ridge Methodist Medical Center that was very informative; the grand rounds were attended by area physicians and local citizens.

The TDH published two Oak Ridge Health Studies Bulletins. The May 1996 issue featured a front page article on past radioiodine releases, brief updates on the other tasks, and an introduction of new panel members. The fall 1996 issue featured a front page article on the first results in the assessment of iodine-131 emissions; a second page article on historical exposures to PCBs, updates on Tasks 2, 4, 5, 6, and 7; and an article on TDH's review of ALS data.

The health studies project now has a home page on the Internet (<http://www.state.tn.us/health>), with an extensive history of the project plus a complete bibliography.

Feasibility of Epidemiologic Studies:

The final report for the ORHASP Feasibility of Epidemiologic Studies was completed on July 3, 1996, by Dr. Puru Thapa of Vanderbilt University Medical Center.

ORHASP Meetings:

During this grant year the State and ORHASP scheduled four business meetings, but held three business meetings and two community meetings. The January ORHASP meeting was canceled at the last minute because of snow/ice storms in middle and east Tennessee. The following summarizes the major agenda items of the business and community meetings held during the year.

On January 31 through February 1, 1996, the ORHASP was scheduled to meet in Oak Ridge, Tennessee; the meeting was canceled because of bad weather.

On May 1 through 3, 1996, the ORHASP met in Oak Ridge, Tennessee. Progress reports were given for Tasks 2, 5, 6, and 7, and an update was given for Task 4. The initial dose and risk assessments for I-131 released from RaLa Processing and for PCBs near Oak Ridge were presented. An update on PCB toxicity was, also, presented.

On September 19 and 20, 1996, the ORHASP met in Oak Ridge, Tennessee. Updates were given on Tasks 1, 4, 5, and 7. Presentations of the preliminary results of the screening-level assessment of doses and health risks from uranium releases and of the source term developments and preliminary results of the mercury dose and risk assessment were given.

On September 19, 1996, a community meeting was held at the Oak Ridge High School Cafeteria. Mr. Tom Widner presented an overview of the dose reconstruction and the progress to date.

The ORHASP met in Oak Ridge, Tennessee, on December 5 and 6, 1996. Updates were given on Tasks 2, 3, 5, and 7. Progress reports on Task 4 and 1 were presented. A report was given on the progress in characterizing historical demography and land uses.

During the grant year no changes occurred in the membership of the ORHASP.

It is anticipated that the ORHASP will continue to meet four or five times during the next grant year. The ORHASP is considering various options to public meetings for keeping the community informed; public meetings are not usually well attended.

Staff and Administration:

During this grant year no staffing or administrative changes occurred.

Financial:

Grant year five expenditures are described in Attachment 3. Travel costs are those incurred for staff and panel members. Travel incurred by contractors are reflected in the cost center where contractor charges are presented.

Expenses for 1996 were within the revised budget.

**McClaren[®]
Hart**

ENVIRONMENTAL SERVICES, INC.

April 29, 1997

Ms. Bonnie Bashor
Tennessee Department of Health
Environmental Health Studies and Services
Cordell Hull Building, Fourth Floor
426 Fifth Avenue, North
Nashville, TN 37247-5282

Dear Bonnie:

**SUBJECT: OAK RIDGE DOSE RECONSTRUCTION PROJECT
FOURTH QUARTER 1996 PROGRESS REPORT**

We are pleased to provide to you this summary of activities undertaken by the Oak Ridge Dose Reconstruction project team during the fourth calendar quarter of 1996. Considerable progress was made on project investigations during the report period, centered around an ORHASP meeting in early December. Following are summaries of activities and achievements of each project task.

Task 1- Investigation of Radioiodine Emissions from Radioactive Lanthanum Processing

At the ORHASP meeting in early May, Task 1 investigators presented an update on the second iteration of the dose and health risk assessment for I-131 emissions from X-10 RaLa processing. The objective of the second iteration of the assessment is to refine the estimates of dose and risk from the preliminary assessment by 1) reducing the uncertainties in the estimates of dose and risk by focussing on major sources of uncertainty identified in the first iteration, 2) refining the analysis for major episodic release events, and 3) evaluating doses and risks to humans from consumption of milk from cows and goats that grazed in locations outside of Bethel Valley and its extensions.

Task 1 source term refinements included searching for additional data on reactor fuel shipped from Richland, Washington to Oak Ridge as a source of barium/lanthanum. While the project team found confirmation at X-10 that the "run books" documenting operational details of RaLa runs were destroyed, over 40 additional teletypes were identified that contain some information about slugs shipped from the Hanford Reservation in Richland. Calculations of the iodine-131

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Ms. Bonnie Bashor
April 29, 1997
Page 2

inventories of fuel slugs used for RaLa are being refined to 1) reflect the new information from Hanford and X-10, 2) reflect advanced neutron flux modeling runs to confirm the basis of the flux factor used in earlier calculations, and 3) include estimation of the content of some iodine isotopes other than iodine-131. A plant process model is being implemented to refine the estimates of how much iodine escaped from the RaLa plant during processing runs. The plant model reflects iodine behavior in the slug dissolver and removal of iodine from exhausted air by a condenser and a caustic scrubber.

Refinements to Task 1 atmospheric dispersion modeling that are underway focus on addressing cross-valley transport of iodine and reflection of the dose and risk contributions from major episodic releases of iodine-131. Enhancements that are planned for the Task 1 iodine exposure assessment include the refinement of pasture-to-milk transfer factors (based on experimental measurements made in the East Tennessee area between 1962 and 1970), reflection of age and sex dependencies of excess thyroid cancer risk, and reflection of the presence and locations of cows within a 20-km radius of the X-10 facility.

Task 2- Investigation of Mercury Releases from Lithium Enrichment

The Task 2 team found documentation of mercury concentrations in East Fork Poplar Creek from 1954 through 1982 in a 1982 memorandum that the project team had been seeking for two years. At the December ORHASP meeting, the Task 2 team described how indoor air mercury concentrations are being used with estimates of building ventilation rates to estimate airborne mercury releases from lithium enrichment process buildings. In a similar manner, records of mercury concentrations in EFPC are being used with records of Creek flow rates to estimate historical releases of waterborne mercury.

Task 2 investigators reviewed information from the recent mercury conference in Hamburg. Data indicate that losses of mercury from EFPC via volatilization may have been lower than originally postulated. Upper-bound losses to air may have been 10 percent or lower. In addition, participants provided data regarding the lack of a significant relationship between mercury in mother's hair and adverse developmental effects.

For the Task 2 exposure assessment, the project team prepared revised probability distribution functions to reflect sensitive subgroups of the population, namely adult females of child-bearing age (*in utero* exposure) and children under age 3. While the revised parameters do not change the preliminary conclusions of the Task 2 assessment, the team is developing toxicity benchmark criteria focussing on the sensitive subgroups.

Ms. Bonnie Bashor
April 29, 1997
Page 3

Task 3- Investigation Releases of PCBs from Oak Ridge Facilities

At the December ORHASP meeting, the Task 3 team presented the results of a fish productivity study that was conducted for EFPC to estimate total sustainable fish harvest and reasonable fish consumption rates for local anglers. The study indicated that the stream is not capable of supporting more than 1-3 aggressive anglers or 40-50 infrequent anglers, and that productivity was probably lower in the past.

The main areas of activity in the exposure assessment for PCBs are furtherance of the investigation of farm family populations, presentation of revised noncancer risk estimates, and preparation of the draft Task 3 report. The investigation of farm families on and near EFPC involved interviews with existing farm families, and resulted in refinement of exposure pathways and parameters, elimination of beef and dairy consumers as exposed populations, and identification of the consumption of turtles as a complete exposure pathway.

Task 4- Investigation of Releases of Radionuclides from White Oak Creek

At the December ORHASP meeting, Task 4 investigators presented a summary of elements of the assessment of doses and health risks from radionuclides released from White Oak Creek. Efforts are underway to model the fate and transport of radionuclides in the Clinch River using the HEC-6-R model. Concentrations are being modeled as a function of time based on independently-calculated estimates of releases over White Oak Dam. Approximately seven sources of uncertainty are being reflected in the estimates of historical releases based on detailed examination of sampling methods, analytical techniques, flow rate measurement methods, calculation practices, and reporting conventions. The HEC-6-R fate and transport model is being calibrated with data from sediment cores taken in 1962 and 1977.

To support the Task 4 assessment, land use along the Clinch River is being characterized from Highway 95 to where the Clinch meets the Tennessee River. Particular attention is being paid to locations of farm families, agricultural activities and disposition of crops, recreational activities, use of river water, and the timing of dredging activities.

Task 4 investigators are quantifying the uncertainties in internal dose conversion factors for the radionuclides of concern, and organ-specific risk coefficients are being developed for approximately 18 potential cancer sites in the body. Uncertainties in exposure parameters are being quantified based on site-specific information to the extent possible, and potential doses and risks via intruder

Ms. Bonnie Bashor
April 29, 1997
Page 4

scenarios are being evaluated. There is anecdotal information indicating that illegal entry to the Oak Ridge Reservation for the purposes of fishing or hunting may have occurred.

Task 5- Systematic Document Search

During October, the Task 5 team reviewed 20 boxes of records that were scheduled to be destroyed, and distributed search plans to TDH for 1) the ORNL Central Research Library, 2) the Radiation Research Collection at the University of Tennessee, 3) the X-10 Chemical Technology Division Document Management Center, and 4) the Tennessee Valley Authority in Knoxville. A total of 30 document summary forms (DSFs) were entered into the project information database. Systematic document search efforts center on Radiation Research Collection at the University of Tennessee, the DOE Records Holding Center, the Office of Scientific and Technical Information (OSTI), the X-10 Chemical Technical Division, the K-25 Environmental Restoration Document Management Center, a list of K. Z. Morgan files at UT, and Y-12 Central Files.

In November, 76 DSFs were entered. Systematic Search efforts focussed on OSTI, the DOE Records Holding Center, TVA records, the Y-12 Technical Library, the Y-12 Document Response Center, the Y-12 Health/Environmental Center, and the K-25 Environmental Restoration Document Center. Members of the project team interviewed health physics pioneer K. Z. Morgan on November 14, 1996.

In December, two DSFs were entered. Systematic document search efforts focussed on OSTI, the DOE Records Holding Center, the Y-12 Technical Library, and X-10 Laboratory Records.

Task 6- Investigation of the Quality of Historical Uranium Effluent Monitoring Data

At the December ORHASP meeting, the Task 6 team presented 1) a summary of independently calculated release estimates for uranium for the Oak Ridge complexes, 2) preliminary results of the Level I screening evaluation of historical doses at off-site locations, 3) a discussion of cancer risks from the Level I screening, 4) a discussion of the chemical toxicity of uranium, 5) a description of how the Task 6 report will be structured, and 6) a discussion of possible areas of refinement of the Task 6 screening analysis.

Uranium emission estimated for Y-12 have been updated by using production rate trends to scale available monitoring data to periods during which there was no monitoring. Release estimates were extended to 1995 for completeness, and results of stack measurements were adjusted to account for

Ms. Bonnie Bashor
April 29, 1997
Page 5

biases in sample collection and measurement. Uranium emission estimates for the K-25 site were refined by application of a 85% reduction factor to account for traps in the purge cascade effluent path and by inclusion of new data in the project teams independently generated list of uranium release events. Emissions from the S-50 Plant were estimated based on the available information regarding uranium losses during several months of the plant's short operational period.

Off-site concentrations of airborne uranium have been estimated using the ISC dispersion model. Reference locations for dose calculation were selected for each complex individually, then for a point of maximal impact from releases from all complexes combined. The area of the Scarboro community north of the Y-12 Plant was identified as the apparent point of maximum combined effect. This selection was based on a dispersion analysis that did not reflect possible terrain effects due to the ridge that exists between the Y-12 Plant and the Scarboro community.

Areas of potential refinement in the Task 6 analysis include collection of information to address key data gaps in the Y-12 and K-25/S-50 source terms and application of a "ridge factor" to reflect terrain effects on uranium transport.

Task 7 - Performance of Additional Screening Calculations

At the December ORHASP meeting, the Task 7 team indicated that recent activity had been somewhat reduced due to a cap on spending during 1996 and the need to clarify strategies for use of classified and unclassified data. Task 7 activities continued to focus on collection of data to support screening-level assessment of potential health risks from past emissions of each of the named Task 7 contaminants of concern (arsenic, chromium-VI, lead, asbestos, tritium, neptunium, plutonium, and materials classified by their mere presence).

The Task 7 team reviewed with the Panel the projected products of Task 7, which will include a letter report or technical memorandum addressing each material of concern, and a summary of Task 7 evaluations in the project's overall summary report.

During the week of the Panel meeting, a meeting was also held of individuals who had security clearances from the project team, the Panel, TDH, DOE, and DOE contractor organizations. The meeting was held to discuss the availability of classified information relevant to screening of certain materials of potential concern. Task 7 team members discussed the classified information of relevance to certain materials of concern, and outlined plans for evaluation of potential off-site doses and risks using unclassified and/or classified data. Potential procedures for conduct of risk

Ms. Bonnie Bashor

April 29, 1997

Page 6

assessment and communication activities in the event that a Task 7 evaluation had to use information that is not publicly releasible were discussed.

Please feel free to contact me if you have any questions concerning our progress reports or the status of project activities.

Sincerely,

A handwritten signature in black ink that reads "Tom". The signature is stylized with a long horizontal stroke at the end.

Thomas E. Widner, CHP, CIH
Managing Principal Environmental Scientist

cc: Tom Mongan
Paul Price
Jack Buddenbaum
Gretchen Bruce
Jennifer Cockroft
Susan Flack
MHES Board Members
Owen Hoffman
Jana Hammonds
Kathy Thiessen
Joe Shonka

trader from Johnson City spelling bee on third try

Joe Howell/News-Sentinel staff

right, of Johnson City and Amber Williams, second from right, of Campbell County look on as foreground, of Maryville tackles a word during Saturday's Southern Appalachian Regional Spelling Bee. In the background, of Maryville tackles a word during Saturday's Southern Appalachian Regional Spelling Bee. In the background, of Maryville tackles a word during Saturday's Southern Appalachian Regional Spelling Bee. In the background, of Maryville tackles a word during Saturday's Southern Appalachian Regional Spelling Bee.

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Meredith Taylor, 13, now goes to national contest

really hoped I'd win, but I didn't know what the competition would be like, though."

Meredith, the daughter of Robert and Debbie Taylor, outlasted 46 other spelling bees from counties in East Tennessee, southwestern Virginia and western North Carolina to win the regional competition. Saturday's victory earns the 13-year-old Liberty Bell Middle School student a spot in the Scripps Howard National Spelling Bee in Washington, D.C., May 28-29.

Campbell County's Amber Williams, 12, was first runner-up. She matched Meredith word for word during the last eight rounds of the 33-round competition before finally stumbling on "Cantonese" by substituting and "i" for the "o."

Maryville's Stephanie Seale, who placed sixth last year, came in third. She survived 24 rounds of mind-boggling words, such as "brag-gadocio" and "mostaccioli" before misspelling "cryophorus."

Mandy Mullins of Sul-

livan County placed fourth, bungling "antipodal." She was followed by Greene County's Jamie Malone who tripped on "interregnum."

Knox County's Yasmine Baktash was among the last 10 spellers in the competition. She was eliminated after misspelling "caliginous."

Lorayne Lester, dean of the College of Arts and Sciences at UT, served as the bee's pronouncer.

The judges were: Betsy Creekmore, UT associate vice chancellor of space and facilities management; Dr. Suzanne Kurth, associate professor of sociology; and Dr. Anne Mayhew, professor of history and economics.

Y-12 was source of mercury exposure — study

Level probably wasn't
enough to affect health

By Frank Munger

News-Sentinel Oak Ridge bureau

OAK RIDGE — Oak Ridgers living near the Y-12 nuclear weapons plant in the 1950s probably received "significant" exposures to mercury from breathing vapors and eating contaminated vegetables, but it's unlikely any notable health effects resulted from the plant's mercury releases.

That's the preliminary analysis from researchers who have scrutinized Y-12's records and other mercury-related documents over the past three years and tried to interpret the information from a public-health perspective.

"We believe that some people were exposed to elevated levels (of mercury), but it's not at the level where we would expect ... observable health effects."

"We believe that some people were exposed to elevated levels (of mercury), but it's not at the level where we would expect ... observable health effects."

Tom Widner
Lead researcher on Oak
Ridge health project

... observable health effects," said Tom Widner, lead researcher on the Oak Ridge health project.

"Based on this, we would be surprised to find a significant number of health effects, if any at all."

A draft report of findings is due to be released next month, but Widner outlined the results at a meeting last week of the health study's steering panel. He elaborated during a subsequent interview.

Mercury's health effects have been a subject of debate in Oak Ridge since late 1982, when the state posted East Fork Poplar Creek as a hazard because of mercury pollution. In 1983, the Department of Energy released a classified document showing that

Please see MERCURY, page A

Mercury

Continued from page A1

2 million pounds of the toxic metal could not be accounted for at Y-12, with much of it believed lost to the environment.

Mercury was used in massive amounts during Cold War development of weapons, mostly to enrich lithium for use in hydrogen bombs. The Oak Ridge inventory of mercury reportedly exceeded 24 million pounds in the 1950s.

As part of a 1991 agreement with the state of Tennessee, DOE agreed to fund a five-year, \$12.5 million project to independently assess the health consequences of pollutants discharged at the government's Oak Ridge nuclear facilities. Mercury, which can damage the kidneys and affect the nervous system, was one of the chief concerns.

Researchers went to extraordinary efforts to gather information for the project. Besides poring over old records — including classified material related to weapons production — they analyzed building drawings to understand the ventilation systems and better estimate emissions that took place at Y-12 decades ago.

The state's team of contractors, headed by ChemRisk of Alameda, Calif., found that earlier projects underestimated the amount of mercury released into the environment.

The new report concludes that 280,000 pounds of mercury entered the East Fork, which originates on Y-12 property and flows through much of Oak Ridge's west side before joining Poplar Creek. The estimated amount is about 42,000 pounds more than previously thought.

The airborne releases of mercury likely totaled about 73,000 pounds — or 41 percent (21,000 pounds) more than earlier calculations. The dramatic difference was largely based on an improved understanding of air-flow rates in Alpha-4, one of the main facilities used for the mercury processing at Y-12.

The peak releases occurred in 1957 and '58.

Project workers researched where people lived in the 1950s and how they lived, including recreational patterns and eating habits. Vegetables grown near the East Fork or in the vicinity were a possible source of toxicity, as well as contaminated fish caught in the creek.

The worst-case scenario involved a farm family that lived adjacent to the East Fork, grew crops in the floodplain and raised beef or dairy cattle there.

"These aren't hypothetical people," Widner emphasized.

Other at-risk residents lived in Union Valley in the airflow pattern during Y-12's peak release periods. Researchers considered other residents of Oak Ridge as well, with particular attention to children at Robertsville School.

Airborne mercury was of greatest concern, either by direct inhalation or vapors coating vegetables grown in the area.

Charts based on the research show that doses to Oak Ridge residents sometimes exceeded the "reference dose" used by regulators to establish maximum safe exposures to mercury. During years of peak releases, the estimated doses to Oak Ridge residents bordered the level where initial health effects from mercury would be seen.

"We're kind of in a gray area, between the area which we would start to be concerned and the area where you'd typically see observable health effects," Widner said.

He noted that health effects from mercury exposures are viewed differently than exposures to radiation and other carcinogens. With cancer-causing agents, it is generally presumed that each additional exposure — no matter how small — poses a risk.

"With mercury," Widner said, "there appears to be a threshold below which you can be exposed and not have any health effects."

Even if the final report concludes that mercury releases didn't harm the local population, the controversy probably won't go away. There remain a number of uncertainties, and the health study cannot resolve all of them.

One issue relates to the form of mercury found in the Oak Ridge environment. Different chemical forms of mercury react differently in the environment and in the human body, posing widely different threats. In addition, the form of mercury can change over time as a result of natural processes or the presence of micro-organisms.

DOE's cleanup plan for the floodplain of East Fork Poplar Creek was based partly on sampling that showed mercury in the soil was mercuric sulfide, a stable compound considered unlikely to migrate or pose a harm to health.

Not everyone, however, agrees with that assessment.

Dr. Nasser Zawia, a toxicologist on the health study's steering panel, said he considers the results to date controversial and inconclusive. He noted how difficult it is to ascertain mercury compounds in the environment.

Even those who agree with the analysis of mercury in the soil, don't necessarily believe that mercury has always been in that form. "We talked to all the experts, and they're busy trying to figure out what the forms are nowadays," Widner said. "And they just laugh when we suggest we're trying to go back 40 years and figure it out then. . . . So, we don't believe it's an answerable question within the scope of our study."

At last week's meeting, there was discussion of how different individuals may vary in their sensitivity to mercury. Standards are based largely on animal studies, although some information on health effects has come from areas where human populations were subjected to known exposures.

Zawia noted it's almost impossible to get experimental data with humans.

At that point, Sandra Reid, a nurse and citizen activist on environmental and health issues in Oak Ridge, expressed her outrage to the panel.

Y-12's operations, Reid said, have resulted in an "uncontrolled human experiment" for decades in Oak Ridge. She and others in the community believe that mercury and heavy metals have contributed to increased rates for immune disorders and some diseases in the area.

Paul Voilleque, chairman of the project's steering panel, acknowledged the complexity of the issues and offered this sendoff to Widner and the staff working on the mercury project:

"The message is you should write this report very carefully," Voilleque said.

March 26, 1997

Uranium releases higher than reported

By Frank Munger News-Sentinel staff writer

In the mid-1980s, the U.S. Department of Energy compiled and released to the public a mountain of statistics on Oak Ridge pollution. Most of the numbers pertained to historic discharges at DOE's nuclear facilities.

This activity was spurred partly by inquiries from the news media and partly by DOE Manager Joe La Grone's self-stated desire to rid the agency of any skeletons loitering in the closet.

Notable in this DOE collection was information on uranium released into the environment at the Y-12 nuclear weapons plant.

As DOE fessed up to unloading tons of uranium into the air and waters around Y-12, not everyone was impressed by the disclosure.

Mike Mobley, the state director of radiological health, called DOE's documents virtually worthless. Mobley said DOE didn't have a clue about the actual totals because Y-12 didn't even monitor many of the vents where uranium was escaping on a daily basis. In other instances, he said, estimates were little more than guesswork.

Some folks, of course, thought Mobley's criticism was shrill and unfair. They felt the open and candid regime at DOE's Oak Ridge office deserved more credit.

As it turns out, Mobley was right.

DOE's documentation grossly underestimated the uranium discharges at Y-12, according to a new report that offers the most exhaustive analysis yet.