Burlington Atomic Energy Commission Plant (BAECP) at Iowa Army Ammunition Plant

Presented by
Dr. Lar Fuortes & Dr. Marek Mikulski
BAECP- Former Worker Medical Screening Program
University of Iowa College of Public Health

April 12, 2016

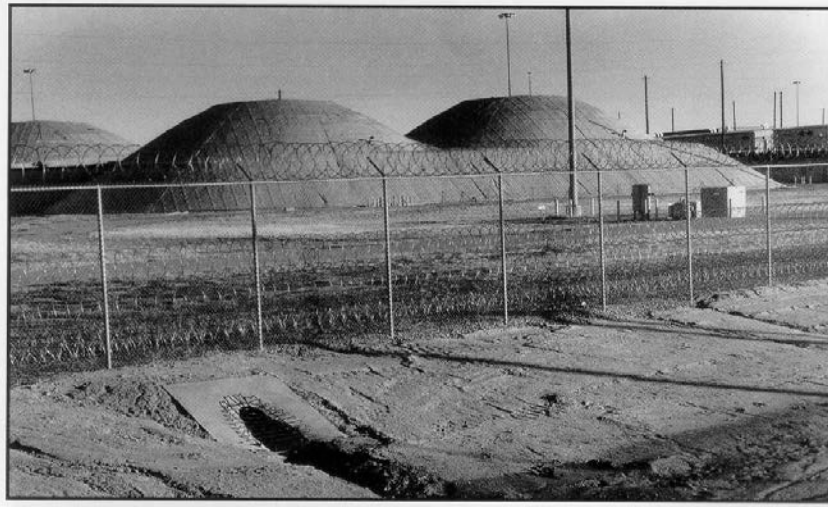
LINE I FROM THE NORTHEAST

Overview

- History of IAAP
- BAECP SEC Class
- Identifying Line 1/Division B workers
- Line 1/Division B Work Tasks by Building
- BAECP Toxic Exposures
- Medical Screenings
- ILO Classification System, CXR Abnormalities
- IAAP Employment Records

Iowa Army Ammunition Plant (IAAP)

- 19,000 acre facility which houses a large DoD conventional explosives manufacturing facility and a previously secret atomic weapons assembly plant in Middletown, IA (Des Moines Co.)
- Designed and built between 1941-1943 as conventional munitions Loading, Assembly and Packing (LAP) facility.
  - Over 1,000 buildings, 142 miles of roads, 103 miles of railroad tracks
  - Produced conventional missile warheads, caliber tank ammunitions, mines, mortars, artillery, demolition charges and weapons' component parts.



"Gravel gerties" are concrete structures whose roofs consist of cable mesh supporting large amounts of gravel. Beneath them are bays, where workers assemble and disassemble nuclear warheads. Should a warhead's conventional explosives accidentally detonate, the roofs of these structures are engineered to give way, releasing the gravel and trapping the plutonium particles. Up to 2,000 warheads per year are now being dismantled at this site. *Pantex Plant, Amarillo, Texas, November 18, 1993*

DoD & AEC Work at IAAP

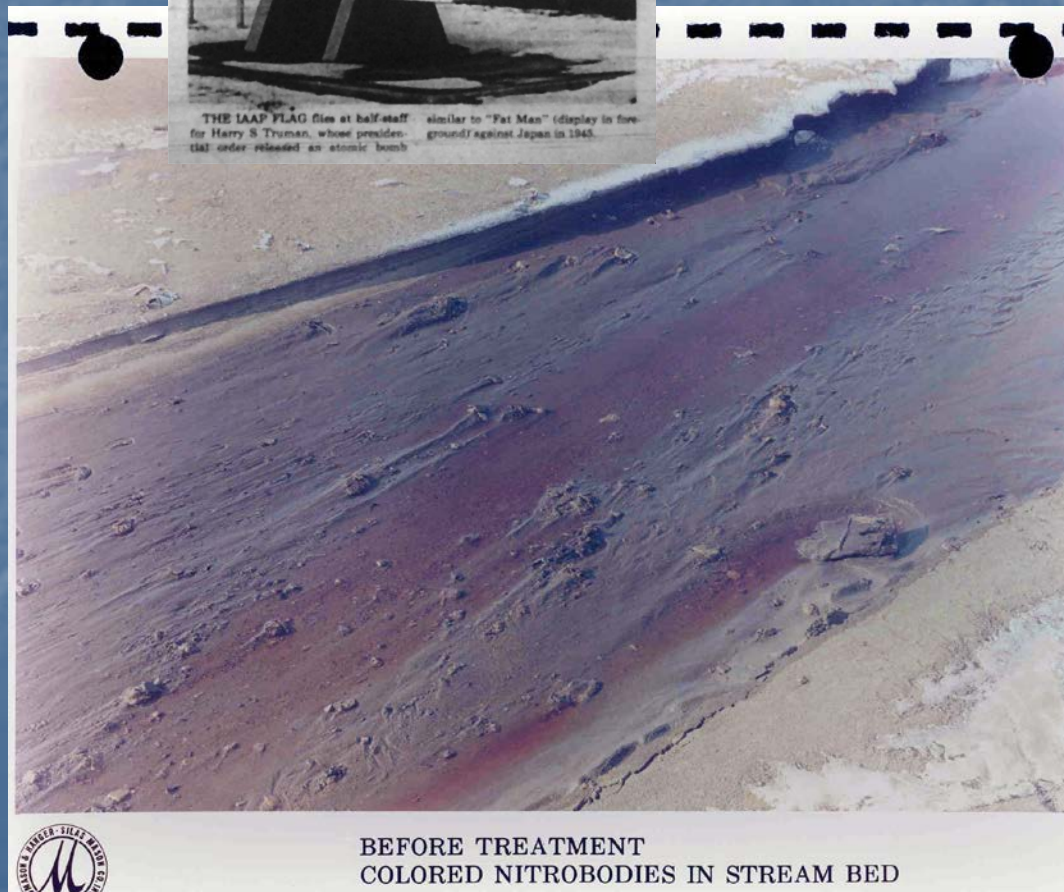
- Conventional Weapons, produced high explosive weapons
  - Department of Defense, Division A
  - ~32,000 workers
  - Still in operation — current workforce approx. 600 employees

- Nuclear Weapons assembled, dissembled, modified
  - AEC/Dept. of Energy, Line 1/Division B, Burlington AEC Plant (BAECP)
  - 1947 – 1975 (production line 1949-1975)
  - 1947 – 1951: the only large scale manufacturer of nuclear weapons in U.S. First plant in the nation to assemble atomic weapons for the AEC.
  - Production transferred to Pantex Plant, Amarillo, TX in 1975
  - ~5,000 workers

Environmental Toxicity from IAAP

- In the 1950s Brush Creek ran red from photochemical products of TNT production effluvia.
- "You could identify workers who worked with Tetryl because their skin was yellow and they turned blond"!!!
- These workers were exposed to solvents, asbestos, heavy metals, explosives, and beryllium
- IAAP designated as a Superfund site in 1990
  - Surface water, ground water wells & creek sediments contaminated with explosives from waste disposal

THE IAAP FLAG flies at half-staff for Harry S Truman, whose presidential order released an atomic bomb similar to "Fat Man" (display in foreground) against Japan in 1945.



BEFORE TREATMENT
COLORED NITROBODIES IN STREAM BED

DATE	EVENT
1940 November	Contract with Day & Zimmerman approved
1941 January	Plant construction begins
1941 July 31	Iowa Ordnance Plant (IOP) dedicated
1941 September	Line 1 loading operations begin (non-nuclear)
1941 November	Line II loading operation begin (Army side)
1941 December	Line III operations begin
1941 December 12	Explosion in Building 1-05-1 of Line 1
1942 January	Lines IV-A and IV-B begin
1942 March	Explosion in Building 3-05-1 of Line III
1943	Line III-A begins
1945-1951	Increased production and recruitment at plant due to Korean War. Overall plant production peaks in 1952.
1947	Iowa Ordnance Plant converted to a weapons assembly plant. Functions were previously performed at Sandia Base. Burlington and Pantex Plants perform primarily nuclear weapons assembly functions from 1951-1975.
1947	Complete rehabilitation of Line 1 for AEC work
1947-1975	Burlington plant produces high explosive main charges (non-nuclear weapons component) for nuclear weapons
1949	Silas Mason Co. accepts responsibility for operation of highly classified Division B facilities (AEC)
1951 January	Silas Mason accepts responsibility of operations for all shell, bomb and component lines at IOP, drew from existing Division B workers to meet demand
1952 December	Division B production peaks with 1,535 employees
1953	Korean War cease-fire and major plant-wide reduction of employees
1956 May	AEC announces it will expand operations at the Burlington site. More production facilities built on Line 1 and a storage area rehabilitated. The Eye (25 May 1956) announces that radioactive materials were to be introduced into production processes.
1957	More employee reductions due to Army economy move
1958 June	Explosion on Line II, Building 2-10
1959 June	Maintenance workers and craftsman stage two day strike. Intervention by AEC labor relations panel ends strike.
1962	Five day strike
1963	AEC takes over “Division B” from Silas Mason-Mason & Hangar
1965	Government scales back weapons assembly, modification and dismantlement—transfers functions to Burlington from the Medina Modification Center in Texas and the Clarksville Modification Center in Tennessee.
1975	Division B Burlington Plant functions transferred to Pantex Plant in Texas

1 February 1963

Army Ammunition
Iowa ~~Ordnance~~ Plant facilities utilized by Contract No. W-49-010-AMC-68 (A). Numbers prefixed by an asterisk (*) identify building constructed by A.E.C., all other numbers represent Ordnance transfer.

First digits of Building Numbers designate location.

I - Line I
11 - Yard "L"
23 - Yard "C"
200 - Guard & Fire
500 - Service
B.G. - Burning Grounds
F.S. - Firing Site Area

Bldg. No.	Bldg. No.	Bldg. No.	Bldg. No.
1-01	1-53	1-82-15	1-99-3
* 1-01-E	* 1-60	1-82-16	1-99-4
1-02	* 1-61	1-82-17	1-99-5
1-03	* 1-61-E	1-82-18	1-99-6
* 1-03-A	* 1-62	1-82-19	1-99-7
* 1-03-1	* 1-63-1	1-82-20	1-99-8
1-04	* 1-63-2	1-82-21	* 1-100
1-05-1	* 1-63-3	1-82-22	1-115-1
* 1-05-1-E	* 1-63-4	* 1-82-51-A	1-115-2
1-05-2	* 1-63-5	* 1-82-51-B	1-115-4
* 1-05-2-E	* 1-63-6	* 1-82-52	1-115-5 Removed Voucher 85-4987-65
1-06-1	* 1-63-E	* 1-82-53	1-115-6
1-06-2	* 1-70	* 1-82-54	* 1-124
* 1-07	* 1-71	* 1-82-55	* 1-129
* 1-07-E	* 1-72	* 1-82-56	1-136-1
1-08-1	* 1-73	* 1-82-57	1-136-2
* 1-08-1-A	* 1-73-E	* 1-82-58	1-136-3
1-10	* 1-74	* 1-82-59	1-136-4
* 1-11	* 1-75	* 1-82-60	1-136-5
1-12	* 1-76	* 1-82-61	1-136-6
1-13	* 1-78	* 1-82-62	1-136-7
* 1-13-E	1-82-1	* 1-82-63	1-136-8
1-14	1-82-2	* 1-82-64	1-136-9
* 1-14-A	1-82-3	* ~~1-82-66~~ Removed 6-12-70	1-136-10
1-15	1-82-4	* 1-82-67	1-136-11
* 1-15-E	1-82-5	* 1-82-68	1-137-1
1-16	1-82-6	* 1-82-69	1-137-2
1-17	1-82-7	* 1-82-70	1-137-3 Reidentified 1-18
* 1-36	1-82-8	* ~~1-82-71~~ Removed 6-1-71	* 1-137-4
* 1-37	1-82-9	* 1-82-72	* 1-137-5
* 1-40	1-82-10	* 1-82-73	1-145
* 1-40-E	1-82-11	* 1-82-74	* 1-155-1
1-50	1-82-12	* 1-82-75	* 1-155-2
1-51	1-82-13	1-99-1	* 1-155-3
1-52	1-82-14	1-99-2	* 1-155-4

Bldg. 1-115-5 removed from

Bldg. No.	Bldg. No.	Bldg. No.	Bldg. No.
* 1-155-5	23-39-10	23-39-35	~~500-108-15~~ ✓
1-188-1	23-39-11	23-39-36	* ~~500-129-3~~ ✓
* 1-198-1 ✓	23-39-12	23-39-37	500-169-1
1-198-2 ✓	23-39-13	23-39-38	500-169-2
* 1-206-1	23-39-14	23-39-39	~~500-183~~ BG-1 = Chgd by Voucher #68-6387-71 dtd 11-6-70
* 1-206-2	23-39-15	23-39-40	500-198-8
* 1-207-1	23-39-16	23-39-41	* B.G.-2
* 1-207-2	23-39-17	23-39-42	* B.G.-3
* 1-211	23-39-18	23-39-43	* B.G.-4
11-37-1	23-39-19	* 23-51	* B.G.-5
11-37-2	23-39-20	* 23-53	* B.G.-11
11-37-3	23-39-21	* 23-55-E	* B.G.-12
* 11-82-1	23-39-22	* 23-82-1	* F.S.-1
* 11-82-2	23-39-23	* 23-115-1	* F.S.-2
11-144	23-39-24	* 23-115-2	* F.S.-3
* 11-206-1	23-39-25	23-137-2	* F.S.-4
23-39-1	23-39-26	* 23-211	* F.S.-5
23-39-2	23-39-27	200-30	* F.S.-6
23-39-3	23-39-28	200-131-2	* F.S.-7
23-39-4	23-39-29	~~200-167-8~~	* F.S.-8
23-39-5	23-39-30	~~200-167-9~~	* F.S.-9
23-39-6	23-39-31	~~500-108-13~~ ✓	* F.S.-10
23-39-7	23-39-32	~~500-108-14~~ ✓	* F.S.-11
23-39-8	23-39-33	30-43-9 (Amend. #1) 5-27-66	* F.S.-115-1
23-39-9	23-39-34		

Electrical Distribution

Primary Lines	Secondary Lines	Total
65, 705 LF.	88, 506 LF.	154, 211 LF.

Steam Transmission Pipe Lines
All pipe sizes 3/4" thru 14"

Total
43, 665 Ft.

Sewage and Industrial Waste Collection
All pipe sizes 4" thru 12"

Total
20. 398 Ft.

Water Distribution Systems
All pipe sizes 1" thru 12"

Total
50, 858 Ft.

Cyclone Fencing

Total
63, 120 Ft.

Bldgs 500-129-3, 500-108-13, -14, -15 removed from Exclusive Use Permit - Agreement ARAO-IAAP63-1 Revision dated 10-29-64.

Bldgs 1-198-1 & 1-198-2 removed from Exclusive Use Permit - Voucher No. 46-4127-70 dated 4-29-70.

Bldgs 200-167-8 & 200-167-9 were removed from Exclusive Permit DA-25-066-ENG-11073 dtd 10-18-67 Vouch. 85-1961-67

Roads	Line I	11.8337	Miles
	F.S. Area	1.401	Miles
	Yard "C"	9.5205	Miles
	Burning Ground	2.3349	Miles
	Yard "L"	.497	Miles
	Total		25.5871 Miles
Railroad 90# Rail	Line I	8.402	Miles
	Yard "C"	7.354	Miles
	Yard "L"	.308	Miles
	Total		16.064 Miles

LAND	ORD. TRANS.	Additional 50' Outside Fence ORD. PROPERTY	TOTAL	
Line I	173.	9.7	182.7	Acres
Gen Area N&E of Line I	10.	48.	58.	Acres
F.S. Area	505.	17.7	522.7	Acres
Yard "C"	390.	16.9	406.9	Acres
Burning Ground	207.	19.7	316.7	Acres
Yard "L"	11.71	2.89	14.6	Acres
TOTAL	1,386.71	114.89	1501.6	Acres

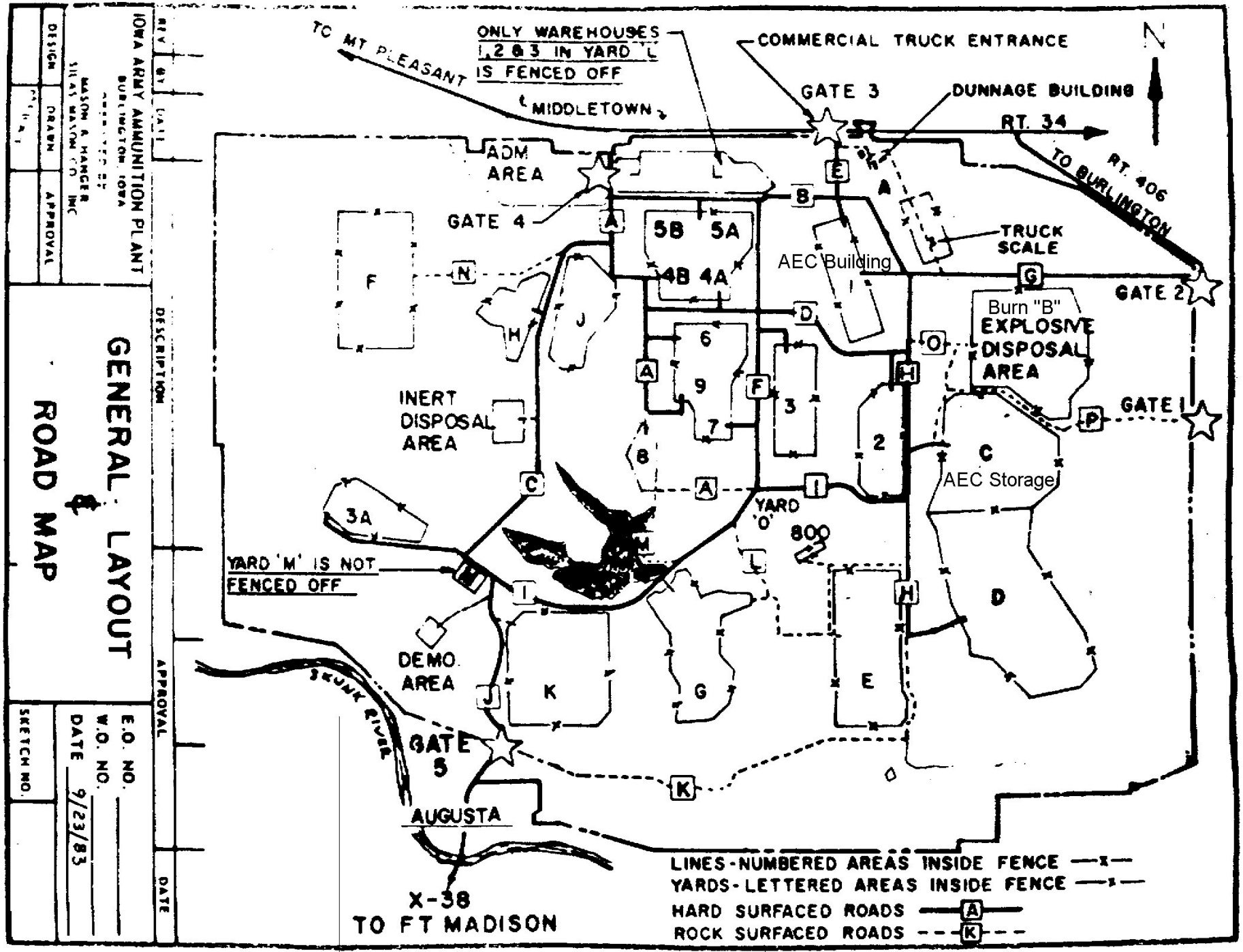
BAECP SEC Class

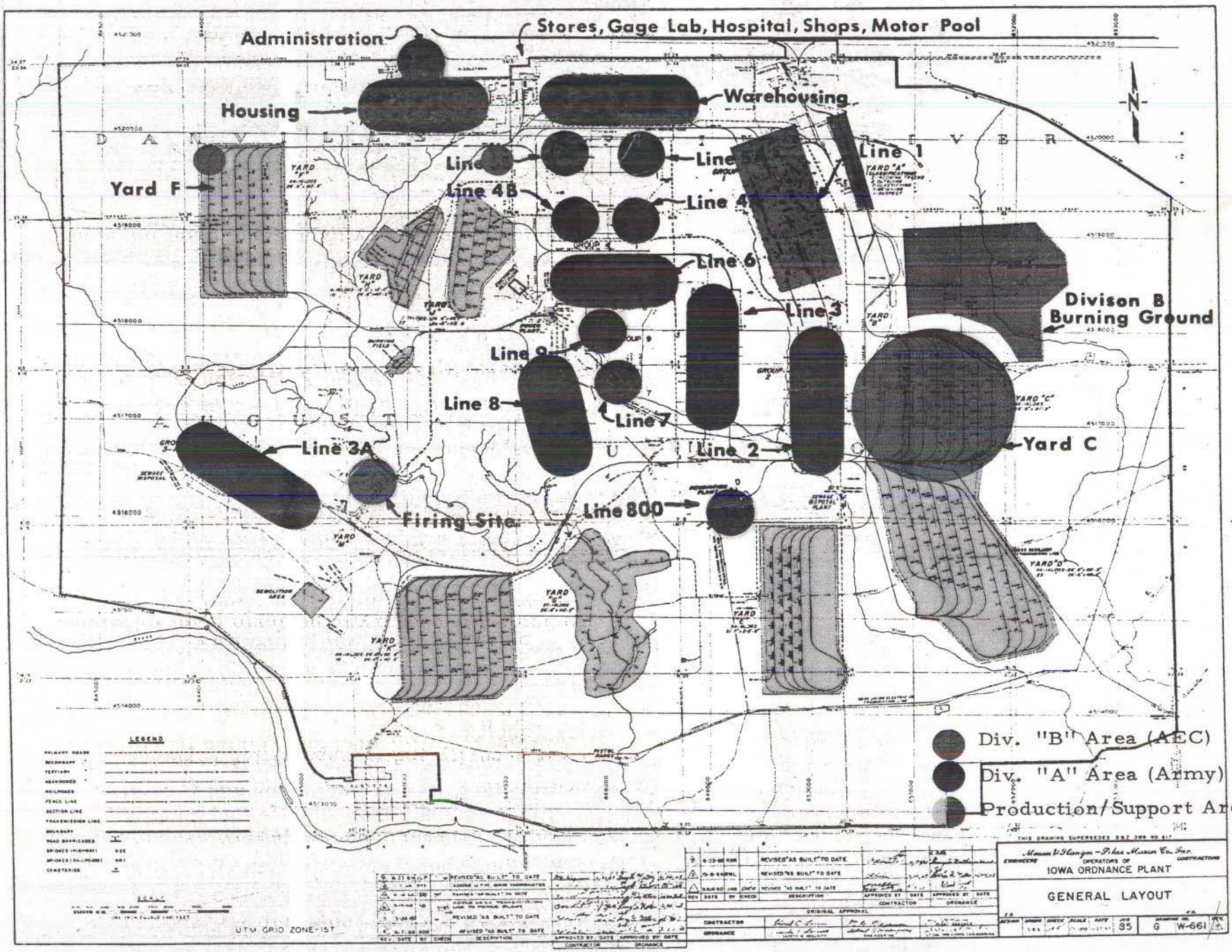
- July 2005, NIOSH clarified that the SEC class for the IAAP encompassed AEC workers at Line 1 and associated areas of the facility between the years 1947 through 1974, including Yard C, Yard G, Yard L , Firing Site Area, Burning Field "B", and Storage Sites for Pits and Weapons including Buildings 73 and 77.

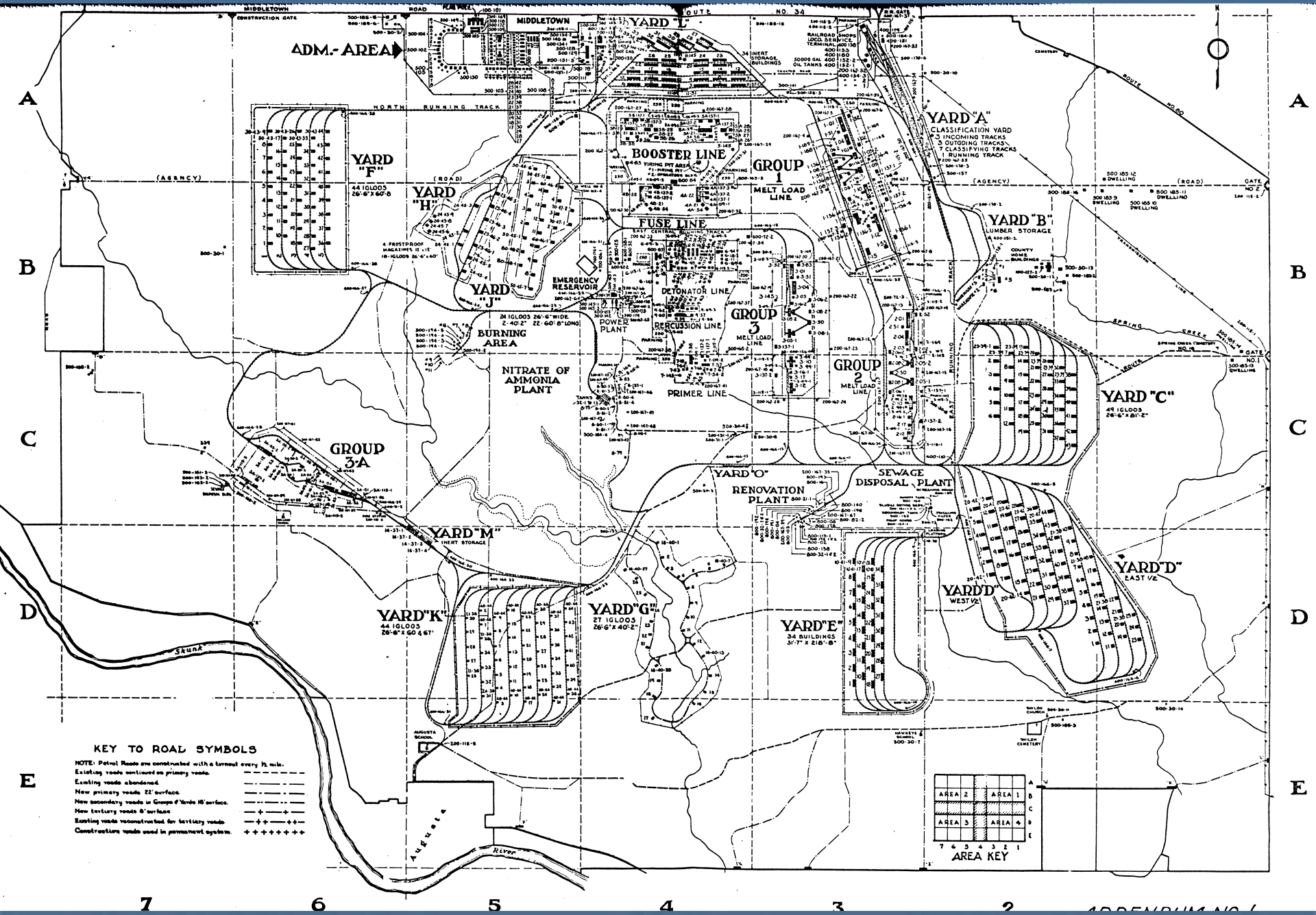
Building No.	Activities/Work Processes
1-01 Maintenance Shops (Pipe Shop or Tool and Gauge Shop)	Fabrication Weapons assembly, disassembly, inspection, and surveillance
1-02 Boiler House	Powerhouse operations
1-03 Water Lab	Chemical analysis Analytical laboratory activities Sample casting preparation and crushing
1-03-2 through 1-03-7	Solvent Storage
1-04 Developmental Lab or Chem. Lab	Health and Safety Offices, and the Information Retrieval Office where chemical analysis was conducted on the south end and maintenance was conducted on the north end Other activities include chemistry laboratory, development, laboratory, oxyacetylene torch metal cutting, and testing
1-05-1 and 1-05-2 Melt Buildings	Known as the melt and pour areas or the "Center of Line" where operations included the melting of composition B, TNT and barium shapes, explosives fabrication, pressing, and machining, explosives melt production, and melting and casting
1-06-1 Magazine for Composition B and TNT	Powder (explosives) receiving, receipt and storage, and storage
1-06-2 Powder Prep	Powder (explosives) receiving, receipt and storage, and storage
1-08	Explosives fabrication, pressing, and machining;
1-08-1	Receipt and storage activities
1-10 Explosives Press and Machining	Explosives fabrication, pressing, and machining Machining
1-11 Receiving and Storage	Receipt and storage activities Shipping and receiving weapons components
1-12	Explosives fabrication, pressing, and machining Assembly operations
1-13	Material handling Weapons assembly, disassembly, inspection, and surveillance (this was an assembly area for uranium 235 pits which involved the assembly of larger nonplutonium weapons (U235) detonators and covers
1-15	Staging area used for storing HE
1-16	Adiprene preparation
1-18	Research and development
1-19	MOCA operations Weapons assembly, disassembly, inspection, and surveillance

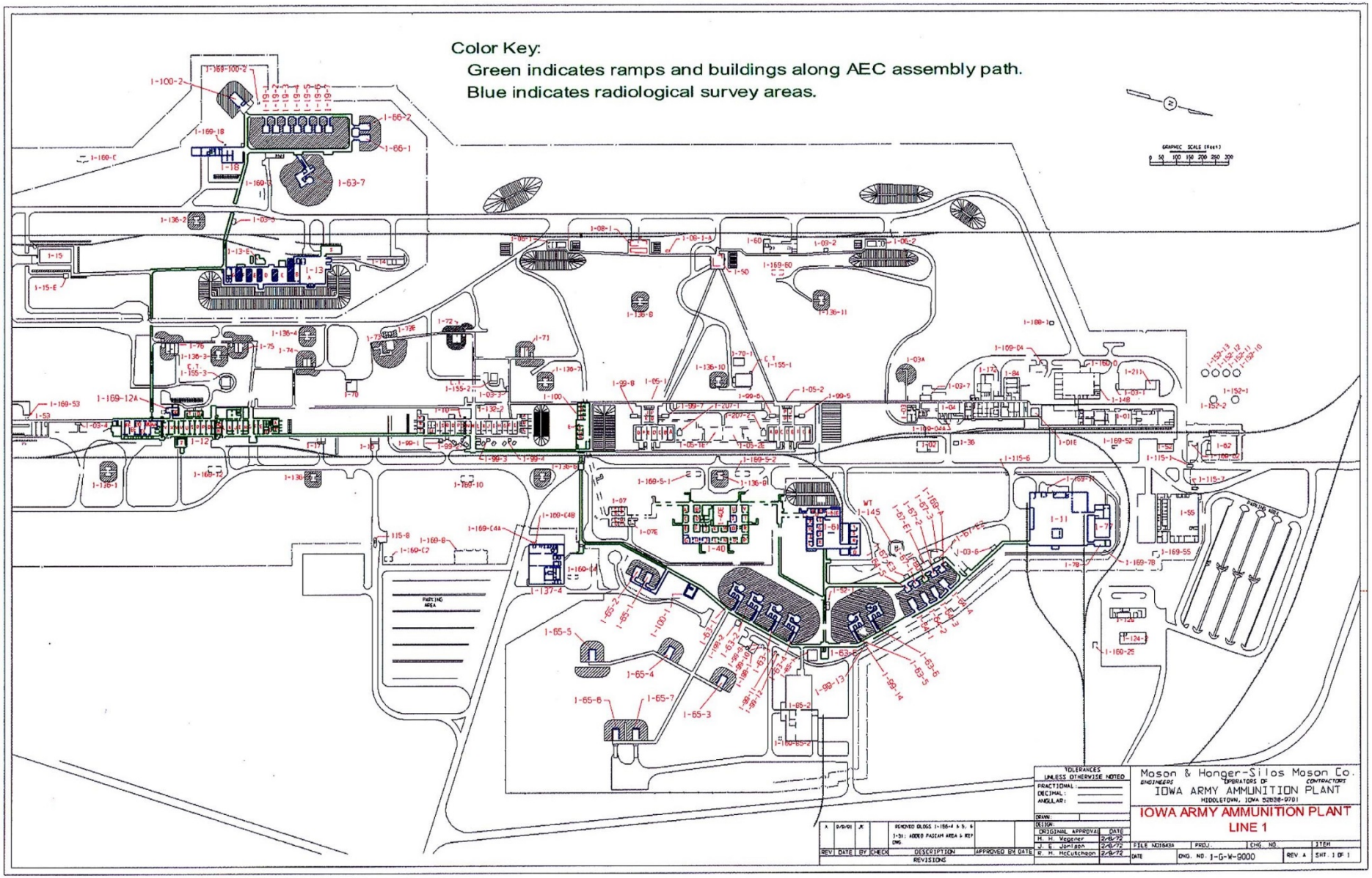
Building No.	Activities/Work Processes
Division B Burning Grounds	Excess material disposal
East Burn Pad	Explosives disposal
Firing Site 1	Firing site operations Hydroshot cleanup Hydroshot operations
Firing Site 12	Explosive charge test firing Hydroshot cleanup Hydroshot operations
Firing Site 14	Plane wave lens shots Plane wave lens shots cleanup Tile shots Tile shots cleanup
Firing Site 6	Explosive charge test firing Plane wave lens shots Plane wave lens shots cleanup
West Burn Pad	Explosives disposal
West Burn Pad Landfill	Landfill activities
Yard L (AEC Inert Storage)	Forklift repair and battery maintenance
Yard C	Storage yard designated for explosive material
Yard G	Storage for finished castings

Criteria for Line 1/Division B cohort selection	Records	N	Comments
3x5 cards job codes match those from the IAMAW job code classifications	7,170	4,364	7,183 by the second run?
3x5 cards job classification matches L class	4,655	3,171	
AEC specific comments in 3x5 cards – transfer to: Line 1, AEC, Division B, contract 68, Pantex	1,618	609	
IAMAW (Machinists' Union) Division B seniority lists – Division B specific comments/job name	916	163	
Available radiation badge information	1708 (n=399) matches	434	35 AEC employees
Employees in industrial hygiene MOCA logs from buildings 1-61, 1-40 and 1-12	249	48	
Security guards (most of whom were Q cleared,– 3x5 job codes: P-31-1, P-71, P-72, P-73, PG-1, PG-2, PG-3	570	418	G-1 AEC status identified by matching with other tables
Codes for firing sites FS-6, FS-12 (P-1-6, P-6-1)	3	3	
PBX Press operators, who pressed the high explosive into its initial form (P-26, PP-26)	16	15	
X-ray operators and technicians identified by job code (PX-1, X-11,PC-7)	65	42	
Sub Total	**16,940**	**4,639**	
Screened by ORISE (BeLPT only)	304	304	identified 65 as Division A
Employees specifically identified on pre-1975 medical records as Line 1 employees	82	82	
Former workers screened by BAECP-FWP from 1/2002 – selected for the screenings from Line 1 cohort or called in and identified themselves as Line 1 workers	942	942 (incl. 6 by NSSP)	Includes subcontractor(s) – Aramark etc.
Total	**18,268**	**5,267**	


IOWA ARMY AMMUNITION PLANT
BURLINGTON, IOWA
MASON & HANGER-SILAS MASON CO., INC.
DESIGN
DRAWN
APPROVAL
DESCRIPTION
DATE
APPROVAL
GENERAL LAYOUT & ROAD MAP
SKETCH NO.
E.O. NO.
W.O. NO.
DATE 9/23/83
TO MT PLEASANT
MIDDLETOWN
ONLY WAREHOUSES 1,2 & 3 IN YARD 'L' IS FENCED OFF
COMMERCIAL TRUCK ENTRANCE
GATE 3
DUNNAGE BUILDING
RT. 34
TO BURLINGTON
RT. 406
N
ADM AREA
GATE 4
5B 5A
4B 4A
AEC Building
TRUCK SCALE
GATE 2
Burn "B" EXPLOSIVE DISPOSAL AREA
GATE 1
INERT DISPOSAL AREA
AEC Storage
YARD 'O'
800
YARD 'M' IS NOT FENCED OFF
DEMO. AREA
SKUNK RIVER
GATE 5
AUGUSTA
X-38
TO FT MADISON
LINES-NUMBERED AREAS INSIDE FENCE
YARDS-LETTERED AREAS INSIDE FENCE
HARD SURFACED ROADS
ROCK SURFACED ROADS

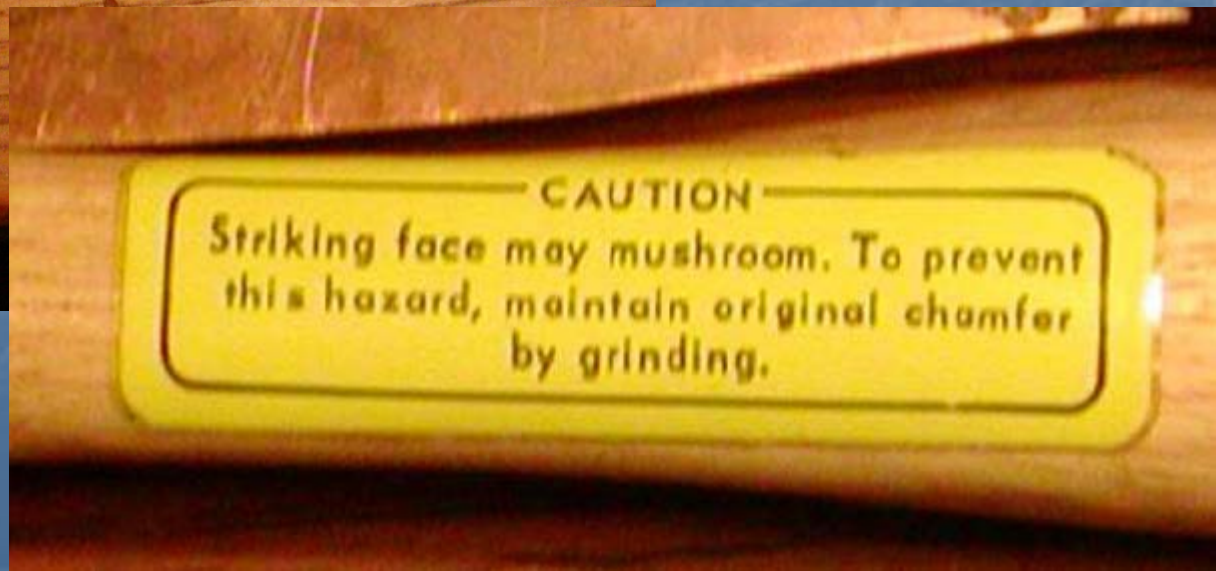

Administration
Stores, Gage Lab, Hospital, Shops, Motor Pool
Housing
Warehousing
Line 1
Line 4
Line 4B
Yard F
Line 6
Line 3
Divison B
Burning Ground
Line 9
Line 8
Line 7
Line 3A
Line 2
Yard C
Firing Site
Line 800
D A N V I L L E
A U G U S T A
Div. "B" Area (AEC)
Div. "A" Area (Army)
Production/Support Areas
LEGEND
UTM GRID ZONE-15T
IOWA ORDNANCE PLANT
GENERAL LAYOUT
W-661


ADM.-AREA
MIDDLETOWN
MIDDLETOWN CONSTRUCTION GATE
ROAD
ROUTE NO. 34
RR GATE
YARD "L"
YARD "A"
CLASSIFICATION YARD
3 INCOMING TRACKS
5 OUTGOING TRACKS
7 CLASSIFYING TRACKS
1 RUNNING TRACK
NORTH RUNNING TRACK
BOOSTER LINE
GROUP 1
MELT LOAD LINE
YARD "F"
44 IGLOOS
26'-6" X 60'-6"
YARD "H"
FUSE LINE
YARD "B"
LUMBER STORAGE
YARD "J"
24 IGLOOS 26'-6" WIDE
2-40'-2" 22'-60'-8" LONG
EMERGENCY RESERVOIR
DETONATOR LINE
GROUP 3
MELT LOAD LINE
BURNING AREA
POWER PLANT
PERCUSSION LINE
NITRATE OF AMMONIA PLANT
GROUP 2
MELT LOAD LINE
PRIMER LINE
YARD "C"
49 IGLOOS
26'-6" X 81'-2"
GROUP 3-A
YARD "O"
RENOVATION PLANT
SEWAGE DISPOSAL PLANT
YARD "M"
INERT STORAGE
YARD "D"
EAST ½
YARD "D"
WEST ½
YARD "K"
44 IGLOOS
26'-6" X 60'-6"
YARD "G"
27 IGLOOS
26'-6" X 40'-2"
YARD "E"
34 BUILDINGS
51'-7" X 218'-8"
SAUNA
AUGUSTA SCHOOL
AUGUSTA RIVER
KEY TO ROAD SYMBOLS
NOTE: Patrol Roads are constructed with a turnout every ½ mile.
Existing roads continued as primary roads.
Existing roads abandoned.
New primary roads 22' surface.
New secondary roads in Groups & Yards 18' surface.
New tertiary roads 8' surface.
Existing roads reconstructed for tertiary roads.
Construction roads used in permanent system.
AREA 2
AREA 1
AREA 3
AREA 4
AREA KEY
A
B
C
D
E
7
6
5
4
3
2

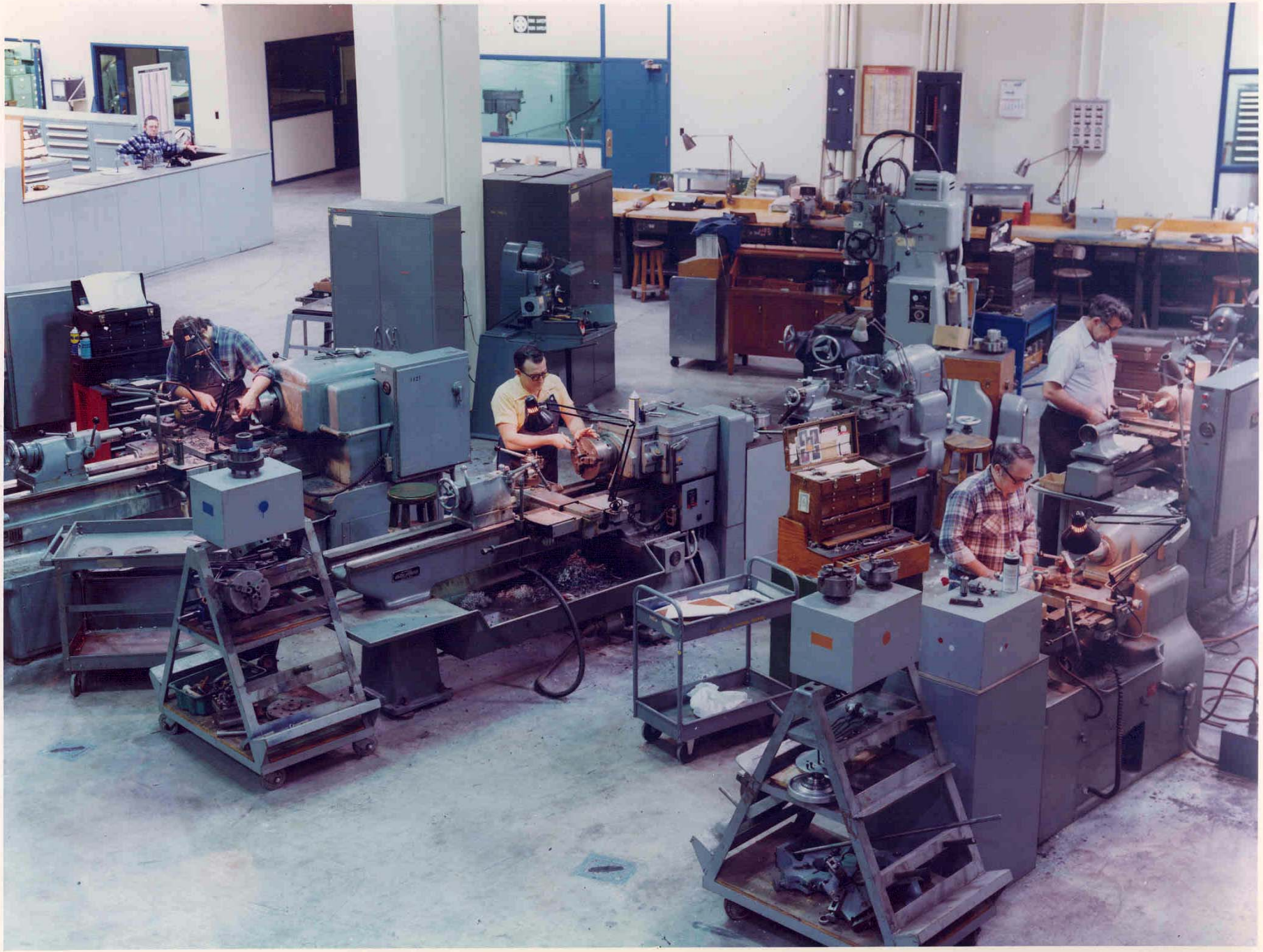

Color Key:
Green indicates ramps and buildings along AEC assembly path.
Blue indicates radiological survey areas.
Mason & Hanger-Silas Mason Co.
IOWA ARMY AMMUNITION PLANT
IOWA ARMY AMMUNITION PLANT
LINE 1

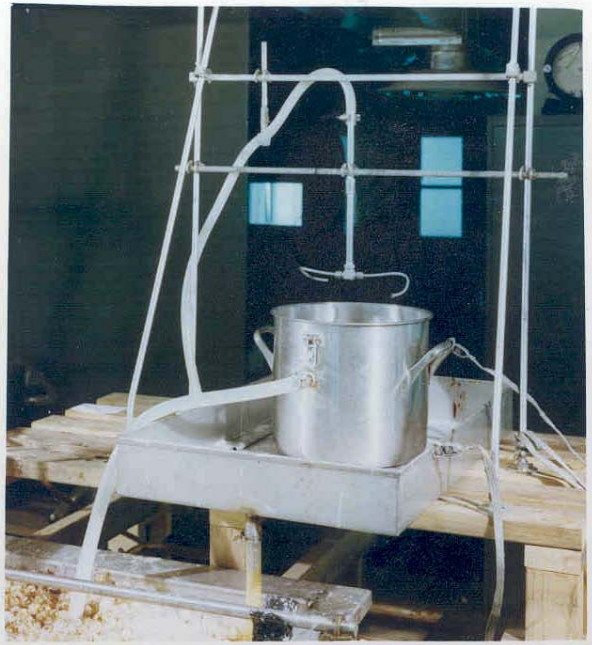
Beryllium tools were the norm in munitions industry. These were typically 2% copper Beryllium alloys, used for avoiding spark.

Copper-Beryllium Non-Sparking Tools



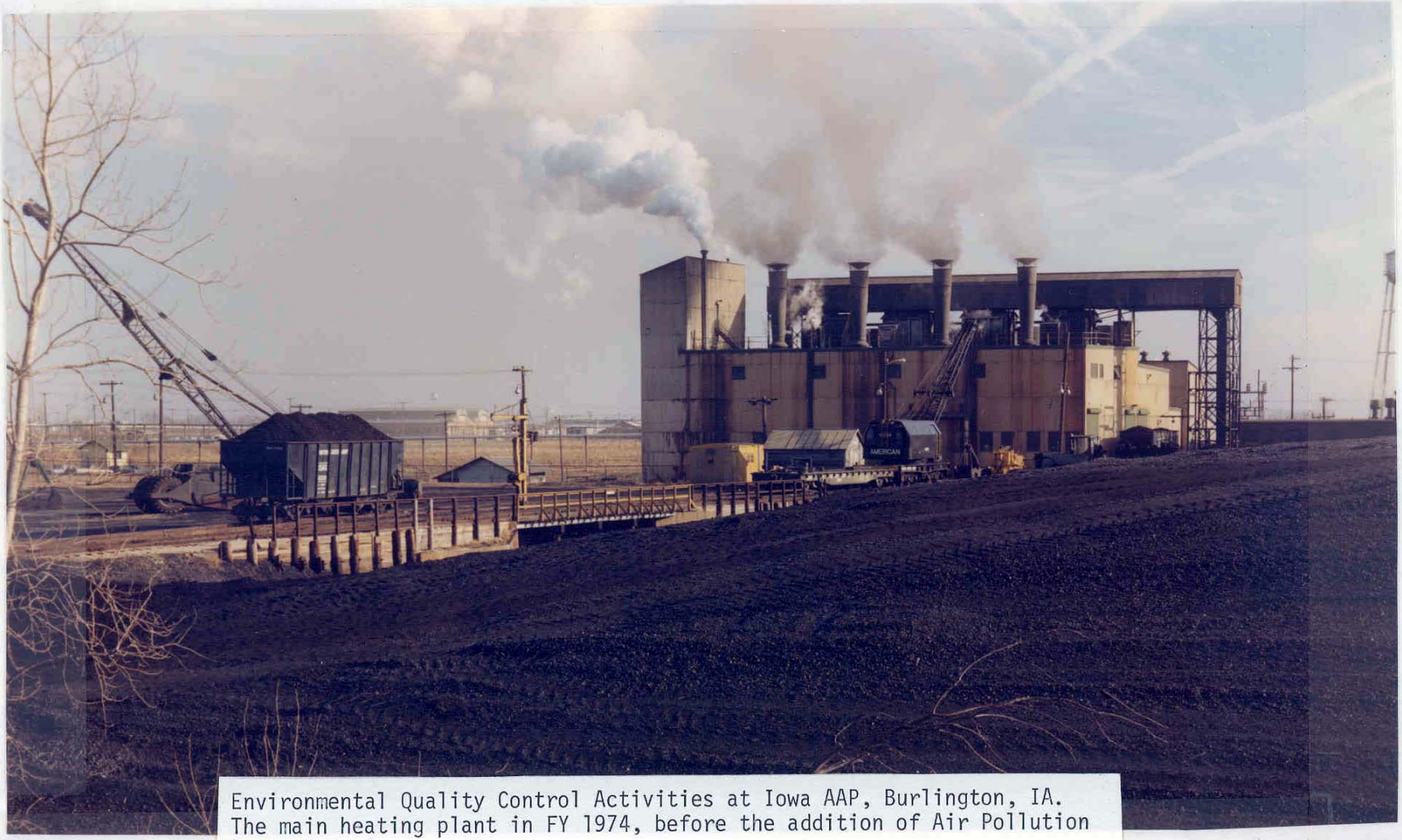
98% Cu, 2% Be





TOP LEFT - 25 LB. LEAD AZIDE DISSOLVING IN NaOH. TOP RIGHT - NaOH CIRCULATING SYSTEM.
BOTTOM LEFT - 2000 GALLON PLATING TANK. BOTTOM RIGHT - PLATING ELECTRODES.


DANGER



Environmental Quality Control Activities at Iowa AAP, Burlington, IA. The main heating plant in FY 1974, before the addition of Air Pollution Control Devices.

BAECP Toxicants

- Occupational exposures to fissionable or radioactive materials and a variety of hazardous substances
  - High explosives, solvents, epoxies, toxic metals, fibrogenic dusts
- Uranium and Plutonium, (U-235, Pu-239)
- Beryllium, Asbestos
- Isocyanates
- MOCA, B-Naphthylamine
- Benzene, Nitrobenzene, Dinitrobenzene
- TNT, DNT, Tetryl
- RDX, PBX, HMX, Octol, PETN
- Lead, Mercury, Arsenic, Cadmium, Manganese
- Depleted Uranium, (U-238)
- Physical Hazards- Noise

Beryllium surface concentrations by munitions plant locations

(% of samples in concentration categories)

	Samples	< LOQ	≤ 0.2	$0.2 < x \leq 3.0$	> 3.0
Main Machine Shop[A]	14	7	36	43	14
Production Line Maintenance Shops[A]	22	5	50	45	-
Production lines[B]	39	5	80	-	-
Change House and Laundry[A,B]	11	18	64	18	-
Non-Production and Administrative Areas[C]	9	67	33	-	-
All Munitions Areas*	95	13	60	25	2
All reference site samples* (Off-Site)	46	28	65	7	0

Superscripts A, B, and C indicate plant areas with significant ($p>0.05$) frequency differences in concentration categories.

* Chi-square test comparing all munitions plant samples and all reference plant samples = 11.1; $p=0.011$.

Sanderson WT, Leonard SA, Ott DK, Fuortes LJ, Field RW (2006) Beryllium Exposure from Use of Non-Sparking Tools in a Military Ammunition Plant, Journal of Occupational and Environmental Medicine, 5: 475-481, 2008

Implications

- Likely similar risks for other workforces exposed to Be alloy tools
- Demonstrated link between workers in the vicinity of Be tools and a higher prevalence of positive BeLPTs
- May provide for improved policy review of Beryllium usage and biomonitoring

Medical Screenings & Interventions

Hazard	Screening Test	Results of Screening
Asbestos	chest x-ray, spirometry	early diagnosis of asbestosis or lung cancer; smoking cessation, pulmonary rehabilitation, flu and pneumonia vaccinations
Beryllium	lymphocyte proliferation test, chest x-ray	early diagnosis of sensitization (i.e., identification of increased risk for chronic beryllium disease), chronic beryllium disease (CBD), or lung cancer, steroid treatment, and interventions noted above.
Explosives, solvents	liver function tests	early diagnosis of chronic liver disease or liver cancer and leukemia, dependent on test abnormality
MOCA	urinalysis	early diagnosis of bladder cancer; surgical intervention
Radiation		early diagnosis of cancers

FWP Medical Screening Program Goals

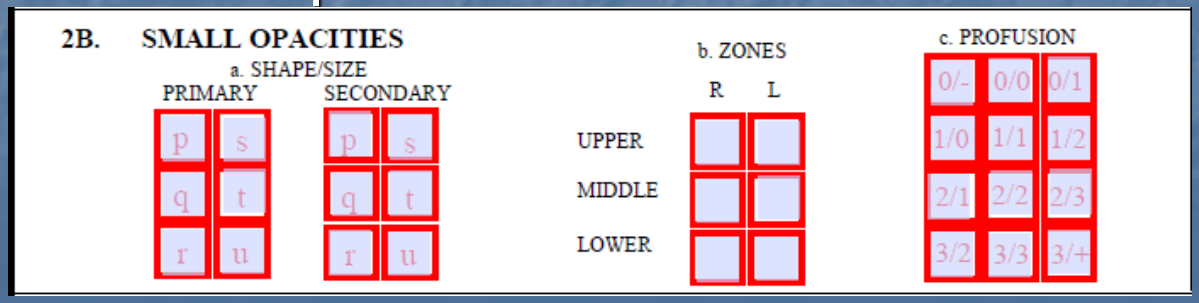
- To detect conditions that are amenable to early intervention
  - colorectal cancer, bladder cancer
- To ameliorate certain conditions
  - chronic respiratory diseases
- To provide primary prevention
  - lung cancer via smoking cessation

- <u>Fortunately, Former Workers lives have been saved as a result of early detection of cancers and other conditions</u>

Background: ILO Classification System

Profusion of small opacities

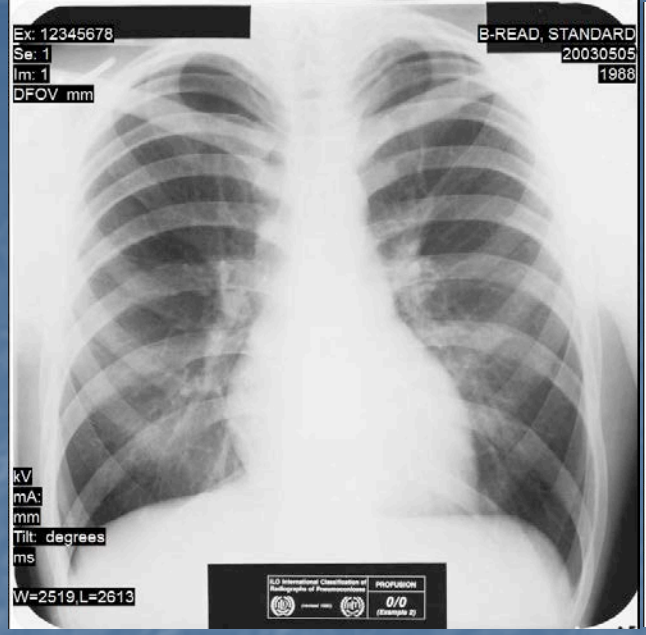
- Determined by comparison of radiograph with standardized reference films
- Reference films represent midrange of four major ordinal categories (0-3)
- Minor categories
  - Help reader place radiograph on continuum
  - Create twelve-point scale

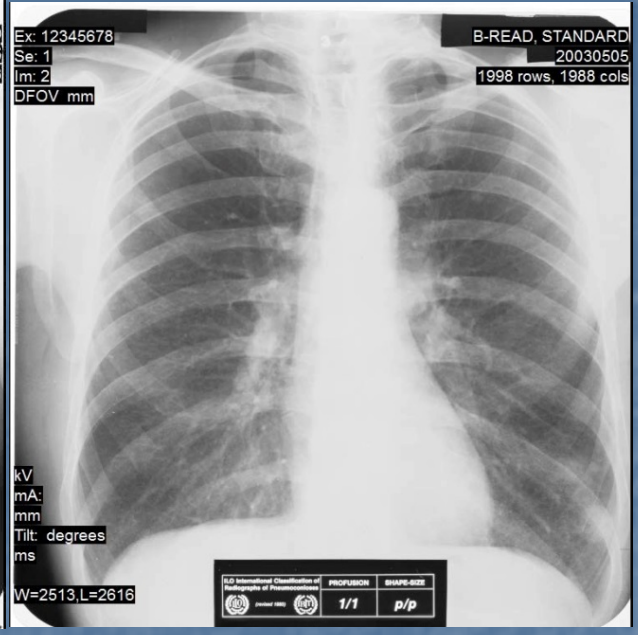


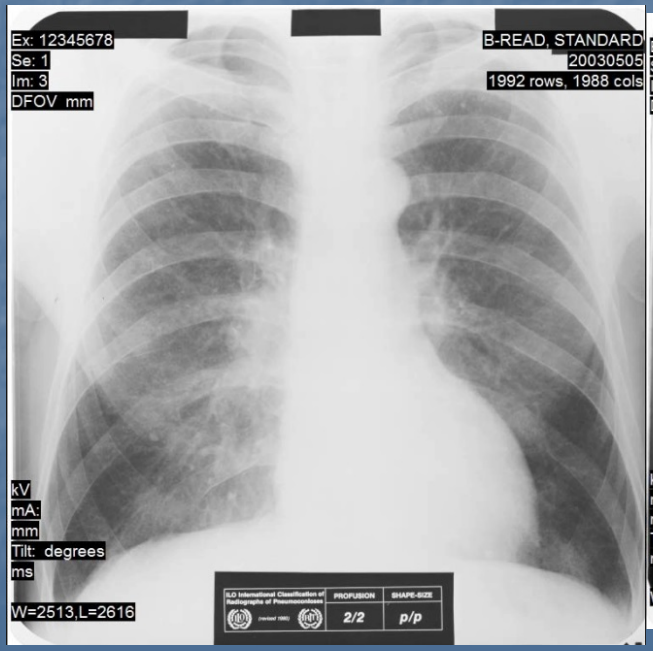
NIOSH Topic: Chest Radiography: B Reader Information for Medical Professionals | CDC/NIOSH." *Centers for Disease Control and Prevention*. 08 Jan. 2010. Web. 10 Sept. 2010. <http://www.cdc.gov/niosh/topics/chestradiography/breader-info.html#e

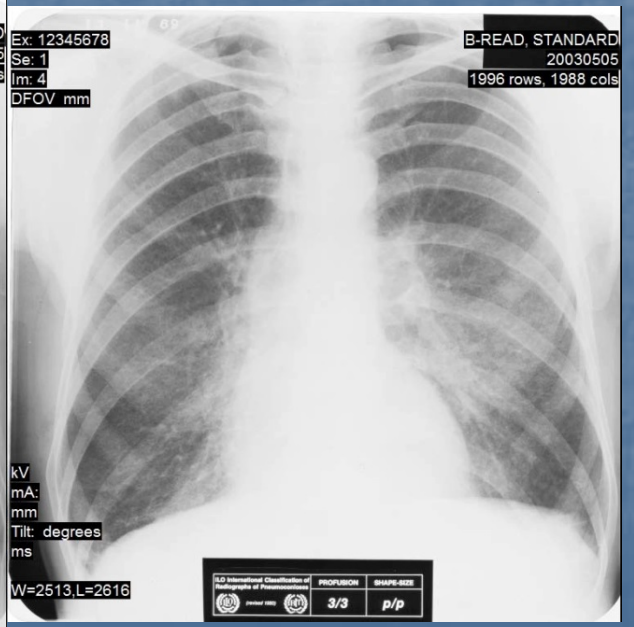
ILO Scoring

Categorization	
0/-	1
0/0	
0/1	2
1/0	3
1/1	4
1/2	5
2/1	
2/2	
2/3	
3/2	
3/3	
3/+	





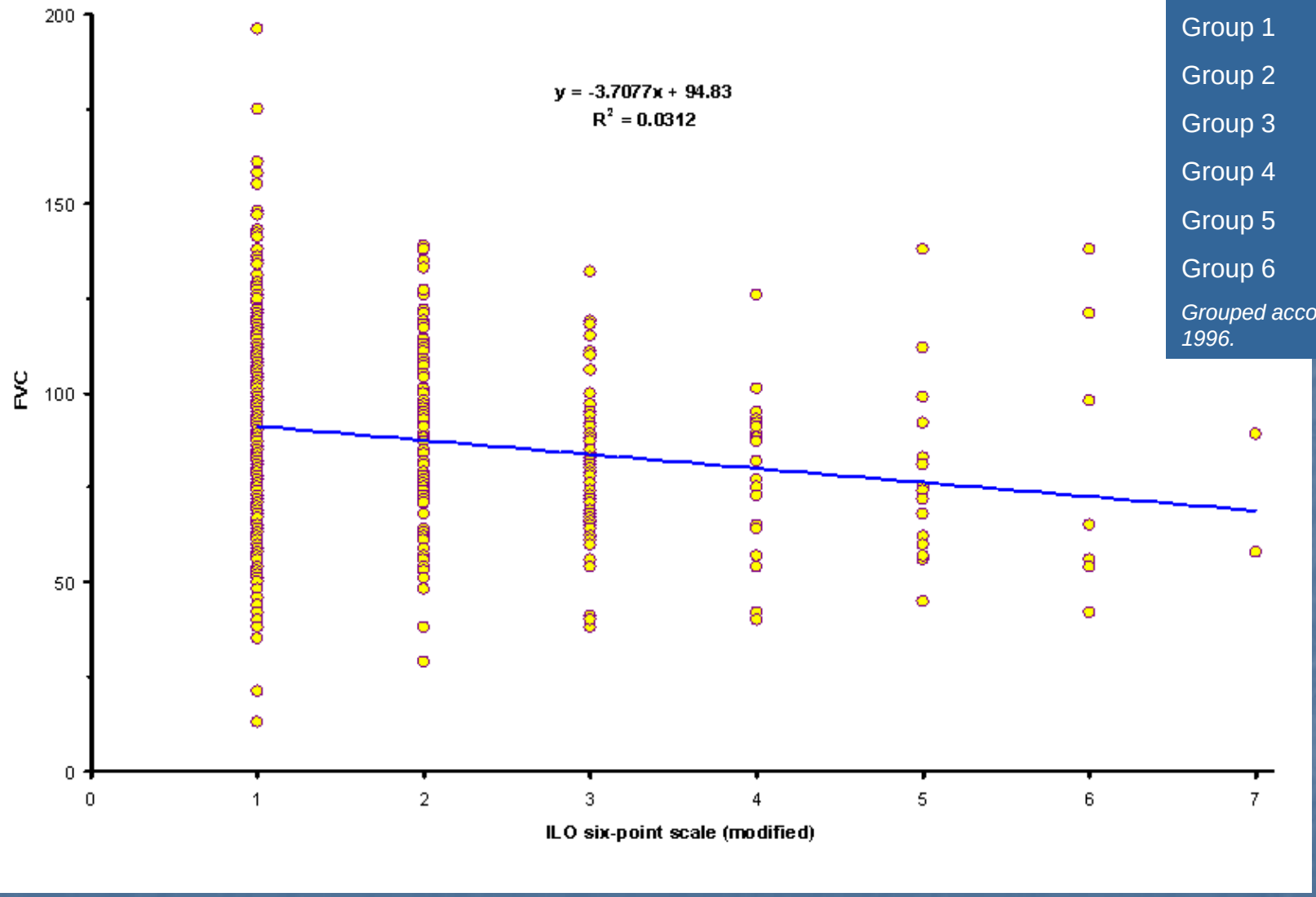




CXR Abnormalities in IAAP DoE Workforce Results

- CXRs n=757 with 3 ILO readings
  - n=45 (5.9%) with ILO parenchymal abnormalities
    - 60% with ILO 1/0
    - 22% with ILO 1/1
    - 18% with ILO ≥1/2 (1/2-3/2)
  - n=19 (2.5%) with ILO parenchymal & pleural abnormalities
    - 47% with ILO 1/0
    - 26% with ILO 1/1
    - 27% with ILO ≥1/2 (1/2-2/2)
  - n=37 (4.9%) with ILO pleural abnormalities only

Increasing ILO scale linked with decreasing FVC



ILO groupings

Group 0	0/-, 0/0
Group 1	0/1
Group 2	1/0
Group 3	1/1
Group 4	1/2
Group 5	2/1, 2/2, 2/3
Group 6	3/2, 3/3, 3/+

Grouped according to Miller et al., 1996.

- The association of ILO score to FVC % predicted is independent of age, gender, smoking status, and Be exposure. Both Be exposure and ILO independently affect FVC % predicted.

TABLE 5. Logistic Regression Models for Spirometry Results as Predictors of ILO Radiographic Abnormalities

Spirometry results*	Parenchymal OR (95% CI)	Parenchymal and Pleural OR (95% CI)	Pleural OR (95% CI)
Normal	1.0	1.0	1.0
Obstructive	2.96 (1.01–8.71)	2.03 (0.23–18.27)	1.68 (0.36–7.93)
Restrictive	2.00 (0.96–4.15)	4.14 (1.32–13.01)	2.82 (1.28–6.20)
Mixed	2.35 (0.87–6.39)	1.36 (1.36–22.11)	3.25 (1.16–9.08)
P	0.09	0.05	0.04

*Controlled for age, sex, race, and smoking.

Hankinson equations for spirometry values based on NHANES

Parameter = $b_0 + b_1 * age + b_2 * age^2 + b_3 * height^2$

FVC = $-0.1933 + 0.00064 * Age - 0.000269 * Age^2 + 0.00018642 * Ht^2$ [Men, Age 20 and over]

FVC = $-0.3560 + 0.01870 * Age - 0.000382 * Age^2 + 0.00014815 * Ht^2$ [Women, Age 18 and over]

FEV1 = $0.5536 - 0.01303 * Age - 0.000172 * Age^2 + 0.00014098 * Ht^2$ [Men, Age 20 and over]

FEV1 = $0.4333 - 0.00361 * Age - 0.000194 * Age^2 + 0.00011496 * Ht^2$ [Women, Age 18 and over]

FWP Screening Summary

- Elevated rate of beryllium sensitization despite low exposures and benefit of IH coordination with surveillance
- Implications for more widespread screenings of DoE populations and other workforces utilizing Be alloys
- Fibrotic lung diseases more prevalent than expected (is this an age, smoking, screening or occupational exposures?)

IAAP Employment Records

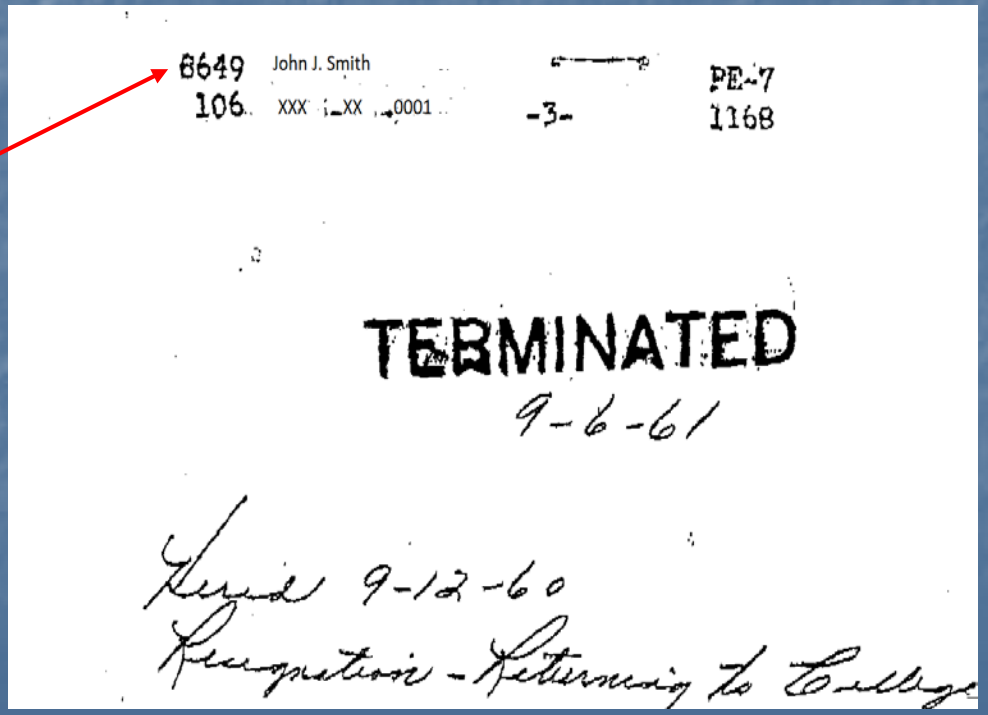
- Historic employment records on file with the University of Iowa Former IAAP BAECP Worker Program
  - Main contractor - Silas and Mason (Mason and Hanger) 3x5 employment cards – scanned images (~35,000 employees)
  - International Association of Machinists and Aerospace Workers Union (IAMAW) Schedules of Job Classifications and Salary Ranges (Job Dictionaries)
  - Radiation Dosimetry Badge Records
  - Union Seniority Lists, Division B Production Workers
  - Line 1 Incident Reports

IAAP Employment Records

- Other (provided by former worker/family)
  - Medical records from IAAP
  - Clearance documents, salary slips, social security records, congratulatory letters and any other documents with IAAP employment information
  - Individual and/or co-workers account of employment history

3x5 Employment Cards

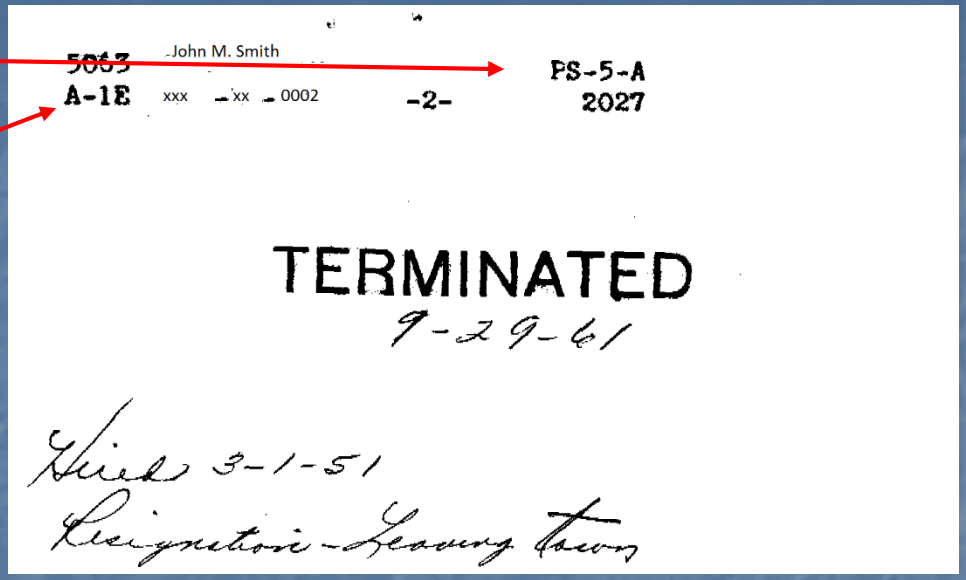
- N>68,000, start in 1948, include AEC era (1949 - 1975), replaced in early 1990s with e-records (PeopleSoft, MainFrame)
- *Contractor only (No Gov't or subcontractor employees)*
- Include:
  - ID (Name, SSN)
  - Badge number
  - Start and end date (<40% with complete hire and pre 6/1/1975 term date information)

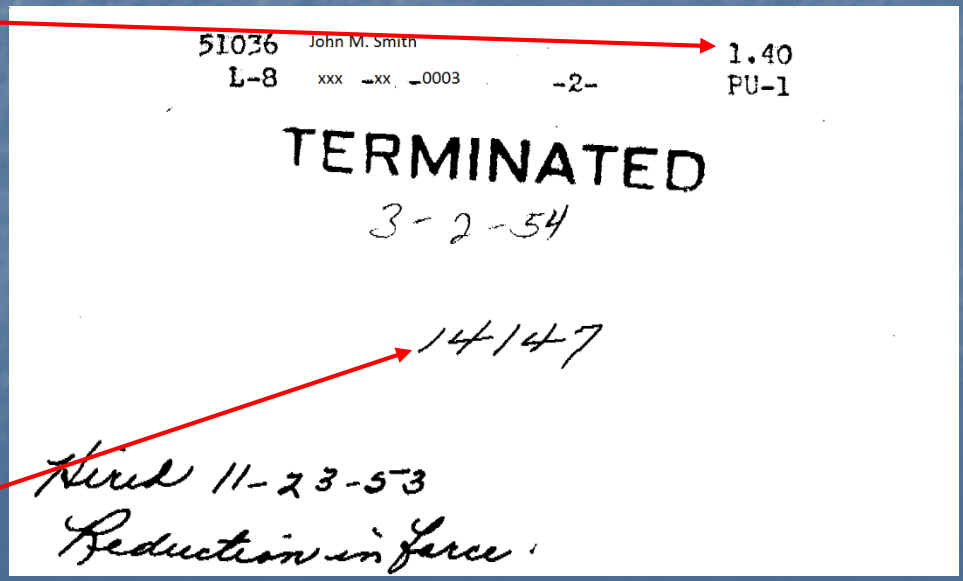


Cards scanned, available in e-format, database searchable

3x5 Employment Cards

- **Job code**
  (N>2000 era and line specific (1950s) job codes)
- **Job class**
  (relevance unknown, no correlation with job codes or AEC employment)
- **Wages**
  (Higher wages in several AEC production jobs compared to DoD)
- **Free text**
  (e.g. reasons for termination)
- **Other** (relevance unknown)





3x5 Cards – Utility in Employment Verification

- Main (available) historical employment roster for IAAP workers
- Include job codes and dates of employment
- Incomplete - no information on:
  - Federal government workers (e.g. AEC inspectors)
  - Subcontractor workers (cafeteria)
  - Duration of employment for every worker (esp. early 1950s)
- Lack of consistency throughout decades
  - 1960s and 1970 job codes no longer specific to Line 1 vs Div. A (DoD)
  - Same job codes used for different job titles

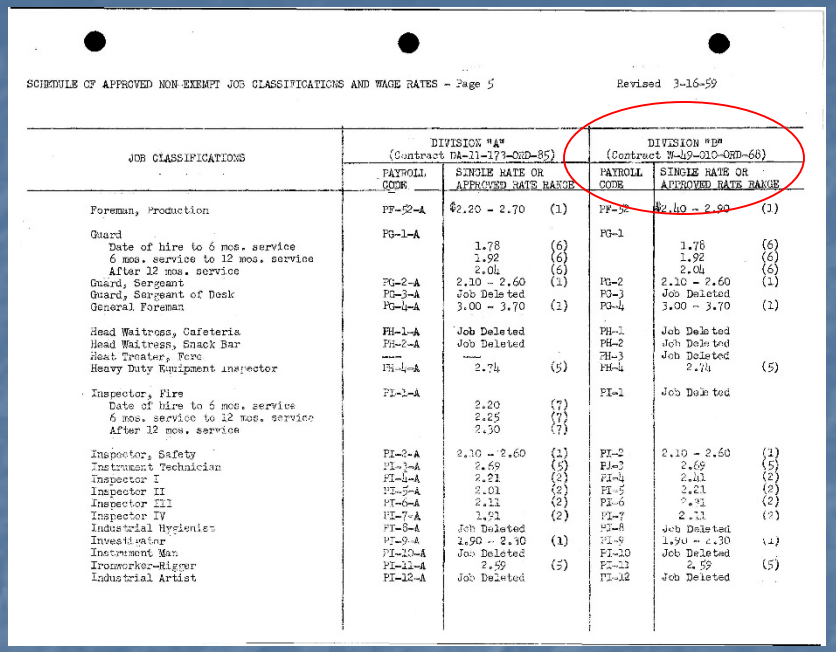
IAMAW Job Dictionaries & Wage Lists

- Approved job classifications for collective bargaining for non-exempt positions
- Include:
  - Job code and job title
  - Div. B (AEC Line 1) vs. Div. A Line 2-9) designation (1950s with few positions in 1960s and 1970s)
  - Wages/salary ranges
  - Contract numbers

  AEC Contract W-49-010-ORD-68

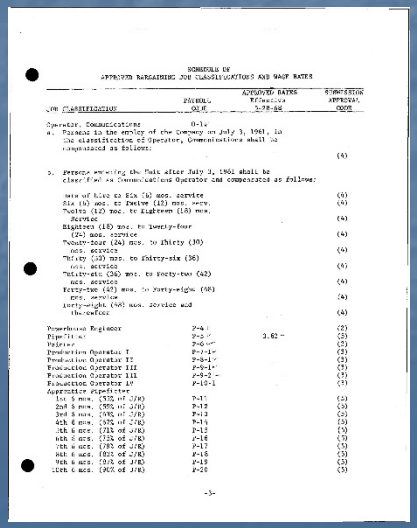
  DoD Contract DA-11-173-ORD-85

Schedules scanned (OCR) - available in e-format, database searchable

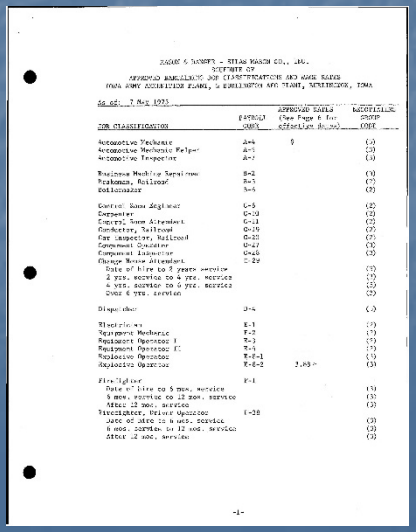


SCHEDULE OF APPROVED NON-EXEMPT JOB CLASSIFICATIONS AND WAGE RATES - Page 5 Revised 3-16-59

JOB CLASSIFICATIONS	DIVISION "A" (Contract DA-11-173-ORD-85) PAYROLL CODE	SINGLE RATE OR APPROVED RATE RANGE		DIVISION "B" (Contract W-49-010-ORD-68) PAYROLL CODE	SINGLE RATE OR APPROVED RATE RANGE	
Foreman, Production	PF-52-A	$2.20 - 2.70	(1)	PF-52	$2.40 - 2.90	(1)
Guard	PG-1-A			PG-1		
Date of hire to 6 mos. service		1.78	(6)		1.78	(6)
6 mos. service to 12 mos. service		1.92	(6)		1.92	(6)
After 12 mos. service		2.04	(6)		2.04	(6)
Guard, Sergeant	PG-2-A	2.10 - 2.60	(1)	PG-2	2.10 - 2.60	(1)
Guard, Sergeant of Desk	PG-3-A	Job Deleted		PG-3	Job Deleted	
General Foreman	PG-4-A	3.00 - 3.70	(1)	PG-4	3.00 - 3.70	(1)
Head Waitress, Cafeteria	PH-1-A	Job Deleted		PH-1	Job Deleted	
Head Waitress, Snack Bar	PH-2-A	Job Deleted		PH-2	Job Deleted	
Heat Treater, Pots	-----	-----		PH-3	Job Deleted	
Heavy Duty Equipment Inspector	PH-4-A	2.74	(5)	PH-4	2.74	(5)
Inspector, Fire	PI-1-A			PI-1	Job Deleted	
Date of hire to 6 mos. service		2.20	(7)			
6 mos. service to 12 mos. service		2.25	(7)			
After 12 mos. service		2.30	(7)			
Inspector, Safety	PI-2-A	2.10 - 2.60	(1)	PI-2	2.10 - 2.60	(1)
Instrument Technician	PI-3-A	2.69	(5)	PI-3	2.69	(5)
Inspector I	PI-4-A	2.21	(2)	PI-4	2.21	(2)
Inspector II	PI-5-A	2.01	(2)	PI-5	2.21	(2)
Inspector III	PI-6-A	2.11	(2)	PI-6	2.31	(2)
Inspector IV	PI-7-A	2.51	(2)	PI-7	2.11	(2)
Industrial Hygienist	PI-8-A	Job Deleted		PI-8	Job Deleted	
Investigator	PI-9-A	2.50 - 2.10	(1)	PI-9	1.90 - 2.30	(1)
Instrument Man	PI-10-A	Job Deleted		PI-10	Job Deleted	
Ironworker-Rigger	PI-11-A	2.59	(5)	PI-11	2.59	(5)
Industrial Artist	PI-12-A	Job Deleted		PI-12	Job Deleted	



SCHEDULE OF APPROVED BARGAINING JOB CLASSIFICATIONS AND WAGE RATES

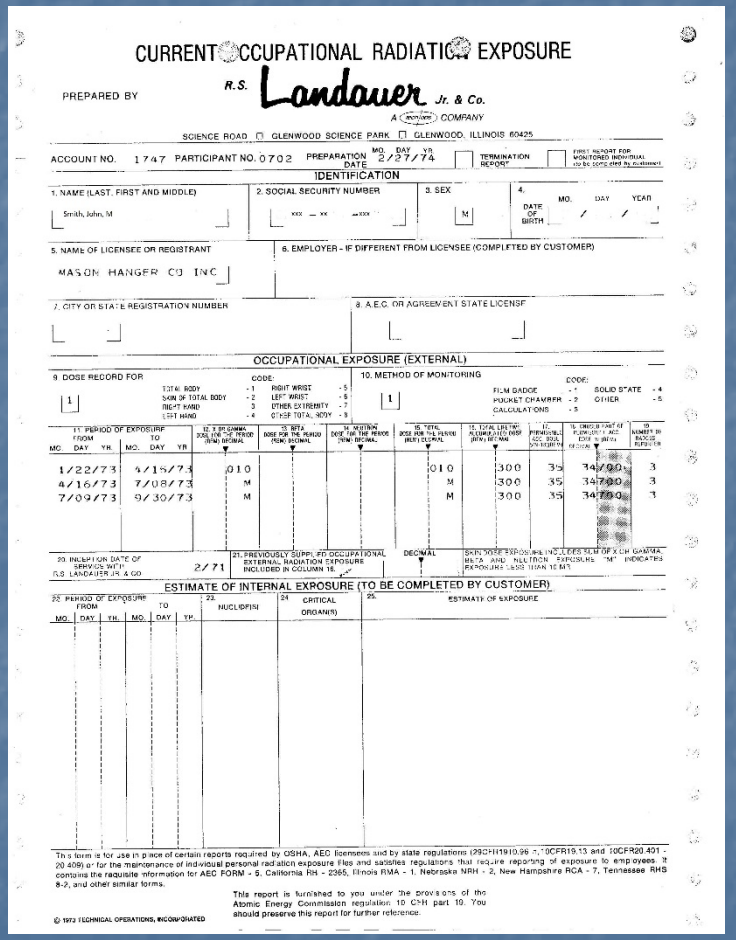


Radiation Dosimetry Badge Reports

- Occupational Radiation Exposure Monitoring Records for AEC workers
  - Dosimetry film badge reports
  - Only AEC workers (N=402)

Include:

- Last, First Name or First Initial, SSN
- Film badge start and end Date
- Exposure dose



CURRENT OCCUPATIONAL RADIATION EXPOSURE

PREPARED BY R.S. Landauer Jr. & Co. A LANDAUER COMPANY

SCIENCE ROAD ☐ GLENWOOD SCIENCE PARK ☐ GLENWOOD, ILLINOIS 60425

ACCOUNT NO. 1747 PARTICIPANT NO. 0702 PREPARATION DATE MO. 2 DAY 27 YR 74 ☐ TERMINATION REPORT ☐ FIRST REPORT FOR MONITORED INDIVIDUAL

IDENTIFICATION

1. NAME (LAST, FIRST AND MIDDLE): Smith, John, M
2. SOCIAL SECURITY NUMBER: xxx – xx – xxxx
3. SEX: M
4. DATE OF BIRTH: MO. / DAY / YEAR
5. NAME OF LICENSEE OR REGISTRANT: MASON HANGER CO INC
6. EMPLOYER - IF DIFFERENT FROM LICENSEE (COMPLETED BY CUSTOMER)
7. CITY OR STATE REGISTRATION NUMBER
8. A.E.C. OR AGREEMENT STATE LICENSE

OCCUPATIONAL EXPOSURE (EXTERNAL)

9. DOSE RECORD FOR: [1] — CODE: TOTAL BODY - 1; SKIN OF TOTAL BODY - 2; RIGHT HAND - 3; LEFT HAND - 4; RIGHT WRIST - 5; LEFT WRIST - 6; OTHER EXTREMITY - 7; OTHER TOTAL BODY - 8
10. METHOD OF MONITORING: [1] — CODE: FILM BADGE - 1; POCKET CHAMBER - 2; CALCULATIONS - 3; SOLID STATE - 4; OTHER - 5

11. PERIOD OF EXPOSURE FROM MO. DAY YR.	TO MO. DAY YR.	12. Rf GAMMA DOSE FOR PERIOD (REM) DECIMAL	13. BETA DOSE FOR THE PERIOD (REM) DECIMAL	14. NEUTRON DOSE FOR THE PERIOD (REM) DECIMAL	15. TOTAL DOSE FOR THE PERIOD (REM) DECIMAL	16. TOTAL LIFETIME ACCUMULATED DOSE (REM) DECIMAL	17. PREVIOUSLY RECORDED DOSE (REM) DECIMAL	18. UNIDENTIFIABLE EXPOSURE (REM) DECIMAL	19. NUMBER OF BADGES BEING REPORTED
1/22/73	4/15/73	.010			.010	.300	35	34700	3
4/16/73	7/08/73	M			M	.300	35	34700	3
7/09/73	9/30/73	M			M	.300	35	34700	3

20. INCEPTION DATE OF SERVICE WITH R.S. LANDAUER JR. & CO. 2/71

21. PREVIOUSLY SUPPLIED OCCUPATIONAL EXTERNAL RADIATION EXPOSURE INCLUDED IN COLUMN 16. DECIMAL

SKIN DOSE EXPOSURE INCLUDES BOTH GAMMA, BETA AND NEUTRON EXPOSURE "M" INDICATES EXPOSURE LESS THAN 10 MR

ESTIMATE OF INTERNAL EXPOSURE (TO BE COMPLETED BY CUSTOMER)

22. PERIOD OF EXPOSURE FROM MO. DAY YR.	TO MO. DAY YR.	23. NUCLIDE(S)	24. CRITICAL ORGAN(S)	25. ESTIMATE OF EXPOSURE

This form is for use in place of certain reports required by OSHA, AEC licensees and by state regulations (29CFR1910.96 -, 10CFR19.13 and 10CFR20.401 - 20.409) or for the maintenance of individual personal radiation exposure files and satisfies regulations that require reporting of exposure to employees. It contains the requisite information for AEC FORM - 5, California RH - 2365, Illinois RMA - 1, Nebraska NRH - 2, New Hampshire RCA - 7, Tennessee RHS 8-2, and other similar forms.

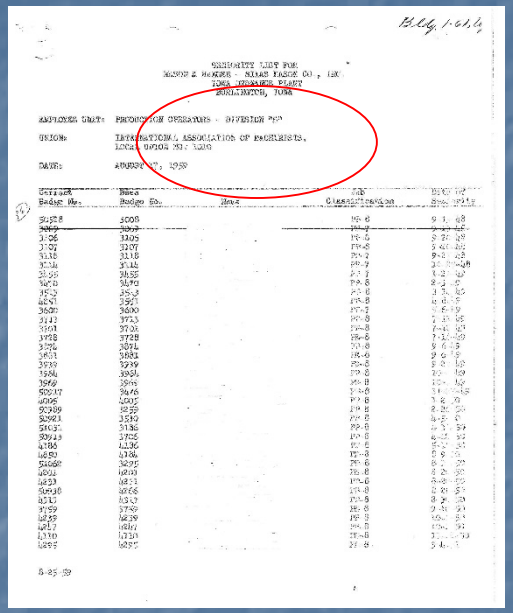
This report is furnished to you under the provisions of the Atomic Energy Commission regulation 10 CFR part 19. You should preserve this report for further reference.

© 1972 TECHNICAL OPERATIONS, INCORPORATED

Reports scanned, available in e-format
Database searchable

Seniority Lists and AEC Incident Reports

- IAMAW Seniority Lists for Div. B (AEC) Production Workers (N=326 workers)



SENIORITY LIST FOR
MASON & HANGER - SILAS MASON CO., INC.
IOWA ORDNANCE PLANT
BURLINGTON, IOWA

EMPLOYEE UNIT: PRODUCTION OPERATORS - DIVISION PP7

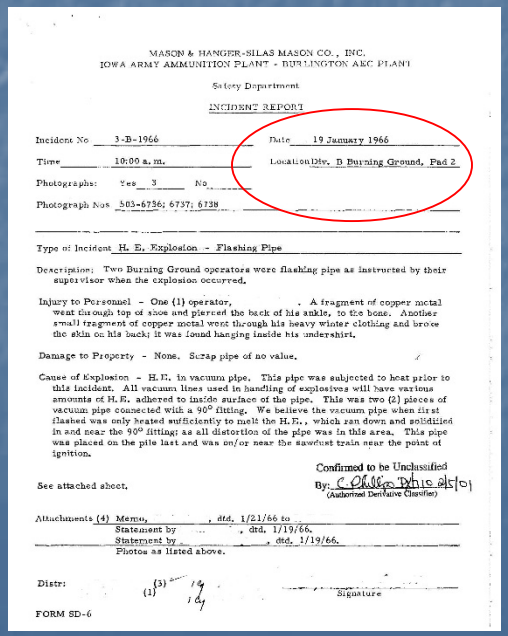
UNION: INTERNATIONAL ASSOCIATION OF MACHINISTS,
LOCAL UNION NO. 1000

DATE: AUGUST 1, 1958

Include:

- First Name, Last Name, MI
- Badge no, job code (PP-7 through 10), seniority date
- Only available for 1950s

Lists scanned (OCR), available in e-format, database searchable



MASON & HANGER-SILAS MASON CO., INC.
IOWA ARMY AMMUNITION PLANT - BURLINGTON AEC PLANT

Safety Department

INCIDENT REPORT

Incident No. 3-B-1966 Date 19 January 1966

Time 10:00 a.m. Location Div. B Burning Ground, Pad 2

Photographs: Yes 3 No

Photograph Nos 503-6736; 6737; 6738

Type of Incident H. E. Explosion - Flashing Pipe

Description: Two Burning Ground operators were flashing pipe as instructed by their supervisor when the explosion occurred.

Injury to Personnel - One (1) operator, . A fragment of copper metal went through top of shoe and pierced the back of his ankle, to the bone. Another small fragment of copper metal went through his heavy winter clothing and broke the skin on his back; it was found hanging inside his undershirt.

Damage to Property - None. Scrap pipe of no value.

Cause of Explosion - H.E. in vacuum pipe. This pipe was subjected to heat prior to this incident. All vacuum lines used in handling of explosives will have various amounts of H.E. adhered to inside surface of the pipe. This was two (2) pieces of vacuum pipe connected with a 90° fitting. We believe the vacuum pipe when first flashed was only heated sufficiently to melt the H.E., which ran down and solidified in and near the 90° fitting; as all distortion of the pipe was in this area. This pipe was placed on the pile last and was on/or near the sawdust train near the point of ignition.

Confirmed to be Unclassified
By: C. Ohlson DNFIS 2/5/01
(Authorized Derivative Classifier)

See attached sheet.

Attachments (4) Memo, , dtd. 1/21/66 to
Statement by , dtd. 1/19/66.
Statement by , dtd. 1/19/66.
Photos as listed above.

Distr: (1) (3)

Signature

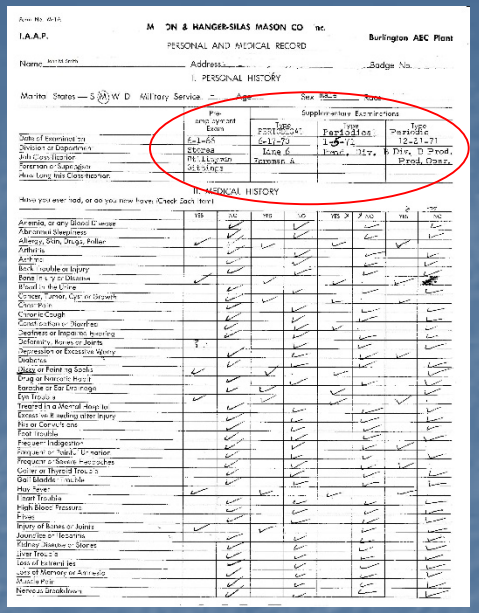
FORM SD-6

- Division B Incident Reports
  - N=6 incidents, 1966-1967
  - N<10 workers involved
  - N<15 Line 1 engineers and safety & health personnel

Reports scanned (OCR), available in e-format

Other (provided by former worker/family/AR)

- Medical Records from IAAP
  - Available per individual request from IAAP HR
  - Claimant required to provide copy of Birth Certificate/Death Certificate
  - S&H cost


M ON & HANGER-SILAS MASON CO Inc.
I.A.A.P. Burlington AEC Plant
PERSONAL AND MEDICAL RECORD
I. PERSONAL HISTORY
II. MEDICAL HISTORY

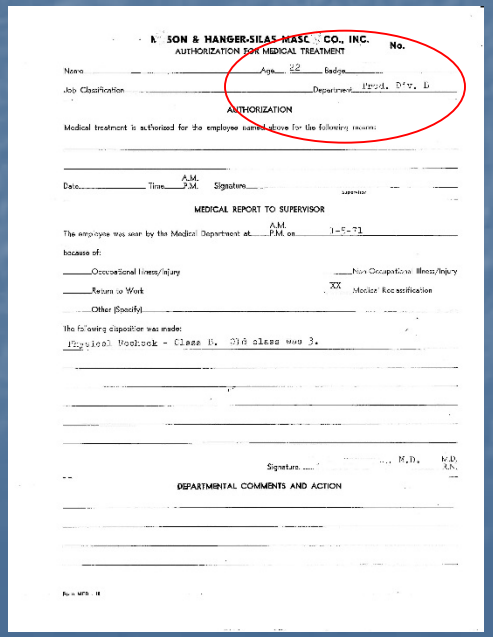
Include:

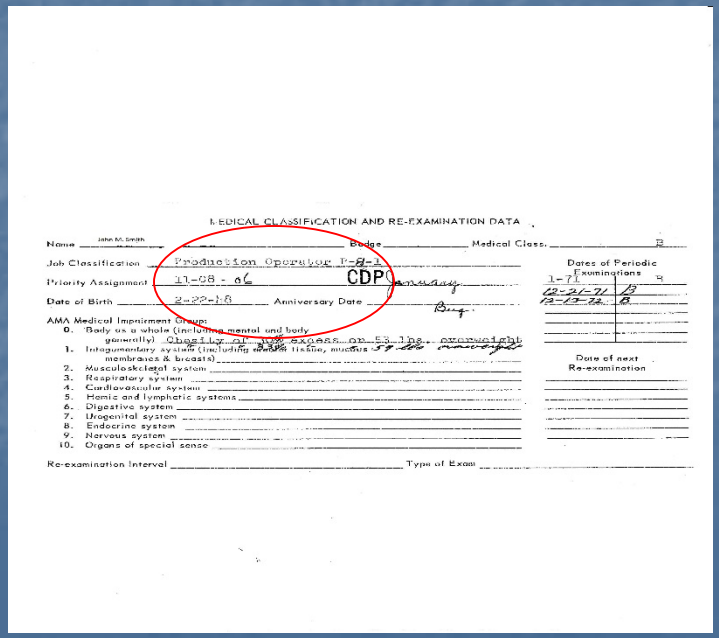
First Name, Last Name, MI

Badge No, Job Code,

Line /Division designation,

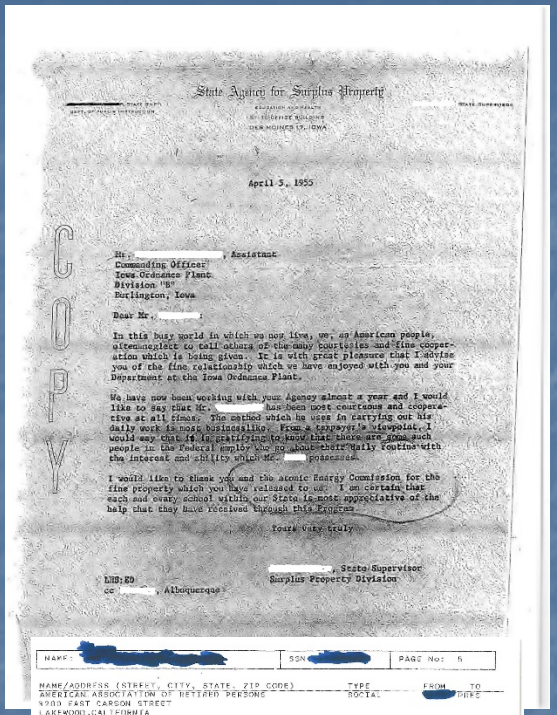
Date of Clinic Visit


N SON & HANGER-SILAS MASC N CO., INC.
AUTHORIZATION FOR MEDICAL TREATMENT
AUTHORIZATION
MEDICAL REPORT TO SUPERVISOR
DEPARTMENTAL COMMENTS AND ACTION


MEDICAL CLASSIFICATION AND RE-EXAMINATION DATA

Other (provided by former worker/family/AR)

- Clearance documents
- Congratulatory letters
- Salary slips
- Social Security information
- Workers own account
- Co-workers account



State Agency for Surplus Property

April 3, 1955

COPY

Mr. [redacted], Assistant
Commanding Officer
Iowa Ordnance Plant
Division "B"
Burlington, Iowa

Dear Mr. [redacted]:

In this busy world in which we now live, we, as American people, oftentimes fail to call others of the many courtesies and fine cooperation which is being given. It is with great pleasure that I advise you of the fine relationship which we have enjoyed with you and your Department at the Iowa Ordnance Plant.

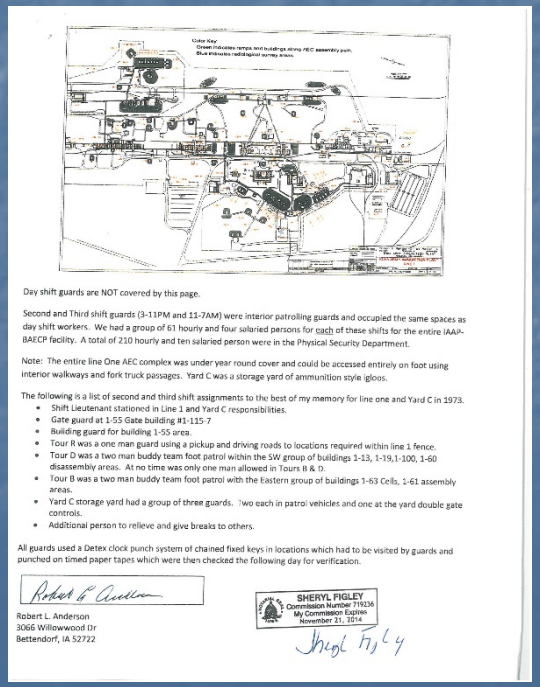
We have now been working with your Agency almost a year and I would like to say that Mr. [redacted] has been most courteous and cooperative at all times. The method which he uses in carrying out his daily work is most businesslike. From a surveyor's viewpoint, I would say that it is gratifying to know that there are some such people in the Federal employ who go about their daily routine with the interest and ability which Mr. [redacted] possesses.

I would like to thank you and the Atomic Energy Commission for the fine property which you have released to us. I am certain that each and every school within our State is most appreciative of the help that they have received through this Program.

Yours very truly,

[redacted], State Supervisor
Surplus Property Division

LHB:ED
cc [redacted], Albuquerque



Day shift guards are NOT covered by this page.

Second and Third shift guards (3-11PM and 11-7AM) were interior patrolling guards and occupied the same spaces as day shift workers. We had a group of 61 hourly and four salaried persons for each of these shifts for the entire IAAP-BAECP facility. A total of 210 hourly and ten salaried person were in the Physical Security Department.

Note: The entire line One AEC complex was under year round cover and could be accessed entirely on foot using interior walkways and fork truck passages. Yard C was a storage yard of ammunition style igloos.

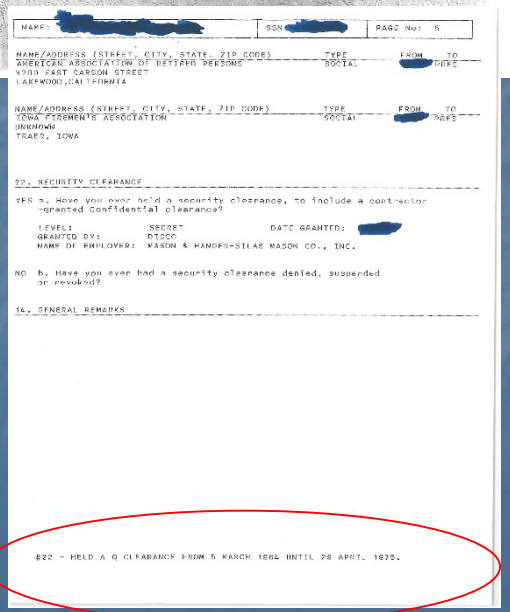
The following is a list of second and third shift assignments to the best of my memory for line one and Yard C in 1973.

- Shift Lieutenant stationed in Line 1 and Yard C responsibilities.
- Gate guard at 1-55 Gate building #1-115-7
- Building guard for building 1-55 area.
- Tour R was a one man guard using a pickup and driving roads to locations required within line 1 fence.
- Tour D was a two man buddy team foot patrol within the SW group of buildings 1-13, 1-19,1-100, 1-60 disassembly areas. At no time was only one man allowed in Tours B & D.
- Tour B was a two man buddy team foot patrol with the Eastern group of buildings 1-63 Cells, 1-61 assembly areas.
- Yard C storage yard had a group of three guards. Two each in patrol vehicles and one at the yard double gate controls.
- Additional person to relieve and give breaks to others.

All guards used a Detex clock punch system of chained fixed keys in locations which had to be visited by guards and punched on timed paper tapes which were then checked the following day for verification.

Robert L. Anderson
3066 Willowwood Dr
Bettendorf, IA 52722

SHERYL FIGLEY
Commission Number 719236
My Commission Expires
November 21, 2014



NAME: [redacted] SSN [redacted] PAGE No: 5

NAME/ADDRESS (STREET, CITY, STATE, ZIP CODE) TYPE FROM TO
AMERICAN ASSOCIATION OF RETIRED PERSONS SOCIAL [redacted] PRES
9200 EAST CARSON STREET
LAKEWOOD,CALIFORNIA

NAME/ADDRESS (STREET, CITY, STATE, ZIP CODE) TYPE FROM TO
IOWA FIREMEN'S ASSOCIATION SOCIAL [redacted] PRES
UNKNOWN
TRAER, IOWA

20. SECURITY CLEARANCE

YES a. Have you ever held a security clearance, to include a contractor-granted Confidential clearance?

LEVEL: SECRET DATE GRANTED: [redacted]
GRANTED BY: DTOCO
NAME OF EMPLOYER: MASON & HANGER-SILAS MASON CO., INC.

NO b. Have you ever had a security clearance denied, suspended or revoked?

14. GENERAL REMARKS

#22 - HELD A Q CLEARANCE FROM 5 MARCH 1964 UNTIL 28 APRIL 1975.

Contacts
BAECP Employment Verifications

Lar Fuortes, MD, MS
Principal Investigator, BAECP-FWP
2207 Westlawn
University of Iowa
Iowa City, IA 52242

Phone: (319) 384-2882
Toll-free: 866-282-5818
Email: laurence-fuortes@uiowa.edu

Marek Mikulski, MD, MPH, PhD
Co-Investigator, BAECP-FWP
2215 Westlawn
University of Iowa
Iowa City, IA 52242

Phone: (319) 384-4296
Toll-free: 866-282-5818
Email: marek-mikulski@uiowa.edu