4- Lawyers reports.

Re: Harry H. Haines deceased

Occupation: Process Operator

Employer: Rockwell International, Rocky Flats Plant

Social Security No: 521-09-4348

Date of Birth: 7.17.11

Date of Death: 3.13.76

Stated Cause of Death: Adeno Carcinoma, Pancreas

Material Reviewed

Lutheran Hospital and Medical Centre: Medical Notes

Postmortem Report

Rocky Flats Plant: Employee Record Card

External Radiation Doses

Internal Radiation: Urine Analyses

Whole Body Counts

Accidents

Review of the Medical Records from the Lutheran Hospital

Mr. Haines remained in reasonably good health until four months before he died. After two months of vague digestive symptoms be became jaundiced and an exploratory operation on February 24th produced evidence of an intestinal tumour which eventually proved to be a malignant tumour in the head of the pancreas with metastases in liver, mesentary and lung. Histological examination showed that tumour was an adeno carcinoma.

Review of the Occupational and Radiation Records from Rockwell International

From February 1953 until he died Mr. Haines was employed as a process operator by Rockwell International (table 1 part i). He was always a production worker and from the time of his first accident in 1967 he had a measurable body burden of plutonium and americium (table 1 part ii and table 2). There were six accidents between 1967 and 1974 (table 2)

but there seems to have been no attempt to obtain postmortem evidence of internal radiation.

On two occasions Mr. Haines' annual dose of external radiation exceeded 5 rems (1966 with 7.6 rems and 1967 with 8.4 rems). There is a missing period of records (1959-63) but we are told that the total cumulative dose was 30.8 rems. After correction for age and latency factors (see guide to MSK III risk estimates for radiation workers) the effective dose is 127.8 rems or over 8 times as high as the doubling dose for all cancers of radiosensitive tissues (which include pancreas).

Conclusions

Mr. Haines died from the effects of pancreatic cancer which in my opinion was probably caused by his exposure to plutonium and other sources of ionizing radiations while working at Rocky Flats Plant.

A.M. Stewart, M.D., F.R.C.P.
25th May, 1983

Table 1

Occupational Records of Harry Haines (1953-76)

(i) External Radiation

Calendar Years	Age in Years	Pre Death Period	Radiation Dose in Rems Actual	Radiation Dose in Rems Effective (1)	Occupation
1953	41	23	225	223	Chemical Operator V
4	42	22	117	151	Furnace Operator VI
1955	43	21	150	218	"
6	44	20	110	176	Operator
7	45	19	300	539	"
8	46	18	111	221	Chemical Operator
9	47	17	300	670	Operator
1960	48	16	300	729	"
1	49	15	300	818	"
2	50	14	300	900	"
3	51	13	302	977	"
4	52	12	170	606	Process Operator
1965	53	11	1018	3927	"
6	54	10	7632	31757	"
7	55	9	8456	37491	"
8	56	8	2169	10368	"
9	57	7	880	4238	"
1970	58	6	2255	11501	"
1	59	5	1778	8684	"
2	60	4	1043	4824	Metal Process Operator
3	61	3	925	3756	"
4	62	2	1095	3504	"
1975	63	1	842	1532	"
1976	64	0	65	0	
			Σ 30.842	127.810	
				RR >3.8*	

(1) See guide to MSK III risk estimates for radiation workers.

* Relative risk. The figure of 3.8 implies a 380% increase in risk as a result of the 1953-75 exposures.

Table 1

Occupational Records of Harry Haines (1953-76) continued

(ii) Internal Radiation

Calendar Years	Occupation	Dept.	1*	2**	3***
1953	Chemical Operator V	Prod. A	5	0	-
4	Furnace Operator VI	"	9	0	-
1955	"	"	2	0	-
6	Operator	"	1	0	-
7	"	"	6	0	-
8	Chemical Operator	"	8	0	-
9	Operator	"	4	0	-
1960	"	"	5	0	-
1	"	"	4	0	-
2	"	MF 76	4	0	-
3	"	MF 44	9	0	-
4	Process Operator	MF 44	4	0	-
1965	"	MF 76	6	0	-
6	"	MF 76	3	1.3	-
7	"	MF 76	4	0.4	(1)
8	"	MF 76	8	3.5	(1)
9	"	MF 776	8	6.3	(2)
1970	"	MF 776	5	6.9	(1)
1	"	MO 776-707	6	6.3	-
2	Metal Process Operator	"	8	7.8	-
3	"	MO Pu Area	7	8.5	-
4	"	"	9	8.3	(1)
1975	"	"	8	7.6	-
1976	"	"	1	8.3	-

* Number of tests for internal deposition of radioactive substances

** Peak levels of Body Burden (x 100)

*** Number of radiation accidents

MF Manufacturing Foundry

MO Metal Operations

Table 2

Harry Haines Accident Data

Date	Area of Contamination	Nature of Accident	Action Taken
2.7.67	Middle Finger Left Hand	Burn from Hot Crucible	
5.31.68	Third Finger Left Hand	Glove Failure, followed by Opening of old Would During Decontamination	Decontamination Whole Body Count
8.3.69	Nil Personal	"Clean up"	Repeated Area Decontamination and 2-3 hours of "air supplied"
8.15.69			
8.17.69			
8.18.69			
8.19.69			
8.29.69			
9.1.69			
9.8. 69			
10.18.69	Nose	Laceration from Dry Box	"Treatment of Wound"
2.13.70	Index Finger Left Hand	Wound from Edge of Drum	Treatment of Wound and Wound Count for (?)
3.8.70	Fourth Finger Left Hand	Knife Wound	Treatment of Wound and Wound Count for Pu
3.11.74	Lungs	Possible Inhalation from Pressurized Release of Contamination	No Record

Re: Ormond Ferguson deceased

Occupation: Patrolman and Process Operator

Employer: Rockwell International, Rocky Flats Plant

Social Security No: 577-05-1373

Date of Birth: 4.18.14

Date of Death: 4.16.80

Stated Cause of Death: Poorly differentiated adeno carcinoma of stomach

Materials Reviewed:

University of Colorado Medical Centre: Autopsy Report

Los Alamos Scientific Laboratory: Radio Chemical Analysis of Autopsy Specimens

Rocky Flats Plant: Employee Record Card

External Radiation Doses

Internal Radiation Doses : Urine Analysis

Review of Autopsy Reports

Though the cause of death was undoubtedly a malignant tumour of the stomach, with extension into the duodenum and pancreas, there are doubts about the precise type of malignancy. The final opinion seems to be a poorly differentiated adeno-carcinoma though earlier biopsy specimens had left an impression of a malignant sarcoma. Of more importance in view of the radiation exposures, is the fact that radiochemical analysis of several postmortem specimens did find evidence of significant quantities of americium and plutonium in the following tissue: liver; lungs; lymph nodes and bone (table 1).

Review of Occupational and Radiation Data

From January 1956 to October 1958 Mr. Ferguson worked at Rocky Flats Plant. For the first three years he was a patrolman. He was then an assistant process operator (1958-70) and finally a technician in the Health Physics laboratories directly concerned with urine analysis of process workers (table 2). During the middle period, when Mr. Ferusons's age

increased from 44 to 56 years his film badges recorded a total dose of 25 rads. After allowing for the effects of age and latency the effective dose was close to 82 rads or over 5 times higher than the doubling dose for cancers of radiosensitive tissues (see guide to MSK III risk estimates for radiation workers).

It is not clear whether Mr. Ferguson was not involved in any radiation accidents but from 1959 onwards there were several occasions when significant amounts of plutonium were found on urine analysis and from 1964 onwards there was evidence of internal depositions of radioactive substances and this was later confirmed in the autopsy specimens.

Conclusions

Mr. Ferguson died of the effects of a stomach cancer which in my opinion was probably caused by his exposure to plutonium and other sources of ionizing radiations while working as a process operator at Rocky Flats Plant.

A.M. Stewart, M.D., F.R.C.P.
25th May, 1983

Table 1

Ormond Furguson (PM 4.1.80)

Analysis of Postmortem Specimens for Evidence of Radionuclides

from U.S. Transuranium Registry Report, December 1981

	Americium (Am^{241})	Plutonium ($Pu^{239-240}$)	Plutonium (Pu^{238})
	Disintegrations per Minute		
Lymph Nodes	2	14	-
Lung Left	71	242	5
Lung Right	40	181	4
Liver	615	1023	22
Vertebra	49	28	1

Table 2

Occupational Records of Ormond Ferguson (1955-80)

(i) External Radiation

Calendar Years	Age in Years	Pre Death Period	Radiation Dose in Rems Actual	Radiation Dose in Rems Effective(1)	Occupations
1955	41	25	0	0	Patrolman
6	42	24	0	0	"
7	43	23	0	0	"
8	44	22	806	1317	Assistant Operator
9	45	21	1946	3566	"
1960	46	20	1686	1771	Operator
1	47	19	3201	7375	"
2	48	18	4486	11385	"
3	49	17	2815	8116	"
4	50	16	1316	4133	Process Operator
1965	51	15	1812	6219	"
6	52	14	2304	8718	"
7	53	13	1360	5655	"
8	54	12	2445	11289	"
9	55	11	1480	7430	"
1970	56	10	471	2651	"
1	57	9	0	0	Technician Bioassay
2	58	8	0	0	"
3	59	7	0	0	"
4	60	6	203	1294	"
1975	61	5	130	801	"
6	62	4	5	0	"
7	63	3	0	0	"
8	64	2	0	0	"
9	65	1			
1980	66	0			
			Σ 25.641	82.018 RR 3.40*	

(1) see guide to MSK III risk estimates for radiation workers

* Relative risk. A figure of 3.40 implies a 340% increase in risk as a result of the 1958-70 exposures.

Table 2

Occupational Records of Ormond Ferguson (1955-80) continued

(ii) Internal Radiation

Calendar Years	Occupation	Dept.	1 *	2 **	3 ***
1955	Patrolman	see-Pl Protect.	0	-	
6	"	"	2	0	
7	"	"	2	0	
8	Assistant Operator	Prod. (C)	2	0	
9	"	Prod. (B)	5	0	
1960	Operator	" B	6	0	
1	"	" C	0	-	
2	"	MF Foundry 76	2	0	
3	"	MF Chem. 71	3	25	
4	Process Operator	Waste 76	0	-	
1965	"	" 74	1	6	
6	"	MF Chem. Waste	2	32	
7	"	" Waste Treat.	4	141	NO RECORDS
8	"	"	1	114	
9	"	"	1	93	
1970	"	"	7	192	
1	Technician Bioassay	HP Hyg. & Biol.	0	-	
2	"	"	0	-	
3	"	"	0	-	
4	"	"	0	-	
1975	"	"	0	-	
6	"	"	1	118	
7	"	"	0	-	
8	"	"	1	133	
9		(retired)	-	-	
1980		Died	-	-	

* Number of tests for internal deposition of radioactive susbtances

** Peak levels of Body Burden (x 100)

*** Number of radiation accidents

MF Manufacturing Foundry

HP Health Physics

Re: William Billingsley deceased

Occupation: Laboratory Technician

Employer: Rockwell International, Rocky Flats Plant

Social Security No: 479-22-6210

Date of Birth: 9.29.25

Date of Death: 11.11.81

Stated Cause of Death: Mesothelioma originating in pleural tissue and mediastrial glands.

Materials Reviewed

Medical Records from Boulder Medical Centre

Postmortem Reports from Dr. Howard Fischer

U.S. Transuranium Registry

Reports from Rockwell International: Employees Record Card

Internal Radiation Doses

Internal Radiation Accidents

External Radiation Doses

Review of Medical Records from Boulder Medical Centre

During the last four months of his life Mr. Billingsley had persistent and increasing pain and stiffness of his neck and spine and chest. A tentative diagnosis of "systematic arthritis" was made in September 1981 but it was soon discovered that Mr. Billingsley was suffering from a diffuse cancer of lungs and mediastinal glands, also a pleural effusion and numerous bone metastases. Following a postmortem examination it was finally established that the cancer was a "malignant diffuse mesothelioma with metastases to regional lymph nodes". Autopsy samples were submitted to the U.S. Transuranium Registry who found evidence of two radionuclides (americium and plutonium) in lymph nodes, lungs and liver (see table 1).

Review of Occupational and Radiation Data

From May 1959 until a month before he died Mr. Billingsley worked as a Laboratory Technician at the Rocky Flats Plant of Rockwell International (table 2 parts i and ii). Before that he was a Student of Colorado University at Boulder who did vacation jobs for a washing machine factory and the railroad. According to four independent witnesses there was no known exposure to asbestos either at work or at home but he was in the habit of smoking two packets of cigarettes a day.

While at Rocky Flats Mr. Billingsley's annual doses of external radiation never exceeded 3 rems but he averaged 0.829 rems per annum and therefore had a cumulative dose of 18.24 rems. After allowing for the effects of age and latency the effective dose was 19.78 rems or nearly 5 rems more than the doubling dose for cancers of radiosensitive tissues (see guide to MSK III risk estimates for radiation workers).

Between 1959 and 1962 Mr. Billingsley was involved in seven radiation accidents, six of which required "complete decontamination" (table 3). As a result of these accidents a series of bioassay tests and whole body counts continued to register significant body burdens of americium and plutonium (table 2) and postmortem examination confirmed the existence of these radionuclides in several tissues (table 1).

Conclusions

Mr. Billingsley died from the effects of a lung cancer which in my opinion was probably caused by his exposure to plutonium and other sources of ionizing radiation while working in the Rocky Flats Plant of Rockwell International.

A.M. Stewart, M.D., F.R.C.P.
25th May, 1983

Table 1

William Billingsley (PM 11.11.81)

Analysis of Postmortem Specimens for Evidence of Radionuclides

from U.S. Transuranium Registry Report, June 1982

	Americium (Am^{241})	Plutonium ($Pu^{239,240}$)
	Disintegrations Per Minute	
Lymph Nodes	4	14
Lung Left	16	99
Lung Right	23	121
Liver	70	185

Table 2

Occupational Records of William Billingsley (1959-81) continued

(ii) Internal Radiation

Calendar Years	Occupation	Dept.	1*	2**	3***
1959	Lab. Assistant	Q.C. Labs.	5	0	(3)
1960	"	"	5	0	(2)
1	"	"	4	0	(1)
2	Lab. Technician B	Anal. Lab. (71)	4	0	(1)
3	"	X-ray Radio. Assay	11	1.0	-
4	"	"	9	16.8	-
1965	Lab. Technician	"	6	9.9	-
6	"	Serv. Lab. (71) X-ray	6	14.6	-
7	"	"	11	13.8	-
8	"	"	9	15.6	-
9	Service Lab. Technician	"	8	18.0	-
1970	"	"	2	19.6	-
1	"	Rad. Chem. 771	9	18.0	-
2	"	"	8	20.8	-
3	"	"	6	18.0	-
4	"	"	4	19.1	-
1975	"	"	8	17.0	-
6	"	"	9	17.5	-
7	"	"	6	17.0	-
8	"	"	12	18.4	-
9	Analyst Lab. Technician	"	8	21.0	-
1980	"	"	8	18.9	-
1981	"	"	4	17.6	-
					Σ 7

* Number of tests for internal deposition of radioactive substances

** Peak levels of Body Burden (x 100)

*** Number of radiation accidents

Table 2

Occupational Records of William Billingsley (1959-81)

(i) External Radiation

Calendar Years	Age in Years	Pre Death Period	Radiation Dose in Rems Actual	Radiation Dose in Rems Effective[1]	Occupation
1959	34	22	411	199	Lab. Assistant
1960	35	21	975	516	"
1	36	20	608	366	"
2	37	19	1104	784	Lab. Tecnician B.
3	38	18	1802	1355	"
4	39	17	667	558	"
1965	40	16	1258	1132	Lab. Technician
6	41	15	2792	2776	"
7	42	14	1577	1785	"
8	43	13	1097	1348	"
9	44	12	1289	1723	Service Lab. Technician
1970	45	11	485	698	"
1	46	10	651	1007	"
2	47	9	752	1227	"
3	48	8	490	820	"
4	49	7	487	845	"
1975	50	6	588	1047	"
6	51	5	172	295	"
7	52	4	251	409	"
8	53	3	262	381	"
9	54	2	359	409	Analyst Lab. Technician
1980	55	1	158	103	"
1981	56	0			
			Σ 18.235	19.783 RR 2.15*	

(1) see Guide to MSK III risk estimates for radiation workers.

* Relative risk. The figure of 2.15 implies a 215% increase in risk as a result of the 1959-81 exposure.

Table 3

William Billingsley Accident Records

Date	Area of Contamination	Nature of Accident	Action Taken
6.9.59	Clothes and Boots	Floor Spill of Hot Waste	Decontamination of 4 workers
8.28.59	Thorax	Leakage from Cap of Vile	Wash and Shave Complete Decontamination
11.18.59	Second Finger of Left Hand	Hole in Dry Box Glove	Routine Cleansing
2.10.60	Fifth Finger of Right Hand	Cut from Broken Glass	Flushing of Wound and Complete Decontamination
5.20.60	Clothes and Boots	Floor Spill of Hot Waste	Decontamination of 2 Workers
12.21.61	"Spread from Control Bay"	No Record	Decontamination of 2 Workers
1.25.62	Spread from Cutting Hood	No Record	Decontamination of 2 Workers

Re: Donald Gabel deceased

Occupation:

Employer: Rockwell Internation, Rocky Flats Plant

Social Security No: 521-70-8393

Date of Birth: 6.16.49

Date of Death: 10.29.80

Stated Cause of Death: Malignant Tumour in the Right Frontal Lobe of the Brain. Grade IV Cytoblastoma Multiforme

Material Reviewed

Luteran Medical Centre: Clinical Records

Cancer Treatment Centre, Albequerque: Initial Valuation for Radiotherapy

U.S. Transuranian Tissue Analysis of Autopsy Specimens

Rocky Flats Plant: External Radiation Doses

Radiation and Epidemiology Studies Status Report for the Year 1981 (RES report)

Review of Medical Records

Before and after a head injury from a motorcycle accident in 1965 Mr. Gabel enjoyed good health until March 1979 when he had a generalized seizure and showed other signs of increased intra cranial pressure. On 4.5.79 a large, partly cystic tumour was removed from the Right Frontal Lobe and Mr. Gabel was refered to a clinic in Albequerqu for radiotherapy treatment. He, nevertheless, died from further effects of the tumour on 10.29.80 and postmortem examination of several tissues revealed significant quantities of americium and plutonium in the following tissues: lymph nodes; lungs and liver (table 1).

Review of Radiation Records

Mr. Gabel worked at Rocky Flats Plant from 10.12.70 until shortly before he died (table 2). During this time he received a total

dose of 16.514 rems (external radiation). Nearly half of this amount (7.66 rems) was received in 1972-3 when he was 22-3 years of age.

The MSK III risk estimates for radiation workers only apply to cancers of tissues which have known sensitivity to cancer induction effects of radiation. The supporting tissue of brain cells (so called glial tissues which were the source of Mr. Gabel's tumour) do not belong to this category. Nevertheless, a follow-up of 7112 Rocky Flats Plant workers (which was successful in 6440 cases) is open to the interpetation that these workers are over three times as likely to die from brain tumours as other persons of the same age and sex (table 3). The cause of this association is still unknown but could be related to the following facts: the blood supply to the brain is exceptionally good and unlike Hanford workers (who are the source of MSK III risk estimates) workers at Rocky Flats Plant are at high risk of internal depositions of radioactive substances (see RES report for 1981).

Conclusions

Mr. Gabel died from the effects of a brain cancer which in my opinion was probably caused by his exposure to plutonium and other sources of ionizing radiations while working at Rocky Flats Plant. The head injury in 1965 is of no etiological importance except in so far as injured tissues are probably more vulnerable to carcinogens than uninjured ones.

Alice M. Stewart, M.D., F.R.C.P.
25th May, 1983

Table 1

D.M. Gabel (PM 10.29.80)

Analysis of Postmortem Specimens for Evidence of Radionuclides from U.A. Transuranium Registry Report, October 1980

	Americium (Am^{241})	Plutonium ($Pu^{239-240}$)	Uranium ($U^{234,235}$)
	Disintegrations per Minute		
Lymph Nodes	9	154	-
Lung	122	1251	21
Liver	27	15	1
Rib	-	3	-

Table 2

D.M. Gabel

Records of External Radiation Doses

while at Rocky Flats Plant

Calendar Years	Age	External Radiation Doses in Rems				
		Annual	Quarterly			
			(1)	(2)	(3)	(4)
1970	20	NR				
1	21	NR				
2	22	4.234	650	1.255	1.170	1.159
3	23	3.426	883	751	823	969
4	24	2.226	612	251	386	977
1975	25	2.406	632	696	564	514
6	26	1.821	466	564	535	256
7	27	0.779	220	158	242	159
8	28	0.558	61	145	146	206
9	29	0.742	234	164	174	170
1980	30	0.251	0.251	-	-	-
Σ	Σ	16.443	4.009	3.984	4.040	4.410

Check total 16.514

Table 3

D.M. Gabel

Observed and Expected Deaths of 6440

Rocky Flats Workers (1953-79)[1]

Diagnostic Groups	Deaths Observed	Deaths Expected[2]	Ratio
Non-Cancer Deaths	337	360.0	0.94
Cancer of Digestive Organs	28	23.1	1.21
Cancer of Respiratory Organs	34	32.9	1.06
Cancer of Brain	16	4.2	3.81
Cancer of Blood Forming Tissues	13	9.9	1.05
Cancer of Other Sites	23	21.4	1.83
All Deaths	452	452.0	1.00

(1) From Voelz et al see Rocky Flats Radiation and Epidemiology Studies Status report for 1981 (excluding 672 men lost to follow-up)

(2) Assuming the same distribution of different causes of death as in age and sex standardized mortality statistics for U.S. men of working age.