SAFETY NOTE #17

BERYLLIUM WORKER INTERVIEWS

Joe Kenny JK

March 1989

Beryllium is found in many applications at Fermilab. Metallic beryllium blocks are employed as selective particle beam absorbers and small amounts of beryllium are found in alloys used in semiconducting heat sinks, wear resistant electrical contacts, wires used in detectors, and non-sparking tools.

Beryllium is also a health hazard. Diseases associated with beryllium exposure include berylliosis, a chronic illness marked by exhaustion, shortness of breath, and nonproductive coughing, and granulomatosis, a long-lived acne-like skin condition. Wounds inflicted with beryllium or beryllium alloys are notoriously slow to heal. Beryllium is also a suspected human carcinogen.

Legal and media attention drawn to beryllium diseases in contractor employees led the Department of Energy to set up the Beryllium Workers Notification Program in October 1987. The purpose of this program is to notify all beryllium workers* of the risks associated with beryllium exposure, conduct seminars on beryllium diseases and refer beryllium workers to medical experts for evaluation and treatment.

In response to the DOE promulgation, the Health & Safety Group of the Safety Section conducted interviews with 78 potential Be workers in February 1989. Much was learned from these interviews including:

1. The administrative control of beryllium containing materials has successfully kept exposures to a minimum. The handling of metallic beryllium outside the close scrutiny of Research Division safety officers is strongly discouraged, as is the machining of beryllium and its alloys. Beryllium jobs that occur are small, few and the subject of much industrial hygiene testing. Non-sparking tools are used only in hydrogen areas and locked in a specially marked chest.

2. Industrial hygiene testing done on beryllium-related operations has yet to show airborne beryllium levels above the 0.002 mg/m^3 (time-weighted average) Fermilab standard. Testing has been done during a variety of activities including light machining, drilling, handling, transporting and clean-up procedures.

3. Fermilab workers are aware of the presence of beryllium. All remembered time spent working with beryllium containing materials and the extent to which they handled them. Two workers had personal written records of their work with beryllium alloy contacts. The interviewer was never posed the question "What's beryllium?" by the person interviewed.

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*DOE has a special definition of "Be worker", see Appendix 1.

4. **Based on an evaluation of exposures, no interviewed past or present Fermilab employee or visitor can be classified as a DOE beryllium worker.** See Appendix 2 for exposure estimation methods.

5. The application of cancer rate estimates to our beryllium exposure estimates (suggests) that one would see 3×10^{-7} total excess fatal cancers in the Fermilab population involved with beryllium containing materials. This is based on the airborne unit cancer risk estimate published by the EPA in the BNA Environment Reporter (8-10-84, p. 616). This estimate of 4×10^{-4} extra cancers is associated with a constant 70 year exposure to 1 $\mu g/m^3$ beryllium. Fermilab's beryllium related cancer risk is negligible next to the fatal cancer rate from all other causes (25%, or 22 of the 88 workers). See Appendix 3 for the methods and calculations of beryllium related cancer risk.

From the 78 interviews, the beryllium histories of ten additional employees unreachable for comment have been constructed. Since to date no Fermilab employee interviewed has worked alone with beryllium, we are confident that these histories are representative. Therefore, the ten extra exposure estimates are included in our cancer risk calculations.

cc.
R.Currier
H.Casebolt
D.Cossairt
C.Turner
W.Nicholson
S.Wilson
R.Scherr
C.Lang
L.Coulson
S.Baker
D.Austin
T.Miller
K.Horsey
K.Weber

Appendix 1: From DOE memo.

DEFINITION OF A BERYLLIUM WORKER

Beryllium workers for the purposes of notification are workers who:

- were assigned to work in an area where air sampling results indicate exposure (without considering respiratory protection) was more than 0.5 micrograms beryllium aerosol per cubic meter of air, in the breathing zone, averaged over any 8 hour working period; or
- were assigned to work in a beryllium facility for more than 30 work days per year; or
- were assigned to work at short-term beryllium operations for more than 30 work days per year.

Beryllium means: beryllium metal; beryllium oxide; and alloys, compounds, and commercial products containing greater than 0.1 percent beryllium.

A beryllium facility means a facility established for working beryllium materials, wnere occupational exposures could have occurred from aerosols, skin penetration, or skin contact. This excludes such operations as non-destructive testing, inspection, and final assembly where no significant potential for occupational exposure exists.

A short-term operation means an operation such as a repair, unique fabrication, or experiment conducted in a facility and with equipment not normally used for beryllium work, where occupational exposures could have occurred from aerosols, skin penetration or skin contact.

Appendix 2: Exposure Estimation.

From the list (p. iii) of compiled data from the Be interviews, exposures are estimated in the following way:

1. If IH testing was performed during a beryllium operation, then the sample results are adopted as the exposure estimate for that job.

2. If no IH testing was done during a beryllium operation, the exposure estimate of a similar, tested operation is adopted.

3. If no IH testing was done during a beryllium operation and no similar operation exists for comparison, a reasonable, worst-case estimate is adopted for that operation. Since the operations involving the least possibility of Be exposure tend not to undergo IH testing, we set this value at 5×10^{-4} mg/m^3; approximately four times Fermilab's heaviest Be air sample result.

FERMILAB EMPLOYEES WITH BERYLLIUM EXPERIENCE

NAME	MATERIAL	ESTIMATED EXPOSURE	DURATION
L.Andersen	3% Be (Cu alloy)	<0.000720 mg/m^3	2 hours
B.Arnold	Target storage remnants	<0.000140	5
G.Athanasiou	Nonsparking tools	<0.000100	24
D.Austin	Alloys & metal	<0.000010	80
D.Bancroft	Target storage remnants	<0.000140	5
L.Bartoszek	Targets	<0.000400	0.5
S.Benesch	Targets	<0.000400	12
J.Blomquist	Wire (<3% Be)	<0.000500	1
G.Bock	Targets	<0.000400	1
J.Bockman	Targets&storage remnants	<0.000055	8
D.Booth	3% Be (Cu alloy)	<0.000400	8
N.Bosek	Targets	<0.000400	2
G.Brown	BeO heat sinks	<0.000500	2
J.Brown	Heat sinks & insulators	<0.000500	6
D.Carpenter	Alloys & pure	<0.000400	12
D. Champion	Alloy	<0.000720	4
R.Currier	Targets	<0.000400	1
J.Ellermeier	Nonsparking tools	<0.000100	24
B.Fellenz	3% Be (Cu alloy)	<0.000400	2
J.Foglesong	Nonsparking tools	<0.000100	24
A.Forni	Ag plated BeCu alloy	<0.000400	20
M.Frett	Alloy contacts	<0.000130	4
W.Ganger	3% Be (Cu alloy)	<0.000400	20
P.Garbincius	Targets	<0.000400	1
J.Geralds	(Targets)	<0.000010	1
T.Golaszewski	Target remnants	<0.000140	5
K.Gray	Targets	<0.000400	1
R.Gustafson	Targets	<0.000400	2
H.Haggerty	Targets	<0.000400	1
S. Hawke	Target remnants	<0.000140	5
R.Haynes	(Targets)	<0.000010	1
R.Heflin	Ag coated 3% Be wire	<0.000100	32
J.Heinrich	Targets	<0.000400	8
D.Hicks	Ag coated 3% Be wire	<0.000100	40
R.Hiller	Box of targets	<0.000550	4
S.Hodges	3% Be (Cu alloy)	<0.000400	2
R.Kadel	Ag coated 3% Be wire	<0.000100	8
K.Kephart	Ag coated 3% Be wire	<0.000100	36
J. Kilmer	Nonsparking tools	<0.000100	20
R.Kingsley	Target remnants	0.000140	5
G.Krafczyk	BeO insulators	<0.000500	2
B.LaVoy	Ag coated 3% Be wire	<0.000100	32
G.Lawrence	<3% Be alloy pipes	<0.000720	24
H.Le	Alloys&ceramics	<0.000500	8
R.Lenz	Targets	<0.000400	1
J.Lockwood	BeO heat sinks	<0.000500	2
A.Malensek	Targets	<0.000400	8
T.Marshall	Targets	<0.000400	2
D.Martin	Ag plated BeCu alloy	<0.000400	8

NAME	MATERIAL	ESTIMATED EXPOSURE	DURATION
D.Mastick	BeO ceramics	<0.000500 mg/m^3	1 hours
J.Misek	Windows	<0.000400	4
J.Morfin	Targets	<0.000400	2
R.Morrison	Targets	<0.000400	1
W.Newby	Ag coated 3% Be wire	<0.000100	54
G.Opperman	Alloy contacts	<0.000720	2
O.Payne	BeO heat sinks	<0.000500	2
D.Poll	BeO heat sinks	<0.000500	2
S.Pordes	Targets	<0.000010	1
J.Richardson	Target transport	<0.000055	12
P.Shepard	Targets	<0.000050	1
J.Smith	BeO heat sinks	<0.000500	2
S.Strecker	Ag coated 3% Be wire	<0.000100	40
D.Szarzynski	<3% Be (Ti alloy)	<0.000490	3
R.Tokarek	Targets	<0.000050	1
F.Turkot	BeO heat sinks	<0.000500	2
J.Urbin	Nonsparking tools	<0.000100	12
J.Urish	(Targets)	<0.000010	1
E.Villegas	<3% Be (Ti alloy)	<0.000400	24
R.Vincent	<10% Be (Cu alloy)	<0.000560	36
J.Voirin	Targets	<0.000400	2
J.Volk	Targets	<0.000050	2
L.Wahl	3% Be (Cu alloy)	<0.000400	20
W.Walker	<3% Be (Cu alloy)	<0.000400	40
J.Wildenradt	Nonsparking tools	<0.000100	1
J.Wilson	<3% Be (Ti alloy)	<0.000400	4
M.Witherell	Targets	<0.000400	1
J.Zuk	<10% Be alloy	<0.000500	12

Appendix 3: Fermilab Beryllium Cancer Risk Estimation

With the equation:

$$T = p \frac{H_e}{6.132 \times 10^5 \text{ hrs/70 yrs.}}$$

Where:

T = Number of beryllium induced, fatal tumors seen in Fermilab BeCM workers.

p = EPA estimated unit cancer risk to one person enduring a continuous 70 year exposure to beryllium at an airborne concentration of $1\mu g/m^3$. (Expressed in tumors/70yr·$\mu g/m^3$)

H_e= Total estimated exposure hours for Fermilab BeCM workers. (Inμg hrs/m^3)

6.132×10^5 = the number of hours in 70 years.

We find:

$$T = 4 \times 10^{-4} \text{ tumors/70yr}\cdot\mu g/m^3 \frac{180 \mu g \cdot h/m^3}{6.132 \times 10^5 \text{ hr/70yr}}$$

$$T = 1.2 \times 10^{-7} \text{ tumors}$$

Appendix 4: Fermilab BeCM workers unreachable for interviews.

NAME(s) &ID#	D/S	BeCM JOB	SOURCE	EST.EXPOSURE
Leo.Indykiewicz N00698	RD	Transport of Be target material from Lab 8 to Target Service Building.	A.Malensek, Lab 7 employees	0.0004 mg/m^3 8 hr/y
William Kells N03423	AD	Possession of pure Be chunk (?)	Purchase order #523210	0.0004 mg/m^3 8 hr/y
Shoji Mikamo N05716	RD	Handling (?) Be targets.	RD Be-target signout list	0.0004 mg/m^3 8 hr/y
M.Sokoloff N02715	RD	"	"	"
Judd Wilcox V03428	Exp.	"	"	"
D.Levinthal N04907	RD	Handling (?) Ag coated, 3% Be wire.	Purchase order #72890	0.0001 mg/m^3 8 hr/y
Doris Rice N0?	AD	Maintenence of BeO heat sinks	J.Lockwood, Purchase order #60299	0.0005 mg/m^3 8 hr/y
Alex Rudolph N0?	TS	Welded shut a box containing Be target material.	IH report # 810812SL01	0.0001 mg/m^3 8 hr/y
Fred Schultz N04942	AD	Maintenence of Beo insulators and heat sinks.	J.Lockwood	0.0005 mg/m^3 10 hr/y
David VonOhlen N0?	AD	"	"	"

Fermilab

July 7, 1989

MEMO

To: Distribution

From: Joe Kenny JK

Subject: ADDENDUM TO SAFETY NOTE #17 (Beryllium Worker Interviews)

It has been brought to my attention that some statements in Safety Note No.17 need clarification and/or correction. In meeting with Bob Scherr, Bill Nicholson, Tim Miller and Ken Weber, the following points were discussed and are stressed.

1. It should be made clear that Research Division policy prohibits the modification of pure beryllium under any circumstances.

2. The modification of beryllium alloys at Fermilab is strongly discouraged and has been restricted to materials containing less than 10% beryllium. Most Be alloys used at Fermilab contain less than 3% beryllium. Non-sparking tools contain less than 1% beryllium.

And, in conversation with the interviewed:

3. The exposure duration of R.Currier is changed from 1 hour to 20 hours.

4. The exposure to D.Rice is removed from the list.

These changes do not affect the cancer risk estimates stated in SN #17.
I can be reached at -3109 or p-973 to answer any questions.

cc w/att:

R. Currier	H.Casebolt	D.Cossairt
C.Turner	W.Nicholson	S.Wilson
R.Scherr	C.Lang	✗ L.Coulson
S.Baker	D.Austin	T.Miller
K.Horsey	K.Weber	

FERMILAB EMPLOYEES WITH BERYLLIUM EXPERIENCE Revised 6-6-89

NAME	MATERIAL	ESTIMATED EXPOSURE	DURATION
L.Andersen	3% Be (Cu alloy)	<0.000720 mg/m^3	2 hours
B.Arnold	Target storage remnants	<0.000140	5
G.Athanasiou	Nonsparking tools	<0.000100	24
D.Austin	Alloys & metal	<0.000010	80
D.Bancroft	Target storage remnants	<0.000140	5
L.Bartoszek	Targets	<0.000400	0.5
S.Benesch	Targets	<0.000400	12
J.Blomquist	Wire (<3% Be)	<0.000500	1
G.Bock	Targets	<0.000400	1
J.Bockman	Targets&storage remnants	<0.000055	8
D.Booth	3% Be (Cu alloy)	<0.000400	8
N.Bosek	Targets	<0.000400	2
G.Brown	BeO heat sinks	<0.000500	2
J.Brown	Heat sinks & insulators	<0.000500	6
D.Carpenter	Alloys & pure	<0.000400	12
D. Champion	Alloy	<0.000720	4
R.Currier	Targets	<0.000400	20
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B.Fellenz	3% Be (Cu alloy)	<0.000400	2
J.Foglesong	Nonsparking tools	<0.000100	24
A.Forni	Ag plated BeCu alloy	<0.000400	20
M.Frett	Alloy contacts	<0.000130	4
W.Ganger	3% Be (Cu alloy)	<0.000400	20
P.Garbincius	Targets	<0.000400	1
J.Geralds	(Targets)	<0.000010	1
T.Golaszewski	Target remnants	<0.000140	5
K.Gray	Targets	<0.000400	1
R.Gustafson	Targets	<0.000400	2
H.Haggerty	Targets	<0.000400	1
S. Hawke	Target remnants	<0.000140	5
R.Haynes	(Targets)	<0.000010	1
R.Heflin	Ag coated 3% Be wire	<0.000100	32
J.Heinrich	Targets	<0.000400	8
D.Hicks	Ag coated 3% Be wire	<0.000100	40
R.Hiller	Box of targets	<0.000550	4
S.Hodges	3% Be (Cu alloy)	<0.000400	2
R.Kadel	Ag coated 3% Be wire	<0.000100	8
K.Kephart	Ag coated 3% Be wire	<0.000100	36
J. Kilmer	Nonsparking tools	<0.000100	20
R.Kingsley	Target remnants	0.000140	5
G.Krafczyk	BeO insulators	<0.000500	2
B.LaVoy	Ag coated 3% Be wire	<0.000100	32
G.Lawrence	<3% Be alloy pipes	<0.000720	24
H.Le	Alloys&ceramics	<0.000500	8
R.Lenz	Targets	<0.000400	1
J.Lockwood	BeO heat sinks	<0.000500	2
A.Malensek	Targets	<0.000400	8
T.Marshall	Targets	<0.000400	2
D.Martin	Ag plated BeCu alloy	<0.000400	8

NAME	MATERIAL	ESTIMATED EXPOSURE	DURATION
D.Mastick	BeO ceramics	<0.000500 mg/m^3	1 hours
J.Misek	Windows	<0.000400	4
J.Morfin	Targets	<0.000400	2
R.Morrison	Targets	<0.000400	1
W.Newby	Ag coated 3% Be wire	<0.000100	54
G.Opperman	Alloy contacts	<0.000720	2
O.Payne	BeO heat sinks	<0.000500	2
D.Poll	BeO heat sinks	<0.000500	2
S.Pordes	Targets	<0.000010	1
J.Richardson	Target transport	<0.000055	12
P.Shepard	Targets	<0.000050	1
J.Smith	BeO heat sinks	<0.000500	2
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D.Szarzynski	<3% Be (Ti alloy)	<0.000490	3
R.Tokarek	Targets	<0.000050	1
F.Turkot	BeO heat sinks	<0.000500	2
J.Urbin	Nonsparking tools	<0.000100	12
J.Urish	(Targets)	<0.000010	1
E.Villegas	<3% Be (Ti alloy)	<0.000400	24
R.Vincent	<10% Be (Cu alloy)	<0.000560	36
J.Voirin	Targets	<0.000400	2
J.Volk	Targets	<0.000050	2
L.Wahl	3% Be (Cu alloy)	<0.000400	20
W.Walker	<3% Be (Cu alloy)	<0.000400	40
J.Wildenradt	Nonsparking tools	<0.000100	1
J.Wilson	<3% Be (Ti alloy)	<0.000400	4
M.Witherell	Targets	<0.000400	1
J.Zuk	<10% Be alloy	<0.000500	12

APPENDIX 4: FERMILAB EMPLOYEES UNREACHABLE FOR INTERVIEWS.

Revised 6-6-89

Name ID#	D/S	BeCM Job	Source	Est.Exposure
L.Indykiewicz N00698	RD	Transport of Be target material from VL08 to TSB.	A.Malensek VL07 employees	0.0004mg/m3 8 hours
W.Kells N03423	AD	Possession of pure Be (?)	Pur.order - #523210	0.0004 mg/m3 8 hours
S.Mikamo N05716	RD	Handling Be targets	RD-Be mgmt. documentation	0.0004 mg/m3 8 hours
M.Sokoloff N02715	RD	"	"	0.0004 mg/m3 8 hours
J.Wilcox V03428	Exp.	"	"	0.0004 mg/m3 8 hours
D.Levinthal N04907	RD	Handling Ag coated Be wire	Pur.order- #72890	0.0001 mg/m3 8 hours
A.Rudolph N0?	TS	Welded shut a box holding Be targets	IH report- #810812SL01	0.0001 mg/m3 8 hours
F.Schultz N04942	AD	Maintenence of BeO heat sinks and insulators	J.Lockwood	0.0005 mg/m3 10 hours
D.VonOhlen	AD	"	"	0.0005 mg/m3 10 hours

→ file

Fermilab

August 27, 1990

To: Doris Thurston

From: Joe Kenny, Safety Section

Subject: Intent of Safety Note #17.

Attached is a copy of Safety Note #17, *Beryllium Worker Interviews*, with its consequent memos and lists.

Please note that the purpose of SN#17 was to demonstrate that no past or present Fermilab employee has met the criteria needed for inclusion in the DOE Beryllium Workers Notification Program, i.e., that Fermilab has never had a DOE "Beryllium Worker," and that medical screening for beryllium-related diseases for the employees listed in SN#17 is not necessary at this time.

Please call me at -3607 if you have any questions.

jk/jk

cc w/o att: K. Weber
T. Miller
D. Morrison