THE UNIVERSITY OF IOWA

COLLEGE OF PUBLIC HEALTH
Department of Occupational and Environmental Health

BURLINGTON ATOMIC ENERGY COMMISSION PLANT
FORMER WORKER PROGRAM

SEC 38

Date June 29, 2005

Dear Mr. Elliot,

Please find enclosed an electronic copy of the Special Exposure Cohort Petition (Draft) for the Ames Laboratory, Ames IA, Department of Energy workers.

This petition covers period between January 1, 1942 and December 31,1955 and is based on information indicating heavy exposures to uranium, thorium and thoron with little engineering control, presumably inadequate personal protection and a lack of personal radiation monitoring results making accurate and timely dose reconstruction problematic or impossible.

Should you have any remarks, comments, or questions please contact us at 1-866-282-5818

Sincerely,

Laurence Fuortes M.D.
The University of Iowa
College of Public Health
2115 Westlawn
Iowa City, IA 52242
Laurence-fuortes@uiowa.edu

UI College of Public Health
2115 Westlawn
Iowa City, Iowa 52242
Toll Free 1-866-282-5818
Fax 319-353-5649

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

Special Exposure Cohort Petition — Form B

OMB Number: 0920-0639 Expires: 05/31/2007

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: **1-800-356-4674.**

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
	X 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) X 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
	LAURENCE	J.	FUORTES, M D

A.4 **Address:**

UNIVERSITY OF IOWA, COLLEGE OF PUBLIC HEALTH, DEPARTMENT OF OCCUPATIONAL AND ENVIRONMENTAL HEALTH
Street Apt # P.O. Box

City	State	Zip Code
IOWA CITY	IA	52246

A.5 **Telephone Number:** (319)335-9819

A 6 **Email Address:** laurence-fuortes@uiowa.edu

A 7 X 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: Laurence Fuortes

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

E.1 Name of DOE or AWE Facility: Ames Laboratory, Iowa State University

E.2 Locations at the Facility relevant to this petition:

Ames Laboratory campus, AEC/DOE facilities including Annex 1, the old womens' gymnasium,"Little Ankeny", Chemistry Bldg, Wilhelm Hall

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:

Scientists, production workers, technicians, salaried graduate students, physical plant workers, maintenance, administrative and support staff

E.4 Employment Dates relevant to this petition:

Start	January 1,1942	End	December 31,1945; for uranium processing exposures
Start	January1,1945	End	December 31,1955; for uranium and thorium processing , thoron gas
Start		End	and to a lesser extent irradiated uranium and plutonium exposures

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):

The work at Ames Lab during the Manhattan Project period 1942 through 1945 involved further processing of over two milion pounds of uranium tetrafluoride, UF(4), "green salt" received from the purification processes carried out by The Malinkrodt Chemical Company in St.Louis,MO. Malinkrodt received crude "yellow cake" (ammonium or sodium diuranate) from various ore processors and dissolved the ores in nitric acid.

The uranium content was purified by a solvent extraction process involving diethyl ether. The extracted uranium of the uranyl nitrate was reduced from the hexavalent state to its tetravalent state and precipitated as uranium tetrafluoride (which was dried and shipped to Ames). At Ames, the uranium tetrafluoride (green salt) was finely ground, mixed with pure, granulated magnesium metal (or possibly sodium or calcium), and heated in the absence of air to obtain pure uranium metal, and separated from the magnesium fluoride slag. The uranium "biscuits" were remelted, recast and machined into ingots, *(lathed under oil to specific tolerances)* and each ingot or the shaved uranium from the lathing process was analyzed for possible contaminants before shipping to the reactor sites (University of Chicago and Oak Ridge). Descriptions of relevant processes and exposures are continued below

Go to Part F.

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 X 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.
Attached are scanned pages from chapter 7 of a text entitled "Industrial Medicine on the Plutonium Project,Survey and Collected Papers, edited by Robert F.Stone, McGraw-Hill Book Co.Published 1951, Chapter 7 is entitled "Uranium Excretion Studies" and reports the results of urinary excretion results for 48 individuals stratified into four groups on the basis of expected exposure to UF(4). These assays were collected on Monday mornings after the most recent exposure ending Saturday at noon Two of eleven workers in the highest exposure category had urinary excretion concentrations measured at 200 micrograms per liter. Also attached are results of area radionuclide monitoring from a survey of the thorium processing activities in 1952 entitled Occupational Exposure to Thorium and Beryllium and a PhD Thesis by Dr. Carolyn Stilts Payne from 1992 entitled The Ames Project: Administering Classified Research

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.
Ames Laboratory staff report being unable to locate personal radiation monitoring results

~~**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.)

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.

Laurence Fuortes — Signature

6-28-05 — Date

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.

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: Laurence Fuortes

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In addition to the implications for elevated Uranium exposure and excretion documented in the textbook chapter appended below, former workers have described the uranium purification as a dusty heavy-industry metallurgical process typical of that era. Unfortunately historical records are scant and the chemical species,physical form and quantity of uranium to which workers were exposed is difficult to determine. Workers were potentially exposed to UF(4) dusts,uranium metal particulate, shards and fume and potentially to uranium oxides. As in the case of of the Mallinkrodt facility "blow-outs", uncontrolled releases from exothermic thermal reactions occurred at the Ames Lab on multiple occassions (from our worker respondents and Dr. Paynes' PhD Thesis, enclosed)

The process of uranium purification by reduction involved a "violent" exothermic reaction performed in a twelve foot diameter gas fired "soaking pit" in which five foot long "bombs" of UF(4) mixed with magnesium, (calcium or sodium), were heated to a temperature below the vaporization temperature of the metal reducing agent and above the vaporization temperature of the UF(4), metal halide. The uranium processing facility at Ames was operating at maximal capacity with three shifts of workers and reportedly ample overtime. The grinding of the "green salt" into fine particulate was accomplished with industrial coffee grinding mills. One worker reportedly described to co-workers awakening to find plumes of green discoloration on his pillow where his nares rested during the night. The worker(s) operating the grinding equipment were referred to as "The Green Horner". Respiratory protection in the form of dust masks was apparently available in the grinding and "jolt-packing" operations but reportedly not uniformly used. Apparently no radiation badge or area radiation monitoring data were collected or are available from this earliest era of operations at the lab. Based upon worker histories there were other,lesser yield,unmonitored potential radiation exposures as well at the lab during the relatively early years. These involved such situations and processes as use of open radiation source material in an underground photography lab to expose crucibles to radiation for thirty minutes for photomicrography. This involved unshielded short term exposures to an as yet undetermined quantity of an undetermined source agent. The Radiochemical group received undetermined quatities of uranium used in the Fermi or other reactors and reportedly isolated plutonium and fission products from "slugs" or ingots of irradiated uranium between the period of 1942 through 1948. These exposures were to masses much lower than those experienced in the in the industrial uranium purification processes. Radiation protection reportedly consisted of use of rubber gloves without shielding. Radiation monitoring was introduced only in the later stages of this process. As this was a methods development and not an industrial process, the quantities analyzed were limited and at a certain point Thorium was introduced as a surrogate for Plutonium because of chemical similarities. There were reportedly several uncontrolled releases of thorium resultant from exothermic reactions gone awry with resultant contamination of the Chemistry Building. The thorium processing work was similar to the uranium processing both technically and in terms of degree of exposures. This was described as very dusty work with documentation included below of area exposure levels of 440,000 d/m/M3 of Thoron and evidence of extensive contamination from Thorium dust. The specific mix(es) of Thorium isotopes is unknown. Notably not all the Thorium received and processed was "fresh"and reports of handling Thorium ten years old with resultant accumulation of decay products was reported to us

Attach to Form B if necessary.

Name or Social Security Number of First Petitioner: Laurence Fuortes

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

Petitioner Authorization Form

OMB Number: 0920-0639 Expires: 05/31/2007

Use of this form is voluntary. Failure to use this form will not result in the denial of any right, benefit

Instructions:

If you wish to petition HHS to consider adding a class of employees to the Special Exposure Cohort and you are NOT either a member of that class, a survivor of a member of that class, or a labor organization representing or having represented members of that class, then 42 CFR Part 83, Section 83 7(c) requires that you obtain written authorization. You can obtain such authorization from either an employee who is a member of the class or a survivor of such an employee You may use this form to obtain such authorization and submit the completed form to NIOSH with the related petition **Please print legibly**

For Further Information: If you have questions about these instructions, 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: **1-800-356-4674**

Authorization for Individual or Entity to Petition HHS on Behalf of a Class of Employees for Addition to the Special Exposure Cohort

I, AMES LAB EMPLOYEES MEMBER OF, between 1942-1955
Name of Class Member or Survivor

Street Address of Class Member or Survivor Apt # P O Box

AMES, IOWA
City, State, Zip Code of Class Member or Survivor

do hereby authorize:

LAURENCE FUORTES
Name of Petitioner

UNIV of IOWA, COLLEGE of PUBLIC HEALTH, 211 S WESTLAWN BLDG
Address of Petitioner Apt # P O Box

IOWA CITY, IA 52242
City, State and Zip Code of Petitioner

to petition the Department of Health and Human Services on behalf of a class of employees that includes:

AMES LAB WORK FORCE
Name of Class Member (employee, not the employee's survivor)

for the addition of the class to the Special Exposure Cohort, under the Energy Employee's Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385).

In providing this authorization, I recognize that the petitioner named above will have all the rights of a petitioner as provided for under 42 CFR Part 83.

K
Signature of Class Member or Survivor — June 10 '05
Date

Name or Social Security Number of First Petitioner: LAURENCE FUORTES

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

Petitioner Authorization Form

OMB Number: 0920-0639 Expires: 05/31/2007

Use of this form is voluntary. Failure to use this form will not result in the denial of any right, benefit,

Instructions:

If you wish to petition HHS to consider adding a class of employees to the Special Exposure Cohort and you are NOT either a member of that class, a survivor of a member of that class, or a labor organization representing or having represented members of that class, then 42 CFR Part 83, Section 83 7(c) requires that you obtain written authorization You can obtain such authorization from either an employee who is a member of the class or a survivor of such an employee You may use this form to obtain such authorization and submit the completed form to NIOSH with the related petition **Please print legibly**

For Further Information: If you have questions about these instructions, 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: **1-800-356-4674**

Authorization for Individual or Entity to Petition HHS on Behalf of a Class of Employees for Addition to the Special Exposure Cohort

I, AMES LAB EMPLOYEES BETWEEN
Name of Class Member or Survivor

Street Address of Class Member or Surviv Apt # P O Box

City, State, Zip Code of Class Member or Survivor

do hereby authorize:

LAURENCE FUORTES M.D.
Name of Petitioner

UNIVERSITY OF IOWA, COLLEGE OF PUBLIC HEALTH, 2115 WESTLAWN BLDG
Address of Petitioner Apt # P O Box

IOWA CITY, IA 52242
City, State and Zip Code of Petitioner

to petition the Department of Health and Human Services on behalf of a class of employees that includes:

AMES LAB WORKFORCE
Name of Class Member (employee, not the employee's survivor)

for the addition of the class to the Special Exposure Cohort, under the Energy Employee's Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385).

In providing this authorization, I recognize that the petitioner named above will have all the rights of a petitioner as provided for under 42 CFR Part 83.

Signature of Class Member or Survivor Date 6/12/2005

Name or Social Security Number of First Petitioner: LAURENCE FUORTES

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Chapter 7

URANIUM EXCRETION STUDIES*

By R. J. Ferretti, G. R. Price, and Samuel Schwartz

ABSTRACT

Since there are no clinical or biochemical tests known to be specific for uranium toxicity, the determination of uranium concentration in urine has proved to be the most important single test for the evaluation of uranium exposure in Project personnel. This is illustrated by data on 86 individuals exposed to uranium on the Ames, Chicago, and Oak Ridge Projects.

Values of over 100 μg of uranium per liter are found only rarely in even the most heavily exposed individuals. Control unexposed students were found to excrete less than 1 μg of uranium per liter.

Because the fluorometric method used is sensitive to 0.0001 μg of uranium, analyses were made using only 0.1 ml of urine. This sample is evaporated to dryness in a platinum dish, ashed over a flame, and fused with sodium fluoride without further purification. Fluorescence is then measured with a specially constructed fluorophotometer.

1 INTRODUCTION

In evaluating the degree of human exposure to any metal it is commonly of decisive importance to determine the amount of that metal in blood and excreta. This is especially true in the vast majority of cases in which exposure is insufficient to cause clinical complaints or abnormal biochemical findings. Even when these abnormal findings result, their specificity can often be ascertained only by correlation with an elevated blood or urine metal concentration.

These facts have been especially apparent in the study of Manhattan Project personnel The syndrome of uranium poisoning, whether acute

*Based on Metallurgical Laboratory Report CH-3592

or chronic, in human beings has never been described. Those biochemical changes that have been described as occurring in animals administered toxic doses of uranium[1] are in no way specific for uranium poisoning. Consequently the interpretation of the meaning of such changes in any individual case is generally impossible. Measurement of the concentration of uranium in the air of laboratories and plants, although valuable, does not tell how much uranium is being absorbed by given individuals. The analysis of the concentration of uranium in urine, therefore, has been the most important test for evaluating the amount of exposure of a given individual or group.

Considerable study has been made of the excretion of uranium by experimental animals following acute exposure.[2] There is only one report in the unclassified literature of the analysis of human urine for uranium. Hoffman[3] reported the urine of an unexposed individual to contain 1.5×10^{-6} g of uranium per liter. The accuracy of his laborious purification procedure,[4] however, is open to serious question. The procedure is based on the visual comparison of the unknown with graded standard beads, which, in half the cases, progressively increase in intensity by factors of 5. In view of the limitations of the method, the reporting of tissue uranium concentrations to three significant figures[5] seems unwarranted

Preliminary reports of excretion of uranium in human urine have recently been issued by a number of laboratories associated with the Manhattan Project and by similar groups in Canada and England. These will not be considered here since final reports have been prepared by the individual groups. Our own studies have been discussed elsewhere,[6] and many of the data in this chapter are taken from these reports.

2. ANALYTICAL PROCEDURE

In general, uranium in biological materials is most commonly determined by spectrographic or fluorometric methods of analysis or by measurement of radioactivity. The applications and limitations of these and other methods are dealt with in exhaustive surveys elsewhere in these volumes.[7,8,9] Since only the fluorometric method has proved sufficiently sensitive to warrant its use in analyses of urine for uranium, it alone will be considered here.

This method is based on the quantitative measurement of the yellowish-green fluorescence emitted by uranium in fused sodium fluoride irradiated with ultraviolet light. As little as 0.001 μg of uranium in 300 mg of fused sodium fluoride may be detected visually by this method. With the use of a very sensitive instrument, it has been possible to quantitate as little as 0.0001 μg of uranium.[9] This sensitivity

is of crucial importance since impurities present in only 1 ml of urine may produce as much as 50 per cent or more quenching of the fluorescence. Only slight quenching, however, is produced by the ashed residue from 0.05 to 0.10 ml of urine so that the uranium may be analyzed in this amount of urine by directly evaporating to dryness in a platinum dish, ashing over an open flame, and fusing with NaF without resort to any purification. The amount of fluorescence is then measured with a specially constructed fluorophotometer. As many as 40 or more careful duplicate analyses per day may be made by one skilled operator.

Detailed studies to test the accuracy of the method under conditions of contamination by various quenching substances are reported elsewhere.[9] These studies have shown that the percentage of fluorescence quenching is a function of the ratio of quenching substance to sodium fluoride; it is not a function of the ratio of uranium to sodium fluoride except when the concentration of uranium is several micrograms per 300 mg of NaF From this it follows that for any given sample of urine, or other material, the fluorescence is a linear function of the amount of uranium present. This is confirmed by the data in Fig. 7.1.

Verification of the accuracy of the method came from a special study in which six different groups in the Manhattan Project analyzed the uranium content of 30 urine samples to which had been added 0 to 2.15 mg of uranium per liter of urine [10] The reported values, illustrated in Fig. 7.2, were found to agree most closely with the theoretical values.[9,10]

3. AVOIDANCE OF CONTAMINATION

Equal in importance to an adequate analytical method is the necessity for scrupulous avoidance of contamination at all stages of the analysis. Thus one investigator has pointed out that his early studies agreed much better with atmospheric conditions than with known levels of personnel exposure. In rainy weather, for example, all values were low, whereas in dry weather all values were high because of atmospheric contamination from a nearby plant.

All careful workers have recognized the necessity for collection of samples away from exposed areas, preferably immediately after a shower, and for analysis of samples in laboratories that are, themselves, not contaminated. The bottle into which the urine is passed and all other equipment must likewise be kept exceptionally clean. Washing in hot nitric acid will suffice for this purpose except in the case of the platinum dishes, when repeated fusion with fresh sodium fluoride may be necessary to dissolve last traces of uranium that have been baked into the dish.

At low levels of uranium concentration the sodium fluoride itself becomes the deciding factor in limiting the sensitivity of the method. The purest sodium fluoride it has been possible to obtain gives the same amount of fluorescence as 0 0002 μg of uranium per 300 mg of

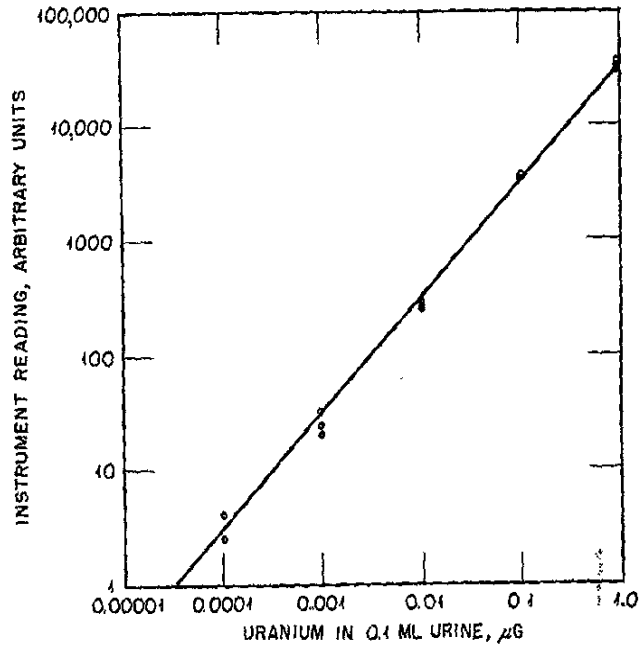

Fig. 7.1—Fluorescence photometer calibration curve for uranium plus urine.

NaF. Therefore, although the instrument itself can at least theoretically detect the fluorescence from 0.000001 μg of uranium, the accuracy of the analysis falls off rapidly below 0.0001 μg.

4. STUDIES OF URANIUM EXCRETION IN MANHATTAN PROJECT PERSONNEL

The studies comprised 170 determinations on 86 individuals exposed to various uranium compounds on the Ames, Chicago, and Oak Ridge Projects.

4.1 Collection of Samples from Ames and Chicago Personnel. Upon leaving work Saturday noon, the men were given a clean bottle enclosed within two large envelopes. They were instructed to remove

the outer envelope at home after carefully washing their hands. The second envelope was to be opened after bathing Sunday evening or Monday morning. The urine sample was to be passed into the bottle after again washing the hands and before getting dressed. The bottle

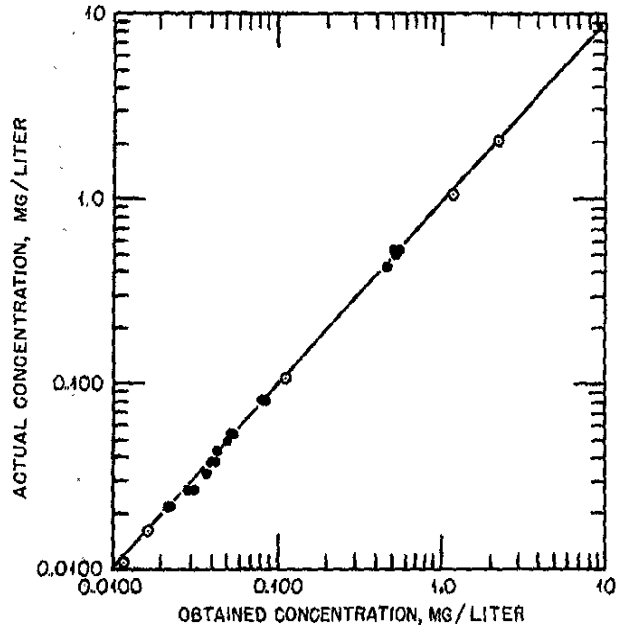

Fig 7 2—Recovery by the Metallurgical Laboratory of uranium added to urine (unknowns prepared at the University of Rochester) • denotes single point; ⊙ denotes two (superimposed) points.

was then to be returned to the envelope. The samples thus obtained were sent to the Chicago laboratory for analysis. Except for the dilute standard uranium solutions, no uranium was handled in the building housing this laboratory. The nearest other building of the Metallurgy Laboratory was three blocks away.

4.2 Analytical Procedure. Analyses were made in duplicate except in some of the earlier studies; the fluorometric method of analysis mentioned above was used

4.3 Results. (a) Iowa State College Personnel. The largest number of analyses were made on urine of personnel working on the Ames Project at Iowa State College. Exposure was chiefly to the UF_4 salt.

For purposes of analysis the men were classified by their supervisors into four groups according to their probable exposure to uranium. Those who were probably exposed to the greatest amount were classed as group 1; those exposed to the next highest amount made up group 2; those with very little but continuous exposure constituted

Table 7.1—Uranium Excretion in Personnel, Group 1

Sample	Case	Amount, μg/liter
1	1	40
2	1	96
3	2	52
4	3	86
5	3	50
6	4	100
7	4	44
8	4	70
9	4	200
10	5	126
11	5	98
12	5	74
13	6	84
14	6	200
15	6	73
16	7	48
17	7	40
18	8	29
19	9	25
20	10	12
21	11	31
		75 (av.)

group 3; and those with only occasional incidental exposure formed group 4. Results of the studies are summarized in Tables 7.1 to 7.4. Values given are in most instances the average of duplicate analyses. It will be noted that in several instances two or more analyses were made of urine collected from the same individuals, generally at intervals of a few weeks or months.

In Table 7.5 the data given in Tables 7.1 to 7.4 are summarized to indicate the degree of correlation between the exposure and the range of the amount of uranium in the urine.

The urine studies described above were subjected to statistical analysis by George Sacher. Of the values reported, 33 were the average of duplicate determinations. The deviations from the means of the duplicate determinations were studied with the following results:

Number of values (N) = 64 (one pair of values was discarded for statistical reasons; $x/\sigma = 8.6$)

Mean deviation from the means (M) = 1.69 μg/liter

Standard deviation from the mean of each pair (σ) = 2.8 μg/liter

Table 7.2—Uranium Excretion in Personnel, Group 2

Sample	Case	Amount, μg/liter
1	12	15
2	13	17
3	14	13
4	15	38
5	16	21
6	17	40
7	18	21
8	19	33
9	19	58
10	20	33
11	21	54
12	22	64
13	23	10
14	23	16
15	24	11
16	24	11
17	25	87
18	25	64
19	25	80
20	26	130
21	27	80
22	28	108
23	29	64
24	29	64
25	30	28
26	31	43
		46 (av.)

In 35 instances in which 0.05 ml of urine was used the amount of quenching of fluorescence was determined by adding 0.01 μg of uranium to another 0.05-ml sample of the same urine and noting the diminution in expected fluorescence. The results may be summarized as follows:

0–10 per cent quenching in 83 per cent of instances
10–20 per cent quenching in 11 per cent of instances
20–30 per cent quenching in 6 per cent of instances

Table 7.3—Uranium Excretion in Personnel, Group 3

Sample	Case	Amount, μg/liter
1	32	24
2	33	27
3	34	7
4	35	9
5	36	19
6	37	22
7	38	22
8	38	18
9	38	3
10	38	3
11	39	5
12	40	16
13	41	15
14	42	33
		16 (av.)

Table 7.4—Uranium Excretion in Personnel, Group 4

Sample	Case	Amount, μg/liter
1	43	<3
2	44	<3
3	45	7
4	46	<3
5	47	<3
6	48	9
		<5 (av.)

Table 7.5—Correlation of Uranium Exposure and Urine Uranium Concentration in Iowa State College Project Personnel

Group	No. of individuals	No. of samples	Percentage of samples containing uranium per liter as shown				
			0–10 μg	10–20 μg	20–40 μg	40–80 μg	80–200 μg
4	6	6	100	0	0	0	0
3	11	14	35	29	35	0	0
2	20	26	0	23	27	31	19
1	11	21	0	5	14	43	38

In all six instances in which over 10 per cent quenching was found, the urine was obtained from individuals in the uranium exposure groups 1 and 2. Since these individuals were also exposed to metals other than uranium, they would be expected to have larger amounts

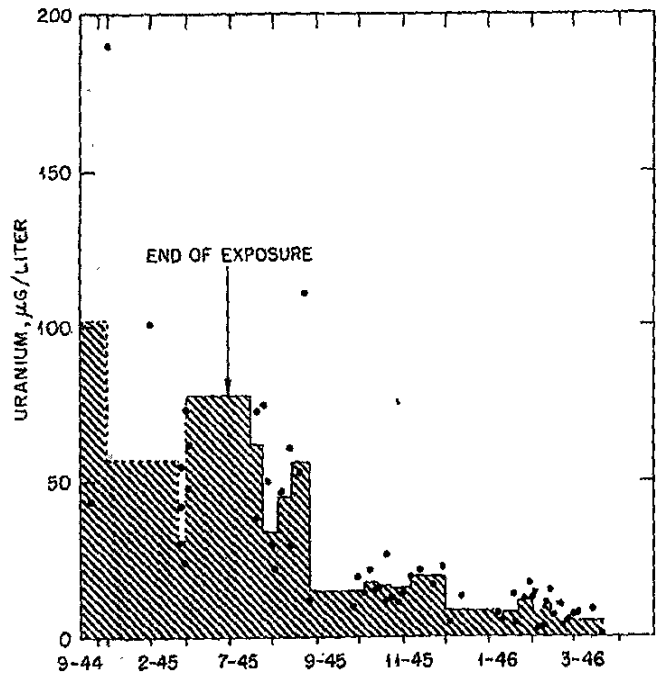

Fig. 7.3—Excretion of uranium in the urine of an individual exposed to various uranium salts.

of quenching materials in their urine than would nonexposed individuals.

A prolonged study was made of the urinary excretion of uranium by one individual believed to have had more exposure than any other individual on the Ames Project. His exposure began in March 1943 and ended July 1, 1945. He did not visit the plant thereafter.

As noted in Fig. 7.3, 10 analyses made from September 1944 to July 1945 ranged from 24 to 200 μg of uranium per liter. Fifty analyses during the eight months after cessation of exposure showed a

leveling off of uranium concentration to approximately 5 to 10 μg per liter at the end of the period.

(b) Metallurgical Laboratory, University of Chicago. Thirty-eight analyses have been made of urine from 28 individuals in the Chicago Metallurgical Laboratory. Of these individuals, five were employed at the Argonne Laboratory. Exposure was chiefly to uranium oxide.

Table 7.6—Study of Uranium Excretion in Urine of Oak Ridge Personnel

Sample*	Days after plant exposure	Amount of uranium, μg/liter
1a	1	11
1b	2	4
2a		10
2b		8
3a	2	60
3b	3	19
4a	3	3
4b	4	2
5a	2	11
5b	3	5
6a	1	19
6b	2	9
7a	3	20
7b	4	4
8a	1	6
8b	2	5
9a	1	3
9b	2	1
10a		9

*The letter "a" denotes samples obtained June 15-16, 1945; "b" denotes samples obtained June 16-17, 1945.

The analyses were made for the most part during 1945 when exposures were relatively low.

In only two instances was more than 10 μg of uranium per liter found. In six cases 5 to 10 μg per liter was present. The highest value in the group was 18 μg per liter.

(c) Oak Ridge, Tenn. The uranium concentration was determined in two consecutive 24-hr collections of urine obtained from 10 hospitalized Army personnel. As noted in Table 7.6, these individuals were away from work for 1 to 3 days before being hospitalized. It should be noted that the uranium concentration in the first day's collection of urine is in every case higher than the second day's collection (average first day = 15.9 μg per liter; average second day = 6.3 μg per liter).

Since these men had been away from exposure for as long as 3 days at the time of hospitalization, it is probably safe to assume that urine collected the morning after exposure would have been comparable in most instances to the level of 20 to 100 μg per liter found in exposed individuals in the plant at Ames, Iowa.

(d) Control Subjects. An attempt was made to determine the uranium concentration in urine from control subjects with no uranium exposure other than that normally encountered. Using 0.1 ml of urine for analysis, values of less than 2 μg per liter were found in the urines of five students at the Veterinary School of Medicine at Iowa State College. Using greater precautions 0.1- and 0.3-ml portions of urine from five medical students at the University of Chicago were analyzed and found to contain less than 1 μg of uranium per liter. Analysis of known amounts of uranium added to 0.3-ml portions of the same urines showed 43 to 56 per cent fluorescence quenching. The amount of fluorescence detected was too small to ascertain accurately the exact amount of uranium present. It is likely, however, that it ranged from 0.1 to 1 μg per liter. This amount is just beyond the present sensitivity range of our method, which employs only 0.1-ml samples of urine for analysis. More accurate study would therefore require the use of 1 to 10 ml of urine and preliminary purification to reduce the concentration of quenching substances.

5. DISCUSSION

From the data presented it is obvious that studies of uranium in urine can yield a valuable index of previous exposure to uranium. Unfortunately, however, studies are still insufficient to permit full interpretation of these data. Specifically, it would be of help to have the answers to the following questions:

1. What do the data mean in terms of uranium deposited in the tissues?

2. Would analysis of blood for uranium be preferable to analysis of urine since there would be less chance for contamination and for variations due to such factors as diet and kidney function?

3. What is the dangerous concentration of uranium in urine, blood, or tissue?

Since there are no data available concerning either the uranium content of tissues from exposed personnel or uranium toxicity in human beings, these questions cannot be answered. Further quantitative discussion is therefore superfluous at the present time. Certain observations, however, may be in order.

5.1 Extrapolation from Experimental Animals to Human Beings. Human exposure, compared to experimental animal exposure, is unique in regard to duration, intensity, and multiplicity of exposures. These factors and others, such as inherent metabolic differences and differences in life span, make extrapolation from animals to human beings difficult. In addition, limitations in accuracy and sensitivity of analytical procedures have until recently permitted urinary uranium analysis only in acute and subacute stages of uranium poisoning in experimental animals. For the purpose of extrapolation it is essential that chronic urine and tissue studies be made.

By administering subcutaneously a more radioactive isotope of uranium, Tannenbaum[11] has recently made relatively chronic studies in mice. Extension of these studies to include the fate of uranium administered slowly by pulmonary or oral routes to coincide more with human exposure would be very desirable.

5.2 Human-tissue Studies. The attempt should be made, whenever possible, to make uranium analyses on tissues obtained at operation or post-mortem examinations of exposed individuals. Simultaneous urine studies should also be made.

5.3 Accuracy of Data. It should be unnecessary to point out that human excretion and tissue-distribution data must be accurate, yet achieving accuracy has heretofore been a serious problem. Our own experience as well as that of numerous other groups attests the futility of making analyses except when contamination can be avoided and when results are sufficiently accurate and can be reproduced.

ACKNOWLEDGMENTS

The authors are indebted to F. H. Spedding, E. Gladrow, and Elaine Katz for their assistance in making the studies at Iowa State College possible. We are also grateful to the medical officers of the Manhattan District at Oak Ridge for the opportunity of studying other samples from exposed personnel.

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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

Special Exposure Cohort Petition — Form B

OMB Number: 0920-0639 Expires: 05/31/2007

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: **1-800-356-4674**.

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
	X 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) X 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
	LAURENCE	J	FUORTES, M D

A 4 **Address:**

Street	Apt #	P.O. Box
UNIVERSITY OF IOWA, COLLEGE OF PUBLIC HEALTH, DEPARTMENT OF OCCUPATIONAL AND ENVIRONMENTAL HEALTH		

City	State	Zip Code
IOWA CITY	IA	52246

A 5 **Telephone Number:** (319)335-9819

A 6 **Email Address:** laurence-fuortes@uiowa.edu

A 7 X 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: Laurence Fuortes

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:**

(M)/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: AMES LAB

C.7d Work Site Location: IOWA STATE UNIVERSITY-AMES LAB

C.7e Supervisor's Name:

Go to Part E.

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

Special Exposure Cohort Petition — Form B

OMB Number: 0920-0639 Expires: 05/31/2007
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 Em;**

(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 Last Name

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

C 4 **Address of Employee** (If living)·

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: AMES LAB

C 7d Work Site Location: IOWA STATE UNIVERSITY-AMES LAB

C 7e Supervisor's Name:

Sign Part G of the original petition.

Name or Social Security Number of First Petitioner: LAURENCE FUORTES

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

E 1 **Name of DOE or AWE Facility:** Ames Laboratory, Iowa State University

E 2 **Locations at the Facility relevant to this petition:**

Ames Laboratory campus, AEC/DOE facilities including Annex 1, the old womens' gymnasium,"Little Ankeny", Chemistry Bldg, Wilhelm Hall

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:**

Scientists, production workers, technicians, salaried graduate students, physical plant workers, maintenance, administrative and support staff

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

Start ___ End ___ x uranium processing exposures

Start ___ End ___ x uranium and thorium processing , thoron gas

Start ___ End ___ and to a lesser extent irradiated uranium and plutonium exposures

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):

The work at Ames Lab during the Manhattan Project period ___ ough ___ involved further processing of over two milion pounds of uranium tetrafluoride, UF(4), "green salt" received from the purification processes carried out by The Malinkrodt Chemical Company in St.Louis,MO. Malinkrodt received crude "yellow cake" (ammonium or sodium diuranate) from various ore processors and dissolved the ores in nitric acid

The uranium content was purified by a solvent extraction process involving diethyl ether. The extracted uranium of the uranyl nitrate was reduced from the hexavalent state to its tetravalent state and precipitated as uranium tetrafluoride (which was dried and shipped to Ames). At Ames, the uranium tetrafluoride (green salt) was finely ground, mixed with pure, granulated magnesium metal (or possibly sodium or calcium), and heated in the absence of air to obtain pure uranium metal, and separated from the magnesium fluoride slag The uranium "biscuits" were remelted, recast and machined into ingots, *(lathed under oil to specific tolerances)* and each ingot or the shaved uranium from the lathing process was analyzed for possible contaminants before shipping to the reactor sites (University of Chicago and Oak Ridge). Descriptions of relevant processes and exposures are continued below

Go to Part F.

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 X 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
Attached are scanned pages from chapter 7 of a text entitled "Industrial Medicine on the Plutonium Project,Survey and Collected Papers; edited by Robert F Stone, McGraw-Hill Book Co Published 1951, Chapter 7 is entitled "Uranium Excretion Studies" and reports the results of urinary excretion results for 48 individuals stratified into four groups on the basis of expected exposure to UF(4). These assays were collected on Monday mornings after the most recent exposure ending Saturday at noon Two of eleven workers in the highest exposure category had urinary excretion concentrations measured at 200 micrograms per liter. Also attached are results of area radionuclide monitoring from a survey of the thorium processing activities in 1952 entitled Occupational Exposure to Thorium and Beryllium and a PhD Thesis by Dr. Carolyn Stilts Payne from 1992 entitled The Ames Project: Administering Classified Research

F 2 X 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.
Ames Laboratory staff report being unable to locate personal radiation monitoring results

~~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.)

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.

_____ 6-28-05
Signature Date

_____ _____
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.

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: Laurence Fuortes _____

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Continuation Page — Photocopy and complete as necessary.

In addition to the implications for elevated Uranium exposure and excretion documented in the textbook chapter appended below, former workers have described the uranium purification as a dusty heavy-industry metallurgical process typical of that era. Unfortunately historical records are scant and the chemical species,physical form and quantity of uranium to which workers were exposed is difficult to determine. Workers were potentially exposed to UF(4) dusts,uranium metal particulate, shards and fume and potentially to uranium oxides. As in the case of of the Mallinkrodt facility "blow-outs", uncontrolled releases from exothermic thermal reactions occurred at the Ames Lab on multiple occassions (from our worker respondents and Dr. Paynes' PhD Thesis, enclosed).

The process of uranium purification by reduction involved a "violent" exothermic reaction performed in a twelve foot diameter gas fired "soaking pit" in which five foot long "bombs" of UF(4) mixed with magnesium, (calcium or sodium), were heated to a temperature below the vaporization temperature of the metal reducing agent and above the vaporization temperature of the UF(4), metal halide. The uranium processing facility at Ames was operating at maximal capacity with three shifts of workers and reportedly ample overtime. The grinding of the "green salt" into fine particulate was accomplished with industrial coffee grinding mills. One worker reportedly described to co-workers awakening to find plumes of green discoloration on his pillow where his nares rested during the night. The worker(s) operating the grinding equipment were referred to as "The Green Hornet". Respiratory protection in the form of dust masks was apparently available in the grinding and "jolt-packing" operations but reportedly not uniformly used. Apparently no radiation badge or area radiation monitoring data were collected or are available from this earliest era of operations at the lab. Based upon worker histories there were other,lesser yield,unmonitored potential radiation exposures as well at the lab during the relatively early years. These involved such situations and processes as use of open radiation source material in an underground photography lab to expose crucibles to radiation for thirty minutes for photomicrography. This involved unshielded short term exposures to an as yet undetermined quantity of an undetermined source agent. The Radiochemical group received undetermined quatities of uranium used in the Fermi or other reactors and reportedly isolated plutonium and fission products from "slugs" or ingots of irradiated uranium between the period of 1942 through 1948. These exposures were to masses much lower than those experienced in the in the industrial uranium purification processes. Radiation protection reportedly consisted of use of rubber gloves without shielding. Radiation monitoring was introduced only in the later stages of this process. As this was a methods development and not an industrial process, the quantities analyzed were limited and at a certain point Thorium was introduced as a surrogate for Plutonium because of chemical similarities. There were reportedly several uncontrolled releases of thorium resultant from exothermic reactions gone awry with resultant contamination of the Chemistry Building. The thorium processing work was similar to the uranium processing both technically and in terms of degree of exposures. This ~~was described as very dusty work with doccumentation included below of area exposure levels of 440,960 d/m/M3 of Thoron and evidence of extensive contamination from Thorium dust. The specific mix~~(es) of Thorium isotopes is unknown. Notably not all the Thorium received and processed was "fresh"and reports of handling Thorium ten years old with resultant accumulation of decay products was reported to us

Attach to Form B if necessary.

Name or Social Security Number of First Petitioner: Laurence Fuortes

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: 05/31/2007

Petitioner Authorization Form

Use of this form is voluntary. Failure to use this form will not result in the denial of any right, benefit,

Instructions:

If you wish to petition HHS to consider adding a class of employees to the Special Exposure Cohort and you are NOT either a member of that class, a survivor of a member of that class, or a labor organization representing or having represented members of that class, then 42 CFR Part 83, Section 83 7(c) requires that you obtain written authorization You can obtain such authorization from either an employee who is a member of the class or a survivor of such an employee You may use this form to obtain such authorization and submit the completed form to NIOSH with the related petition **Please print legibly**

For Further Information: If you have questions about these instructions, 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: **1-800-356-4674**

Authorization for Individual or Entity to Petition HHS on Behalf of a Class of Employees for Addition to the Special Exposure Cohort

I, AMES LAB EMPLOYEES between MEMBER OF,
Name of Class Member or Survivor

Street Address of Class Member or Survivor Apt # P O Box

AMES, IOWA
City, State, Zip Code of Class Member or Survivor

do hereby authorize:

LAURENCE FUORTES
Name of Petitioner

UNIV of IOWA, COLLEGE of PUBLIC HEALTH, 215 WEST AWN Bldg.
Address of Petitioner Apt # P O Box

IOWA CITY, IA 52242
City, State and Zip Code of Petitioner

to petition the Department of Health and Human Services on behalf of a class of employees that includes:

AMES LAB WORK FORCE
Name of Class Member (employee, not the employee's survivor)

for the addition of the class to the Special Exposure Cohort, under the Energy Employee's Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385).

In providing this authorization, I recognize that the petitioner named above will have all the rights of a petitioner as provided for under 42 CFR Part 83

Signature of Class Member or Survivor June 10 '05
Date

Name or Social Security Number of First Petitioner: LAURENCE FUORTES

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: 05/31/2007

Petitioner Authorization Form

Use of this form is voluntary. Failure to use this form will not result in the denial of any right, benefit,

Instructions:

If you wish to petition HHS to consider adding a class of employees to the Special Exposure Cohort and you are NOT either a member of that class, a survivor of a member of that class, or a labor organization representing or having represented members of that class, then 42 CFR Part 83, Section 83.7(c) requires that you obtain written authorization. You can obtain such authorization from either an employee who is a member of the class or a survivor of such an employee. You may use this form to obtain such authorization and submit the completed form to NIOSH with the related petition. **Please print legibly.**

For Further Information: If you have questions about these instructions, 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: **1-800-356-4674**

Authorization for Individual or Entity to Petition HHS on Behalf of a Class of Employees for Addition to the Special Exposure Cohort

I, AMES LAB EMPLOYEES BETWEEN
Name of Class Member or Survivor

1023 GRAND AVE
Street Address of Class Member or Survivor Apt # P.O. Box

AMES IOWA 50011
City, State, Zip Code of Class Member or Survivor

do hereby authorize:

LAURENCE FUORTES M.D.
Name of Petitioner

UNIVERSITY OF IOWA, COLLEGE of PUBLIC HEALTH, 2115 WESTLAWN BLDG
Address of Petitioner Apt # P.O. Box

IOWA CITY, IA 52242
City, State and Zip Code of Petitioner

to petition the Department of Health and Human Services on behalf of a class of employees that includes:

AMES LAB WORKFORCE
Name of Class Member (employee, not the employee's survivor)

for the addition of the class to the Special Exposure Cohort, under the Energy Employee's Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385).

In providing this authorization, I recognize that the petitioner named above will have all the rights of a petitioner as provided for under 42 CFR Part 83.

Signature of Class Member or Survivor

6/12/2005
Date

Name or Social Security Number of First Petitioner: LAURENCE FUORTES

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: 05/31/2007

Petitioner Authorization Form

Use of this form is voluntary. Failure to use this form will not result in the denial of any right, benefit,

Instructions:

If you wish to petition HHS to consider adding a class of employees to the Special Exposure Cohort and you are NOT either a member of that class, a survivor of a member of that class, or a labor organization representing or having represented members of that class, then 42 CFR Part 83, Section 83 7(c) requires that you obtain written authorization. You can obtain such authorization from either an employee who is a member of the class or a survivor of such an employee You may use this form to obtain such authorization and submit the completed form to NIOSH with the related petition **Please print legibly**

For Further Information: If you have questions about these instructions, 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: **1-800-356-4674**.

Authorization for Individual or Entity to Petition HHS on Behalf of a Class of Employees for Addition to the Special Exposure Cohort

I, MEMBER OF AMES LAB WORK FORCE

_____ # P O Box

City, State, Zip Code of Class Member or Survivor

do hereby authorize:

Laurence Fuortes
Name of Petitioner

University of Iowa, College of Public Health, 2124 Westlawn
Address of Petitioner Apt # P.O Box

Iowa City, Iowa 52242
City, State and Zip Code of Petitioner

to petition the Department of Health and Human Services on behalf of a class of employees that includes: Through Uranium Processing Activities, Ames Laboratory Production, Scientific, Technical and Support Staff
Name of Class Member (employee, not the employee's survivor)

for the addition of the class to the Special Exposure Cohort, under the Energy Employee's Occupational Illness Compensation Program Act (42 U.S.C. §§ 7384-7385).

In providing this authorization, I recognize that the petitioner named above will have all the rights of a petitioner as provided for under 42 CFR Part 83.

_____ June 17, 2005
Signature of Class Member or Survivor Date

Name or Social Security Number of First Petitioner: _____

(S.S. No. of :)

[redacted]

Box 1
AMES-1 12/8C

AMES RESEARCH LABORATORY

OCCUPATIONAL EXPOSURE TO THORIUM & BERYLLIUM

U.S. Atomic Energy Commission
New York Operations Office
Health and Safety Division

Copy 6

[redacted]

OPTIONAL FORM NO. 10
5010-104

UNITED STAIES GOVERNMENT

Memorandum

TO : A. J. Breslin, Director, Health Protection Engineering Division, HASL

DAIE: September 26, 1962

FROM : Lewis C. Cooper, Classification Officer, NY

SUBJECT: DECLASSIFICATION REVIEW OF AMES-1 ENTITLED "AMES RESEARCH LABORATORY - OCCUPATIONAL EXPOSURE TO THORIUM AND BERYLLIUM" BY P. B. KLEVIN, HASL, JULY 14, 1952

TSC:LCC

Subject document has been declassified without deletions, but must be handled as Official Use Only until released by the Assistant General Counsel for Patents, AEC HQ.

Your declassified file copy is hereby returned.

Enclosure:
Subj. rpt.

cc: C. E. Teeter, CH
R. A. Anderson, PAT, HQ
H. S. Potter, NYPG, BH
P. B. Klevin, BH

[redacted]

AMES RESEARCH LABORATORY

OCCUPATIONAL EXPOSURE TO THORIUM AND BERYLLIUM

by

This document consists of 96 pages
No. 6 of 6 copies, series A

Paul B. Klevin
Industrial Hygiene Branch
Health and Safety Division

77239

Date of Survey: March 18-21, 1952

Date of Report: July 14, 1952

CLASSIFICATION CANCELLED
DATE 4-20-62
For The Atomic Energy Commission
W. R. Carnell
Chief, Declassification Branch

Distribution:

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(Dr. Hardie)
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U. S. Atomic Energy Commission
New York Operations Office
Health and Safety Division

[redacted]

[redacted]

[redacted]

Scope

This is a report of a preliminary survey performed during the period March 18-21, 1952 at the Ames Metallurgical Laboratories, Iowa State College. This survey, made in response to a request from the Chicago Operations Office, covered the health and safety problems existing during refining and thorium metal production. In addition, a brief study was made of several beryllium operations.

Purpose

This survey was made with the following objectives in mind:

1. To gather data from which an estimation of the daily weighted average exposure can be determined for the personnel working on the AEC project;

2. To suggest the physical and procedural changes which should be made in order to correct excessive exposures.

Results of Study

1. Thorium

Of the twenty-two employees studied in the thorium production areas, nine (41%) were exposed to thorium concentrations exceeding the maximum permissible level; six employees were exposed to concentrations of 791 to 3100 alpha disintegrations per minute per cubic meter of air ($d/m/M^3$). A complete breakdown of the daily weighted thorium exposure of the production personnel is as follows:

a. Summary of Daily Weighted Thorium Exposure

Number of Personnel Studied	22	
Average Exposure ($d/m/M^3$)*	530	
Maximum Exposure ($d/m/M^3$)	3100	
No. of Persons less than 70 $d/m/M^3$	13	(59%)
" " 70 to 210 $d/m/M^3$	2	(9.2%)
" " 210 to 350 $d/m/M^3$	1	(4.6%)
" " 350 to 700 $d/m/M^3$	0	
" " over 700 $d/m/M^3$	6	(27.4%)

* $d/m/M^3$ = disintegrations per minute per cubic meter of air.
70 $d/m/M^3$ = maximum allowable concentration (MAC) presently observed by the MCO.

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APPENDIX A

Job Analysis Sheets

APPENDIX B

Sample Record Sheets
(copies #1 & #6 only)

2. Thoron

The following tables summarize the thoron exposure of the Ames production personnel:

b. Summary of Daily Weighted Thoron Exposure

Number of Personnel Studied	22
Average Exposure ($d/m/M^3$)	1.3×10^4
Maximum Exposure ($d/m/M^3$)	3×10^4
No. of Persons less than 2.2×10^4 $d/m/M^3$*	19 (86.4%)
" " 2.2×10^4 to 4.4×10^4 $d/m/M^3$	3 (13.6%)

* 2.2×10^4 $d/m/M^3$ MAC for thoron.

3. Beryllium

Two of the personnel manufacturing crucibles were studied and were found to be exposed to acceptable daily weighted beryllium concentration of 0.95 γ/M^3. However, several of the operations studied exposed these technicians to concentrations exceeding the AEC maximum concentration for a single exposure by 6 to 8 times. One additional beryllium sample was found to be 16 times the allowed single sample concentration.

No outdoor neighborhood survey was made since the nature of the beryllium operations and the small amounts of material handled did not constitute a problem.

4. Radiation Measurements

External radiation measurements made in each of the thorium operating areas showed excessive amounts of radiation present in both the storage and loading areas. The highest radioactivity found was 22 mr/hr gamma, greater than 20 mreps/hr beta (261QA B-γ Survey Meter) and 100,000 $d/m/100cm^2$ alpha.

Included in the tabulation of the radioactivity measurements are values showing both growth and decay of thorium daughters.

Recommendations are included in this report which should reduce existing airborne contamination and external radiation at the various operations and in the general laboratory area.

Method of Study

1. Sampling Procedures

a. Thorium

Dust samples were collected on 1-1/8" Whatman #41 filter paper, using a 0.5 c.f.m. Universal air sampler. The sample collection period varied from thirty seconds to two hours, depending on conditions of operation and dust loading.

The dust samples collected divided into the following categories:

(1) General air samples - a sample obtained of a general area or room atmosphere,

(2) Breathing zone samples - a sample obtained in the actual breathing zone of an operator during the performance of a particular task.

b. Thoron

It is not possible with portable equipment to measure thoron concentrations directly; therefore, the concentration of the thoron daughter products, as collected with airborne dust, is used as an indication of thoron activity. The dust collection media and apparatus is the same as described above.

c. Beryllium

Beryllium dust samples were collected on 10 cm. Bureau of Mines All Dust Filter, BM #2133, using a 35-45 c.f.m. high volume air sampler. Periods of sampling varied from one minute to 30 minutes, depending on same conditions as mentioned above.

2. Job Analysis Sheets

The job analysis sheets give a detailed analysis of the operational time relationship of each employee on the project. This consisted of a statement of the total time spent on a particular job with an additional breakdown as to the number of minutes each task is performed per day. In addition, the average thorium alpha concentration and the thoron daughters' alphas, as obtained from the sample record sheets, are recorded. The average alpha concentration per 9 hour day is determined by dividing the alpha concentration times total time by the total number of minutes per day.

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3. Analytical Procedure

Because of the unusual decay characteristics of the thorium series, it would be well at this point to indicate briefly the analytical methods which we used to derive the results expressed in the report:

a. Samples were counted on an alpha scintillation counter assuming a 30% self-absorption.

b. Samples were counted as soon as received in the laboratory. The time of counting of samples varied from 1 to 3 days after sampling. The first count was then extrapolated back to time of sampling.

c. All samples were re-counted after one week to determine the presence of long-lived material. Counting procedure was identical to the first count.

d. The second count was subtracted from the extrapolated first count to yield the thoron daughter concentration; the second count being the thorium concentration. No evaluation of airborne beta or gamma emitters was made.

e. Beryllium samples, which were taken at a rate of about 0.5 cubic meters per minute, were analyzed on a solution photo-fluorimeter measuring the fluorescence of the beryllium morin complex.

It is not possible to measure the activity of thoron gas directly with field equipment. Therefore, the measurement of thoron concentration must be carried out indirectly by determining the alpha activity of the thoron daughter products collected with airborne dust. Since the half-life of Po^{216} (Th A) is only 0.16 sec., the alpha activity that is used is that of the daughter products following Pb^{212} (Th B) which has a half-life of 10.6 hours.

If the system is in radioactive equilibrium, the equivalence shown will be one daughter alpha disintegration per thoron disintegration. This allows counting at any reasonable time after sampling and calculation of the activity at the time of sampling by simple extrapolation. The long-lived alpha activity due to thorium may be obtained by counting after decay of the daughter products, and this activity may be subtracted from the total to obtain the daughter product activity.

The extrapolation of the daughter product activity at the time of counting to the activity at the time of sampling is based on the decay of Th B, which is the slowest rate in the series following thoron. The activity due to the long-lived thorium is determined by recounting the sample after allowing the daughter products to decay.

A_o = Daughter product activity at sampling time

A_1 = Total activity at first count

A_2 = Thorium activity at second count

A = $A_1 - A_2$ = Daughter product activity at first count

λ = Decay constant for ThB

t = Time after sampling

Then, $A = A_o e^{-\lambda t}$

And A_o may be calculated.

The ratios of A to A_o for several times after sampling are given below:

2 days.....	.0250
3 "	.0051
4 "	.0018

The shortcomings of the method are the assumption that radioactive equilibrium exists and the assumption of complete collection of the daughter products on airborne dust. However, it is the best method available for field use at the present time.

Process Description

1. Thorium

(a) Thorium Refining & Metal Production

(1) Solution and Precipitation Stage

Thorium received as a nitrate in drums is weighed out and dissolved in dilute nitric acid and oxalic acid. Thorium oxalate, the precipitate, is filtered in an Kimco press. The thorium oxalate is dumped into 30 gal. drums in a damp state and sealed.

(2) Calcination and Hydrofluorination Stage

The damp thorium oxalate is transferred to trays and dried. The dried thorium oxalate is weighed out in trays and calcined in an electric muffle furnace at 1100° F. The trays containing thorium oxide are cooled and dumped into a loading hood. The thorium oxide is transferred to flat type trays, weighed and then placed into reactors for hydrofluorination to thorium tetrafluoride. The thorium tetrafluoride is cooled and packaged in 5 gal. containers.

(3) Metal Reduction

Calcium reduction to the thorium biscuit is accomplished by adding a mixture of zinc chloride, calcium fluoride and thorium

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tetrafluoride to a dolomite-lined bomb and gas firing. The biscuits are unloaded from the bomb and conveyed manually to the thorium casting area.

(4) Thorium Metal Casting

By two successive vacuum furnace castings, the impure thorium biscuit is desinced and terminally purified to the thorium billet.

(5) Machining operations are then performed on each of the billets. These operations include sawing, turning and milling and cropping.

2. Beryllium

Beryllium operations consist of the manufacturing of beryllium shapes and crucibles from raw beryllium oxide.

Discussion

In order to interpret the data of this report, it is necessary to have criteria for judging whether or not an exposure is potentially hazardous. For this purpose, the following maximum allowable concentrations are suggested:

1. Thorium:

Although there is no generally accepted MAC for thorium, we are tentatively using 70 $d/m/M^3$, which is the level which has been in use for some time for insoluble uranium compounds.

2. Thoron:

As in the case of thorium, there is as yet no generally accepted MAC but the Conference of Governmental Industrial Hygienists has tentatively proposed 10^{-11} curies per liter, the value used in this report. This is equivalent to 2.2×10^4 $d/m/M^3$.

3. Beryllium:

The Commission recommendations for control of beryllium hazards are:

a. The in-plant atmospheric concentration of beryllium at beryllium operations should not exceed 2 micrograms per cubic meter as an average concentration throughout an 8 hour day.

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b. Even though the daily average might be within the limits of recommendation a, no personnel should be exposed to a concentration greater than 25 micrograms per cubic meter for any period of time, however short.

c. In the neighborhood of an AEC plant handling beryllium compounds, the average monthly concentration at the breathing zone level should not exceed 0.01 microgram per cubic meter.

In the course of the study, it was found that all thoron daughters exposures and, therefore, the probable thoron exposure, except that of the HF operators, were below the permissible limit and that one only slightly above. The thorium exposures, on the other hand, were found to be high in several cases. The operators working with thorium nitrate tetrahydrate, thorium oxalate and the calcined oxalate, in general, had exposures ranging to as high as 40 times this level, the maximum exposure occurring to the HF operators of 3100 $d/m/M^3$. These individual values are given in Table I. Table II, which shows the breakdown of operations giving the individual exposures for each, indicates that the maximum exposures occurred on the tray handling operations where values of 12,000 and 17,000 $d/m/M^3$ were found. These are single sample values while those above are daily weighted average exposures.

The following points were made in the meeting between Mr. Harris of this office and various of the laboratory personnel:

1. In general, ventilation which is supplied to the areas appears to be adequate. Most of the operations could be modified or controls supplied without major expense.

2. Housekeeping in the industrial areas is poor and no adequate means for housekeeping is provided.

3. Tracking through the laboratory is quite general and off-plant tracking appears to be likely.

4. Compressed air hose cleaning and man-cooling fans probably add significantly to the dispersion of airborne dust.

Table III, which gives the average general air concentrations, indicates very high concentrations in Room 303 (drying and calcining area) with moderately high concentrations in various areas of Room 33.

As far as it was possible to investigate it during the period of study, the weighted averages of exposures to beryllium are satisfactory. Individual high exposures were found, however, which should be corrected.

The radiation measurements which were taken indicate values of gamma radiation up to 22 mr/hr. It can be seen from Table IV that older thorium billets show radiation buildup. For example, a reading taken 6" from the long side of 12 boxes of billets showed 16 mr/hr when the billets were 3 weeks old, 9 mr/hr near billets which were one week old.

Several recommendations are included in the report. If these recommendations are followed, it should be possible to reduce all exposures to within acceptable limits.

Recommendations

In order to reduce airborne contamination in the thorium and beryllium areas, the following recommendations are presented:

1. Thorium Production

   a. Thorium Extraction Area

      Rec. #1 Provide additional ventilation at site of loading thorium nitrate tetrahydrate into hopper. Unloading of thorium nitrate tetrahydrate should be performed inside same hood. This hood should also include all weighing apparatus required for the extraction operation and should be adequately ventilated.

      Rec. #2 Eliminate broom sweeping. Use vacuum cleaner which should be exhausted out of doors.

      Rec. #3 Eliminate use of cooling fans.

      Rec. #4 Provide wall exhaust fan behind slurry tanks.

   b. Calcining and Hydrofluorination Area

      Rec. #5 Local exhaust ventilation should be provided at front of dryers and calcining furnaces.

      Rec. #6 A buggy should be devised to transport trays from loading hood to dryer and calciner and HF furnaces and back.

      Rec. #7 Tray weigh scale should be incorporated with the loading hood.

      Rec. #8 Cooling areas and tables should be adequately ventilated or hooded.

Rec. #9 ThO drums should be unloaded onto trays within the confines of a hood.

Rec. #10 Portable vacuum cleaner should be used in this area. Eliminate all broom and foxtail sweeping.

Rec. #11 All drums when not in use should be kept lidded.

c. Thorium Crude

Rec. #12 Provide ventilated enclosure at site of drum dumping of ThF_4 into grinder. Enclosure should be provided with drum access door, glove openings and cover unlidding device.

Rec. #13 Ventilation should be provided at charging and discharging ends of mixer.

Rec. #14 Central vacuum system should be installed for use in the thorium crude area.

Rec. #15 Provide local exhaust ventilation at bomb loading and bomb capping areas.

Rec. #16 Vacuum clean tops and sides of bomb before transporting same to topping and capping areas.

d. Metal Casting

Rec. #17 Provide floor grill type exhaust hood at site of dumping desinced billets from graphite pots.

Rec. #18 Provide local exhaust ventilation at site of loading desinced billet into beryllium crucible.

Rec. #19 Provide central vacuum cleaning system in thorium metal casting area and machining and beryllium crucible. Clean out area (Rooms 29-22 and 15)

Rec. #20 Eliminate use of air hosing when cleaning off furnace parts.

Rec. #21 Provide exhaust hood for furnace unloading, parts and clean out area.

Rec. #22 Exhaust discharge portable vacuum cleaner now in use into ventilation system or change to central vacuum system.

Rec. #23 Discharge the effluent of the Kinney vacuum pump into the ventilation system.

e. Machining Areas

Rec. #24 Provide local exhaust ventilation at milling machine, Room 22.

Rec. #25 Provide exhaust ventilation at saw and lathe in Room 15.

2. Beryllium Operations

Rec. #26 Confine all loading and weighing operations within a ventilated hood.

Rec. #27 Provide ventilated enclosure at site of dumping BeO and lime charge into large mixer.

Rec. #28 Provide ventilation at discharge of large mixer.

3. Operating Criteria

Rec. #29

1. The following operating criteria should be met in the Metallurgical Building:

   a. The daily average personnel exposure to long-lived thorium alphas should be less than 70 d/m/M^3.

   b. Gamma radiation - maximum or whole body or any part (except hands or forearms) should not exceed 300 mr/wk.

   c. Beta plus gamma, whole body or any part (except hands or forearms) should not exceed 500 mreps/wk, no more than 300 of which should be gamma.

   d. The hands and forearms should be less than 1000 mr gamma or 1500 mreps beta plus gamma.

   e. Weekly average concentration of thorium dust should be no greater than 0.7 d/m/M^3 at all places beyond the site perimeter. (Based on 1% of in-plant preferred level)

Rec. #30

2. A weekly radiation survey of all production, locker and lunch room facilities should be made. In addition, a monthly "spot" survey should be made in the other Metallurgy Building facilities.

Rec. #31

3. Suitable radiation warning signs should be provided in all drum, tray and metal storage areas. The practice of roping or sectioning off of areas where known direct radiation hazards are present should be encouraged.

4. General

Rec. #32 Install a personnel monitoring service which will include film badge service, radiation monitoring, etc.

Rec. #33 Provide work clothes, cover shoes and shoes and hats for all operating personnel.

Rec. #34 Provide two room change lockers, one for contaminated clothing and the other for non-contaminated street clothes.

Rec. #35 Provide shower facilities for personnel.

Rec. #36 Provide supervisory control to insure adequate housekeeping throughout the operating areas.

TABLE I

DAILY WEIGHTED AVERAGE EXPOSURE - AMES LABORATORY

Job	No. of Employees	Daily Weighted Concentrations d/m/m³	
		Thorium	Thoron
Kimco Unloader	1	7.7	22,000
Extraction Leader Operator	1	111	19,000
Drying Operator	1	1500	1,400
HF Operators	2	3100	30,000
Foreman, Thorium Crude	1	84	3,800
Bomb Unloaders	2	44	3,100
Bomb Loaders	2	852	14,000
Packing & Jolting	1	69	4,800
Weigh Man	1	791	19,000
Foreman Metal Casting	1	0.89	1,900
Casting Operator	1	0.06	1,000
Half-time Dezincing Operators	3	49	14,000
Casting & Dezincing Operators	3	66	19,000
Thorium Milling Operator	1	61	6,400
Thorium Machining Operation	1	276	2,000
TOTAL PERSONNEL	22		
AVERAGE DAILY WEIGHTED CONCENTRATION		530	13,000

* Thorium data extrapolated to time of sampling.