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May 8, 2024
Oak Ridge, Tennessee

Review of ORISE Epidemiologic Studies and the U.S. Department of Energy Health and Mortality Studies Program

Presentation to the National Academies of Sciences, Engineering, and Medicine Committee to Conduct a Feasibility of Assessing Veteran Health Effects of Manhattan Project (1942-1947) Related Waste

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Disclosure Statement

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Overview

- ORAU, the ORISE contract, and ORISE Health Studies Programs
- Review and timeline of DOE Health Studies
  - Specific emphasis on the ORAU/ORISE Health and Mortality Study of DOE Workers (HMS)
- The DOE Comprehensive Epidemiologic Data Resource (CEDR)
- Epidemiologic Study of One Million U.S. Radiation Workers (aka Million Person Study)
- NASEM committee questions
- Other resources and references

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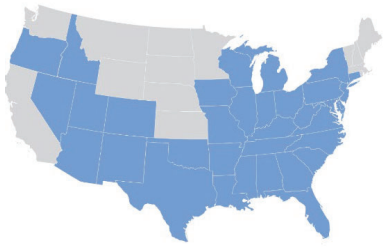
Oak Ridge Associate Universities (ORAU)

- ORAU, a 501(c)(3) nonprofit corporation, provides science, health and workforce solutions that address national priorities and serve the public interest.
- Through our specialized teams of experts and access to a consortium of more than 150 major doctorate-granting institutions, ORAU works with federal, state, local and commercial customers to provide innovative scientific and technical solutions and help advance their missions.
- ORAU manages the Oak Ridge Institute for Science and Education (ORISE) for the U.S. Department of Energy.
- Based in Oak Ridge, TN, with nearly 1,000 employees working across the U.S.

Provides science, health and workforce solutions

Specialized Teams of Experts



Consortium of 150+ PhD-Granting Universities

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DOE Mission Enabler

"The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions."

Unique DOE mission-support asset

Established in 1992

Managed as a FAR-based contract

Programs dating back to 1946

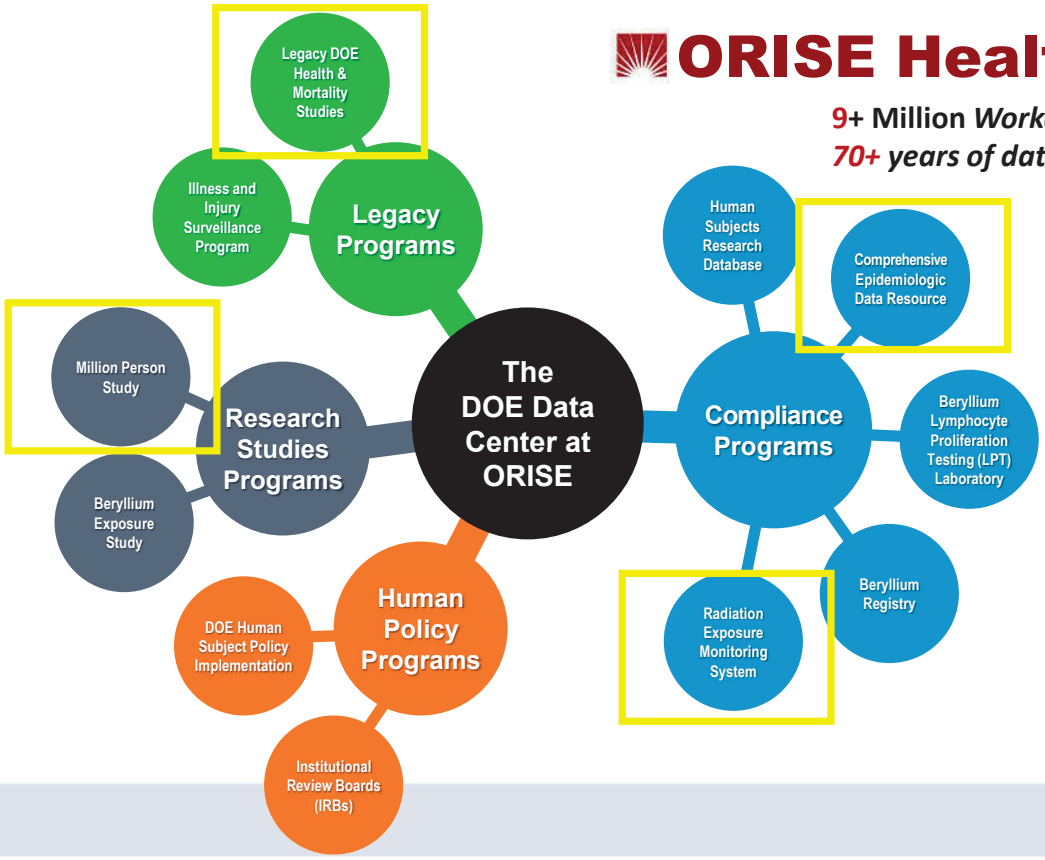




Mission and Capabilities

ORISE develops people and solutions to strengthen our nation's competitive advantage in science.

- **STEM Workforce Development**
- **Scientific Peer Review**
- **REAC/TS**
- **Health Studies**
- **Independent Environmental Assessments & Verification**



ORISE Health Studies

9+ Million *Workers*, 17+ Million *Records*, *70+ years of data & information*

Work funded under DE-SC0014664 between Oak Ridge Associated Universities (ORAU) and the U.S. Department of Energy.

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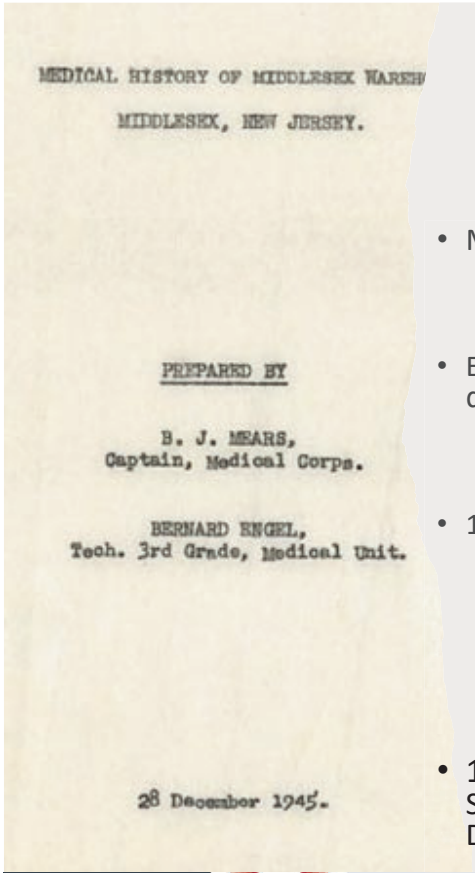

MEDICAL HISTORY OF MIDDLESEX WAREH

MIDDLESEX, NEW JERSEY.

PREPARED BY

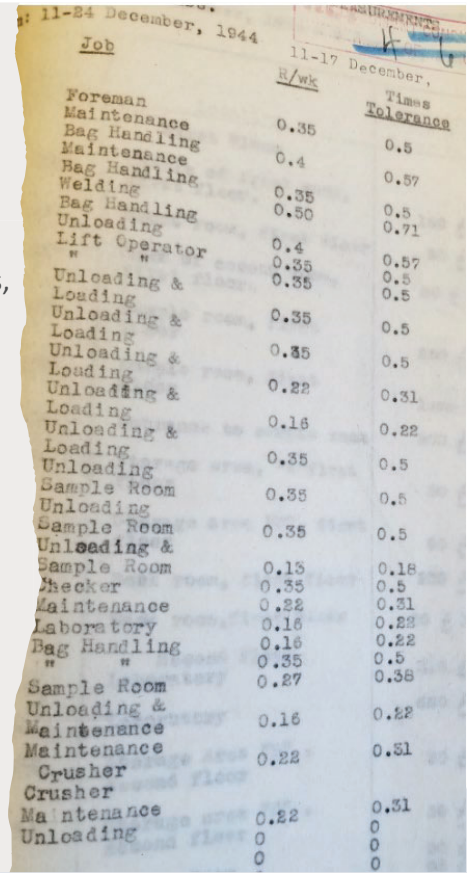
B. J. MEARS,
Captain, Medical Corps.

BERNARD ENGEL,
Tech. 3rd Grade, Medical Unit.

28 December 1945.

Timeline of DOE Health Studies

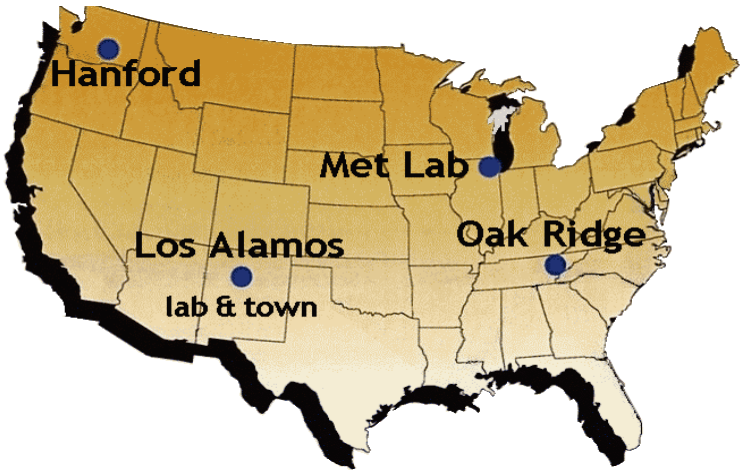
- Medical surveillance of workers began in 1942
  - Physicals, film badge, radon breath, urinalysis, & dust exposure (*Mears & Engel 1945*)
- Early 1960s – Feasibility of using occupational documents for long term mortality studies
  - University of Colorado – Mallinckrodt (MCW) & Fernald. (*Bell 1965, 1966; Quigley 1967*)
- 1964-1969 – Pilot study led by U of Pittsburgh
  - Locate hard copy records – save from destruction, make 'machine-readable'
    - Most relevant data for creating worker rosters and ascertaining vital status
  - Standardized procedures – vital status and death certificates
- 1970-1977 – The AEC Health and Mortality Study – Hanford and Manhattan Engineer District Sites *(Mancuso 1977)*


11-24 December, 1944

11-17 December,

Job	R/wk	Times Tolerance
Foreman		
Maintenance	0.35	0.5
Bag Handling		
Maintenance	0.4	0.57
Bag Handling		
Welding	0.35	
Bag Handling	0.50	0.5
Unloading		0.71
Lift Operator	0.4	
"	0.35	0.57
Unloading & Loading	0.35	0.5
Unloading & Loading	0.35	0.5
Unloading & Loading	0.35	0.5
Unloading & Loading	0.22	0.31
Unloading & Loading	0.16	0.22
Unloading	0.35	0.5
Sample Room Unloading	0.35	0.5
Sample Room Unloading &	0.35	0.5
Sample Room	0.13	0.18
Checker	0.35	0.5
Maintenance	0.22	0.31
Laboratory	0.16	0.22
Bag Handling	0.16	0.22
" "	0.35	0.5
Sample Room	0.27	0.38
Unloading & Maintenance	0.16	0.22
Maintenance Crusher	0.22	0.31
Crusher Maintenance	0.22	0.31
Unloading	0	0
	0	0

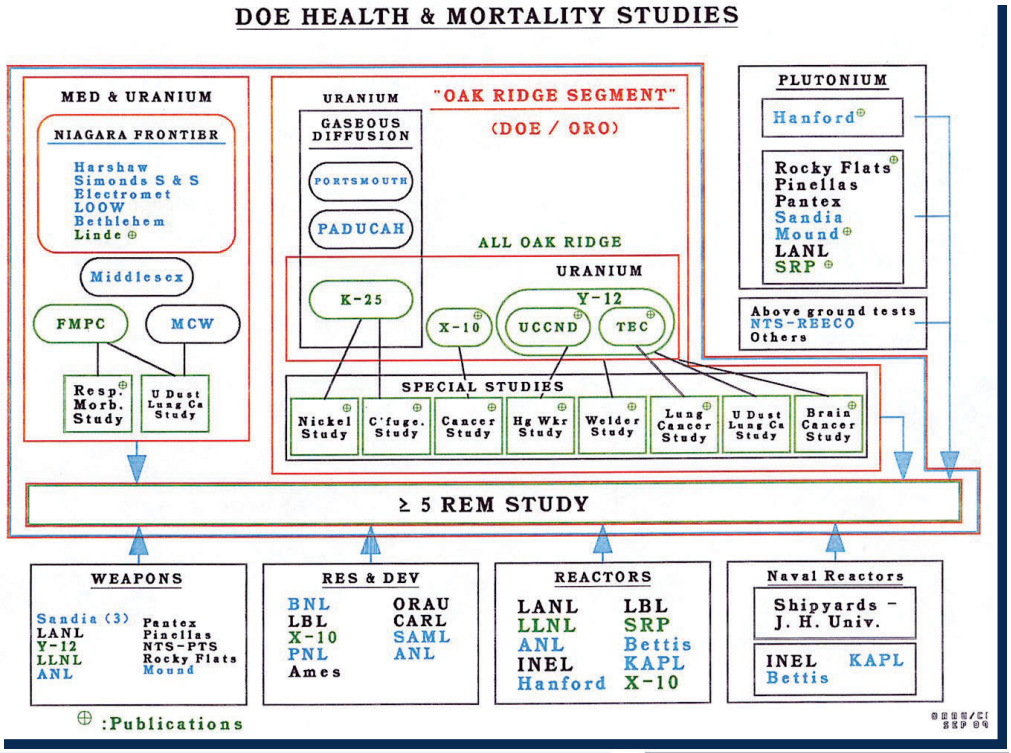
Timeline of DOE Health Studies



Ellis, et al. 2019 Historical perspective on the Department of Energy mortality studies: focus on the collection and storage of individual worker data. Int J Radiat Biol. 2022;98(4):560-567. doi: 10.1080/09553002.2018.1547851.

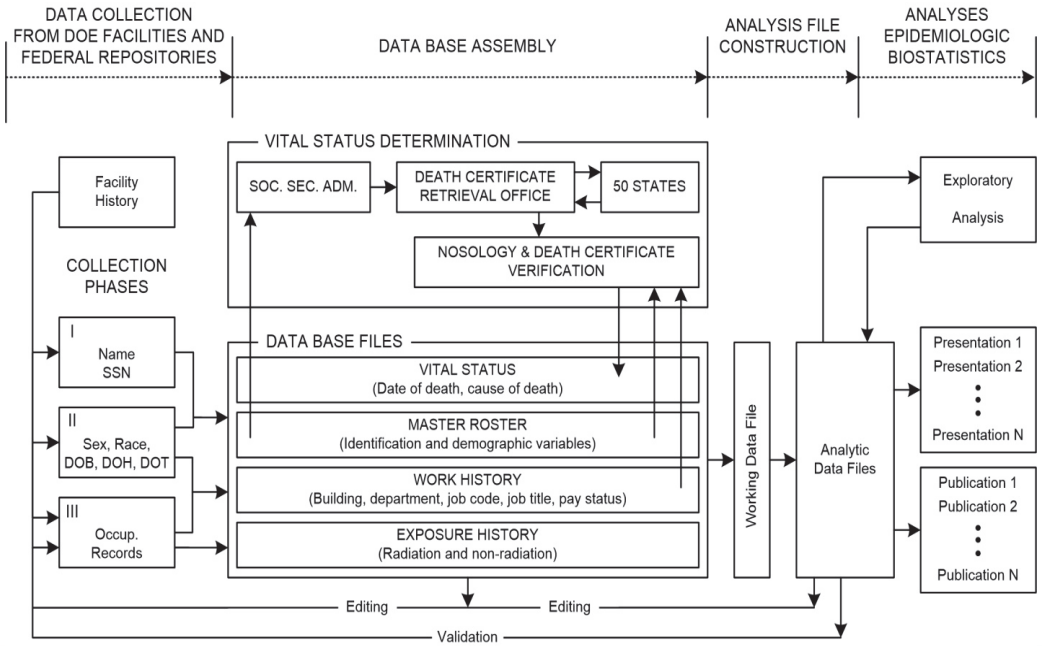
- 1977-1992 – Program was transitioned to three research groups
  - Hanford/PNNL – Hanford site; LANL – Plutonium sites; ORAU – Uranium sites
    - ~360,000 workers
  - Three sites operated independently except for vital status ascertainment and death certificate retrieval, which was performed by ORAU
- 1990-1995 – Program transferred to CDC NIOSH (Health Related Energy Research Branch)
  - Memorandum of Understanding with DOE ended ~2010
  - See: A 1990 Memorandum of Understanding | Review of the Worker and Public Health Activities Program Administered by the Department of Energy and the Department of Health and Human Services | The National Academies Press
- 2010 – DOE Office of Science Low-Dose Program funds the Million Person Study

- 1979 – HMS expansion to 76 identified sites, ~600K workers
  - Sites were studied as funding allowed.
- Evaluate effects of chronic exposure to low dose ionizing radiation from external & internal radiation sources from DOE operations (*Lushbaugh 1983*)
- ORAU created an integrated, relational database for worker roster information from multiple facilities to facilitate vital status tracing for all research centers
  - Center for Epidemiologic Research (CER) Data Model (DM)
  - Later – the 'DOE data model at ORISE'

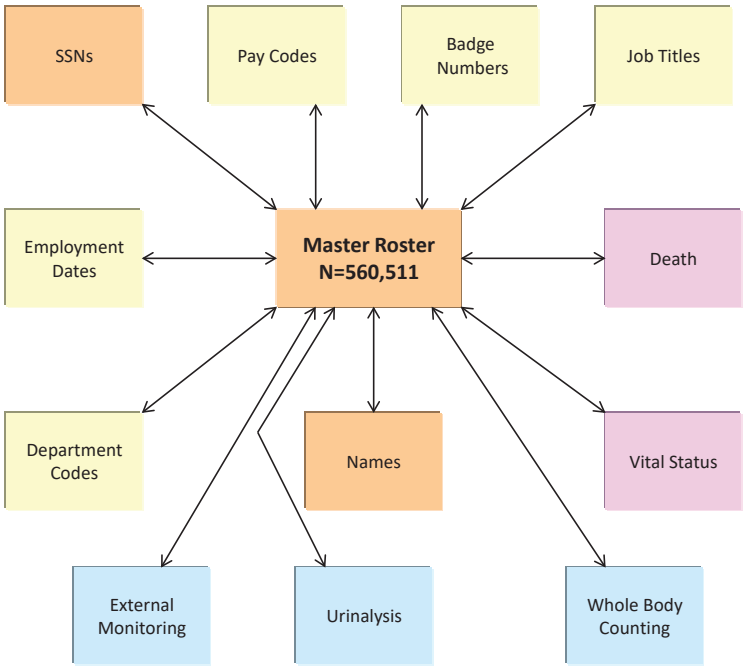


DOE Health & Mortality Studies Process

- Data model (DM)
  - 4 main elements
  - Last major update, 2000
- Exposure history
  - Not linked due to significant variability
- Working data files – linked information that required cleaning/analytic decisions
- Analytic data files – final research product used to produce study results



ORISE/CER Data Model



CERID – unique pseudo-ID

Limitations of ORISE/CER data model

- Created to support epidemiologic research
  - NOT a comprehensive, human resources database of all individuals at DOE sites
  - Cannot guarantee the accuracy or completeness of the information provided by DOE sites and sub-contractors at the time of capture
- Data captured did not routinely include original records, only COPIES
  - There are a few exceptions where ORAU took possession (MCW, Fernald) of original records OR borrowed them from a DOE record center
    - All 'original records' transferred/returned to DOE Records Centers or NARA – 1998, 2010, 2023
- Only 'pertinent' data were digitized
  - Ex: military status, education, etc. often not included
  - Ex: K25 survey with 100+ elements, only ~20 variables
- Exposure data maintained separately
  - Substantial variation across sites & time periods
  - Often, documentation/data dictionaries are limited

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Comprehensive Epidemiologic Data Resource (CEDR)

Comprehensive Epidemiologic Data Resource (CEDR) 1990- Present

- 1998 - Independent review of DOE's epidemiology program
  - Transparency for worker & public health concerns
  - Advance science with data available for validation & research
  - Support education– data for students & teachers
- Three DOE epi programs provided working & analytic files
  - No personally identifiable information, masked dates
- National repository of free de-identified data
  - 1.6M+ workers; 400+ datasets (3GB of data)
  - 4000+ citations – unique bibliography
  - 124 Current users (verified accounts)
  - Average monthly visitors: 30k+ from 50 countries, 35 states

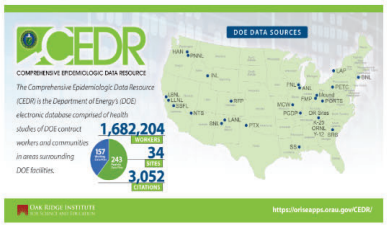
CEDR Website

- *Headlines –*
  - CEDR newsfeed of updates
- *Read More –*
  - General information about CEDR
  - Provides specific information about DOE facilities
- *Examples –*
  - Example code from SAS, R, Access, & Tableau
- *Browse Bibliographies –*
  - Historical documents available for CEDR users
  - Full CEDR bibliography (4000+)

Comprehensive Epidemiologic Data Resource (CEDR)

The Comprehensive Epidemiologic Data Resource (CEDR) is the U.S. Department of Energy (DOE) electronic database comprised of health studies of DOE contract workers and environmental studies of areas surrounding DOE facilities. DOE recognizes the benefits of data sharing and supports the public's right to know about worker and community health risks. CEDR provides independent researchers and educators with access to de-identified data collected since the Department's early production years. Current CEDR holding include more than 80 studies of over 1.5 million workers at 34 DOE sites. Access to these data is at no cost to the user.

Most of CEDR's holdings are derived from epidemiologic studies of DOE workers at many large nuclear weapons plants, such as Hanford, Los Alamos, the Oak Ridge reservation, Savannah River Site, and Rocky Flats. These studies have primarily used death certificate information to identify excess deaths and patterns of disease among workers to determine what factors contribute to the risk of developing cancer and other illnesses. In addition, many of these studies have radiation exposure measurements on individual workers. CEDR is supported by the Oak Ridge Institute for Science and Education (ORISE) in Oak Ridge, Tennessee. Now a mature system in routine operational use, CEDR's modern internet-based systems respond to thousands of requests to its web server daily. With about 1,500 internet sites pointing to CEDR's web site, CEDR is a national online digital repository, with a large audience for data that are not available elsewhere.



Website: https://OriseApps.orau.gov/cedr/

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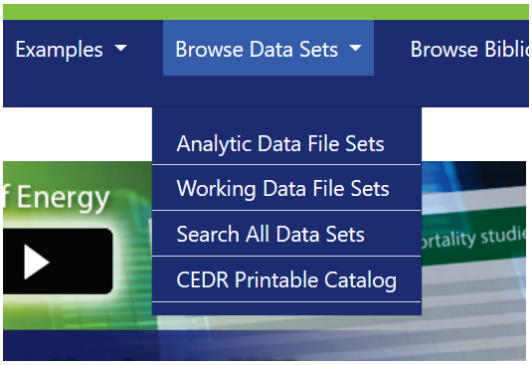
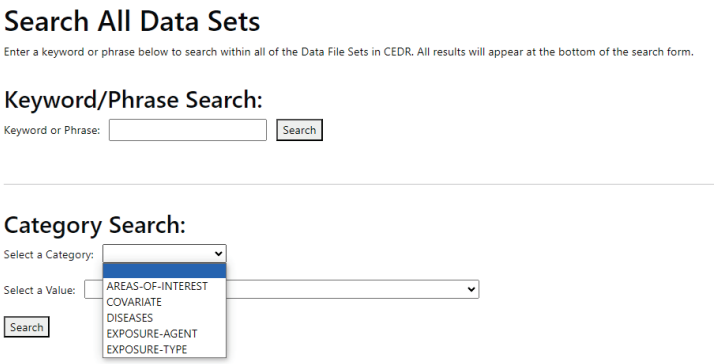
Search Options on CEDR

- **Analytic Files**
  - Final analysis files
  - Only include study data after selection criteria was applied by study PI
    - Typically, only the data/variables used to create an associated publication or report
- **Working Files**
  - Entire study cohort (as provided by study PI)
  - May include extra variables
  - May need extra data cleaning/processing
- **Category Search**
  - Searches datasets based on specific info
  - Similar to Key Words or Terms





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Search Results

Search Results for "lanl":

Source	Data File Set	Year Added	Study	Site Name(s)
Analytic	LAB22A01	2022	Mortality among Workers at the Los Alamos National Laboratory, Employed 1943-1980	Los Alamos National Laboratory
Analytic	LAFEMA01	1993	Los Alamos National Laboratory (LANL) Female Cohort Mortality Study	Los Alamos
Analytic	LAHSWA04	1998	Analytic Health Study of Los Alamos, Zia Company, and Manhattan Project Workers, 1994	Los Alamos National Laboratory (including Zia)
Analytic	LAMENA03	1996	Los Alamos National Laboratory (LANL) Male Cohort Mortality Study, 1993	Los Alamos
Analytic	LASUIA02	1993	Los Alamos National Laboratory (LANL) Female Suicide Analytic Study	Los Alamos

- Search by site or by topic
- Provides links to the dataset in the study description
- Year added – the year the dataset was added to CEDR
  - Not the year the study was published/performed

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- **Study Characteristics**
  - Snapshot of the study data
- **Cite Dataset**
  - Provides citation that can be copied in one format
- **Description**
  - Study summary
  - Typically, the publication abstract
- **Citations Associated**
  - Any publications associated with the data

Data File Set Results

To view a certain data file set, select the data file set below:

Not what you are looking for? Try Another Search

Data File: LAB22A01

Cite Dataset

Data Files (5):

LAB22A01_d1 - Person data
LAB22A01_d2 - Annual Dose file w 5 yr lag for LUNG
LAB22A01_d3 - Doses with 2 year Lag
LAB22A01_d4 - Doses with 10 year Lag
LAB22A01_d5 - Raw Doses - No Lag

Study Name: Mortality among Workers at the Los Alamos National Laboratory, Employed 1943-1980
Cohort Size: 26,328
Races: Asian, Black, Hispanic, Native American, White, Unknown
Sexes: Males, Females
Diseases: Cancer and non-cancer mortality were assessed using information collected from the National Death Index. Some outcomes reported in the publication (Boice et al, 2021) were suppressed from the data files due to small frequencies.
Earliest Exposure: 01/01/1940
Latest Exposure: 12/31/1980
Follow-Up: 12/31/2017
Exposure Type: Combined External and Internal Radiation
Exposure Agent: Photons, neutrons, tritium, 238Pu and 239Pu
Covariate: Education
Sites: Los Alamos National Laboratory

Description:

Background: During World War II (WWII), the Manhattan Engineering District established a secret laboratory in the mountains of northern New Mexico. The mission was to design, construct and test the first atomic weapon, nicknamed 'The Gadget' that was detonated at the TRINITY site in Alamogordo, NM. After WWII, nuclear weapons research continued, and the laboratory became the Los Alamos National Laboratory (LANL).

Materials and methods: The mortality experience of 26,328 workers first employed between 1943 and 1980 at LANL was determined through 2017. Included were 6157 contract workers employed by the ZIA Company. Organ dose estimates for each worker considered all sources of exposure, notably photons, neutrons, tritium, 238Pu and 239Pu. Vital status determination included searches within the National Death Index, Social Security Administration and New Mexico State Mortality Files. Standardized Mortality Ratios (SMR) and Cox regression models were used in the analyses.

Results: Most workers (55%) were hired before 1960, 38% had a college degree, 25% were female, 81% white, 13% Hispanic and 60% had died. Vital status was complete, with only 0.1% lost to follow-up. The mean dose to the lung for the 17,053 workers monitored for radiation was 28.6 weighted-mGy (maximum 16.8 weighted-Gy) assuming a Dose Weighting Factor of 20 for alpha particle dose to lung. The Excess Relative Risk (ERR) at 100 weighted-mGy was 0.01 (95%CI -0.02, 0.03; n = 839) for lung cancer. The ERR at 100 mGy was -0.43 (95%CI -1.11, 0.24; n = 160) for leukemia other than chronic lymphocytic leukemia (CLL), -0.06 (95%CI -0.16, 0.04; n = 3043) for ischemic heart disease (IHD), and 0.29 (95%CI 0.02, 0.55; n = 106) for esophageal cancer. Among the 6499 workers with measurable intakes of plutonium, an increase in bone cancer (SMR 2.44; 95%CI 0.98, 5.03; n = 7) was related to dose. The SMR for berylliosis was significantly high, based on 4 deaths. SMRs for Hispanic workers were significantly high for cancers of the stomach and liver, cirrhosis of the liver, nonmalignant kidney disease and diabetes, but the excesses were not related to radiation dose.

Conclusions: There was little evidence that radiation increased the risk of lung cancer or leukemia. Esophageal cancer was associated with radiation, and plutonium intakes were linked to an increase of bone cancer. IHD was not associated with radiation dose. More precise evaluations will await the pooled analysis of workers with similar exposures such as at Rocky Flats, Savannah River and Hanford.

Citations Associated:

Boice, J. D., Jr, Cohen, S. S., Mumma, M. T., Golden, A. P., Howard, S. C., Girardi, D. J., Ellis, E. D., Bellamy, M. B., Dauer, L. T., Samuels, C., Eckerman, K. F., & Leggett, R. W. (2021). Mortality among workers at the Los Alamos National Laboratory, 1943-2017. International journal of radiation biology, 1–28. Advance online publication. https://doi.org/10.1080/09553002.2021.1917784

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Data File Set: LAB22A01_d4

File Name: Doses with 10 year Lag

Login to Download Data * You must go and login to retrieve data

To learn more about a given variable for a column below, hover over its title and click it to open up its definition in another window.

CERID	year	age_entry	age_exit	cum_bladder_x1_gy_lag10	cum_bladder_x10_gy_lag10	cum_bladder_x20_gy_lag10	bladder	cum_bone_x1_gy_lag10	cum_bone_x10_gy_lag10	cu
194	1948	31	33	0	0	0	0	0	0	0
194	1949	33	34	0	0	0	0	0	0	0
194	1950	34	35	0	0	0	0	0	0	0
194	1951	35	36	0	0	0	0	0	0	0
194	1952	36	37	0	0	0	0	0	0	0

- After logging in…
  - Shows first 10 first of all variables
  - Data files can be downloaded
    - Soon to be based on tier level of access
  - Links to data dictionary for viewing

Variable-Level File Details and Download

Variable Level File for LAB22A01_4

Download This Variable File (FREE)

VarID	VariableName	Description	Unit Of Measure	CodeSet
CERID	CERID	identification variable		
year	year	year of annual dose		
age_entry	age_entry	attained age at the beginning of each calendar year of radiation exposure		
age_exit	age_exit	attained age at the end of each calendar year of radiation exposure		
cum_bladder_x1_gy_lag10	cum_bladder_x1_gy_lag10	cumulative annual bladder dose in Gy with dose weighting factor of 1 and a 10 year lag	Gray	
cum_bladder_x10_gy_lag10	cum_bladder_x10_gy_lag10	cumulative annual bladder dose in Gy with dose weighting factor of 10 and a 10 year lag	Gray	
cum_bladder_x20_gy_lag10	cum_bladder_x20_gy_lag10	cumulative annual bladder dose in Gy with dose weighting factor of 20 and a 10 year lag	Gray	

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Historical Documents

- Access to bibliography and historical study documents
  - Over 4,000 citations are searchable from DOE studies
  - Several hundred documents are downloadable
- Searchable by title only
  - Future project to update search functions
- Documents updated regularly
  - Added more than 100 documents in the past year


Historical I

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Search Title

Document Title

A Case-Control Study
Malignant Melanoma
Lawrence Livermore Na
Laboratory Employees

A CDC Review Panel's
Recommendations on
Effects and Epidemiolo
Studies at SRS Plant, A

A Computer Code for
Dose Equivalent to a Ta
Organ per Microcurie-
Residence of a Rad

A Continuing Study of
in Hanford Workers

A Method for Determi
Level Alpha Activity fro
Americium241, Curium
Californium252 in Biol
Materials

A Method for Estimati
Occupational Radiatio
Individuals, using Wee
Dosimetry Data

This Historical Publication may not be fully accessible

JAN 25 1994

ornl

ORNL-6778

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LABORATORY

MARTIN MARIETTA

A Method for Estimating Occupational Radiation Dose to, Individuals, Using. Weekly Dosimetry Data

Toby J. Mitchell
George Ostrouchov
Edward L. Frome
George D. Kerr

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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Million Person Study

Million Person Study (MPS)

- Largest occupational cohort ever studied
  - Focused on workers & veterans monitored for occupational exposure to radiation
  - Goal – achieve greater statistical precision for chronic, low dose radiation exposure
- Multi-agency support since 2010
  - Fluctuating funding until 2017 (DOE EHSS-13)
- Multi-institutional collaboration
  - Coordinated by NCRP - John Boice, Larry Dauer

Sub-Cohort	Number
Manhattan Project and others (DOE)	300,000
Atomic Veterans (DOD)	113,806
Nuclear Power Plant Workers (NRC)	135,193
Industrial Radiographers (NRC)	123,556
Medical Radiation Workers (Landauer)	109,019
Nuclear Submariners (US Navy)	210,000
Radium Dial Workers (DOE)	3,200

Vanderbilt-Ingram Cancer Center

NCRP

ORISE

Oak Ridge National Laboratory

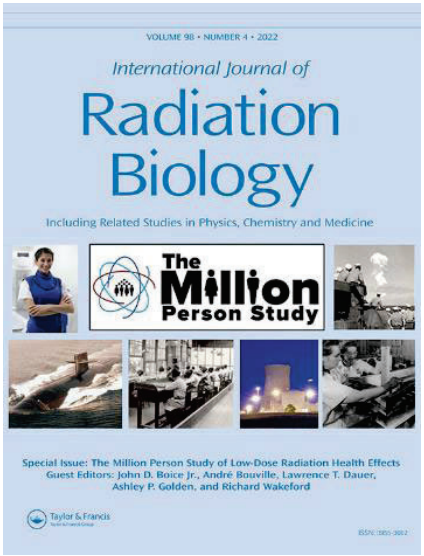
Memorial Sloan Kettering Cancer Center

Boice et al. *The Million Person Study, Whence it Came and Why*. IJRB March 2019

How are we studying One Million People?

Special Issue on MPS IJRB 98(4) – April 2022

- **Phase 1.0** – Study individual cohorts
  - Define the cohort
    - Build /update from previously studied populations (HMS, CEDR)
    - Rely on data registries & partnerships
      - ORISE - DOE REMS (including REMS historical), NRC REIRS
      - Vanderbilt (Mike Mumma) - DOD, Landuer, others
  - Refine the dosimetry (NCRP Report 178, 2019)
    - Use all sources of radiation to obtain organ doses
  - Consistent methodology
    - Vital status tracing (Mumma et al, IJRB 2019)
    - Statistical models (Golden et al, IJRB 2019)
- **Phase 2.0** – Pool cohorts through data harmonization



Select DOE Cohorts in the MPS

Cohorts	Estimated Populations	Total CEDR Datafiles	Reference Cohorts in CEDR
Los Alamos	26,328	3 separate datafiles	Wiggs, 1987; Wiggs et al., 1994; Galke et al., 1992
TEC	26,650	1 datafile	Polednak & Frome, 1981
Mallinckrodt	2,514	4 datafiles	Dupree-Ellis et al., 2000
Rocky Flats	9,397	2 datafiles	Wiggs 1994*
Hanford	37,100	3 datafiles	Gilbert et al., 1993
Radium Dial Painters	3,276	25 datafiles	Polednak et al., 1978; Stebbings et al., 1984
Y12	20,183	6 datafiles	Frome et al., 1997
X10	22,744	6 data files	Frome et al., 1997
K25	49,699	6 data files	Frome et al., 1997

Unpublished dataset

MPS datasets in CEDR – more to come!

Boice et al., 2022. Mortality among workers at the Los Alamos National Laboratory, 1943-2017. Int J Rad Bio

Source	Data File Set	Year Added	Study	Site Name(s)
Analytic	LAB22A01	2022	Mortality among Workers at the Los Alamos National Laboratory, Employed 1943-1980	Los Alamos National Laboratory

Boice et al., 2022. Mortality among Tennessee Eastman Corporation (TEC) uranium processing workers, 1943–2019. Int J Rad Bio

Analytic	TEB22A01	2022	Mortality among Tennessee Eastman Corporation (TEC) uranium processing workers, 1943–2019	Oak Ridge Tennessee Eastman Company

Golden et al., 2022. Updated mortality analysis of the Mallinckrodt uranium processing workers, 1942–2012. Int J Rad Bio

Working	MCG19W01	2020	Working dataset for the Mallinckrodt uranium processing workers, 1942-2012	Mallinckrodt Chemical Works
Analytic	MCG19A01	2019	Follow-up mortality analysis of the Mallinckrodt uranium processing workers between 1942 and 2012	Mallinckrodt Chemical Works

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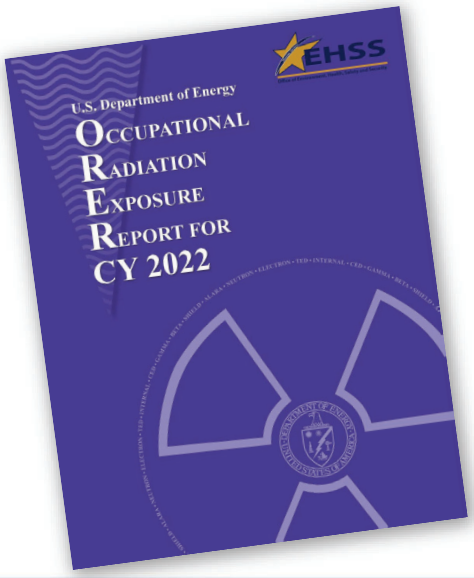
- Major findings to date
  - Positive, but non-significant, excess risk of lung cancer, with no sex-differences
  - Except for heart (IHD), most risk coefficients are positive
  - Risks are lower but generally statistically compatible with studies of Japanese atomic bomb survivors – single cohort studies to date
  - Positive, but mostly non-significant, risk of Parkinson's disease = new finding
- Chronic condition incidence, other confounder information soon to come from MEDICARE

DOE Radiation Exposure Monitoring System (REMS)

Radiation Exposure Monitoring System (REMS)



- DOE Office of ESH Reporting and Analysis (EHSS-23)
  - Began 1987, brought to ORISE 1995
- Central repository of occupational radiation exposure records from for all DOE employees, contractors, subcontractors, and members of the public in areas monitored for radiation exposure.
  - *Required by: Rule 10 CFR 835.702 and DOE Order 231.1B*
- Regulatory based data reporting
  - Effective doses, primary for external radiation
  - Limited information on internal radiation exposures
- REMS historical (pre-1987)
  - Hanford data for 1942-1947
    - n-=5,595 unique people
    - >13,000 records
  - Hanford Operations began 1944
    - Mainly construction prior

Monitoring Year	Record Count
1944	1585
1945	3017
1946	3429
1947	5244

Answers to NASEM Committee Questions

Question 1 – Available Information

Given the focus of the committee's task is on military service members who served 1942-1947, what information on this group is available (presence or specific activities, estimated number [total or by year/location])? For example, rosters or an indicator in records?

- ORISE data model has n=560,511 unique workers
  - Varying levels of identifiable information available (SSN, DOB, Name)
  - n=102,496 unique people worked from 1942-1947
- No indictor of military service
  - Matching with rosters (SSN, DOB, Name, Gender) of veterans (if available)
    - Probability-based matching methods if information is incomplete
  - Military service may be available in site HR or medical records – dependent on site, knowledge of record locations, and ability to extract
- Work history information varies greatly
  - Year of hire, Year of termination (less available), job title, other job information (task, department, building location, etc.)
- Exposure information varies substantially, limited digitized data for 1942-1947

- 1942-1947
- Data for locations aligned to NAS 13 primary sites of interest
- n=110,069 total number of workers
  - n=102,496 unique people
  - N=7,573 worked at more than 1 site
- 10 sites with digitized dosimetry & death data

Facility	Location	# People	Dosimetry	Death Info
AMES	Ames, IA	102		
Argonne	Chicago, IL	106		
Brookhaven	Upton, NY	10		
Hanford Construction	Richland, WA	10		
Hanford Operations	Richland, WA	11,372	Y	Y
K25	Oak Ridge, TN	30,646	Y	Y
Kansas City Plant	Kansas City, MO	3		
Knolls Atomic Power Plant	Niskayuna, NY	354		
Lawrence Livermore Lab	Livermore, CA	38		
Linde	Tonawanda, NY	1,519	Y	Y
Los Alamos National Laboratory	Los Alamos, NM	6,187	Y	Y
Mallinckrodt Chemical Works	St. Louis, MO	1,125	Y	Y
Middlesex Sampling Plant	Middlesex, NJ	499	Y	Y
Mound	Mound, OH	1,157	Y	Y
National Lead of Ohio	Hamilton County, OH	9		
Special Alloyed Materials Labs	New York, NY	2,139		
Sandia National Lab	Albuquerque, NM	222		
Tennessee Eastman Company	Oak Ridge, TN	47,126	Y	Y
X10 (ORNL)	Oak Ridge, TN	5,024	Y	Y
Y12	Oak Ridge, TN	2,421	Y	Y
Total		110,069		

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Question 1a&b – Obtaining Smoking Info

Availability of Smoking Data

- Collected from site specific medical records
  - Limited digitized smoking information
  - Varies by site & time-period for availability and format
    - Example - Smoking (y/n), categorical (current, former, never), pack-years, etc.
- Info for TEC smoking obtained from the DOE Oak Ridge Records Management Center (ORRMC)
  - Occupational medical records
  - Knew of the existence based on prior knowledge/experience, i.e. no 'inventory' necessarily available

Access to DOE ORRMC

- Required a specific request and justification to DOE ORRMC
- Provided *exact identifiers* to ORRMC
- Coordinate time with ORRMC manager for staff to pull records for data extraction
  - Must have clearance (L) to enter facility
  - Must provide staff to extract data
  - Data required to be extracted to a data sheet (hard copy)
  - Data/info from ORRMC cannot leave with out classification review
- Data must be entered into digital database once extracted

Question 1a&b – Obtaining Smoking Info

- Effort/Cost for TEC abstraction
  - Total labor hours - 266
    - Time to prepare lists - 75
    - Time to abstract data - 105
    - Time to enter/QA data - 82
  - Total cost - $29K
- Total Duration – 18 months
  - Limited by COVID restrictions
  - Limited by cleared staff availability
- Similar effort for military status?
  - Requires identification of location of records for sites/cohort of interest
- Matching options
  1. Roster of veterans with PII
  2. Review all records during time period of interest
- Likely more efficient ways to ID military veterans

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Question 2 – Military History

Does your office or any partnering organizations keep work history and/or military history, such as information on employees who entered and/or left the military?

- No explicit capture in ORISE/CER/HMS data
- Most likely source at ORMMC
  - Personal Security Cards (PSC) - Set of 3x5 index cards in green metal card catalogue
  - Tens of thousands of cards with information from Manhattan Project Era
  - Information varies but includes some combination of:
    - Full name
    - Address
    - Birth date & place of birth
    - DOE site
    - Hair & eye color
    - Skin tone
    - Security related information – possibly military rank, service period, etc.
- Other possibilities
  - MPS matches to DOD dosimetry databases
  - DOD/VA provide identifiable information for target population

Question 3 – Dosimetry Records Y12, X10, K25

- ORISEWD Data (CEDR) contains working dataset from multiple DOE sites including K-25, X-10, Y-12, Linde, Savannah River, Mallinckrodt and Fernald
  - n=534,154 total people in data set (all sites, all years)
  - Earliest exposure 1942
  - Full work history included
    - Dates at each facility
    - Job titles & time periods for each facility
  - Variable dosimetry from each site
    - Film badge
    - Bioassay
    - Radon Breath
    - Whole Body Counts
    - X-rays
  - No non-radiological exposures included

Facility	1942	1943	1944	1945	1946	1947	Totals
K25	1	47	7,187	22,035	2,842	300	32,412
X10		947	1,501	916	1,253	641	5,258
TEC	1	7,150	25,815	15,883	1,596	59	50,504
Y12						2,421	2,421
Totals	**2**	**8,144**	**34,503**	**38,834**	**5,691**	**3,421**	**90,595**

Note: The table shows the total number of people who worked at a specific site during the year. In any year, there could be overlap in workers between cohorts.

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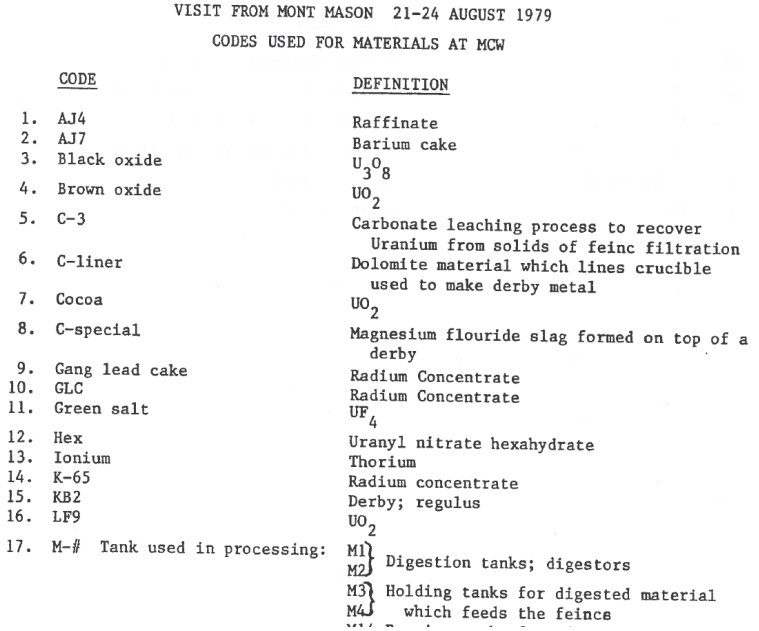
Question 4 – Other Chemical Exposures

- Non-radiological exposures captured inconsistently
  - Possible exposures vary by site & time-period
  - Hazards may include beryllium, mercury, solvents, acids, & many others
  - Information located on both CEDR & in ORISE Data Model
- Types of data
  - Commonly 'flags' for possible exposures (ex: Fernald)
  - Early data coded = effort to verify/review decoding
  - Very limited area-level measurements
    - One study at Hanford, LANL, X10, & SRS
    - >700 chemicals in chemical hazards – beryllium, aluminum, asbestos, nitric acid, cadmium, etc.



VISIT FROM MONT MASON 21-24 AUGUST 1979

CODES USED FOR MATERIALS AT MCW

	CODE	DEFINITION
1.	AJ4	Raffinate
2.	AJ7	Barium cake
3.	Black oxide	U_3O_8
4.	Brown oxide	UO_2
5.	C-3	Carbonate leaching process to recover Uranium from solids of feinc filtration
6.	C-liner	Dolomite material which lines crucible used to make derby metal
7.	Cocoa	UO_2
8.	C-special	Magnesium flouride slag formed on top of a derby
9.	Gang lead cake	Radium Concentrate
10.	GLC	Radium Concentrate
11.	Green salt	UF_4
12.	Hex	Uranyl nitrate hexahydrate
13.	Ionium	Thorium
14.	K-65	Radium concentrate
15.	KB2	Derby; regulus
16.	LF9	UO_2
17.	M-# Tank used in processing:	M1, M2 } Digestion tanks; digestors M3, M4 } Holding tanks for digested material which feeds the feince

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Question 4 –Exposures

- n=23 datasets in CEDR with non-radiological exposures
  - n=11 exposures in time period 1942-1947
  - Most relying on 'flags' alone for exposures
- Limited work histories
  - If chemicals are known, possibility of assigning exposures based on job titles or job exposure matrices if documentation
- ORISE 'hazards' surveys
  - Never published
  - Voluntary survey sent to sites
  - Needs review
    - 25+ boxes of information
    - Time period unclear

Dataset	Facility	Earliest Exposure Year	Potential Chemical Exposures
LND87A01	Linde	1943	Chlorine, Hydrofluoric Acid, Lead Sulfate, Nickel, Nitric Acid & Nitrogen Oxides, Silicon Dioxide, Sulfuric Acid
MFMCHMA1	K25, X10, Y10, SRS	1943	chemical exposure (no flags as to type in data)
MFMM98A1	Hanford, LANL, X10, SRS	1943	Aromatic hydrocarbons, Asbestos, Beryllium, Cadmium, ELF/EMF, Halogenated hydrocarbons, Mercury, Microwave, Nickel, Lead, Static magnetic fields, Welding fumes
ORK25A02	K25	1945	Hydrofluoric acid
ORMULA01	K25, X10, Y10	1943	Nickel Oxides
ORMULA04	K25, X10, Y10	1943	Nickel Oxides
ORX10A01	X10	1943	Mercury, Beryllium, Lead
ORX10A03	X10	1943	Mercury, Beryllium, Lead
ORY12A04	Y12	1943	Phosgene
ORY12A05	Y12	1947	Beryllium, Mercury, Solvents, Other Industrial Agents (no flags in data)
PETC04A1	PETC	1944	Perchloroethylene, Coal, Glue Gas, Oil Shale (no flags in data)

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Question 5 – Health Information

- Health information from DOE HMS mainly limited to mortality data
  - Limited info on pre-employment or exit physicals in medial records (mostly non-digital)
    - General health information – height, weight, CBC, etc.
- DOE Health & Mortality Studies – valuable pre-1979 death info
  - Nearly 90,000 DOE DCs maintained at ORISE
    - Only underlying cause of death consistently digitized; some DCs not digitized at all
- MPS Health outcomes
  - Vital Status ascertainment - combination from multiple sources
    - National Death Index (NDI)
    - Social Security Administration (SSA) Death Master File, SSA Service to Researchers
    - State mortality files, Historical HMS information
  - Prospective information
  - Centers for Medicare and Medicaid
  - National Pooled Virtual Registry Cancer Linkage
- Other source of prospective health info: DOE former worker screening programs (EHSS-14)

Question 6 – Requesting MPS Data

- MPS Published data available on CEDR
  - Fully available as de-identified/masked
    - See slide 28 for examples
  - Require approval from EHSS-13 & DOE Central IRB for matching
- MPS CEDR data files include
  - Final analytic file for all studies
    - Person data – COD flags, SES, age, etc.
    - Dosimetry – Lagged annual absorbed organ/tissues doses
  - Some working files – dose components
- On-going research data
  - Require discussion with EHSS-13 for what is appropriate and scientifically ethical

Completed
- Mallinckrodt
- Los Alamos National Laboratory
- TEC
- Medical* Workers
- Nuclear Power Plant Workers
- Rocketdyne*
- Mound*

In Progress
- Industrial Radiographers
- Rocky Flats
- Radium Dial Painters
- Fernald
- Middlesex
- Hanford

Future Efforts
- Oak Ridge (Y12, X10, K25)
- Pantex
- Savannah River
- Linde
- Portsmouth
- Paducah

*Coming soon to CEDR

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Question 7 - Historical Documents Archive

Overview of ORISE

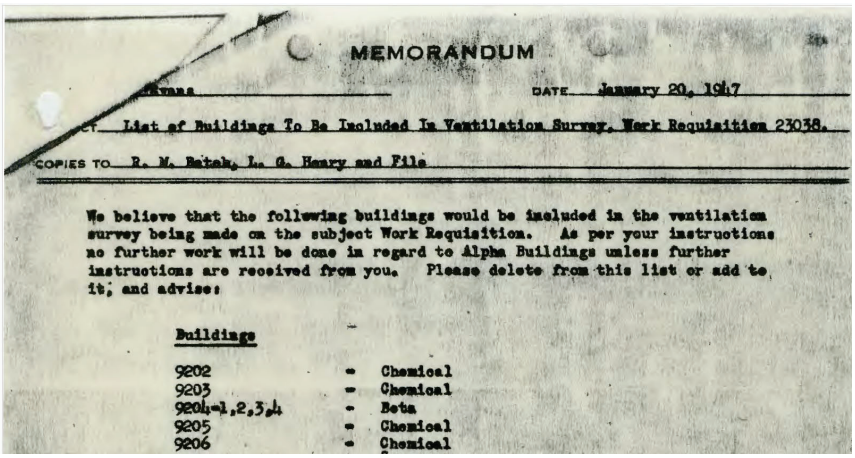
- Since early 1960s, ORISE has been gathering historical documents relating to DOE operations
  - >2,500 record boxes; ~700 likely relevant
  - High-level inventory available, but significant effort required for review
- Technical reports, government memos, research articles, maps, surveys, etc.
  - Variety of forms - some digitized, many typed & handwritten document
  - Not original records but copies of information
- Digitization in process for many documents
  - Difficult due to age, medium (i.e., onion skin)
  - If possible, made available on CEDR or OSTI
    - Not all documents can be made available publicly due to Controlled Unclassified Information (CUI) guidelines

Specific DOD/Military Documents

- Several DOD reports or papers related directly to nuclear weapons testing (mainly non-digital)
- Sample documents of interest:
  - US Army War Department. 1943. **War Department Decimal File System - A subjective decimal classification with a complete alphabetical index for use of the w**ar department and the United States Army
  - Select Service System Special Monograph Volume 1. 1947. **Physical examination of selective service registrants**
  - McRaney, W., McGahan, J. 1980. **Radiation Dose Reconstruction, U.S. Occupation Forces in Hiroshima and Nagasaki, Japan**, 1945-1946. McLean, VA: Science Applications, Inc.; Report DNA 5512F.
  - Summers DL. 1980. **Nuclear Casualty Data Summary**. Report DNA 5427F
  - Hacker. 1982. **Radiological Safety at Los Alamos, 1943-1945**. Chapter 3 of Elements of Controversy: A History of radiation safety in the nuclear weapons testing program.

Question 7 - Historical Documents Archive

- Ex: Tennessee Eastman Corporation
- Technical reports 1943-1947
  - All hard-copies of scanned documents
  - Unclassified Controlled Nuclear Information (UCNI)
    - Cannot be share with foreign nationals
  - Likely the only 'readily available' copies
  - ORISE working with DOE to determine disposition
- Arranged in 25, 3-ring binders
  - Need review for pertinent information



MEMORANDUM

DATE January 20, 1947

List of Buildings To Be Included In Ventilation Survey, Work Requisition 23038.

COPIES TO R. M. Batch, L. G. Henry and File

We believe that the following buildings would be included in the ventilation survey being made on the subject Work Requisition. As per your instructions no further work will be done in regard to Alpha Buildings unless further instructions are received from you. Please delete from this list or add to it, and advise:

Buildings

9202	-	Chemical
9203	-	Chemical
9204-1,2,3,4	-	Beta
9205	-	Chemical
9206	-	Chemical

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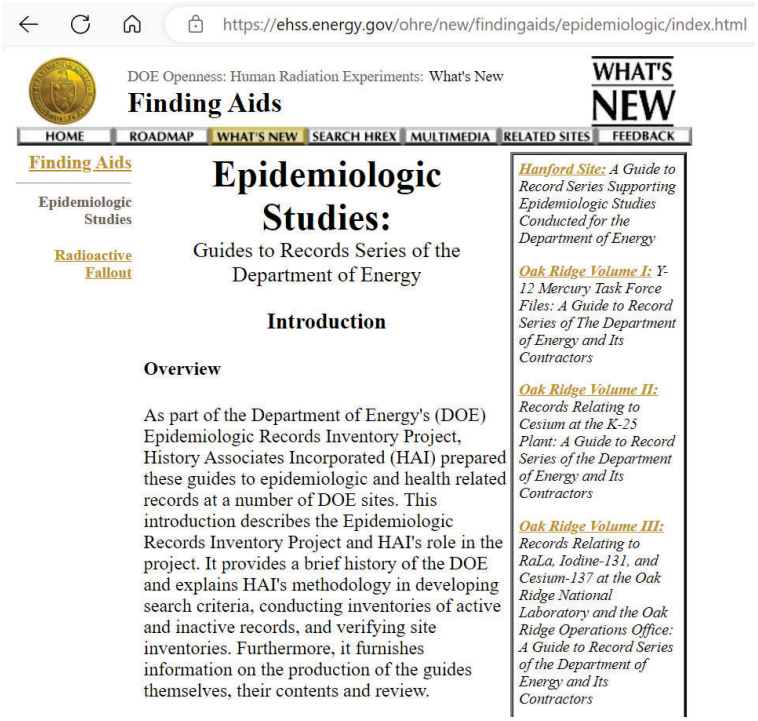
Question 7

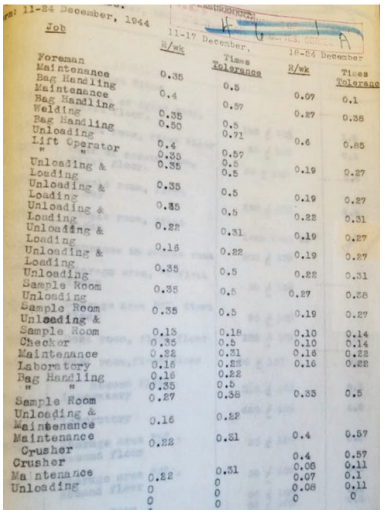
Non-ORISE Resources

- DOE Openness – History Associates Inc. Finding Guides for Epidemiologic Studies
  - Very good histories/inventory of files and data
  - Completed 1992-1993
    - May be outdated
    - Ex: ORISE has since transferred many records sets to DOE
- General observation – Best/most complete digital information would be the NIOSH Dose Reconstruction Site Profiles, Technical Basis Documents, and site database
  - Dr. Tim Talubee's presentation



Question 8 – Possible Information at National Laboratories

- Most information would be available in human resource record or the in the occupational medical record
  - Records are time and site specific
    - Example – Badging practices, regularity of urinalysis, etc.
  - Minimal consistency in how data are generated and maintained
    - Example – Historical dosimetry information or work history may not be digitized
  - Maintaining historical records is prime contractor dependent
    - Digitization could be usable data or scans of documents
    - Quality of scans are often poot – No OCR scanning or NLP for extraction
- Bottom line - No centralized system of records



Question 9 – Other Organizations

Other DOE (related) data systems	USTUR	MPS/Vanderbilt/IEI

• Computerized Accident Incident Reporting System (CAIRS)
• Occurrence Reporting and Processing Systems (ORPS)
• Department of Labor EEIOCPA claims
	• Studies actinide elements deposited within the human body
	• Registrants must meet specific career dose or dose rate
	• Limited number of people (<1,000)
	• Medical & work history available in varying amounts
		• Radiation monitoring information
		  • Landauer database
		  • Military dose
		  • Navy, Army, Air Force
		• Only external dosimetry information
		• Mike Mumma from MPS has access to databases

Final Thoughts

- "*We are only limited by our imagination, and our pocketbooks*" – John Boice
- "*Is the juice worth the squeeze*?" – John Boice
- Data, documentation, & information are (or have been) available to address the charge of Manhattan Era exposures for Veterans
  - Key Elements
  1. Efficient mechanism to identify Veterans from DOE
  2. Ability to find and digitize important exposure information
  3. Congressional/funding agency fortitude to support scientific valid epidemiological studies

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Special Thanks

- **Elizabeth (Betsy) Ellis**
  - Providing substantial input on historical information, CEDR, and MPS
- **Sara Howard**
  - Providing information on CEDR and MPS
  - Assisting in the creation of slides
- **David Girardi**
  - Providing information on CEDR
  - Queries of the CER data model

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