computer systems, and supervised five personnel. I had been promoted from Production Supervisor, where I supervised 31 personnel, planned manpower requirements, wrote weekly and monthly status reports, and conducted training and communication sessions. In May of 1984, I began my duties as Methods Analyst/ Lead Auditor for National Lead of Ohio (NLO, Inc.) at the Feed Materials Processing Center in Fernald, Ohio.

My job responsibilities while at Fernald included planning, coordinating, performing and reviewing compliance audits on Standard Operating Procedures, Manufacturing Specifications, Procurement Specifications, and Maintenance Procedures. I also executed special projects and developed Quality Assurance Documentation. I maintained a security clearance (Level L, or limited) and attended several training sessions and seminars, as well as myself training other quality assurance/audit personnel. In January, 1986, NLO, Inc. was replaced as Contractor at Fernald by Westinghouse Materials Company of Ohio (WMCO). My job responsibilities at Fernald remained essentially unchanged until my departure on March 24, 1986, approximately 22 months after starting there.

CONDITIONS AT FERNALD

When I first reported to work at Fernald, I observed several serious problems. My first impression was that the facility was antiquated and in poor condition. I immediately noticed that the building where I worked, the Laboratory Building, was contaminated with uranium dust from personnel wearing process shoes and clothing into and throughout the building. Process shoes and clothing were strung throughout the corridors (particularly the west corridor) and even placed on benches that were used for coffee breaks. A layer of dust also covered the cabinets, shelves, and horizontal surfaces throughout the building.

In the operation buildings, I found layers of uranium dust; magnesium fluoride, green salt, orange oxide and uranium saw chips covered the floors to a level of one-quarter inch thick. At times, the air was so full of uranium dust I had trouble breathing, and afterwards, acquired a sore throat. This was especially true in Production Plants 1, 4, 5, and 9. Respirators and masks were not being worn by personnel.

But the main problem I encountered from Day One was in the Quality Assurance Department itself. I discovered that there was no comprehensive audit program in place. I found that the department was understaffed; only three audit department personnel had responsibility for performing literally hundreds of audits, updating and revising procedures, keeping current with DOE Orders and performing a variety of other functions. The audit department had no independence from, and in fact took orders from, production; under NLO, in particular, the Quality Assurance Department was at the bottom of the organizational chart, reporting to the Technical Division. I was not allowed to pursue audits in certain critical areas of plant operations; for example, I was warned not to undertake any audits of the chemical pits, the K-65 silo area, the dust collector systems in the production areas, and the mechanical shops located throughout the

Production Buildings. On some of the audits that I performed, I was not allowed to undertake follow-ups, or I was restricted to looking at a limited area of plant operations. For instance, in my audit of the scales used at Fernald, which are important for measuring materials and discovering discrepancies, I was restricted to auditing Plant 5 scales only, where I found a widespread breakdown in compliance with procedures.

Another example is in my audit of hoists and cranes used at Fernald, where, after finding widespread discrepancies in compliance with procedures in Plant 5, I was restricted from performing other hoists and cranes audits throughout the facility. (Summary of audit findings will be discussed later.)

My department was the only department that audited procedures at Fernald. My immediate supervisor was Mr. Weichold, whose job title was Chief Methods Analyst, and our department head was Mr. Tippenhauer, who was the Quality Assurance/Quality Control Head under NLO, Inc.. With me was Ms. Tilney, a Technical Assistant. Operations told Mr. Tippenhauer what to audit and when.

Physically, there was very little to work with in our department. There were not enough desks, no bulletin boards, no filing racks, no procedure filing system, and no basic listing of current procedures, among other problems.

I stated that from the beginning I was uncomfortable with the audit arrangement. Occasionally, I would perform an audit on my own which resulted in complaints from production, and in turn pressure from Mr. Tippenhauer, the head of the department, to alter, or even stop the audit entirely. After nine months, my office became the storage area for desks, chairs, and filing cabinets, making my office crowded and inadequate. This action was accompanied by warnings and threats about my job security from Mr. Tippenhauer and "through the grapevine." After I complained about my office space, I was told by Mr. Tippenhauer that if I didn't like it, "You know where the door is." I stopped complaining.

The bulk of my responsibilities within the first year involved audits of three areas: Standard Operating Procedures (SOP), Manufacturing Specifications (MS) and Maintenance Procedures (MP). An audit involves comparing the written current procedure against the actual performance of an operation. Adherence to the procedures is required in order to promote efficiency and prevent accidents, as well as to avoid radiological occurrences such as an accidental nuclear criticality.

Despite the importance of the procedures, I consistently found that the procedure being audited was often non-existent, out-of-date, inadequate, ignored, or inaccurate. Complicating the situation was the fact that management was slow to respond; the submittal of an audit report requires a response from management within thirty days, yet management often failed to respond for as long as four months.

Management also ignored key items for correction, and failed to implement corrective action when promised. In an audit of the water testing procedures at Fernald in late November, 1985, I discovered that many of the water samples were brought to the laboratory frozen solid. Management, in its response to the audit, disclaimed this finding, and flatly stated, "We doubt that samples are brought in frozen solid." I had personally witnessed this occurrence, but I was powerless to press my point - - management had made up its mind that there was no problem, therefore no corrective action was required. This uncaring, unprofessional attitude and practice of management continued. Massive health and safety problems uncovered during the course of an audit went unresolved.

Finally, follow-up audits revealed that several, sometimes none, of the corrective actions promised had been implemented. This problem was so pervasive that I wondered why I was wasting my time doing the audits at all. In one instance, in an audit on "Derby Breakouts", dated November 11, 1984, I identified many significant violations of the procedure. For one, the procedures were not current, did not reflect the operations as performed, were not even available in the work areas, and left out important health and safety requirements, such as the requirements for respirators in high radioactive dust areas. Even though management agreed with the problems identified in the audit, and promised corrective action in a March 23, 1985 response (three months late), a follow-up audit performed by myself eight months later found that none of the promised corrective actions had been implemented.

Another problem that I noted was that many of the divisions and departments at Fernald were only self audited, in violation of the whole concept of Quality Assurance/Control, as well as DOE Orders. This was the case in the Health and Safety

Department, Laboratory Department, Procurement Department, Engineering Division, Nuclear Materials Control and Accountability Department, Transportation Department, Maintenance Department, Production Control Department, and ironically enough, the Quality Assurance/Control Department.

The implications of this disarray became immediately evident in the very building that I worked. The uranium dust in the Laboratory Building was unusually thick, and I inquired about why such conditions were tolerated in February, 1985. I was informed by Mr. Tippenhauer that there was only one dust collector and it was in the basement. I went to the basement and took a look at the dust collector, and then asked who was responsible for changing the bag on this particular collector. Nobody knew. So I asked where the procedures were for changing the collector's bag. I discovered that there were no procedures. The bag, as far as I could determine, had never, in the life of the plant, been replaced. Months went by, and finally, in June 1985, I insisted that the bag be replaced, which it was. Mr. Graver, Mr. Fallings and I witnessed the removal of the old bag which had disintegrated. Uranium dust had not only been building up in the Lab Building for years, but dust was bypassing the bag and going straight up the stack. Upon further inquiry, I discovered that many of the dust collectors in the production plants lacked procedures, notably the portable dust collectors.

In tandem with this problem was the lack of radiation monitoring equipment at Fernald. To my knowledge, until about nine months ago (mid-1985) there was not one state-of-the-art piece of radiation monitoring equipment for general personnel. It was never standard procedure to require such monitoring as well. I saw only one hand-held radiation monitor in use at the plant, and two broken monitors that were never used. It was not standard to screen personnel either coming or going at Fernald. New monitoring equipment was installed in the summer of 1985, in my opinion, thirty-three years too late.[1/]

Another glaring procedural deficiency that I discovered in my audits was the lack of a filing system for Maintenance Procedures. File cabinets were simply stuffed full of documents in no particular order, and it would often take hours to find the procedure being audited. I also found that Standard Operating Procedures (SOP's) and Manufacturing Specifications (MS's) that had been "reissued", i.e. supposedly updated and improved, were actually unchanged from the old versions.

Increasing my frustration was the Quality Assurance/Control Department's total powerlessness. I did not have the authority to put a hold on non-complying equipment or work. The auditor's job was simply an advisory role. I was used to a stronger Quality Assurance function . . . in order for a quality assurance department to be effective, it must be independent from production.

1/ My opinion of the state of Fernald's environment is shared by many others. In July or August of 1985, Northwest Pacific Laboratories was contracted to assess Fernald's environment. I overheard one technician who came from the Health and Safety Building exclaim, "The building is as hot as a firecracker." The same technician commented about the Lab building where I worked, "The Laboratory is a pigsty."

Deficiencies that were identified were not recorded in a systematic manner, and therefore no "trend analyses" could be performed. Trend analysis is like institutional memory. Incidents and mistakes that are recorded systematically can be evaluated to help prevent repeat mistakes. At Fernald, they kept commiting the same mistakes over and over again. In effect, Fernald was not learning from its past mistakes.

The extent of the problem and its implications are further revealed by an audit I performed in the first few months of my tenure at Fernald. I performed the first audit ever of Maintenance Procedures at Fernald. I found that these procedures were out of order, and were not kept up to date. I found it incredible that maintenance operation at a nuclear maaterials facility was allowed to go unchecked and unverified for over 30 years. Maintenance of sensitive equipment was simply left to the memory of supervisors and workers. By the time of my departure, I had finally put the Maintenance Procedures in order, but had not succeeded in convincing management that a system for updating and revising maintenance procedures should be established.

As far as the audit program itself, there were terrible inadequacies. For instance, there were no procedure audits performed at all until the mid-1970's. Half of the audits performed in the late 1970's are missing, presumably irretrievably gone. In the area of auditing Manufacturing Specifications (MS's), I found that NLO had only performed six audits in the entire lifetime of the plant. It is extremely important that MS's are followed. A possible result of failing to follow an MS is that a nuclear criticality accident could occur. Manufacturing Specifications dictate what a particular machine's or instrument's capacity is or is not; how much material a machine can withstand, at what rate, and under what conditions. Manufacturing Specifications are important in most industries for efficient and safe operations . . . in a nuclear materials plant, they are the cornerstone of safe operation that protect against one of the most deadly of accidents.

The reviewing and compliance of Manufaacturing Specifications are important enough that DOE requires strict compliance. Yet the MS system at Fernald was in total disarray. The blatant violation at Fernald would lead to civil penalties in private industry; at the government-owned Fernald plant, violations were simply routine oversights. As far as I could determine, the plant was essentially self-regulated - - DOE had abdicated its role as overseer by failing to check up on whether the contractor was obeying the rules. The DOE preferred to rely on the contractor's flawed and inadequate quality assurance program.

Recordkeeping in the area of DOE Orders was also literally a joke. DOE "regulates" its plants through directives in the form of Orders. A DOE Order is supposed to set the requirements for the total operation and maintenance in the areas of worker protection, environmental, health and safety, reporting of accidents, and in almost every area of operation. I discovered just how seriously Fernald management viewed the DOE Order system when Westinghouse took over operations at

Fernald in January, 1986.

Mr. Grumski, head of Westinghouse's Quality Assurance, directed me in January 1986 to get the DOE Orders out, as the Orders would be needed in performing investigations. I searched for hours but could not locate the Orders. I finally reached Mr. Spencely, the former President of NLO (still on site at the time), and was told to check the library. I knew that that was wrong, since DOE Orders were never maintained in the library. I then called Mr. Spencely's former secretary, Ms. Brown, who stated that the DOE/OR Orders were kept in the Legal Department, but that the Orders hadn't been kept updated for two years because she wasn't given time to do so. I then went to the Legal Department accompanied by Ms. Murphy, secretary, and President Boswell's secretary, Ms. Kinnett, and located the Orders -- they were literally heaped on a shelf, in total disarray. The binders that held the Orders were not in any order, and many labels that titled the binders were on the floor. Many Orders were missing, some were not filed, and some were also on the floor. I discovered that the Legal Department had not kept up the files for over <u>five</u> years. I reported the problem to Mr. Grumski of Westinghouse, but as of my departure, nothing had yet been done.

GENERIC OBSERVATION ON AUDITS

During my two year stay at Fernald, I conducted 23 audits and one investigation. I have kept a copy of not only my audits, but of management's responses to the audits, as well as the follow-up audits that were performed. Audits are highlighted as an addenda to this affidavit.

Every single operation that I audited was deficient in some way as far as having up-to-date, comprehensive and workable procedures. Massive noncompliances with written procedures were observed in areas of critical safety. I had to rewrite procedures myself in some cases, even though that is generally not the responsibility of an auditor. I only was able or permitted to audit a very small portion of the overall plant procedures . . . I was warned not to touch the chemical or waste pit areas; K-65 areas; dust collection systems in the production areas; and many other areas of critical plant safety.

Another observation was that management had the power to accept or reject audit findings and recommendations at they saw fit. There were many instances where management chose to institutionalize a dangerous practice that I had discovered, or to ignore the problems altogether. I was often instructed not to pursue certain audit follow-ups, especially beyond a certain stage.

Out of 23 audits I performed, management disagreed in whole or part with the suggested corrective actions, failed to respond altogether, or failed to provide the requested corrective action as promised.

Finally, it should be noted that Westinghouse ended my audits altogether. On January 6, 1986, after I submitted to management a Quality Assurance overview of all procedure audits performed over the lifetime of the Fernald site, I was instructed by the head of QA/QC of Westinghouse, Mr. Grumski, not to perform any further audits. In this respect, I was muzzled from performing my standard duties. His explanation was that there was "nothing to audit on a QA basis." I could certainly agree with that, but I wondered what Mr. Grumski intended to do until Westinghouse had finished installing its QA replacement program.

The Quality Assurance overview of procedure audits that was submitted to management consisted of Audit Indexes. These indexes catalogued the number of audits, audit follow-ups actually performed (with corresponding dates), and the number of audits that were never performed. The numbers, provided below, speak for themselves.

AUDITS PERFORMED IN LIFETIME OF FERNALD

Standard Operating Procedure Compliance Audit Index, 1/1/86

Audits performed:	83
Audits required, but never performed:	296

Manufacturing Specifications Compliance Audit Index, 1/1/86

Audits performed:	7
Audits required, but never performed:	95

Maintenance Procedure Compliance Audit Index, 1/1/86

Audits performed:	3
Audits required, but never performed:	218

Quality Assurance Compliance Audit Index, 1/1/86

Audits performed:	93
Audits required, but never performed:	609
Audits with followups:	16
Audits with no followups:	77

To give the reader an idea of the kind of problems that I was finding during my audits, it is worthwhile to focus on just two of my audits briefly. The first audit I would like to focus on was performed from November 13 to November 30, 1984, and the subject of the audit was the operation of the water plant, which included water treatment and site-wide responsibilities. The report is dated January 31, 1985 and it is numbered Quality Control Audit Report No. 4.02.

The treatment of water at Fernald includes sampling and testing, preventing uranium losses to the environment via water channels, the treatment of water for plant personnel consumption, sanitary sewage disposal, testing fire pumps, water sampling and testing from the chemical pits and more. The objective of the audit was to "evaluate the operation of the Water Plant and verify that current operations and inspection practices are in compliance with authorized procedures."

During my audit, I found massive noncompliances. I identified 14 procedures that should have been referenced in the Standard Operating Procedure (hereinafter, "SOP") that were not referenced. I also found inconsistencies with what the SOP called for and the actual practice. Several operations listed in the SOP, which called for routine daily checks by operating personnel, were not performed either "routinely" or "daily."

The steps for operations in the Chemical Pits failed to mention how often the prescribed operations are to be performed, how often the flow charts are to be changed, and that samples of the effluent are taken for analysis.

I observed that, contrary to the SOP, Test Well No. 1

Shallow was no longer sampled for uranium or other contamination. Even the pump had been removed from the well. Upon inquiry, I was told that uranium levels in the well were too high, and therefore testing on that well was no longer done. I was later instructed by Mr. Tippenhauer and Mr. Weichold not to put this information into my audit report.

Several problems as noted above were also problems for the Sewage Treatment Plant, the Ultra Violet Treatment Facility, the Manhole 175 Area, the Check of Manhole pH Meters and Alarms, and other areas audited.

Under "General" observations in my audit, I noted that several samples (including water and seage sludge samples) were placed into one carrying rack that did not contain divided compartments. As a result, the samples would tip over and intermix with, and leak onto other samples in the carrying rack. I also observed that "some samples would be brought into the Water Plant Laboratory frozen solid." During the audit, I observed that sulfuric acid spilled from the acid storage tank while the acid tank above the clear well was being charged with acid. "The acid was contained in the concrete basin, but quickly leaked out through the bottom." Also, the acid tank above the clear well rested on a severely warped piece of plywood. I wrote: "If this board warps enough or breaks, the acid tank could tip and spill acid out. It is recommended that a thorough inspection be made of the structure."

The management response on February 16, 1985 from Mr. Leist is indicative of the powerlessness of the Quality Assurance

Department. Mr. Leist was the Director of the Technical Services Group, which controlled the Quality Assurance/Control Department under NLO, Inc. Even though Mr. Leist agreed with the bulk of the my recommendations, he chose to reject the corrective action suggested for the problem of water samples intermixing, and he "doubted" that any samples were brought in frozen. Extensive follow-up on this audit was not performed.

The second audit I would like to focus on was performed from December 26, 1984 through April 9, 1985, and involved the water plant laboratory procedures, which included all the tests performed on water from different sources throughout the Fernald site. The report is dated April 30, 1985 and it is numbered Quality Assurance Report No. 4.03.

Some of the water sources that are tested include production wells, drinking fountains, storm sewer, general sump, sewage treatment plant, chemical waste pits, test wells throughout the site, Great Miami River water, Paddy's Run Creek water and other sources. The objective of the audit was to evaluate the operation of the Water Plant Laboratory and verify that current operations are in compliance with authorized operating procedures.

During the audit I found several non-compliances. The measurements of chemicals used for testing samples were inconsistent with the measurements listed in the operating procedure. Several tests listed in the procedure were not performed at all, and several tests that were performed were not listed in the procedure. Information on what chemicals were to be mixed together to perform many of the tests were also not.

listed in the procedure. No records were kept for the length of time chemicals were stored to evaluate the stability of the chemicals.

During the audit I observed that samples of sewage treatment waste were placed in a small, unventilated furnace set at 600 degrees Fahrenheit for over an hour. The object of the test was to determine total dissolved solids. Due to the dense smoke and strong, offensive odor that was created, all personnel had to evacuate the laboratory room. Later with the door open to let out the smoke, I entered the laboratory room and found smoke residue on supposedly sterile equipment. When I informed Mr. Tippenhauer of my experience, I was told not to include information in the audit about finding the smoke residue on the sterile lab equipment.

I was amazed at the widespread deficiencies and "no common sense" approach during these audits. Since 1952, the public and the government has relied upon Fernald's self-regulation of its water sampling and testing for uranium and other contaminants, but this audit reveals that, at least up to the time that corrective action was taken in response to my audit, that such testing is inherently unreliable. I have also observed that Westinghouse, in its latest Environmental Monitoring Report, showcased the water plant laboratories as an example of Fernald's excellent quality assurance. I had to laugh.

WESTINGHOUSE

When Westinghouse took over operations at Fernald on January 1, 1986, organizational changes occurred site-wide. The line was, "Forget what has gone on in the past. It's a whole new ball game." I first realized the meaning of this when on January 6 I was told by Mr. Grumski, the Westinghouse Quality Assurance/Quality Control Manager not to perform any more audits, because there was "nothing to audit on a QA basis." What was meant was that there was no QA program onsite to date. However, I felt that they should at least follow up on previous audit responses. Mr. Grumski and Mr. Weichold (my immediate supervisor) told me and Mr. Weissenberg to write an audit evaluation of each previous audit over the last year (1985) and identify the deficiencies, especially those outstanding. I was told that these evaluations would be presented at the January monthly QA meeting. This was not done. Nor were they presented in February or March. Yet there were many outstanding deficiencies.

I expected better communications and attitudes to improve throughout the site with Westinghouse, and to some extent it was better. Westinghouse promised that Quality Assurance would be a high priority. But, when it came to specific projects, Production had total control. I concluded that Westinghouse was adept at saying the right things, but when it counted, it was "business as usual."

Mr. Grumski gave Mr. Weichold the assignment, in February 1986, of deciding who should be responsible on Fernald site for maintaining and distributing DOE/OR Orders. Mr. Weichold made the decision that the Company Library should be responsible for the Orders. When Weichold contacted Librarian Ms. Gardewing and her immediate supervisor, Mr. Elikan, manager of Technical Services for Westinghouse, an agreement could not be reached. As of the date of my departure, nothing had been established as to who was to be responsible for maintaining the Orders. Given my past experiences with the DOE Order maintenance under NLO, I was dismayed that Westinghouse management was still dragging their feet on this seemingly important task. However, my first actual insight into how things were to be under Westinghouse came with my first assignment - - investigation of transportation shipment vessels, called "T-Hoppers", that carry radioactive materials.

A T-hopper is a transportation vessel used to transport uranium oxide from Hanford to Fernald and to transport greensalt from Paducah to Fernald. The Hanford to Fernald shipment is performed by rail service; Paducah to Fernald shipment is performed by truck. I was to investigate the overall operation of transporting T-hopper vessels.

It is important to explain the background behind this incident. A shipment of an externally contaminated T-hopper from Fernald to the DOE's Hanford facility on 7/23/85, sparked a DOE investigation (released 11/25/85) which heavily criticized Fernald for lack of procedures, training, quality assurance and more. The DOE report found, <u>inter alia</u>:

- operating procedures used at both Fernald and Hanford to inspect the shipping container and to prepare it for shipment were not sufficiently detailed to assure that the package closure was sealed and contamination-free.

- monitoring for contamination was not performed on T-Hopper 651 prior to package, closure and release for offsite shipment from Fernald and was not required by any operation or safety procedures in effect at Fernald.

- the release of contaminated T-Hopper 651 at the Fernald site was attributed to inadequate management control systems, primarily in the areas of radiological safety and quality assurance audits, and ineffective overview of the radioactive material packaging, safety, and transportation activities at the FMPC site by the DOE-OR field office.

- the NLO Quality Assurance Audit Committee conducted its biennial audit of the NLO QAP on March 12, 1985. The audit did not concern any assessment of the implementation of the Quality Assurance Plan.

- T-Hopper 651 was inappropriately labeled as an "empty" shipping container because it contained uranium that exceeded the allowable internal contamination limits as prescribed in 49 C.F.R. 173.427(c).

- NLO does not check for removable contamination on T-hoppers prior to release of the shipment. DOT 49 C.F.R. 173.443(a) requires that sufficient measurements shall be taken to assess the nonfixed contamination levels.

- NLO procedures do not address the quality control requirements for 49 C.F.R. 173.475. This regulatory section covers the condition of the closure devices in three subsection. The closure devices must be properly installed, free of defects, properly closed and sealed. T-hopper closures were found that had rust, deformed and contaminated gaskets, improper nuts on the eyebolts, warped lids, and foreign materials on the flanges, lids and gaskets.

- procedures at Fernald were less than adequate or nonexistent.

- operating procedures for weighing the T-hoppers were out of date and incomplete. Consequently, erroneous weights are being taken by the operating personnel. These errors create weight differences and material accountability problems between Hanford and NLO.

- because the Transportation Dep't (at NLO) did not understand the applicable federal regulations, they did not properly train NLO employees, especially the IH&R technicians.

- the Transportation Department at Fernald did not follow the QA plan for the preparation and shipment of radioactive materials in that shipments are released without all applicable documents being executed and turned in.

- NLO IH&R Department did not understand their responsibilities in monitoring packages and vehicles for compliance with DOT regulations.

- the failures in implementation are of significant magnitude that even a cursory audit of implementation of the QAP would have disclosed failures.

- one of the recommendations from an earlier DOE report dated February 7, 1985 to implement a dynamic internal audit system to systematically evaluate the NLO environmental protection program was not in place for the handling of radioactive shipments and plant operations. The receipt and shipment of radioactive materials are essential to the operations and mission of FMPC. Noting that the recommendation of a previous board and similar findings in the handling of radioactive shipments and plant operations, the Board concludes that this is a generic problem within NLO management system. The internal audit system is inadequate, and NLO is in violation of DOE Orders 5482.1A, 5480.3 and 5480.1A

Unfortunately, there is much more to the report that is critical of Fernald. In response to this stinging DOE indictment, and under orders from DOE, NLO submitted an Action Plan in September, 1985. Despite the obvious and glaring inadequacies, T-Hopper shipments continued throughout this period.

On January 14, 1986, DOE sent the DOE Investigation Report to Westinghouse management, and instructed them to comply with the Report's recommendations within a month. On January 28, 1986, Westinghouse responded to DOE with a letter that guaranteed that Westinghouse was in compliance with the DOE mandate.

On January 31, 1986 Mr. Grumski approached me and assigned me the task of evaluating the "Action Plan" developed by NLO in response to the DOE report, as well as the Transportation Department's compliance with the Plan. The Action Plan guaranteed to DOE that corrections had been made and that a recurrence of shipping contaminated and leaking T-hoppers would not happen again.

On February 7, 1986, I personally submitted my investigation report to Mr. Grumski. He was impressed enough with the report that he came into my office that same day and said, "This is the best thing I have seen come out of here yet. Damn good job." My investigation revealed fourteen areas that were deficient, including:

- No program had yet been established by the Materials Control and Accountability Department for periodic weight verification of T-hoppers.
- No tamper-proof seals on bottom closure of T-hopper.
- No leak testing maintenance procedures and bottom gasket replacement.
- Leak testing is not performed on T-hoppers from Paducah by FMPC -- instead it is performed by Paducah.
- An Environment, Safety & Health procedure had not yet been written on radiation checking and visual inspection for all incoming T-hoppers.
- There were discrepancies in washer sizes.
- No operating procedure for 5-year leak testing and bottom gasket replacement, despite commitment to contrary.
- ES&H procedure which includes information on the maximum radiation level acceptable was still in the process of being written.
- Many areas requiring development of SOP and audit procedures, including:
    - Need for revision in procedure to include information on scale preparation and use by production personnel.

- Need for maintenance standards for --

  * scale calibration revision
  * calibrating NLO-fabricated checkweight (revision needed.)

On February 11, 1986 a DOE Transportation Safety Appraisal team visited the site and spent the whole day reviewing Fernald's procedures. Four DOE personnel, including Mr. Pryor, Mr. Hansen, Mr. Fouck and Mr. Slatterly conducted the review. On February 12, 1986, they held a close-out meeting to discuss their findings. I was told to attend the meeting by Mr. Weichold. On the way to the meeting, I was told by Mr. Weichold that, "If you are asked any questions, be careful what you say. Say as little as possible." I knew what he was referring to, because I realized that the true state of affairs in the Transportation Department in relation to T-Hoppers was such that Fernald was in jeopardy of being suspended from being able to transport the T-Hoppers at all. Conceivably, production could grind to a halt if that happened.

The meeting occurred, and sure enough, nothing at all was mentioned about my investigation. At the meeting was Mr. Grumski, Mr. Weichold, Mr. Block of the Transportation Department, myself and the DOE representatives. Incredibly, the DOE team only uncovered three items that they felt were of concern. Two of these items were problems I identified in my investigation. DOE, with a four man investigation team, had totally overlooked twelve major problems that one single auditor had found in twenty hours. It was clear that Westinghouse management was not about to volunteer this information. It was

3128804

also clear that DOE had failed to uncover my investigation report. Presumably, all they would have to do was to ask for all Westinghouse reviews in order to receive my investigation report.

Westinghouse's failure to bring up my investigation, and management's "advice" to me to not bring it up unless asked, was worrisome. I had expected different behavior from the company that "Was Sure."

To DOE's credit, the three items that the Appraisal Team found lacking were enough to ban Fernald from shipping T-Hoppers, two days later, on February 14, 1986. However, this was not in time to prevent yet another contaminated T-Hopper shipment from Fernald to Hanford on February 18, 1986. Within a year, despite the hoopla and criticisms, despite the promises and commitments from Fernald management, Fernald had repeated its mistake.

Westinghouse claimed that the T-Hopper was sent out on January 30, 1986. This is of small reassurance, since Westinghouse had sent a letter to DOE on January 28 guaranteeing that radiation surveys were being conducted. In fact, the surveys were performed, but without benefit of a written procedure. Westinghouse attempted to escape blame by claiming that they implemented the corrective actions promised to DOE. Westinghouse had performed a radiation survey on the T-Hopper - - three weeks prior to shipment. They had followed a flawed and vague procedure, exactly the danger that I tried to point out in my investigation report. But it gets worse.

On February 25, 1986, a Westinghouse internal memo to WMCO Vice President Britton, outlined in grim terms the shortage of greensalt that Fernald was facing while the ban on T-Hopper shipments was in effect. The memo warned that there was only a two week supply of the vital production material available. Production thereafter would cease.

Two days later, Mr. Britton wrote to the DOE, announcing that Fernald management had completed correcting the three items that the DOE team had found wanting. Again, no mention was made of my investigation report. Mr. Britton had failed to raise the following information to DOE that my investigation had revealed:

> (1) No procedure existed that included information on the weighing, receiving and shipping inspection requirements for T-Hoppers from Paducah;
>
> (2) No environmental, safety and health procedure existed that included information on how to perform a radiation check and visual examination on incoming T-Hoppers;
>
> (3) No ES&H procedure existed that included information on how to perform a smear test and radiation check on T-Hoppers;
>
> (4) No procedure existed that included information on how to replace the bottom gasket of the T-Hoppers;
>
> (5) No procedure existed that included information on specifications for bottom gasket of the T-Hopper;
>
> (6) No procedure existed that included information on how to tack weld the two opposite bolts at bottom closure of T-Hopper;
>
> (7) A program had not been established for periodic weight verification of T-Hoppers and T-Hopper dollies;
>
> (8) A program had not been established for five-year interval leak testing and bottom gasket replacement on T-Hoppers;
>
> (9) The following procedures did not include information on Scale No. 4-44, which is used to weigh T-Hoppers;

With all of these deficiencies unaddressed - - and unannounced - - by Westinghouse, I could only wonder how Westinghouse was really different from its predecessor, NLO. Once again, it seemed that environmental, health and safety concerns were taking a back seat to production goals. Contrary to Westinghouse's bold assertions and reassurances to the community and to the public, it was business as usual at Fernald.

In conclusion, from my viewpoint Westinghouse and NLO both were slow to correct the deficiencies identified by DOE. I estimate that two weeks of hard work could have accomplished the up-grading of all procedures necessary. Westinghouse affirmatively misled the DOE by failing to bring to their attention information from their audit files of relevance to the DOE's investigation. Production concerns obviously played a heavy role in Westinghouse management's failure to do so. Finally, Westinghouse failed to respond and follow-up on my investigation report.

For DOE's part, DOE overlooked many important problems identified by my audit. A team of four investigators failed to identify 12 major items uncovered by my investigation in the same amount of time. To its discredit, DOE even failed to unearth my investigation report.

Immediately following this incident, I was assigned what turned out to be my last project at Fernald. For me, it was the final straw which led to my resignation and convinced me that I had to come forward to expose the intolerable situation at Fernald.

PLUTONIUM OUT OF SPECIFICATION

The assignment was to develop procedures for processing "plutonium-out-of-specification" or POOS. The assignment was initiated because Fernald had received a shipment of plutonium-contaminated ash in 1980, and had processed a portion of that plutonium-bearing material in a manner which had jeopardized the workers' health and safety. A September, 1985 DOE investigation report of Fernald's handling of plutonium-bearing material in the past was highly critical, and serves as background information for this incident.

Plutonium-bearing materials containing more than 10 parts per billion (PPB) require special handling, including the use of protective equipment, respirators, constant air monitoring, routine worker exposure analysis and strict adherence to Quality Assurance/Control procedures. These requirements were established by a DOE directive of April 4, 1985, and adopted internally by NLO in March of 1985. Apparently, previous to this commitment, NLO had considered that materials containing 20 parts per billion or more of plutonium required special procedures. In 1982 Fernald had processed plutonium-bearing materials of up to 7,757 parts per billion without observance to any of these safeguards. According to the September 1985 DOE investigation entitled, "The Report of the Joint Task Force on Uranium Recycle Materials Processing", the Fernald facility:

> - Did not keep accountability records of transuranic and fission products elements it worked with. As such, "the Task Force could not determine, with confidence, the quantity of contaminants that may have been received and processed at the FMPC. Only best estimates were available for the reveiw."

- It could not be established by the Task Force that DOE formally knew of the plutonium levels in the ash, which ranged from 67 parts per billion (ppb) to 7,757 ppb. About 168 metric tons of plutonium-bearing material currently remains at FMPC in the form of uranium trioxide. Special precautions will need to be taken to process this material.

- The Task Force concluded that "insufficient effort and attention was given to worker safety and radiation exposure control. For example, during routine operations the decision on whether an ingestion of radioactive material has taken or could take place rests with the worker. It did not appear to the Task Force that workers have had enough training and/or knowledge to intelligently make such decisions."

- Deficiencies in the Fernald's Health Physics and Environmental Programs were noted by the Task Force.

Against this background, Westinghouse was planning to process more of this material in response to pressure from Hanford, and in order to alleviate a shortage of greensalt that was about to develop. The plans called for processing appoximately 168 metric tons of uranium oxide containing an unknown level of plutonium contamination, as well as some raffinate containing, according to a November 1985 report, up to 3,500 ppb..

On February 7, 1986, I was assigned to develop procedures for the plutonium-out-of-specification processing (POOS). The assignment was to upgrade procedures for the POOS program. A meeting on February 10, 1986, attended by Mr. Macaulay, Mr. Bonfer, Mr. Dunaway, Mr. Neyer, Mr. Weichold, Mr. Walker, Mr. Herman, Mr. Christianson and myself, was held to discuss the program. Mr. Weichold and I were told to write two new procedures and revise six others. The Environmental, Health and Safety Department was given the responsibility of writing a special procedure that would include information on all health and safety aspects of the operations. I stated at the time that other procedures were involved. I was told by Mr. Macaulay, Westinghouse Operations Training Manager, to stick with the eight. Two days later, February 12, at another meeting management decided to add four more procedures.

Management gave eight calendar days to complete the procedures, and added six calendar days to complete development and implementation of training, roping off areas, procurement of disposable clothing, cleaning, etc. That was far too little time. I felt that at least two months were required due to the magnitude of the project, and I said as much. Despite this, Mr. Weichold and I were the only ones assigned to write/revise procedures.

On February 11, Mr. Weichold informed me that he would not be working on the project, and gave me the full responsibility for completing the assignment. This change definitely made it impossible to meet the deadline for the project. I had already pointed out in the February 10 meeting that I believed that everyone was "unduly overly optimistic" concerning the preparation time given to process the plutonium. The unanimous response at that time was "No, we can do it." As Mr. Macaulay said, "I think you guys can get the job done."

The next meeting was held on February 14, 1986. Mr. Macaulay, Mr. Gardner, Mr. Hinnefeld, Mr. Neyer, Mr. Walker, Mr. Weichold and I were present. At this meeting Mr. Macaulay wanted the procedures signed off. I stated that the procedures were inadequate, especially the Health and Safety Procedure. I then told Macaulay that all procedures would have to be sent around again for review. They reluctantly agreed to one more review. I also pointed out that maintenance personnel would have to be trained. No one had thought of that. I was amazed that Mr. Macaulay, Operating Training Manager and head of the plutonium program had not thought about trining maintenance personnel.

Finally, a meeting was held on February 20, 1986. At the beginning of this meeting, Mr. Macaulay asked, "What does 'MS' stand for?" I was astonished that the head of Westinghouse Operations did not know what "MS" stood for when he was in charge of the project. "MS", for the record, stands for Manufacturing Specification. It is an important term in the realm of Quality Assurance, because it establishes the criteria for (1) nuclear safety requirements, (2) nuclear materials control and record requirements, and (3) raw material, process, and product specifications. This industry-wide standard is critical for safe and efficient operation of instrumentation and equipment. Mr. Macaulay wanted the procedures signed off the next day. Again I stated that the H&S Procedure would be inadequate to cover all operations in a safe manner that would protect worker health and safety. This statement received <u>no</u> reply. I then stated that I could not go along with the project, and walked out of the meeting.

I waited for Mr. Weichold at the exit door after this meeting, and while we walked back to Laboratory Building, I told Mr. Weichold that I would do anything he wanted with the procedures, but I wasn't going to sign off on them. Someone else would have to sign off on the them. There was no reply from Mr.

2280484

HEALTH PROTECTION APPRAISAL

NATIONAL LEAD COMPANY OF OHIO

AUGUST 1972

by

THOMAS M. JELINEK

ROBERT W. POE

I. Purpose and Scope

The annual health protection appraisal of NLO was conducted by members of the Health Protection Branch, Safety and Environmental Control Division, ORO, on August 22-25, 1972. Emphasis was placed on compliance with AEC Manual Chapters and the Department of Labor Occupational Safety and Health Standards in the areas of health physics and industrial hygiene.

II. Summary

The overall health protection program continues to be satisfactory. Several areas within the program require modification and/or increased attention to comply with the Occupational Safety and Health Standards. Several plant areas visited were judged to be presenting hazardous working environments for employees and recommendations were made for immediate corrective action.

At the conclusion of this appraisal, detailed comments and recommendations were presented to NLO management and to the AEC Site Representative.

III. Recommendations

A. Recommendations of 1971 Appraisal

There were no recommendations made as a result of the 1971 appraisal.

B. Current Recommendations

It is recommended that NLO:

1. Continue periodic monitoring of extremity exposure for those operations which are identified as potentially exceeding 10% of the annual extremity exposure guide, and provide continuous extremity exposure monitoring for those operations identified as exceeding 50% of the annual extremity exposure guide. (See Section IV.A.)

2. Urine samples collected from the chemical operator group be spread out to cover the entire quarter, rather than one month as at present. (See Section IV.D.)

3. Immediately clean up the contamination in the refinery and recovery plants; that safety devices and operating equipment be kept in proper repair; and that increased attention be given to reducing contamination that results from abnormal operating conditions.

4. Post those areas where ear protection has been determined to be necessary.

5. Review and achieve compliance with the Occupational Safety and Health Standard concerning respiratory protection; further, those plant areas where respiratory protection is required should be posted.

IV. Findings

A. Extremity Exposure

Several areas of the plant present extremity exposure potentials which exceed 10% of the AEC guide of 75 Rem/yr. The operators in these areas have been monitored in the past on a periodic basis, and annual extremity exposures have been extrapolated from this data. Contamination of wrist badges has, however, resulted in large uncertainties in the results. NLO has recently acquired a new wrist badge which precludes much of the contamination. These new badges were used for a two-week period to monitor extremity exposure in Plant 5. Results indicate that extrapolated quarterly exposures range from 3-17 Rem/quarter. On the basis of these results, it is recommended that NLO continue the periodic monitoring of all potential extremity exposures; that those operations identified which result in greater than 10% of the annual limit be monitored at least two weeks each quarter; and that those operations identified which result in greater than 50% of the annual limit be monitored continuously. Should monitoring indicate a high exposure (greater than 50% of the annual limit) for certain operations, NLO should consider engineering or operational changes to reduce the exposure potential. (Specific reference is made to crucible loading in remelt area of Plant 5).

B. Whole Body Exposure

Whole body external radiation exposure continues to remain well within the AEC guides. The maximum whole body penetrating radiation exposure for the first half of 1972 was approximately one (1) Rem. Two employees received close to quarterly whole body skin exposures, approximately 9.5 Rem in the first quarter 1972. The employees were moved to lower exposure jobs to assure that quarterly limits would not be exceeded. Operational changes were also made to reduce the exposure potential.

Changes in job assignments necessitated by radiation exposure are not consistently requested in a formal manner, as is done for other medical job restrictions. It is suggested that the NLO Industrial Hygiene and Radiation Department formally notify supervision of the necessity to preclude further exposure for a specific time period.

C. In Vivo Monitoring

In vivo lung counting continues to be used by NLO as the primary means of assessing internal exposure to radioactive materials. At the present time, approximately eight chemical operators from the Refinery and four from other plants have lung burdens greater than 50% of the recommended maximum permissible lung burden (MPLB). NLO has determined that the chemical operators are the only group of employees that require annual lung monitoring. This group will be counted at least annually, and more frequently if the previous in vivo count, or the two-year average, is above 50% of the MPLB. Other employees with potential exposure will be counted as time permits, but at least 50% of these will be counted each year. The in vivo lung counting program is satisfactory.

D. Urinalysis

Urine samples are collected at least quarterly from those employees who have potential internal exposure. Except for the Refinery chemical operator group, urinalysis indicates no exposure problem. Several very high urine samples have been detected among the Refinery chemical operators. These data appear to indicate that the exposure is to relatively soluble uranium. The data have been used primarily as an indication of operating conditions within the Refinery. The chemical operator group is routinely sampled on a quarterly basis, with the samples of the group being collected over a one-month period. It is recommended that the samples be collected over the entire quarter, thereby reducing the possibility that high exposure situations go unnoticed. Further, NLO should attempt to determine the significance of the large voidings of uranium noted in several of the chemical operators. In this connection, it would be desirable to obtain urine data on one or more individuals in that group after they have been removed from further exposure. The practice of obtaining special urine samples from chemical operators following operational difficulties or indication of high uranium content in the urine, should be continued.

E. Refinery and Recovery Plants

The refinery and recovery plants were toured extensively to observe operating conditions. In general, housekeeping was very poor, and some operating equipment was in a state of disrepair. Extensive radioactive material contamination was noted in the work areas, presenting hazardous working environments to the employees. Safety equipment, such as eye washers, were not in proper working order. At least one employee respirator was found to be contaminated. Inlet air filters were missing and/or extensively damaged on at least two air supply units. Water from eye washers was rusty or otherwise contaminated. Uranium concentrates were puffing out of a screw conveyor system, creating airborne and surface contamination. Inspection ports and vessel lids were not properly secured. The needle of a scrubber water pressure indicator was broken off.

These, and other conditions, necessitated a recommendation that prompt cleanup of the areas be initiated, that safety devices and operating equipment be kept in proper repair, and that increased attention be given continued cleanup of the areas, especially following abnormal operational occurrences, such as blockage of the screw conveyor system.

F. Irradiation Facilities

A ^{252}Cf source has been added to the neutron activation facility. The 153 microgram source is currently in storage; use is planned in 4-5 months. The procedures, interlocks, etc., in use for the Cockroft-Walton machine will also apply to the ^{252}Cf source. No radiation hazard exists at present, as verified by surveys performed by the IH&R Department.

G. Training

The professional staff of the IH&R Department participates in periodic seminars and technical sessions offered by universities and professional societies.

Plant employees attend monthly safety meetings. Health physics and industrial hygiene topics are occasionally presented at these monthly meetings. Subjects covered recently include noise and respirators. The IH&R Department distributes appropriate phamplets and booklets pertaining to safety and also informs supervision by letter of selected hazardous materials or operations. This training program is considered to be satisfactory.

H. Noise

Major noise areas within the NLO plant have been identified. Those areas which exceed the Occupational Safety and Health Standard have been evaluated in terms of providing engineering solutions to correct the problem. Several of these engineering changes have been incorporated while others require further evaluation. Protective equipment is utilized where necessary. During this review only one operator was noted as not wearing the required ear protection. NLO should continue to stress the importance of wearing ear protection when it is required. None of the areas which have been determined to require ear protection was posted as such. It is recommended that these areas be posted. NLO should continue to resolve noise problems through the application of engineering design solutions. Where these are not feasible, exposure should be reduced through the use of administrative control and the use of protective equipment.

I. Respirator Program

The Occupational Safety and Health Standards, 1910 Subpart I, Paragraph 134, contain specific standards for the documentation and content of a respirator protection program. The NLO respirator program does not now comply with this standard. It is recommended that NLO review the standard and modify its respirator program to achieve compliance. It is further recommended that areas within the plant where respiratory protection is required be posted.

J. Ventilation

Laboratory hoods, a vapor degreaser, and ventilation systems for several drumming and dumping stations were evaluated to determine air flow rates. The basic standard used was 100 fpm, except for systems specifically covered by the OSHS, such as the vapor degreaser. With only few exceptions, the ventilation systems appeared to be adequate. NLO intends to perform a detailed review of all ventilation systems prior to November 1, 1972. Results of this review will be supplied to ORO. Subsequent to that review, it is suggested that NLO initiate a program of ventilation evaluation to assure that systems continue to function properly. Each ventilation system should be checked at least annually.

K. Heat Stress

Several areas within the plant appear to be capable of causing heat stress in employees. It is suggested that NLO evaluate these areas using the method of evaluation outlined by the American Conference of Governmental Hygienists. This evaluation should properly be performed during the hottest season of the year.

L. Control of Toxic chemicals

No formal program for control of toxic chemicals, with the exception of solvents, currently exists at NLO. Chemicals can be obtained by operating personnel from at least three sources, including direct purchase, with division approval, from a vendor. Industrial hygiene approval is required prior to the purchase of solvents. It is suggested that in order to assure that users of chemicals are aware of the toxicity, a method of inventory, labeling, and toxicity information dissemination be established. Similarly, chemical users should be encouraged to dispose of chemicals no longer needed, and storage areas should be checked to assure compatibility of the chemicals with the storage environment.

M. Standard Operating Procedures and Safety Manual

Documentation of the Industrial Hygiene and Radiation Safety programs was reviewed and found to be satisfactory Standard Operating Procedures prepared for each plant operation contain sufficient detail relative to safety precautions and instructions.

Reviewers: Thomas M. Jelinek
Health Physicist

Robert W. Poe
Health Physicist

Background Fernald/ Health Physics

Battelle
Pacific Northwest Laboratories
P.O. Box 999 KRH 012-85
Richland, Washington U.S.A. 99352
Telephone (509) 375-2819
Telex 15-2874

February 28, 1985

Robert W. Barber
Acting Director
Office of Nuclear Safety (PE-22)
U.S. Department of Energy
Washington, D.C. 20545

Dear Mr. Barber:

Attached are findings, observations and recommendations covering recent site visits to the Portsmouth Gaseous Diffusion Plant in Piketon, Ohio and NLO Feed Material Production Center in Fernald, Ohio. On these visits I was requested to accompany Joe Fitzgerald to provide technical support and consultation, especially focusing on the internal dosimetry aspects.

As an aside I feel I should relay one other comment even though it was outside the scope of my assignment. In discussion with the NLO staff at the Fernald Plant it was suggested that they had been receiving mixed signals from DOE in their recent appraisals. The fact that they had received several "low" appraisals in the area of Health and Safety while at the same time receiving relatively "high" marks in their overall appraisal suggested that the DOE emphasis may be on production rather than additional refinements of radiation protection for the worker.

Should you have any comments or questions on the attached report feel free to call me on (509) 375-2819.

Very truly yours,

K. R. Heid
Staff Scientist
Health Physics Technology Section
RADIOLOGICAL SCIENCES DEPARTMENT

KRH:mae

Enclosure

cc: JE Fitzgerald
BL Murphy
JM Selby
EJ Vallario

PE507

SUMMARY

PORTSMOUTH GASEOUS DIFFUSION PLANT

Monitoring of the work place was generally good, with one possible exception. The movement of air in the process facilities apparently has never been checked to determine if "dead-air" pockets exist or if their air samplers are properly located.

Monitoring of the worker for possible internal exposure appeared to be adequate, however, the installation of a permanent, better shielded in-vivo counter would be of benefit in that the detection level could be lower and the counter would be available at all times for follow-up measurements if an intake has or probably has occurred.

NLO FEED MATERIAL PRODUCT IN CENTER

Both the monitoring of the work place and of the workers appeared to be less than adequate in my opinion. Air sampling was almost non-existent, personnel contamination survey equipment both in the work place and at exits from the work place were not apparent, and though both direct and indirect bioassay measurements are made, no efforts were visible in trying to use these data to estimate internal exposure.

MISCELLANEOUS

The scope of this review did not include consideration of chemical toxicity vs. radiotoxicity of uranium. Recently there has been some speculation that the radiotoxicity limit is controlling but to my knowledge this question has never been completely resolved. I have discussed my concern on this matter with Ed Vallario. Perhaps a DOE Ad-Hoc Committee could be formed to investigate and resolve this matter.

SITE VISIT

February 21-22, 1985

Feed Material Production Center
National Lead of Ohio
Fernald, Ohio

Contacts: M. W. Boback, Director Health and Safety; R. B. Weidmer, Chief, Industrial Hygiene and Radiation; S. L. Hinnefeld, Technologist; T. A. Dugan, Supervisor, Bioassay Lab; W. A. Hayes, Technologist

OVERVIEW

The internal dosimetry program provided for the workers at the Fernald FMPC was reviewed in depth. The primary contacts were R. A. Weidmer and W. A. Hayes. The following elements of their program were reviewed in depth:

- Work place monitoring
- Worker monitoring
- Miscellaneous

Overall their program and practices appeared to be lacking in many aspects. These are discussed in the body of the report.

A. WORK PLACE MONITORING

A.1 Observation

There are no fixed area air samplers installed in the process facilities. Some lapel samplers are assigned to workers performing jobs with higher release potential.

Comment: Area air sampling is an essential element of an effective work place monitoring program. Criteria for placement of samplers, the installation of samplers, and a study to assure that samplers are not located in a dead-air pocket are essential for a good program since the airborne contamination is not uniformally distributed throughout the entire work area.

Recommendation: A study should be performed to chart air movement. Criteria for the placement of area air samplers should be documented and air samplers should be installed.

A.2 Observation: There are no contamination survey instruments kept at the work site for use in checking for skin and clothing contamination. Neither are there any hand and shoe counters available for use either before or after showering.

Comment: This practice is totally unacceptable. Workers are forced to accept that the shower at the end of the day is completely effective in removing any skin contamination. Also, this practice does not provide any "triggers" for follow-up action to ascertain if the workers have taken any uranium into the body. Experience shows that skin and clothing contamination are often the first (and maybe the only) signal of loose contamination in the work area.

Recommendation: Appropriate contamination survey equipment should be installed and maintained in the work place and at selected locations for exit surveys.

A.3 Observation

Routine contamination surveys are made of the higher potential areas on a quarterly basis.

Comment: This would seem to be adequate, assuming recommendation A.2 is implemented.

A.4 Observation

Most of the enriched uranium is handled in Building 1; however, there is some movement between the buildings. There were no procedures for keeping enriched (up to 20% ^{235}U) uranium physically separated from normal or depleted uranium (<5% ^{235}U).

Recommendation: Enriched uranium should be isolated from normal uranium. Otherwise it is extremely difficult to distinguish which is which using portable survey instruments.

B. WORKER MONITORING

B.1 Observation

The routine surveillance program to monitor internal exposure of workers consists of both in-vivo and excreta measurements. The frequency of the examination depends on the job assignment but is generally at least once per year.

Comment: This combination provides the basis for a good program, provided their air sampling program is upgraded per recommendation A.1.

B.2 Observation

The detection level for the in-vivo counter which is provided by Oak Ridge is as follows:

depleted uranium	4 mg
normal uranium	47 µg
enriched uranium (>5% ^{235}U)	110 µg

The counter is located near the administration building and workers are instructed to shower before being counted.

Comment: The detection capability is not state-of-the-art.

Recommendation: An in-vivo counter in a shielded facility should be installed. This would also improve follow-up capabilities in the event of a known or suspected intake.

A.3 Observation

Maximum permissible lung burden (MPLB) values of 260 µg ^{235}U for 1.5% enriched material and 100 µg ^{235}U or 50 mg ^{238}U for 0.2% enriched material have been established. Frequency of in-vivo measurement is generally on an annual basis, however, should an in-vivo count indicate ≥50% MPLB the frequency of examination is increased to twice per year.

Comment: This forms the basis for an adequate program provided air sampling capabilities are upgraded for Recommendation A.1.

A.4 Observation

Detection level for uranium in a routine urine sample is ∿10 µg/L. At 40 µg/L, a second sample is collected from the worker.

Comment: These levels are about normal for a uranium facility. However, there was no indication that a level has been established (for uranium in urine) that would trigger investigation of the workers exposure, or that would restrict a worker from further work with uranium until the excretion level decreases.

Recommendation: Levels be established for removal/return of workers from the work place based on concentration level of uranium in urine.

B.5 Observation

Involvement of a worker in an incident triggers special urine sampling. However, their understanding of what constitutes an incident is rather vague and does not seem to be well understood, especially by the field monitoring technicians.

Recommendation: "Incident" criteria should be documented.

C. MISCELLANEOUS

C.1 Observation

Good records were available for both bioassay and in-vivo examination.

Comments: Though records of measurements are recorded and retained there was little evidence to suggest anything such as dose assessment was being done with the data.

Recommendation: The bioassay measurement data collected (both urine and in-vivo) should be used to estimate intake, dose or in some manner estimate the severity of the intake and resulting deposition and systemic uptake.

C.2 Observation

A sign on what appeared to be a shipping container indicated plutonium bearing material had been processed at the NLO plan probably in the 1980-1982 period.

Finding: In discussion with NLO staff it seems that some special precautions had been taken (such as workers wearing respiratory protective air being sampled) during the work. Exposure of the workers to plutonium was probably minimal; however, there was no evidence of clean-up or of subsequent control to isolate the plutonium.

Comment: Plutonium is extremely difficult to distinguish from uranium using portable field survey instruments. About the only way to distinguish the plutonium is to take smears and count them.

Recommendation: Remove or decontaminate the plutonium contaminated equipment. Take whatever steps are necessary to ensure all the plutonium contamination is removed from the work site. If similar material is processed in the future it should be totally isolated and handled in a manner more appropriate for plutonium.

NATIONAL LEAD COMPANY OF OHIO

A SUBSIDIARY OF NL INDUSTRIES, INC.

CINCINNATI, OHIO 45239

November 24, 1980

SUBJECT COMMENTS ON DRAFT REPORT OF HEALTH PHYSICS APPRAISAL, OCTOBER 7-10, 1980

TO B. J. Davis and K. Shank

FROM R. C. Heatherton

REFERENCE

As I commented to K. Shank over the phone on 11/21/80, we do take exception to some things which are said in the report. The exceptions represent a difference in opinion regarding the seriousness of some of the deficiencies found at the time of the appraisal. Our primary concern was how the report might be interpreted by opposition critics who might obtain the report under the Freedom of Information Act and quote from it for proof of our poor management and hazard to employees and the public in continued operation of the plant. If the report and our response do not convey the impression of undue hazard we are not greatly concerned.

We do take exception to the use of the word poor with reference to exposure control in the summary and conclusions on page one. Consider the plant has been operating for more than 25 years and most of our work force has been here that long. These people received their radiation exposure control indoctrination and initial job training when less stringe standards were in effect. We have emphasized the need to meet standards but also attempted to avoid creating fear of radiation or harmful effects of exposure at these levels. Additionally, allowable exposures have been periodically lowered. In view of the circumstances, it does not seem that one case of exceeding the current maximum permissible exposure to the skin can be called poor control.

We must admit to some failure in the commitment to the ALAP or ALARA principle. The foregoing comments, in part, explain why it is difficult to get our people to change some practices. While efforts were made, we realize now the effort and achievement were not what is expected.

Many of us at the management level believed our objective was to operate this plant to turn out a quality product safely, efficiently, and economically. In order to achieve this objective, judgments were made regardin cost of exposure control and expected benefit. Perhaps our judgment was poor, especially considering what is generally expected with ALARA.

0114424

PLAINTIFF'S EXHIBIT 509-C

COMMENTS ON DRAFT REPORT OF HEALTH PHYSICS APPRAISAL, OCTOBER 7-10, 1980
B. J. Davis and K. Shank
November 24, 1980

Some of the things observed, such as failure to use protective equipment, are not in any way excusable. There is now and will be a concerted effort to change these things. I would like to point out that smoking in areas exposed to radioactive material has been allowed. Perhaps most plants would prohibit this as poor practice. In our case it was a considered judgment that it caused very little exposure and improved the efficiency of the work force. Similarly, it was our judgment that routine monitoring of work clothing after laundering produced little benefit for the required expenditure.

Regarding recommendation 80-6 pertaining to film badge calibration, the impact of scatter was investigated many years ago. The error introduced by our present method of calibration is extremely small, much less than other errors which must be assumed for monitoring exposure by any dosimetry system. The documentation is not readily available because it was done at a time when documentation was not that important. This is not an oversight or failure.

This generally covers the exceptions we might take to the report. I realize it may make no difference in the report as you put it in final form. We realize we have quite a bit to do to get the program up to expected standards. We are making progress and expect to continue progressing at a faster rate over the next several months.

Thanks for the opportunity to comment.

R. C. Heatherton

RCH/fb

cc: N. R. Leist

0114425

NATIONAL LEAD COMPANY
OF OHIO
P. O. BOX 158, MT. HEALTHY STATION
CINCINNATI 31, OHIO

April 19, 1955

SUBJECT RADIATION FROM THORIUM MATERIALS

TO J. A. Quigley, M. D.

FROM R. C. Heatherton

REFERENCE

There is no information available on the difference in radiation levels from thorium fluoride prepared from nitrate in the original method used in Plant 9 and that prepared from oxide which is the method used in the last few months of operation. However there is some information to indicate that there was no appreciable difference in the levels of radiation. Thorium fluoride made by the new method gave 15 mr/hr as measured with an instrument in contact with a 30-gallon drum. Slightly higher readings have been obtained from thorium nitrate and thorium oxide. The sump cake obtained by the old method gave readings of about 3.5 mr/hr at contact with 55-gallon drums. This indicates that most of the material giving the gamma radiation remained with the fluoride. These readings were all taken on freshly prepared material. Considerable information has been accumulated on the radiation from thorium metal and some information on the build-up of radiation from a cast ingot. 48.5 mr/hr gamma was measured with an instrument at contact with thorium rods stored in H-beams. The estimated surface area was 21 x 6 ft., or about 120 sq. ft. It is assumed that this would be about the same as a reading obtained from an [illegible] source. Readings in contact with a thorium ingot range from 8 mr/hr, 3 days after casting, to 18.5 mr/hr, 12 days after casting. The readings then remained at that level for a period of 75 days. No readings were taken beyond the 75th day. Slices of ingot showed the same relationship between time and radiation build-up with lower readings from the ingot slices. Radiation levels were approximately 50% of those measured from the ingot itself.

Since all readings were actually instrument contact readings and not surface dose rate measurements. An attempt was made to compare the radiation from thorium with that or uranium, in which the surface dose is known. These measurements indicate that a gamma radiation level from thorium is approximately 10-20 times that from uranium, while the beta radiation from thorium is approximately 25% of that from uranium. Assuming a surface dose of 5 mr/hr gamma and 240 mreps/hr beta from uranium metal, I think that we can say the contact dose with thorium is in the neighborhood of 50-100 mr/hr gamma and 75 mreps/hr beta.

Attached is a report of information summarized by E. V. Barry.

[redacted]

R. C. Heatherton

RCH:mk

2910030

1600385

BS 9/2

2236847

NATIONAL LEAD COMPANY OF OHIO

P. O. BOX 39158 CINCINNATI 39, OHIO

AUG 1 7 1965

Mr. C. L. Karl, Area Manager
U. S. Atomic Energy Commission
P. O. Box 39188
Cincinnati, Ohio 45239

SUBJECT: STANDARD FOR THORIUM-230

Dear Mr. Karl:

We would like to request an exception to the concentration for thorium-230 given in Annex 1, AEC Appendix 0524, Standards for Radiation Protection. This exception is requested because of a probable need should we process the Middlesex thorium nitrate which contains up to 5 ppm of thorium-230.

COPY

The value for thorium-230 shown in Table 1, Column 1, of Appendix 0524 is 2×10^{-12} μc/ml for air. The values for thorium-232 and thorium (natural) are 3×10^{-11} μc/ml. Considering the total energy per disintegration, thorium-230 is a far less health problem than is natural thorium or thorium-232. For this reason the provisional statement given in the ICRP and NCRP publications, from which the numbers in the Manual Chapters were taken, should have included thorium-230. We request that for the purpose of our operations we be permitted to use the 3×10^{-11} μc/ml for all thorium isotopes.

We would expect to measure the airborne concentration of thorium from any of our thorium operations in the usual manner. That is, air dust samples would be collected and counted for alpha activity, and weighted exposure evaluations would be made from the results. Our National Lead Company of Ohio Concentration Guide (NCG) of 100 $d/m/m^3$ would apply.

0311672

Sincerely yours,
Original Signed By
J. H. NOYES
Manager

J. H. Noyes
Manager

[redacted]

RCH/mb

cc: C. L. Karl
C. R. Chapman
S. Marshall
X A. Quigley, M. D.

UNITED STATES
ATOMIC ENERGY COMMISSION
WASHINGTON 25, D. C.

[illegible] . 195

326 – Atomic Energy Commission
Division of Biology + Medicine (1129)
1
7

Mr. Gordon Dean, Chairman
Atomic Energy Commission
1901 Constitution Avenue
Washington 25, D. C.

Dear Mr. Dean:

The Advisory Committee for Biology and Medicine was particularly fortunate in being able to hold their twenty-ninth meeting at the Las Vegas test site on October 28 and 29, 1951. For most of us this was the first opportunity to witness an atomic detonation and to observe first-hand the radiological safety operations in which the Committee has been vitally interested since its inception, and to which we hope we may have made some contribution. We are grateful to Mr. Tyler and Dr. Graves for making this possible, and to Drs. Warren, Bugher and Shipman for an interesting and instructive program.

While most of our time was devoted to field trips and briefing sessions, we arranged to meet formally on Monday to consider two items of pressing importance: the effects of the National Science Foundation's training plans on the AEC fellowship program; and the AEC's responsibility in cancer research and therapy.

The Committee reviewed the current status of fellowships in light of the plans of the NSF and supported the plans of the Division of Biology and Medicine to continue the special fellowships in industrial medicine and in health physics, and such renewals in the fields of biology and medicine as constitute a moral obligation. They were in accord with the decision to give no new fellowships, predoctoral or postdoctoral, in the field of biology and medicine, believing that the program of the NSF would serve to meet the need existing here. The Committee recommends that in the event the NSF proves unable to carry on an adequate fellowship program the Commission be prepared to re-establish a program in biology and medicine.

The Committee considered the cancer program of the Commission in light of the memoranda of Commissioners Glennan and Murray to the

PLAINTIFF'S EXHIBIT 560

Received in Office of Chairman 12/3/51 [illegible] A.M.

99

General Manager (dated August 21 and 23, 1951, respectively), and recalled that the present program of the Division of Biology and Medicine evolved as a result of recommendations of the Medical Board of Review, chaired by Dr. Robert F. Loeb, which met in June, 1947, and of the Committee made at its sixth meeting on February 14, 1948. The cancer research program was initiated on passage of Public Law 269 (appropriation for FY 1948) which made available to the Commission $5,000,000 for cancer research, this amount having been reduced by efforts of the Commission from a suggested $25,000,000. Each succeeding annual budget submitted to Congress has contained specific items for cancer research.

Cancer is a specific industrial hazard of the atomic energy business. This significant fact justifies, in the opinion of the Committee, the continued exploitation of the Commission's special facilities for radiation in cancer research, diagnosis and therapy. The Committee recommends the cancer program be vigorously pursued as a humanitarian duty to the nation.

We are scheduling our next meeting for January 11 and 12, 1952, at the University of California at Berkeley, California.

Sincerely yours,

E. W. Goodpasture, M.D.
Vice Chairman
Advisory Committee for Biology and Medicine

2132269

62-1-3

January 22, 1957

Mr. John E. Bailey
Safety Engineer
National Lead Company, Inc.
P. O. Box 338
Monticello, Utah

Ref: Your ltr., 1/17/57

Dear John:

The impression which you have that a urine sample collected soon after exposure should give a higher result than one collected after a period away from exposure is basically correct. Many factors, however, influence the rate of excretion. Among the most important of these are fluid balance and the diet of the individual. Also involved is the rate of absorption into the body.

The relatively non-soluble uranium compounds which you deal with are absorbed rather slowly. The material, to a large extent, is deposited in the respiratory system on first entering the body. A portion of this will be coughed up and expectorated. The remainder will soon be transported up the respiratory tract and will be swallowed where it will be acted upon by the acid content of the stomach and later by the alkaline content of the small intestine. Absorption takes place by this latter mechanism from the small intestine. It is therefore understandable that absorption will continue for a period of time even after a man is removed from an exposure area.

Water balance will also be involved, especially where an individual is exposed to relatively high temperatures which will cause perspiration and a reduced volume of liquid passing through the kidneys. Diet is also important, especially the ingestion of alkalies which enhance the release of the uranium ion from the blood stream.

Commonly, immediate post-exposure urines are higher. We do not become concerned, however, when relatively few do not follow this pattern, since it is our practice to re-check all high samples before becoming overly concerned. When repeat samples are high, we always have the Industrial Hygiene group

[redacted]

investigate the man's working environment and particularly his work methods, since careless operators may receive high exposures doing exactly the same work that careful operators may do without harm to themselves. This enables us to educate supervision so that they may be able to exercise the proper control over their employees.

I am enclosing a report on samples submitted in the latter part of December. Many of these again are quite high, and I would recommend that you discuss results with your plant manager, Mr. Brower Dellinger.

Sincerely yours,

ORIGINAL SIGNED BY
J. A. QUIGLEY, M. D.

J. A. Quigley, M.D.
Director of Health & Safety

JAQ/mb

cc: B. Dellinger
Dr. A. Stewart
G. W. Wunder

Central Files

Encl.

F8-2

NATIONAL LEAD COMPANY
OF OHIO

P.O. BOX 158, MT. HEALTHY STATION
CINCINNATI 31, OHIO December 22, 1953 2220342

SUBJECT Weekly Report - Ind. Hygiene & Radiation Dept.
Period - 8 am, December 15 to 8 am, December 22 Incl.

TO J. A. Quigley, M.D.

FROM R. C. Heatherton

REFERENCE

General

1. Plant 1

   1. Leakage of beaver lodge feed materials which is being shipped to MCW is continuing. This condition has been noted in last week's report. Carriers are being lined with heavy brown paper to prevent contamination.

   2. Two (2) overexposures to gamma radiation have been noted to personnel handling Q-11. Mr. J. Costa has been asked to minimize handling of this material.

2. Plant 2

   1. The digestion area has been operating to the satisfaction of Mr. Strattman. However, we are aware of a few sources of dust.

3. Plant 3

   1. De-nitration - Approximately eight (8) batches of material have been run in the pots as part of the shakedown phase of equipment. Some dust conditions have been noted. These could be attributed to inexperienced operation.

   2. A dust problem has been noted at the exhaust end of the gulper. This is due to the tearing of bags in the collector. To minimize the dispersal of the dust a drum or bag will be installed at the discharge of this collector.

4. Plant 4

   1. A meeting with Messrs. Stewart, Bucher, Heatherton, and Stefanec was held on December 15 concerning the health problems in Plant 4. One of these problems included the pulling of the ribbon conveyor which was witnessed on December 18 by Messrs. Stefanec and Schumann. For this operation the casket was employed and the dusting seemed to be considerably below the

0319165

PE 744C

levels noted when conveyors were pulled with inadequate hoods. We are still not satisfied with this operation although if proper caution is used we feel that the dust concentration can be lowered to within a safe permissible level.

2. The blending of magnesium with green salt at Plant 4 is being tried. If successfully done this will eliminate many operations in Plant 5.

5. Plant 5

1. We are happy to report that no overexposures have been recorded in the "B" area of Plant 5 for the week of December 5. We feel this is quite an accomplishment since in the past we have received on the average of about five employees who have had an overexposure to radiation.

2. On December 16 a flood occurred in Plant 5 due to the incapacity of the pumps to pump to the cooling tower. No damage other than inconvenience resulted from this.

3. A survey is being made to develop means of increasing the heat in Plant 5. This can possibly be done through the reduction of outgoing air.

6. Plant 6

1. Plans are in the making to exhaust the oil fumes from the ingot pre-heat furnace. This should also lower the dust concentration to a level below the MAC.

2. The work to improve the lighting in the inspection area has begun.

7. Plant 8

1. The muffle furnace which is used to oxidize green salt is developing into a dust problem. It seems the drum dumper was designed for a 30-gallon drum and much of the scrap green salt is stored in 5-gallon drums. This operation will have to be studied to determine ways and means of eliminating the dust.

8. Pilot Plant

1. The 3620 area has been operating satisfactorily.

2. The 3013 personnel are assiting in Plant 2 start-up.

3. The 3037 area has been operating satisfactorily.

NATIONAL LEAD COMPANY
OF OHIO
P. O. BOX 158, MT. HEALTHY STATION
CINCINNATI 31, OHIO

September 5, 1957

SUBJECT IH&R DEPARTMENT MONTHLY REPORT - AUGUST 1 - AUGUST 31, 1957

TO J. A. Quigley, M.D.

FROM R. H. Starkey for R. C. Heatherton

REFERENCE

CENTRAL FILES

Plant Air Dust Survey and Exposure Evaluation

Reports for Plants 2, 4, and 6 have now been completed and the report for Plant 3 is still in progress. Surveys are underway in Plants 1, 5, 8, and 9. The survey in Plant 5 has been temporarily halted as the results received in the earlier portion of the survey were extremely high and improvements for the correction of these poor conditions are underway. A complete survey of the Laboratory Building has been written and at the present time is awaiting distribution.

Unit Air Evaluation Studies

Special surveys have been made on a number of operations and areas during this month. A special survey was initiated and completed in the Laundry in preparation for the visit by AEC personnel. A final report on this survey is in progress.

A special study is presently underway to ascertain the radon concentrations in the metal oxide storage silos. As yet no results have been reported by the Analytical Laboratory, but this study will be continued.

The shearing of E metal slabs in the Maintenance Shop is being followed quite closely to makecertain that the recommendations made earlier are carried out. As long as these recommendations are followed there appears to be no problem with this operation.

Urine Study Program

A study of all Plant 5 personnel is underway at the present time. All personnel have submitted one sample and a follow-up sample is to be taken the week of September 9. As yet information is not available as to the levels of uranium found.

A special study is being made on four Plant 5 maintenance men found working inside dust collectors with no or improper respiratory protection. J. Ketay has been notified of this improper practice and a report as to the urinary findings is forthcoming.

External Radiation

Film badge results show that the number of persons receiving over 1/2 beta MPD for the period of 7/25 to 8/22 has decreased by three

NLO-GEN-698-1 (12-14-55)

from the number of persons receiving a similar exposure in the preceeding four-week period. Only one badge exceeded MPD.

One badge also exceeded MPD for gamma exposure. This was a badge worn by a man while working on the thorium redrumming operation. Time limits have been established to prevent this from reoccurring.

Liquid Effluents

This month the river flow has been lower than usual because of the lack of rain. The lowest flow of the month was 475 cfs on August 26. This combined with large amounts of contaminants in the effluent stream has given the highest results since March. Relatively high amounts of contaminants in the effluent were resulted from Plant 3 being partly shut down for repairs from August 12 to August 14.

The high fluoride liquor from Plant 4 is being precipitated with lime and the solids and CaF settled and pumped to the fluoride pit because of the low river flow.

The liquid effluent from the Laundry has been sampled and a report is being written.

The Refinery requested and was given permission to dump raffinate from two columns to the General Sump for three days. This solution was to be settled prior to pumping to the river and the settleable solids distributed to the clay pit for storage. A procedure was written for this approval in the future and agreed upon by both Production and Health & Safety.

Fallout Sampling

All gumpaper samples are being changed approximately once each week in an effort to determine the reliability of gumpaper results. Preliminary results indicate that one month is too long for reliable results.

Results of gumpaper samples taken this month show that in the month of July the amount offallout on the site increased to above five times the fallout of the two previous months. This may be due to fallout from weapons testing since the amount of uranium in the fallout increased only 20% during the month of July.

Out-Plant Air Sampling

The program for the collection of out-plant but on-site air dust samples, which has been previously outlined, has been undertaken. All sample results are not in and therefore no conclusions can as yet be drawn.

Radiation Surveys

The Plant 5 radiation survey has been revised to include weighted radiation exposure figures. The report on this survey is now in progress and should be ready for distribution in September.

PE 7455

Glove Cleaning Program

A total of 153 loads or approximately 22,950 gloves were cleaned during the month of August. Cleaning efficiency runs are currently underway along with the accumulation of cost data.

Stack Losses

Stack losses for the month of August were estimated at 3658 lbs. of uranium as compared to 504 lbs. in July. However, this now appears to be in error as the large loss reported for G5-259 appears to be very high. As was stated in a letter to J. Mahaffey, we could only estimate very roughly just how much material was lost during the incident with this collector, and from all appearances now this was extremely high. A more complete investigation is still underway.

Special Hygiene Problems

A survey was conducted on the use of Saf-T-Solv for cleaning the cut-off wheel in the sample preparation room of the Laboratory Building. It was recommended to F. Jenkins, supervisor, that Texaco C soluble detergent be tried on this job. This is being used quite satisfactorily in Plant 6 and it was thought that this would be suitable for this operation also.

Contamination Monitoring

An investigation was made of the contamination on the ground surrounding Plant 6 Rotoclone collector. This has been an unsightly mess for a number of months so we finally decided to clean it up. Samples were taken and submitted to the Analytical Laboratory for uranium determination in order to decide just how this earth should be disposed of.

Investigation of Fume, Gas, and Dust Exposures

An investigation was completed on C. Webb, Plant 5 circular saw operator, who got sick from hot oil fumes. This man often minds the fumes when hot ingots are being run, so the separation booth operators have been cautioned to try to cool the ingots more when C. Webb is operating the saw. by the foreman

An investigation was completed on C. Waller, Plant 2 chemical operator, who was exposed to NO_2 around the digestion pots. He said the NO_2 was stronger than usual that night as the ventilation was not strong enough to pull it off. However, he wore no respiratory protection even when taking measurements on the pots. Air line respirators should be worn if the ventilation is bad, especially when bending over the pots to take a measurement.

CENTRAL FILES

June 4, 1958

IH&R DEPARTMENT MONTHLY REPORT FOR MAY, 1958

J. A. Quigley, M. D.

J. W. McKelvey for R. H. Starkey 2118215

Air Hygiene Studies

The routine complete air dust evaluation for Plant 5 production personnel is being prepared in final form. The routine complete air dust evaluation for Plant 6 production personnel has been started. Preparations have been made to begin the routine complete air dust evaluation for Plant 8 production personnel. This survey will be conducted simultaneously with the Plant 6 survey.

Individual air dust evaluations of operations and equipment in Plant 9 were begun during this period. The collection of samples is approximately 80% complete. As the sampling of individual areas or complete operations is completed, a report covering that portion will be written and distributed. A complete routine air dust evaluation of Plant 9 is planned to be undertaken in approximately six months. Suggestions for respiratory protection for personnel involved in some operations in Plant 9 were made to Plant 9 supervisory personnel. These suggestions were based on visual observations and sample results obtained at similar operations. It was recommended that wherever possible these suggestions be incorporated into the temporary operating procedures until such time as these individual evaluations are completed or indicate it to be unnecessary. These major areas include the UF_4 reduction area, derby reduction area and operations associated with this area, machining area, sump area, chip crusher, and degreasing operations.

Re-evaluation of UAP Furnace Drumming Station, Plant 8 - The report has been written and distributed. The breathing zone air dust levels were found to be <u>16 times the MAC.</u> It was recommended that good drums and rings be used and that the scoop sampling be done inside the existing ventilated enclosure.

040628

[redacted]

Re-evaluation of Cleaning the Sperry Filter Press, Plant 9 - The report has been written and distributed. Air dust levels have decreased over previous surveys. However, the wearing of dust-type respirators was still recommended due to the variation of air dust levels normally encountered in operations of this type.

Evaluation of Baling Q-11 Drums, K-65 Area - The report has been written and distributed. Breathing zone air dust levels were found to be as much as 30 times the MAC downwind of the operation. The use of dust-type respirators was recommended at all times when the baler is in operation.

Evaluation of UF_4-Mg Blend Briquetting Press, Pilot Plant - The report has been written and distributed. Some breathing zone samples were found to be as much as 81 times the MAC. Due to the expected short term of this operation, only a temporary type of ventilation was attached. The use of dust-type respirators was recommended at all times while the briquette is in operation.

Processing Beryllium-Contaminated Material, Plant 8 - A letter with specific recommendations for personnel protection immediately prior to and during the initial processing of Beryllium-contaminated material was prepared and distributed. These recommendations included respiratory and glove protection and are intended to cover not only the campaign of accumulated material tentatively scheduled to begin Wednesday, June 4, 1958, but to apply as well to any future operations of this type.

Special Radiation Studies

During the shut-down of digestor tank 104 in Plant 8 for repairs, special test film badges were exposed for varying periods of time. These badges are now being processed and, upon reading, will provide a comparison between our monitoring instrument readings and film badge exposure data. Also, survey readings were taken in tank 101 before starting a campaign of special material. Readings will be taken again soon (approximately one month after first readings) to determine whether or not such material is contributing to the high radiation readings currently found in the digestor tanks.

Radiation surveys are being made in connection with the K-65 drum baling operation currently in progress. Average instrument readings in working areas are 1 to 5 mr/hr. Special film badges have been placed at locations representative of working areas, and these and regular film badges will, upon processing, give a clearer picture of personnel exposure at that particular job.

Approximately 25 tons of K-65 drums have been baled preparatory to a test melt at Knoxville, Tennessee. Contact readings of the bales range from 1 to 5 mr/hr. Estimates of the radium content indicate there will be 25 to 50 mg Ra in the 50 tons necessary for the melt. This indicates that there will be little, if any, radiation hazard associated with the metal recovery operation at Knoxville.

Monitoring service is currently being provided the Residue Committee Chairman in the preparation for disposal of thorium-contaminated wastes at FMPC.

A wrist film badge, inadvertently left near some radium-containing samples in the Radio Chemical Laboratory, showed 480 mr gamma. This occasioned a radiation survey of the laboratory and special film badges were placed about the area for confirmatory data. Instrument readings indicated a gamma exposure of 1 to 10 mr/hr at working distance below the waist, due to materials on cabinet shelves below bench tops. Film data will be reported later.

Laundry studies of dust collector bags are currently in progress. Bags reading up to 30 mrep/hr before cleaning show readings of 0.5 to 5.0 mrep/hr after cleaning. The wool type is usually under 1.0 mrep/hr after cleaning, while the canvas material reads higher. Further report will follow upon completion of study.

Miscellaneous Special Studies

Investigations were continued this month in an effort to ascertain the cause of the chlorine releases in Plant 8. These particular releases occur when the caustic scrubber is dropped into a digestion tank and hydrochloric acid is added. A more frequent dropping of the scrubber was recommended as desirable in alleviating the problem. Adding the acid more slowly and the use of a digestion tank close to the scrubber for better ventilation was also suggested. Plant 8 personnel are investigating the possibility of removing the scrubber liquor directly to the sump, as uranium analyses are usually low.

A rough draft of Health and Safety specifications for solvents is nearly completed. This will be reviewed by Dr. Birmingham of the USPHS before being submitted to the division director for final approval. This same degree of completion is applicable to the specifications for powdered hand soaps.

An investigation was made concerning the clothing change requirements for subcontractor personnel involved in relocating the drum baler in the drum reconditioning building. Only those men involved in cleaning the baler will be required to make a complete clothing change.

The Methyl Chloroform report and an information bulletin on Fluorine have been reviewed and is currently being revised and corrected. These reports are expected to be completed in time for the July safety campaign.

Fume and Dermatitis Investigations

During May, two fume inhalations were investigated as well as five cases of dermatitis. No cause for the dermatitis conditions have been determined as yet. Two of these cases were declared occupational. A meeting concerning this was held between the Assistant Director of Personnel, the Services Department Head, the porters' foreman and a representative from this department. The various compounds used by the porters were discussed and it was agreed that a check be made on the dermatological aspects of these compounds. Our preliminary investigation indicated that no new material has been recently added to the materials handled by the porters.

Urine Study Program

The remainder of Plant 6 personnel (Inspection, Transportation, Accountability, Production Records) will be tentatively scheduled for sampling during the second and third weeks of June.

Noise and Lighting Surveys

The noise level of the Swagging machine in the Development Machine Shop was analyzed and it was determined that the present enclosure is not designed to provide the maximum of efficiency in reducing the noise level to the operator. A fire hazard also exists because of the present unit. This hazard is caused by oil which is deposited on the fiber glass lining and then ignited by sparks from the machining operation. A new enclosure is being designed by Engineering which will reduce the noise level of the operator and provide him with less limitations of movement than is presently possible. The ventilation of this machine is also in the process of being improved and the oil controlled by improved splash guards so that the fire hazard will be eliminated.

Pilot Plant personnel requested that a means to reduce the noise level on the 3620 reactor vibrators be investigated. A new type of fiber piping is currently being tested by this department to determine if it will be of any aid in this regard. The feasibility of this will be determined within the next few days.

Nighttime lighting surveys were completed in the Health & Safety Building, Technical Laboratory Building and the Service Building.

Reports were completed and distributed during May on lighting surveys which were taken in the Administration Building, Employment Building and the Service Building.

Ventilation Projects

A complete evaluation was made of the Plant 4 packaging stations' ventilation. This was done in conjunction with Production Engineering in order to determine what improvements were necessary for adequate ventilation. It was concluded that a new dust collector would be necessary and redesign of some of the existing ventilating facilities was also deemed desirable.

At the request of this department, the dust collector bags in G43-27 dust collector in Plant 8 were made with an overlapping seam instead of the usual butted seam. It was felt that this type of seam would be stronger and have a better collecting efficiency providing that the blow rings didn't exert too much wear on the seam. A month and a half has elapsed since installation and these bags show no signs of abnormal wear. If they continue to work satisfactorily, this type of bag will replace Purchase Order #GS-1670.

Stack Sampling

Stack losses during May were approximately 856 lbs. of uranium as compared to 428 lbs. for April. A loss of 451 lbs. originated from G4-7 in Plant 4 while 83 lbs. originated from G43-27 in Plant 8, 70 lbs. from G1-754 in Plant 2, and 61 lbs. are reported as lost from G42-615 in Plant 9. The cause of the losses has been investigated and it has been established that the broken bags undoubtedly were the cause. These bags have been replaced. The total loss for Plant 5 during May was 46 lbs. of uranium, the second lowest ever reported in their history.

External Radiation

Film badges worn during the period 4/16 to 4/30 indicate that eight persons were exposed to 600 mreps or more of beta radiation, and two were exposed to 150 mr or more of gamma. The highest beta exposure was 830 mreps and the highest gamma exposure was 165 mr.

Film badges worn during the period 4/30 to 5/14 indicate that six persons were exposed to 600 mreps or more of beta radiation, and one was exposed to 150 mr or more of gamma. The highest beta exposure was 760 mreps and the gamma exposure was 165 mr.

Of the 17 exposures noted above, 13 were in Plant 5, one in Plant 8, one in Plant 1, one in Plant 2, and one in the Laboratory.

Ground Contamination Surveys

No special surveys were taken during this period. A few small spills were noted and cleaned up by responsible persons. A drum of grinder sludge at the Plant 6 pad spontaneously ignited and ejected material over most of the pad. The area was cleaned up by hosing into drain system. Radiations did not exceed 15 mrep/hr.

Plant Effluent

Analyses of effluent samples for the period from April 24 through May 21 show no contamination above MAC. The following table shows maximum concentrations of contaminants in the river and two main effluent streams for this period:

Contaminant	MAC	River	Maximum Concentration Manhole #175	Storm Sewer
Uranium (ppm)	0.35	0.0024	9.80	3.50
Fluoride (ppm)	1.20	0.0065	72.0	61.0
Nitrate (ppm)	44.0	2.359	3656.0	1571.0
Alpha (d/m/ml)	6.8	0.008	34.0	----
Beta (d/m/ml)	13.6	0.125	1251.0	----
TSS (ppm)	--*	0.824	1443.0	----

*No settlable solids

During this period (on May 5), 8,000 gallons of excess evaporator product was released to the General Sump. This caused no significant rise in contamination of the river or effluent stream. Permission was given to the Refinery to release daily amounts of evaporator product, not to exceed 2,000 gallons/day, to the General Sump until further notice is received by them from the Health & Safety Division.

040633

2. APD, Whole-body (gamma) - 417 mrem/mo.
   a. Persons receiving APD or greater - 1
   b. Distribution: Thorium Warehouse - 1.

3. **MPD, Skin (beta plus gamma) - 2,500 mrem/mo.
   a. Persons receiving MPD or greater - 14
   b. Distribution: Plant 5 - 12, Plant 6 - 1, Plant 9 - 1.
   c. Highest skin dost - 5,690 mrem - Plant 5

4. MPD, Whole-body (gamma) - 1,250 mrem/mo.
   a. Persons receiving MPD - 0
   b. Highest whole-body dose - 450 mrem - Thorium Warehouse

*APD - Average Permissible Dose - Monthly fraction of average dose/year lifetime occupational (AEC Manual Chapter 0524)
**MPD - Maximum Permissible Dose - Monthly fraction of maximum dose/year (AEC Manual Chapter 0524)

Ground Contamination Survey

The weekly ground contamination survey conducted in the vicinity of each of the production plants is continuing, and it is thought with some success. The line supervisors are all cooperative to the extent of correcting undesirable conditions as they are brought to their attention. There are still a number of undesirable conditions existing, such as the major backlog of turnings in the east side of Plant 6 and a number of damaged drums on the storage pad. However, definite progress is being made considering the entire plant, and it is thought that this improvement will start reflecting in the lower efflant contamination. A few of the more serious spills during the month are as follows: trailer cake spills between Plant 8 and the waste pit continue, overloading of the trailer results in occasional spills of trailer cake along the roadway. Although these spills are cleaned up immediately upon notification by members of this department, definite steps should be taken to prevent the spills in the first place.

A sizable quantity (approximately 50 lbs) of black oxide was mistaken for dirt or soot in a metal container sent from the Pilot Plant to the Welding Shop for alterations before installing in Plant 6. This material was flushed onto the floor and pad at the Welding Shop and some washed into the storm sewer before inspection revealed the nature of the material. The remainder was then shoveled up and delivered to Plant 8 for recovery. Pilot Plant supervision was consulted and agreed that the equipment should have been cleaned first, then sent to the Decontamination Building. OR? why not?

A major release of liquid UNH occurred at Plant 3 on June 17, with some 800 gallons blowing out onto the pad and ground to the SE of the plant and as far away as Plant 7 shipping area. No notice was given this department, and the incident was discovered by chance late on June 22. The gravel was extensively covered with the uranium salt. Rains occurred the night of June 22 and the day of June 23. On June 24, a sample of

November 11, 1969

IH&R DEPARTMENT MONTHLY REPORT FOR OCTOBER 1969

J. A. Quigley, M.D.

M. W. Boback

Air Hygiene Studies

Traverse studies of Plant 8 dust collectors G8-2 and G43-27 showed that these collectors were performing at design capacity.

Due to odor complaints a check of the exhaust ventilation for the shower and drying rooms was made. The exhaust was found to be working. However, it was noted that the exhaust grill in the drying room was about 40% covered with lint, thus restricting the effectiveness of the system. This was discussed with E. Peterson and he is taking action to have the lint removed from the grill.

Several operations in the Pilot Plant's production of thorium metal ar apparently high air dust operations, as noted from the amount of visible dust. Due to lack of manpower and other pressing duties, samples have not yet been obtained. It is planned to spend a full week in November sampling these operations. Respiratory protection is being worn at these operations.

Special Radiation Studies

On October 8, 1969, the RDA test evacuation drills were conducted for second and third shift Refinery personnel. These tests were held up until the new plastic RDA horns were installed. It was reported that the horns, lights, and personnel evacuation drills were satisfactory.

Health physics surveillance was provided at the Technical Division radiometric facility upon receipt of a 5 curie cesium-137 source. Due to a misunderstanding, it almost became necessary to build or purchase a storage pig to transfer the source into. It was not clearly understood from the beginning that the shipping pig could be retained by NLO and that only the shipping container would have to be returned. This created

[redacted]

additional work and some slight, but unnecessary, radiation exposure which could have been avoided by thorough communication. More explicit information on the purchase order would have helped.

Some preliminary investigation of the radiation exposure to the hands of various operators is being made. Wrist film dosimeters have been worn by the burnout and mold reconditioning operators in Plant 5. These dosimeters have not been processed yet.

Measurements of the gloves worn by the burnout operator for a full day showed inside radiation levels of 60 to 100 mr/hr. When the operator changed gloves after every third crucible the levels were less than 20 mr/hr. The mold reconditioning operator normally used three pairs of gloves per shift. Radiation levels in these gloves were 10 to 25 mr/hr.

Miscellaneous

A lighting survey was performed in the General Purpose Warehouse. As noted in an earlier survey, the illumination was less than the recommended levels for seeing tasks. A follow-up survey will be made to determine lighting improvement after the existing 200 watt light bulbs are replaced with 300 watt bulbs in each ceiling fixture.

This department witnessed a demonstration of an air powered drill in Plant 5 and found its performance favorable in not creating a dust problem. An air diffuser is used to control dusting that some other air powered tools do not have.

We observed a preliminary test to determine if precipitated thorium fluoride could be dewatered in a centrifuge. The Plant 9 chip centrifuge was lined with a filter cloth and used in this test. No industrial hygiene problems were seen if the filtrate, which contains hydrofluoric acid, can be removed to a vented tank. In the test it leaked to the floor and caused some eye irritation to the people present.

External Radiation

During September two film badges received beta and gamma radiation in excess of the MPD (2500 mrem per month for whole body skin). The badges were worn in Plant 5 by charging operators and had received

PE745eee

exposures of 2550 and 3250 mrem. There were ten badges that exceeded one-half the MPD or APD. A breakdown of these exposures is as follows:

Plant 5	6	Remelt Area Operators
Pilot Plant	3	Thorium Processing
Plant 9	1	Remelt Area Operator

Ground Contamination

The amount of uranium lost via the Storm Sewer System for October was 254 pounds. No unusual spills of contaminating materials or losses to the Storm Sewer were found to have occurred.

Stack Losses

The estimated uranium loss from dust collectors during October totaled 62 pounds. No thorium loss was estimated.

Environmental Sampling

No NCG values were exceeded during October in the Miami River or Paddy's Run. The total suspended solids concentration in Manhole 175 effluent continues to average well below the NCG of 100 mg/l.

Our off-site sampling results for nitrogen dioxide and fluoride during October were all below NCG values.

Work Statistics

Samples Collected	155
Air Dust	114
Stack	14
Water	11
Fluoride	8
Nitrate	8

Equipment Material Passes - 29
Nuclear Safety Change-Over Inspections - 16
Receipts Monitored - 4
Radiation Work Permits - 8
Drawings Reviewed - 3

ORIGINAL SIGNED BY

M. W. Boback

MWB/fb

cc: J. A. Quigley, M. D. - 3x

BEST COPY AVAILABLE

AFFIDAVIT

State of Ohio:
County of Hamilton: SS

I, being duly cautioned and sworn, state as follows:

1. I live at

2. I worked at the Feed Materials Production Center ("Fernald") at Fernald, Ohio from 1953 until 1971. For the entire time that I worked at Fernald I worked in the Industrial Hygiene Section of the Health & Safety Division. My supervisors were Richard Heatherton, Robert Starkey and Michael Boback. Dr. Joseph Quigley was the Director of Health & Safety during my employment at Fernald.

3. I was an industrial hygienist for the entire time that I worked at Fernald. My job responsibilities consisted of conducting surveys in the various plant areas and making recommendations on such items as air dust sampling, toxic gases, and ventilation surveys; measuring dust collector exhaust systems and establishing sampling rate for particulate emissions; preparing monthly reports to management for material being exhausted to the atmosphere via dust collectors, as well as plant effluent to the river; investigating fume releases, dermititis cases as to possible cause, high film badge exposure, and higher than normal urinalysis results; performing ground contamination surveys and plant safety and housekeeping inspections; and monitoring shipments. The duties of this position also included issuing radiation work permits; collecting water samples from the river; performing miscellaneous special studies; representing the Company on off-site trips; and helping conduct heat, noise, and lighting surveys with other industrial hygienists.

4. I did air dust surveys in all the plants at Fernald. I used a homemade sampler which consisted of a small vacuum with a Whatman filter where air was drawn through at a given flow rate. The samples were all collected open face which means that the filter paper was not protected on the front of the sampler so, for example, that it was possible to lose some of the dust if you were bumped. You could also lose dust when transferring the filter paper into an envelope.

5. When I did air dust surveys, I could get a higher reading if I stood in the direction that the dust was blowing from the employee that I was sampling. Conversely, I would get a lower reading if I stood in the opposite direction from the way that the dust was blowing. Where I stood could make 100% difference in the results that I recorded depending on how dirty the operation was. For

[redacted]

example, if I stood on one side, the reading might be zero while on the other side, the reading might be 50 times Maximum Allowable Concentration ("MAC").

6. In order to obtain an accurate result of what the employee is breathing, it is important that the air dust survey be done as close as possible to the production plant employee's breathing zone. The sample should be taken in the direction that the dust is blowing if the employee is subjected to the dust.

7. On several occasions during the term of my employment, when I got air dust survey results that were above the MAC, I was told by my supervisors that the results were in error and I was told to go back and resample. I remember one specific occasion when I was sampling the jolter in plant 5 where ventilation modifications had just been made and I was sent out there to sample the air. The production plant employee was working over the jolter and the dust was coming up into his face. I obtained results that were above the MAC. I think that my results were correct the first time that I sampled because they were similar to the results that I had obtained before the modifications and the modifications were not effective. Nevertheless, my supervisors told me to go back and resample. When I resampled, the results were still above the MAC. I was sent back by my supervisors five or six times. Finally, I stood in the opposite direction from the employee from the way that the dust was blowing and I obtained a result that was below the MAC. When I returned the result that was below the MAC to the Health & Safety Division it was an acceptable result.

8. In air dust surveying there were many other variables that could change the results. For example,

(a) the results were lower in the summer because the windows in the plants were open;

(b) if there was dust laying on the ground or on equipment, this dust could be resuspended and become airborne;

(c) fork truck traffic would increase the airborne activity;

(d) if the ventilation ducts were partially or completely plugged, the air dust would be higher in the work areas;

(e) production rates would affect air dust results; and

(f) whether the standard operating procedures were followed would affect the results.

9. When there were fires in the buildings, the windows and doors were opened to get the smoke out and sometimes the air dust surveys were not taken until after the smoke had cleared.

10. When there were fires outside the buildings, generally on a storage pad, the air dust surveys that were taken were random as to location and time.

11. In the annual air dust survey reports I wrote recommendations for reducing air dust levels in the plants. Some of these

recommendations would not cost anything to implement. For example, I would recommend vacuuming up the radioactive material in the work areas, wearing respirators properly, making sure that all ventilation lines were clear and operating in accordance with the standard operating procedure. Nevertheless, these recommendations were sometimes not followed.

12. On occasion, the employees were exposed needlessly to airborne radioactive dust and fumes because the production supervisors were operating at a rate in excess of the production rates set forth in the standard operating procedures. Sometimes when ventilation lines were blocked, production supervisors told the employees to go ahead and dump uranium anyway causing the radioactive dust and fumes to billow out into the plant.

13. In the 1950s no industrial hygienists worked on the second shift, third shift or on weekends. It is my understanding that many operations that would not be condoned by the Health & Safety Division would be done on the second shift, third shift and on weekends when no industrial hygienists were present.

14. There was no fit testing for respirators used at Fernald during the years that I was employed there. Respirators were not used by the production plant employees as frequently as recommended by Health & Safety Division. Often the respirators were left in the production areas uncovered where the respirators became dirty and covered with radioactive dust. The employees would then pick up the dirty respirators and use them.

15. Management condoned smoking in the production plants. Employees would carry the cigarettes in their coveralls where the cigarettes would become contaminated with radioactive dust and then the employees would smoke the cigarettes.

16. People that were injured in the production plants were assigned "light duty". Light duty could be anything - such as sitting in a chair for eight hours. These injured employees were picked up at their homes and brought to work so that the statistics on lost time accidents would be favorable to the company. The lost time statistics reported by NLO are inaccurate.

17. Dust collectors often were not shut off as soon as possible when a bag ruptured. This resulted in a decrease in ventilation at the work stations and excess uranium dust released into the atmosphere and onto the ground.

18. Many times during my employment plants 2 and 3 had to be evacuated because of nitric acid fumes. No samples were taken at the time of evacuation, however samples were taken before the employees were allowed to return to the buildings.

19. Supervisory personnel were aware that employees were being

overexposed to radioactive dust and fumes and also overexposed to acids. Nevertheless, supervisory personnel allowed the employees to continue to work in areas where they were being overexposed to radioactive dust and fumes and to acids. These overexposures continued throughout my seventeen years of employment at Fernald.

Further Affiant Sayeth Naught.

State of Ohio)
County of Hamilton) SS

Sworn to me and subscribed in my presence this second day of February 1993.

Jane A. Walker

JANE A. WALKER
Notary Public, State of Ohio
My Commission Expires August 4, 199[illegible]

CENTRAL FILES

#2

JUL 11 1966

2154431

Mr. C. L. Karl, Area Manager
U. S. Atomic Energy Commission
P. O. Box 39188
Cincinnati, Ohio 45239

Subject: Proposed Employer-State-Federal Records and Reports System for Radiation Workers:

Dear Mr. Karl:

Although we have not been officially asked to comment on the subject proposal, I would like to provide comments regarding the proposed record keeping system. It is not clear from the proposal what leeway may be afforded the individual employer in his record keeping. We are opposed to uniformity in record keeping if uniformity means sameness. Different situations encountered in different operations should require some difference in the type of records which will be kept. I believe that each employer should be left free to decide to some extent how he will keep his records and what information will be recorded.

In our opinion the record keeping as outlined in the proposal is far too detailed for the individual worker. We would propose instead that the records be maintained in two parts. First, the company records pertaining to the processes, methods of making radiation surveys, and levels of radiation encountered would be kept. The individual employee record would contain only his external radiation exposure as measured by film badge, urinalyses and body counting data if available, and perhaps a broad description of his duties.

While we believe that externally received industrial radiation can be and is measured accurately, the state of the art for accurate estimates of radiation from internal emitters is not sufficiently advanced to make good estimates. We are opposed to using either airborne concentration or urine data to derive a rem dose to a particular organ.

It does not make much sense to us to keep very accurate records of the industrial exposure when exposures are low and at the same time not have information

0188903

[redacted]

September 8, 1959

[redacted]

ITINERARY OF URANIUM FROM TIME OF EXPOSURE UNTIL TIME OF EXCRETION IN THE URINE.
Bio-Assay Committee, R. C. Heatherton, Chairman

J. A. Huesing

Listed are some random thoughts on the itinerary of uranium from the time of exposure until time of exeretion in the urine.

1. Exposure

Motivation, Protection or Research ?

Procedures exist which enable us to determine with a fair degree of accuracy airborne exposure concentrations. However, little is known about actual intake and retention. The use of respiratory protection further complicates the exposure-intake ratio.

2. Type of Material

Airborne uranium contamination is usually measured in alpha counts per minute per cubic meter of air. While the alpha emission of uranium remains unchanged in the different chemical compounds of uranium, the physical and chemical properties of uranium compounds do differ. Therefore, the physiological breakdown of each uranium compound is on an individual basis. An extreme example is the difference in metabolism of soluble and insoluble uranium compounds. But just as striking differences occur here , less striking differences occur in the metabolism of the different insoluble compounds. For example UO_2, UO_3, U_3O_8, UF_4, etc. each have their specific physical and chemical properties which influence their retention and metabolism.

3. Solubility of Material

a. Inhalation - the more readily soluble the material, the higher the percentage of retention in the lung. Handbook figures indicate 25% of soluble contaminant remains in the lung while only 12-1/2% of insoluble contaminant is fixed in the lung. The soluble material is cleared from the lung in a matter of hours while the insoluble material is cleared much more slowly.

b. Ingestion - It is estimated that 60 to 75% of inhaled uranium is moved by ciliated action of respiratory tract epithelium back toward the pharynx and is in turn swallowed. It is further estimated that only from .02 to .07% of soluble uranium is absorbed from the gut. Any absorption through the gut would for the most part, enter the portal blood in this event.

It is also worthy of comment to note that absorption studies from the GI tract are based on animal experimentation for the most part. In the human, to be considered is the high acidity of the stomach with the possibility of chemical reactions or increased solubility of uranium compounds that normally are insoluble in water or at neutral pH's. Any uranium passing from the stomach to the small intestine capable of chemical reaction would be met with the alkaline pH and high bicarbonate content of the small intestine, it is thought that bicarbonate compounds of uranium are readily soluble.

Little is known of the process by which the absorbed uranium crosses the gut barrier; whether body deficiencies in other metallic elements such as calcium, potassium, etc. would enhance uranium absorption is subject for thought. It has been reported, however, in some of the older literature that orally administered doses of as high as 3.0 grams of uranyl nitrate per day were tolerated without albuminuvia or glycosuria.

4. Breathing Habits

a. Rate - Inhalation of contaminant is naturally proportional to respiratory rate, however % retention diminishes with increased respiratory rate due to the rapid inward and outward movement of air; therefore, while there is a linear relationship between breathing rate and inhalation of contaminant, there is not a linear increase in the retention of contaminant with increased breathing rates.

b. Volume - The tidal volume equals the volume of inspired air per breath. Minute volume equals the tidal volume times the respiratory rate per minute. Body needs determine the minute volume which can be increased by increasing the tidal volume, the rate, or both.

e.g. Tidal Volume X Rate = Minute Volume
"Worker A" 500 ml X 30 = 15000 ml or 15 l/minute
"Worker B" 1000 ml X 15 = 15000 ml or 15 l/minute

In this example, both workers have identical minute volumes and thus have inhaled identical concentrations of contaminant, however, "Worker B" with his slower and deeper respirations would retain more contaminant.

c. Age - As a person ages, elasticity of the lungs decrease. With this loss of elasticity compensation usually occurs by an increase in respiratory rate with increased oxygen needs. To the other extent, the inactive or dead air space volume of the lung increases. Therefore, retention of airborne contamination between a worker of age 18 and a worker of age 60 could vary considerably. Little investigation has been done along this line.

5. Particle Size

Largest proportion by weight of most airborne contaminants is in the 1 to 3 micron range. There is wide variation in the estimate of retention in the lower respiratory tract for different particle sizes. However, there is general agreement that only a small % of particles over 5 microns in diameter reach the alveoli. But of particles reaching the alveoli, retention is favored by the density X diameter^2; therefore, once a large particle reaches the alveoli it is likely to be retained. Also it is worthy of note that large particles that are alpha emitters form a greater radiological risk to tissue since the radiation is confined to a smaller tissue area (e.g. alpha activity from a 10 micron particle is absorbed in 1/1000 the tissue area that would absorb the alpha activity from a 1 micron particle) The influence of particle size on solubility is also thought to be significant.

6. Density

Retention of airborne contaminant varies directly with the density of the contaminant. Therefore uranium compounds being of a very dense nature, are retained to a greater extent than other airborne contaminants of equal particle size.

7. Shape

Total weight of contaminant particle varies with shape. For a sphere total volume is equal to $4/3 \pi r^3$, while with a cube is equal to length X width X height.

8. Age of Material

Some investigators report a difference in solubility as uranium salts age.

9. Lining of Respiratory Tract

Inhaled particles before they reach the alveoli of the lower respiratory tract meet resistance to their flow from the mucous-like epithelial lining of the trachea and bronchi. Also growing from this epithelium are hair-like projections called cilia which by wave motion sweep particles back up the respiratory tubes. For this reason, only a small percentage of larger sized particles reach the alveoli. It may be noted that individuals with chronic bronchitis (e.g. many cigarette smokers) after a period of time become denuded of this normal respiratory epithelium and cilia. Areas denuded of this normal epithelium become possible foci for permanent deposition of contaminant. It would be individuals such as this that would run increased risk to other pathological conditions such as bronchogenic carcinoma.

10. Lungs

As particles move down the respiratory tubes anatomical structure may favor certain areas for retention. The main respiratory tube, the trachea, is in almost a vertical position, however, its two terminal branches, one to the left lung and one to the right lung, are at angles. The angle of the branch to the left lung is greater than the angle to the right lung. Therefore, one would suspect that retention of dense particles would be greater in the right lung. Each of the main branches or bronchi sub-divide into smaller branches which supply the individual lobes of the lungs, two lobes to the left lung, three lobes to the right lung. Animal studies indicate that there is increased deposition of contaminant in the right lung. In fact, some studies have pin-pointed the location to be within the right upper lobe. It must be remembered however, with humans we have a standing position and the right lower lobe may be favored for increased deposition of contaminant. Autopsy data with this taken into account would be of interest, especially if it would show that contamination concentrations are not uniform throughout the lung and certain areas do have increased deposition.

Original Signed By
J. A. Huesing

JAH:mjs

cc: J. A. Quigley, M. D.
T. G. Byrne, M. D.
J. F. Ziegler, M. D.
R. H. Starkey
J. F. Wing — JFW 9/9/59
Central File

NLCO-895

A CONTINUED PROGRAM OF ANALYSIS FOR URANIUM IN HUMAN AND ANIMAL TISSUES

Richard C. Heatherton
Michael W. Boback
Joseph A. Quigley, M. D.

National Lead Company of Ohio
Cincinnati, Ohio

September 20, 1963

Prepared for presentation at the Ninth Annual Bioassay and Analytical Chemistry Conference
San Diego, California
October 10-11, 1963

The work reported herein was performed for the U. S. Atomic Energy Commission under Contract No. AT(30-1)-1156

[redacted]

The purpose of this paper is to report the current status and findings of the tissue analysis study which was begun at the National Lead Company of Ohio in 1956. At that time the plant work force numbered about 2400 persons including about 1600 process workers who had been engaged for 2 to 4 years in some phase of the uranium fuel production work. This work was a source of some exposure to airborne uranium dusts and fumes.

As might be expected, whenever a death occurred in this group, the question of causal relationship between exposure and death was generally raised. The program began as an attempt to settle the question of causal relationship through the analysis of tissues obtained whenever an autopsy was ordered for former employees. Because of mutual interests, a cooperative program was worked out with the county coroners and the pathologists at local hospitals. We obtained portions of body organs of interest whenever postmortem examinations were made. Then, acting as agents for the coroner or pathologist, we analyzed the tissues for uranium and submitted results to him. Through this arrangement, we were also provided with some tissues from autopsies of persons without known history of occupational exposure to uranium.

Related case history information and tissue results from our first six autopsy cases were reported in 1958.[1] The analytical investigations made in conjunction with the start of the program were reported the same year.[2]

New Cases

We have since obtained information from two autopsies of former employees, three biopsies of employees, and nine autopsies of unexposed subjects. Analysis of human stomach tissue obtained from surgery, a finger severed in an accident,

HANFORD ENVIRONMENTAL
HEALTH FOUNDATION

Rec 7/11

July 11, 1979

Mr. Herschel Hickman, Director
Manufacturing Division
Oak Ridge Operations Office
P.O. Box E
Oak Ridge, Tennessee 37830

Dear Mr. Hickman:

The letter will inform you of a dialogue that has been taking place almost a year now.

In May 1978, Hanford Environmental Health Foundation (HEHF) of Richland, Washington, was given a contract by DOE to develop an Occupational Health Study of Uranium workers. HEHF is being assisted by Pacific Northwest Laboratories (Battelle) in carrying out this study.

National Lead Of Ohio (NLO) represents a very unique group of Uranium workers for possible autopsy study. As the work force has contracted over the years, workers have been retained, as you know, on a seniority basis. Thus the 600 workers presently employed have for the most part been there since Manhattan Project Days. National Lead of Ohio during this time has been involved in all phases of Uranium work.

As you know Mr. Richard C. Heatherton and Mr. Michael Boback at National Lead Of Ohio (NLO), have long been interested in the ultimate disposition of Uranium in the human body, and both of them have written and given papers on this subject. Since October 1978, Mr. Heatherton and

[redacted]

Mr. Boback, and representatives of the U. S. Uranium Registry have been in conversation about a potential project. It would seem that NLO has a unique population for study, and that the U. S. Uranium Registry can offer NLO a mechanism by which autopsies may be obtained and tissue analysis accomplished.

The purpose of this letter is to make you aware of these conversations. If, there develops a basis for an active relationship between NLO and the U. S. Uranium Registry, we hope you would react favorably to Mr. Samuel F. Audia regarding such an effort.

I would be pleased to supply additional information, or answer any questions you may have about this potential effort.

who is he? L

Sincerely,

R. H. Moore, M.D.

jm
File/lb
CC: C. C. Lushbaugh, M.D.

Mr. Audia is Manager of National Lead of Ohio.

September 11, 1981

NLO, INC.

RESPONSE TO

DOSIMETRY ASSESSMENT FACT SHEET

I. History of "Hazards" to Assess Overall Monitoring Program

A. The primary radiation hazards at the FMPC have always been from uranium. Uranium of various U^{235} content, ranging from depleted to slightly enriched, has been processed with the average content being close to normal. Periodically, small amounts of natural thorium have been processed.

B. There have been no significant radiation hazards that have not been monitored.

C. External Radiation Monitoring: film badge dosimeters have always been used to measure whole body penetrating and skin doses. From 1951 through 1960 the film packet was sealed in plastic and placed in a metal case which attached to the worker's security badge. A portion of the film was not covered by the metal case and served as a means of monitoring skin dose. Beginning January, 1961, the ORNL Badge Meter, Model II was put into service at this site. This dosimeter is described in detail in the report ORNL-3126.

Extremity exposures were monitored with wrist film badges from 1969 until 1977. From 1977 through the present, TLD's have been used for this purpose. The TLD's are the Telydyne teflon impregnated with calcium sulfate type.

Internal Radiation Monitoring: all measurements of internal (lung) depositions have been made with DOE's mobile body counter which is operated and maintained by Union Carbide's Y-12 personnel. The counter has been used at this site from 1968 until the present time.

D. Additional information on our present film badge dosimetry system is contained in the two attachments.

II. External Monitoring Data

A. Personnel Monitoring Badges

1. Types of badges used:
   - Film for whole-body and skin exposure
   - Film for extremity exposure (limited program)
   - TLD for extremity exposures

2. Dates each type dosimeter used:
   Film (whole-body monitoring): since plant start-up (1951) to date
   Film (extremity monitoring): 1969 to 1977
   TLD (extremity monitoring): 1977 to present

3. Types of measurement:
   Gamma whole-body dose
   Beta and gamma skin dose
   Beta and gamma extremity (hands and forearm) dose

4. All dosimeter evaluations were "in house" except for approximately the first 12 months of operation when film badges were processed by DOE's Health and Safety Laboratory, New York, NY (presently called EML).

5. No procedure manual is available.

   a. Calibration procedure and frequency. Film badges: Gamma calibration are performed by exposing badges to a radium source at various distances. Beta and Gamma calibration are obtained by exposing films to a uranium metal slab for various lengths of time. Six to eight sets of calibration films are prepared at a time. One set is processed each month along with the films from the personnel dosimeters.

      TLD extremity dosimeter: calibration exposures are made in essentially the same manner as with film badges by exposing the TLD's to a slab of uranium metal. Calibration checks of the entire TLD system are made each month. The individual TLD's are calibrated after every two or three uses.

   b. The radium source used for gamma calibrations was calibrated at NBS. The uranium metal slabs used for beta and gamma calibrations have not been calibrated. The published surface dose rate for aged natural uranium metal is assumed for the metal slabs.

   c. For film dosimeters, a calibration curve of film density versus exposure is prepared from the calibration films. The density of the personnel films is converted to dose using the calibration curve. This was done manually at first but is now performed by computer.

   d. "Test" dosimeters are not routinely processed. However, five or ten gamma and six or eleven beta and gamma calibration films were processed along with each batch of personnel films. Also, as mentioned previously, TLD's are exposed for calibration purposes after every two or three uses.

e. Test dosimeters were not routinely evaluated.

f. Special care was always taken in the method used to store films, to carefully control film processing conditions, and in preparing calibration films. Calibration films were always from the same lot and processed along with the workers' films. See also attached Report On Examination "Audit of Controls Over Radiation Badges" dated June 6, 1978.

G. There were no specific training requirements for the film badge technicians when this program began in 1951. The technicians received on-the-job training. The technician now performing all film badge processing began this work in 1952 and has been only technician doing this task since 1959.

6. Personnel who make use of the dosimetry results are convinced that the dosimetry procedures provide a reliable measurement of radiation doses. Knowledge of the calibration, development and read-out processes leads them to conclude that the precision would be better than ±25%.

B. Use of Badges

1. Since badges were always a combination security-dosimeter badge and also contained nuclear accident dosimetry materials, all employees have always worn badges. However, exposures were not always determined for all employees. During certain periods female employees were not routinely monitored. Periods when male and female employees were monitored were:

   1951 - 1960: male employees only
   1961 - 1968: male and female employees
   1969 - 1978: male employees only
   1979 - present: male and female employees

2. AEC (ERDA, DOE) Manual Chapter 0524. Female employees were not monitored during certain periods because the potential did not exist for them to exceed 10 percent of the quarterly standards.

3. Yes.

4. Because of the dual nature of the badge, the time employees did not wear badges was minimal.

5. Initially, heat damage from leaving badges in cars during hot weather was a problem. However, this has not been a real problem for many years. Leaving badges in desks, cars, etc., did not have a significant impact on the overall external dosimetry program.

6. Temporary badges were provided if a worker left his badge at home or lost his badge. If the dose registered on the temporary badge was considered to be of no consequence, no adjustment was made to the individuals dose record.

7. Workers normally wore their badges on the upper part of the body (on shirt collars or shirt pockets).

C. Other External Monitoring Techniques

Only film badges or TLD's have been used for determining actual personnel exposures. Neutron monitoring is not required at this site.

D. Administration and Recordkeeping

1. Initially, external radiation doses were reported in mrads and later in units of mrem.

   For our gamma (whole body) exposures, the units of roentgen, rad and rem were assumed to be equivalent and no conversion factors were used to convert from one to the other. For beta and gamma (skin) exposures no conversion factors were used to convert from rads to rems. The published value for the absorbed dose rate produced by natural uranium metal expressed in mrad/hr was assumed to be equal to the same dose expressed in mrem/hr.

2. No quality factors or modifying factors were used to evaluate dose equivalent.

3. Anytime a reading was considered questionable, an investigation was conducted. A decision as to whether or not the reading was legitimate was based on the findings of the investigation.

4. A dose is assigned to a worker if his dosimeter is lost or damaged. The amount of dose assigned is based on which jobs the worker performed during the unmonitored period.

5. Several films (blanks) are taken from the supply of films which are stored in a refrigerator and developed with the calibration and personnel films. The blank films are used to zero the film densitometer. This automatically compensates for background radiation.

6. Records are complete.

7. This has not been necessary.

8. Most of the monitoring data is computerized. Data is not computerized for workers who terminated before computerization of records. Computer records also do not contain monthly or yearly breakdown of exposures for workers prior to 1961.

   The format of the computer records has not always been the same. For 1958 through 1960, exposures for each badge period and yearly totals are listed. From 1961 to present, exposures for each month, quarter, year and employment total are listed.

9. One week, two week and month (four or five weeks) long monitoring periods have been used. Since 1959, only monthly monitoring periods have been used.

10. The only summaries available are those reported annually since 1961 on AEC Form 190. There are yearly summaries of whole body (gamma) penetrating radiation. There are no summaries available for skin or extremity exposures.

III. Internal Monitoring Data

A. Bioassay Program

Uranium in urine analyses have been performed on a regular basis to monitor employees for exposure to airborne uranium. However, we have not used these results to make estimates of internal exposure.

B. Whole-Body Counting

1. Whole-body counting has been used since 1968.

2. Groups of employees doing the same jobs are scheduled for counting on the basis of their potential for exposure to airborne uranium. Additional counts are obtained on individuals whose count results are above 50% of a permissible lung burden.

3. Whole-body counting was done "in house."

4. We use the DOE's mobile body counter which was designed and is maintained by Union Carbide's Y-12 personnel. Initially, Y-12 personnel operated the counter at our site. Since about 1970 we have been operating the counter ourselves.

5. The mobile body counter was programmed to provide radionuclide content of the workers. Consequently, we-were not required to calculate this from the raw counting data.

6. The amount of U^{235} in one lung burden or uranium at various U^{235} enrichments has been calculated on the basis that 0.017 µCi of uranium produces a dose to the lung of 15 Rem/year. The enrichment of the uranium in the lung is calculated from the total uranium and U^{235} values provided by the body counter. The amount of U^{235} representing one lung burden for that enrichment is then divided into the amount of U^{235} in the lung to obtain the percent of a lung burden.

C. Other Internal Monitoring Techniques

1. Air monitoring results were never used to estimate internal deposition.

2. No other monitoring methods were used to estimate internal deposition other than whole-body counting.

D. Administration and Recordkeeping

1. Internal monitoring reports are not computerized.

2. Unusual values are validated by additional counts obtained on the individual. If a medically administered radioisotope is suspected, confirmation is obtained from the individual's doctor or the hospital.

3. If artifacts are discovered, a notation that the count results are unreliable is made in the worker's record. The reason for judging the count to be unreliable is also included in the notation.

4. Prior to 1979, there was no formal procedure for merging internal and external dosimetry data although this was done for the higher exposures. Since 1979 a listing has been prepared of those employees with either internal or external exposures above certain levels.

Attachments: Radiation Records Survey Questionnaire
Report on Examination, "Audit of Controls Over Radiation Badges"

NATIONAL LEAD COMPANY
OF OHIO
P. O. BOX 158
MT. HEALTHY STATION
CINCINNATI 31, OHIO

May 5, 1955

SUBJECT: PRELIMINARY REPORT - EXTERNAL RADIATION - LEVELS FROM URANIUM AND THORIUM

TO: R. C. Heatherton

FROM: E. V. Barry

REFERENCE:

Introduction

In comparing the two elements for radioactivity we find that uranium and its daughters are more radioactive than thorium and its daughters insofar as their respective beta activities are concerned, while thorium is more potent than uranium in regard to gamma activity.

When uranium is separated from the ore and processed into metal form the radioactive chain is so radically broken that equilibrium is not achieved due to the long half lives of some of its daughters ($_{90}Th^{230}$ - T½ = 80,000 years and $_{88}Ra^{226}$ - T½ = 1600 years). The equilibrium that is achieved is among the two daughters UX1 ($_{90}Th^{234}$) and UX2 ($_{91}Pa^{234}$) which lie between U^{238} and U^{234}. In approximately 241 days 99.9% of the equilibrium values of these two daughters are formed.

The thorium chain on the other does not possess any long lived daughters - the longest being MsTh ($_{88}Ra^{228}$) which has a half life of 6.7 years. After processing into metal the daughters rapidly build up. In approximately 20 days the first period of equilibrium is achieved. This period lasts for approximately 60 days after which the activity decreases by 25 to 30%. This decay period lasts until 3 years after separation. From then on the activity increases till at the end of 60 years the second and final period of equilibrium is achieved. The activity at the second period is twice that of the first period.

Radiation Levels

In uranium the surface beta dose rate is 240 mreps/hr, while for thorium the surface dose rate at the end of the third year is 43 mreps/hr. The dose rate during the first period of equilibrium (writer's opinion) is approximately 60 mreps/hr. The dose rate during the second period of equilibrium is 115 mreps/hr.

Because no separation is 100% complete equilibrium is achieved sooner. This is not too important in the case of uranium but it is so in the case of thorium because of the more intense gamma radiation emitted by the thorium daughters.

[redacted]

The gamma levels from thorium rods have been as high as 50 mr/hr on contact as measured with a Juno type instrument, while the levels from uranium gamma are only 5 mr/hr on contact. The energies of the thorium gammas are higher than those of the uranium gammas. This means an additional potential hazard insofar as radiation is concerned.

Radiation Exposures at Fernald

Uranium:

There are several location where overexposures to beta radiation have occurred. One is during the recasting of uranium. A separation occurs between the uranium and UX_1 and UX_2.

The daughters rise to the top of the molten metal thereby concentrating the daughters. The radiation coming from the top of the ingot has been as high as 400 mreps/hr. The crucible lids have read as high as 5000 mreps/hr. The enclosures for burning out the crucibles and the enclosure dust collectors have been high in beta radiation thereby necessitating time limits for work in these enclosures.

Another area where high exposures are possible (and have occurred) is in the handling of aged uranium materials, such as scrap turnings and duds.

No overexposures have occurred during the handling of uranium concentrates; orange oxide, green salt, hex gas, ammonium diuranate, soda salt, rods, slugs, or derbies.

Thorium:

Overexposures to gamma radiation have occurred during the handling and pipe sampling of thorium nitrate, during the inspection of thorium slugs, and during the start up phase of the thorium plant. Time limits imposed by this department have reduced the overexposures to essentially zero. (The use of shielding has been discussed with several of the supervisors and in many cases it was decided that a time limit was much more practical than shielding).

E. V. Barry

EVB/bg

Surface Measurements

Ingots:

	Thorium			Uranium	
Age	B & G mreps/hr	G mr/hr	B mreps/hr	B & G mreps/hr	G mr/hr
30 minutes				2	.1
~5 hours				2.5	.2
2 days				10	.3
4 "	12	8	4		
5 "	15	10	5		
7 "	17	12	5		
12 "	25.5	18.5	7.0		
14 "	25.5	18.5	7.0		
15 "	25.5	18.5	7.0		
20 "	26.5	19.0	7.5		
21 "	26.5	19.0	7.5		
22 "	26.5	19.0	7.5		
26 "	26.5	18.5	8.0		
27 "	26.5	18.5	8.0		
29 "	26.5	18.5	8.0		
32 "	26.5	18.5	8.0		
33 "	25.5	18.5	7.0		
3[illegible] "				50	4
35 "	25.5	18.5	7.0		
47 "				60	4
56 "	26.0	18.5	7.5		
74 "	25	18.0	7.0		
216 "				84	4
229 "				90	5

Age	Side B & G mreps/hr	Side G mr/hr
Derbies (Uranium)		
15 minutes	24	2
20 minutes	7	3
5 hours	12	1
1 day	27	3
2 days	35	2
Derbies (Thorium)		
1 day	15	8
1 day	25	14
5 days	19	9
Slugs (Uranium)		
4 days	7	.1
6 days	6	.1
14 days	17	.4
14 days	17	.4
20 days	20	.8
20 days	20	.9
157 days	42	3
>270 days	41	2
Slugs (Thorium)		
149 days	15	10
149 days	16	12
149 days	17	11
144 days	17	12
30 to 100 days casting dates unknown	22 - 26	15.5 - 20

Program for Obtaining Measurements

Thorium.

After the chemical process is studied, samples will be collected of the various thorium compounds and waste products for radioactivity measurements. These samples will include slices of thorium and a thorium slug. Periodic instrument and film measurements will be made so that activity curves may be plotted. Comparisons will also be made of instrument readings with film badge results. The information obtained will then be written into a report.

Uranium.

A similar sampling and measuring program will be undertaken with uranium.

E. V. Barry

EVB/bg

R-20000-47

CRR Information
MV File

NATIONAL LEAD COMPANY
OF OHIO

[redacted]

22256

September 28, 1961

SUBJECT: FINAL SUMMARY AND INVENTORY OF THORIUM

TO: F. ? McCreery

FROM: J. ? Carmitti

REF: Data as of 10/1/61

During the past three years all of the thorium residue materials and the thorium products were inspected, segregated, redrummed, reweighed and recoded by the Project Labor Pool.

This program entailed a great deal of work due to the improperly coded items and at times the work was somewhat hazardous due to drums exploding, catching on fire or causing obnoxious fumes. A full drum (55 gallon) of calcium metal was also found among the drums and it had been coded as a thorium residue. At times the work on this project was at a standstill due to the radiation and there were no workers to rotate who were not exposed to the maximum agreeable monthly radiation dosage. The radiation dosages were checked monthly with Health and Safety Division.

It should be noted that much of the work performed by the Project Labor Pool could have been avoided if proper and greater care would have been taken in the drumming, coding, segregating or marking of the original drums. Many of the drums of metal residues were oxidized or corroded into sludges and were further oxidized at Plant 6 thorium furnace. It can be said that the thorium residues were in a worse condition than the depleted or normal residues and this was a major cause of the thorium contamination to the storm sewers. The thorium materials are now in good condition and the material probably will not require redrumming for several years. The housekeeping is now greatly improved and there should be no more thorium contamination going into the storm sewer system.

All drums or boxes of the good thorium products and potentially remelt metal are located in undercover storage and all the residues are on the outside pad. Approximately 6,000 drums of low grade thorium residues were discarded at some off site burial area and over 1,500 drums (240,000 pounds - net weight) have been sent to Plant 6 thorium furnace for oxidation.

The following summary describes each lot of material stating the new lot number, number of drums, the new weight and material description. By copy of this letter please change your October 1, 1961 inventory tab run accordingly. If you desire to take an actual part physical inventory on November 1, 1961, please advise Production Records and Plant 1 of this fact (note, I will gladly assist on any inventory).

Type 201: All of the product TNT was redrummed with no change in lot numbers. This TNT must be removed in the opposite order that it was stored, i.e. last in - first out.

Lots 1H-201-0000, AAJ-201-0001, LAB-201-0006 and ION-201-0002 have been redrummed and recoded to 1K-201-1001. This new scrap lot contains nine drums and weighs 2,381 net pounds. This new scrap lot should have a lower assay than product TNT because it contains cleanup material, soda ash, merco-dri and vermiculite. There was a large loss of this material to the storm sewer.

The 50 bottles of meridan nitrate was recoded from type 289 material to lot MMW-201-0168 weighing 1,755 net pounds (776 pounds SS) and were redrummed into 11 drums. (EF-289-0144)

Type 202: All of the product ThF_4 originally produced in Plant 4 was moved into the warehouse (Building #65) with no change in lot numbers.

Lots 1H-202-0000 and FMB-202-0006 were recoded to type 236 material.

Type 204: These ingots and ingot pieces were made into two lots. Some of these ingot pieces were originally with the type 207 material. Ingot numbers are available upon request.

1K-204-0101	1 box	2,496 pounds	7" dia.	11 pieces
1K-204-0201	1 box	668 pounds	3" dia.	7 pieces

Type 205: The rods are listed below. The clad and hollow rods were originally with the type 289 material.

1K-205-1001	Box #1	298 pounds	all diameter rods and lengths
	#2	1,457	
	#3	718	
	#4	1,382	
		3,855 pounds	

This material is good remelt scrap after pickling.

1K-205-2001	Box #1	510 pounds	clad and hollow rods or tubes (not certain of impurities)

This lot might be made into remelt material after pickling or de-cladding.

Type 206: Delete - This item was recoded to type 207 and 275 material.