Claimant ID #
DOL Batch #
DOL D.O. #
NIOSH/OCAS

December 2, 2008

National Institute for Occupational Safety and Health
Robert A. Taft Laboratories
4676 Columbia Parkway
Cincinnati, OH 45226-1998

RE: Employee:
File No.:
NIOSH ID:

Gentlemen:

The Department of Labor concluded that my did not qualify as a "covered employee" with cancer under 42U.S.C. Section 7384(9)B and that the recommended claims filed by for survivor benefits under the EEOICPA be denied. This denial is based upon the NIOSH Report of Dose Reconstruction under EEOICPA, dated February 1, 2008. The report states the probability of causation value of colon cancer was less than 50%, and showed that the colon cancer was not "as least as likely as not" related to employment at the covered facility.

I am petitioning NIOSH to designate employees of ElectroMet in Niagara Falls, NY as members of the "Special Exposure Cohort" for the following reasons:

<u>*Lack of Evidence*</u>

Clearly there was no evidence before NIOSH or the Department of Labor that colon and liver cancer were caused other than by his exposure to radiation at the ElectroMet plant in Niagara Falls, New York. Prior to my father's diagnosis of colon cancer by , he was not treating for any medical condition at the time of his death in 1965. He devoted almost his entire work life to the ElectroMet (April 1937 through January 1965). He was employed as a laborer, working in the furnace areas of the ElectroMet. was not obese, did not smoke, was not suffering from diabetes nor was he suffering from any inflammatory bowel disease. His diet was nutritional and he had no family history of colon cancer or liver cancer.

<u>Flawed Dose Reconstruction</u>

It is my understanding that to determine the probability of causation for a cancer claim under EEOICPA, the Department of Labor utilized a computer software application developed by NIOSH in collaboration with the National Cancer Institute, called NIOSH - IREP. Apparently, the computer software is a science-based tool that allows DOL to determine the probability of cancer was caused by a person's radiation dose from nuclear weapons production work. The actual outcome of a claim depends on a number of important factors such as <u>dose estimates of the past exposures and the type of cancer that has been diagnosed</u>.

Records within the files of the Department of Labor, and the Department of Energy demonstrate that at the ElectroMet radiation doses were either **not monitored** or there was **very little monitoring done**. With respect to ElectroMet, dose reconstruction would require extensive data gathering and analysis which clearly is unavailable. The software used by NIOSH in evaluating exposure could not have included any specific characteristics of the monitoring procedures, if any, at ElectroMet. The software did not include any evaluation of production processes and safety procedures and the locations and activities of exposed employees at ElectroMet. There would have to be conducted a variety of complex analysis to understand any of the data, even if it was available from ElectroMet.

As an attorney, I have assisted several families who have filed EEOICPA claims for survivor benefits on behalf of former employees of the ElectroMet. The decisions I have reviewed from DOL are all claims for ElectroMet employees who have died of lung cancer. Claims for **bladder cancer** and **colon cancer** have been denied. NIOSH must seek a new method for evaluating radiation exposure at the ElectroMet since many employees of ElectroMet have been diagnosed with the specific cancers caused by exposure to radiation.

A USA Today article noted that the DOL and DOE have documents and memos in their possession demonstrating that ElectroMet, (which processed uranium from 1943 through 1952), radioactive dust levels often soared to **hundreds of times the prevailing safety limits**. Did the NIOSH software take this fact into consideration. Electromet failed to even vacuum work areas, despite being "persistently instructed", a 1949 AEC memo noted. When AEC medical officials suggested that the commission could pay for new ventilation, higher-ups balked at the cost. It was felt that it would only be a few more years before federal facilities would be built to take over the work done at ElectroMet. I enclose a copy of the USA Today articles dated August 16, 2000.

The Article states that the Institute for Energy and Environmental Research, after reviewing the records available, estimated that during peak years, workers' annual lung doses of radiation ranged from 50 to 6000 rem – measurements up to hundreds of times the limits of the day. Based on conventional risk formulas, exposure toward the high end of that range, even for just a few years, translates into a "***very high probability***" of cancer and kidney ailments, the Institute reported. The cost concerns that stymied action at ElectroMet were not unusual. More often, the major obstacles were operational. Clearly, ElectroMet along with Monsanto Chemical in Dayton, Ohio tended to have the biggest problems with worker exposures. Yet, NIOSH reports that my father's colon was only exposed to 9.78 rem. How certain can that figure be in view of the deplorable working conditions at ElectroMet.

It was noted that the Institute for Energy and Environmental Research estimates that workers with the worst cumulative radiation exposures got the equivalent of a whole-body radiation dose of about **1000 rem**. The level corresponds to a **40% chance of dying from cancer** over a lifetime and a **200% increase in cancer risk** compared with unexposed persons. No one at NIOSH, DOL or DOE can explain how my father, could have contracted colon and liver cancer other than by exposure to radiation while working at ElectroMet.

Uranium metal was fabricated at ElectroMet from uranium tetrafluoride (green salt). The process involved the mixing of green salt with magnesium metal flakes and the mixture was inserted into a furnace where the green salt was reduced to metal. It is noted that historically, the process at ElectroMet was **typically troublesome, involving frequent blow-outs**, especially under conditions of production pressure that characterized the first two decades of the nuclear era. The uranium would typically be a mixture of moderately soluble and insoluble compounds, with the former predominating, since green salt belongs in this category.

The USA Today article states that adequate data covering the entire time period of the ElectroMet operations, which began during the Manhattan Project and ended in 1953 **is mostly unavailable**. There was a limited amount of data on the range of air concentrations found in working areas at the ElectroMet, as well as air concentrations weighted over the working day. Actual exposure for personnel who worked at ElectroMet for a large portion of the period for which the plant operated can be expected to be considerably higher. ***One cannot assume that there would be a simple multiple of calculated doses, since air concentration data are not available from ElectroMet in the detail needed to make even an approximate calculation for the entire period.***

It is documented that industrial hygiene at ElectroMet was very poor. Many workers were evidently severely overexposed, since highly contaminated environmental conditions persisted in the workplace for prolonged periods. It is estimated that for production workers, committed lung doses due to exposure over a single 12-month period would range from over 50 rem to well over 6,000 rem. The most severely exposed workers would have a very high probability of contracting cancer. One would expect to find some heavy metal toxicity to the kidneys due to exposure to green salt. ***One can only wonder, did NIOSH's software for dose reconstruction take into consideration all of the facts I have enumerated in the USA Today article.***

The Article states that there are clearly uncertainties in any estimates in that there are variations in conditions experienced among the workers; the differences in physiology leading to different metabolic rates, and so on. Some workers would likely have encountered mainly insoluble types of uranium, while others would have encountered mainly soluble. There is uncertainty in the measurements of air concentrations, in the fluctuations in such concentrations from one day to the next, and in the estimates of dose conversion factors for any particular chemical form of uranium, and in the estimates of the effects of radiation exposure.

Records within the various federal agencies show that **working conditions at ElectroMet were very poor** and among **the most terribly reported** for any plant in the United States. Doses to many workers at ElectroMet are likely to have exceeded the dose limit of about **15 rem per year** that was established in 1949. The data and calculations suggest that the highest exposed workers had a "***high probability*** of cancer mortality as a result of the exposure."

There is also ample evidence that plant authorities, as well as the government of the United States, which contracted with these privately-owned companies to process material for its nuclear weapons program, were well aware at the time that workers at these plants were being overexposed over prolonged periods of time. There is also evidence that the U.S. government deliberately misled workers about health and safety issures by concealing the facts of very poor working conditions from them and by failing to undertake the **needed level of radiation dose surveillance**, including frequent and **widespread urine sampling, that was warranted**. A number of documents discuss inadequate controls of contamination and recommendations for improvement that were only sometimes taken into account.

It is unimaginable that the families of an employee that died of cancer while working at ElectroMet during the war years are compelled to accept the conclusions and recommendation of the Department of Labor and NIOSH that the employee does not qualify as a covered employee with cancer under EEIOCPA because a software program failed to establish that the probability of causation value was not 50% or greater.

The statement of the Honorable John N. Hostettler, Chairman of the Subcommittee in Congress on the implementation of the EEIOCPA stated in his address of December 5, 2006:

> The overreaching purpose of these hearings has been to make sure the Government is fulfilling the promises made to these workers who sacrificed so much for their country during the Cold War. This program was created to help them.....not as some science experiment to provide unlimited employment for the Government contractors' community, and certainly not to set these workers up to be deceived and minimized by the Government yet again.
>
> *****
>
> Because DOE and its contractors often did not properly monitor workers' exposure to radiation and other toxins and often records of worker exposure is no longer exist, EEIOCPA provided that HHS could

> designate such workers as members of the "Special Exposure Cohort" (SEC). Under a designated SEC, benefits are paid to workers who received on-the-job radiation exposure for a period of time and who have been diagnosed with one of twenty-two "radiosensitive" cancers.

Congressman Hostettler stated that:

> "When this law was enacted in 2000 (EEOICPA) Congress did not know how many new groups of workers might be designated as belonging in a Special Exposure Cohort, but from hearings in this committee we knew there was limited radiation monitoring data and non-existent health physics programs in the earliest years and this would make it almost impossible to accurately reconstruct dose for many claimants."

How can the Department of Labor and Department of Energy assure survivors of ElectroMet employees that the dose reconstruction software used by NIOSH is **accurate** with the limited radiation monitoring data and non-existent health physics programs at ElectroMet.

Congressman Hostettler said,

> Without the ability to add workers to the Special Exposure Cohort, many would face an insurmountable burden of proof, when it was the Government who placed them in harm's way, frequently misled them about the hazards they were facing, and failed to properly monitor their exposures.

According to Congressman Hostettler,

> At ElectroMet in Niagara Falls, New York, the AEC found that most of the process workers were exposed to uranium dust at 5 times the so-called preferred level, and the "bomb loaders" were exposed to 600 times the preferred level in 1948.

*****

> The AEC wrote that many employees of the various plants involved with the Manhattan Project were transferred from department to department and no record made of that fact. It is impossible without relying on the memory of individual employees and their family, to reconstruct the dust exposure records of many employees.

The Honorable John N. Hostettler concluded:

> To the workers, I say a heartfelt thank you. Thank you for your service to our nation. There are many of us who do appreciate you and your family's contribution to our world and want to do right by you........Finally, I want you to know that I have confidence that there are many people in this Government and this country who will continue to fight for you to get the respect and care you deserve for all you have done for us.

I respectfully implore NIOSH to take the necessary steps to designate employees of ElectroMet as members of the "Special Exposure Cohort"

Very truly yours,

Special Exposure Cohort Petition — Form B

Use of this form and disclosure of Social Security Number are voluntary. Failure to use this form or disclose this number will not result in the denial of any right, benefit, or privilege to which you may be entitled.

General Instructions on Completing this Form *(complete instructions are available in a separate packet):*

Except for signatures, please **PRINT** all information clearly and neatly on the form.

Please read each of Parts A — G in this form and complete the parts appropriate to you. If there is more than one petitioner, then each petitioner should complete those sections of parts A – C of the form that apply to them. Additional copies of the first two pages of this form are provided at the end of the form for this purpose. A maximum of three petitioners is allowed.

If you need more space to provide additional information, use the continuation page provided at the end of the form and attach the completed continuation page(s) to Form B.

If you have questions about the use of this form, please call the following NIOSH toll-free phone number and request to speak to someone in the Office of Compensation Analysis and Support about an SEC petition: 1-877-222-8570.

If you are:	☐ A Labor Organization,	Start at D	on Page 3
	☐ An Energy Employee (current or former),	Start at C	on Page 2
	☒ A Survivor (of a former Energy Employee),	Start at B	on Page 2
	☐ A Representative (of a current or former Energy Employee),	Start at A	on Page 1

A Representative Information — Complete Section A if you are authorized by an Employee or Survivor(s) to petition on behalf of a class.

A.1 **Are you a contact person for an organization?** ☐ Yes (Go to A.2) ☐ No (Go to A.3)

A.2 **Organization Information:**

Name of Organization

Position of Contact Person

A.3 **Name of Petition Representative:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

A.4 **Address:**

Street Apt # P.O. Box

City State Zip Code

A.5 **Telephone Number:**

A.6 **Email Address:**

A.7 ☐ Check the box at left to indicate you have attached to the back of this form written authorization to petition by the survivor(s) or employee(s) indicated in Parts B or C of this form. An authorization

If you are representing a Survivor, go to Part B; if you are representing an Employee, go to Part C.

Name or Social Security Number of First Petitioner: ____

Special Exposure Cohort Petition
under the Energy Employees Occupational Illness Compensation Act

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

B Survivor Information — Complete Section B if you are a Survivor or representing a Survivor.

B.1 **Name of Survivor:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

B.2 **Social Security Number of Survivor:**

B.3 **Address of Survivor:**

Street Apt # P.O. Box

City State Zip Code

B.4 **Telephone Number of Survivor:**

B.5 **Email Address of Survivor:**

B.6 **Relationship to Employee:**
- ☐ Spouse
- ☒ Son/Daughter
- ☐ Parent
- ☐ Grandparent
- ☐ Grandchild

Go to Part C.

C Employee Information — Complete Section C UNLESS you are a labor organization.

C.1 **Name of Employee:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.2 **Former Name of Employee** (e.g., maiden name/legal name change/other):

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.3 **Social Security Number of Employee:**

C.4 **Address of Employee** (if living):

Street Apt # P.O. Box

City State Zip Code

C.5 **Telephone Number of Employee:** ( ) -

C.6 **Email Address of Employee:**

C.7 **Employment Information Related to Petition:**

C.7a Employee Number (if known):

C.7b Dates of Employment: Start 1937 End 1965

C.7c Employer Name: ELECTRO METALLURGICAL COMPANY

C.7d Work Site Location: ROYAL AVENUE
NIAGARA FALLS, N.Y.

C.7e Supervisor's Name: UNKNOWN

Go to Part E.

Name or Social Security Number of First Petitioner: ____

D Labor Organization Information — Complete Section D ONLY if you are a labor organization.

D.1 **Labor Organization Information:**

____
Name of Organization

____
Position of Contact Person

D.2 **Name of Petition Representative:**

____

D.3 **Address of Petition Representative:**

____
Street Apt # P.O. Box

____
City State Zip Code

D.4 **Telephone Number of Petition Representative:** (____) ____-________

D.5 **Email Address of Petition Representative:** ______________________________

D.6 **Period during which labor organization represented employees covered by this petition** (please attach documentation): Start ____________ End ____________

D.7 **Identity of other labor organizations that may represent or have represented this class of employees** (if known):

____

Go to Part E.

E Proposed Definition of Employee Class Covered by Petition — Complete Section E.

E.1 **Name of DOE or AWE Facility:** ELECTRO METALLURGICAL COMPANY

E.2 **Locations at the Facility relevant to this petition:**
ROYAL AVENUE
NIAGARA FALLS, N.Y. EMPLOYEE IN
ALL BUILDINGS INCLUDING FURNACE BUILDING WERE EXPOSED TO RADIATION DUST.

E.3 **List job titles and/or job duties of employees included in the class. In addition, you can list by name any individuals other than petitioners identified on this form who you believe should be included in this class:** LABORERS, FURNACE WORKERS
MAINTENANCE WORKERS, SHIPPING EMPLOYEES

E.4 **Employment Dates relevant to this petition:**

Start 1942 End 1953

Start ____ End ____

Start ____ End ____

E.5 **Is the petition based on one or more unmonitored, unrecorded, or inadequately monitored or recorded exposure incidents?:** ☒ Yes ☐ No

If yes, provide the date(s) of the incident(s) and a complete description (attach additional pages as necessary):

URANIUM METAL WAS FABRICATED AT ELECTROMET FROM URANIUM TETRAFLUORIDE. THE PROCESS INVOLVED MIXING OF GREEN SALT WITH MAGNESIUM METAL FLAKES, AND THE INSERTION OF THE MIXTURE INTO A FURNACES, WHERE GREEN SALT WAS REDUCED TO METAL.

THE PROCESS WAS TYPICALLY TROUBLESOME INVOLVING FREQUENT BLOW-OUTS. DATES OF BLOW-OUTS IS UNKNOWN.

SEE ATTACHED USA ARTICLE

Go to Part F.

Name or Social Security Number of First Petitioner: ____

F Basis for Proposing that Records and Information are Inadequate for Individual Dose — Complete Section F.

Complete **at least one** of the following entries in this section by checking the appropriate box and providing the required information related to the selection. You are not required to complete more than one entry.

F.1 ☒ I/We have attached either documents or statements provided by affidavit that indicate that radiation exposures and radiation doses potentially incurred by members of the proposed class, that relate to this petition, were not monitored, either through personal monitoring or through area monitoring.

(Attach documents and/or affidavits to the back of the petition form.)

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that potential radiation exposures were not monitored.

URANIUM PRODUCTION (METAL) WAS OCCURING IN THE LATE 1940'S AT ELECTROMET. ONLY LIMITED DATA ON THE RANGE OF AIR CONCENTRATIONS FOUND IN WORKING AREAS, AS WELL AS AIR CONCENTRATIONS WEIGHTED OVER THE WORKING DAY ARE AVAILABLE IN THE DETAIL NEEDED TO MAKE EVEN AN APPROXIMATE DOSE CALCULATION. SEE USA ARTICLE ATTACHED.

F.2 ☒ I/ We have attached either documents or statements provided by affidavit that indicate that radiation monitoring records for members of the proposed class have been lost, falsified, or destroyed; or that there is no information regarding monitoring, source, source term, or process from the site where the employees worked.

(Attach documents and/or affidavits to the back of the petition form.)

Describe as completely as possible, to the extent it might be unclear, how the attached documentation and/or affidavit(s) indicate that radiation monitoring records for members of the proposed class have been lost, altered illegally, or destroyed.

AIR CONCENTRATION DATA IS LIMITED AT ELECTROMET SO ONE CAN ONLY ASSUME THE WAS LITTLE MONITORING IN DETAIL OR MONITORING RECORDS WERE LOST OR DESTROYED. INDUSTRIAL HYGIENE WAS "VERY POOR" AT ELECTROMET. MANY WORKERS WERE EVIDENTLY SEVERLY OVEREXPOSED TO RADIATION, AMPLE EVIDENCE U.S. GOVERNMENT AND ELECTROMET AUTHORITIES WERE WELL AWARE OF OVEREXPOSURE.

Part F is continued on the following page.

F.3 ☒ I/We have attached a report from a health physicist or other individual with expertise in radiation dose reconstruction documenting the limitations of existing DOE or AWE records on radiation exposures at the facility, as relevant to the petition. The report specifies the basis for believing these documented limitations might prevent the completion of dose reconstructions for members of the class under 42 CFR Part 82 and related NIOSH technical implementation guidelines.

(Attach report to the back of the petition form.) ATTACHED USA ARTICLE OF DOSE RECONSTRUCTION BY INSTITUTE FOR ENERGY AND ENVIRONMENTAL RESEARCH

F.4 ☐ I/We have attached a scientific or technical report, issued by a government agency of the Executive Branch of Government or the General Accounting Office, the Nuclear Regulatory Commission, or the Defense Nuclear Facilities Safety Board, or published in a peer-reviewed journal, that identifies dosimetry and related information that are unavailable (due to either a lack of monitoring or the destruction or loss of records) for estimating the radiation doses of employees covered by the petition.

(Attach report to the back of the petition form.)

Go to Part G.

G Signature of Person(s) Submitting this Petition — Complete Section G.

All Petitioners should sign and date the petition. A maximum of three persons may sign the petition.

Signature: [signature] Date: 1/9/09

Signature ______________________ Date ________

Signature ______________________ Date ________

Notice: Any person who knowingly makes any false statement, misrepresentation, concealment of fact or any other act of fraud to obtain compensation as provided under EEOICPA or who knowingly accepts compensation to which that person is not entitled is subject to civil or administrative remedies as well as felony criminal prosecution and may, under appropriate criminal provisions, be punished by a fine or imprisonment or both. I affirm that the information provided on this form is accurate and true.

Send this form to:
SEC Petition
Office of Compensation Analysis and Support
NIOSH
4676 Columbia Parkway, MS-C-47
Cincinnati, OH 45226

If there are additional petitioners, they must complete the Appendix Forms for additional petitioners. The Appendix forms are located at the end of this document.

Name or Social Security Number of First Petitioner: ______________________

Public Burden Statement

Public reporting burden for this collection of information is estimated to average 300 minutes per response, including time for reviewing instructions, gathering the information needed, and completing the form. If you have any comments regarding the burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, send them to CDC Reports Clearance Officer, 1600 Clifton Road, MS-E-11, Atlanta GA, 30333; ATTN:PRA 0920-0639. Do not send the completed petition form to this address. Completed petitions are to be submitted to NIOSH at the address provided in these instructions. Persons are not required to respond to the information collected on this form unless it displays a currently valid OMB number.

Privacy Act Advisement

In accordance with the Privacy Act of 1974, as amended (5 U.S.C. § 552a), you are hereby notified of the following:

The Energy Employees Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385) (EEOICPA) authorizes the President to designate additional classes of employees to be included in the Special Exposure Cohort (SEC). EEOICPA authorizes HHS to implement its responsibilities with the assistance of the National Institute for Occupational Safety (NIOSH), an Institute of the Centers for Disease Control and Prevention. Information obtained by NIOSH in connection with petitions for including additional classes of employees in the SEC will be used to evaluate the petition and report findings to the Advisory Board on Radiation and Worker Health and HHS.

Records containing identifiable information become part of an existing NIOSH system of records under the Privacy Act, 09-20-147 "Occupational Health Epidemiological Studies and EEOICPA Program Records. HHS/CDC/NIOSH." These records are treated in a confidential manner, unless otherwise compelled by law. Disclosures that NIOSH may need to make for the processing of your petition or other purposes are listed below.

NIOSH may need to disclose personal identifying information to: (a) the Department of Energy, other federal agencies, other government or private entities and to private sector employers to permit these entities to retrieve records required by NIOSH; (b) identified witnesses as designated by NIOSH so that these individuals can provide information to assist with the evaluation of SEC petitions; (c) contractors assisting NIOSH; (d) collaborating researchers, under certain limited circumstances to conduct further investigations; (e) Federal, state and local agencies for law enforcement purposes; and (f) a Member of Congress or a Congressional staff member in response to a verified inquiry.

This notice applies to all forms and informational requests that you may receive from NIOSH in connection with the evaluation of an SEC petition.

Use of the NIOSH petition forms (A and B) is voluntary but your provision of information required by these forms is mandatory for the consideration of a petition, as specified under 42 CFR Part 83. Petitions that fail to provide required information may not be considered by HHS.

Name or Social Security Number of First Petitioner: ______________________________

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Special Exposure Cohort Petition
under the Energy Employees Occupational Illness Compensation Act

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

Appendix — Petitioner 2

Use of this form and disclosure of Social Security Number are voluntary. Failure to use this form or disclose this number will not result in the denial of any right, benefit, or privilege to which you may be entitled.

Use this Appendix for Petitioner 2.

This appendix form is to be used as needed. Petitioner 2, or his or her representative, should complete the parts applicable to him or her.

Refer to the General Instructions on completing petitioner information for Parts A, B, or C.

If you need more space to provide additional information, use the continuation page provided at the end of the form and attach the completed continuation page(s) to Form B.

Except for signatures, please **PRINT** all information clearly and neatly on the form.

If you are:	☐ An Energy Employee (current or former),	Start at C
	☒ A Survivor (of a former Energy Employee),	Start at B
	☐ A Representative (of a current or former Energy Employee),	Start at A

A Representative Information — Complete Section A if you are authorized by an Employee or Survivor(s) to petition on behalf of a class.

A.1 **Are you a contact person for an organization?** ☐ Yes (Go to A.2) ☐ No (Go to A.3)

A.2 **Organization Information:**

Name of Organization

Position of Contact Person

A.3 **Name of Petition Representative:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

A.4 **Address:**

Street Apt # P.O. Box

City State Zip Code

A.5 **Telephone Number:**

A.6 **Email Address:**

A.7 ☐ Check the box at left to indicate you have attached to the back of this form written authorization to petition by the survivor(s) or employee(s) indicated in Parts B or C of this form. An authorization form for this purpose is provided.

If you are representing a Survivor, go to Part B; if you are representing an Employee, go to Part C.

Name or Social Security Number of First Petitioner: ______________________

Special Exposure Cohort Petition
under the Energy Employees Occupational
Illness Compensation Act

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

Appendix — Petitioner 2

B Survivor Information — Complete Section B if you are a Survivor or representing a Survivor.

B.1 **Name of Survivor:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

B.2 **Social Security Number of Survivor:** ______

B.3 **Address of Survivor:**

Street Apt # P.O. Box

City State Zip Code

B.4 **Telephone Number of Survivor:** (____) ____-______

B.5 **Email Address of Survivor:** ______

B.6 **Relationship to Employee:**
- ☐ Spouse
- ☒ Son/Daughter
- ☐ Parent
- ☐ Grandparent
- ☐ Grandchild

Go to Part C.

C Employee Information — Complete Section C.

C.1 **Name of Employee:**

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.2 **Former Name of Employee** (e.g., maiden name/legal name change/other):

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.3 **Social Security Number of Employee:** ______

C.4 **Address of Employee** (if living):

Street Apt # P.O. Box

City State Zip Code

C.5 **Telephone Number of Employee:** (____) ____-______

C.6 **Email Address of Employee:** ______

C.7 **Employment Information Related to Petition:**

C.7a Employee Number (if known): ______

C.7b Dates of Employment: Start ______ End ______

C.7c Employer Name: ______

C.7d Work Site Location: ______

C.7e Supervisor's Name: ______

Sign Part G of the original petition.

Name or Social Security Number of First Petitioner: ___

Special Exposure Cohort Petition
under the Energy Employees Occupational Illness Compensation Act

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

Appendix — Petitioner 3

Use of this form and disclosure of Social Security Number are voluntary. Failure to use this form or disclose this number will not result in the denial of any right, benefit, or privilege to which you may be entitled.

Use this Appendix for Petitioner 3.

This appendix form is to be used as needed. Petitioner 3, or his or her representative, should complete the parts applicable to him or her.

Refer to the General Instructions on completing petitioner information for Parts A, B, or C.

If you need more space to provide additional information, use the continuation page provided at the end of the form and attach the completed continuation page(s) to Form B.

Except for signatures, please **PRINT** all information clearly and neatly on the form.

If you are:	❑ An Energy Employee (current or former),	Start at C
	❑ A Survivor (of a former Energy Employee),	Start at B
	❑ A Representative (of a current or former Energy Employee),	Start at A

A Representative Information — Complete Section A if you are authorized by an Employee or Survivor(s) to petition on behalf of a class.

A.1 **Are you a contact person for an organization?** ❑ Yes (Go to A.2) ❑ No (Go to A.3)

A.2 **Organization Information:**

____
Name of Organization

____
Position of Contact Person

A.3 **Name of Petition Representative:**

____
Mr./Mrs./Ms. First Name Middle Initial Last Name

A.4 **Address:**

____
Street Apt # P.O. Box

____
City State Zip Code

A.5 **Telephone Number:** (____) ____-________

A.6 **Email Address:** ______________________

A.7 ❑ Check the box at left to indicate you have attached to the back of this form written authorization to petition by the survivor(s) or employee(s) indicated in Parts B or C of this form. An authorization form for this purpose is provided.

If you are representing a Survivor, go to Part B; if you are representing an Employee, go to Part C.

Name or Social Security Number of First Petitioner: ______________________

Special Exposure Cohort Petition
under the Energy Employees Occupational Illness Compensation Act

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
National Institute for Occupational Safety and Health

OMB Number: 0920-0639 Expires: 07/31/2010

Special Exposure Cohort Petition — Form B

Appendix — Petitioner 3

B Survivor Information — Complete Section B if you are a Survivor or representing a Survivor.

B.1 **Name of Survivor:**

____

Mr./Mrs./Ms. First Name Middle Initial Last Name

B.2 **Social Security Number of Survivor:** ____________________

B.3 **Address of Survivor:**

____

Street Apt # P.O. Box

____

City State Zip Code

B.4 **Telephone Number of Survivor:** (____) ____-________

B.5 **Email Address of Survivor:** ____________________

B.6 **Relationship to Employee:**
- ❑ Spouse
- ❑ Son/Daughter
- ❑ Parent
- ❑ Grandparent
- ❑ Grandchild

Go to Part C.

C Employee Information — Complete Section C.

C.1 **Name of Employee:**

____

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.2 **Former Name of Employee** (e.g., maiden name/legal name change/other):

____

Mr./Mrs./Ms. First Name Middle Initial Last Name

C.3 **Social Security Number of Employee:** ____________________

C.4 **Address of Employee** (if living):

____

Street Apt # P.O. Box

____

City State Zip Code

C.5 **Telephone Number of Employee:** (____) ____-________

C.6 **Email Address of Employee:** ____________________

C.7 **Employment Information Related to Petition:**

C.7a Employee Number (if known): ____________________

C.7b Dates of Employment: Start __________ End __________

C.7c Employer Name: ____________________

C.7d Work Site Location: ____________________

____

C.7e Supervisor's Name: ____________________

Sign Part G of the original petition.

Name or Social Security Number of First Petitioner: ____________________

Special Exposure Cohort Petition — Form B

Appendix — Continuation Page

Continuation Page — Photocopy and complete as necessary.

Attach to Form B if necessary.

Name or Social Security Number of First Petitioner: ____________________

09/06/00- Updated 11:48 AM ET

Preliminary Partial Dose Estimates from the Processing of Nuclear Materials at Three Plants during the 1940s and 1950s[1]

Arjun Makhijani,[2] Bernd Franke[3] and Hisham Zerriffi[4]

8/16/2000

1. Introduction

We analyzed some data in regard to working conditions and radiation exposures of workers at three nuclear materials processing facilities, pursuant to a contract between USA Today and the Institute for Energy and Environmental Research. The plants were:

1. The Simonds Saw & Steel Co. of Lockport, New York.
2. The Harshaw Chemical Co., Cleveland, Ohio
3. Electro-Metallurgical Co., Tonawanda, New York

All three plants processed uranium during portions of the 1940s and 1950s. Simonds also processed thorium metal. This study is a preliminary and partial evaluation of worker exposure in some job categories or locations. Its purpose was to perform screening type of calculations to ascertain whether the doses to workers in at least some locations or job categories were high enough to cause serious health concerns. This study is necessarily limited in scope and partial since a thorough effort would require far more documentation and data, time, and resources than were available in this project.

Since we did not have the data to perform individual worker dose assessments, or even to determine whether such assessments could be reliably performed, a relatively low dose in a particular job category may not correspond to a low dose for a specific worker. We performed only partial dose evaluations by job category. We have not assessed external doses. Job category dose estimates would lead to the most reliable conclusions for those workers who spent most or all their working time doing the jobs specified in the calculations, or working at the locations where the conditions described were prevalent. A low dose estimate for a particular job category may not correspond to an actual low dose, since our estimates are partial.

We have estimated doses due to inhalation of uranium by first calculating the amount of uranium breathed in by a worker in a typical work-day at a specific location or in a specific job category. In most cases, the time-weighted air concentrations were available in the documents provided to IEER by USA Today. The air concentration calculations were done by plant personnel at the time by estimating the total time spent in various locations by personnel in various job categories. For instance, a portion of the day would be at the specific location where uranium was being machined or processed, a portion in the general area of the processing, a portion in the lunch-room, etc. By weighting the air concentrations in various locations with the time typically spent in each location, the total amount of uranium that a worker was exposed to for the day can be calculated.

The dose from this intake of uranium can then be assessed, if we know the chemical form of the uranium, which tells us its solubility and hence approximately how long that uranium would remain in the body. Standard tables of "dose conversion factors" – the radiation dose per unit of a particular radioactive material inhaled or ingested – have been published by various scientific and regulatory bodies and provide differing factors depending on the solubility of the material. The dose conversion factors used in the United States are published in a 1988 report by the U.S. Environmental Protection Agency called the Federal Guidance Report No. 11.[5] We have used these in our calculations.

All dose calculations shown here are "committed doses." When a radioactive material is inhaled, it is eliminated gradually from the body, and the dose is received over a considerable period of time (depending on the solubility, particular size, and method of incorporation into the body). The term "committed doses" reflects the fact that exposures resulting from a single intake are considered over the entire time that inhaled uranium remains in the body.

Dose estimates derived from a given air concentration depend greatly on the assumed solubility of the material that is inhaled. To illustrate this point, we calculated the dose to lung tissue using the dose conversion factors in the Federal Guidance Report No. 11 from inhalation of natural uranium over an entire year (2000 working hours). We have assumed constant exposure at the in-plant maximum permissible concentration of 70 disintegrations per minute per cubic meter (dpm/m^3) in the plant air that was in effect at the time these facilities were operating.[6] The federal limit for concentration in air prevalent since 1949 was 38 dpm/m^3.[7] This limit was established based on the chemical toxicity of uranium and seems to have been ignored both by the government and its contractors, so far as we can determine. A limit of 0.009 μCi of uranium lung burden (apparently with a 90 day biological half-life) seems to have been established in 1951.[8]

The resulting doses calculated using an air concentration of 70 dpm/m^3, the prevailing radiological standard in the plants, and as calculated by present methods, are as follows:

- High solubility (class D): 0.084 rem/yr
- Moderate solubility (class W): 4.2 rem/yr
- Low solubility (class Y): 79 rem/yr

The difference between the lowest and the highest estimate is a factor of 940. It is apparent that if the solubility of material is not known, the results of calculations are subject to major uncertainties. For comparison, the federal limit of doses to any individual organ of the body, established in the early 1950s was 0.3 rem/week (or about 15 rem/year).[9]

Rather than relying on assumptions about the mixture of the materials, we used the results of our previous analysis of historical records for the workers at the Feed Material Production Center (FMPC) uranium facility in Fernald, Ohio. This allows the direct determination of the solubility of the inhaled material by comparing concentrations measured in lung tissue and in urine excretion.[10] This approach is justified because various processes at the three plants analyzed in this report were all done at the Fernald plant at one time or another. The Fernald worker data suggested that on the average, the inhaled uranium had metabolic characteristics of a mixture of material with about 90% moderate solubility (class W) and 10% of low solubility (class Y). For the above example, one year of continuous inhalation of natural uranium at the historical maximum permissible concentration of 70 disintegrations per minute per cubic meter results in a committed dose to the lung tissue of 12 rem. We believe that using the solubility mixture that was found for the Fernald facility provides the best estimate at the current time for the three plants reviewed here. Our assumption is subject to review and revision if more information about the specific mixtures of materials in the air at these three plants becomes available. An additional factor of uncertainty is the particle size of the material. The dose conversion factors are based on a mean aerodynamic size of 1 micron (μm). For 5 micron (μm) particles, doses could be up to 30% lower. The default assumption of a 1 micron particle size is standard practice when no data are available.

We have used a rather conservative estimate for the breathing rate of 20 liters per minute, averaged over a working day, corresponding to light work. Many operations involving uranium would fall into the category of heavy work, so that the average breathing rate over the working day for typical workers involved in manual work may well have exceeded that assumed here. Moreover, heavier breathing rates would likely apply to periods of work in more contaminated areas, so that average air concentration, weighted by breathing rate would be higher than the one we have assumed. Since the estimated dose is directly proportional to the breathing rate, our assumption of a 20 liters/minute breathing rate (as recommended by the ICRP for default calculations) may result in a considerable underestimate of doses for some workers.[11]

While the lung tissue is the organ that receives the largest dose from uranium of moderate to low solubility, doses can also be expressed in terms of "effective dose equivalent." The effective dose equivalent (EDE) is a calculated value for which doses to various tissues are multiplied by a factor that indicates the relative risk of a fatal cancer as a result of the tissue exposure. In the above example calculation, a 12 rem lung dose results in an EDE of 1.44 rem. According to the International Commission on Radiological Protection,[12] an effective dose of 1 rem is associated with a 0.04% excess risk of cancer mortality, assuming a linear dose-response relationship. While this risk factor is subject to uncertainties and its accuracy is being debated in the scientific community, we used this widely applied value as a benchmark to illustrate the risks associated with the exposures.

If the uranium activity in air were to contain more soluble compounds, the estimated radiation doses and cancer risk would be smaller. However, forms of soluble uranium, such as uranium hexafluoride and uranyl fluoride, are associated with more severe nephrotoxic effects. Nephrotoxicity – damage to the kidney – is a well-known effect of uranium as a heavy metal. That is, it results from uranium as a heavy metal (like lead or mercury), rather than as a radioactive material. Severe damage to the kidneys could, in turn, cause a variety of other serious health problems and death.

We checked our calculations for consistency against the scant urine data that were available for the Harshaw plant, and this check confirms our principal conclusion that many workers were severely overexposed to uranium dust. An extensive and definitive check is not possible, since the necessary urine data are not available.

One more note on methodology is in order. The methods used to calculate doses in the 1940s and 1950s were not the same as those prevalent today. We have used dose estimation factors that are in use today for regulatory purposes in the United States. Methods prevalent at the time would have resulted in dose estimates about a factor of two lower for the same uranium air concentration data.

2. The Simonds Saw & Steel Co.

Between 25 and 35 million pounds of uranium metal was rolled at Simonds between March or April 1948 and 1956 (with the vast majority of the work done between 1948 and 1952).[13] About 99 percent of this work was done on a 16 inch mill, while the rest was done on a 10 inch mill.[14] Simonds also rolled 30,000 to 40,000 pounds of thorium metal. Thorium was processed on the 10 inch mill.

The work with uranium and thorium was done approximately half-time during the period of peak production (1948-1952), while the same machines were used to roll steel for commercial applications the rest of the time.[15] There is ample evidence that the plant premises became seriously contaminated during processing of radioactive materials. For instance, even air in the lunch areas was measured to have contamination far above allowable limits of contamination.[16] As a result, workers were certainly exposed to radiation, for instance through re-suspended particles, even when steel processing was going on. We have not attempted to assess the doses to workers during steel processing. We have also not attempted to estimate the consequences of food becoming contaminated as a result of poor industrial hygiene. Including all of these factors could substantially increase the dose estimates.

We have also not attempted to assess the radiological consequences to workers and the general public of processing, transporting or using steel that was fabricated on machines that were contaminated in a plant that was contaminated. Finally, we have not estimated the exposures suffered by the families of the workers who may have tracked significant amounts of radioactive contamination home on their clothes, bodies, and vehicles. Doses in some of these categories may have been significant. In particular, doses to workers during the periods when they were processing steel were likely to have been significant in at least some cases, since the working environment was severely contaminated. The re-suspension of uranium and thorium dust during work operations as well as during clean-up of the plant premises were not evaluated. In other words, our calculations were strictly limited to calculating the dose to workers from uranium (and thorium) inhaled during the days when processing of these materials was done.

We did not have data on all the radiological surveys. We have used the available data to make estimates of doses from uranium metal processing up until 6 August 1954. We do not have survey data covering the rest of the period through the end of operations in December 1956. Thus, the doses presented here are partial exposure estimates that underestimate doses to personnel who worked through the entire period of processing. We have made exposure estimates by job classification. If one person did the job for the entire period, the dose estimate represents a typical expected exposure (see below for discussion of uncertainties). If the personnel doing the job changed, this dose estimate would not apply to any particular individual, but rather to the sequence of individuals who did the particular job over the specified period.

When uranium metal is rolled it becomes hot and can even catch fire. The emissions from the operation are typically a mixture of oxides of uranium, whose solubility range from very insoluble to moderately soluble. It may take many months or years for highly insoluble materials to be eliminated once lodged in the lung, while moderately soluble materials may be eliminated within a few weeks. Figure 1 shows the lung dose estimates for the particular jobs associated with uranium rolling operations at Simonds during the peak production period of 1948-1952.

Figure 1

Workers in the same job may have had doses several times higher or lower than this, depending on specific working times and conditions, as well as individual differences in the metabolic behavior of uranium in the body.

The records for the period from 1953 to the end of the contract in 1956 indicate that the amount of uranium processed per year was lower by about an order of magnitude than the early years. Air concentrations of uranium dropped considerably in the 1953-1956 period, hence the cumulative dose in this period would likely have been much lower to many or most workers than in the previous period. Finally, we have no data for 1955 and 1956. For these reasons, we have not included any estimate of dose for the 1953 to 1956 period. The shorter work times and lower concentrations would likely result in lower average doses in the 1953-1956 period though this does not preclude the possibility that individual workers may have had substantial doses in this period.

Many workers were also exposed to thorium dust. Even though the amount of thorium processed was almost a factor of one thousand less than uranium, exposures to workers who processed thorium appear to have been substantial. This is because exposure to thorium results in larger doses than uranium per unit of radioactive contamination of air. Further, thorium doses are far less sensitive to assumptions about solubility than uranium doses (i.e. differences in solubility result in much smaller differences in the final dose with thorium). Finally, radioactive decay products build up relatively rapidly in thorium, if it is stored for a few years before processing. We have not been able to estimate doses due to these decay products, since we do not have data on how long the thorium was stored after conversion to metal and prior to rolling operations.

Thorium processing operations may have taken as little as one week and possibly much longer.[17] Based on available data, it is not possible for us to estimate the total number of full time equivalent days for which the thorium milling operation was conducted. We have therefore calculated thorium doses corresponding to one week of full time work. Bone surface doses over a one-week exposure period would range from about 400 rem to almost 2,500 rem, depending on working conditions and thorium solubility. We do not have a basis on which to select a mix of solubilities based on the available data. If the work was carried out for several weeks, then the dose estimates would be correspondingly higher.

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

3. Harshaw Chemical Co.

Harshaw Chemical Co. conducted a number of chemical operations to produce uranium hexafluoride for uranium enrichment operations. Part-time operations began during the World War II Manhattan Project, during which highly enriched uranium was used to make the nuclear bomb that was dropped on Hiroshima. Production was scaled up after the war and "substantially expanded" in 1947.[18]

The chemical forms of uranium present at Harshaw range from the highly soluble (uranium hexafluoride) to the highly insoluble (uranium dioxide).[19] Industrial hygiene was very poor, with air contamination exceeding maximum allowable concentrations in some cases by several hundred fold, averaged over the entire working day.[20]

Assuming that workers were exposed to the same mix of uranium compounds as seen at Fernald, as would be likely for at least some portion of the plant personnel, the radiation doses to the lungs of workers in moderately exposed categories would be in the hundreds of rem, cumulative (Table 1). The calculations assumed an 8-hr work day, and 20 work days per month, averaged over a year. In the case of the most severely exposed workers, who either worked in highly contaminated conditions, or for long periods, and, in the worst cases, both, cumulative lung doses were thousands of rem. If the assumptions we have made about the solubility of uranium are correct, the lung dose in the highest category in Table 1 is 8,400 rem. This is equivalent to an effective dose of about 1,000 rem, using official lung to whole body dose equivalence factor for the lung of 0.12.[21] Using the EPA (and ICRP) fatal cancer risk factor of 4 deaths per 10,000 rem, we can estimate that a worker would have a 40 percent chance of dying from cancer as a result of an exposure of 1,000 rem. This is an increase of 200 percent in fatal cancer risk compared to unexposed persons.

Table 1. Distribution of employees by length of employment and level of dust exposure at Harshaw Chemical Co. 1945-1949. Mean lung doses were estimated assuming the same solubility of uranium as found at FMPC.

Exposure category	Number of months of exposure				
	0 to 6	6 to 12	12 to 24	24 to 36	36 to 48
0 to 70 dpm/m^3 # of workers estimated mean lung dose, rem	1 1.4	2 4,2	2 8.4	0 14	1 20
70 to 350 dpm/m^3 # of workers estimated mean lung dose, rem	1 6.3	1 9	0 38	0 63	2 88
350 to 1,750 dpm/m^3 # of workers estimated mean lung dose, rem	0 31	5 94	5 190	12 310	10 440
1,750 to 8,750 dpm/m^3 # of workers estimated mean lung dose, rem	0 160	0 470	0 940	0 1,600	0 2,200
> 8,750 dpm/m^3 # of workers estimated mean lung dose, rem	0 600	17 1,800	10 3,600	3 6,000	4 8,400

Note 1: To estimate mean dose, we have used the geometric mean of the lowest and highest uranium concentration (except for the 0 to 70 category, where we have used the arithmetic mean, since the geometric mean gives an implausible zero result). This use of the geometric mean gives a lower mean dose estimate than would be obtained by the use of an arithmetic mean. Doses corresponding to the minimum and maximum concentrations in a category would be a factor of 2.23 lower or higher than the geometric mean dose (except for the first row, in which case the range is from 0 to a factor of two higher). We have used the arithmetic mean for the number of months. The result in this case is insensitive to the use of geometric or arithmetic mean.

Note 2: The dose for the final category was calculated using the geometric mean of 8,750 dpm/m^3 and the maximum exposure recorded, which was 25,900 dpm/m^3 (370 times the maximum allowable concentration).

Note 3: No doses were calculated beyond the 48-month exposure category. However, it is necessary to note that one worker received exposures less than the MAC for over 48 months and eleven workers received exposures at levels between 5 and 25 times the MAC for over 48 months.

If the uranium were to be of more soluble compounds, the estimated radiation doses and cancer risk would be smaller and the likelihood of severe nephrotoxic effects would be far larger. Plant documents indicate that such kidney damage was in fact reported.[22] Lower radiation doses and higher nephrotoxic effects would be more likely for workers who were exposed primarily to soluble uranium, notably uranium hexafluoride and its hydration product, uranyl fluoride.

The results were checked against a simple calculation of the expected amount of uranium in the urine of a hypothetical worker exposed to the level of uranium in air that would be consistent with a lung dose of about 15 rem/yr. The excretion in urine expected from exposure to this level and particular mix of uranium would be about 10 micrograms per liter.[23] Urine data for six individuals from Harshaw are as follows[24]:

1 person: 17 micrograms per liter

2 persons: between 100 and 200 micrograms per liter

1 person: between 200 and 300 micrograms per liter

2 persons: more than 300 micrograms per liter.

These data are consistent with our dose calculations made from uranium concentrations prevalent in the plant and tend to support the hypothesis that many workers were exposed to more than prevailing dose limits.

Harshaw documents also indicate that external gamma and beta doses, were also high in some cases. Uranium emits x-rays, and the uranium decay products include both beta and gamma emitters, leading to external radiation exposures. Cumulative doses due to external beta-gamma radiation measured with film badges were reported to be up 160 rep.[25] Further, thorium-234 and protactinium-234, are present in larger than usual concentrations in the types of operations that took place at Harshaw. These two radionuclides give rise to beta radiation exposures. We have not attempted within the scope of this limited study to systematically quantify external exposures. However, even a cursory review of Harshaw documents shows that for at least some workers, these may have been high and that they would compound the problems resulting from internal uranium exposure.

Finally, the manufacture of uranium hexafluoride involves the use of severely toxic chemicals, including fluorine. Moreover, when uranium hexafluoride makes contact with the humidity in air (which would be high in the Cleveland area during at least some parts of the year), it readily combines with water vapor to yield uranyl fluoride and hydrofluoric acid. Hence, exposure to uranium hexafluoride would also generally entail exposure to hydrofluoric acid, which is highly toxic.

4. Electro-Metallurgical Co. (Electromet)

Uranium metal was fabricated at Electromet from uranium tetrafluoride (also called "green salt").[26] The process involves the mixing of green salt with magnesium metal flakes, and the insertion of the mixture into a furnace, where the green salt is reduced to metal. Historically, the process was typically troublesome, involving frequent blow-outs, especially under conditions of production pressure that characterized the first two decades of the nuclear era. The uranium would typically be a mixture of moderately soluble and insoluble compounds, with the former predominating, since green salt belongs in this category. Electromet also conducted other operations including thorium processing, which we are not addressing in this report.

We did not have adequate data covering the entire time period of Electromet operation, which began during the Manhattan Project and ended in 1953.[27] We know that full time uranium metal production was occurring in the late 1940s, for which we have some data on the range of air concentrations found in working areas, as well as air concentrations weighted over the working day.[28] We have performed dose calculations using these figures for one individual over 240 working days (corresponding to a working year of 48 weeks, 5 days per week). Actual exposure for personnel who worked for a large portion of the period for which the plant operated can be expected to be considerably higher. However, we cannot assume that they would be a simple multiple of the calculated doses, since air concentration data are not available in the detail needed to make even an approximate calculation for the entire period.

Industrial hygiene at Electromet was very poor. Many workers were evidently severely overexposed, since highly contaminated environmental conditions persisted in the workplace for prolonged periods. We estimate that for production workers, committed lung doses due to exposure over a single twelve-month period would range from over 50 rem to well over 6,000 rem. The most severely exposed workers would have a very high probability of contracting cancer. One would also expect to find some heavy metal toxicity to the kidneys due to exposure to green salt.

5. Uncertainties

There are two types of uncertainties in our estimates (other than the issue of the partial nature of the calculations themselves, which means that actual doses would be systematically higher than the ones reported here). First, there are the variations in conditions experienced among the workers, the differences in physiology leading to different metabolic rates, and so on. For instance, some workers at Harshaw would likely have encountered mainly insoluble types of uranium, while others would have encountered mainly soluble types of uranium.

The second type of uncertainty relates to the uncertainties in the measurements of air concentrations, in fluctuations in such concentrations from one day to the next, in the estimates of dose conversion factors for any particular chemical form of uranium, and in estimates of the effects of radiation exposure.

In addition to these uncertainties, our estimates are partial since we have not included external doses, and since we have not been able to estimate doses over the entire working period in several cases.

Actual exposures of workers within any group could easily be several times lower or higher than those estimated here. The limited nature of the study and the preliminary and partial nature of the calculation does not justify extensive effort on a formal uncertainty analysis. We recommend that a more formal effort, with a more complete set of data be undertaken. However, there is enough evidence to come to a reasonably certain conclusion that due to poor working conditions, exposures to many workers were very high and far above then-prevailing regulations.

6. Conclusions

Working conditions at these three plants were very poor and among the most terrible reported for any plant in the United States. Based on our screening calculations, doses to many workers are likely to have exceeded the dose limit of about 15 rem per year that was established in 1949. The data and our calculations also suggest that the highest exposed workers had a high probability of cancer mortality as the result of the exposure. It must be remembered that we have arrived at this conclusion even though our dose calculations are partial and do not cover the entire periods of plant operation and all types of doses. Other types of health problems, including kidney damage, would also be likely among those workers exposed to the more soluble forms of uranium.

We do not have comparable data from nuclear weapons plants that processed uranium in the Soviet Union during the late 1940s and early 1950s. Some external dose data for workers at a reactor and a reprocessing plant in the southern Ural Mountains have been reported. Heretofore, we have assumed, based on available evidence, that worker exposures were far higher in the Soviet Union that in the United States.[29] However, the partial estimates that we have made here are so high that this assumption may need to be revisited for many of the workers at these forgotten nuclear weapons plants. We should also note that the extent of the health damage may have extended to the families of workers and to the general public in ways that we have not assessed in this preliminary report.

Finally, there is ample evidence that plant authorities as well as the government of the United States, which contracted with these privately-owned companies to process material for its nuclear weapons program, were well aware at the time that workers at these plants were being severely overexposed over prolonged periods of time. There is also evidence that the US government deliberately misled workers about health and safety issues by concealing the facts of very poor working conditions from them and by failing to undertake the needed level of radiation dose surveillance, including frequent and widespread urine sampling, that was warranted. A number of documents discuss inadequate controls of contamination and recommendations for improvement that were only sometimes taken into account. For example, in discussing the problems at Harshaw, one document states that:

> These findings [90% of plant workers being exposed to higher than the "preferred level" of contamination with 76% exposed to 10 to 374 times that level] are consistent with the results of other NYOO investigations, and show that the equipment and procedures presently used for the control of alpha-emitting dust and fumes are completely inadequate.

> The last survey points up the urgent need for control measures, which have been previously recommended in considerable detail to the contractor. The situation was discussed in a conference held during the month with the Plant Manager. A summary of the survey findings, together with all recommendations to date, will be given to the contractor, whose attention has been called to contractual obligations for observing health and safety requirements.[30]

In some cases, there was a hesitation to spend money to correct problems in plants that were expected to be placed on stand-by and no longer be in use for production. At least a year before the Electromet facility was to transition to stand-by, one AEC document notes that:

> In order to provide for adequate dust control, a substantial sum of money ($50,000 to $100,000) would have to be spent. As before, whether or not extensive dust exposures are corrected will depend on policy decision as to the advisability of spending funds for the purpose of placing stand-by plants in satisfactory medical condition.
>
> During the next few months, minor changes in process ventilation can be expected to alleviate the dust exposure to some extent.[31]

One document points clearly to the practice of keeping information about the health risks of their jobs from the workers. In a letter from W. E. Kelley, Manager of the New York Operations Office of the AEC to the vice-president of the Harshaw Chemical Company, a briefing for workers is described. In that briefing, a staff member of the AEC spoke to the employees to "explain to them that all of our [AEC] records indicated that no unusual hazard existed, but that the Harshaw Company, with the assistance of the Atomic Energy Commission, was proceeding more intensively in an effort to uncover any possibility of danger." This was done because it was understood that "extensive sample taking ... may upset employees and cause them to wonder about their health and safety." However, the very next paragraph of the letter states that according to their early animal studies and general knowledge of radiation, 50 micrograms per cubic meter was the "most popular figure" of what could be tolerated and that this level had been exceeded. Measurements indicated levels exceeding 1,000 micrograms per cubic meter (34 out of 67 samples) and even 10,000 micrograms per cubic meter (17 out of 67 samples). Thus, it was clear that the levels of radioactive material in the air were above what was coming to be understood to be the limit that was tolerable. At the same time the workers were being told that "no unusual hazard existed."[32]

The findings of this study may have broad applicability to many other privately owned plants where uranium processing was done during the 1940s and 1950s. One of our findings, relating to the high radiation doses due to thorium-232 exposure at the Simonds plant, has considerable importance for some government-owned nuclear weapons plants as well as the privately owned plants not studied here. Thorium processing occurred at several other places (including the Fernald plant near Cincinnati, for instance). This is an issue that needs to be more carefully evaluated, since it is possible that exposures to workers, their families and to members of the general public due to thorium processing (and possibly also thorium handling) may have been considerable despite the relatively small amounts (compared to uranium) of thorium that were processed.

It is clear that the effects of the nuclear weapons enterprise on society are even vaster than heretofore acknowledged. The tasks of health monitoring for affected populations, health care for the sick, and environmental remediation of the legacy of nuclear weapons production will be even more complex and larger than currently anticipated.

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[1] This report was produced by the Institute for Energy and Environmental Research (www.ieer.org) under contract to USA Today, which supplied IEER with the plant documents as well as summaries of operating periods for the plants.

[2] Arjun Makhijani is president of the Institute for Energy and Environmental Research in Takoma Park, Maryland

[3] Bernd Franke is a scientific director at ifeu-Institut für Energie- und Umweltforschung GmbH in Heidelberg, Germany.

[4] Hisham Zerriffi is a senior scientist at the Institute for Energy and Environmental Research.

[5] K.F. Eckerman et al., *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, Federal Guidance Report Number 11. Washington, DC: U.S. Environmental Protection Agency, 1988.

[6] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. Appendix III of this document details the calculation of this air concentration limit.

[7] National Bureau of Standards, *Maximum Permissible Amounts of Radioisotopes in the Human Body and Maximum Permissible Concentrations in Air and Water.* National Bureau of Standards Handbook 52, Washington DC: U.S. Department of Commerce, issued March 20, 1953. This handbook provides concentration limits for certain radionuclides in the body, air, and water (Table 3). The values for uranium provided in Table 3 were agreed upon at the meeting of the University of Rochester Atomic Energy Project and members of the Atomic Energy Commission, Rochester, NY, Sept. 27, 1949 as cited on page 17.

[8] *NBS Handbook 52,* Table 3A. While the handbook was issued in 1953, the values in the table are from October 1951

[9] *NBS Handbook 52,* p. 13. The handbook states that the "maximum permissible concentration of radioisotopes in air and water and the

external radiation should not exceed values that will permit an exposure of 0.3 rem/week to any part of the body except the epidermal skin layer."

[10] Bernd Franke and Kevin Gurney, *Estimates of Lung Burdens for Workers at the Feed Materials Production Center, Fernald, Ohio.* Institute for Energy and Environmental Research, July 1994. Additional reports describing the methodology and theory are cited in this document. The Fernald worker report was produced for the plaintiffs in a class action lawsuit filed by the Fernald workers against the contractor of the plant, National Lead of Ohio. The U.S. Department of Energy (called the Atomic Energy Commission during the decades immediately after World War II) owns the plant, which was closed in 1989. The US government settled the lawsuit in 1994, one week after the trial began, providing most of the workers with medical monitoring as well as $15 million in compensation.

[11] International Commission on Radiological Protection. *Limits for Intakes of Radionuclides by Workers.* Annals of the ICRP, ICRP Publication 30, Part 1, Vol 2, No. 3/4. Oxford: Pergamon Press, 1979, p. 9. The ICRP recommends 20 liters/minute, the value for "light activity," as the default value in the absence of more precise information.

[12] International Commission on Radiological Protection. *1990 Recommendations of the International Commission on Radiological Protection.* Annals of the ICRP, ICRP Publication 60, Vol. 21, No. 1-3. Oxford: Pergamon Press, 1991, p. 70.

[13] This information comes from an undated government memorandum, apparently generated by Oak Ridge circa 1958. It is contained in the New York State Archives and is part of materials obtained through the Freedom of Information Act by the State of New York in preparation for a 1981 report by the New York State General Assembly. The documents were obtained by the State from the Environmental Protection Agency, which obtained the document in 1977-1978. The title of the page is *Uranium History.*

[14] *Authority Review for the Former Simonds Saw and Steel Co., Lockport, New York.* Formerly Utilized Sites Remedial Action Program (FUSRAP), Aug. 9, 1984.

[15] According to the *Uranium History*, Simonds processed approximately 5.46 million pounds of uranium per year in the time period 1948-1952. Another document, *Industrial Hygiene Survey of Uranium rolling at Simonds Saw & Steel Co.* by Charles E. Schumann, Health and Safety Division, National Lead Company of Ohio, February 5, 1953, describes the rolling procedures. Processing approximately 300,000 pounds of uranium required 130 working hours and was done using two shifts of ten hours each. Therefore, processing the annual throughput of 5.46 million pounds would require a total of 2400 hours per year. Assuming two shifts per day were always used and a fifty week work-year, this would require approximately 24 working hours per week. We have rounded this estimate to one significant figure and used 20 hours per week in our calculations.

[16] For example, one survey found that the alpha radiation concentration in the lunch area air was 1,410 dpm/m^3 (20 times the

plant's maximum permissible concentration). *Simonds Saw and Steel Co., Occupational Exposure to Radioactive Dust, Visit of October 27, 1948.*

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

[18] *Review Summary Report, Harshaw Chemical Company, Cleveland Ohio*. Formerly Utilized Sites Remedial Action Program (FUSRAP), 20 November 1984, Enclosure 1.

[19] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. p. 24

[20] For example, see Memo from R. E. Hayden to M. Eisenbud, "Health Survey of Harshaw Chemical Company, Area C." May 4, 1948.

[21] ICRP Publication Number 60, Oxford, 1991, p. 8.

[22] For example, see U.S. Atomic Energy Commission, New York Operations Office, Health and Safety Division. *Monthly report of Field Activities, September 1950.* p. 6

[23] For an explanation of the methodology of converting lung burden to urine concentration see Franke and Gurney 1994.

[24] Letter from W.E. Kelley, Manager, New York Operations Office, Atomic Energy Commission, to C.S. Parke, Vice-President, The Harshaw Chemical Company, January 28, 1948.

[25] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. Figure 8. Rep - "Roentgen equivalent physical" is a historical dose unit used in the 1940s. One rep represents the energy absorption of 93 ergs per gram of tissue. The measurements are difficult to interpret, however, since the specific sensitivity of the film badges to beta and gamma radiation is not know. Hence, the depth of tissue penetration cannot be determined without additional information. At least some parts of worker skin tissues are likely to have been exposed to the level measured with film badges.

[26] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. p. 68.

[27] Electro Metallurgical Company (Electromet), Niagara Falls, New York. Formerly Utilized Sites Remedial Action Program (FUSRAP), 11/1985. P. 5-120 – 5-121. The site did not have continuous AEC operations between 1946 and 1953, but rather conducted AEC operations on specific projects for a few months or more at a time (in one case for two years). It should also be noted that after the AEC contract was terminated in June 1953, Electromet continued to process uranium and thorium for commercial use.

[28] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. pp. 30-31 and *Dust Hazards at Electrometallurgical Company.* Transmitted to Mr. E.C. Forbes, Superintendent of Area Plant, Electrometallurgical Company by F.M. Belmore, Director, Production Division. New York Operations Office, U.S. A.E.C., June 18, 1948.

[29] Arjun Makhijani, Howard Hu and Katherine Yih, eds., *Nuclear Wastelands.* Cambridge, MA: MIT Press, 1995, Chapter 7, p. 367.

[30] *Monthly Status and Progress Report for December 1948.* Submitted by the New York Operations Office of the Atomic Energy Commission by W.E. Kelley, Manager. January 5, 1949. p. 17

[31] U.S. Atomic Energy Commission, New York Operations Office. *Health Hazards in NYOO Facilities Producing and Processing Uranium (A Status Report – April 1, 1949).* Prepared by NYOO Medical Division. Issued April 18, 1949. p. 31

[32] Letter from W.E. Kelley, Manager, New York Operations Office, Atomic Energy Commission, to C.S. Parke, Vice-President, The Harshaw Chemical Company, January 28, 1948.
