RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Donald W. Eckart
ET & DL
BLDG 2700, RM 2C129

2. PERMIT NUMBER: 028

3. EXPIRATION DATE: 1 MAY 95

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
AMRAY 1610 SEM Phillips X-Ray Diff. Unit Double Crystal X-Ray Diff. Unit	N/A	N/A

CONDITIONS:

1. Facility/devices to be surveyed on an annual basis by CECOM Safety Office.

2. Devices may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when devices are in operation.

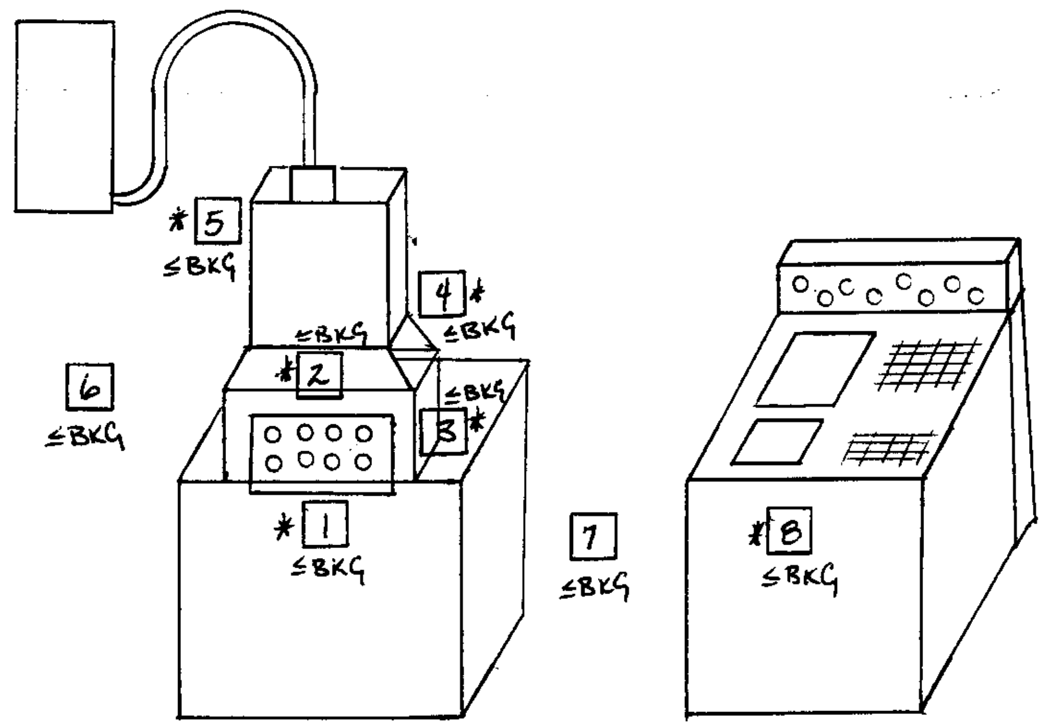
4. Devices to be used IAW SOP numbers EP-007 and EP-008.provided with permit application.

APPROVED: Barry Solb for
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 MAY 92

MEYER CENTER RM 2C131
AMRAY - 1610 SEM

RADIATION SURVEY



OPERATING SETTINGS 20 KV / 100 mA

Legend: * Contact reading
O Wipe Location

Background <0.2 mR/hr

Postings

SOP	✓	Dosimetry Requirements	N/A
Caution Radioactive Mat'l	N/A	NRC Form 3	N/A
Caution Radiation Area	N/A	Section 206	N/A
Caution High Rad Area	N/A	Notice to Workers	N/A

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: WILLIAM CRAIG Date: 7 DEC 93

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

myer center Bldg 2700 1B121/123

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP ATTACHED

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

THIS IS DESCRIBED in ATTACHED SOP

10. Signature of Director of Responsible Individual:

Name MELANIE WILL COLE Signature Melanie Will Cole

CECOM SAFETY USE ONLY:

Instrumentation: none

Dosimetry: yes, Whole Body B/G TLD's will be provided.

Reviewed by: Hugo Bianchi Date: 25 Mar 92

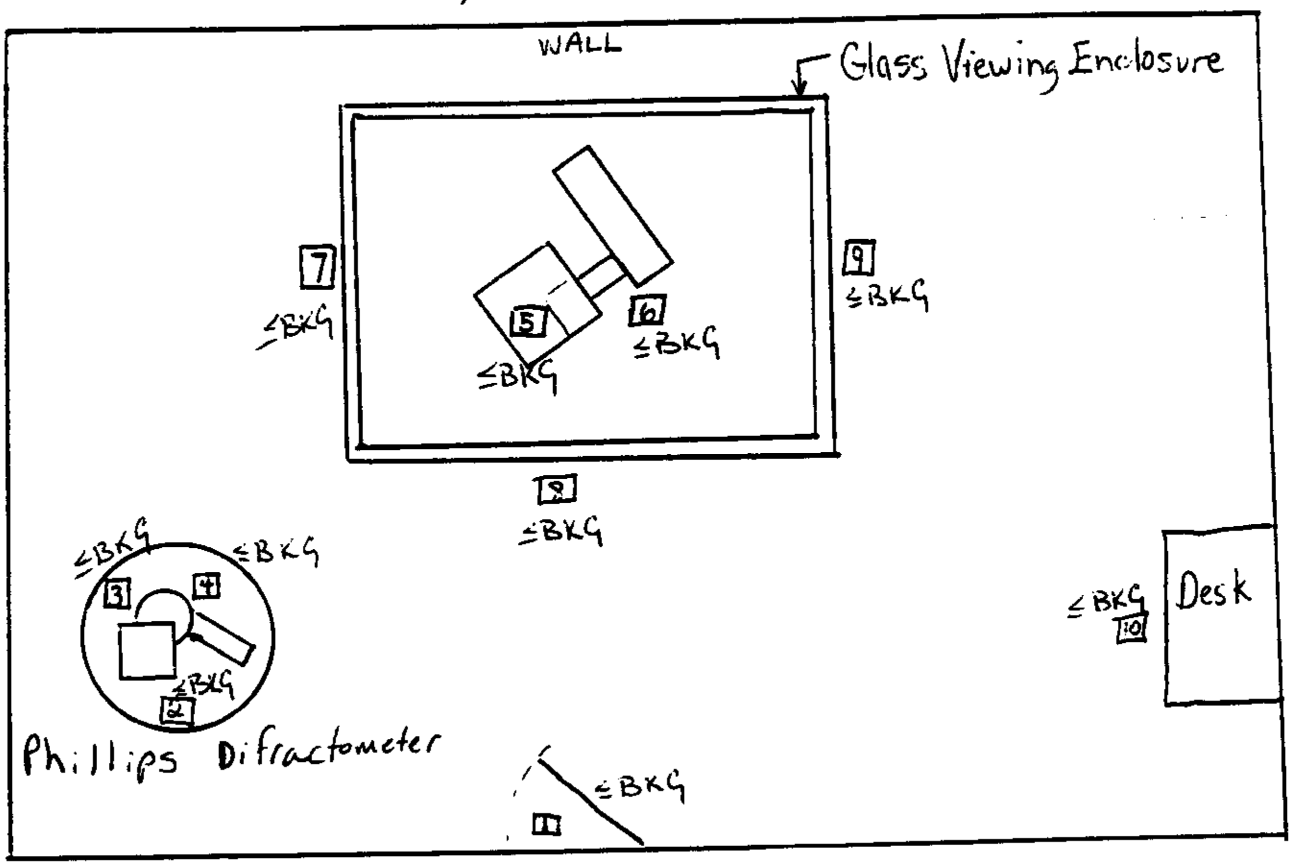
Approved by: Joseph M Santarsiero Date: 25 Mar 92

DOUBLE CRYSTAL X-RAY SPECTROMETER

RADIATION SURVEY

Meyer Center Rm. 2C129

Don Eckart
X42635



Legend: * Contact reading
☐ Primary survey location

Background ≤.2

35 KV 15 mA

20 KV 15 mA

Postings

SOP ✓

Section 206 N/A

Caution Radioactive Mat'l N/A

NRC Form 3 N/A

Notice To Workers ✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: WILLIAM CRAIG Date: 7 DEC 93

x42635

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 20 april 92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 028

1. To: CECOM Safety Office
AMSEL-SF-RER (BIANCHI)
FT MON, NJ 07703

2. Organization Applying for Permit:
ET+DL ATT: SLCET-EP

3. Radiation Area Supervisor: Name DONALD W. ECKART

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
NA			

5. Other Sources of Ionizing Radiation Producing Devices:

1. PHILIPS X-RAY DIFFRACTION UNIT
2. DOUBLE CRYSTAL DIFFRACTION UNIT - SPELLMAN GENERATOR
3. SCANNING ELECTRON MICROSCOPE - AMRAY 1610

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

DONALD W. ECKART, JOSEPH R. FLEMISH, WEIYU HAN,
WILLIAM D. WILBER, MICHELLE DORNATH-MOHR,
STEVEN C. TIDROW, ARTHUR TAUBER, PAUL W COOKE,
MADAN DUBEY, JAGADEESH PAMULAPTI

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

2C129 MYER CENTER

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP ATTACHED

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

SAFETY SHUTTERS ON X-RAY DIFFRACTION UNIT
LEAD LINED WALLS AND DOOR ON X-RAY ROOM

10. Signature of Director of Responsible Individual:

Name Kenneth A Jones Signature Kenneth A Jones

CECOM SAFETY USE ONLY:

Instrumentation: none provided

Dosimetry: none required or provided by CECOM Safety Office

Reviewed by: Hugo Bianchi Date: 30 Apr 92

Approved by: Joseph M Santarcielli Date: 30 Apr 92

Radiological Permit Application Supplement

Name: ECKART (Last) DONALD (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: SEM, X-RAY DIFFRACTION + RADIATION SAFETY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
FORT MONMOUTH		YES NO	YES NO
PHILIPS ELECTRONIC INSTRUMENTS	80 HRS	YES NO	YES NO

2. Experience: 32 years in X-RAY, 12 years in SEM

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Flemish (Last) Joseph (First) R. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	1 yr	YES NO	YES NO
Penn State	1 yr.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Han WEIYU.
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: for double-crystal X-ray

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETOL	One year	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Wilber (Last) William (First) D. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Colorado State University	1 semester	YES NO	YES NO
Ft Monmouth ETDL	~6 mo.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: DORNATH-MOHR MICHELLE
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-Ray Diffraction

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Iowa State University	1 semester	YES NO	YES NO
		YES NO	YES NO

2. Experience: 6 month Lab Experience

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Tidrow (Last) Steven (First) Clay (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-ray Diffraction

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Texas Tech University	5 years	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: TAUBER ARTHUR
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-RAY DIFFRACTION + RADIATION SAFETY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
BROOKLYN POLY.	1 YEAR	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: COOKE PAUL W
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X RAY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ATaT BELL	4 1/2 YRS.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: DUBEY (Last) MADAN (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-Ray diffraction

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
NCSU	5 yr	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: PAMULAPATI, JAGADEESH
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
FT. MONMOUTH	2 WKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURE

SOP NO: EP-007

TITLE: STANDING OPERATING PROCEDURE FOR Amray 1610 SEM

DIVISION/BRANCH: EDRD/Electronic Materials, Process & Analysis Branch (EP)

PLACE OF OPERATION OR TEST: Room 2C131a

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised unless approved in writing by the Safety/Environmental Office.

Supervisory personnel will assure that all personnel involved with this SOP have been properly trained and instructed in its provisions and attest on this condition by requiring them to affix their signature on page 2.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF:

KENNETH A. JONES

APPROVED:

DATE: 9-25-91

MICHAEL R. WALTERSCHIELD
Safety/Environmental Officer

SOP NO: EP-007

EXPIRES:

SOP NO: EP-007

SUBMITTED BY:

Signature

RICHARD T. LAREAU
Printed/Typed Name

Research Physical Scientist
Title

Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EP-007. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-007

TITLE: STANDING OPERATING PROCEDURE FOR AMRAY 1610 SEM

1. STATEMENT OF WORK: The AMRAY 1610 scanning electron microscope is used to obtain microstructural and microchemical data on solids such as semiconductors, electronic and magnetic materials.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 30,000 Volts) the use of liquid nitrogen and the generation of X-rays special safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the Amray 1610 system they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: The X-rays generated by this instrument are not considered hazardous due to their containment in the instrument.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. If interlock system does not work, do not use system and call for qualified service. For details on the safety interlock system, please refer to the OEM operations manual.

(2) Shielding: The Amray 1610 high voltage power supply(s) safety covers are designed to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power, or power to individual high voltage supplies are ON. Repair of high voltage power supplies should be performed by qualified personnel.

b. Procedural Controls:

(1) Clothing: Protective face mask and gloves to be worm when transfering liquid nitrogen.

(2) First Aid/Fire Fighting Equipment: In case of fire, a fire extinguisher is located in the room witgh the instrument.

(3) Access Control: The Amray 1610 Scanning Electron Microscope is located in the SEM room of ETDL's Device Microanalysis Center (Rm 2C131, Bldg. 2700). This room has no restricted (i.e. walk-in) access during normal operating hours and is key locked after operating hours.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors or power supplies. NEVER remove safety covers from any power supply when they are ON. The operator shall inform adjacent personnel of high voltage hazards. If a water leak from the water cooling lines should occur when the instrument is in operation the instrument should be TURNED-OFF immediately and not powered-up until the water leak is fixed and surrounding parts and environment dried.

5. SEQUENCE OF OPERATIONS: Please refer to the OEM operations manual for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that the electron source covers and high voltage power supply covers are securely in place.

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-007

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department	- 911		
First Aid	- 911		
Police	- 911		
CECOM Health Clinic	- x22452/x44484		
Building Security	- x44684/x42222		
Building Manager	- x44238/x42981	Beeper:	517-6560
ETDL Branch Office	- x44408		
ETDL Division Office	- x42452/x42080		
ETDL Division Safety	- x44418/x43635	Beeper:	517-7859
ETDL Safety Office	- x44717/x44936		
Team Leader (Lareau)	- x20119		
Operator (Eckart)	- x42635		

STANDING OPERATING PROCEDURE

SOP NO: EP-008

TITLE: STANDING OPERATING PROCEDURE FOR X-RAY GENERATORS

DIVISION/BRANCH: EDRD/Electronic Materials, Process & Analysis Branch (EP)

PLACE OF OPERATION OR TEST: Room 2C129

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded of superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised unless approved in writing by the Safety/Environmental Office.

Supervisory personnel will assure that all personnel involved with this SOP have been properly trained and instructed in its provisions and attest on this condition by requiring them to affix their signature on page 2.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF:

KENNETH A. JONES

APPROVED:

MICHAEL R. WALTERSCHIELD
Safety/Environmental Officer

DATE: 9-25-91

SOP NO: EP-008

EXPIRES:

SOP NO: EP-008

SUBMITTED BY:

Signature

RICHARD T. LAREAU
Printed/Typed Name

Research Physical Scientist
Title

Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EP-008. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
	4/3/92		

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-008

TITLE: STANDING OPERATING PROCEDURE FOR XRAY GENERATORS

1. STATEMENT OF WORK: The X-ray Generators are used to produce X-rays which impinge on a material to obtain microchemical analysis on a wide variety of materials.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 30,000 Volts) and the generation of X-rays, special safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the X-ray Generators they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: The X-rays generated by this instrument are not considered hazardous when the prescribed safety steps outlined in the OEM operations manual are followed.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. If interlock system does not work, do not use system and call for qualified service. For details on the safety interlock system, please refer to the OEM operations manual.

(2) Shielding: The X-ray Generators high voltage power supply(s) safety covers are designed to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power, or power to individual high voltage supplies are ON. Repair of high voltage power supplies should be performed by qualified personnel.

To prevent exposure to X-rays, the connection of diffraction cameras to the X-ray Generators Tower is interlocked with a safety shutter system. The safety shutter, painted in red, must be closed at all times when the X-ray Generator is operational.

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-008

b. Procedural Controls:

(1) Clothing: Not applicable.

(2) First Aid/Fire Fighting Equipment: In case of fire, a fire extinguisher is located in the room. near the instrument.

(3) Access Control: The X-ray Generators are located in the X-ray analysis room of ETDL's Device Microanalysis Center (Rm 2C129, Bldg.2700). This room has no restricted (i.e. walk-in) access during normal operating hours and is key locked after operating hours. This room is specially designed with lead walls to prevent accidental leakage of X-rays to the surrounding environment.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors or power supplies. NEVER remove safety covers from safety covers from any power supply when they are ON. The operator shall inform adjacent personnel of high voltage hazards. If a water leak from the water cooling lines should occur when the instrument is in operation the instrument should be TURNED-OFF immediately and not powered-up until the water leak is fixed and surrounding parts and environment dried. Keep the lead-lined door to the X-ray analysis room closed at all time when operating this equipment. An emergency power shut-off switch (RED) is located at the entrance to the X-ray analysis room for quick power shut-down of all of the equipment located in this room.

5. SEQUENCE OF OPERATIONS: Please refer to the OEM operations manual for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that all X-ray cameras and high voltage power supply covers are securely in place.

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-008

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department	- 911		
First Aid	- 911		
Police	- 911		
CECOM Health Clinic	- x22452/x44484		
Building Security	- x44684/x42222		
Building Manager	- x44238/x42981	Beeper:	517-6560
ETDL Branch Office	- x44408		
ETDL Division Office	- x42452/x42080		
ETDL Division Safety	- x44418/x43635	Beeper:	517-7859
ETDL Safety Office	- x44717/x44936		
Team Leader (Lareau)	- x20119		
Operator (Eckart)	- x42635		

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Robert Murray
E&PSD, ARL
ATTN: AMSRL-EP-ME
BLDG 2700, RM 2D312

2. PERMIT NUMBER: 051

3. EXPIRATION DATE: 1 DEC 95

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
ARACOR SEMICONDUCTOR IRRADIATION SYSTEM Model: 4100	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Semiconductor irradiation system may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the irradiation system is in operation.

4. Dosimetry, provided by CECOM Safety Office, must be worn when operating semiconductor irradiation system.

5. Instrumentation, provided by CECOM Safety Office, should be used whenever system is energized to produce X-Rays.

6. System to be used IAW SOP number Q1014 provided with permit application.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 DEC 92

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 11/20/92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 051

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: ARL AMSRL - [illegible]EP - ME

3. Radiation Area Supervisor: Name Robert Aaron Murray

4. Radioactive Material: None

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

X-Ray Tube contained in Aracor Semiconductor Irradiator, Model 4100

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Robert Aaron Murray

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

MEYER CENTER, 2D310

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SEE SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

X-ray tube is isolated in a shielded compartment with interlocks.

10. Signature of Director of Responsible Individual:

Name V.G. GELNOVATCH Signature V G Gelnovatch

CECOM SAFETY USE ONLY:

Instrumentation: Eberline RO-2 IC

[redacted]

Dosimetry: provided by CECOM Safety Office to be used by operators

Reviewed by: Hugo Bianchi Date: 30 Nov 92

Approved by: Joseph M. Santarelli Date: 30 Nov 92

Radiological Permit Application Supplement

Name: Murray (Last) Robert (First) Aaron (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

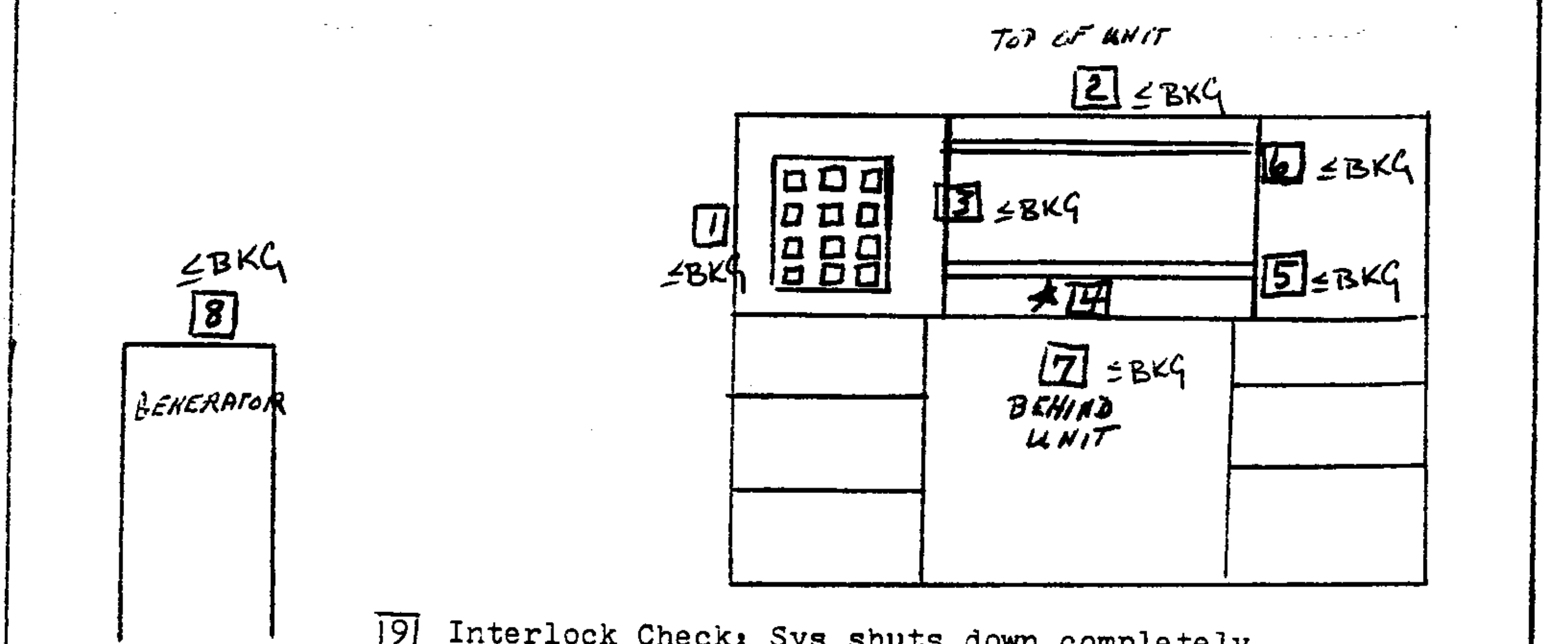
Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
William Jewell College	4 yrs	YES NO	YES NO
University of Kansas	5 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
X-Ray Tube	40 KeV, 60 mA Max.	Meyer Center	1 yr.	Research

RADIATION SURVEY

MEYER CENTER RM 2D312
ARACOR Semiconductor Irradiation Sys.
50KV, 40mA



9 Interlock Check: Sys shuts down completely when opened during operation.
CHECKED OK

Legend: * Contact reading
☐ Primary survey location

Background <.2

20 KeV 10 mA

Postings

SOP ✓

Section 206 ✓

Caution Radioactive Mat'l N/A

NRC Form 3 ✓

Notice To Workers ✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: WILLIAM CRAIG Date: 2 DEC 93

STANDING OPERATING PROCEDURES
ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

TECHNOLOGY TO WIN

SOP NO: Q1014

TITLE OF SYSTEM OR PROCESS	ARACOR X-Ray MODEL 4100	
ROOM NO.:	2D312	
BUILDING:	2700	
BRANCH:	Freq Control & Timing	POC: RAYMOND L. FILLER, Leader Crystal Resonator Team
DIVISION:	EDRD	EXTENTION: 42467

DATE OF PUBLICATION

ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

FREQUENCY CONTROL AND TIMING BRANCH

SOP NO. <u>01014</u>

<u>TITLE</u>: STANDARD OPERATING PROCEDURE FOR THE MODEL 4100 (X-RAY) SEMICONDUCTOR IRRADIATION SYSTEM

1. <u>STATEMENT OF WORK</u>: X-ray Generators are used to produce X-rays which impinge on a material to obtain radiation-induced changes on a wide variety of materials.

2. <u>HAZARDS INVOLVED</u>: Because of the presence of high voltages (as high as 30,000 Volts) and the generation of X-rays, special safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the X-ray Generators they must be thoroughly familiar with the Model 4100 operations manual and this SOP.

3. <u>PROTECTION STANDARDS/LIMITS</u>: The X-rays generated by this instrument are not considered hazardous when the prescribed safety steps outlined in the Model 4100 operations manual are followed.

4. <u>SAFETY CONTROLS</u>: The system has the following engineering and procedural controls.

a. <u>Engineering Controls</u>:

(1) <u>Interlocks</u>: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. If interlock system does not work, do not use system and call for qualified service. For details on the safety interlock system, please refer to the Model 4100 operations manual.

(2) <u>Shielding</u>: The X-ray Generators high voltage power supply(s) safety covers are designed to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power, or power to individual high voltage supplies are ON. Repair of high voltage power supplies should be performed by qualified personnel.

To prevent exposure to X-rays, the Model 4100 contains the following safety provisions:

A. A radiation-tight enclosure and gravity-activated X-ray tube port shutter system.

B. Interlocks on the cover which disable the radiation producing equipment when the cover is open.

C. A red warning light that signals when the X-ray tube shutter is open (unit is in operation).

D. A yellow warning light that signals when the X-rays are being produced.

b. Procedural Controls:

(1) Clothing: Not applicable.

(2) First Aid/Fire Fighting Equipment: In case of fire, a fire extinguisher is located in the room, near the instrument.

(3) Access Control: The Model 4100 X-ray system is located in room 2D312, bldg. 2700, this room has no restricted (i.e., walk-in) access during normal operating hours and is key locked after operating hours.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors or power supplies. NEVER remove safety covers from any power supply when they are ON. The operator shall inform adjacent personnel of high voltage hazards. If a water leak from the water cooling lines should occur when the instrument is in operation the instrument should be TURNED-OFF immediately and not powered-up until the water leak is fixed and surrounding parts and environment dried.

5. SEQUENCE OF OPERATIONS: Users must read the Model 4100 operations manual to learn the full detailed operational procedure. Verify that all safety interlocks are energized. Check that all high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of General emergency phone numbers are listed below.

Fire Department	-	117
First Aid	-	116/118
Police	-	911
Building Nurse	-	x44484
Building Security	-	x44684/x42222
Building Manager	-	x44238/x42981
ETDL Branch Office	-	x44805/44275
ETDL Division Office	-	x42452
ETDL Safety Office	-	x44717/x42739

Last Revised on 3 Aug 89

ENDORSEMENTS

SUBMITTED BY: Vincent Rosati 8/24/89
SIGNATURE TITLE DATE

REVIEWED BY: John R [illegible] 24 Aug 89
SIGNATURE SUPERVISOR DATE

APPROVED BY: John R [illegible] 24 Aug 89
SIGNATURE BRANCH CHIEF DATE

Jack L. [illegible] 8-20-90
SIGNATURE DIVISION DIRECTOR DATE

SIGNATURE ETDL SAFETY OFFICE DATE

SIGNATURE LABCOM SAFETY OFFICE DATE

SIGNATURE CECOM SAFETY OFFICE DATE

I HAVE READ AND UNDERSTAND THE CONTENTS OF SOP NO. Q-1014
I AGREE TO FOLLOW THESE PROCEDURES WHEN PERFORMING THIS OPERATION. SIGN AND DATE:

John G. Gualtieri 8/15/89
[illegible] 8/15/89
[illegible] 8/20/90
[illegible] 8/20/90
[illegible] McLaffey 8/20/90
John G. Gualtieri 8/20/90

U.S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in Item 5.

1. ACTIVITY GRANTED PERMIT

ARL, Physical Sciences Directorate,
Electronics Division,
Frequency Control Team
Attn: AMSRL-PS-ED
Building 2700, Room 2D310

2. POC / RESPONSIBLE INDIVIDUAL

Robert Aaron Murray

3. PERMIT NUMBER	**4. EXPIRATION DATE**
051	1 December 97

5. MATERIAL/DEVICE	**6. CHEMICAL/ PHYSICAL FORM**	**7. ACTIVITY**
ARACOR Semiconductor Irradiation System, Model 4100, SN: 32787	N/A	N/A

8. CONDITIONS:

a. The Semiconductor Irradiation System shall be used for the production of x-rays which impinge on a wide variety of materials to obtain radiation induced changes for research purposes.

b. Authorized place of use for the Semiconductor Irradiation System is listed in Item 1.

c. Authorized device will be utilized under the supervision of the individual listed in Item 2. Additional users will be approved by the Fort Monmouth Radiation Protection Officer. The individual's training and education must be commensurate with the device being used as stated in Item 5. The individual identified in Item 2 is responsible for ensuring all users meet minimum training and education requirements for operation of the device listed in Item 5.

d. Semiconductor Irradiation System may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

e. No unauthorized personnel are allowed in the room when the Semiconductor Irradiation System is in operation.

APPROVED: Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division/Fort Monmouth
Radiation Protection Officer

DATE: 1 December 95

U.S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH

RADIOLOGICAL PERMIT

SUPPLMENTARY SHEET

PERMIT NUMBER 051	4. EXPIRATION DATE 1 December 97

CONDITIONS

f. Notify the CECOM Safety Office, Attn: AMSEL-SF-RER, Fort Monmouth, NJ 07703-5024, Voice: (908) 427-3112, extensions 6427, 6441 or 6444 as soon as practical concerning any administrative or technical changes to the Radiological Permit Application for the device listed in Item 5.

g. The environmental dosimeter (TLD badge) provided by the CECOM Safety Office, is to remain in use as a monitoring device when the Semiconductor Irradiation System is in operation. It is not to be removed or worn on the body of the individual operating the device.

h. Semiconductor Irradiation system to be used IAW SOP Number Q1014, approved 13 November 1995, as provided with Radiological Permit Application, dated 8 November 1995.

i. Unless specifically provided otherwise, the device listed in Item 5 shall be possessed and used IAW statements, representations and procedures contained in the Radiological Permit Application, dated 8 November 1995, signed by Barry Perlman, Director of Electronics Division, ARL.

RADIOLOGICAL PERMIT APPLICATION

Check One Date 11/8/95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

✓ Applications for Renewal of Permit No. 051

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit: ARL
AMSRL-PS-ED

3. Radiation Area Supervisor: Name Robert Aaron Murray

4. Radioactive Material: NONE

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:
X-Ray tube in ARACOR Semiconductor Irradiator
Model 4100

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Robert A. Murray

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

MEYERS CENTER

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SEE SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

X-RAY TUBE IS ISOLATED IN A SHIELDED COMPARTMENT WITH INTERLOCKS.

10. Signature of Director of Responsible Individual:

Name B. PERLMAN Signature [signature]

CECOM SAFETY USE ONLY:

Instrumentation: (1) RO-2 or equivalent provided by CECOM Safety Office.

Dosimetry: (1) TLD, environmental badge for system, change-out - quarterly by CECOM Safety Office.

Reviewed by: Hugo Bianchi Date: 27 Nov-95

Approved by: Joseph M. Santarsiero Date: 11-29-95

Radiological Permit Application Supplement

Name: MURRAY (Last) Robert (First) AARON (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
William Jewell College	4 yrs.	YES NO	YES NO
University of Kansas	5 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
X-RAY TUBE	40 KeV, 60 mA MAX.	MEYER CTR. 2D310	4 yr.	RESEARCH

STANDING OPERATING PROCEDURES
ARMY RESEARCH LABORATORY
PHYSICAL SCIENCES DIRECTORATE

SOP # Q1014

Title of system or process

ARACOR X-Ray Model 4100

Room No. 2D310

Building 2700

Branch: RF/Acoustic

Division: E

POC: Aaron Murray

Extension X72474

Date of Publication ______________

ENDORSEMENTS

SUBMITTED BY: Vasan Bhandi Physicist 10/17/95

SIGNATURE TITLE DATE

REVIEWED BY: Ann Murray Elect Engineer 10/16/95

SIGNATURE TITLE DATE

APPROVED BY: Bernard Smith 17-10-95

SIGNATURE BRANCH CHIEF DATE

SIGNATURE DIVISION DIRECTOR DATE

SIGNATURE PSD SAFETY OFFICE DATE

SIGNATURE ARL SAFETY OFFICE DATE

SIGNATURE CECOM SAFETY OFFICE DATE

I HAVE READ AND UNDERSTAND THE CONTENTS OF SOP NO. Q1014

I AGREE TO FOLLOW THESE PROCEDURES WHEN PERFORMING THIS OPERATION.

SIGN AND DATE:

Ann Murray 11/22/95

STANDING OPERATING PROCEDURE

TITLE: Aracor X-Ray Model 4100

DIVISION/BRANCH: **ELECTRONICS/FREQUENCY CONTROL & TIMING**

PLACE OF OPERATION OR TEST: RM 2D310, MYER CENTER

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environment Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on a page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Bernard Smith
Signature

Bernard Smith
Printed/ Typed Name

Approved:

MWalterschied
MICHAEL R. WALTERSCHIED
Safety/Environment Officer

DATE: 13 Nov 95

SOP NO: Q1014

Expires: 13 Nov 96

ARMY RESEARCH LABORATORY
PHYSICAL SCIENCE DIRECTORATE
ELECTRONICS DIVISION
MICROWAVE AND TIMING BRANCH

FREQUENCY CONTROL AND TIMING BRANCH

SOP NO. Q 1014

TITLE: STANDING OPERATING PROCEDURE FOR THE MODEL 4100 (X-RAY) SEMICONDUCTOR IRRADIATION SYSTEM

1. STATEMENT OF WORK: X-ray Generators are used to produce Xrays which impinge on a material to obtain radiation-induced changes on a wide variety of materials.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 30,000 Volts) and the generation of X-rays, special safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the X-ray Generators they must be thoroughly familiar with the Model 4100 operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: The X-rays generated by this instrument are not considered hazardous when the prescribed safety steps outlined in the Model 4100 operations manual are followed.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Enqineerinq Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. If interlock system does not work, do not use system and call for qualified service. For details on the safety interlock system, please refer to the Model 4100 operations manual.

(2) Shielding: The X-ray Generators high voltage power supply(s) safety covers are designed to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power, or power to individual high voltage supplies are ON. Repair of high voltage power supplies should be performed by qualified personnel. To prevent exposure to X-rays, the Model 4100 contains the following safety provisions:

A. A radiation-tight enclosure and gravity-activated X-ray tube port shutter system.

B. Cover interlocks that disable the radiation producing equipment when the cover is open.

C. A red warning light that signals when the X-ray tube shutter is open (unit is in operation).

D. A yellow warning light that signals when the X-rays are being produced.

b. Procedural Controls:

(1) Clothing: Not applicable.

(2) First Aid/Fire Fiqhtinq Equipment: In case of fire, a fire extinguisher is located in the room, near the instrument.

(3) Access Control: The Model 4100 X-ray system is located in room 2D310, Bldg. 2700, this room has no restricted (i.e., walk-in) access during normal operating hours and is key locked after operating hours.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors or power supplies. NEVER remove safety covers from any power supply when they are ON. The operator shall inform adjacent personnel of high voltage hazards. If a water leak from the water cooling lines should occur when the instrument is in operation the instrument should be TURNED-OFF immediately and not powered-up until the water leak is fixed and surrounding parts and environment dried.

5. SEQUENCE OF OPERATIONS: Users must read the Model 4100 operations manual to learn the full detailed operational procedure. Verify that all safety interlocks are energized. Check that all high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of fire, shock, or injury. Notify supervisor, who will notify Division and Laboratory safety officers. General emergency telephone numbers are listed below:

Fire	-911
First Aid	-911
Police	-911
Nurse	-74484
Security	-74684/72222
Building Manager	-74238
Branch Office	-72474/74275
Division Office	-74024
Safety Office	-74936
CECOM Safety Office	-73112

The last revision of this document : October 12, 1995

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

1. **USER:** Alan LePore E&PSD, ARL ATTN: AMSRL-EP-EF BLDG 2700, RM 1B120	2. **PERMIT NUMBER:** 090 3. **EXPIRATION DATE:** 19 MAR 96

4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Electron Beam Lithography System LEICA EBPG-4	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Lithography System is in operation.

4. Personal dosimetry is not required for operation of the Lithography system.

5. System to be used IAW SOP.

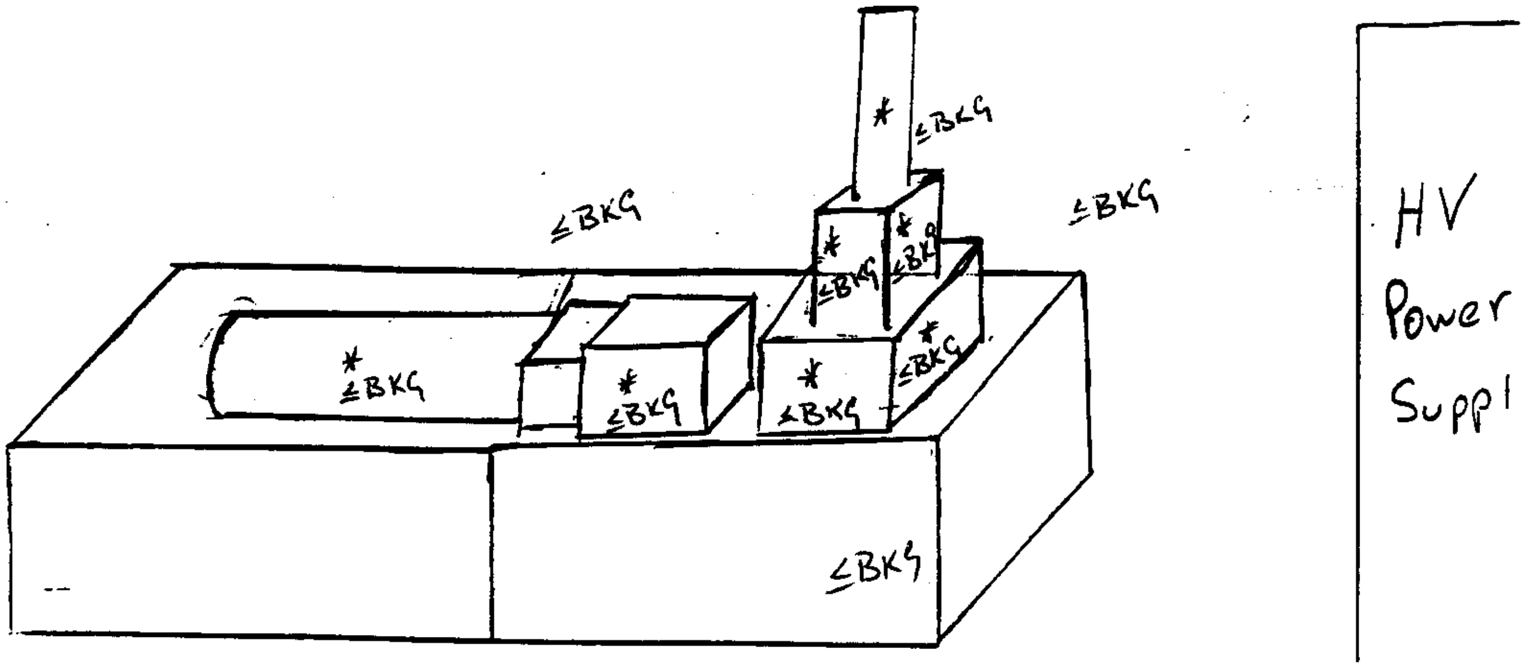
APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 19 MAR 93

MEYERS CENTER RM 1B120

RADIATION SURVEY

ULTRA LITHOGRAPHY MACHINE



50 KV

@ FULL CURRENT

Legend: * Contact reading
☐ Primary survey location

Background <.2

Postings

SOP ✓

Section 206 N/A

Caution Radioactive Mat'l N/A

NRC Form 3 N/A

Notice To Workers ✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO-2

Calibration Due Date: 13 JAN 93

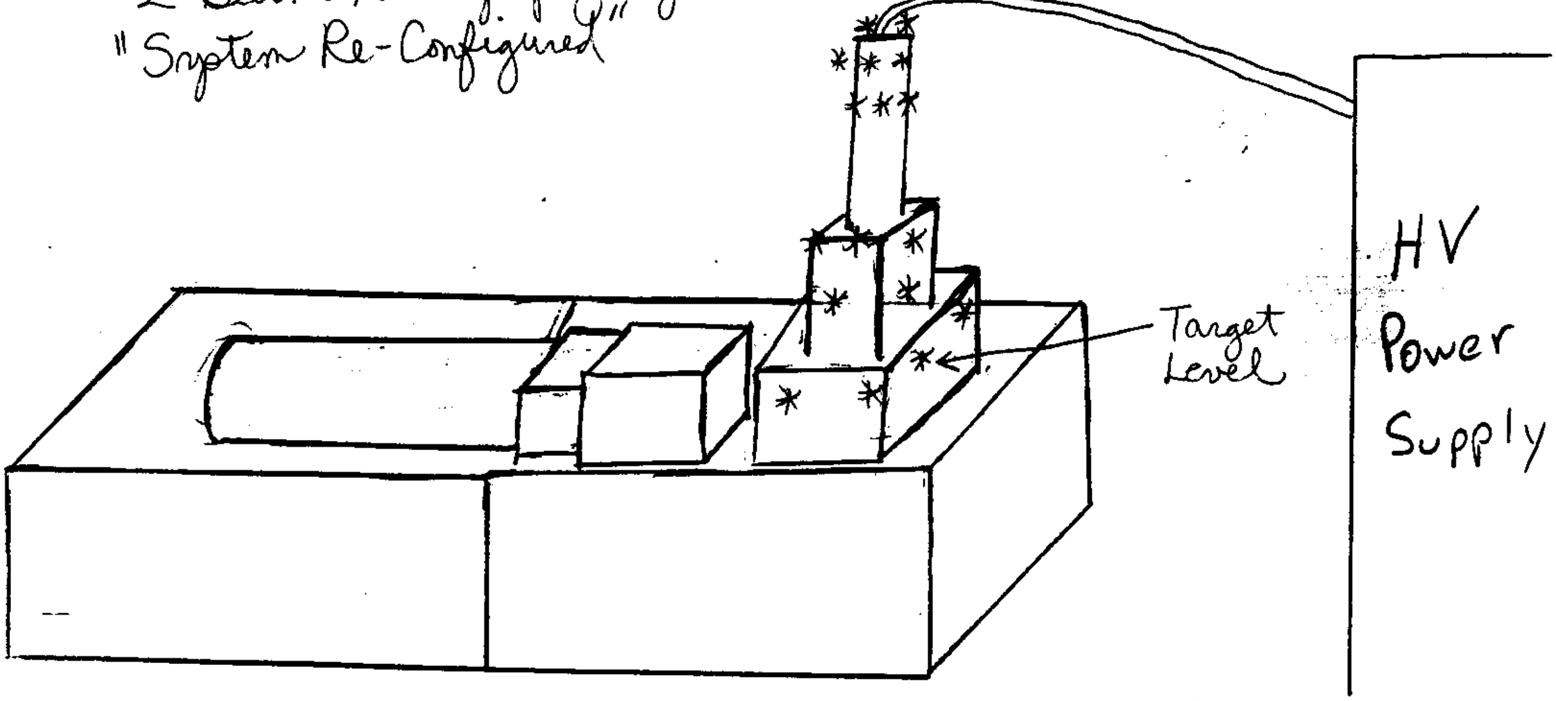
Serial #: 3511

Surveyor: WILLIAM CRAIG

Date: 7 DEC 93

RADIATION SURVEY

E Beam Lithography System "System Re-Configured" Rm 1B120 Myer Center



Target material - none
op voltage - 100 KV
amps - 400 n Amps

all contact readings (*) were ≤ BKG

Legend: * Contact reading
☐ Primary survey location

Background <0.2

Postings

SOP will ~~to~~ write

Section 206 N/A

Caution Radioactive Mat'l N/A

NRC Form 3 N/A

Notice To Workers provided

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated. attn: AMSRL-EP-EF

Survey instrument: Eberline RO-2

Calibration Due Date: 21 Mar 93 **Serial #:** 6022

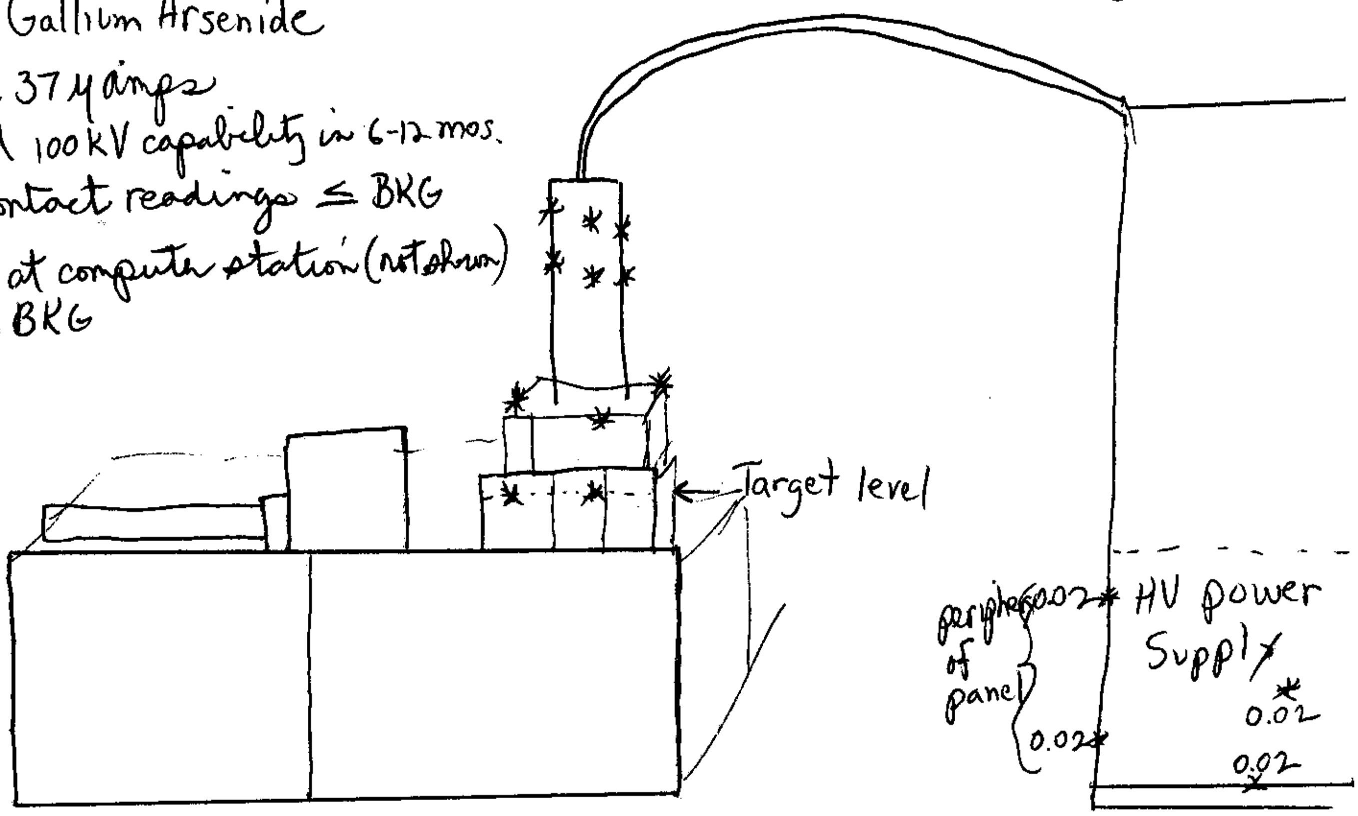
Surveyor: Bianchi / Piazza **Date:** 23 Feb 93

RADIATION SURVEY

Electron Beam Lithography System
Rm. 1B120 Myer Center

'Initial' Survey

1. Target - Gallium Arsenide
2. 20 KV, 37 μ amps
3. will add 100 KV capability in 6-12 mos.
4. * all contact readings ≤ BKG
5. Reading at computer station (not shown) was ≤ BKG



Legend: * Contact reading
☐ Primary survey location

Background 0.02

Postings

SOP ✓

Section 206 N/A

Caution Radioactive Mat'l N/A

NRC Form 3 N/A

Notice To Workers will provide

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: Ludlum 3 w/44-9

Calibration Due Date: 28 Apr 92 Serial #: 20243

Surveyor: H Bianchi Date: 25 Feb 92

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER:

Alan LePore
ET & DL
B. 2700 Rm 1B120

2. PERMIT NUMBER: 090

3. EXPIRATION DATE: 23 MAR 95

---

4. MATERIAL/DEVICE:	5. CHEMICAL/PHYSICAL FORM:	6. ACTIVITY:
Electron Beam Lithography System LEICA EBPG-4	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Lithography System is in operation.

4. Personal dosimetry provided by CECOM Safety Office to be worn whenever the Lithography System is in operation.

5. Device to be used IAW SOP.

APPROVED:

Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br
Radiation Protection Officer

DATE: 23 MAR 92

RADIOLOGICAL PERMIT APPLICATION

Check One Date 29-Jan-92

X Initial Permit Application #90

___ Application for Amendment to Permit No. ____

___ Applications for Renewal of Permit No. ____

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit: ETDL

3. Radiation Area Supervisor: Name Allen Lepore

4. Radioactive Material: None

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Electron-beam lithography system.
Currently configured for 20 and 50 kV, will upgrade to add 100 kV capability in 6-12 months

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Allen Lepore
Ronald Thompson
Doran Smith

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Bldg 2700 (Myer Center), room 1B120

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP attached

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

No radiation protective clothing is employed. Operator is seated approx. 2 meters from target area. Target area is enclosed by metal chamber.

10. Signature of Director of Responsible Individual:

Name Joel R. Sharonio Signature Joel R. Sharonio

CECOM SAFETY USE ONLY:

Instrumentation: none provided

Dosimetry: whole body B&G TLD's not provided until 100 KV upgrade is accomplished circa Mar 1993

Reviewed by: Hugo Bianchi Date: 23 Mar 92

Approved by: Joseph M. Fortassiew Date: 23 Mar 92

Radiological Permit Application Supplement

Name: Lepore (Last) Allen (First) N (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
None		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
electron beam lithography	40kV/50kV	Cornell University	5 yrs.	semiconductor fabrication
ion implantation	200kV	"	"	"
electron microscope	120kV	ETDL	2 yrs	"

Radiological Permit Application Supplement

Name: Thompson Ronald J
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
None		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
electron microscope	120 kV	ETDL	2½ yrs	Semiconductor fabrication

Radiological Permit Application Supplement

Name: Smith Doran D
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
None		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
None				

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. ____________

TITLE: STANDING OPERATING PROCEDURE FOR LEICA EBPG-4

1. STATEMENT OF WORK: The Leica EBPG-4 electron beam lithography system is used to define patterns on resist covered substrates. This is accomplished by scanning the electron beam across a resist coated sample in a prearranged fashion. Applications usually involve patterning of microelectronic devices, however, any conducting, semiconducting or insulating device may patterned.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 100,000 Volts) and possible generation of x-rays special safety precautions must be taken by those personnel operating and maintaining this system. The machine has been surveyed while in operation and no stray x-rays have ever been detected. This SOP is to be considered a supplement to the EBPG-4 operations manual. Before anyone may operate the EBPG-4, they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: In the routine operation of this microscope, there is no contact with any type of volatile chemical. Procedures before and after may require additional precautions.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. The high voltage will shut down if the vacuum degrades or if the column or gun chamber is tampered with. It always must be manually switched on after a failure. In addition, a physical grounding lever will discharge the high voltage cable whenever the system is opened for servicing. However, if interlock system appears not to be working, do not use system and call for qualified service. For details on the safety interlock system, please refer to the EBPG-4 operations manual.

(2) Shielding: The high voltage power supply has safety covers to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. **NEVER** remove these covers while the instruments power is on. Repair of high voltage power supplies should be performed by qualified personnel or Leica EBPG-4 service engineers only.

b. Procedural Controls:

(1) Clothing: No special requirements related to safety.

(2) First Aid/Fire Fighting Equipment: Control, extinguish with dry type fire extinguisher.

(3) Access Control: The Leica EBPG-4 is located on the first floor of the Albert J. Meyer Research Center, Room 1B120 (Bld. 2700). This room has restricted entry and is controlled by magnetic key locks at all times. Not more than ten people have access at this time and of these only three routinely operate the equipment.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors, and power supplies. If the water cooling lines to system should leak the instrument should be **TURNED-OFF** immediately and not powered-up until the water leak is fixed and surrounding parts and environment dried.

5. SEQUENCE OF OPERATIONS: Please refer to the **Leica EBPG-4 Operations Manual** for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that all access panels and high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies &/or the System Main Power Switch and obtain qualified service before powering the instrument back up. If a water leak occurs while the instruments high voltage is on, **IMMEDIATELY** shut-down the system using the **System Main Power Switch**. If access to this swich is impaired, then either the power conditioner input circuit breakers or the service panel breaker may be disabled. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department	- 117
First Aid	- 116/118
Police	- 911
Building Nurse	- x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981
ETDL Branch Office	- x42111
ETDL Division Office	- x44308/x42452
ETDL Safety Office	- x44717/x42739

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 19 Feb 93

SUBJECT OF CONVERSATION: Upgrade of E Beam Litho Sys. RWP 090

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
Alan LePore	EPSD AMSRL-EP-EF	X28963
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**
Mr. Bianchi	AMSEL-SF-RER	X75366

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**

SUMMARY OF CONVERSATION:

Mr. Lepore called me to relay the fact that his LEICA EBPG-4 is being upgraded to add 100 KV capability as mentioned on his orginal RWP application, dated 25 Jan 92. I will survey the EB Litho Sys upon reconfig of the system w/additional sheilding installed. Date for survey is tentatively set for 23 Feb 93. Dosimetry considerations will be made upon completion of survey.

Hugo Bianchi

DA FORM 1 APR 66 751

REPLACES EDITION OF 1 FEB 58 WHICH WILL BE USED.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1981—341-646/8692

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Alan LePore
Physical Sciences Dir., ARL
ATTN: AMSRL-PS-DA
BLDG 2700, RM 1B120

2. PERMIT NUMBER: 090

3. EXPIRATION DATE: 1 MAY 97

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4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Electron Beam Lithography System Phillips EBPG-5HR	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Lithography System is in operation.

4. Personal dosimetry is not required for operation of the Lithography system.

5. System to be used IAW SOP No. DA-450, 6 April 1995.

APPROVED: Joseph M. Santarsiero 4/25/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 5Apr95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 090

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: ARL/PSD

3. Radiation Area Supervisor: Name Allen Lepore

4. Radioactive Material: None

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:
Electron-beam lithography system capable of 20, 50, and 100 keV operation

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Allen Lepore   Doran Smith
Luis Casas
Ronald Thompson
Louis Poli
Christine Kondek

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Building 2700 (Myer Center), Room 1B120

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP attached

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

System has factory-designed shielding including steel chamber and lead column shields

10. Signature of Director of Responsible Individual:

Name JOEL SHAPPIRIO Signature Joel R. Shappirio

CECOM SAFETY USE ONLY:

Instrumentation: None provided

Dosimetry: None provided

Reviewed by: Hugo Bianchi Date: 25 Apr 95

Approved by: Joseph M. Santarelli Date: 4-25-95

Radiological Permit Application Supplement

Name: Lepore (Last) Allen (First) N (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
electron beam lithography (ionizing source)	40 keV	Cornell University	5 years	electron-beam lithography
ionizing source	100 keV	PSD/ARL	3 years	"
ionizing source	120 keV	PSD/ARL	6 years	electron microscopy

Radiological Permit Application Supplement

Name: Casas (Last) Luis (First) M (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
ionizing source	30kV	ARL/PSD	3 years	electron microprobe (sputter Auger)

Radiological Permit Application Supplement

Name: Thompson (Last) Ronald (First) J (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
ionizing source	120 keV	ARL/PSD	6 years	electron microscopy
ionizing source	100 keV	ARL/PSD	3 years	electron beam lithography

Radiological Permit Application Supplement

Name: Poli Louis C
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
ionizing Source	40 keV	ARL/PSD	7 years	electron beam lithography

Radiological Permit Application Supplement

Name: Kondek Christine D
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
ionizing source	40 keV	ARL/PSD	3 years	electron beam lithography

Radiological Permit Application Supplement

Name: Smith Doran D
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
ionizing Source	100keV	ARL/PSD	3 years	electron beam lithography

STANDING OPERATING PROCEDURE

SOP NO: DA-540

TITLE: Philips EBPG-5HR Electron-Beam Lithography System

DIVISION/BRANCH: Advanced Devices Fabrication Division
Advanced Microdevices Branch, AMSRL-PS-DA

PLACE OF OPERATION OR TEST: Room 4D120 Myer Center

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Robert Zeto

ROBERT ZETO
Printed/Typed Name

APPROVED: Michael R. Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 6 April 95

SOP NO: DA-540

EXPIRES: 6 Apr 96

STANDING OPERATING PROCEDURE

SOP NO: DA-540

SUBMITTED BY: Allen Lepore
Signature

Allen Lepore
Printed/Typed Name

Electrical Engineer
Title

06 Apr 95
Date Submitted

SIGNATURES

I have read and understand the contents of SOP NO. DA-540. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
[illegible]	12-APR-95		
Allen Lepore	12 Apr 95		
[illegible]	12 Apr 95		
[illegible]	12 Apr 95		
Chris Kovach	12 Apr 95		
Luis M. Casas	18 Apr 95		

STANDING OPERATING PROCEDURE

SOP NO: DA-540

1. STATEMENT OF WORK: The Philips EBPG-5HR Electron-Beam Lithography System is used to generate patterns on wafers and substrates for device fabrication. The patterns are exposed by a finely-focused, high-voltage electron beam. Because of the presence of high voltage, safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the Philips EBPG-5HR Electron-Beam Lithography System, they must be thoroughly familiar with the operators manual and this SOP.

2. HAZARDS INVOLVED: (1) Electrical, (2) Mechanical, (3) High Vacuum, (4) Ionizing Radiation

3. PROTECTION STANDARD/LIMITS: Isopropyl Alcohol is used in the cleaning of components. Limits and cautions when using Isopropyl Alcohol are as follows:

Isopropyl Alcohol: (CAS No. 67-63-0)

Permissible Exposure Limit (PEL): 400 ppm
Threshold Limit Value TLV-STEL: 500 ppm
Routes of Entry - Inhalation, skin contact
Flammable vapors: 2.0-12.7% in air

All personnel must review and understand the contents contained in the related Material Safety Data Sheets. Personnel using Isopropyl Alcohol to clean the Philips EBPG-5HR Electron-Beam Lithography System must wear organic chemically-rated clean room gloves and Encon/Midland 503-RU Chemically-rated Goggles. Since only a small amount of Isopropyl Alcohol is being used, dispensed from a squeeze bottle, and because of the large volume of air flow in the Photoroom, the PEL and TLV should not be exceeded and therefore an organic vapor cartridge respirator should not be necessary. If, for any reason, the PEL or TLV is exceeded, an organic vapor cartridge respirator must be worn.

Non-ionizing radiation:

(a) Electromagnetic radiation

(1)(i) Electromagnetic radiation is restricted to that portion of the spectrum defined as the radio frequency region, which shall include the microwave frequency.

(2)(i) For normal environmental conditions and for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the radiation protection guide is 10 mW/cm^2 as averaged over any possible 0.1 hour period.

Ionizing Radiation:

The Philips EBPG-5HR Electron-Beam Lithography System produces ionizing radiation. Factory shielding is provided to prevent leakage outside the system chamber. This instrument is operated in accordance with CECOM Regulation 385-18, Ionizing Radiation Protection Program, under permit number 090.

4. SAFETY CONTROLS: The system has the following engineering controls. Personnel must also take note of the following procedural controls.

a. Engineering Controls:

(1) Ventilation: Ventilation of the vacuum pumps for the system is required to avoid allowing the exhausted vapor from entering the room. A connection to a negative pressure vent of a rooftop scrubber is provided. Be sure that this connection is secure, the valve is open, and the scrubber is operating prior to operating the mechanical pumps.

(2) Interlocks: The Philips EBPG-5HR Electron-Beam Lithography System is equipped with interlocks to prevent the generation of high voltage if the system is not under high vacuum, if the high voltage cable is not properly seated, if sufficient water cooling is not available, or if the AC power has been interrupted and subsequently restored. A mains disconnect switch is provided to disable all system power at the central power distribution panel located adjacent to the system.

(3) Shielding: The Philips EBPG-5HR Electron-Beam Lithography System is equipped with a shielded high-voltage cable, with interlocks to prevent operation if the cable is not properly seated at either end. Panels are provided to cover electronic components during operation. Manufacturer-designed internal shielding is provided to control the emission of ionizing radiation outside the system chamber.

b. Procedure Controls:

(1) Clothing: Always wear clean room garments and clean room gloves when handling internal vacuum components of the Philips EBPG-5HR Electron-Beam Lithography System.

(2) Monitoring: Monitor vacuum level via software or by pressure gauge inside the right-most electronics cabinet. Monitor the electron beam conditions using the appropriate software commands to address the Bertan power supply.

(3) First Aid/Fire Fighting Equipment: Standard first aid and fire fighting procedure and

equipment shall be followed.

(a) In case of a fire or injury, contact x911 immediately.

(b) In case of an accident, contact the ETDL Safety Environmental Officer immediately.

(4) Access Control: The Philips EBPG-5HR Electron-Beam Lithography System is located in the basement of the Albert J. Meyer Center (Bldg. 2700, Room 1B120). This room has key restricted entry for access control.

(5) Special Precautions: Personnel working with the system or its circuitry must observe all safety requirements and understand First Aid procedures related to burns and shock and must be familiar with procedures for working with high-voltage equipment. Be sure that the high voltage power supply has been deactivated and grounded with the ground wand prior to performing system maintenance. Do not remove protective covers or defeat interlocks when system power is on. Notify adjacent personnel of high-voltage hazards when operating.

When the system is under bakeout, the exterior of the upper gun area will reach high temperatures and should not be touched for several hours after the bakeout has finished. This heated region is located such that accidental contact is unlikely.

Special caution is required when replenishing gun oil for the high-voltagecable. Use of the improper oil could generate toxic fumes during the high-temperature bakeout . Use only the manufacturer's recommended gun oil.

Use the safety stairs to access elevated components for servicing.

5. SEQUENCE OF OPERATIONS: Before operating the Philips EBPG-5HR Electron-Beam Lithography System, check that the exhaust connections, power connections, and safety interlocks/covers are secure and operational up to unit specifications. Check that nitrogen gas and sufficient water cooling are available and that the laboratory air conditioning system is functioning properly. Check also that vacuum pumps are operational such that sufficient operating vacuum can be achieved. Before any maintenance is performed, shut off system power and allow 60 minutes for equipment cooling.

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of fire, shock or injury. Detailed instructions are given below:

a. Rotate the Main Switch on the power distribution panel to the Off position

b. Shutdown AC power to the system at breaker in the AC service panel located in the service area adjacent to the North end of the lab.

c. Call x911

General emergency phone numbers are listed below:

Fire Fire Department	- 911	
First Aid	- 911	
Police	- 911	
CECOM Health Clinic	- x22452/x24611	
Building Security	- x44684/x42222	
Building Manager	- x44238/x42981	Beeper: 517-6560
EPSD Branch Office	- x20250/x42111	
EPSD Division Office	- x44308/x42452	
EPSD Safety Office	- x44717/x42739	
EPSD Div Safety	- x44418/x43635	Beeper: 517-7859

POC: Allen Lepore, x28963, x43400, home phone (609) 466-3213

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Louis Poli E&PSD, ARL ATTN: AMSRL-EP-ED BLDG 2700, RM 4D130	**2. PERMIT NUMBER:** 085 **3. EXPIRATION DATE:** 28 JAN 97

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4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Electron Beam Lithography System, EMBF 10.5	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Lithography system is in operation.

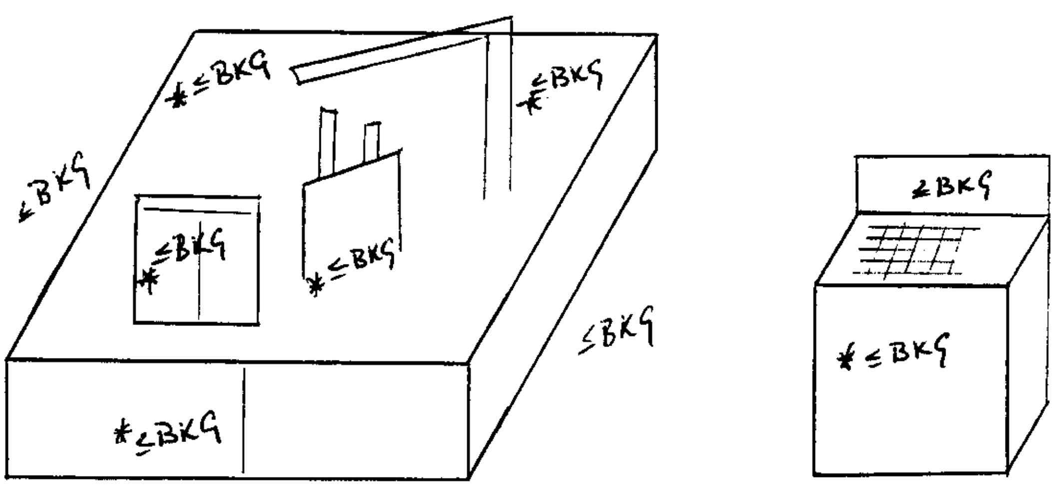
4. System to be used IAW SOP number EM-106

APPROVED: Barry Keller
for JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 28 JAN 94

ELECTRON BEAM LITHOGRAPHY
MEYER CENTER RM 4D130

RADIATION SURVEY



Legend: * Contact reading
O Wipe Location

Background <0.2 mR/hr

Postings

SOP	✓	Dosimetry Requirements	N/A
Caution Radioactive Mat'l	N/A	NRC Form 3	N/A
Caution Radiation Area	N/A	Section 206	N/A
Caution High Rad Area	N/A	Notice to Workers	✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: William Craig Date: 8 DEC 93

RADIOLOGICAL PERMIT APPLICATION

Check One Date 2 DEC 93

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 085

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit:
ARMY RESEARCH LAB (ARL)
AMSRL-EP-ED

3. Radiation Area Supervisor: Name LOUIS C. POLI
ALLEN N. LEPORE

4. Radioactive Material:
N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

POSSIBLE X-RAY OUTPUT FROM ELECTRON BEAM COLUMN ASSEMBLY OF EBMF 10.5 - MAXIMUM OPERATING ENERGY IS 40KeV.

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

LOUIS C. POLI

ALLEN LEPORE

CHRIS KONDEK

WENDELL WINDSOR

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

ALBERT J. MYER CENTER

RM 4D130

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

N/A

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

N/A

10. Signature of Director of Responsible Individual:

Name Robert J Zeto Signature ROBERT J. ZETO

CECOM SAFETY USE ONLY:

Instrumentation: none supplied

Dosimetry: none supplied

Reviewed by: Hugo Bianchi Date: 27 Jan 94

Approved by: [signature] Date: 27 Jan 94

Radiological Permit Application Supplement

Name: POLI / LOUIS / C
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	2 WEEKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV	MYERCENTER 4D130	5 YRS	LITHOGRAPHY

Radiological Permit Application Supplement

Name: LEPORE (Last) ALLEN (First) N. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
CORNELL UNIV. KNIGHT LAB.	2 WEEKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV	M YOR CONTROL 4D17D	8 YRS	LITHOGRAPHY

Radiological Permit Application Supplement

Name: KONDEK (Last) CHRISTINE (First) A (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	2 WEEKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV	MTTR CENTER 4D130	4 YRS	LITHOGRAPHY

Radiological Permit Application Supplement

Name: WINDSOR (Last) WENDELL (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	2 WEEKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV	MYER CENTER 4D130	4 YRS	LITHOGRAPHY

STANDING OPERATING PROCEDURE

SOP NO. EM-106

TITLE: LEICA INSTRUMENTS EBMF-10.5 E-BEAM LITHOGRAPHY TOOL

DIVISION/BRANCH: EDRD/Micro-Electronic Devices Branch (AMSRL-EP-ED)

PLACE OF OPERATION OR TEST: Room 4C131 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will insure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

Branch Chief: Robert J. Zeto

ROBERT J. ZETO
Printed/Typed Name

APPROVED:

Michael R. Walterschied
MICHAEL R. WALTERSCHIED
Risk Management Officer

DATE: ____________

SOP NO: EM-106

EXPIRES: ____________

SOP NO: EM-106

SUBMITTED BY: ____________________
Signature

Louis C. Poli

Electronics Engineer
Title

31 Jan 1994
Date Submitted

SIGNATURES

I have read and understand the contents of SOP NO. EM-106 . Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

Title: Standing Operating Procedure for the Electron Beam Lithography Tool, Leica Instruments EBMF-10.5.

1. **Statement of Work:** The Leica Instruments EBMF-10.5 Electron Beam Lithography tool is used to draw and define a wide variety of lithographic patterns. Samples to be patterned are coated with a radiation sensitive resist film. These are then placed upon workpiece chucks and moved into an airlock. The airlock is then brought under vacuum. When in operation, the EBMF uses a sharply defined electron beam to write the pattern of interest on the sample. Much of the EBMF operation is controlled by two imbedded computer systems. A third microVax computer system is dedicated solely to EBMF ADP requirements, and is located in the ARL computer center. Applications include patterning of microelectronic devices on various wafer or mask substrates. All operators shall be thoroughly familiar with the operating manual before using the Lithography Tool.

2. **Hazards Involved:** (1) Electrical, (2) high temperature, (3) X-Ray. Because of the presence of high voltages (up to 40 Kilovolts) in the Column gun assembly (the large cylindrical assembly above the equipment and air suspension table), special safety precautions must be taken by any personnel within the E-Beam room. Under no conditions should any personnel unfamiliar with the EBMF, touch the column or cables leading to the column, at any time. High voltages are usually applied, even when the system is in an idle state. The EBMF is surveyed yearly for production of X-rays. No X-rays have been detected. Three hot oil diffusion pumps are located within the enclosed equipment on the air suspension table. No contact with these pumps is possible for persons other than maintenance personnel, since these enclosure panels are never removed.

3. **Protection Limits/Standards:** In the routine operation of this lithography tool, there is no possibility of contact with chemicals, electrical circuits, or hot surfaces.

4. **Safety Controls:** The system has the following engineering and procedural controls.

Revised on 31 Jan 1994

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

a. Engineering Controls:

(1) **Interlocks:** System interlocks are instituted with this instrument to prevent accidental contact with the gun supply high voltage. The high voltage will shut down if the vacuum level degrades sufficiently. The electron gun high voltage must be manually reset. The vacuum system is extensively protected by a computer driven system of vacuum interlocks and sensors. This system is not normally under operator control. It serves to prevent operator error. If improper vacuum system activity is noted, cease operation and if possible, issue commands to the computer to return the work piece chuck to the chuck magazine. Notify the team leader and the Leica field service representative.

(2) **Shielding:** The gun supply high voltage and the three VAC-ION vacuum pumps each have their own high voltage supply sets. These equipment sets are mounted near the machine. Under no conditions are the cables from these equipment sets to be handled or the equipment covers to be removed. Shielding of possible x-ray generation by the column is accomplished within the column system and cannot be removed or defeated.

b. Procedural Controls:

(1) **Clothing:** No special requirements.

(2) **First Aid/Fire Fighting Equipment:** Control, extinguish with dry type fire extinguisher.

(3) **Access Control:** The EBMF-10.5 lithography tool is located in the ARL Microfabrication Center (Bldg. 2700, 4D-130). The machine and its supporting vacuum systems, electronics and computers are located in a separate room reserved for E-beam lithography.

(4) **Special Precautions:** Mounted on the column are three VAC-ION diffusion pumps. High voltage anode supply (20 kilovolts) cables connect to the pumps and are partially exposed. Under no conditions, should personnel other than qualified EBMF operation and maintenance engineers touch the column or the connecting cables.

Revised on 31 Jan 1994

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

5. **Sequence of Operations:** The procedures for warmup, preparation and calibration of the EBMF for normal lithography operation can be found in the EBMF-10.5 operation manual.

6. **Emergency Procedures:** Leave the E-beam machine room and immediately notify the ARL Branch, Division, and Safety offices. In case of flooding, shut down all system electrical power via the main power switch box in the back of the E-beam room. Do this only if the switch can be safely reached. A complete and orderly shut down for the EBMF is normally completed in about 30 minutes. This allows the hot diffusion pumps to cool. A near shutdown of the EBMF for system maintenance or repair takes about 10 minutes. Both these procedures can only be executed by qualified EBMF operators and service engineers. Therefore an emergency shutdown via the main power switch should only be executed if necessary. Possible damage to the computers and vacuum system may result. Follow standard emergency procedures in case of fire, shock or injury. All injuries shall be reported to the ARL Risk Management office within one hour of their occurrence.

General **emergency** phone numbers are listed below.

Fire Department, First Aid, Police - 911
CECOM Health Clinic - x22452
Building Security - x44684/x42222
Building Manager - x44238/x42981
ARL Branch Office - x44872/x43446
ARL Division office - x44308/x42452
ARL Risk Mngmt - x44936

Revised on 31 Jan 1994.

U.S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in Item 5.

1. ACTIVITY GRANTED PERMIT

ARL, Physical Sciences Directorate,
Advanced Electronics Devices Division,
Micro-Electronics and Mechanical Devices
Branch, Attn: AMSRL-PS-DA,
Building 2700, Room 4D130

2. POC / RESPONSIBLE INDIVIDUAL

Louis Poli

3. PERMIT NUMBER

085

4. EXPIRATION DATE

28 January 98

5. MATERIAL/DEVICE	**6. CHEMICAL/ PHYSICAL FORM**	**7. ACTIVITY**
Electron Beam Lithography Tool, Leica Instruments, Model EBMF-10.5, SN: 3012-103552	N/A	N/A

8. CONDITIONS:

a. The Electron Beam Lithography tool shall be used to draw and define a wide variety of lithographic patterns on samples coated with a radiation sensitive resist film.

b. Authorized place of use for the Electron Beam Lithography tool is listed in Item 1.

c. Authorized device will be utilized under the supervision of the individual listed in Item 2. Additional users will be approved by the Fort Monmouth Radiation Protection Officer. The individual's training and education must be commensurate with the device being used as stated in Item 5. The individual identified in Item 2 is responsible for ensuring all users meet minimum training and education requirements for operation of the device listed in Item 5.

d. Electron Beam Lithography tool may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

e. No unauthorized personnel are allowed in the room when the Electron Beam Lithography tool is in operation.

APPROVED: Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division/Fort Monmouth
Radiation Protection Officer

DATE: 25 January 96

U.S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH

RADIOLOGICAL PERMIT

SUPPLMENTARY SHEET

PERMIT NUMBER 085	**4. EXPIRATION DATE** 28 January 98

CONDITIONS

f. Notify the CECOM Safety Office, Attn: AMSEL-SF-RER, Fort Monmouth, NJ 07703-5024, Voice: (908) 427-3112, extensions 6427, 6441 or 6444 as soon as practical concerning any administrative or technical changes to the Radiological Permit Application for the device listed in Item 5.

g. Electron Beam Lithography tool is to be used IAW SOP Number EM-106, approved 22 January 1996, as provided with Radiological Permit Application, dated 16 January 1996.

h. Unless specifically provided otherwise, the device listed in Item 5 shall be possessed and used IAW statements, representations and procedures contained in the Radiological Permit Application, dated 16 January 1996, signed by Robert J. Zeto, Chief, Micro-Electronics and Mechanical Devices Branch, ARL.

RADIOLOGICAL PERMIT APPLICATION

Check One　　　　　Date 16 JAN 96

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 085

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: AMSRL-PS-DA

3. Radiation Area Supervisor: Name A. LEPORE, L. POLI

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

X-RAY OUTPUT FROM COLUMN ASSEMBLY OF ELECTRON BEAM TOOL, MAXIMUM OPERATING ENERGY IS 40 KeV.

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Dr. A LEPORE

MR. L. POLI

MS. C. KONDEK

MR. L. CASAS

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

ALBERT J. MYER CENTER ARL - PSD
RM 4D130

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

N/A

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

CLASS 100 CLEAN ROOM FACILITY
CLEAN ROOM OVERALLS

10. Signature of Director of Responsible Individual:

Name [signature] Signature ROBERT J. ZETO

CECOM SAFETY USE ONLY:

Instrumentation: none provided/required

Dosimetry: none provided/required

Reviewed by: Hugo Bianchi Date: 25 Jan 96

Approved by: Joseph M. Santarsiero Date: 25 Jan 96

Radiological Permit Application Supplement

Name: LEPORE (Last) ALLEN (First) N. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
CORNELL UNIV.	2 WEEKS	YES NO	YES NO
ARL FACILITY	> 6 MO.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV E-BEAM	MYER CTR 4D130	N/A	LITHOGRAPHY

Radiological Permit Application Supplement

Name:	POLI	LOUIS	C
	(Last)	(First)	(Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	2 WEEKS	YES NO	YES NO
〃	> 6 MO.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV E-BEAM	MYER CTR. 4D130	N/A	LITHOGRAPHY

Radiological Permit Application Supplement

Name: KONDEK (Last) CHRISTINE (First) A (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	>6 MO	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV E-BEAM	MYER CTR 4D130	N/A	LITHOGRAPHY

Radiological Permit Application Supplement

Name: CASAS (Last) LUIS (First) M (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL FACILITY	>6 MO.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
EBMF 10.5	40 KeV E-BEAM	MYER CTR 4D130	N/A	LITHOGRAPHY

STANDING OPERATING PROCEDURE

SOP NO. EM-106

TITLE: LEICA INSTRUMENTS EBMF-10.5 E-BEAM LITHOGRAPHY TOOL

DIVISION/BRANCH: EDRD/Micro-Electronic Devices Branch (AMSRL-EP-ED)

PLACE OF OPERATION OR TEST: Room 4C131 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will insure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

Branch Chief:

ROBERT J. ZETO
Printed/Typed Name

APPROVED:

MICHAEL R. WALTERSCHIED
Risk Management Officer

DATE: 22 Jan 96

SOP NO: EM-106

EXPIRES: 22 Jan 97

SOP NO: EM-106

SUBMITTED BY: Lou C. Poli
Signature

Louis C. Poli

Electronics Engineer
Title

15 Jan 1996
Date Submitted

SIGNATURES

I have read and understand the contents of SOP NO. EM-106. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Allen Cyan	18 Jan 96		
Luis M. Gasos	18 JAN 96		
Lou C Poli	18 JAN 96		
Christine Kandel	18 Jan 96		

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

Title: Standing Operating Procedure for the Electron Beam Lithography Tool, Leica Instruments EBMF-10.5.

1. **Statement of Work:** The Leica Instruments EBMF-10.5 Electron Beam Lithography tool is used to draw and define a wide variety of lithographic patterns. Samples to be patterned are coated with a radiation sensitive resist film. These are then placed upon workpiece chucks and moved into an airlock. The airlock is then brought under vacuum. When in operation, the EBMF uses a sharply defined electron beam to write the pattern of interest on the sample. Much of the EBMF operation is controlled by two imbedded computer systems. A third microVax computer system is dedicated solely to EBMF ADP requirements, and is located in the ARL computer center. Applications include patterning of microelectronic devices on various wafer or mask substrates. All operators shall be thoroughly familiar with the operating manual before using the Lithography Tool.

2. **Hazards Involved:** (1) Electrical, (2) high temperature, (3) X-Ray. Because of the presence of high voltages (up to 40 Kilovolts) in the Column gun assembly (the large cylindrical assembly above the equipment and air suspension table), special safety precautions must be taken by any personnel within the E-Beam room. Under no conditions should any personnel unfamiliar with the EBMF, touch the column or cables leading to the column, at any time. High voltages are usually applied, even when the system is in an idle state. The EBMF is surveyed yearly for production of X-rays. No X-rays have been detected. Three hot oil diffusion pumps are located within the enclosed equipment on the air suspension table. No contact with these pumps is possible for persons other than maintenance personnel, since these enclosure panels are never removed.

3. **Protection Limits/Standards:** In the routine operation of this lithography tool, there is no possibility of contact with chemicals, electrical circuits, or hot surfaces.

4. **Safety Controls:** The system has the following engineering and procedural controls.

Revised on 15 Jan 1996

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

a. **Engineering Controls:**

(1) **Interlocks:** System interlocks are instituted with this instrument to prevent accidental contact with the gun supply high voltage. The high voltage will shut down if the vacuum level degrades sufficiently. The electron gun high voltage must be manually reset. The vacuum system is extensively protected by a computer driven system of vacuum interlocks and sensors. This system is not normally under operator control. It serves to prevent operator error. If improper vacuum system activity is noted, cease operation and if possible, issue commands to the computer to return the work piece chuck to the chuck magazine. Notify the team leader and the Leica field service representative.

(2) **Shielding:** The gun supply high voltage and the three VAC-ION vacuum pumps each have their own high voltage supply sets. These equipment sets are mounted near the machine. Under no conditions are the cables from these equipment sets to be handled or the equipment covers to be removed. Shielding of possible x-ray generation by the column is accomplished within the column system and cannot be removed or defeated.

b. **Procedural Controls:**

(1) **Clothing:** No special requirements.

(2) **First Aid/Fire Fighting Equipment:** Control, extinguish with dry type fire extinguisher.

(3) **Access Control:** The EBMF-10.5 lithography tool is located in the ARL Microfabrication Center (Bldg. 2700, 4D-130). The machine and its supporting vacuum systems, electronics and computers are located in a separate room reserved for E-beam lithography.

(4) **Special Precautions:** Mounted on the column are three VAC-ION diffusion pumps. High voltage anode supply (20 kilovolts) cables connect to the pumps and are partially exposed. Under no conditions, should personnel other than qualified EBMF operation and maintenance engineers touch the column or the connecting cables.

Revised on 15 Jan 1996

ARMY RESEARCH LABORATORY (ARL)

SOP NO. EM-106

5. **Sequence of Operations:** The procedures for warmup, preparation and calibration of the EBMF for normal lithography operation can be found in the EBMF-10.5 operation manual.

6. **Emergency Procedures:** Leave the E-beam machine room and immediately notify the ARL Branch, Division, and Safety offices. In case of flooding, shut down all system electrical power via the main power switch box in the back of the E-beam room. Do this only if the switch can be safely reached. A complete and orderly shut down for the EBMF is normally completed in about 30 minutes. This allows the hot diffusion pumps to cool. A near shutdown of the EBMF for system maintenance or repair takes about 10 minutes. Both these procedures can only be executed by qualified EBMF operators and service engineers. Therefore an emergency shutdown via the main power switch should only be executed if necessary. Possible damage to the computers and vacuum system may result. Follow standard emergency procedures in case of fire, shock or injury. All injuries shall be reported to the ARL Risk Management office within one hour of their occurrence.

General **emergency** phone numbers are listed below.

Fire Department, First Aid, Police - 911
CECOM Health Clinic - x22452
Building Security - x74684/x72222
Building Manager - x74238/x72981
ARL Branch Office - x74872/x73446
ARL Division office - x74308/x72452
ARL Risk Mngmt - x74936

Revised on 15 Jan 1996.

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER:

Dr. Robert L. Pfeffer
ET & DL
B. 2700 Rm 2D139

2. PERMIT NUMBER: 031

3. EXPIRATION DATE: 1 MAY 95

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4. MATERIAL/DEVICE:	5. CHEMICAL/PHYSICAL FORM:	6. ACTIVITY:
Tandetron Model 4117A High Voltage Ion Accelerator	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when accelerator is in operation.

4. Personal dosimetry provided by CECOM Safety Office to be worn whenever the accelerator is in operation.

5. RADIAC meter provided by CECOM Safety Office must be used by operator when ever the accelerator is in operation.

6. Device to be used IAW SOP No. EP-012

APPROVED:

Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br
Radiation Protection Officer

DATE: 1 MAY 92

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 3 March 1992

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 031

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: SLCET-EP

3. Radiation Area Supervisor: Name Dr. Robert L. Pfeffer

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
N/A			

5. Other Sources of Ionizing Radiation Producing Devices:
Tandetron Model 4117A high voltage ion accelerator (MFR: High Voltage Engineering Europa, Amersfoort, The Netherlands)

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

1. Dr. Robert L. Pfeffer
2. Mr. Lawrence A. Lacktis
3. Dr. Robert A. Lux

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Myer Center, Rm 2D139

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

cf. SOP (att)

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

c.f. safety sheets (att)

10. Signature of Director of Responsible Individual:

Name Dr. Robert L. Pfeffer Signature [signature]

CECOM SAFETY USE ONLY:

Instrumentation: (1) Ludlum Model 5 SN:13746

Dosimetry: provided by CSO for Lux & Pfeffer B,G & N TLD's (L. Locktis - to be added 4/1/92)

Reviewed by: Hugo Bianchi Date: 23 Mar 92

Approved by: Joseph M. Santarsiero Date: 23 Mar 92

Radiological Permit Application Supplement

Name: Pfeffer (Last) Robert (First) L. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
C.C.N.Y., U. of Pa., Stevens Institute	9 yrs	YES NO	YES NO
Ft. Monmouth, NJ	26 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
^{60}Co	120 kCi	Evans Area	18 yrs	Experiments
^{137}Cs	100 Ci	Evans Area	18 yrs	″
^{241}Am	1 mCi	″ ″	″	″
Miscellaneous check sources	< 1 μCi	″ ″	″	Calibration
Flash X-rays	N/A	Aberdeen, AFWL, PI	1 mo	Experiments
Van de Graaff	N/A	Evans Area, AFWL	18 yrs	″
Neutron Generator	N/A	Kaman Corp. (Colorado Springs)	1 wk	″
LINACs	N/A	RPI, AFRRI WSMR	1 mo	″
Fast Burst Reactors	N/A	Aberdeen, WSMR	1 mo	″
Tandetron Accelerator	N/A	Hexagon	5 yrs	″

Radiological Permit Application Supplement

Name: LACKTIS LAWRENCE
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft Monmouth NJ	5 yrs	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
60 Co	120 KCi	Evans Area	5 yrs	Experiments
137 Cs	100 Ci	"	"	"

Radiological Permit Application Supplement

Name: Lux (Last) Robert (First) A. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
U. of Chicago, U. of Wisconsin	6½ yrs	YES NO	YES NO
Ft. Monmouth	23 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
^{60}Co	120 kCi	Evans Area	15 yrs	Experiments
^{137}Cs	100 Ci	" "	"	"
^{241}Am	1 mCi	" "	"	"
Miscellaneous check sources	< 1 µCi	" "	"	Calibration
Flash X-ray	N/A	AFWL	1 wk	Experiments
Van de Graaff	N/A	Evans Area	15 yrs	"
Neutron Generator	N/A	" "	"	"
Fast Burst Reactors	N/A	Aberdeen, WSMR	1 wk	"
FM Synchrocyclotron	N/A	U of Chicago	1½ yr	"

}PLASER }.mt 6

STANDING OPERATING PROCEDURE

SOP NO: EP-012

TITLE: STANDING OPERATING PROCEDURE FOR GENERAL IONEX TANDETRON MODEL 4117A HIGH VOLTAGE ION ACCELERATOR

DIVISION/BRANCH: EDRD/Electronic Materials, Process and Analysis Branch (EP)

PLACE OF OPERATION OR TEST: Room 2D139

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded of superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised unless approved in writing by the Safety/Environmental Office.

Supervisory personnel will assure that all personnel involved with this SOP have been properly trained and instructed in its provisions and attest on this condition by requiring them to affix their signature on page 2.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: ____________________

____
Kenneth A. Jones

APPROVED:

____
MICHAEL R. WALTERSCHIELD
Safety/Environmental Officer

DATE: 10/15/1991

SOP NO: EP-012

EXPIRES: ________

SOP NO: EP-012

SUBMITTED BY: ____________________

____
Robert L. Pfeffer

____
Research Physicist

____
11 Oct 1991

00
SIGNATURE

I have read and understand the contents of SOP NO. EP-012 . Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE

USA ELECTRONICS TECHNOLOGY & DEVICES LABORATORY (LABCOM)

SOP NO. EP-012

TITLE: STANDARD OPERATING PROCEDURE FOR:

GENERAL IONEX TANDETRON MODEL 4117A HIGH VOLTAGE ION ACCELERATOR

1. STATEMENT OF WORK: The General Ionex High Voltage Ion Accelerator is primarily used for performing Rutherford Backscattering Spectrometry (RBS) on device-related materials (e.g., superconducting thin films) to ascertain sample stoichiometry, interface diffusion, lateral profiling, as well as, a number of properties associated with crystalline quality.

However, it should be noted that: depending on the particular arrangement of the experimental setup, varying types of analyses can be performed (for example: RBS, ion-beam channeling, Nuclear Reaction Analysis (NRA), Proton Induced X-ray Emission (PIXE), etc).

Therefore, the specific experimental setup(i.e., beam energy, bombarding and target species) could drastically effect the potential hazards associated with the operation of this machine.

2. HAZARDS INVOLVED: There are three general areas of concern in the accelerator laboratory: (1) High Voltage, (2) Radiation, and (3) Hazardous Compounds.

HIGH VOLTAGE: The ion source at the injector floats at an extraction voltage of 20,000 V (20 kV) during normal operation.

IONIZING RADIATION: Can be emitted when the machine is operated under certain highly specific conditions:

1) X-rays
   a) Bremsstrahlung: a continuous spectrum of x-rays emitted when energetic electrons are rapidly decelerated. The main source of this is secondary electrons accelerated along the high energy end of the accelerator column. The accelerator column has been designed to completely suppress them. (Semiannually surveys by RPO to confirm)

   b) X-rays proper: products of certain nuclear reactions.

2) Gamma rays
   Emitted from nuclei during certain nuclear reactions.

3) Neutrons
   Emitted from nuclei during certain nuclear reactions.

USA ELECTRONICS TECHNOLOGY & DEVICE LABORATORY (LABCOM)

SOP NO. EP-012

HAZARDOUS COMPOUNDS:

1) Gases

a) Boron Trifluoride - very toxic by inhalation, corrosive, reacts violently with water, causes severe burns.

b) Sulfur Hexafluoride - nontoxic, irritant.

c) Carbon monoxide, ammonia, oxygen, hydrogen, argon, xenon, helium, freon, and nitrogen.

2) Liquids

a) Tetrachloroethylene, TCE (5 gallons) - very harmful if inhaled or absorbed through the skin.

b) 1,1,1 - Trichloroethane (3 gallons) - harmful if inhaled, causes irritation.

c) Electron-emitting cathode coating, which contains: calcium, strontium, barium carbonate in a nitrocellulose vehicle (contains carbonyl nickel) - Nickel and nickel oxides are suspected carcinogens. Nickel metal has low oral toxicity, irritant. Hazardous decomposition products, such as CO, may be produced. High concentrations have a narcotic effect when inhaled.

d) Diethyl chlorophosphate - Chemical, physical, and toxilogical properties have not fully been investigated.

e) Polystyrene - harmful vapors, flammable (contains toluene)

f) Propanol-2, acetone (1 gallon), deuterium oxide (1 quart), paint catalysts, vacuum oils (Precision, 705, Santovac-5), and a variety of cleaning compounds.

3) Solids

a) Cesium - reacts violently with water, flammable

b) Lithium - reacts violently with water, causes severe burns.

c) Thallium containing thin-film superconducting material - Heavy metal poisoning if inhaled or absorbed through the skin. Toxicity related to ingestion (a cumulative effect).

d) Epoxy, silicone rubber - irritates skin and eyes.

3. PROTECTION STANDARDS/LIMITS: The General Ionex High Voltage Ion Accelerator is designed to be safe and hazard free. However, an active safety program encompassing all of the potential dangers listed below is essential:

HIGH VOLTAGE: Ensure that the ion-source safety cage is properly mounted whenever the extraction voltage is to be applied.

RADIATION: The operator's manual states that: "It is the responsibility of the operator to maintain calibrated radiation instrumentation appropriate to the beam being accelerated (p.3)." Monthly radiation measurements are presently being performed by the operator. Radiation Safety (namely, Sargent Bianci) is to receive copies of the monthly status reports. Radiation badges have been found to be unnecessary, since the radiation emitted during operation(in the RBS/channeling mode) is not significantly above background. However, in other operating modes or at sufficiently high energies, the possibility or occurence of any relevant reactions (those reactions whose emissions pose health threats) should be seriously considered.

HAZARDOUS COMPOUNDS: Keep in appropriate storage area (cool, dry, etc). Use ventilation hoods, gloves, goggles, protective clothing, masks, etc., when appropriate. Carefully read warnings and safety labels on containers. If there is any doubt : contact the manufacturer, refer to appropriate literature, or consult an informed authority. Wash after handling.

All personnel must review and understand the contents contained in the attached Material Safety Data Sheets.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are located throughout the machine to reduce the probability of accident. (e.g., the interlocks could shut down the injector (floating at 20 kV) if effectively tripped.)

(2) Shielding: Shielding for the high terminal voltage is provided using a portion of a sewage pipe to house the accelerating electrodes and insulating sulfur hexafluoride

b. Procedural Controls:

(1) Clothing: Protective clothing, eye covering and plastic gloves must be worn where appropriate.

(2) First Aid/Fire Fighting Equipment: In case of a cesium metal spill, stand back from area and allow the small amount of cesium (1 gm.) to react with air and burn away (controlled burn). If fire is out of control, extinguish with a "dry" type of fire extinguisher. (Located in an easily accessible location and properly maintained.)

(3) Access Control: Located in the Accelerator Laboratory (room 2D139 of ET&DL's Device Microanalysis Center). This room is kept locked if ever vacant, including those of normal working hours(8am - 5pm).

(4) Special Precautions: Use extreme caution when working on or near electrical connectors, power supplies, or ion sources. NEVER remove safety covers from ion sources while the high voltage ion source power supplies are ON. The operator shall inform adjacent personnel of high voltage, radiation, or chemical hazards. If a water leak from the water cooling lines should occur when the instrument is in operation, the instrument should be TURNED-OFF immediately and not powered-up until the leak is fixed.

5. SEQUENCE OF OPERATIONS: Please refer to the OEM operations manual for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that all ion source covers and high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies &/or the System Main Power Key and obtain qualified service before powering the instrument back up. If a water leak occurs while the instruments high voltage is on, IMMEDIATELY shut-down the system using the System Main Power Key. There is no danger with the cesium ion source while it is attached to the

STANDARD OPERATING PROCEDURE:

Tandetron 4117A High Voltage Ion Accelerator
Room 2D 139, Hexagon

1. Starting the Injector
   a) proper vacuum, fully leak-checked
 * b) good filament installed & outgassed
   c) all electrical connections made
   d) lithium charge in boiler
   e) gas bottle full
   f) gas line purged of air up to the leak valve
   g) all breakers are closed
   i) 90° magnet power supply is on
   j) source and magnet cooling is on

2. Lithium Canal Startup
   a) lower console boiler to zero
   b) adjust end heaters to 300 C
   c) set boiler controller to maximum value (temp indicator not being used, setpoint offset by 150 C)
   d) Press STANDBY: this switch activates the canal end heaters, and allows them to start heating up.
   e) Should the lithium canal be oxidized for some reason, raise the boiler control in 20 degree steps until operating temperature is reached.

3. Striking an Arc
   a) Duoplasmatron source evacuated with its bypass valve evacuated with its bypass valve opened(for higher conductance than thru just the aperature button) [If outgassing is done in the duoplasmatron source head, this valve should be kept open while the coating is being converted]
   b) With the valve open replace the personal shield and increase the current filament slowly to operating levels(@30A). Observe pressure reading When vacuum has returned to base level, lower the filament current to zero, remove personal shield and close the bypass valve.
   c) Replace the personal shield and swing the Faraday cup into the "IN" position.
   d) Raise the filament current to 28 A
   e) Raise the source magnet(duoplasmatron solenoid

magnet) current to one ampere(1 A).

f) Raise the arc ~~current~~ control knob ~~[illegible]~~3 turns of its full scale position. The voltage will rise to approximately 150 V and no current will be drawn. If a finite arc current is drawn, the outgassing cycle is not yet complete. As the vacuum cleans up, the voltage will slowly rise until the arc "drops out". If the cleanup rate is too slow, turn down the filament and arc, open the source bypass valve, and repeat the above procedure. When the arcgoes out, the bypass valve must again be closed before normal operation begins.

g) Slowly open the gas leak valve until either a stable arc discharge is struck; or a pressure rise is seen on the Penning gauge.

Caution: Do not exceed 4×10^{-5} or 2 ampers of arc current

4. Tuning the Injector

At this point the lithium canal is at 510-520 C and the injector Faraday cup is in position

a) Raise the SOURCE EINZEL LENS to 30% of full scale

b) Turn on the extraction powersupply and raise slowly (front console control) to 20 - 23 kV

c) Turn on power supply for the two 45° magnets and raise the current slowly until a negative beam peak is observed on the Faraday cup readout. For helium this will occur at 5-7 amperes while for hydrogen, the required current will be reduced by a factor of two.

d) Readjust the eizel lens and 45° magnets successively to maximize the beam. Readjust the source gas leak valve to maximize the output and again readjust the lens and magnet. Increase of the source magnet current will often bring up the beam intensity.

e) If additional intensity is required, increase the canal temperature to the temperature recommended earlier; or the arc current may also be increased as high as two amperes. This adjustment should be followed by returning of source gas, lens, and magnets for maximum beam

5. 1.7 MV Power Supply Operation

a) Turn on the three phase breaker for the driver. (It is located on the back of the plate power supply.

b) Turn on the control power breaker in the driver rack.(After 68 sec the contactor will pull in)

c) Turn the VOLTAGE pot on the Tandetron control panel down below 0.5 to initialize the power supply

d) Turn the VOLTAGE pot above approximmately 0.5 to 1.0 and observe the voltage rise on the digital voltmeter

e) Slowly turn the VOLTAGE pot up until the desired voltage is reached

6. High Energy Extension Tuning

At this point the beam is assumed to be tuned optimally in the low energy Faraday cup. The on switched and the terminal high voltage has been brought up to 1.7 MV. The end station gate valve should be open, Faraday cup on the beam intercepting position("IN") and both apertures in the end station collimator rotated out to the "clear" position.

a) Set the following initial tuning parameters:

1)Terminal Voltage			1700kV
2)LE Electrostatic Steerers		X	500
		Y	500
3)Tube Lens			414
4)Triplet Lens	Lens		400
	Trim		500
5)HE Steerers		X	500
		Y	500
6)Stripper Gas			100-200 psi
			(2×10^{-5} Torr)

b) Rotate the low energy Faraday cup out of position and look for beam in the high energy Faraday cup on the lowest scales of the current monitor.

c) If you cannot find the beam, slowly vary each of the following about the preset condition, returning to the original setting before going on to the next:
 1) 15 Degree Deflector
 2) HE Steerers X, Y
 3) 45 Degree Magnet(very fine adjust)

d) If the beam is still not present, something is wrong in the wiring or vacuum hardware and the system should be checked thoroughly. It would be helpful to verify that voltage is present at the output of the magnet, triplet and tube supplies, and that there is current flowing in the steerer plates. If all these are normal, a problem may exist in the vacuum hardware.

e) Once the beam is located sucessfully, the intensity should be maximized by varying:
 1) Doublet Lens/Trim
 2) 15 Degree Magnet
 3) HE Steerer X, Y
 4) Tube Lens
 5) 45 Degree Magnets
 6) LE Electrostatic Steerers
 7) 3 - 6
 8) 1 - 3
 9) Stripper(Caution: Long time constant

f) Insert the collimator aperature closest to the final chamber and maximize the beam intensity using E1 - E6. From this point on DO NOT TUNE any lens element since the final beam spot and angle specification depend upon a beam waist at the last aperture in the beam line.

g) Insert the collimator aperture closest to the gate valve. TUNE ONLY the deflecting elements:

<u>CONDITIONING</u>: If the machine has been up to air before voltage is applied, bring the voltage up in slow steps. Any instability noted in the terminal voltage or pressure in the beamline during this initial runup signals the operator to stop raising the voltage until the terminal restabilizes. This lack of stability is due to the conditioning of the tubes. Vacuum insulation is used inside the acceleration tubes and in the high energy extension. When vacuum is highly electrically stressed, the materials in the vacuum chamber undergo a process called conditioning. Conditioning consists of field dependent currents, the magnitude of which depends on the condition of the cathode surface. Tarnished, water vapor covered, or microscopically rough surfaces produce much higher conditioning currents than clean surfaces. The self-quenching, conditioning discharges apparently "smooth" the sufaces and allow higher potentials to be applied. Therefore, if the voltage is raised too quickly during this conditioning phase, the machine may spark and power supply damage may result. During this initial run up, bring the voltage to 1.75 MV or higher, if possible, to promote stability at lower operating voltages.

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. **USER:** Dr. Robert L. Pfeffer Physical Sciences Dir., ARL ATTN: AMSRL-PS-PC BLDG 2700, RM 2D139	2. **PERMIT NUMBER**: 031 3. **EXPIRATION DATE:** 1 MAY 97

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4. **MATERIAL/DEVICE**	5. **CHEMICAL/PHYSICAL FORM**	6. **ACTIVITY**
Tandetron Model 4117A High Voltage Ion Accelerator	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when accelerator is in operation.

4. Personal dosimetry provided by CECOM Safety Office to be worn whenever the accelerator is in operation.

5. RADIAC meter provided by CECOM Safety Office must be used by operator when ever the accelerator is in operation.

6. Device to be used IAW SOP No. EC-412, 6 April 1995.

APPROVED: Joseph M. Santarsiero 5/25/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 1995

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 6 Apr 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 031

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: AMSRL-PS-PC

3. Radiation Area Supervisor: Name Dr. Robert L. Pfeffer

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:
Tandetron Model 4117 A high voltage Ion accelerator, Mfgr: HV Engineering Europa, Amersfoort, Netherlands

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

1. Dr. Robert L. Pfeffer
2. Mr. Robert J. Youmans
3. Dr. Robert A. Lux

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Myer Center, Rm 2D139

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

see attached SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

Ion accel. (item 5), externally vented fume hood, laminar flow workstation, 2 relay racks, 2 PC's, 5 storage cabinets, flammable storage cabinet, 8 gas cylinders, water chiller.

10. Signature of Director or Responsible Individual:

Name ROBERT J. ZETO Signature [signature]

CECOM SAFETY USE ONLY:

Instrumentation: One (1) RADIAC meter provided by CECOM Safety Office to be used by authorized users.

Dosimetry: Beta/Gamma and Neutron dosimetry provided for all authorized users.

Reviewed by: Hugo Bianchi Date: 25 Apr 95

Approved by: Joseph M. Santarsiero Date: 4/25/95

Radiological Permit Application Supplement

Name: Pfeffer (Last) Robert (First) L. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
C.C.N.Y., U. of Pa., Stevens Institute	9 yrs	YES NO	YES NO
Ft. Monmouth, NJ	29 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
^{60}Co	120 kCi	Evans Area	18 yrs	Experiments
^{137}Cs	100 Ci	Evans Area	18 yrs	"
^{241}Am	1 mCi	" "	"	"
Miscellaneous check sources	< 1 μCi	" "	"	Calibration
Flash X-rays	N/A	Aberdeen, AFWL, PI	1 mo	Experiments
Van de Graaff	N/A	Evans Area, AFWL	18 yrs	"
Neutron Generator	N/A	Kaman Corp. (Colorado Springs)	1 wk	"
LINACs	N/A	RPI, AFRRI WSMR	1 mo	"
Fast Burst Reactors	N/A	Aberdeen, WSMR	1 mo	"
Tandetron Accelerator	N/A	Hexagon	9 yrs	"

Radiological Permit Application Supplement

Name: Youmans (Last) Robert (First) J (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth NJ	2 months	YES NO	YES NO
"	2 hrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Tandetron Accelerator	N/A	Myer Ctr	2 months	Experiments
~~Reflect~~				

Radiological Permit Application Supplement

Name: Lux (Last) Robert (First) A. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
U. of Chicago, U. of Wisconsin	6½ yrs	YES NO	YES NO
Ft. Monmouth	23 yrs	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
^{60}Co	120 kCi	Evans Area	15 yrs	Experiments
^{137}Cs	100 Ci	" "	"	"
^{241}Am	1 mCi	" "	"	"
Miscellaneous check sources	< 1 μCi	" "	"	Calibration
Flash X-ray	N/A	AFWL	1 wk	Experiments
Van de Graaff	N/A	Evans Area	15 yrs	"
Neutron Generator	N/A	" "	"	"
Fast Burst Reactors	N/A	Aberdeen, WSMR	1 wk	"
FM Synchrocyclotron	N/A	U of Chicago	1½ yr	"

STANDING OPERATING PROCEDURE

SOP NO: EC-412

TITLE: HIGH VOLTAGE ION ACCELERATOR / GENERAL IONEX TANDETRON

DIVISION/BRANCH: SOLID STATE BRANCH

PLACE OF OPERATION OR TEST: BLDG. 2700, ROOM 2D139

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: [signature]

for ERNEST POTENZIANI
Printed/Typed Name

APPROVED: [signature]

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 6 APRIL 1995

EXPIRES: 6 APRIL 1996

SOP NO: EC-412

SUBMITTED BY: ROBERT PFEFFER
Printed/Typed Name

Signature

Research Physicist
Title

6 April 1995
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. EC-412 . Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date
Robert J. Youmans	4/6/95
Robert Long	4/17/95

SOP: EC-412

TITLE: STANDING OPERATING PROCEDURE FOR HIGH-VOLTAGE ION ACCELERATOR (General Ionex Tandetron Model 4117A)

1. STATEMENT OF WORK: The General Ionex High Voltage Ion Accelerator (Model 4117A) is primarily used for performing Rutherford Backscattering Spectrometry (RBS) on device-related materials such as superconducting thin films to ascertain sample stoichiometry, interface diffusion, lateral uniformity, and crystalline defect density and strain.

It should be noted that depending on the particular arrangement of the experimental setup varying types of analyses can be performed, such as Ion-Beam Channeling, Nuclear Reaction Analysis (NRA), or Proton Induced X-ray Emission (PIXE).

Therefore, the specific experimental setup (i.e., beam energy, bombarding and target species) could strongly effect the potential hazards associated with the operation of this machine.

2. HAZARDS INVOLVED: There are three general areas of concern in the accelerator laboratory: (1) High Voltage, (2) Radiation, and (3) Hazardous Compounds.

HIGH VOLTAGE: The ion source at the injector floats at an extraction voltage of 20,000 V (20 kV) during normal operation.

IONIZING RADIATION: Emitted when the machine is operated under certain highly specific conditions:

a. X-rays

(1) Bremsstrahlung: A continuous spectrum of x-rays emitted when energetic electrons are rapidly decelerated. The main source of this is secondary electrons accelerated along the high energy end of the accelerator column. The accelerator column has been designed to completely suppress them. (Quarterly surveys by RPO confirm this.)

(2) X-rays proper: Products of certain nuclear reactions.

b. Gamma rays

Emitted from nuclei during certain nuclear reactions.

c. Neutrons

Emitted from nuclei during certain nuclear reactions.

HAZARDOUS COMPOUNDS:

a. Gases

(1) Sulfur Hexafluoride (high-voltage tank insulation) - nontoxic, irritant.

(2) Ammonia, oxygen, hydrogen, argon, helium, freon, and nitrogen (possible ion source gases).

b. Liquids

(1) Tetrachloroethylene, 1,1,1-Trichloroethane TCE (vacuum system cleaning solvents) - very harmful if inhaled or absorbed through the skin
- harmful if inhaled, causes irritation.

(2) Electron-emitting cathode coating, which contains: calcium, strontium, barium carbonate in a nitrocellulose vehicle (contains carbonyl nickel) - Nickel and nickel oxides are suspected carcinogens. Nickel metal has low oral toxicity, irritant. Hazardous decomposition products, such as CO, may be produced. High concentrations have a narcotic effect when inhaled.

(3) Propanol-2, acetone (1 gallon), deuterium oxide (1 quart), paint catalysts, vacuum oils (Precision 705, Santovac-5), and a variety of cleaning compounds and solvents.

c. Solids

(1) Cesium (ion source component) - reacts violently with water, flammable.

(2) Lithium (charge exchange canal component) - reacts violently with water, causes severe burns.

(3) Thallium containing thin-film superconducting material - Heavy metal poisoning if inhaled or absorbed through the skin. Toxicity related to ingestion (a cumulative effect).

(4) Epoxy, silicone rubber (vacuum system sealants) - irritates skin and eyes.

3. PROTECTION STANDARDS/LIMITS: The General Ionex High Voltage Ion Accelerator is designed to be safe and hazard free. However, an active safety program encompassing all of the potential dangers listed below is essential:

HIGH VOLTAGE: Ensure that the ion-source safety cage is properly mounted whenever the extraction voltage is to be applied.

RADIATION: The operator's manual states that "It is the responsibility of the operator to maintain calibrated radiation instrumentation appropriate to the beam being accelerated (page 3)." Periodic radiation measurements are presently being performed by the operator. Radiation Protection Officer (namely, Mr. Hugo Bianchi) is to receive copies of the status reports. Radiation badges have been found to be unnecessary, since the radiation emitted during operation (in the RBS/channeling mode) is not significantly above background. However, in other operating modes or at sufficiently high energies, the possibility of occurrence of any reactions whose emissions pose health threats should be seriously considered.

HAZARDOUS COMPOUNDS: Keep in appropriate storage area (cool, dry, etc). Use ventilation hoods, gloves, goggles, protective clothing, masks, etc., when appropriate. Carefully read warnings and safety labels on containers. If there is any doubt, contact the manufacturer, refer to appropriate literature, or consult an informed authority. Wash after handling. All personnel must review and understand the contents of the attached Material Safety Data Sheets.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are located throughout the machine to reduce the probability of accident, e.g., the interlocks shut down the injector if properly tripped.

(2) Shielding: Shielding for the high terminal voltage is provided using a portion of a sewer pipe to house the accelerating electrodes and insulating sulfur hexafluoride

b. Procedural Controls:

(1) Clothing: Protective clothing, eye covering and plastic gloves must be worn

where appropriate.

(2) First Aid/Fire Fighting Equipment: In case of a cesium metal spill, stand back from area and allow the small amount of cesium (1 gm) to react with air and burn away (controlled burn). If fire is out of control, extinguish with a "dry" type of fire extinguisher (located in an easily accessible location and properly maintained).

(3) Access Control: Located in the Accelerator Laboratory (room 2D139 of EPSD's Device Microanalysis Center). This room is kept locked if ever vacant, including those of normal working hours (8am - 5pm).

(4) Special Precautions: Use extreme caution when working on or near electrical connectors, power supplies, or ion sources. NEVER remove safety covers from ion sources while the high voltage ion source power supplies are ON. The operator shall inform adjacent personnel of high voltage, radiation, or chemical hazards. If a water leak from the water cooling lines should occur when the instrument is in operation, the instrument should be TURNED-OFF immediately and not powered- up until the leak is fixed.

5. SEQUENCE OF OPERATIONS: Please refer to the OEM operations manual for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that all ion source covers and high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies and/or the System Main Power Key and obtain qualified service before powering the instrument back up. If a water leak occurs while the instruments high voltage is on, IMMEDIATELY shut-down the system using the System Main Power Key. There is no danger with the cesium ion source while it is attached to the instrument, however, extreme caution must be taken when cleaning or reloading the ion source with cesium (refer to aforementioned precautions). Follow standard emergency procedures in case of fire, shock, or injury. Immediately notify supervisor, Branch, Division, and Safety Offices of EPSD. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	- 911
CECOM Health Clinic	- x22452/x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981 Beeper: 517-6560
EPSD Branch Office	- x43552/x42556

EPSD Division Office	- x42452/x42080
EPSD Division Safety	- x44418/x43635 Beeper: 517-7859
EPSD Safety Office	- x44936/x44717
POC: Dr. R. Pfeffer	- x42585

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER Mr. B. Widuta ET & DL B-2700 Rm 4D130	**2. PERMIT NO.** 044 **3. EXPIRATION DATE:** 1 Aug 95

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4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Veeco 2100 Ion Implanter	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when a implanter is in operation.

4. Personal dosimetry provided by CECOM Safety Office to be worn whenever the implanter is in operation.

5. Device to be used IAW SOP No. EM-107.

APPROVED: **DATE:** 1 Aug 92

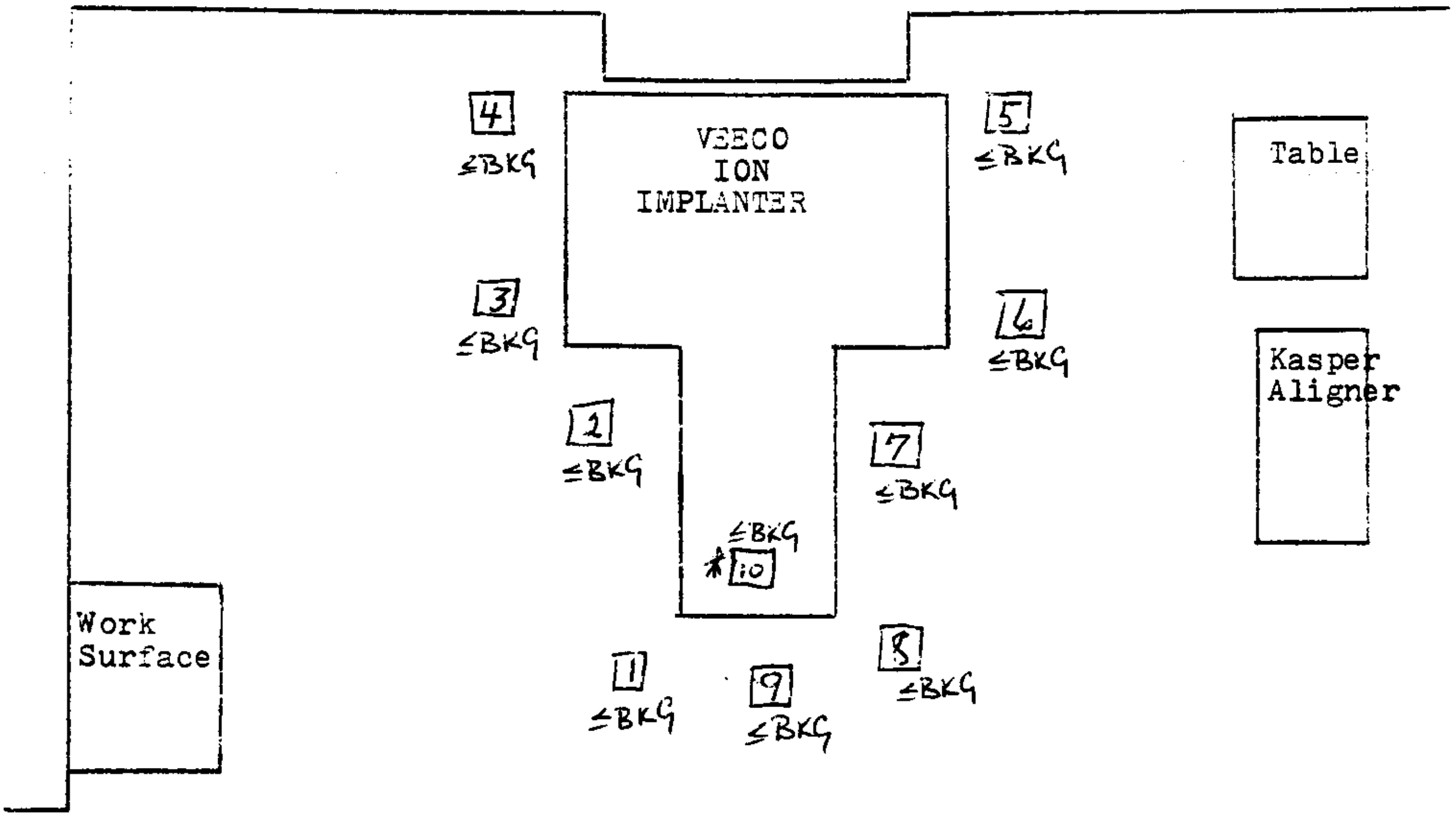
Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

RADIATION SURVEY

MEYER CENTER RM 4D130

Current 180ma 0-230KV
Ion-Phosphorous Focus Flag-Aluminum



Legend: * Contact reading
☐ Primary survey location

Background <0.2

Postings

SOP ✓

Caution Radioactive Mat'l N/A

Notice To Workers ✓

Section 206 N/A

NRC Form 3 N/A

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 **Serial #:** 3511

Surveyor: WILLIAM CRAIG **Date:** 8 DEC 93

RADIOLOGICAL PERMIT APPLICATION

Check One Date 7-8-92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 044

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit: Army Research laboratory

3. Radiation Area Supervisor: Name Robert Widuta

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
Boron 10, 11	Borontrifluoride	Gas	
Phosphorous 31	Phosphorous-Pentafluoride	Gas	
Silicon 28, 29, 30	Silicon Tetrafluoride	Gas	
Argon 40	Argon	Gas	
Hydrogen 1, 2	Hydrogen	Gas	
Oxygen 16	Oxyden	Gas	

5. Other Sources of Ionizing Radiation Producing Devices:

Carbon 12, 13	Carbon Dioxide	Gas
Deuterium	Deuterium	Gas
Nitrogen 2	Nitrogen	Gas
Boryllium 9	Beryllium oxide	solid

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Robert Widuta

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Albert J. Myer Center Bldg 2700 Rm 4D130

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

See Attached SOP#EM-107

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

Lead shielding around Hi Voltage term. Ion sources are inside of shield area.

10. Signature of Director of Responsible Individual:

Name Robert J. Zeto Signature ROBERT J. ZETO

CECOM SAFETY USE ONLY:

Instrumentation:

Dosimetry:

Reviewed by: ______________________ Date: ____________

Approved by: ______________________ Date: ____________

Radiological Permit Application Supplement

Name: Widuta (Last) Robert (First) C (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Varian IEG Woburn Ma Nova IEG Austin Tx	1 week	YES NO	YES NO
RCA MEC Somerville N.J.	1 week	YES NO	YES NO

2. Experience: 13 years ion implant operation and maintenance

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURE

SOP NO: EM-107

TITLE: Veeco 2100-MPR Ion Implanter

DIVISION/BRANCH: EDRD/Micro-Electronic Devices Branch (SLCET-EM)

PLACE OF OPERATION OR TEST: Room 4D130 Myer Center

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Robert J. Zeto

ROBERT J. ZETO
Printed/Typed Name

APPROVED:

Michael R. Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 11/20/1991

SOP NO: EM-107

EXPIRES: 12/20/92

SUBMITTED BY: Robert W. Widuta
Signature

R. Widuta
Printed/Typed Name

Research Physical Sci. Tech.
Title

15 October 1991
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EM-107. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Robert W. Widuta	1-8-92		

US ARMY ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY (LABCOM)

SOP NO. EM-107

TITLE: STANDING OPERATING PROCEDURE FOR VEECO 2100-MPR ION IMPLANTER

1. STATEMENT OF WORK: The 2100 implanter is used to implant various species of ions into silicon and gallium arsenide surfaces. The process is called doping. It is a large piece of equipment that is 16 ft long, 8 ft wide, 7 ft high and weighs 4 tons. Because of the presence of a 200 kV high voltage, highly toxic dopant gases, emission of radiation, exhaust system into scrubbers on roof, cooling water being pumped into the terminal magnet, complex circuitry that may be compromised, 80 lbs of nitrogen pressure on plastic hoses that activate large gate valves may burst, special safety precautions must be taken by those personnel operating and maintaining this system and for personnel working in the immediate area. This SOP is to be considered a supplement to the VEECO Ion Implanter manual. Before anyone may operate this system, they must be thoroughly familiar with this SOP.

2. HAZARDS INVOLVED: (1) Electrical, (2) Mechanical, (3) Toxic gases, (4) High Voltage, (5) High Pressure, (6) Radiation.

3. PROTECTION STANDARDS/LIMITS:

(A) Electrical: Electrical circuits can be damaged if process sequences are not followed. All breakers not related to the area being serviced must be off. Circuit boards may retain high potentials. Ground temporarily if possible.

(B) Mechanical: Removing contaminated oil from mechanical pump should be done using rubber gloves and disposed of into waste containers. Removal of mechanical pump from system for servicing must be done by two people to avoid injury.

(C) Toxic Gases: Toxic gases commonly used in the Implanter are Boron Trifluoride and Phosphorus Pentafluoride. These are in small steel cylinders and once installed into their respective slots in the high voltage terminal they pose no danger. All fittings are stainless steel and vacuum tight. The gases flow through evacuated lines into the ion source and are controlled by regulators and three safety valves. The cylinders are always shut off when not in use and lines are under vacuum. In case of a building fire they can be easily removed and disposed of.

In the event of a gas leak, after installation, personnel should evacuate the area and fire dept notified for safe removal.

(D) High Voltage: The 2100 Veeco Implanter is a Pre-analysis machine which means all components as the 175 kV and 200 kV terminals and associated electronics are above ground potential. The whole unit is isolated from ground by a pedestal assembly. It also houses a cryo pump and its compressor, the analyzing magnet, power supplies, accelerator tubes, ion source, and capacity for three gas cylinders. The complete system, called the high voltage terminal, is in an enclosed structure. Entrance is through two doors. Upon opening, two shorting bars simultaneously short out both terminals rendering it safe to enter. It is mandatory that any servicing done inside should be done by no less than two personnel familiar with the hazards of working with high voltages. Immediate first aid procedures for electrical shock should be available.

(E) High Pressure: The 2100 Veeco Implanter has components which require water for cooling and for actuating valves. Nitrogen is supplied at a pressure of 80 psi for opening and closing isolation and gate valves. A separate polyethylene line supplies 10 psi of nitrogen for back filling the target chamber. The nitrogen plastic lines are rated to hold pressures over 100 psi and if ruptured would pose no danger except to release nitrogen a neutral gas. DI water is pumped thru a number of hard plastic Eastman hoses for cooling three cryo-pump compressors, the 90 magnet, and associated electronic components. City water flows thru soft copper pipes for cooling the DI water thru a heat exchanger integrated into the main frame of the machine. The plastic city water line was replaced with copper to prevent flooding in case of a water line break.

(F) Radiation: The 2100 Veeco Implanter emits radiation as do all implanters which is characteristic of their functions. When the accelerated ions hit the target, secondary electrons are emitted as x-rays. All implanters are shielded by 1/8-in to 1/4-in thick Lead as required, to protect all personal in the vicinity of these machines. For added safety the Veeco 2100 implanter is daily checked for radiation leaks by a Geiger Counter made by DOSIMETER CORP Model 3007. The meter has a sensitivity from 0 to 0.5 mR/hr in the low range to 300 mr/hr in high range. Due to heavy shielding by Veeco Corp the 2100 implanter emits no detectable radiation.

4. SAFETY CONTROLS: The system has the following safety controls.

(A) Ventilation: Ventilation is be scrubbed exhaust and is connected to machine by a 6 inch flexible hose to the top of the high voltage terminal.

(B) Interlocks: System interlocks prevent the operation of the high voltage when the doors are open, a key controls the low voltage power supplies in the high voltage terminal.

(C) Shielding: Lead plate is surrounding the inside of the high voltage terminal walls, the end of the acceleration tube and the operator end of the implant chamber. No radiation leakage greater then back ground is detectable with a Geiger counter.

(D) Clothing: No particular clothing is required other then the clean room gloves while handling the wafer carousel.

(E) Monitoring: Listen for the sound of the air flow inside the terminal and check the scrubber power button on the wall next to the machine. Don't open doors if the exhaust is off.

(F) First Aid/Fire Fighting: No special first aid or fire fighting equipment is necessary, but familiarity with first aid for electrical shock or toxic gas inhalation is recommended.

(G) Access Control: The Veeco Ion Implanter is located in the ETDL's Microfabrication center (Bldg 2700, Room 4D-130). Access to this location is restricted by use of a coded magnetic key.

(H) Special Precautions: Keep hands and clothing clear of moving parts. Use caution when working with electrical parts. Ground the high voltage terminal when working inside.

(I) Gas Handling Precautions: Operators MUST observe all precautions and wear a an OBA unit (oxygen breathing apparatus), when changing any toxic gas cylinder.

5 SEQUENCE OF OPERATIONS: Check ion gauge controllers for vacuum reading below 10E-6 microns range, check water flow, and heck circuit breakers for power on. Vent implant chamber by pressing the vent button. When lid raises, remove carousel and load wafers into holders. Place carousel into chamber and press pump button to evacuate. Open regulator shut off valve to gas that is to be implanted. Activate terminal by turning key.

Adjust magnet control to gauss for gas being run. Increase filament to mid point adjust gas flow until the beam line vacuum is approx. 2E-6, and increase filament until the anode current raises.

Adjust magnet control until the beam current is at maximum. Turn on high voltage and increase to desired value, then refocus the beam, and adjust source controls for maximum beam current. When beam current is satisfactory, adjust the wafer counter for one more number then there are wafers. Press the run button on the console, and the implant button on the implant controller. (implant will begin and continue until the carousel gets to the last number entered on the wafer counter) Decrease the gas flow, filament control, high voltage. Press the vent button to removed wafers. Before anyone may operate this system, they must be thoroughly familiar with the operations manual.

6. EMERGENCY PROCEDURES:

(A) Known Power Outage

Place all vacuum systems into standby
Close all gas valves
Shut down all cryo pumps and mechanical pump
Turn off all circuit breakers

(B) Sudden Power Outage

Place all vacuum systems into standby
Shut off all circuit breakers
Shut down all cryo pumps and mechanical pump

(C) Others: Immediately notify Branch, Division, and Safety Offices of ETDL, and the Eaton Service Engineer. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police - 911
CECOM Health Clinic - x22452
Building Security - x44684/x42222
Building Manager - x44238/x42981
ETDL Branch Office - x43446/x44872
ETDL Division Office - x44308/x42452
ETDL Safety Office - x44717/x42739

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

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1. **USER:** Bob Widuta
   Physical Sciences Dir., ARL
   ATTN: AMSRL-PS-DA
   BLDG 2700, RM 4D130

2. **PERMIT NUMBER:** 044

3. **EXPIRATION DATE:** 1 MAY 97

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4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Ion Implanter VEECO 2100-MPR	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by the CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Implanter is in operation.

4. Personal dosimetry is required for operation of the Implanter.

5. System to be used IAW SOP No. ED-407, 10 April 1995.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO 5-10-95
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 3-13-95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 044

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit:
Army Research Laboratory

3. Radiation Area Supervisor: Name Robert Widuta

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
Boron 10,11	Boron Tri Fluoride	Gas	
Phosphorous 31	Phosphorous Penta Fluoride	Gas	
Silicon 28,29,30	Silicon Tetrafluoride	Gas	
Argon 40	Argon	Gas	
Hydrogen 1,2	Hydrogen	Gas	
Oxygen 16	Oxygen	Gas	

5. Other Sources of Ionizing Radiation Producing Devices: Ion Implanter

Sulfer 16	Sulfer Hexafluoride	Gas
Deuterium	Deuterium	Gas
nitrogen 2	nitrogen	Gas
Boryllium 9	Boryllium oxide	solid

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Robert Widuta

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Albert J. Myer Center Bldg 2700 Rm 4D13[illegible]

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

See Attached SOP # EM-107

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

Lead shielding around High voltage term. Ion sources are inside of shield area

10. Signature of Director of Responsible Individual:

Name [signature] Signature 14 Mar 95

CECOM SAFETY USE ONLY:

Instrumentation: None required, none provided.

Dosimetry: Provided by the CECOM Safety Office

Reviewed by: Hugo Bianchi Date: 28 Apr 95

Approved by: Joseph M. Santarius Date: 5-10-95

Radiological Permit Application Supplement

Name: Widuta (Last) Robert (First) C (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Varian IEG Woburn MA Nova IEG Austin TX	1 wk	YES NO	YES NO
RCA MEC Somerville NJ	1 wk	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURE

SOP NO. ED-407

TITLE: Ion Implanter (Veeco 2100-MPR)

DIVISION/BRANCH: Micro-Electronics Devices Branch

PLACE OF OPERATION OR TEST: Room 4C130 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: ROBERT ZETO

Charles O Mulford for RT Zeto
SIGNATURE

APPROVED:

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 10 April 1995

EXPIRES: 10 April 1996

SUBMITTED BY: ROBERT WIDUTA ______________________
Printed/Typed Name

____
Signature

Physical Science Technician ____________
Title

____
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. ________ . Further, I agree to follow all these procedures when performing this operation/test.

Signature Date

____

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ARMY RESEARCH LABORATORY (ARL)

SOP NO: ED-407

TITLE: STANDING OPERATING PROCEDURE FOR VEECO 2100-MPR ION IMPLANTER

1. STATEMENT OF WORK: The 2100 implanter is used to implant various species of ions into silicon and gallium arsenide surfaces. The process is called doping. It is a large piece of equipment that is 16 ft long, 8 ft wide, 7 ft high and weighs 4 tons. Because of the presence of a 200 kV high voltage, highly toxic dopant gases, emission of radiation, exhaust system into scrubbers on roof, cooling water being pumped into the terminal magnet, complex circuitry that may be compromised, 80 lbs of nitrogen pressure on plastic hoses that activate large gate valves may burst; special safety precautions must be taken by those personnel operating and maintaining this system and for personnel working in the immediate area. This SOP is to be considered a supplement to the VEECO Ion Implanter manual. Before anyone may operate this system, they must be thoroughly familiar with this SOP.

2. HAZARDS INVOLVED: (1) Electrical, (2) Mechanical, (3) Toxic gases, (4) High Voltage, (5) High Pressure, (6) Radiation.

3. PROTECTION STANDARDS/LIMITS:

(A) Electrical: Electrical circuits can be damaged if process sequences are not followed. All breakers not related to the area being serviced must be off. Circuit boards may retain high potentials. Ground temporarily if possible.

(B) Mechanical: Removing contaminated oil from mechanical pump should be done using rubber gloves and disposed of into waste containers. Removal of mechanical pump from system for servicing must be done by two people to avoid injury.

(C) Toxic Gases: Toxic gases commonly used in the Implanter are Boron Trifluoride and Phosphorus Pentafluoride. These are in small steel cylinders and once installed into their respective slots in the high voltage terminal ~~they~~, pose no danger. All fittings are stainless steel and vacuum tight. The gases flow through evacuated lines into the ion source and are controlled by regulators and three safety valves. The cylinders are always shut off when not in use and lines are under vacuum. In case of a building fire they can be easily removed and disposed of.

BORON TRIFLUORIDE (CAS NO. 7637-07-2):

TLV-C	1 ppm
IDLH	100 ppm

PHOSPHORUS PENTAFLUORIDE (CAS NO. 7647-19-0):
Intensely Irritating
Inhalation May Cause Pulmonary Edema

In the event of a gas leak, after installation, personnel should evacuate the area and fire dept notified for safe removal.

(D) High Voltage: The 2100 Veeco Implanter is a Pre-analysis machine which means all components as the 175 kV and 200 kV terminals and associated electronics are above ground potential. The whole unit is isolated from ground by a pedestal assembly. It also houses a cryo pump and its compressor, the analyzing magnet, power supplies, accelerator tubes, ion source, and capacity for three gas cylinders. The complete system, called the high voltage terminal, is in an enclosed structure. Entrance is through two doors. Upon opening, two shorting bars simultaneously short out both terminals rendering it safe to enter. It is mandatory that any servicing done inside should be done by no less than two personnel familiar with the hazards of working with high voltages. Immediate first aid procedures for electrical shock should be available.

(E) High Pressure: The 2100 Veeco Implanter has components which require water for cooling and for actuating valves. Nitrogen is supplied at a pressure of 80 psi for opening and closing isolation and gate valves. A separate polyethylene line supplies 10 psi of nitrogen for back filling the target chamber. The nitrogen plastic lines are rated to hold pressures over 100 psi and if ruptured would pose no danger except to release nitrogen a neutral gas. DI water is pumped thru a number of hard plastic Eastman hoses for cooling three cryo-pump compressors, the 90 magnet, and associated electronic components. City water flows thru soft copper pipes for cooling the DI water thru a heat exchanger integrated into the main frame of the machine. The plastic city water line was replaced with copper to prevent flooding in case of a water line break.

(F) Radiation: The 2100 Veeco Implanter emits radiation as do all implanters which is characteristic of their functions. When the accelerated ions hit the target, secondary electrons are emitted as x-rays. All implanters are shielded by 1/8-in to 1/4-in thick Lead as required, to protect all personal in the vicinity of these machines. For added safety the Veeco 2100 implanter is daily checked for radiation leaks by a Geiger Counter made by DOSIMETER CORP Model 3007. The meter has a sensitivity from 0 to 0.5 mR/hr in the low range to 300 mr/hr in high range. Due to heavy shielding by Veeco Corp the 2100 implanter emits no detectable radiation.

4. SAFETY CONTROLS: The system has the following safety controls.

(A) Ventilation: Ventilation is be scrubbed exhaust and is connected to machine by a 6 inch flexible hose to the top of the high voltage terminal.

(B) Interlocks: System interlocks prevent the operation of the high voltage when the doors are open, a key controls the low voltage power supplies in the high voltage terminal.

(C) Shielding: Lead plate is surrounding the inside of the high voltage terminal walls, the end of the acceleration tube and the operator end of the implant chamber. No radiation leakage greater then back ground is detectable with a Geiger counter.

(D) Clothing: No particular clothing is required other then the clean room gloves while handling the wafer carousel.

(E) Monitoring: Listen for the sound of the air flow inside the terminal and check the scrubber power button on the wall next to the machine. Don't open doors if the exhaust is off.

(F) First Aid/Fire Fighting: No special first aid or fire fighting equipment is necessary, but familiarity with first aid for electrical shock or toxic gas inhalation is recommended.

(G) Access Control: The Veeco Ion Implanter is located in the EPSD's Microfabrication center (Bldg 2700, Room 4D-130). Access to this location is restricted by use of a coded magnetic key.

(H) Special Precautions: Keep hands and clothing clear of moving parts. Use caution when working with electrical parts. Ground the high voltage terminal when working inside.

(I) Gas Handling Precautions: Operators MUST observe all precautions and wear a an OBA unit (oxygen breathing apparatus), when changing any toxic gas cylinder.

5 SEQUENCE OF OPERATIONS: Check ion gauge controllers for vacuum reading below 10E-6 microns range, check water flow, and heck circuit breakers for power on. Vent implant chamber by pressing the vent button. When lid raises, remove carousel and load wafers into holders. Place carousel into chamber and press pump button to evacuate. Open regulator shut off valve to gas that is to be implanted. Activate terminal by turning key. Adjust magnet control to gauss for gas being run. Increase filament to mid point adjust gas flow until the beam line vacuum is approx. 2E-6, and increase filament until the anode current raises.

Adjust magnet control until the beam current is at maximum. Turn on high voltage and increase to desired value, then refocus the beam, and adjust source controls for maximum beam current. When beam current is satisfactory, adjust the wafer counter for one more number then there are wafers. Press the run button on the console, and the implant button on the implant controller. (implant will begin and continue until the carousel gets to the last number entered on the wafer counter) Decrease the gas flow, filament control, high voltage. Press the vent button to removed wafers. Before anyone may operate this system, they must be thoroughly familiar with the operations manual.

6. EMERGENCY PROCEDURES:

(A) Known Power Outage

Place all vacuum systems into standby
Close all gas valves
Shut down all cryo pumps and mechanical pump
Turn off all circuit breakers

(B) Sudden Power Outage

Place all vacuum systems into standby
Shut off all circuit breakers
Shut down all cryo pumps and mechanical pump

(C) Others: Immediately notify Branch, Division, and Safety Offices of EPSD, and the Eaton Service Engineer. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	911
CECOM Health Clinic	x22452
Building Security	x44684/x42222
Building Manager	x44238/x42981
EPSD Branch Office	x43446/x44872
EPSD Division Office	x44308/x42452
ETDL Safety Office	x44936

STANDING OPERATING PROCEDURE

SOP NO. ED-407

TITLE: ION IMPLANTER (Veeco 2100-MPR)

DIVISION/BRANCH: Micro-Electronic Devices Branch

PLACE OF OPERATION OR TEST: Room 4C130 Myer Center

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A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: ROBERT ZETO

Robert Zeto

SIGNATURE

APPROVED:

M. Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 10 April 1995

EXPIRES: 10 April 1996

SUBMITTED BY: ROBERT WIDUTA
Printed/Typed Name

Signature

Physical Scientist Technician
Title

Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. ED-407 . Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date

ARMY RESEARCH LABORATORY (ARL)

SOP NO: ED-407

TITLE: STANDING OPERATING PROCEDURE FOR VEECO 2100-MPR ION IMPLANTER

1. STATEMENT OF WORK: The 2100 implanter is used to implant various species of ions into silicon and gallium arsenide surfaces. The process is called doping. It is a large piece of equipment that is 16 ft long, 8 ft wide, 7 ft high and weighs 4 tons. Because of the presence of a 200 kV high voltage, highly toxic dopant gases, emission of radiation, exhaust system into scrubbers on roof, cooling water being pumped into the terminal magnet, complex circuitry that may be compromised, 80 lbs of nitrogen pressure on plastic hoses that activate large gate valves may burst, special safety precautions must be taken by those personnel operating and maintaining this system and for personnel working in the immediate area. This SOP is to be considered a supplement to the VEECO Ion Implanter manual. Before anyone may operate this system, they must be thoroughly familiar with this SOP.

2. HAZARDS INVOLVED: (1) Electrical, (2) Mechanical, (3) Toxic gases, (4) High Voltage, (5) High Pressure, (6) Radiation.

3. PROTECTION STANDARDS/LIMITS:

(A) Electrical: Electrical circuits can be damaged if process sequences are not followed. All breakers not related to the area being serviced must be off. Circuit boards may retain high potentials. Ground temporarily if possible.

(B) Mechanical: Removing contaminated oil from mechanical pump should be done using rubber gloves and disposed of into waste containers. Removal of mechanical pump from system for servicing must be done by two people to avoid injury.

(C) Toxic Gases: Toxic gases commonly used in the Implanter are Boron Trifluoride and Phosphorus Pentafluoride. These are in small steel cylinders and once installed into their respective slots in the high voltage terminal they pose no danger. All fittings are stainless steel and vacuum tight. The gases flow through evacuated lines into the ion source and are controlled by regulators and three safety valves. The cylinders are always shut off when not in use and lines are under vacuum. In case of a building fire they can be easily removed and disposed of.

BORON TRIFLUORIDE (CAS NO. 7637-07-2):

TLV-C	1 ppm
IDLH	100 ppm

PHOSPHORUS PENTAFLUORIDE (CAS NO. 7647-19-0):
Intensely Irritating
Inhalation May Cause Pulmonary Edema

In the event of a gas leak, after installation, personnel should evacuate the area and fire dept notified for safe removal.

(D) High Voltage: The 2100 Veeco Implanter is a Pre-analysis machine which means all components as the 175 kV and 200 kV terminals and associated electronics are above ground potential. The whole unit is isolated from ground by a pedestal assembly. It also houses a cryo pump and its compressor, the analyzing magnet, power supplies, accelerator tubes, ion source, and capacity for three gas cylinders. The complete system, called the high voltage terminal, is in an enclosed structure. Entrance is through two doors. Upon opening, two shorting bars simultaneously short out both terminals rendering it safe to enter. It is mandatory that any servicing done inside should be done by no less than two personnel familiar with the hazards of working with high voltages. Immediate first aid procedures for electrical shock should be available.

(E) High Pressure: The 2100 Veeco Implanter has components which require water for cooling and for actuating valves. Nitrogen is supplied at a pressure of 80 psi for opening and closing isolation and gate valves. A separate polyethylene line supplies 10 psi of nitrogen for back filling the target chamber. The nitrogen plastic lines are rated to hold pressures over 100 psi and if ruptured would pose no danger except to release nitrogen a neutral gas. DI water is pumped thru a number of hard plastic Eastman hoses for cooling three cryo-pump compressors, the 90 magnet, and associated electronic components. City water flows thru soft copper pipes for cooling the DI water thru a heat exchanger integrated into the main frame of the machine. The plastic city water line was replaced with copper to prevent flooding in case of a water line break.

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4. SAFETY CONTROLS: The system has the following safety controls.

(A) Ventilation: Ventilation is be scrubbed exhaust and is connected to machine by a 6 inch flexible hose to the top of the high voltage terminal.

(B) Interlocks: System interlocks prevent the operation of the high voltage when the doors are open, a key controls the low voltage power supplies in the high voltage terminal.

(C) Shielding: Lead plate is surrounding the inside of the high voltage terminal walls, the end of the acceleration tube and the operator end of the implant chamber. No radiation leakage greater then back ground is detectable with a Geiger counter.

(D) Clothing: No particular clothing is required other then the clean room gloves while handling the wafer carousel.

(E) Monitoring: Listen for the sound of the air flow inside the terminal and check the scrubber power button on the wall next to the machine. Don't open doors if the exhaust is off.

(F) First Aid/Fire Fighting: No special first aid or fire fighting equipment is necessary, but familiarity with first aid for electrical shock or toxic gas inhalation is recommended.

(G) Access Control: The Veeco Ion Implanter is located in the EPSD's Microfabrication center (Bldg 2700, Room 4D-130). Access to this location is restricted by use of a coded magnetic key.

(H) Special Precautions: Keep hands and clothing clear of moving parts. Use caution when working with electrical parts. Ground the high voltage terminal when working inside.

(I) Gas Handling Precautions: Operators MUST observe all precautions and wear a an OBA unit (oxygen breathing apparatus), when changing any toxic gas cylinder.

5 SEQUENCE OF OPERATIONS: Check ion gauge controllers for vacuum reading below 10E-6 microns range, check water flow, and heck circuit breakers for power on. Vent implant chamber by pressing the vent button. When lid raises, remove carousel and load wafers into holders. Place carousel into chamber and press pump button to evacuate. Open regulator shut off valve to gas that is to be implanted. Activate terminal by turning key. Adjust magnet control to gauss for gas being run. Increase filament to mid point adjust gas flow until the beam line vacuum is approx. 2E-6, and increase filament until the anode current raises.

Adjust magnet control until the beam current is at maximum. Turn on high voltage and increase to desired value, then refocus the beam, and adjust source controls for maximum beam current. When beam current is satisfactory, adjust the wafer counter for one more number then there are wafers. Press the run button on the console, and the implant button on the implant controller. (implant will begin and continue until the carousel gets to the last number entered on the wafer counter) Decrease the gas flow, filament control, high voltage. Press the vent button to removed wafers. Before anyone may operate this system, they must be thoroughly familiar with the operations manual.

6. EMERGENCY PROCEDURES:

(A) Known Power Outage

Place all vacuum systems into standby
Close all gas valves
Shut down all cryo pumps and mechanical pump
Turn off all circuit breakers

(B) Sudden Power Outage

Place all vacuum systems into standby
Shut off all circuit breakers
Shut down all cryo pumps and mechanical pump

(C) Others: Immediately notify Branch, Division, and Safety Offices of EPSD, and the Eaton Service Engineer. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	911
CECOM Health Clinic	x22452
Building Security	x44684/x42222
Building Manager	x44238/x42981
EPSD Branch Office	x43446/x44872
EPSD Division Office	x44308/x42452
ETDL Safety Office	x44936

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. **USER:** Melanie Cole
   EDRD, ARL
   ATTN: AMSRL-EP-EC
   BLDG 2700, RM 1B121/123

2. **PERMIT NUMBER:** 099

3. **EXPIRATION DATE:** 02 JUN 97

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4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Transmission Electron Microscope (TEM), JEOL, Model 2010, SN: 135009-20	N/A	N/A

CONDITIONS:

1. Facility/TEM to be surveyed on a semi-annual basis by the CECOM Safety Office. System interlocks will be tested during the survey.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the TEM is in operation.

4. Device listed in item 4 shall be used in accordance with ARL SOP number EC-401.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 02 JUN 94

RADIOLOGICAL PERMIT APPLICATION

Check One

Date May 31 '94

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. # 099

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit: ARL; EPSD

3. Radiation Area Supervisor: Name Melanie Cole

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
N/A	N/A	N/A	

5. Other Sources of Ionizing Radiation Producing Devices:

Jeol 2010 200 KeV Transmission Electron Microscope
Serial No 135009-20

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Melanie Cole

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

ALBERT J MYER CTR rm 121/123 1B

X44052, X42369

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

ATTACH SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

The microscope has lead shields along column & high voltage has safety interlocks.
NO protective clothing is needed to be worn

10. Signature of Director of Responsible Individual:

Name Kenneth A Jones Signature MWE for KAJ

CECOM SAFETY USE ONLY:

Instrumentation: None issued

Dosimetry: None used/issued

Reviewed by: Hugo Bianchi **Date:** 2 Jun 94

Approved by: [signature] **Date:** 2 Jun 94

Radiological Permit Application Supplement

Name: Cole, (Last) Melanie (First) ow (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Iowa State Univ. X-ray diffraction		YES NO	YES NO
US Army ETDL Transmission electron microscope		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
N/A	N/A	N/A	N/A	N/A

STANDING OPERATING PROCEDURE

SOP NO: EC-401

TITLE: TEM (JEOL 2010)

DIVISION/BRANCH: EDRD/Electronic Materials, Processes and Analysis Branch (AMSRL-EP-EC)

PLACE OF OPERATION OR TEST: Room 1B121/123 Myer Center

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth A Jones

KENNETH JONES
Printed/Typed Name

APPROVED:

MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 02/14/1994

SOP NO: EC-401

EXPIRES: 2/14/95

SUBMITTED BY: Melvina W. Cole
Signature

Dr. M. COLE, x44052
Printed/Typed Name

Research Physical Scientist
Title

14 February 1994
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EC-401. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Melvina W. Cole	3-1-94		

TITLE: STANDING OPERATING PROCEDURE FOR TRANSMISSION ELECTRON MICROSCOPE (JEOL 2010)

1. STATEMENT OF WORK: The JEOL-2010 TEM is used to perform microscopy and energy dispersive x-ray analysis on thin foil materials. Applications usually involve electronic materials. however. any conducting or semi-conducting solid-phase non-radioactive material can be analyzed.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 200 kV) and possible generation of x-rays special safety precautions must be taken by those personal operating and maintaining this system. The instrument has been surveyed while in operating and no stray x-rays have ever been detected. This SOP is to be considered a supplement to the JEOL 2010 TEM operations manual. Before anyone may operate they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: In the routine operation of this microscope, there is no contact with any type of volatile chemical. Procedures before and after may require additional precautions.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. The high voltage will shut down if the vacuum gets too low or if the column or gun chamber is tampered with. It must always be manually switched on after a failure. However, if the interlock system appears not to be working (no power), do not use the instrument and immediately call for qualified service. For details on the safety interlock system, please refer to the JEOL 2010 TEM operations manual.

(2) Shielding: The high voltage power supply has safety covers to shield operators from High Voltages. Removal of any of these covers may expose personal to High Voltage sources. **NEVER** remove these covers while the instruments power is on. Repair of high voltage power supplies should be performed by qualified personnel or JEOL service engineers.

b. Procedural Controls:

(1) Clothing: No special requirements. In the case of pregnant women as operators, it is suggested by some health professionals that a lead vest be worn as a protective measure against any stray x-rays.

(2) Monitoring: If any of the monitoring systems indicate there is a problem, leave the area **IMMEDIATELY**, and notify the EPSD safety officer. **DO NOT** reenter the area until notified by the safety officer - **ALL CLEAR**.

(3) First Aid/Fire Fighting Equipment: Control, extinguish with dry type fire extinguisher.

(4) Access Control: The JEOL 2010 TEM is located on the first floor of the Albert J. Myer Research Center room 1B121/123 (Bldg 2700). This room is controlled by magnetic key locks at all times. Not more than six people have access at this time.

(5) Special Precautions: Use extreme caution when working on or near electrical connectors, and power supplies. If the water cooling lines to the oil diffusion pump should leak the instrument shall be **TURNED OFF** immediately and not powered- up until the water leak is fixed and surrounding parts and environment dried.

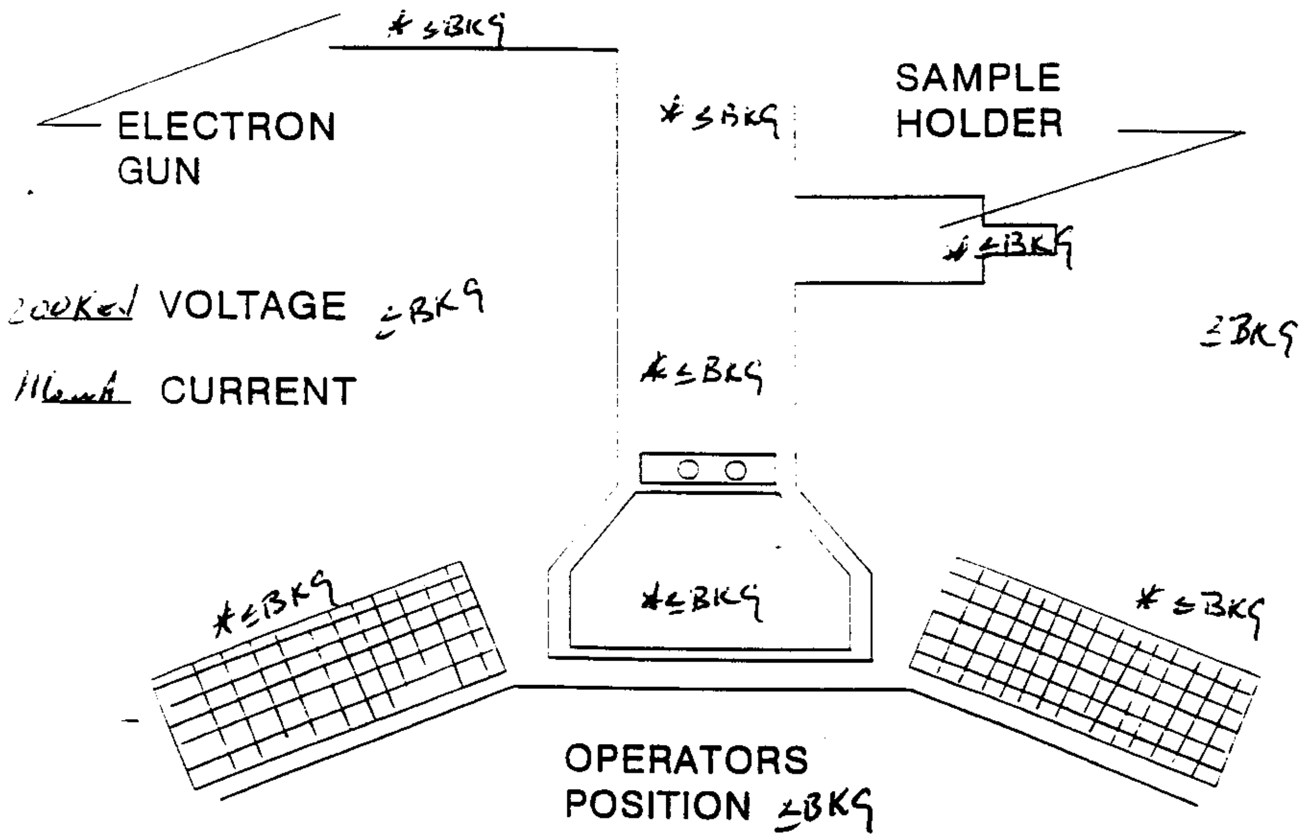
5. SEQUENCE OF OPERATIONS: One must refer to the JEOL 2010 TEM operations manual for a full detailed operational procedure before operating. Verify that all safety interlocks are energized. Check that all high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies and/or the system main back up. If a water leak occurs while the instruments high voltage is on, **IMMEDIATELY** shut-down the system using the system main power switch. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Immediately notify supervisor, Branch, Division, and Safety Offices of EPSD. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

	Fire Department, First Aid, Police	- 911
	CECOM Health Clinic	- x22452/x44484
	Building Security	- x44684/x42222
	Building Manager	- x44238/x42981 Beeper: 517-6560
	EPSD Branch Office	- x43552/x42556
	EPSD Division Office	- x42452/x42080
	EPSD Division Safety	- x44418/x43635 Beeper: 517-7859
	EPSD Safety Office	- x44936/x44717
POC:	M.W. Cole	- x44052/x42369

RADIATION SURVEY
JEOL TEM MODEL 20K
MEYER CENTER RM 1B123



Legend: * Contact reading
○ Wipe Location

Background 1.34E-2 mR/hr
Background N/A mrem/hr

Postings

SOP/Radiation Permit ✓
Caution Radioactive Mat'l N/A
Caution Radiation Area N/A
Caution High Rad Area N/A

Dosimetry Requirements N/A
NRC Form 3 N/A
Section 206 N/A
Notice to Workers ✓

Radiation Area Monitors Sourced Checked Passed/Failed/N/A
Interlock Systems Checked Passed/Failed/N/A

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument/Probe: ESP-2 / HP 270

Inst./Probe Serial #: 1088 / 1088-1 Pre Op Checks Performed: Sat/Unsat

Cal Due Date: 23 Jan 94 Surveyor: William Craig Date: 16 Jun 94

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. **USER:** Melanie Cole Physical Sciences Dir., ARL ATTN: AMSRL-EP-EC BLDG 2700, RM 1B121/123	2. **PERMIT NUMBER:** 099 3. **EXPIRATION DATE:** 01 MAY 97

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4. **MATERIAL/DEVICE**	5. **CHEMICAL/PHYSICAL FORM**	6. **ACTIVITY**
Transmission Electron Microscope (TEM), JEOL, Model 2010, SN: 135009-20	N/A	N/A

CONDITIONS:

1. Facility/TEM to be surveyed on a semi-annual basis by the CECOM Safety Office. System interlocks will be tested during the survey.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the TEM is in operation.

4. Device listed in item 4 shall be used in accordance with ARL SOP No. EC-401, 28 APR 95.

APPROVED: Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 01 MAY 95

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Myer ctr bldg 2700 rm 18121/123

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP attached

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

This is described in SOP; The microscope has lead shields along column, high voltage has safety interlocks
No protective clothing is needed to be worn

10. Signature of Director or Responsible Individual:

Name Melanie Will Cole Signature Melanie Will Cole

CECOM SAFETY USE ONLY:

Instrumentation: None provided

Dosimetry: None provided.

Reviewed by: Hugo Bianchi Date: 28 Apr 95

Approved by: Joseph M. Santarosa Date: 1 May 95

Radiological Permit Application Supplement

Name: Cole (Last) Melanie (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL	6 mo on Job training	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
TEM	N A	1B121	8 yrs	NA
STEM	N A	1B121	8 yrs	N A
SEM	N A	1B121	8 yrs	N A
EDX	N A	1B121	8 yrs	NA

STANDING OPERATING PROCEDURE

SOP NO: EC-401

TITLE: TEM (JEOL 2010)

DIVISION/BRANCH: EDRD/Electronic Materials, Processes and Analysis Branch (AMSRL-EP-EC)

PLACE OF OPERATION OR TEST: Room 1B121/123 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth Jones

KENNETH JONES
Printed/Typed Name

APPROVED: Michael Walterschied
MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 4/28/95

SOP NO: EC-401

EXPIRES: 4/28/96

SUBMITTED BY: Melanie W. Cole
Signature

Dr. M. Cole
Printed/Typed Name

Research Physical Scientist
Title

27 April 1995
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EC-401. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Melanie Cole	27 Apr 95		

ARMY RESEARCH LABORATORY (ARL)

SOP NO: EC-401

TITLE: STANDING OPERATING PROCEDURE FOR TRANSMISSION ELECTRON MICROSCOPE (JEOL 2010)

1. STATEMENT OF WORK: The JEOL-2010 TEM is used to perform microscopy and energy dispersive x-ray analysis on thin foil materials. Applications usually involve electronic materials, however, any conducting or semi-conducting solid-phase non-radioactive material can be analyzed.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 200 kV) and possible generation of x-rays special safety precautions must be taken by those personal operating and maintaining this system. The instrument has been surveyed while in operating and no stray x-rays have ever been detected. This SOP is to be considered a supplement to the JEOL 2010 TEM operations manual. Before anyone may operate they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: In the routine operation of this microscope, there is no contact with any type of volatile chemical. Procedures before and after may require additional precautions.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. The high voltage will shut down if the vacuum gets too low or if the column or gun chamber is tampered with. It must always be manually switched on after a failure. However, if the interlock system appears not to be working (no power), do not use the instrument and immediately call for qualified service. For details on the safety interlock system, please refer to the JEOL 2010 TEM operations manual.

(2) Shielding: The high voltage power supply has safety covers to shield operators from High Voltages. Removal of any of these covers may expose personal to High Voltage sources. **NEVER** remove these covers while the instruments power is on. Repair of high voltage power supplies should be performed by qualified personnel or JEOL service engineers.

b. Procedural Controls:

(1) Clothing: No special requirements. In the case of pregnant women as operators, it is suggested by some health professionals that a lead vest be worn as a protective measure against any stray x-rays.

(2) Monitoring: If any of the monitoring systems indicate there is a problem, leave the area **IMMEDIATELY**, and notify the EPSD safety officer. **DO NOT** reenter the area until notified by the safety officer - **ALL CLEAR**.

(3) First Aid/Fire Fighting Equipment: Control, extinguish with dry type fire extinguisher.

(4) Access Control: The JEOL 2010 TEM is located on the first floor of the Albert J. Myer Research Center room 1B121/123 (Bldg 2700). This room is controlled by magnetic key locks at all times. Not more than six people have access at this time.

1910.306(f)(1) X-Ray Equipment - Disconnecting means: A disconnecting means shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the x-ray control.

(5) Special Precautions: Use extreme caution when working on or near electrical connectors, and power supplies. If the water cooling lines to the oil diffusion pump should leak the instrument shall be **TURNED OFF** immediately and not powered- up until the water leak is fixed and surrounding parts and environment dried.

5. SEQUENCE OF OPERATIONS: One must refer to the JEOL 2010 TEM operations manual for a full detailed operational procedure before operating. Verify that all safety interlocks are energized. Check that all high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies and/or the system main back up. If a water leak occurs while the instruments high voltage is on, **IMMEDIATELY** shut-down the system using the system main power switch. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Immediately notify supervisor, Branch, Division, and Safety Offices of EPSD. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	- 911
CECOM Health Clinic	- x22452/x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981 Beeper: 517-6560
EPSD Branch Office	- x43552/x42556
EPSD Division Office	- x42452/x42080
EPSD Division Safety	- x44418/x43635 Beeper: 517-7859
EPSD Safety Office	- x44936
POC: M.W. Cole	- x44052/x42369

Immediately notify supervisor, Branch, Division, and Safety Offices of EPSD. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	- 911
CECOM Health Clinic	- x22452/x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981 Beeper: 517-6560
EPSD Branch Office	- x43552/x42556
EPSD Division Office	- x42452/x42080
EPSD Division Safety	- x44418/x43635 Beeper: 517-7859
EPSD Safety Office	- x44936
POC: M.W. Cole	- x44052/x42369

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Melanie Cole Physical Sciences Dir., ARL ATTN: AMSRL-EP-EC BLDG 2700, RM 1B121/123	**2. PERMIT NUMBER:** 099 **3. EXPIRATION DATE:** 01 MAY 97

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Transmission Electron Microscope (TEM), JEOL, Model 2010, SN: 135009-20	N/A	N/A

CONDITIONS:

1. Facility/TEM to be surveyed on a semi-annual basis by the CECOM Safety Office. System interlocks will be tested during the survey.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the TEM is in operation.

4. Device listed in item 4 shall be used in accordance with ARL SOP No. EC-401, 28 APR 95.

APPROVED: Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 01 MAY 95

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Melanie Cole
Physical Sciences Dir., ARL
ATTN: AMSRL-EP-EC
BLDG 2700, RM 1B121/123

2. PERMIT NUMBER: 099

3. EXPIRATION DATE: 01 MAY 97

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Transmission Electron Microscope (TEM), JEOL, Model 2010, SN: 135009-20	N/A	N/A

CONDITIONS:

1. Facility/TEM to be surveyed on a semi-annual basis by the CECOM Safety Office. System interlocks will be tested during the survey.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the TEM is in operation.

4. Device listed in item 4 shall be used in accordance with ARL SOP No. EC-401, 28 APR 95.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 01 MAY 95

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER:

Dr. Ernest Potenziani
ET & DL
B. 2700 Rm 4C111

2. PERMIT NUMBER: 026

3. EXPIRATION DATE: 1 MAY 95

---

4. MATERIAL/DEVICE:	5. CHEMICAL/PHYSICAL FORM:	6. ACTIVITY:
Cobalt-57/Mossbauer Spectrometer	Palladium Matrix/ Encapsulated solid	< 1.0 mCi

---

CONDITIONS:

1. Facility to be surveyed on a monthly basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Mossbauer source is in operation.

4. Personal dosimetry provided by CECOM Safety Office to be worn whenever the Mossbauer source is in operation.

5. RADIAC meter provided by CECOM Safety Office must be used by operator when ever the Mossbauer source is in operation.

6. Source to be used IAW SOP No. EP-105.

APPROVED:

Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br
Radiation Protection Officer

DATE: 1 MAY 92

RADIOLOGICAL PERMIT APPLICATION

Check One **Date** 25 Feb 1992

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 026

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit:
ET&D Lab (SLCET-ET-H) LABCOM

3. Radiation Area Supervisor: Name Dr. Ernest Potenziani II

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form Activity (mCi)
Cobalt-57	Paladium Matrix	Encapsulated solid, less than 1 mCi

5. Other Sources of Ionizing Radiation Producing Devices:

None

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Dr. Ernest Potenziani II

Dr. Arthur Tauber

Mr. Robert Finnegan

7. **Locations where source(s) of ionizing radiation will be used (Bldg, rm):**

Myer Center (Hexagon Bldg), Room 4D110/4C111

8. **Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.**

Current SOP is attached

9. **Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)**

Lead apron, fume hoods, radiation survey meter and a lead enclosure for the Mossbauer spectrometer are available.

10. **Signature of Director of Responsible Individual:**

Name Dr. Joel Shappirio **Signature** Joel Shappirio

CECOM SAFETY USE ONLY:

Instrumentation: (1) Ludlum Model 5, SN: 44281

Dosimetry: Whole Body and Wrist B·G TLD's are provided by CSO.

Reviewed by: Hugo Bianchi **Date:** 23 Mar 92

Approved by: Joseph M. Fantasia **Date:** 23 Mar 92

Radiological Permit Application Supplement

Name: Potenziani, (Last) Ernest (First) II (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi	Columbia U, NY, NY	3 yrs	Mossbauer Spectr
Cobalt-57	15 mCi	Ft. Monmouth	8 yrs	Mossbauer Spectr
Europium 149	20 mCi	Ft Monmouth	3 months	Mossbauer Spectr.

Radiological Permit Application Supplement

Name: Tauber, Arthur
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi initially	Myer Ctr	10 years	Mossbauer Spect

Radiological Permit Application Supplement

Name: Finnegan, Robert
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi initially	Myer Ctr	10 years	Mossbauer Spectr

USA ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

SOP NO: ET - 105

TITLE: STANDING OPERATING PROCEDURE FOR MÖSSBAUER SPECTROSCOPY SYSTEM

1. **STATEMENT OF WORK:** The Mössbauer spectrometer is to be used for the non-destructive testing of iron-bearing materials.

2. **HAZARDS INVOLVED:** This system utilizes a radioactive ^{57}Co source, of no greater strength than 25 mCuries.

3. **PROTECTION STANDARDS/LIMITS:** The radiation level outside the posted area can be no greater than twice the normal background level (0.1 mREM/hour). If the level is greater, leave the area and notify radiation safety. Any levels greater than 5 mREM/hour should be considered extremely serious.

4. **SAFETY CONTROLS:**

   a. Engineering Controls: The source will always be operated in the provided lead enclosure (locked) or stored in its associated lead pig.

   b. Procedural Controls:
      1. All users will familiarize themselves with the proper operation of all equipment and their manuals.
      2. All personnel not directly involved with the system will leave the area whenever the lead box is unlocked and opened.
      3. The lead box will never be left unattended while unlocked.
      4. All personnel will wear their issued wrist/body radiation film badges while the lead box is opened. The film badges will be changed monthly by the Radiation Safety office.
      5. Gloves are to be worn while handling the source. Radiation Safety will perform periodic wipe tests of the source to test the integrity of the plastic encapsulant.
      6. Dr. Potenziani will unlock the lead box when necessary. In emergencies, one can break the glass in the box on the wall next to the system.
      7. Any new personnel requiring access to the source will first receive training by Radiation Safety and obtain a radiation film badge. All personnel using the system will receive annual training. Failure to do either of the above will result

in the loss of access privileges for the system.

8. The lead box containing the radioactive source will be clearly marked by radiation warning signs. If the source is to be removed (after first obtaining permission from Radiation Safety), the signs will be taken down.
9. If the system or its surrounding are on fire, **NO** personnel except authorized firefighters will enter the lab or approach the system.
10. Upon surpassing the useful life of the source, radiation safety will be called in for proper transportation and disposal.
11. A calibrated, functional radiation counter will always be available for periodic checks of environmental radiation levels.

5. SEQUENCE OF OPERATIONS:

a. Put on wrist and body radiation film badges.
b. Unlock lead box and load sample on holder. Lock box.
c. Turn on MCA, amplifiers and proportional counter tube.
d. Load running parameters into the MCA and begin operation.

6. EMERGENCY PROCEDURES:

All accidents are to receive immedite medical attention and are to be reported to the Safety Officer and Radiation Safety Officer within one hour!

Fire Department, First Aid, Police - 911
Nurse - 44484
Security - 44684/42222
Health Physics Off. - 44427/42981
Installation Safety Office - 20083

Radiation Safety - 45606

Bldg. Manager - 44238/42981

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Dr. E. Potenziani
Physical Sciences Dir., ARL
ATTN: AMSRL-EP-EC-H
BLDG 2700, RM 4C111

2. PERMIT NUMBER: 026

3. EXPIRATION DATE: 1 MAY 97

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Cobalt 57 Mossbauer Spectroscopy System	Solid Paladium Matrix	Encapsulated solid, 0.05 mCi

---

CONDITIONS:

1. Mossbauer Spectroscopy System to be surveyed on a monthly basis by the CECOM Safety Office.

2. Source may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Mossbauer System is in operation.

4. Personal dosimetry is required for operation of the Mossbauer Spectroscopy System.

5. RADIAC meter to be used by operator whenever the Mossbauer Spectroscopy System is in operation.

6. System to be used IAW SOP No. EC-419, 10 APR 95.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 20 Mar 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 026

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: EPSD (AMSRL-EP-EC-H) ARL

3. Radiation Area Supervisor: Name Dr. Ernest Potenziani

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form Activity (mCi)
Cobalt-57	Solid,Paladium Matrix	Encapsulated Solid, 25 mCi in 1986;now about .05 mCi

5. Other Sources of Ionizing Radiation Producing Devices:

none

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Dr. Ernest Potenziani II

Dr. Arthur Tauber

Mr. Robert Finnegan

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Myer Center, Room 4D110/4C111

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

Current SOP is attached

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

Lead apron, fume hoods, radiation survey meter, locked lead enclosure for the entire Mossbauer spectrometer, body & wrist badges, latex gloves

10. Signature of Director of Responsible Individual:

Name Dr. Mike Tompsett **Signature** M Tompsett

CECOM SAFETY USE ONLY:

Instrumentation: Provided by CECOM Safety Office

Dosimetry: Provided by CECOM Safety Office. (WB + Wrist)

Reviewed by: Hugo Bianchi **Date:** 28 Apr 95

Approved by: Joseph M. Santarsiero **Date:** 5-10-95

Radiological Permit Application Supplement

Name: Potenziani, Ernest II
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi	Columbia U. NY, NY	3 years	Mossbauer Spectrometer
Cobalt-57	15 McI	Ft. Monmouth	8 years	Mossbauer spectrometer
Europium 149	20 mCi	Ft. Monmouth	3 months	Mossbauer Spectrometer
Cobalt -57	25 mCi	Ft. Monmouth	7 years	Mossbauer ~~Spectrometer~~

Radiological Permit Application Supplement

Name: Tauber (Last) Arthur (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi	Ft. Monmouth	8 years	Mossbauer
Cobalt-57	25 mCi	Ft.Monmouth	6 years	Mossbauer

Radiological Permit Application Supplement

Name: Finnegan, (Last) Robert (First) D. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	annual	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt-57	15 mCi	Ft.Monmouth	8 years	Mossbauer
Cobalt-57	25 mCi	Ft. Monmouth	6 years	Mossbauer

STANDING OPERATING PROCEDURE

SOP NO. EC-419

TITLE: Mossbauer Spectroscopy System

DIVISION/BRANCH: Solid State Branch

PLACE OF OPERATION OR TEST: Room 4D110 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: ERNEST POTENZIANI

SIGNATURE

APPROVED:

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 10 April 1995

EXPIRES: 10 April 1996

SOP NO. EC-419

SUBMITTED BY: Dr. E. Potenziani
Printed/Typed Name

Signature

Research Physicist
Title

28 Apr 95
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. _______ . Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date
Robert D Finnegan	95.4.28
Arthur Tauber	May 9, 1995

ARMY RESEARCH LABORATORY (ARL)

SOP NO: EC-419

TITLE: Standing Operating Procedure for Mössbauer Spectroscopy System

1. **STATEMENT OF WORK:** The Mössbauer spectrometer is to be used for the non- destructive testing of iron-bearing materials.

2. **HAZARDS INVOLVED:** This system utilizes a radioactive ^{57}Co source, of no greater strength than 25 mCuries.

3. **PROTECTION STANDARDS/LIMITS:** The radiation level (as determined by the calibrated radiation meter) outside the posted area can be no greater than twice the normal background level (0.1 mREM/hour). If the level is greater, leave the area and notify radiation safety. Any levels greater than 5 mREM/hour should be considered extremely serious.

4. **SAFETY CONTROLS:**

a. Engineering Controls: The source will always be operated in the provided lead enclosure (locked) or stored in its associated lead pig.

b. Procedural Controls:

(1) All users will familiarize themselves with the proper operation of all equipment and their manuals.

(2) All personnel not directly involved with the system will leave the area whenever the lead box is unlocked and opened.

(3) The lead box will never be left unattended while unlocked.

(4) All personnel will wear their issued wrist/body radiation film badges while the lead box is opened. The film badges will be changed monthly by the Radiation Safety office.

(5) Gloves are to be worn while handling the source. Radiation Safety will perform periodic wipe tests of the source to test the integrity of the plastic encapsulant.

(6) Dr. Potenziani will unlock the lead box when necessary. In emergencies, one can break the glass in the box on the wall next to the system.

(7) Any new personnel requiring access to the source will first receive training by Radiation Safety and obtain a radiation film badge. All personnel using the system will receive annual training. Failure to do either of the above will result in the loss of access privileges for the system.

(8) The lead box containing the radioactive source will be clearly marked by radiation warning signs. If the source is to be removed (after first obtaining permission from Radiation Safety), the signs will be taken down.

(9) If the system or its surrounding are on fire, NO personnel except authorized firefighters will enter the lab or approach the system.

(10) Upon surpassing the useful life of the source, radiation safety will be called in for proper transportation and disposal.

(11) A calibrated, functional radiation counter will always be available for periodic checks of environmental radiation levels.

5. <u>SEQUENCE OF OPERATIONS</u>:

a. Put on wrist and body radiation film badges.
b. Unlock lead box and load sample on holder. Lock box.
c. Turn on MCA, amplifiers and proportional counter tube.
d. Load running parameters into the MCA and begin operation.

6. <u>EMERGENCY PROCEDURES</u>:

All accidents are to receive immediate medical attention and are to be reported to the Safety Officer and Radiation Safety Officer within one hour!

Fire Department, First Aid, Police	- x911
CECOM Health Clinic	- x22452/x44484
Health Physics Office	- x44427/x43112
Building Security	- x44684/x42222
Building Manager	- x44238/x42981
Branch Office	- x44835/x42085
EPSD Division Office	- x44308/x42452
EPSD Safety Office	- x44936

POC: E. Potenziani II - x43629

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Melanie Cole ET & DL BLDG 2700, RM 1B121-123	**2. PERMIT NUMBER:** 030 **3. EXPIRATION DATE:** 1 MAY 95

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Phillips STEM EM 420-T, SN: D647 STEM ATTACHMENT SN: D795	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the STEM is in operation.

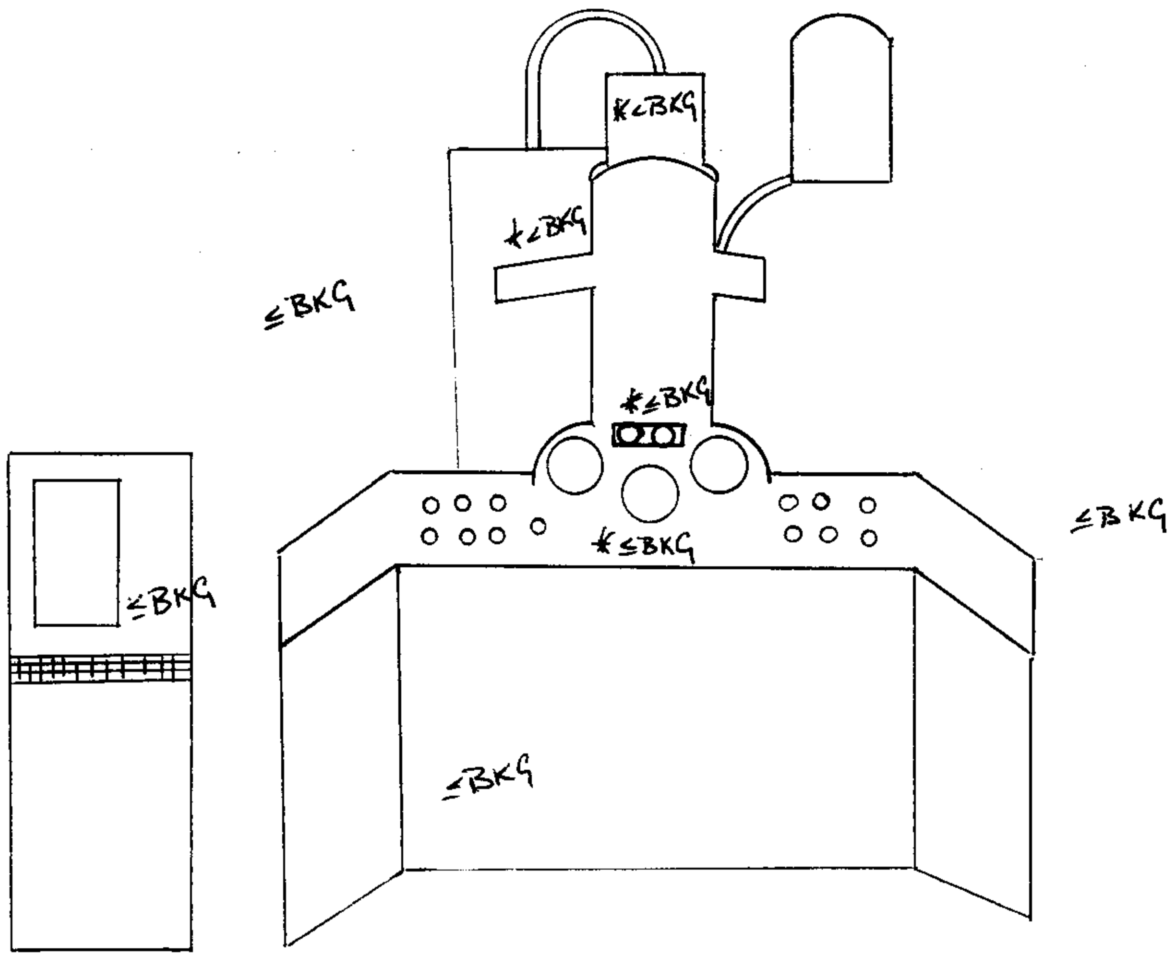
4. Device to be used IAW SOP number ET-103.

APPROVED: Barry Little
for JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 MAY 92

PHILLIPS STEM EM 420
MEYER CENTER RM 1B121

RADIATION SURVEY



Legend: * Contact reading
O Wipe Location

Background <0.2 mR/hr

Postings

SOP /RWP	✓	Dosimetry Requirements	N/A
Caution Radioactive Mat'l	N/A	NRC Form 3	N/A
Caution Radiation Area	N/A	Section 206	N/A
Caution High Rad Area	N/A	Notice to Workers	✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: RO2 EBERLINE

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: William Craig Date: 8 DEC 93

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 25 Feb 92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 030

1. To: Attn Mr Bianchi CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: ET&DL

3. Radiation Area Supervisor: Name Melanie W. Cole

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
N/A			

5. Other Sources of Ionizing Radiation Producing Devices:
Philips Scanning Transmission Electron microscope (STEM)
EM 420T SN: D647, STEM ATTACHMENT SN: D795

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

1. Melanie W. Cole
2. Alan Lepore
3. Ron Thompson
4. Charles F. Cook

Radiological Permit Application Supplement

Name: COLE (Last) Melanie (First) WILL (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETDL	6 mo on the job training	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
TEM	NA	1B121	5yrs	NA
STEM	NA	1B121	5yrs	NA
SEM	NA	2D128	5yrs	NA
EP	NA	1B121	~~10~~ 5yrs	NA

Radiological Permit Application Supplement

Name: Lepore (Last) Alan (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETDL	2mo	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
STEM (PHILIPS 420T)	NA	18121	2YR	NA
SEM	NA	Previous experience at another location 4yrs		

Radiological Permit Application Supplement

Name: Thompson (Last) Ron (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETDL	6 mo	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
STEM (Philips 420T)	NA	1B121	2 yr	NA

Radiological Permit Application Supplement

Name: Cook (Last) CHARLES (First) E (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETOL	5 yrs	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
TEM	NA	1B121	30 yrs	NA
STEM	NA	1B121	5 yrs	NA
SEM	NA	2D128	15 yrs	NA
ED	NA	1B121	30 yrs	NA

STANDING OPERATING PROCEDURE

SOP NO: EP-103

TITLE: SCANNING TRANSMISSION ELECTRON MICROSCOPE (Philips EM420)

DIVISION/BRANCH: EDRD/Electronic Materials, Process & Analysis Branch (SLCET-EP)

PLACE OF OPERATION OR TEST: Room 1B121/123 STEM Lab, Myer Center

This standing operating procedure (SOP) will be in effect for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth A. Jones

KENNETH A. JONES
Printed/Typed Name

APPROVED:

Michael R. Walterschied
MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 02/20/1992

SOP NO: EP-103

EXPIRES: 2/20/1993

SUBMITTED BY: Melanie Will Cole
Signature

MELANIE WILL COLE
Printed/Typed Name

Research Physical Scientist
Title

15 February 1992
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EP-103. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE

connectors, and power supplies. If the water cooling lines to the oil diffusion pump should leak the instrument should be **TURNED-OFF** immediately and not powered-up until the water leak is fixed and surroundings parts and environment dried.

5. **SEQUENCE OF OPERATIONS**: One must refer to the PHILIPS EM420 operations manual for a full detailed operational procedure before operating. Verify that all safety interlocks are energized. Check that all the high voltage power supply covers are securely in place.

6. **EMERGENCY PROCEDURES**: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies and/or the System Main Power Switch and obtain qualified service before powering the instrument back up. If a water leak occurs while the instruments high voltage is on, **IMMEDIATELY** shut-down the system using the System Main Power Switch.

Immediately notify supervisor, Branch, Division, and Safety Offices of ETDL. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	- 911
CECOM Health Clinic	- x22452/x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981 Beeper: 517-6560
ETDL Branch Office	- x43552/x42556
ETDL Division Office	- x42452/x42080
ETDL Division Safety	- x44418/x43635 Beeper: 517-7859
ETDL Safety Office	- x44936/x44717

POC:	M.W. Cole	- x44052/x42369
	A. Lepore	- x28963
	R. Thompson	- x42920

Author: LEPORE@ftmon.arl.mil at Internet_Gateway
Date: 3/26/97 7:27 AM
Priority: Normal
TO: Hugo Bianchi at safe1
Subject: Rad permit 090

Hugo- This is to inform you that our organization will cease radiation-producing operations with the Leica/Philips electron-beam lithography system in Myer Center Room 1B120 prior to 1 May 1997. This memo will thus serve to officially close out Rad Permit #090 for the above instrument.
Regards, Allen Lepore, 908 532-8963

Army Research Lab
Sensors and Electron Devices Directorate
EO & Photonics Division

AMSRL-SE-EI 29 Jan 97

MEMORANDUM TO: AMSEL-SF-RER , Radiation Protection Officer

SUBJECT: Request for turn-in and disposal of radioactive source

1. I currently use a radioactive Mössbauer source in our lab, 4D110, Myer Center.

2. I would like to initiate disposal of this source. It is a Cobalt-57 source that we purchased from Amersham around Feb 86 with an initial strength of 25 mCi. With a half-life of 271 days, it is extremely weak by now.

3. You can pick it up at any time but please call me first so that I'll be around to unlock the box it is in. I can be reached at ext-73628, email at EPOTENZIANI@FTMON.ARL.MIL if there is other paperwork I need to do . Thanks very much for your help.

ERNEST POTENZIANI
Branch Chief
IR Materials

U. S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH
RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices in Item 5.

1. ACTIVITY GRANTED PERMIT	2. POC / RESPONSIBLE INDIVIDUAL	
TECOM/Vinnell Services P.O. Box 60, Bldg. 286 (Russell Hall) Fort Monmouth, NJ 07703	Gregory Kucharewski	
	3. PERMIT NUMBER	4. EXPIRATION DATE
	180A	20 March 2002

5. MATERIAL / DEVICE	6. CHEMICAL/ PHYSICAL FORM	7. ACTIVITY
Desk Top Cabinet Security X-Ray Screening System Fitted with Colour Camera Model: SCANMAX 20 CC Manufactured by: SCANNA MSC Inc. Sarasota, FL SN: SR3151 BC: 2678M	N/A	N/A

8. CONDITIONS:

a. The SCANMAX 20 CC listed in item 5 is used to x-ray letters/packages mailed to Fort Monmouth.

b. Authorized place of use is Building 2700 Myer Mail Center, Room 1B401A.

c. The SCANMAX 20 CC x-ray machine will be utilized under the supervision of the Fort Monmouth Radiation Safety Officer and IAW the Operating and Maintenance Manual, Issue 1, as provided with the Radiological Permit Application for the SCANMAX 20 CC, dated 15 February 2000.

APPROVED:

DATE: 20 March 2000

JM Santarsiero

JOSEPH M. SANTARSIERO
Fort Monmouth
Radiation Safety Officer

U. S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH
RADIOLOGICAL PERMIT

SUPPLEMENTARY SHEET

PERMIT NUMBER: 180A	EXPIRATION DATE: 20 March 2002

CONDITIONS:

d. Authorized users shall wear a whole body dosimeter when operating the SCANMAX 20 CC x-ray machine.

e. The SCANMAX 20 CC may not be removed, reconfigured or modified in any manner.

f. Notify the CECOM Directorate for Safety, Attn: AMSEL-SF-RE, Fort Monmouth, NJ 07703-5024, Voice: (732) 427-3112, extensions 6427, 6405 or 6444 as soon as practical concerning any administrative or technical changes to the Radiological Permit Application for the device listed in item 5, to include procuring additional devices.

g. The SCANMAX 20 CC shall be surveyed annually for leakage.

h. Unless specifically provided otherwise, the device listed in item 5 shall be possessed and used IAW statements, representations and procedures contained in the Radiological Permit Application, dated 15 February 2000, signed by Gregory Kucharewski, TECOM/Vinnell Services.

RADIOLOGICAL PERMIT APPLICATION

Check One

Date 15 February 2000

X Initial Permit Application (#180A)
___ Application for Amendment to Permit No. ________
___ Application for Renewal of Permit No. ________

1. To: CECOM Dir. for Safety AMSEL-SF-RE Ft. Monmouth, NJ 07703	2. Organization Applying for Permit: TECOM/ Vinnell Services PO Box 60, Bldg. 286 (Russell Hall) Fort Monmouth, NJ 07703

3. Radiation Area Supervisor: Name Gregory Kucharewski

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

SCANNMAX 20 CC > 65 KVP 7MA SN: SR3151
GEN. TLO424/3 TUBE Y475 BC: 2678M

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person listed below.

ANTHONY SAJDAK, DCI
DORIS CAMACHO, TVS
JAMES FINALDI, TVS
Ellen Edwards

RADIOLOGICAL PERMIT APPLICATION

7. **Location where source(s) of ionizing radiation will be used (Bldg, rm) :**

   Bldg. 2700 Myer Mail Center, Rm. 1B 401A

8. **Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.**

   See Attached Manual

9. **Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)**

   Self Contained Interlock

10. **Signature of Director of Responsible Individual:**

Name: Gregory Kucharewski **Signature** Gregory Kucharewski

CECOM DFS USE ONLY:

Instrumentation: Not required.

Dosimetry: Provided by CECOM DS (whole body badge.)

Reviewed by: Hugo Bianchi **Date:** 9 March 2000

Approved by: Joseph M. Santarsiero **Date:** 10 Mar 00

Radiological Permit Application Supplement

Name: Sajdak Anthony
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: Scanna LtD.

Where Trained	Duration of Training	On the Job	Formal Course
Bldg. 976-A		YES NO	YES NO
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or Other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Camacho Doris

(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: Scanna LtD.

Where Trained	Duration of Training	On the Job	Formal Course
Bldg. 976-A		YES NO	YES NO
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or Other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Finaldi James

(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: Scanna LtD.

Where Trained	Duration of Training	On the Job	Formal Course
Bldg. 976-A		YES NO	YES NO
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or Other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Edwards Ellen

(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: Scanna LtD.

Where Trained	Duration of Training	On the Job	Formal Course
Bldg. 976		YES NO	YES NO
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or Other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

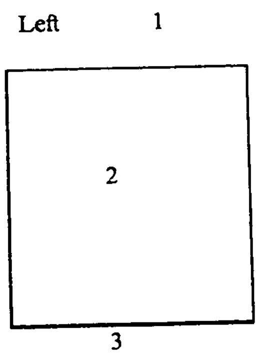
SCANNA SCANMAX 20 CC ; S/N 3151 ; Myer Ctr

Instrument: Eberline R02 Ion Chamber Serial #: 3511
Probe: ______________ Serial #: __________

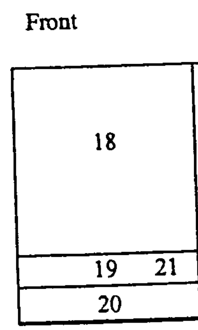
Cal Due Date: 23 May 00
Pre-Op checks performed: Sat/Unsat

Postings:
Caution Radioactive Material Sign: ________
SOP/Radiation Permit: ______ NRC Form 3: ____________
Section 206: ______________ Notice To Workers: ______

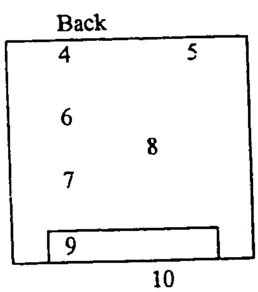
No Smoking, Etc. Sign: ________
Dosimetry Requirements: _______



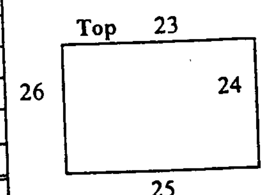
Area No	Left Side Panel Name	Readings
1	Front Panel Vertical Seam	0*
2	Left Side Panel	0*
3	Bottom Edge	0*
	Highest Reading	0



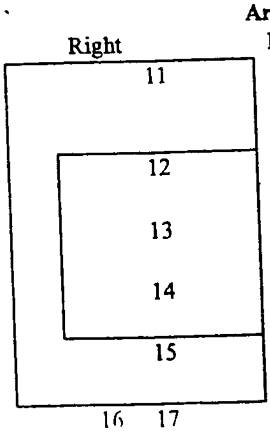
Area No	Front Panel Name	Readings
18	Front Panel	0*
19	Viewing Boot	NA
20	Control Panel	0*
21	Bottom Viewer Panel	0*
22	Bottom Edge	0*
	Highest Reading	0



Area No	Back Panel Name	Reading
4	Left Vertical Seam	0*
5	Right Vertical Seam	0*
6	Top Door Hinge	0*
7	Bottom Door Hinge	0*
8	Back Panel	0*
9	Electrical Plug	0*
10	Bottom Plug	0*
	Highest Reading	0



Area No	Lid Name	Reading
23	Back Lid Seam	0*
24	Right Lid Seam	0.3*
25	Front Lid Seam	0*
26	Left Lid Seam	0*
	Highest. Reading	0.3



Area No	Right Side Panel Name	Reading
11	Top Right Side Panel	0*
12	Top Door Seam	0*
13	Door	0*
14	Bottom Door Seam	0*
15	Bottom Right Side Panel	0*
16	Front Panel Vertical Seam	0*
17	Bottom Edge	0*
	Highest Reading	0

Background: 0 mR/hr

LEGEND: * Contact Reading

NOTE: All readings are in mR/hr at waist level unless otherwise indicated.

Performed By: Barry Zelber Date: 16 Mar 00

OPERATING AND MAINTENANCE MANUAL
ISSUE 1

SCANMAX 20 CC

DESK TOP CABINET
SECURITY X-RAY SCREENING SYSTEM
FITTED WITH COLOUR CAMERA
(110V)

SCANNA MSC Inc.
3340 Espanola Drive
Sarasota
FL 34239 USA

Telephone
Nat: 941 925 9730
Int.: 00 1 941 925 9730

Facsimile
Nat: 941 925 1548
Int.: 00 1 941 925 1548

Date	Amendment No	Page No	Details

IMPORTANT NOTICE

This machine meets all of the safety standards specified in the United States Federal Standard 21, Section 1020.40. On average, leakage of radiation does not exceed 0.1mR per hour at any point 2 inches (5 cm) from any surface. This is five times safer than the permissible leakage of radiation of 0.5 mR per hour specified in the Federal Standard. When operated in accordance with the instructions contained in this manual, this machine is completely safe for operating personnel or other persons who may be within the vicinity.

However it is imperative that operating personnel be instructed in the operation of this equipment as well as radiation safety procedures and that sign's be posted stating -
" Caution - Operation by Authorised Personnel Only".

Further, as a precautionary measure we strongly recommend that operating personnel wearX-Ray monitoring Film Badges.

In the unlikely event of a malfunction causing excessive leakage of radiation, the machine should be turned off immediately and the incoming power line disconnected. The machine should not be re-energised until the malfunction has been corrected by afactory authorised technician and the machine surveyed for radiation leakage.

NOTE

California State Law requires that all radiation producing devices located within the State must be registered by the user within 30 days after accepting delivery from the seller of the equipment. Failure to do this will place you in violation and you could be subject to penalties.

Contact the State of California Department of Health Services.Radiological Health Branch, PO Box 1525, Sacramento, California 95805. Telephone (916) 445-6256

WARNING NOTICE

Safety precautions for use and operation of x-ray producing equipment

X-RAY PRODUCING EQUIPMENT CAN BE DANGEROUS TO BOTH THE OPERATOR AND PERSONS WITHIN THE IMMEDIATE VICINITY UNLESS SAFETY PRECAUTIONS ARE STRICTLY OBSERVED.

Exposure to excessive quantities of X- Radiation may be dangerous to health. Therefore users should avoid exposing any parts of their person, not only to the direct beam, but also to secondary or scattered radiation which occurs when an x-ray beam strikes or has passed through any material.

The X-Ray producing equipment is installed in a cabinet providing adequate radiation shielding, the user should be aware that the useful beam can constitute a distinct hazard if not employed in strict accordance with instructions contemplated to provide maximum safety for the operator.

Also, the electrical circuits, although enclosed for the protection of the operators, must be considered as a potential hazard calling for strict observance of safety practices pertaining to operation and maintenance. Proper electrical grounding must always be used.

Before using the equipment all persons designated or authorised to operate the equipment, or supervise its operation, should have a full understanding of its nature and become familiar with established safe exposure factors by a careful study of the National Bureau of Standards Handbook " X-Ray Protection" HB93, pertaining to X-Ray protection.

OPERATION MANUAL FOR THE SCANMAX 20C

CONTENTS **PAGE**

INTRODUCTION

The SCANMAX 20 (Fig One) is a fluoroscopic X-ray cabinet specifically designed for the detection of explosive devices, hate mail and other contraband material concealed in incoming mail and packages. Items are placed in the inspection chamber and simply by pressing a push button switch a high resolution image is displayed on the video monitor. Image reversal, high penetration and 2 different color palettes are available. These and the zoom facility will expedite the recognition of the items in the package.

It is ideally suited for use in government and commercial mailrooms, embassies, prisons and courtrooms. It can also be used in reception areas for the inspection of briefcases and hand-delivered items not passing through the central mailroom.

The SCANMAX 20 is completely self contained and can be put into operation immediately and can examine the contents of a parcel 40 x 40 cm (16" x 16"). A parcel, briefcase or a batch of envelopes/small packets can be examined in less than 10 seconds.

The SCANMAX is designed to ensure operator protection against radiation hazards through the use of lead shielding. An interlock system on the door prevents the generation of X-rays when the inspection chamber door is opened, ensuring maximum protection to personnel. Even so, always be aware that radiation (X-rays) can constitute a distinct hazard if not employed in strict accordance with the instructions provided in this manual.

Before operating the SCANMAX 20 all personnel designated to operate the unit, or supervise its operation, must have a full understanding of the contents of this manual.

UNPACKING / INSTALLATION INSTRUCTIONS

The installation of the SCANMAX 20 is relatively simple and requires no special tools. It is shipped as a whole in a sturdy ply wood container mounted on a wooden pallet. The shipping crate is designed to withstand normal handling during overseas shipments.

Despite these safeguards, damage may occur in transit. Therefore, immediately inspect the exterior of the container for evidence of damage. In the event damage has occurred, immediately notify the carrier at your location.

UNPACKING THE SCANMAX 20

To remove the SCANMAX from the shipping crate, perform the following:

1. Undo the binding and open the box with the help of a large screwdriver.
2. Using extreme care, remove the pallet and lift the equipment into place. For this use a lifting trolley or fork-lift truck. Care must be taken to avoid scratching the unit.
3. Inspect the SCANMAX cabinet for evidence of any physical damage.

WARNING: **Physical damage to the SCANMAX cabinet may result in excessive radiation emission levels. Any damage observed should be thoroughly investigated, prior to operating the unit.**

WARNING: **To ensure operator safety, radiation emission levels must be checked before putting the SCANMAX into operation.**

PRE INSTALLATION CHECKS

Prior to first time operation, it is essential for the safety of the operator and for the long life of the equipment that the following instructions are strictly observed.

Ensure that the system voltage is the same as the mains supply voltage available. If in doubt regarding the mains voltage at hand, perform a measurement. Units will be set at 110V unless otherwise instructed and should therefore only be operated from a 110V mains supply. Connecting to a different mains voltage will result in improper operation or even destruction of the unit.

Ensure that a good mains earth is provided. To minimise shock hazard the SCANMAX must be connected to an electrical ground or earth. The unit is equipped with athree conductor AC mains lead. The corresponding socket at the installation must be fitted with a reliable protective earth contact.

SCANNA or the supplier cannot be held responsible for incorrect connection.
Do not operate the equipment in the presence of flammable gases or fumes.
protective devices (fuses etc.).

INSTALLATION GUIDE

1. Take unit out of box (following the instructions in the previous section) and place on a strong table/base capable of supporting up to 200 kgs. Take extreme care when lifting as the unit is very heavy (157 kgs/372 lbs). Use a lifting trolley or fork lift truck. Ensure that there is unrestricted access to the inspection chamber door on the right of the unit. Ensure that the door is fully closed.

2. Connect monitor to unit by means of the 'D' connector and power cables supplied

3. Connect the trackball and place on a suitable surface. (Can be hand held during operation)

4. Plug unit into the mains supply after checking voltage of machine matches local voltage

5. Ensure that the door is fully closed and insert the key into the key switch on the front control panel and turn it clockwise to switch on the unit. The green **SYSTEM READY** light should illuminate to indicate the interlocks have been operated and that the equipment is ready for use.

6 Perform interlock check by doing the following:
Activate the red **X-RAY ON** button on the front control panel. Observe that all X-ray lights illuminate and that they remain illuminated. Slowly open the loading door and verify that the **X-RAY ON** and warning indicators switch off ***as soon as the door is opened.***

7. Check image quality by placing a sample package into the centre of the inspection cabinet.

8. Using the Trackball check that the left hand switch rotates through the zoom function and that the right hand switch rotates through the six image formats.

IMPORTANT

Upon installation and after any relocation a critical examination report should be carried by qualified staff with the appropriate radiation survey equipment.

If all controls function properly and the radiation tests show the equipment to be safe then the SCANMAX is ready for operation

WARNING

THIS EQUIPMENT PRODUCES IONISING RADIATION WHEN ENERGISED AND SHOULD BE OPERATED ONLY BY TRAINED PERSONNEL

IMPORTANT:
INSTALLATION ADVICE WHEN USING A SUPPORT TROLLEY

TO FIT THE TOP UNIT TO THE BASE THE FOLLOWING PROCEDURE MUST BE USED

1. Ensure that the feet have been removed from the base of the Scanmax before attemptingto place the unit on its trolley.

2. The unit ***MUST*** be placed on its base, with the front of the unit to the open side of the trolley

3. Assemble the unit at, or close to, the intended site of operation as the Scanmax 20 is topheavy when on its base. Care must be taken whilst moving the unit on its base.

IMPORTANT SAFETY PRECAUTIONS

The SCANMAX 20 utilises an X-ray generator which is lead shielded against radiation emissions. The generation of X-rays stops automatically as soon as the door is opened, accidentally or otherwise. This high level of safety conforms to the strictest protective measures against radiation.

The SCANMAX 20 is inspected prior to shipment to ensure that radiation emission levels are well within the legal requirements.

Modification No modification of the SCANMAX, particularly the radiation chamber, should be attempted without written consent from the manufacturer.

Support If the SCANMAX is moved after initial operation, extreme care should be taken to ensure proper handling. Use mechanical aids such as forklifts or lifting jacks. **Do not place the unit on an inadequate support or try to lift it unaided.** If the unit is dropped, do not attempt to resume operation before consulting a qualified service technician. The user must be aware that excessive radiation leakage could develop due to mishandling.

Relocation A radiation leakage survey, conducted by highly qualified personnel, must be conducted after any relocation of this equipment or after any modification to the equipment. This procedure will prevent radiation health hazards to operating personnel.

Grounding To avoid electrical shock, ensure that the grounding is not defeated.

Wiring it is obvious that any abnormal use or modification of the internal wiring is highly discouraged. We cannot be responsible for any damage or injury caused by such action

Health & Safety UK radiation control regulations require the registration of radiation Sources with the local Health and Safety Executive. Registration should be made within 30 days of purchase. Contact your local HSE for further information.

SAFETY INSTRUCTIONS

WARNING: Radiation hazard can result if this unit is operated improperly.

Below is a list of common ways in which this might occur. This is not an exhaustive list andfinal responsibility for safe operation is assumed by the user.

1. Never operate with the safety interlocks defeated. Never attempt to make the unit function with the door opened. Make sure the plunger interlock on the door does not become broken or damaged.

2. Never operate with any of the enclosure panels removed or damaged.

3. Never operate a unit which has become physically damaged unless it is successfully re-tested for radiation integrity by qualified staff.

4. Never compromise cabinet integrity by drilling holes or attaching fasteners.

5. If when viewing the equipment the lead glass appears to be damaged, switch off the unit and report as faulty. Do not use the system until it has been checked by a competent engineer and a successful radiation check carried out.

6. In the event of any concern regarding the safe operation of theSCANMAX contact your supplier or your local Radiological Protection Adviser immediately.

WARNING: SCANMAX is an electrical device and is subject to shock hazard.

Good operating procedure should be practised to avoid electrical hazards.Final responsibility for safe operation is assumed by the user.

1. A grounded or earthed supply must be used, preferably with ground fault interruption.

2. SCANMAX is designed for indoor use. Do not operate outside where moisture or rain can create a shock hazard. Do not operate in excessively wet environments.

WARNING: **If you are involved in servicing this unit, be aware that lethal voltages can be present in the controller and at the tube head even when the key is switched off.**

1. Physically disconnect line power or take appropriate precautions before making adjustments. Also note that power resistors inside the power supply can burn the skin if touched after prolonged use.

2. If a problem is detected, discontinue use and call your service representative.

INTRODUCTION TO X-RAYS

Radiation and the inherent dangers of radiation have in recent years received much publicity however since 1972 the use of x-ray systems has become commonplace throughout the world particularly at Airports. Indeed in these troubled times the public and staff demand the level of security provided by these x-ray screening systems.

The use of x-rays is no more dangerous than a piece of industrial machinery with moving parts, if you put your hand in moving machinery, such as a guillotine, you may be seriously injured, fortunately this type of accident is rare, if common sense and safety procedures are implemented.

The same is true with an x-ray unit. Not interfering with guarding or access panels,*NEVER* defeating interlocks and regularly servicing the equipment will provide a high degree of safety.

Contrary to Radioactive Sources the x-rays or Ionising Radiation used in the Scanmax 20 and other systems supplied by Scanna are non residual. That is the x-rays are produced electrically and as soon as the power is removed from the x-ray generator there are no x-rays in the system.

The following safety measures and devices are included in the equipment supplied by Scanna MSC.

Low x-ray dose.
X-ray beam limiting.
Interlock system.
X-ray On indicators.
Lead Shielding

In the United Kingdom the requirement is a leakage rate as low as is practicable but in no case to exceed 1 micro Sievert per hour. It is the stated intention ofScanna to provide equipment designed so that irradiation leakage is zero. The Regulations and the Code of Practice has introduced conditions whereby doses of radiation can and are maintained considerably below the threshold where the radiation has an detrimental effect. Indeed it is accepted that by far the largest contribution to population dose is from our natural background, e.g. radiation from space (300 symbol 109 \f "Symbol" \s 11µ Sv), Gamma radiation from earth (350 symbol 109 \f "Symbol" \s 11µSv), internal radiation from natural radioneuclides in the body.(380 symbol 109 \f "Symbol" \s 11µSv) and inhaled gases and nuclear fallout (970 symbol 109 \f "Symbol" \s 11µSv). The current safety limit for annual exposure is 5000 symbol 109 \f "Symbol" \s 11µ Sv

Sieverts	rem			
0.1 0.01	10 1	1 dental x-ray exposure Natural radiation.	5 rem 200 m rem per year	0.05 Sv 2,000 symbol 109 \f "Symbol" \s 10µSv
0.001 0.000,1	0.1 0.01	1 Transatlantic Flight	2.5 m rem	25 symbol 109 \f "Symbol" \s 10µ Sv

0.000,01 0.000,001 0.000,000,1	0.001 0.000,1 0.000,01	Leakage from Scanmax 20	0.000,002 rem	0.2 symbol 109 \f "Symbol" \s 10μ Sv max.
0.000,000,01	0.000,001			

It can be seen from the above figures that spending every hour of your working life within 1 inch of the equipment with the x-rays switched on would still not so much as double your annual dose of radiation accrued simply from being alive.

OPERATING INSTRUCTIONS

1. Switch on mains isolating switch on the rear panel. Note that the front panel "POWER ON " indicator on the front control panel illuminates.

2. Insert the key into the key switch and turn a quarter turn to the right ensure that the TV monitor is turned on.

3. Place objects to be inspected inside the chamber and close the door firmly (take care not to slam the door). This enables the radiation safety interlocks and the SYSTEM READY light will illuminate.

4. Depress the "X-RAY ON" switch and release. The "X-RAY ON" indicators will illuminate for 5 seconds.

5. After 5 seconds an X-ray image of the item will become visible on the monitor screen, adjust the Brightness and Contrast controls on the monitor to obtain the optimum image on the screen.

6. Security Screening can be accomplished quickly and can normally be completed within 5-10 seconds. This is usually sufficient to determine whether a package is harmless or contains a suspect article however the image is displayed for as long as required

7. Closer examination can be made by use of the trackball. When the ball is moved a square is illuminated on the screen, move the square centrally over the area for closer examination and press the left hand key and the image will be enlarged by a factor of 2 (Zoom x 2) If a further close look is required press the left hand key again for x4 or x8 and then press again for Normal image.
   The image will revert to Normal image when a new image is obtained by pressing the X-ray On switch.

8. The right hand key of the trackball will give the following image displays:

   1 Normal display
   2 Brightened "high penetration" grey
   3 "inverse" (negative) grey level image
   4 Greem/Orange/Grey "Organisc" mode
     Dense objects show as green, less dense objects (plastics and narcotics may show as orange) Other regions show as grey scale
   5 Red/Grey "Bomb" mode. Very dense objects show as red other regions as grey scale
   6 Red/Green/Yellow. A "vivid" bright colour display to emphasise colour capability.

Access is gained to each enhancement by repeatedly pressing the right hand trackball key until the image required is displayed, repeated pressing will return to the Normal image.
When a new image is obtained the last enhancement used will be the display mode used for the new image.

9. Normal letters, express mail etc., can be inspected in batches of 25 or more at a time. This will expedite the screening process. It also reduces the use of the system. Larger packages or briefcases should be inspected individually. (See next section for more details).

10. The **SCANMAX 20** should be turned off when not in use and the key removed from the equipment. The key should be kept by a designated key-holder/supervisor

11. Operator maintenance involves only the cleanliness of the unit both inside the inspection chamber and the outside of the unit and regular safety checks to include mains lead etc.

Hints:

- Tilt or change the orientation of an object to obtain a clearer profile.
- If photographing, use shutter setting 30 or 60 to allow for the camera to synchronise to the monitor (Lines will appear across the film if it not synchronised) to ensure good depth of field, black and white film will tend to give higher apparent contrast.
- If used for law enforcement or security, obtain appropriate training from a qualified personnel.

X-RAY SCREENING PROCEDURES

1. Envelopes may be processed in batches, or evenly spread out within the inspection chamber.

2. Larger packages or briefcases should be placed towards the centre of the unit and processed flat and one at a time.

3. Any item screened which shows the presence of anything unusual (i.e., wires, electrical switches, batteries etc), or which contains high density (black) materials which cannot be penetrated should be treated with extreme caution.

4. If the item appears suspicious, security staff should be alerted and the appropriate security procedures implemented.

SCANNA strongly recommend that users of X-ray inspection equipment implement proper security procedures for dealing with suspect packages.

We also recommend that operators have appropriate training in the recognition of suspect packages and X-ray image identification. Contact SCANNA or your local Police/Law Enforcement Agency for advice on suitable courses.

Be sure to display contacts and appropriate emergency telephone numbers adjacent to the unit.

MAINTENANCE

The **SCANMAX 20** contains no user serviceable parts other than lamps and fuses. For reasons of safety maintenance of the unit should be undertaken by a trained engineer at least once a year during which the security, integrity and levels of all components should be checked. A radiation leakage check should be carried out using a calibrated radiation level monitor. Please contact your service representative or **SCANNA MSC Inc.** for most maintenance needs. A few common procedures are described below and all should be referred to your service representative.

Refer any further problems to **SCANNA MSC Inc.** Procedures listed in this section include:

Line grounding and regulation
Fuse replacement
X-ray source replacement
Door Adjustment
Camera adjustment and cleaning
Testing for radiation leakage

SCANNA MSC Inc does not assume any liability for damages resulting from system modifications performed by the customer.

Line Grounding and Regulation

Regulation
When the unit is energised, the line voltage should drop no more than 5% at the wall outlet. Any further drop indicates that your AC power source needs to be upgraded.

Grounding
A three pin plug should be used with a suitable earth or frame ground. If this ground is not at actual earth potential a shock hazard can exist. For this reason it should be checked and if possible, outlets with ground fault interruption should be used.

Warning
Always disconnect the power cable when working on the tube head or controller. Line voltage can be present at the controller when the key switch is not activated.

Fuse Replacement

Below the mains input socket for the power cord at the rear of the unit is a fuse holder. It is covered by a rectangular piece of black plastic which is part of the holder. Pull outward on this holder until the fuse is exposed. Replace with a 15 amp, 230V, 2 AG style Slow Blow fuse. An extra location is provided where a spare fuse can be kept if needed. If the fuse blows repeatedly, call your service representative.

X-ray Generator and Controller Replacement – Trained Service Personnel Only

In the event of failure quote the Serial number of both the unit and the faulty x-ray generator must be given to SCANNA to ensure that the correct replacement will be supplied.

If a Controller replacement is required the Serial number of both the unit and the x-ray generator must be given to SCANNA to ensure that the correct replacement will be supplied.

This allows the Primary voltage , tube current and the filament resistance to be selected in the software, and it insures that factory pre-sets have been observed. Contact SCANNA if alternate arrangements need to be made. To replace the x-ray generator and controls follow the procedure below. Read safety precautions listed elsewhere in this manual before proceeding.

S1. Warning: disconnect the power. Remove the cover at the top of the unit. Disengage the wiring connections carefully from the x-ray source.

S2. Loosen the x-ray generator by unfastening the four screws holding it in place.

S3. Disconnect the in-line plug / socket to the x-ray source. (Early models may requirethe connections unsoldering, ensure that a note is made of the connections.

S4. Remove the x-ray generator from the case.
Caution :The x-ray generator is heavy two persons are required for this task.

S5. Pack the x-ray generator in a shock resistant shipping carton so that the ceramic and glass parts of the system do not become damaged. Note, any compression or shock to the outside of the tube head container is transferred directly to the glass envelope of the X-ray tube!

To install a new x-ray generator, repeat the process but in reverse.

S1. Install the new x-ray generator and bolt down.

S2. Reattach the connections to the x-ray generator.

S3. Refit the top panel ensuring the earth lead is re-connected

Controller Removal

S1. Ensure that the unit is disconnected from the mains supply.

S2. Remove the rear connection panel (Eight screws).
NOTE: The Controller is isolated via a panel interlock switch by this action.

S3. Note the position of the connections and disconnect.

S4. Remove the Controller by removing the four mounting nuts taking care not to misplace the nuts or the insulators.

Fit the new Controller in reverse order

S1. Fit the PCB.

S2. Refit the connectors to the PCB.

S3. Refit the rear connection panel and test the unit. Check the panel interlock for correct operation

Door Adjustment: This must be carried out by service representative

To re-seat the door in case of mechanical trauma or accidental loosening of screws, use the following procedure:

S1. Loosen screws on right side of door and back out the set screws until flush with the hinge.

S2. Lift the door and secure the screws. This should eliminate radiation leakage at the door.Be sure that the plunger interlock on the door is not damaged.

S3. Re-tighten screws to fix position. Tighten set screws to ensure that setting does not change. Set screws can also be used to provide a very slight adjustment from left to right if needed.

S4. Test for radiation leakage and correct as needed. You must reject the unit at this point iflevels of 1symbol 109 \f "Symbol" \s 11µSv/hr are exceeded.

Final re-seating of the door should be performed in conjunction with radiation testing to ensurethat proper fit has been achieved. Door fit was correct upon shipping of the unit from the factory if proper installation instructions have been followed.

The attached Maintenance Report Sheet should be completed by the engineer carrying out the maintenance.

Camera Adjustment and Cleaning

Disconnect the unit from the mains supply.

If carrying out adjustments in the bottom of the unit to the camera and its lens whilst the unit is energised be sure to keep all parts of the body and metallic tools clear of the Isolating transformer and any wiring.

The camera is accessed by removing the front control box.

Three screws on the base of the control box are removed and the box carefully lifted taking care not to put tension on the connections to the control panel.

The camera may be pointing upwards and therefore the lens may after a period of time become dusty. It is recommended that any loose dust on the lens should be initially orally blown off and thenclean the lens using a proprietary lens or spectacle cleaning cloth ensuring that the lens is not scratched.

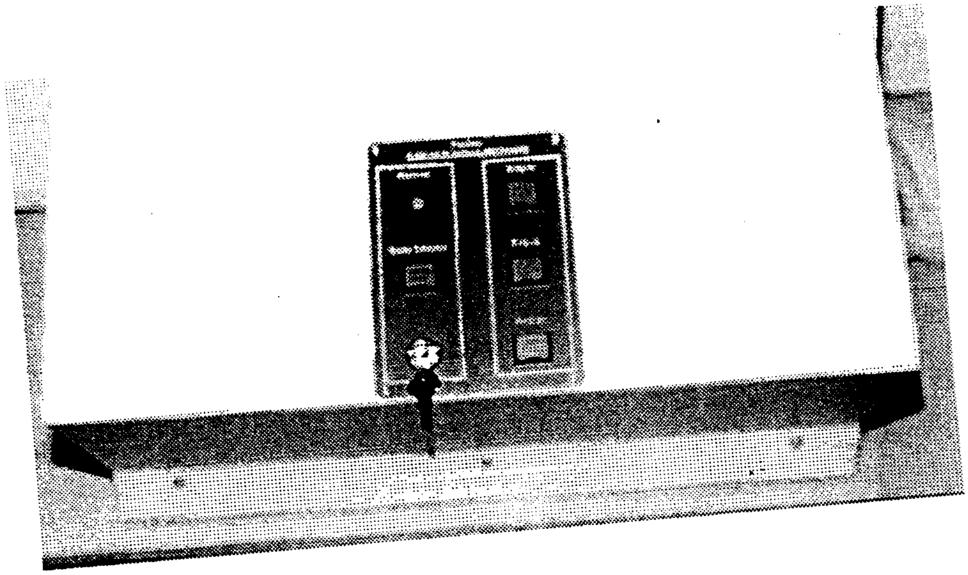
The lens is normally kept with the aperturewide open (f1.6). If the unit is to be checked with the side panel off close the lens until the image on the screen is suitable*(Remember to return to f1.6 before replacing the side panel)* The camera / lens can be focused on its own image reflected from the lead glass in the base of the inspection chamber.

Re-fit the access panel after adjustments ensuring that the earth straps are re-fitted to the panel.

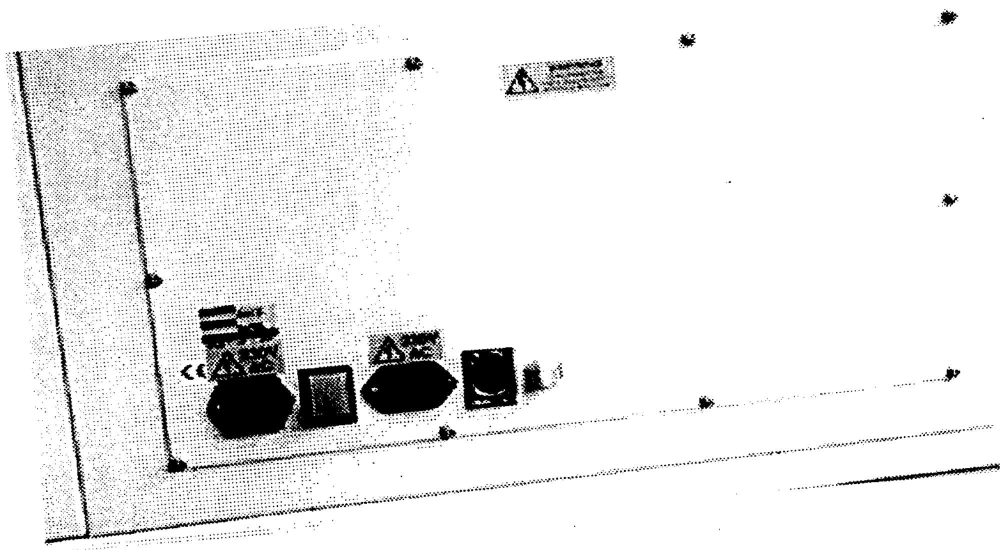
Testing for Radiation Leakage

To complete an accurate radiation leakage test, follow the detailed instructions on the enclosed radiation leakage form.

WARNING:
This can only be accepted when performed by a qualified technician using an approved radiation meter.

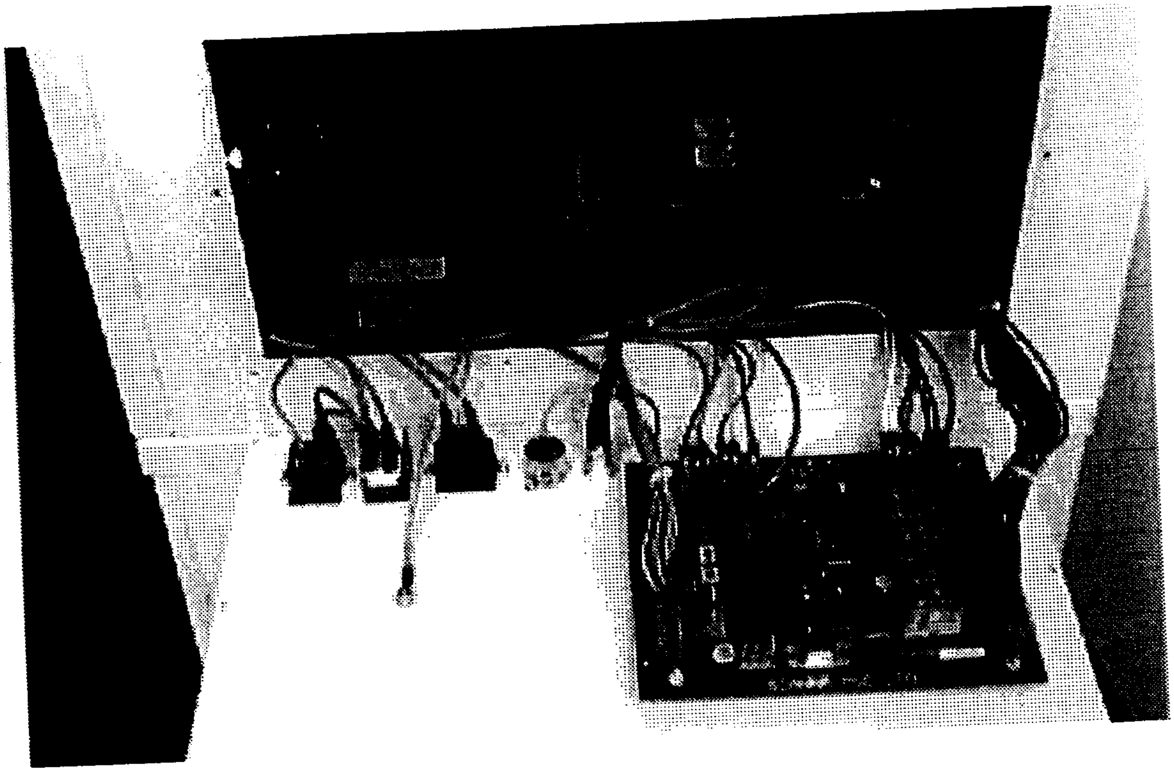


View of front panel

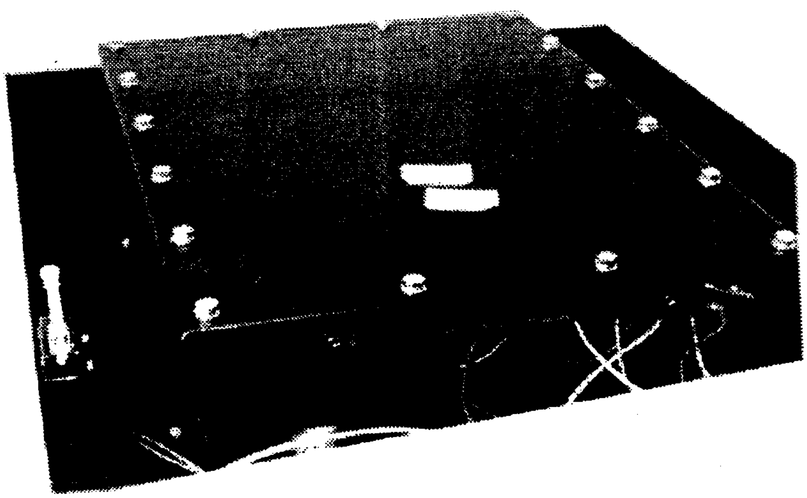


View of rear panel

From Left	1	Mains input (with fuse under)
	2	Mains isolating switch
	3	Mains for Monitor (if applicable)
	4	Remote "X-ray On"
	5	Video Out



View of controller with rear panel open



View of generator showing top panel interlock

MAINTENANCE REPORT SHEET

Customer	Site

The Ionising Radiation Regulations (1985) and the Approved Code of Practice, regulate the use of the equipment's listed. this report and attached Radiation Test Certificate comply with the requirements of the regulations.

Equipment	Serial No.

Item	Check	Result	Comment
1	Check Indicators		
2	Check switch operation		
3	Check door operation and interlock		
4	Clean equipment internally		
5	Check X-ray generator		
6	Check tube current		
7	Check all connectors		
8	Check timer operation		
9	Check all panels are secure		
10	Check monitor controls		
11	Check camera operation		
12	Carry out radiation check		
13	Clean equipment externally		
14			

Comments

Engineer

Customer

Date

Date

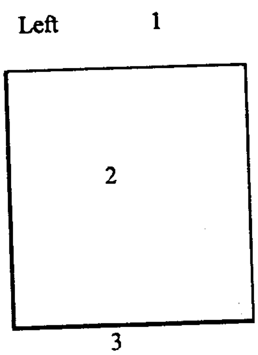
SCANNA MSC LIMITED
CRITICAL EXAMINATION REPORT

Customer: ____________________ Unit Serial No.: ____________________

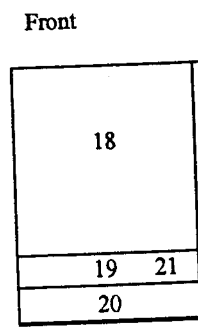
Order No.: ____________________ X-ray Source Serial No.: ____________________

Date: ____________________

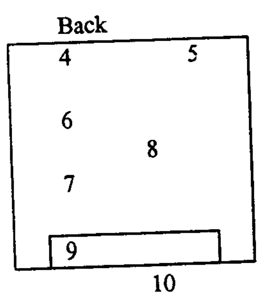
1. Radiation emission levels are not to exceed 1µSv/hr. at any inspection point.



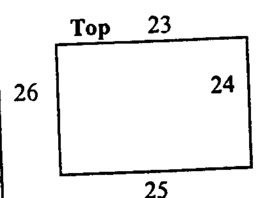
Area No	Left Side Panel Name	Readings
1	Front Panel Vertical Seam	
2	Left Side Panel	
3	Bottom Edge	
	Highest Reading	



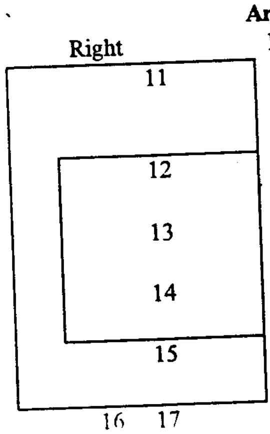
Area No	Front Panel Name	Readings
18	Front Panel	
19	Viewing Boot	
20	Control Panel	
21	Bottom Viewer Panel	
22	Bottom Edge	
	Highest Reading	



Area No	Back Panel Name	Reading
4	Left Vertical Seam	
5	Right Vertical Seam	
6	Top Door Hinge	
7	Bottom Door Hinge	
8	Back Panel	
9	Electrical Plug	
10	Bottom Plug	
	Highest Reading	



Area No	Lid Name	Reading
23	Back Lid Seam	
24	Right Lid Seam	
25	Front Lid Seam	
26	Left Lid Seam	
	Highest. Reading	



Area No	Right Side Panel Name	Reading
11	Top Right Side Panel	
12	Top Door Seam	
13	Door	
14	Bottom Door Seam	
15	Bottom Right Side Panel	
16	Front Panel Vertical Seam	
17	Bottom Edge	
	Highest Reading	

Radiation Monitor Used: ____________________

Serial Number ____________________

All readings are shown in symbol 109 \f "Symbol" \s 9µ Sv/hr

Inspected By:...

SPECIFICATIONS

Physical Specifications-	Height:	107 cm (42.5 inches)
	Width:	55.8 cm (22 inches)
	Depth:	52 cm (20.4 inches)
	Weight:	160 kg (352 lb)
Inspection Chamber size	Height:	48 cm (20 inches)
	Width:	49 cm (19 inches)
	Depth:	45 cm (17 inches)
Door Opening	Height:	41 cm (16 inches)
	Width:	44 cm (17 inches)
Image Area	Depth:	41 cm (16 inches)
	Width:	48 cm (20 inches)
Shipping Dimensions		130 x 80 x 70 cm. (51 x 31 x 27 inches) Weight: 169 kgs (372 lbs)
Power Requirements		110 VAC +/- 10% 60 HZ Single Phase
X=Ray Source	Focal Spot	1.5 mm
	Anode Angle	35 degrees
	Anode Type	Stationary
	Kvp	65 KV (85KV max)
	Tube Current	7 mA (20mA max)
	Cooling method	Oil cooled
Resolution		36 AWG
Radiation Safety		Complies with all current radiation regulations.
Climatic Conditions		0-40° C. Maximum humidity: 95% non condensing.
Control specifications	Front Panel:	Key switch, Exposure Switch (X-ray On) Power On Light, X-ray On light System Ready
	Power Electronics:	Auto line voltage compensation. Inverse suppression network. ma Stabiliser, Interlock input, foot switch input. 110 v AC Line in. X-ray generator / Control panel connectors.
Duty Cycle		100%

Camera Specifications

Pick-up device	1/2" Interline-Transfer CCD.
No. of Elements	795 (h) x 595 (v) 473025
Sensing Area	4.9 mm x 3.7 mm
Scanning System	CCIR & SVGA
Sync. System	Internal.
Resolution	752 X 582
Lens Mount	C Mount.
Minimum illumination	0.02 Lux, F1.4 Output Voltage will work to 0.011x
Cpu BOARD	2MB DRAM 512KB Flash 30-150 MIPS.
Video Output	Monochrome CCIR Colour SVGA
Ambient Temperature	-20symbol 176 \f "Symbol" \s 11.5°C ~ +55symbol 176 \f "Symbol" \s 11.5° C less than 95% (non condensing)
Power Requirements	12 VDC
Power Consumption	1.8 W.
Weight	250 gm (1.46 lbs).
Dimensions	120 x 50 x 35 mm

CCD CAMERA

The VC21 camera has been specifically modified for use with the Scanmax 20 camera system and care must be taken when handling the camera and the lens mountings to ensure that connection of the multi way connector is not damaged or broken.

PRECAUTIONS

- Do not aim the camera towards the sun or extremely bright object.
- Do not touch the CCD imager which is very sensitive and not user serviceable.
- Do not attempt to disassemble the camera unnecessarily. There are no user serviceable components inside.

FEATURES

High sensitivity in a low light level down to 0.02 lux for excellent picture quality.

Picture burn in does not occur

Excellent immunity to vibration and shock.

The camera interface uses solid state components and requires no periodical maintenance work or replacement of components during normal use.

ADJUSTMENTS

The only adjustment available is the lens aperture and focus.
A live image display mode is provided to allow for easy installation of the camera. In this mode the camera operates as a standard camera, displaying a live image on the monitor. This mode is used for setting the camera into its correct position and setting the focus. Live display can be activated by switching the set-up line and will stay in that mode until the x-rays are energised when the camera automatically reverts to normal operation.

WARRANTY

NOTICE: **THIS SHIPMENT LEFT OUR FACTORY IN PERFECT CONDITION.**

If merchandise is delivered in damaged condition, *do not reject shipment*. Purchaser must have the driver note the damage (or the fact that possible damage exists and inspection will follow, or any shortage or overage) and sign all copies of the freight bill duly noted as damaged. Purchaser must examine for concealed damage as soon as possible. Notice of freight claim must be given to carrier within 5 days of delivery. Damaged merchandise and packaging must be retained until inspected by carrier. ***Seller shall not be responsible for any losses sustained due to Purchaser's failure to comply with this freight claim procedure. Seller's invoice must be paid in full, when due, irrespective of pending freight claim.***

REPAIRS:
A one year warranty is provided on the labour performed and any new parts installed by service technician at SCANNA's premises. This warranty is limited to labour performed and parts installed in the repair of a specifically identified problem and does not cover other problems which might develop within the same X-ray unit at another time.

Transportation to the factory or service centre is to be prepaid and is the responsibility of the purchaser. Shipment must not be made without first gaining authorisation from SCANNA or its agent.

IMPORTANT NOTICE:

Damage occurring due to operation or installation of this machine in a manner other than that detailed in this manual, will void the warranty.

Any type of damage to the fluoroscopic screen will not be covered.

Damage resulting from exceeding the duty cycle will not be covered.

Damage resulting from improper adjustment of the head or controller by an unqualified technician (as approved by SCANNA) will not be covered.

Bombs in the Post... Be Alert

Look for the unusual:-

Shape	**Wrapping**	**Writing**
Size	**Grease Marks**	**Spelling**
Thickness	**Postmark**	**Unsolicited mail**
Scaling	**Signs of wire or batteries**	**Wrong name, title or address**

If you are suspicious:-

DON'T

1. **Don't try to open it.**
2. **Don't press squeeze or prod it.**
3. **Don't put it in sand or water.**
4. **Don't put it in a container.**
5. **Don't let anyone else do one of these.**

DO

1. **Keep calm**
2. **Look for sender's name on the back**
3. **Check with the sender**
4. **Check with the addressee.**

Still think you have got one?

Leave it where found
Evacuate the room
Lock the door and keep the key
Send for the security officer and

INVOKE YOUR EMERGENCY PROCEDURES OR TELEPHONE THE POLICE

PAGE 30 BLANK

TROUBLE SHOOTING

1 **Insert key and turn on power.**	Is Power light lit	No	Check that the mains lead is connected.	At the wall socket and then to the rear connection pa
			Check that the mains socket is active.	If not contact electrician
			Check mains input fuse	If faulty, replace,
			If fuse blows again check with door open	If faulty, replace,
			fuse blows again check with door closed	If faulty, replace,
			Check bulb	Change controller and x-ray generator
				If faulty, replace
2 **System Ready**	Is System Ready light	No	Check door is fully closed	)
			Check Rear panel interlock	) Ensure interlocks are made
			Check top panel interlock	)
			Check LED	
2 **Press X-ray On switch No Picture**	Is X-ray On light lit	No	Is System Ready lamp lit	)
			Check door is fully closed.	) Ensure interlock is made.
			Check LED	If faulty, replace.
			Check mains input fuse	If faulty, replace.
2 **Cont.**	Is X-ray On light lit	Yes	Is the TV Monitor Switched on	Switch on
			Are the TV Monitor mains and video cables connected or damaged.	If faulty replace
			Is the Monitor working	If faulty, replace
			Is the camera working.	If faulty, replace

3	**Dim Picture**			Is there a large object in the viewing chamber Is fluorescent screen damaged Is the TV Camera lens dirty	Remove and check with an empty chamber Replace fluorescent screen Clean lens
				Seek qualified help to check Controller and Source	Check with your local distributor

SCANNA

CRITICAL EXAMINATION REPORT

Customer:	
Customer Order No.	Location:
Equipment Type: 20CC11	Serial No: 3152
Options:	

We confirm that the equipment detailed above has been installed and that all necessary checks have been carried out correctly, and that, as of the certificate date, the x-ray system described below, conforms to the current Radiation Safety Regulations of the United Kingdom as detailed in the:-

"Approved Code of Practice"
"The Protection of Persons against Ionising Radiation arising from any work activity"
"The Ionising Radiation Regulations 1985"

In that the dose rate measured on the surface of the equipment was less than 1µSv/hr and that all indicator lights and operational switches operated correctly.

The Radiation leakage was checked using a Mini-monitor Type G, Serial Number..049302

Certificate Date: 1st December 1999

Inspection Engineer: S.J MAZZOTTA.

Signature: S.J [signature]

SCANNA MSC LTD, 104 New Bond Street, London W1Y 9LG.
Tel: 0207 355 3555 Fax: 0207 355 3556 Email: info@scanna-msc.com Web: www.scanna-msc.com

CRITICAL EXAMINATION REPORT

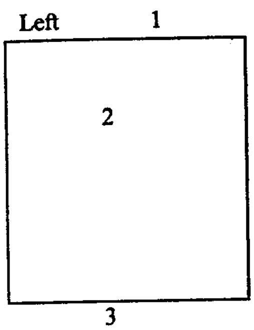
Customer: | Equipment Type 20CC11

Order No.: | Model Serial No.: 3152

Date: 1ST December 1999

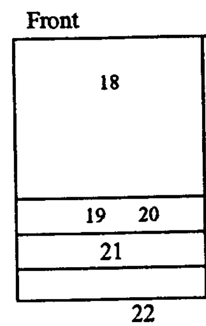
1. Scan all seams and mark with an ''X'' any areas than the specified limit
2. Radiation levels are not to exceed 1µSv/hr. at any inspection point.
3. Write the readings in the columns

Area Left Side Panel



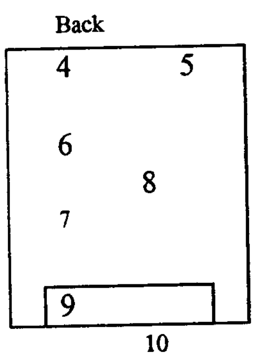
No	Name	
1	Front Panel Vertical Seam	<0.1
2	Left Side Panel	<0.1
3	Bottom Edge	<0.1
	Highest Reading	<0.1

Area Front Panel



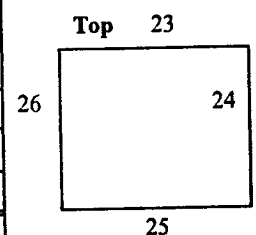
No	Name	
18	Front Panel	<0.1
19	Viewing Boot	NA
20	Control Panel	<0.1
21	Bottom Viewer Panel	<0.1
22	Bottom Edge	<0.1
	Highest Reading	<0.1

Area Back Panel



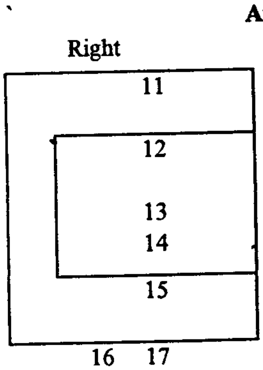
No	Name	
4	Left Vertical Seam	<0.1
5	Right Vertical Seam	<0.1
6	Top Door Hinge	<0.1
7	Bottom Door Hinge	<0.1
8	Back Panel	<0.1
9	Electrical Plug	<0.1
10	Bottom Plug	<0.1
	Highest Reading	<0.1

Area Lid



No	Name	
23	Back Lid Seam	<0.1
24	Right Lid Seam	<0.1
25	Front Lid Seam	<0.1
26	Left Lid Seam	<0.1
	Highest. Reading	<0.1

Area Right Side Panel



No	Name	
11	Top Right Side Panel	<0.1
12	Top Door Seam	<0.1
13	Door	<0.1
14	Bottom Door Seam	<0.1
15	Bottom Right Side Panel	<0.1
16	Front Panel Vertical Seam	<0.1
17	Bottom Edge	<0.1
	Highest Reading	<0.1

Readings carried out using Radiation Monitor Type:

Mini-monitor 900G Serial Number 049302

All reading shown are in µSv/hr

As part of this examination the warning indicators and safety interlocks have been checked and found to be functioning satisfactorily.

Approved By: S. S [signature]

SCANMAX 20
QUALITY CERTIFICATE

SCANMAX #20	Camera	Serial Number	3152
X-ray Generator	TL0424/3	X-Ray Tube	Y475
Voltage	110 Vac	Frequency	60 Hz
Controller Serial No.		Software Issue	XRAY 5

Mechanical Check

Unit wiring layout checked and termination correctly fitted	YES
X-ray source secured correctly	YES
Transformers secured correctly	YES
Mirror secured correctly	YES
Door fitted correctly	YES
Generator check for oil leaks	YES
All screws fitted correctly with flat & spring washers	YES

Checked By S.J.M.

Operational check

Control operational	YES
Lights operational	YES
Push buttons operational	YES
Image centred in viewing area	YES
Zoom and colour functions operational	YES
Door Interlocks functioning correctly	YES
Top Panel Interlock functioning correctly	YES
Rear Panel Interlock functioning correctly	YES
Camera functioning correctly	YES
Monitor functioning correctly	YES

Checked By SJM.

SCANMAX 20
QUALITY CERTIFICATE

Final Check

All panels fitted correctly	YES
Paint finish appearance and texture	OK
All screws correct and secure	YES
Radiation check (Examination report attached)	YES

Checked By SSM

Label Check

Identification and serial number plate	Rear Panel	YES
Voltage (Mains Input)	Above mains input	YES
Voltage (Monitor output)	Above mains output to monitor	YES
Warning	Top of rear connection panel Rear of top panel	YES
Radiation Trefoil	Above door opening	YES
Scanmax ~~5~~ 20	Top left of front panel	YES
X-ray ON lens above door		YES
System Ready in green lens on front panel		YES

Checked By SSM

SCANMAX 20
QUALITY CERTIFICATE

Packing Check

Manual	YES
Radiation Certificate	YES
Final Inspection Certificate	NO
Mains Cable	YES
Keys (Two)	YES
Monitor	YES
Mouse	YES
Video Cable	NA.

Inspected By SS [illegible] **Date** 1st December 1999

U. S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH
RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices in Item 5.

1. ACTIVITY GRANTED PERMIT

TECOM/Vinnell Services
P.O. Box 60, Bldg. 286 (Russell Hall)
Fort Monmouth, NJ 07703

2. POC / RESPONSIBLE INDIVIDUAL

Gregory Kucharewski

3. PERMIT NUMBER	**4. EXPIRATION DATE**
180A	**20 March 2002**

5. MATERIAL / DEVICE	**6. CHEMICAL/ PHYSICAL FORM**	**7. ACTIVITY**
Desk Top Cabinet Security X-Ray Screening System Fitted with Colour Camera **Model: SCANMAX 20 CC** **Manufactured by: SCANNA MSC Inc. Sarasota, FL** **SN: SR3151** **BC: 2678M**	**N/A**	**N/A**

8. CONDITIONS:

a. The SCANMAX 20 CC listed in item 5 is used to x-ray letters/packages mailed to Fort Monmouth.

b. Authorized place of use is Building 2700 Myer Mail Center, Room 1B401A.

c. The SCANMAX 20 CC x-ray machine will be utilized under the supervision of the Fort Monmouth Radiation Safety Officer and IAW the Operating and Maintenance Manual, Issue 1, as provided with the Radiological Permit Application for the SCANMAX 20 CC, dated 15 February 2000.

APPROVED:

DATE: 5 December 2000

for Richard J. [signature]

JOSEPH M. SANTARSIERO
Fort Monmouth
Radiation Safety Officer

U. S. ARMY
COMMUNICATIONS - ELECTRONICS COMMAND
AND
FORT MONMOUTH
RADIOLOGICAL PERMIT

SUPPLEMENTARY SHEET

PERMIT NUMBER: 180B	EXPIRATION DATE: 20 March 2002

CONDITIONS:

d. Authorized users shall wear a whole body dosimeter when operating the SCANMAX 20 CC x-ray machine.

e. The SCANMAX 20 CC may not be removed, reconfigured or modified in any manner.

f. Notify the CECOM Directorate for Safety, Attn: AMSEL-SF-RE, Fort Monmouth, NJ 07703-5024, Voice: (732) 427-3112, extensions 6427, 6405 or 6444 as soon as practical concerning any administrative or technical changes to the Radiological Permit Application for the device listed in item 5, to include procuring additional devices.

g. The SCANMAX 20 CC shall be surveyed annually for leakage.

h. Unless specifically provided otherwise, the device listed in item 5 shall be possessed and used IAW statements, representations and procedures contained in the Radiological Permit Application, dated 15 February 2000, signed by Gregory Kucharewski, TECOM/Vinnell Services (TVS).

i. Delete and add personnel as stated in the Application for Amendment to Permit Number 180B, dated 10 July 2000, signed by Gregory Kucharewski, TVS.

j. Delete and add personnel as stated in the Application for Amendment to Permit Number 180B, dated 28 November 2000, signed by Gregory Kucharewski, TVS.

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 11-28-00

___ Initial Permit Application
✓ Application for Amendment to Permit No. 180B
___ Application for Renewal of Permit No. _____

1. To: CECOM Dir. for Safety AMSEL-SF-RE Ft. Monmouth, NJ 07703	2. Organization Applying for Permit: TECOM/Vinnell Services P.O. Box 60, Bldg. 286 (Russell Hall) Fort Monmouth, NJ 07703

3. Radiation Area Supervisor: Name Gregory Kucharewski

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Scannmax 20 cc >65 KVP 7mJ SN: SR3153
BC: 2677M
Gen. TLO 424/3 Tube Y475

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person listed below.

Delete - Suzanne Courtney, TVS
Add - Osmond Kay, TVS to RWP # 180B

RADIOLOGICAL PERMIT APPLICATION

7. **Location where source(s) of ionizing radiation will be used (Bldg, rm) :**
761 Mail Center, Main Post Bldg. 761

8. **Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.**
See attached Manual

9. **Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)**
Self Contained Interlock

10. **Signature of Director of Responsible Individual:**
Name: Gregory Kucharewski **Signature** Gregory Kucharewski

CECOM Directorate for Safety USE ONLY:

Instrumentation: None required.

Dosimetry: Provided by CECOM Dir. for Safety

Reviewed by: Hugo Bianchi **Date:** 5 Dec 2000

Approved by: [signature] **Date:** 11 Dec 2000

Radiological Permit Application Supplement

Name: ~~Osmond~~ Kay Osmond

(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job	Formal Course
761 Mail Center	1 hour	YES NO	YES NO
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or Other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

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1. **USER:** Richard Sartore
   E&PSD, ARL
   ATTN: AMSRL-EP-RA
   BLDG 2700, RM 4D206

2. **PERMIT NUMBER:** 073

3. **EXPIRATION DATE:** 1 NOV 95

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4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
SCANNING ELECTRON MICROSCOPE (SEM) AMRAY Model: 1700	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when SEM is in operation.

4. System to be used IAW SOP provided with permit application.

APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 NOV 92

RADIOLOGICAL PERMIT APPLICATION

Check One Date 22 Oct 92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 73

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit: E&PSD, Army Research LAB
ATTN: AMSRL-EP-RA
Ft. Mon, NJ 07703-5601

3. Radiation Area Supervisor: Name EDWARD B. HAKIM

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Scanning Electron Microscope AMR 1700 (operated at 1 to 30KV)

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Richard G. SARTORE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm): Meyer Center, Room 4D206

X42261, 20955

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

Operating Manual and SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

N/A

10. Signature of Director of Responsible Individual:

Name Joseph A. KEY Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: Not required or provided

Dosimetry: None required

Reviewed by: Hugo Bianchi Date: 29 Oct 92

Approved by: Joseph M. Santarsiero Date: 29 OCT 1992

Radiological Permit Application Supplement

Name: SARTORE (Last) Richard (First) G (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Meyer Center	2 days	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Scanning Electron Microscope	30kV Accelerating Voltage	Meyer Center	10 years	Operation

STANDING OPERATING PROCEDURES
ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

TECHNOLOGY TO WIN

SOP NO: ______

TITLE OF SYSTEM OR PROCESS AMR Scanning Electron Microscope

ROOM NO.: 4D204

BUILDING: Hexagon

BRANCH: SLCET-RR

DIVISION:

POC: R. SARTORE

EXTENTION: x42261

9/20/89

DATE OF PUBLICATION

STANDARD OPERATING PROCEDURE

TITLE: Standard Operating Procedure for AMR 1700 Scanning Electron Microscope

1. STATEMENT OF WORK: The scanning electron microscope is to be used for visual inspection of microelectronic devices and materials.

2. HAZARDS INVOLVED: There are no known hazards with a standard scanning electron microscope when operated as designed. The vacuum system and high voltage circuits are safety interlocked provided the equipment is operated in a normal manner.

3. PROTECTION STANDARDS/LIMITS: Equipment is required to be operated in an environmentally controlled room to prevent damage, i.e., temperature between 65°F and 80°F and humidity between 25 and 50 percent relative humidity.

4. SAFETY CONTROLS:

a. Engineering Controls: All vacuum system and high voltage circuits are safety interlocked to prevent damage to equipment or operator.

b. Procedural Controls:

1. Assure that vacuum chamber pressure is low enough before turning on console power or operating microscope. Monitor vacuum gauges and interlock lights.

2. Assure that all safety and interlock precautions are functioning before operating microscope.

5. SEQUENCE OF OPERATION:

a. Insert sample in vacuum chamber.
b. Start vacuum pump down cycle.
c. Turn on console power when vacuum gauge is reading low enough pressure and safety interlock vacuum light indicates go ahead.
d. Utilized microscope in normal operating mode.
e. After work is finished, turn of console power.
f. Vent vacuum chamber and remove sample.

6. EMERGENCY PROCEDURES: All accidents are to be reported to the Safety Office within one hour.

Fire Department	- ~~117~~ 911	Police	- 911
First Aid	- 116/~~118~~ 911	Nurse	- 44484
Security	- 44684/42222	Bldg Mgr	- 44238/42981
Health Physics	- 75366		

ENDORSEMENTS

Reviewed 10/22/92

SUBMITTED BY: ______ ______ 9/21/89
SIGNATURE TITLE DATE

REVIEWED BY: ______ 10/5/89
SIGNATURE SUPERVISOR DATE

______ 10/5/89
SIGNATURE BRANCH CHIEF DATE

______ 10/6/89
SIGNATURE DIVISION DIRECTOR DATE

APPROVED BY: ______
SIGNATURE ETDL SAFETY OFFICE DATE

______
SIGNATURE LABCOM SAFETY OFFICE DATE

______
SIGNATURE CECOM SAFETY OFFICE DATE

I HAVE READ AND UNDERSTAND THE CONTENTS OF SOP NO. ______.
I AGREE TO FOLLOW THESE PROCEDURES WHEN PERFORMING THIS OPERATION.
SIGN AND DATE:

-67

ENDORSEMENTS

Reviewed 10/22/92

SUBMITTED BY: Physicist 9/21/89
SIGNATURE TITLE DATE

REVIEWED BY: 10/5/89
SIGNATURE SUPERVISOR DATE

10/5/89
SIGNATURE BRANCH CHIEF DATE

10/6/89
SIGNATURE DIVISION DIRECTOR DATE

APPROVED BY:
SIGNATURE ETDL SAFETY OFFICE DATE

SIGNATURE LABCOM SAFETY OFFICE DATE

SIGNATURE CECOM SAFETY OFFICE DATE

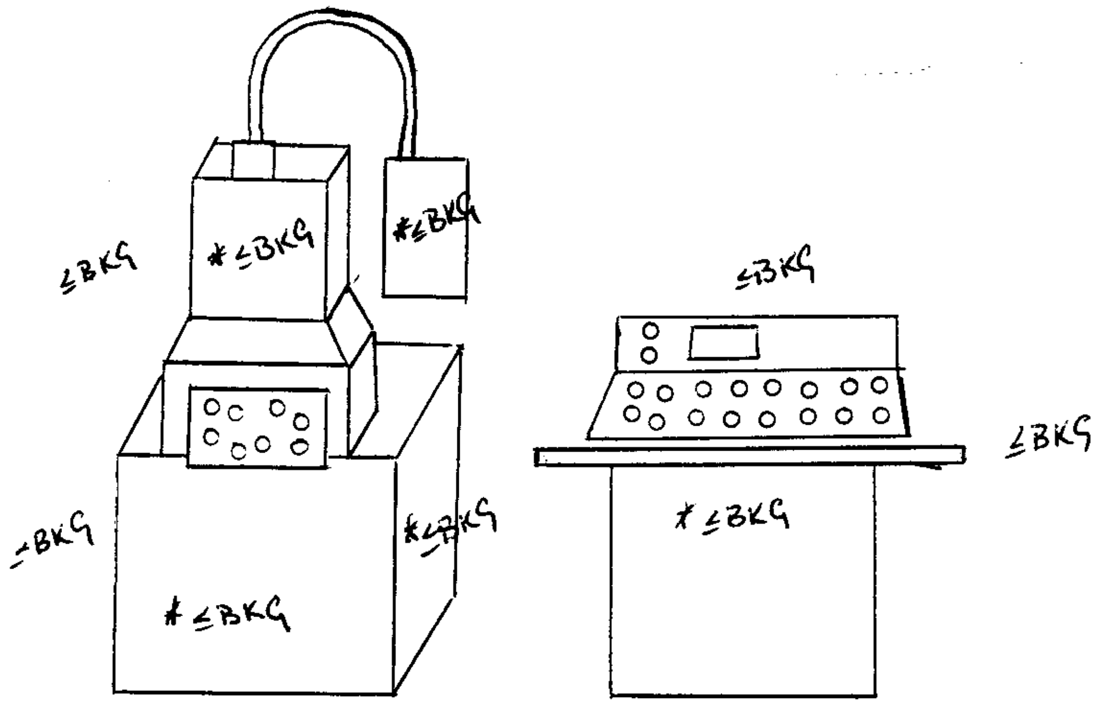
I HAVE READ AND UNDERSTAND THE CONTENTS OF SOP NO. ______.
I AGREE TO FOLLOW THESE PROCEDURES WHEN PERFORMING THIS OPERATION.
SIGN AND DATE:

-67

MEYER CENTER 4D204

AMRAY SEM 1700

RADIATION SURVEY



Legend: * Contact reading
O Wipe Location

Background <0.2 mR/hr

Postings

SOP	✓	Dosimetry Requirements	N/A
Caution Radioactive Mat'l	N/A	NRC Form 3	N/A
Caution Radiation Area	N/A	Section 206	N/A
Caution High Rad Area	N/A	Notice to Workers	✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO 2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: William Craig Date: 7 DEC 93

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Richard Sartore
Physical Sciences Dir., ARL
ATTN: AMSRL-EP-RA
BLDG 2700, RM 4D206

2. PERMIT NUMBER: 073

3. EXPIRATION DATE: 1 MAY 97

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4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Scanning Electron Microscope AMRAY Model: 1700	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by the CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the SEM is in operation.

4. Personal dosimetry is not required for operation of the SEM.

5. System to be used IAW SOP No. SEM-1, dated 13 FEB 95.

APPROVED: Joseph M. Santarsiero 5/9/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One

Date 2 Mar 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 73

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: PSD, Army Research Lab. AMSRL-EP-RA Ft. Mon, NJ 07703-5601

3. Radiation Area Supervisor: Name Edward B HAKIM

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Scanning Electron Microscope AMR 1700
(operated at 1 to 30kV)

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Richard G. SARTORE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm): Myer Center, Room 4D206

X42261, x20155

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

Manufacturer Operating Manual and SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

N/A

10. Signature of Director or Responsible Individual:

Name Joseph A. Key Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: None required, none provided.

Dosimetry: None Required, none provided.

Reviewed by: Hugo Bianchi Date: 28Apr95

Approved by: Joseph M. [illegible] Date: 5/9/95

Radiological Permit Application Supplement

Name: SARTORE (Last) Richard (First) G (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Myer Center	2 days	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
SEM	30 kev electrons	Myer Cntr	12 yrs	Operation

STANDING OPERATING PROCEDURE

SOP NO: SEM-1

TITLE: AMR 1700 SEM

DIVISION/BRANCH:

PLACE OF OPERATION OR TEST:

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Edward B. Hakim

EDWARD B. HAKIM

Printed/Typed Name

APPROVED: M. Walterschied

MICHAEL R. WALTERSCHIED

Safety/Environmental Manager

DATE: 13 Feb 95

EXPIRES: 13 Feb 96

SOP NO: SEM-1

SUBMITTED BY: Richard SARTORE
Printed/Typed Name

Signature

Physicist
Title

Feb 8, 1995
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. SEM-1. Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date

US ARMY RESEARCH LABORATORY

TITLE: OPERATING PROCEDURE FOR AMR 1700 SCANNING ELECTRON MICROSCOPE

1. STATEMENT OF WORK: The scanning electron microscope is to be used for visual inspection of microelectronics devices and materials.

2. HAZARDS INVOLVED: There are no known hazards involved with the operation of a standard scanning electron microscope when operated as designed. The vacuum system and high voltage circuits are safety interlocked provided the equipment is operated in the normal manner.

3. PROTECTION STANDARDS/LIMITS: Equipment is required to be operated in an environmentally controlled room to prevent damage, i.e., temperature between 65 F and 80 F and humidity between 25 and 50 percent relative humidity.

4. SAFETY CONTROLS:

a. Engineering Controls: All vacuum system and high voltage circuits are safety interlocked to prevent damage to equipment or operator.

b. Procedural Controls:

1. Assure that vacuum chamber pressure has reached operating point (less than 1 Torr) before turning on the electronic console power and operating the microscope. Monitor vacuum gauges for correct pressure and insure that all interlock lights are green.

2. Assure that all safety and interlock precautions are functioning before operating the scanning electron microscope.

5. SEQUENCE OF OPERATION:

a. Insert sample in vacuum chamber, properly secured to movable stage with set screw.
b. Start vacuum pump down according to instrument operation manual supplied by manufacturer.
c. Turn on console power when vacuum gauge is reading low enough pressure (less than 1 Torr) and the safety interlock lights are green.
d. Operate the scanning electron microscope as directed in the manual provided by the manufacturer.
e. After completing work on the microscope, turn off console power.
f. Vent vacuum chamber and remove sample.

6. EMERGENCY PROCEDURES: In event of emergency shut off electrical power to unit and close all gas valves.

All accidents will be reported to the Safety/Environmental Office within one hour.

Safety/Environmental Office:
M. Walterschied , 44936

Fire Department: 911

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

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1. **USER:** Richard Sartore
   Physical Sciences Dir., ARL
   ATTN: AMSRL-EP-RA
   BLDG 2700, RM 4D206

2. **PERMIT NUMBER:** 074

3. **EXPIRATION DATE:** 1 MAY 97

---

4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Scanning Electron Microscope (SEM) Model ISI WB-6	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by the CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the SEM is in operation.

4. Personal dosimetry is not required for operation of the SEM.

5. System to be used IAW SOP No. SEM-2, dated 13 FEB 95.

APPROVED: Joseph M. Santarsiero 5/9/95

JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One

Date 2 Mar 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 74

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: PSD, Army Research Lab. Attn: AMSRL-EP-RA Ft Mon, NJ 07703

3. Radiation Area Supervisor: Name Edward B Hakim

4. Radioactive Material: NA

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Scanning Electron Microscope ISI-WB6 (operated at 1 to 2 kV)

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Richard G. SARTORE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm): Myer Center, Room 4D206

X H2261, x 20155

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

Manufacturer Operating Manual and SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

NA

10. Signature of Director of Responsible Individual:

Name Joseph A. Key Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: None required, none provided

Dosimetry: None required, none provided.

Reviewed by: Hugo Bianchi Date: 28 Apr 95

Approved by: Joseph M. Santarelli Date: 5/9/95

Radiological Permit Application Supplement

Name: SARTORE (Last) Richard (First) G. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Myer Center	1 day	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
SEM	30keV electrons	Myer Ctr	10 yrs	Operation

STANDING OPERATING PROCEDURE

SOP NO: SEM-2

TITLE: ISI WB6 SEM

DIVISION/BRANCH:

PLACE OF OPERATION OR TEST:

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Edward B. Hakim

EDWARD B. HAKIM
Printed/Typed Name

APPROVED:

M Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 13 Feb 95

EXPIRES: 13 Feb 96

SUBMITTED BY: Richard SARTORE
Printed/Typed Name

Richard Sartore
Signature

Physicist
Title

Feb 8, 1995
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. SEM-2. Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date

US ARMY RESEARCH LABORATORY

TITLE: OPERATING PROCEDURE FOR ISI WB6 SCANNING ELECTRON MICROSCOPE

1. STATEMENT OF WORK: The scanning electron microscope is to be used for visual inspection of microelectronics devices and materials.

2. HAZARDS INVOLVED: There are no known hazards involved with the operation of a standard scanning electron microscope when operated as designed. The vacuum system and high voltage circuits are safety interlocked provided the equipment is operated in the normal manner.

3. PROTECTION STANDARDS/LIMITS: Equipment is required to be operated in an environmentally controlled room to prevent damage, i.e., temperature between 65 F and 80 F and humidity between 25 and 50 percent relative humidity.

4. SAFETY CONTROLS:

a. Engineering Controls: All vacuum system and high voltage circuits are safety interlocked to prevent damage to equipment or operator.

b. Procedural Controls:

1. Assure that vacuum chamber pressure has reached operating point (less than 1 Torr) before turning on the electronic console power and operating the microscope. Monitor vacuum gauges for correct pressure and insure that all interlock lights are green.

2. Assure that all safety and interlock precautions are functioning before operating the scanning electron microscope.

5. SEQUENCE OF OPERATION:

a. Insert sample in vacuum chamber, properly secured to movable stage with set screw.
b. Start vacuum pump down according to instrument operation manual supplied by manufacturer.
c. Turn on console power when vacuum gauge is reading low enough pressure (less than 1 Torr) and the safety interlock lights are green.
d. Operate the scanning electron microscope as directed in the manual provided by the manufacturer.
e. After completing work on the microscope, turn off console power.
f. Vent vacuum chamber and remove sample.

6. EMERGENCY PROCEDURES: In event of emergency shut off electrical power to unit and close all gas valves.

All accidents will be reported to the Safety/Environmental Office within one hour.

Safety/Environmental Office:
M. Walterschied , 44936

Fire Department: 911

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. **USER:** Richard Sartore
   E&PSD, ARL
   ATTN: AMSRL-EP-RA
   BLDG 2700, RM ~~4B206~~ 4C205 HB

2. **PERMIT NUMBER:** 074

3. **EXPIRATION DATE:** 1 NOV 95

---

4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
SCANNING ELECTRON MICROSCOPE (SEM) Model: ISI WB-6	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when SEM is in operation.

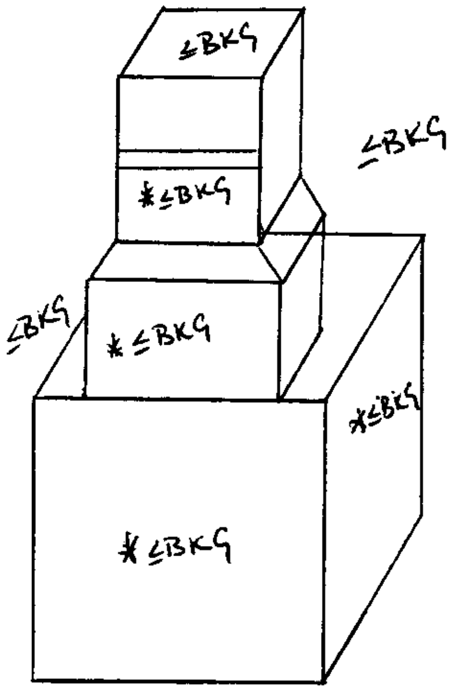
4. System to be used IAW SOP provided with permit application.

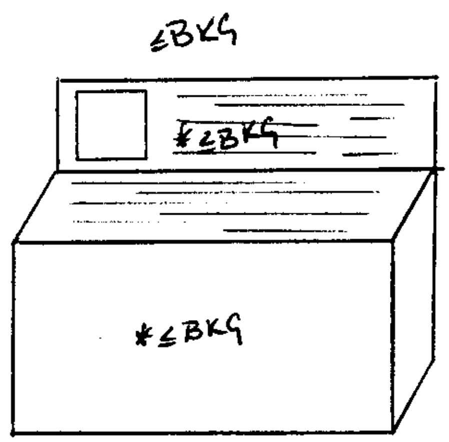
APPROVED: Joseph M. Santarsiero
JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 NOV 92

MEYER CENTER 4C205
SEM 131 WB-6

RADIATION SURVEY





Legend: * Contact reading
O Wipe Location

Background <0.2 mR/hr

Postings

SOP	✓	Dosimetry Requirements	N/A
Caution Radioactive Mat'l	N/A	NRC Form 3	N/A
Caution Radiation Area	N/A	Section 206	N/A
Caution High Rad Area	N/A	Notice to Workers	✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: William Craig Date: 7 Dec 93

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 22 Oct 92

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

_X_ Applications for Renewal of Permit No. 74

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: E+PSD, Army Research LAB ATTN: AMSRL-EP-RA Ft Mon, NJ 07703-5601

3. Radiation Area Supervisor: Name EDWARD B. HAKIM

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Scanning Electron Microscope ISI WB-6 (operated at 1 to 2KV)

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

Richard G. SARTORE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm): Meyer Center, Room 4D206

x42261 x20155

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

Operating Manual and SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

N/A

10. Signature of Director of Responsible Individual:

Name Joseph A. Key Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: Not required or provided.

Dosimetry: none required

Reviewed by: Hugo Bianchi Date: 29 Oct 92

Approved by: Joseph M. Santarnecio Date: 29 OCT 1992

Radiological Permit Application Supplement

Name: SARTORE (Last) Richard (First) G (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Meyer Center	1 day	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Scanning Electron Microscope	30kV Accelerating Voltage	Meyer Center	6 years	Operation

STANDING OPERATING PROCEDURES

ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

SOP NO: ______

TITLE OF SYSTEM OR PROCESS: JSI Scanning Electron Microscope

ROOM NO.: 4D206

BUILDING: Hexagon

BRANCH: SLCET-RR

DIVISION:

POC: R. SARTORE

EXTENTION: X42261

9/20/89

DATE OF PUBLICATION

STANDARD OPERATING PROCEDURE

TITLE: Standard Operating Procedure for ISI WB-6 Scanning Electron Microscope

1. STATEMENT OF WORK: The scanning electron microscope is to be used for visual inspection of microelectronic devices and materials.

2. HAZARDS INVOLVED: There are no known hazards with a standard scanning electron microscope when operated as designed. The vacuum system and high voltage circuits are safety interlocked provided the equipment is operated in a normal manner.

3. PROTECTION STANDARDS/LIMITS: Equipment is required to be operated in an environmentally controlled room to prevent damage, i.e., temperature between 65^{O}F and 80^{O}F and humidity between 25 and 50 percent relative humidity.

4. SAFETY CONTROLS:

a. Engineering Controls: All vacuum system and high voltage circuits are safety interlocked to prevent damage to equipment or operator.

b. Procedural Controls:

1. Assure that vacuum chamber pressure is low enough before turning on console power or operating microscope. Monitor vacuum gauges and interlock lights.

2. Assure that all safety and interlock precautions are functioning before operating microscope.

5. SEQUENCE OF OPERATION:

a. Insert sample in vacuum chamber.
b. Start vacuum pump down cycle.
c. Turn on console power when vacuum gauge is reading low enough pressure and safety interlock vacuum light indicates go ahead.
d. Utilized microscope in normal operating mode.
e. After work is finished, turn of console power.
f. Vent vacuum chamber and remove sample.

6. EMERGENCY PROCEDURES: All accidents are to be reported to the Safety Office within one hour.

Fire Department	- ~~117~~ 911	Police	- 911
First Aid	- ~~116/118~~ 911	Nurse	- 44484
Security	- 44684/42222	Bldg Mgr	- 44238/42981
Health Physics	- 75366		

ENDORSEMENTS

Reviewed 10/22/92

SUBMITTED BY: Physicist 9/21/89

SIGNATURE TITLE DATE

REVIEWED BY: 10/5/89

SIGNATURE SUPERVISOR DATE

10/5/89

SIGNATURE BRANCH CHIEF DATE

10/6/89

SIGNATURE DIVISION DIRECTOR DATE

APPROVED BY:

SIGNATURE ETDL SAFETY OFFICE DATE

SIGNATURE LABCOM SAFETY OFFICE DATE

SIGNATURE CECOM SAFETY OFFICE DATE

I HAVE READ AND UNDERSTAND THE CONTENTS OF SOP NO. ______.

I AGREE TO FOLLOW THESE PROCEDURES WHEN PERFORMING THIS OPERATION.

SIGN AND DATE:

467

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Melanie Cole
Physical Sciences Dir., ARL
BLDG 2700, RM 1B121-123

2. PERMIT NUMBER: 030

3. EXPIRATION DATE: 1 MAY 97

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
Phillips STEM EM 420-T, SN: D647 STEM ATTACHMENT SN: D795	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on an annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the STEM is in operation.

4. Device to be used IAW SOP No. EC-403, 28 APR 95.

APPROVED: Joseph M. Santarsiero

JOSEPH M. SANTARSIERO
Chief, Radiological and 5-1-95
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One

Date 18 April 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 030

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: ARL

3. Radiation Area Supervisor: Name Melanie W. Cole

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
N/A			

5. Other Sources of Ionizing Radiation Producing Devices:

Philips Scanning Transmission Electron Microscope (STEM)
EM 420T SN: D647, STEM ATTACHMENT SN: D795

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

1. Melanie W. Cole
2. Allen Lepore

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Myer Ctr Bldg 2700 1B121/123

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP Attached

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

This is described in SOP

10. Signature of Director of Responsible Individual:

Name Melanie Will Cole Signature Melanie Will Cole

CECOM SAFETY USE ONLY:

Instrumentation: None provided.

Dosimetry: None Provided.

Reviewed by: Hugo Bianchi Date: 28Apr95

Approved by: Joseph M. Santarsiero Date: 1May95

Radiological Permit Application Supplement

Name: Cole (Last) Melanie (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ARL	6 mo on job Training	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
TEM	N A	1B121	8 yrs	N A
STEM	N A	1B121	8 yrs	N A
SEM	N A	1B121	8 yrs	N A
EDX	N A	1B121	8 yrs	N A

Radiological Permit Application Supplement

Name: Lepore (Last) Allen (First) N (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
		YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
electron beam lithography (ionizing source)	40 keV	Cornell University	5 years	electron-beam lithography
ionizing source	100 keV	PSD/ARL	3 years	"
ionizing source	120 keV	PSD/ARL	6 years	electron microscope

STANDING OPERATING PROCEDURE

SOP NO: EC-403

TITLE: STEM (Philips EM420)

DIVISION/BRANCH: EDRD/Electronic Materials, Processes and Analysis Branch (AMSRL-EP-EC)

PLACE OF OPERATION OR TEST: Room 1B129/123 Myer Center

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth A. Jones

KENNETH JONES
Printed/Typed Name

APPROVED: Michael Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 4/28/95

SOP NO:

EXPIRES: 4/28/96

SUBMITTED BY: Melanie Cole
Signature

Dr. M. Cole
Printed/Typed Name

Research Physical Scientist
Title

27 April 1995
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EC-403. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Melanie Cole	27 Apr 95		
Allen Lepore	4-27-95		

ARMY RESEARCH LABORATORY (ARL)

SOP NO: EC-403

TITLE: STANDING OPERATING PROCEDURE FOR STEM (Philips EM-420)

1. **STATEMENT OF WORK**: The PHILIPS EM420 Scanning Transmission Electron Microscope is used in two modes. It's primary mode is to do microscopy and analysis on thin foil materials. Applications usually involve electronic materials, however, any conducting or semi-conducting, solid-phase, non-radioactive material can be analyzed. It's secondary mode, for which it was modified, is for writing nanometer sized structures. This is accomplished by scanning the beam across a resist coated sample in a pre-arranged fashion.

2. **HAZARDS INVOLVED**: Because of the presence of high voltages (as high as 12,000 Volts) and possible generation of x-rays special safety precautions must be taken by those personal operating and maintaining this system. The machine has been surveyed while in operation and no stray x-rays have ever been detected. This SOP is to be considered a supplement to the PHILIPS EM420 operations Manual. Before anyone may operate the PHILIPS 420 STEM they must be thoroughly familiar with the operations manual and this SOP.

3. **PROTECTION STANDARDS/LIMITS**: In the routine operation of this microscope, there is no contact with any type of volatile chemical. Procedures before and after may require additional precautions.

4. **SAFETY CONTROLS**: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. The high voltage will shut down if the vacuum gets too low or if the column or gun chamber is tampered with. It always must be manually switched on after a failure. However, if interlock system appears not to be working, do not use system and call for qualified service. For details on the safety interlock system, please refer to the PHILIPS EM420 operations manual.

(2) Shielding: The high voltage power supply has safety covers to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power is on. Repair of high voltage power supplies should be performed by qualified personnel or PHILIPS service engineers only.

b. Procedural Controls:

(1) **Clothing**: No special requirements.

(2) **First Aid/Fire Fighting Equipment**: Control, extinguish with dry type fire extinguisher.

(3) **Access Control**: The PHILIPS 420T STEM is located on the first floor of the Albert J. Myer Research Center Room 1B121/123 (Bldg 2700). This room is controlled by magnetic key locks at all times. Not more than six people have access at this time.

(4) **Special Precautions**: Use extreme caution when working on or near electrical connectors, and power supplies. If the water cooling lines to the oil diffusion pump should leak the instrument should be **TURNED-OFF** immediately and not powered- up until the water leak is fixed and surroundings parts and environment dried.

1910.306(f)(1) X-Ray Equipment - Disconnecting means: A disconnecting means shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the x-ray control.

5. **SEQUENCE OF OPERATIONS**: One must refer to the PHILIPS EM420 operations manual for a full detailed operational procedure before operating. Verify that all safety interlocks are energized. Check that all the high voltage power supply covers are securely in place.

6. **EMERGENCY PROCEDURES**: In case of any high voltage arcing (loud popping noises), shut off the high voltage power supplies and/or the System Main Power Switch and obtain qualified service before powering the instrument back up. If a water leak occurs while the instruments high voltage is on, **IMMEDIATELY** shut-down the system using the System Main Power Switch.

Immediately notify supervisor, Branch, Division, and Safety Offices of EPSD. Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

Fire Department, First Aid, Police	- 911
CECOM Health Clinic	- x22452/x44484
Building Security	- x44684/x42222
Building Manager	- x44238/x42981
	- Beeper: 517-6560
EPSD Branch Office	- x43552/x42556
EPSD Division Office	- x42452/x42080
EPSD Division Safety	- x44418/x43635
	- Beeper: 517-7859
EPSD Risk Management	- x44936
POC: M. W. Cole	- x44052/x42369
A. Lepore	- x28963
R. Thompson	- x42920

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Dr. E. B. Hakim
Physical Sciences Dir., ARL
ATTN: AMSRL-EP-RA
BLDG 2700, RM 4D206

2. PERMIT NUMBER: 025

3. EXPIRATION DATE: 1 MAY 97

---

4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
TORREX 150 Radiographic/ Fluoroscopic Inspection System	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by the CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Fluoroscopic Inspection System is in operation.

4. Device to be used IAW SOP No. X-RAY 2, 13 FRB 95.

APPROVED: Joseph M. Santarsiero 5/9/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One   Date 2 Mar 95

___ Initial Permit Application

___ Application for Amendment to Permit No. ___

X Applications for Renewal of Permit No. 25

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: PSD, Army Research Lab. AMSRL-EP-RA Fort Monmouth, NJ 07703

3. Radiation Area Supervisor: Name Edward B. HAKIM

4. Radioactive Material: N/A

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

Torrex - 150 Fluoroscopic Insp. System

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

E. Hakim

R. SARTORE

K. Cuneo

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm): Myer Center, Room 4D206

X 42185

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

N/A

10. Signature of Director of Responsible Individual:

Name Joseph A. Key Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: None required, none provided.

Dosimetry: None required, none provided.

Reviewed by: Hugo Bianchi Date: 28Apr95

Approved by: Joseph M. Santarius Date: 5/9/95

Radiological Permit Application Supplement

Name: SARTORE, RICHARD G.
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth, NJ	1 hour	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Torrex		4C205	5 years	X-Ray Research

Radiological Permit Application Supplement

Name: HAKIM, EDWARD B.
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth, NJ	1 hour	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: KUNEO, KERRY R
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. MON, NJ	1 Hr.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

SOP NO: X-RAY2

TITLE: TORREX-150 XRAY SYSTEM

DIVISION/BRANCH:

PLACE OF OPERATION OR TEST:

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Edward B. Hakim

EDWARD B. HAKIM
Printed/Typed Name

APPROVED:

M Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 13 Feb 95

EXPIRES: 13 Feb 96

SOP NO: X-RAY 2

SUBMITTED BY: Richard SARTORE

Printed/Typed Name

Signature

Physicist

Title

Feb 8, 1995

Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. X-RAY2. Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date
Kerry R. Cuneo	4/28/95

US ARMY RESEARCH LABORATORY

TITLE: OPERATING PROCEDURE FOR TORREX-150 XRAY INSPECTION SYSTEM

1. STATEMENT OF WORK: The xray inspection system is to be used for xray inspection of microelectronics devices and materials.

2. HAZARDS INVOLVED: XRAY leakage from machine

There are no known hazards involved with the operation of the xray system when operated as designed. The door and high voltage circuits are safety interlocked provided the equipment is operated in the normal manner.

3. PROTECTION STANDARDS/LIMITS:

XRAYs:
Permissible Exposure Limit(PEL): NRC exposure limit
Threshold Limit Value(TLV): NRC threshold limit

4. SAFETY CONTROLS:

a. Engineering Controls: The door and high voltage circuits are safety interlocked to prevent exposure of operator to xrays.

b. Procedural Controls:

1. Assure that door is closed before turning on the electric power and operating the xray inspection system. Stand a distance away from machine during operation. Monitor gauges for correct voltage and ensure xray generator is off before opening door.

2. Assure that all safety and interlock precautions are functioning before operating the xray inspection system.

5. SEQUENCE OF OPERATION:

a. Read operating manual.
b. Use key to turn machine on.
c. Place item to be xrayed in machine.
d. Close door to engage safety interlock.
e. Press button to activate xrays..
f. Stand back several feet from machine until exposure is complete (precautionary measure to reduce any possible exposure.
g. Retrieve sample, shut off machine and close door.

6. EMERGENCY PROCEDURES: In event of emergency shut off electrical power to unit and close all gas valves.

All accidents will be reported to the Safety/Environmental Office within one hour.

Safety/Environmental Office:
M. Walterschied , 44936

Fire Department: 911

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Donald W. Eckart
Physical Sciences Dir., ARL
Attn: AMSRL-PS-DB
BLDG 2700, RM 2C129, 2C131

2. PERMIT NUMBER: 028

3. EXPIRATION DATE: 1 MAY 97

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4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
a. AMRAY 1610 SEM	N/A	N/A
b. Phillips X-Ray Diff. Unit		
c. Double Crystal X-Ray Diff. Unit		

CONDITIONS:

1. Facility/devices to be surveyed on an annual basis by the CECOM Safety Office.

2. Devices may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when devices are in operation.

4. Dosimetry must be worn when operating x-ray diffraction units (items 4b and 4c).

5. Device listed in 4a above to be used IAW SOP No. X-RAY-1, 10 APR 95, devices 4b and 4c to be used IAW SOP No. EC-407, dated 26 AUG 94.

APPROVED: Joseph M. Santarsiero 5/10/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One — Date 29MARCH95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 028

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: U.S. ARMY RESEARCH LABORATORY BLDG 2700 RM 2C129

3. Radiation Area Supervisor: Name DONALD W. ECKART

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)

5. Other Sources of Ionizing Radiation Producing Devices:

AMRAY 1610 SEM
PHILIPS X-RAY DIFFRACTION UNIT
DOUBLE CRYSTAL X-RAY DIFFRACTION UNIT

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

DONALD W. ECKART	MARY-LLOYD LEMEUNE	MEDAN DUBEY
WILLIAM WILBER	JOSEPH FLEMISH	RICHARD LAREAU
STEVEN TIDROW	MARY HENDRICKSON	WEIYU HAN
ARTHUR TAUBER	~~STEVEN SLANE~~ HB	TIMOTHY MONAHAN
PETER NEWMAN	JAGDEESH PAMULAPATI	ROBERT MOERKIRK
~~PAUL [illegible]~~ HB		

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

2C129 PHILIPS + DOUBLE CRYSTAL UNITS
2C131 AMRAY 1610 SEM

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

LEAD BRICK WALLS IN ROOM 2C129 FOR X-RAY UNITS

10. Signature of Director of Responsible Individual:

Name JOEL SHAPPIRIO Signature Joel R. Shappirio

CECOM SAFETY USE ONLY:

Instrumentation: None required, none provided.

Dosimetry: Provided by CECOM Safety Office.

Reviewed by: Hugo Bianchi Date: 28 Apr 95

Approved by: Joseph M. Santarsiero Date: 10 May 95

Radiological Permit Application Supplement

Name: ECKART (Last) DONALD (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: SEM, X-RAY DIFFRACTION + RADIATION SAFETY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
FORT MONMOUTH		YES NO	YES NO
PHILIPS ELECTRONIC INSTRUMENTS	80 HRS	YES NO	YES NO

2. Experience: 32 years in X-RAY, 12 years in SEM

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: MONAHAN (Last) TIMOTHY (First) — (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-RAY DIFFRACTION/RADIATION TRAINING

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
FORT MONMOUTH	10 HRS	YES NO	YES NO
FORT MONMOUTH	4 HRS.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: PAMULAPATI, JAGADEESH
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
FT. MONMOUTH	2 WKS	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: DUBEY NADAN
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-Ray diffraction

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
NCSU	5 yr	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: COOKE (Last) PAUL (First) W (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X RAY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
AT&T BELL	4 1/2 YRS.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: TAUBER (Last) ARTHUR (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-RAY DIFFRACTION + RADIATION SAFETY

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
BROOKLYN POLY.	1 YEAR	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Tidrow (Last) Steven (First) Clay (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-ray Diffraction

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Texas Tech University	5 years	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Newman Peter Graham
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
X-ray training Ft. Monmouth	8 weeks	YES NO	YES NO
Gamma Irradiation training @ Salk Institute	24 hours	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Cobalt		Salk Institute	2 mos	Gamma Irradiation
Iodine		Salk Institute	4 mos.	Labelling

Radiological Permit Application Supplement

Name: Le Meune (Last) Mary-Lloyd (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-ray diffraction - Radiation Training

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth Radiation Training	32 hrs	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Hendricksen (Last) Mary (First) A (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-Ray Diffraction / Radiation Training

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	16 HRS.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: LAREAU RICHARD T
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: X-ray Diffraction // Radiation Training

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
A.S.U. College Ph.D. Course	~40 hrs +	YES NO	YES NO
Fort Monmouth	4 hrs. +	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Wilber (Last) William (First) D. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Colorado State University	1 semester	YES NO	YES NO
Ft. Monmouth ETDL	~6 mo.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Han WEIYU
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training: for double-crystal X-ray

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
ETOL	One year	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: Flemish (Last) Joseph (First) R. (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth	1 yr	YES NO	YES NO
Penn State	1 yr.	YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURE

SOP NO. XRAY-1

TITLE: X-RAY DIFFRACTOMETER

DIVISION/BRANCH: Device Processes Science Branch

PLACE OF OPERATION OR TEST: Myer Center, Room 2C129

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth A. Jones

SIGNATURE

APPROVED:

MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 10 April 1995

EXPIRES: 10 April 1996

SUBMITTED BY: DONALD W. ECKART
Printed/Typed Name

Donald W. Eckart
Signature

Research Physical Scientist
Title

10 April 1995
Date Submitted

SIGNATURES

I have read and understand the contents of SOP No. XRAY-1. Further, I agree to follow all these procedures when performing this operation/test.

Signature	Date	Signature	Date
Timothy Monahan	24 APRIL 95	Joseph R. [illegible]	1 May 95
Mary Lloyd LeMeune	24 APRIL 95	Arthur Faulkner	1 May 95
William Wolfe	25 Apr 1995	Richard T. Lorenz	3 May 95
[illegible]	8 May 95	Don Pirie	8 May 95
Steven J Adrow	1 May 1995	[illegible]	8 May 95
Luis M. Casas	1 May 95	Mary Heath	8 May 95
Kurt Marshall	1 May 95		
Jagadeesh Ramalogam	MAY 1, 1995		
Madan [illegible]	1 May 95		

STANDARD OPERATING PROCEDURE
FOR X-RAY DIFFRACTOMETER

1. STATEMENT OF WORK:

This Standard Operating Procedure (SOP) covers the safe operation and maintenance of the Blake Industries/Spellman DXR 3000 X-ray diffraction equipment located in the Microanalysis Center Room 2 C129 Myer Center

2. SYSTEM DESCRIPTION:

a. Summary: The X-ray diffraction system consists of a generator, an X-ray tube and housing, a monochromator and housing mounted on a goniometer stage, a sample holder mounted on another goniometer stage, a scintillation detector and electronics, and a computer for data acquisition and analysis. The X-ray tube is cooled by water from a heat-exchanger-type water chiller. The tube, monochromator, sample holder, and detector are enclosed by a tin-impregnated plastic radiation enclosure.

b. Generator: The X-ray generator (Spellman DXR 3000, located beneath the radiation enclosure) supplies power to the X-ray tube. There are separate power on/off , X-ray standby and on/off switches.). Voltage is continually variable to a maximum of 60 kV. Current is continually variable to a maximum of 60 mA. Note that the maximum power deliverable exceeds the maximum rating of the tube (see below). *The user must be careful not to exceed this limit.* Shutter controls for the tube are mounted on the electronics panel. The X-rays will not come on unless the water chiller is turned on and water is flowing to the X-ray tube. The manual for the generator is located in 2C129.

c. X-Ray Tube: The X-ray tube and housing are located inside the radiation enclosure. The tube is mounted horizontally, with shutters to the left, right, top, and bottom. The latter two shutters are disabled. The anode in the tube is made of copper, which is bombarded by electrons to produce the X-rays. The spectrum of radiation produced by the tube consists of discrete Cu $K\alpha 1$, $K\alpha 2$, and Kb lines as well as a continuous background. While the intensity of the background at a particular wavelength is weak compared with that of the discrete peaks, the overall background strength (integrated over all wavelengths) is larger than that of the peaks since the background spectrum extends to high energies. The maximum power rating of the tube is 1.5 kW.

d. Monochromator: The monochromator, mounted on a goniometer stage, is located to the left of the X-ray tube in a shielded cavity. The monochromator consists of a specially cut, low-defect Ge single crystal. X-rays passing through the monochromator are diffracted before exiting the monochromator; as a result, the beam emerging from the monochromator is decreased in intensity by a factor of about 10 and consists entirely of Cu $K\alpha l$ radiation (S = 1.5406 A). The continuous background is essentially eliminated. The entire beam path from the X-ray tube to the monochromator consists of a shielded collimator. Alignment of the monochromator is effected by rotation of the goniometer stage and a translation control.

These controls should not be adjusted during normal operation of the instrument. The cover to the monochromator is not interlocked to the 2-ray tube or shutters; entry into the monochromator is therefore very dangerous.

e. Sample Holder: The sample to be studied is mounted on a sample holder located at the center of a goniometer. Samples can be translated horizontally in two directions (parallel and perpendicular to the sample surface), rotated about a horizontal axis perpendicular to the sample surface (i.e., sample rotation), rotated about a horizontal axis parallel to the sample surface (i.e., "tilted"), and rotated about a vertical axis (this is the goniometer rotation). The translation motions, as well as the sample rotation, are controlled manually by micrometers on the sample holder and are used for initial positioning of the sample. The tilt rotation is controlled externally by a small motor attached to a micrometer drive on the sample holder. The goniometer rotation can be controlled in five ways: (1) the goniometer can be disengaged from the stepper motor and rotated by hand; (2) very coarse goniometer motion can be effected by means of a spring loaded control within the radiation enclosure; (3) the stepper motor can be accessed and turned by hand; (4) the stepper motor controller can step the goniometer in single steps or in a quasi-continuous fashion; (5) the computer drives the stepper-motor controller to acquire data.

f. Detector: The scintillation detector is mounted on a platform that can rotate about the goniometer axis. The detector can be removed from the platform to enable the user to set the angles of the detector and the sample holder appropriately for any desired diffraction geometry.

g. Electronics and Data Acquisition: The detector is supplied by a power supply mounted in the electronics cabinet; electrical pulses from the detector pass through a pulse-height discriminator and signal average. There is a ratemeter with analog and audio displays that correspond to the number of counts per second (CPS) passing through the discriminator; the full scale on the ratemeter can be set by the user at values ranging from 10 to 10^6 CPS. In addition to the detection electronics and the stepper motor controller, the electronics cabinet also contains an optical encoder capable of measuring and displaying absolute angular differences (corresponding to goniometer rotation) to an accuracy of 1 arc second. During a data scan, the computer steps the stepper motor at preset intervals and records in a file the measured diffracted beam intensity as a function of the goniometer angle.

h. Interlock Box: A box with two indicator lights sits on top of the X-ray generator; this box indicates the status of the interlocks on the radiation enclosure. The box also has a key-operated provision for interlock override, which is necessary to perform certain system maintenance tasks and to align the monochromator.

3. HAZARDS INVOLVED:

a. X-Ray: The X-ray diffraction system produces very intense levels of X-radiation. The level in the primary X-ray beam during operation at 40 kV and 35 mA (corresponding to approximately the maximum operating power of the X-ray tube) can be approximately 1000 R/hr at a distance of about 1 foot.

This level is extremely high and can result in overexposure of body parts exposed in a very short period of time. Since the X-ray beam is very narrow, the X-ray levels are confined to a very small area. The beam exists between the X-ray tube and the red X-ray shield mounted to the right; the X-ray level in the beam to the left (used for diffraction measurements) is attenuated by a factor of about 100 by the monochromator. Placing any portion of the body into the X-ray beam, [redacted], is strictly prohibited. In the words of the National Bureau of Standards in Handbook 111, "X-ray diffraction equipment can cause severe and permanent injury if any part of the body is exposed to the primary beam even for a few seconds. In cases of accidental exposure, severe burns affecting the upper extremities are the most frequently reported injury. These are slow to heal and can lead to cancer. Amputation of one or more fingers is sometimes required. Exposure of the lens of the eye to large doses can result in cataracts and other opacities. Sometimes the damage does not become apparent until years later. Consideration must also be given to other injuries such as genetic damage affecting the future offsprings of irradiated persons."

b. Beryllium: The windows on the X-ray tube are made of beryllium, which is a toxic material. Exposure to the X-radiation promotes oxidation of beryllium; as a result, the windows will develop a chalky coating, which can rub off onto the skin if touched. Contact with the skin is prohibited. Any cutting or machining of the windows is strictly prohibited.

c. High Voltage: Lethal voltages exist within the X-ray tube and the generator. The X-ray level behind the lead shields and outside the radiation enclosure is background level. The level inside the enclosure, but outside the X-ray beam, is generall background level.

4. PROTECTION STANDARDS/LIMITS:

a. X ray:

1. Whole Body: Exposure to the whole body is virtually impossible because of the narrow beam and the inaccessibility of the whole body to the beam.

2. Head, Lens of the Eye: If control measures were defeated or failed,it is possible that the head and/or eye could be placed into the beam. For a non-radiation worker, the radiation exposure standard for such an exposure is 2 mrem/hr, not to exceed 100 mrem/yr. Operating at 40 kV and 35 mA, these levels could be exceeded in the beam in 7.2 msec, and 360 msec, respectively. It is obvious that the head and/or eye can not make any contact with the beam.

3. Hands and Wrists: If control measures were defeated or failed, it is possible that the hands or wrists could accidentally be placed into the X-ray beam. For a nonradiation worker, the radiation exposure standard for such an exposure is 1.875 rem/quarter, not to exceed 7.5 rem/year. Operating at 40 kV and 35 mA, these levels could be exceeded in 6.75 seconds and 27 seconds, respectively. It is obvious that any contact with the beam will approach or exceed the protection standards.

b. Beryllium: The handling of beryllium components without gloves is unacceptable. The inhalation of any beryllium dust is also unacceptable.

5. GENERAL CONSIDERATIONS:

Before proceeding to the details of potentially hazardous X-ray device operations, we present some general ground rules for use of the X-ray diffraction equipment.

a. Responsible Persons:Donald W. Eckart of the Electronic Processes Branch is the technical person responsible for the operation of the X-ray diffraction system. No person shall conduct any operation on the X-ray diffraction system without his authorization. Joseph M. Santarsiero,Chief,Radiological Engrg. Branch is the radiation protection officer.

b. Manuals: This SOP is not intended to be a full description of the operation of the X-ray diffraction system. Therefore, all users should acquaint themselves with all portions of the X-ray system manuals that are relevant to their activities in the X-ray lab. A complete set of manuals is located in the X-ray lab, room 2C129, and should not be removed from the lab.

c. American National Standard N43.2: All users of the X-ray diffraction equipment should become acquainted with American National Standard N43.2-1977, *Radiation Safety for X-Ray Diffraction and Fluorescence Equipment*, a copy of which is attached to this SOP and which is incorporated into the SOP by reference.

d. Instrument Classification: According to the classification scheme of Standard N43.2, the X-ray diffraction system in the Electronic Processes Branch meets all requirements for an enclosed beam X-ray system during normal operation. The region within the radiation enclosure is considered a radiation area, and the region external to the enclosure is considered a noncontrolled area.

6. SAFETY CONTROLS:

a. EngineeringControls:

1. Interlocks: All movable panels on the radiation enclosure are interlocked to the x-ray tube shutters so that any open shutters will close if a panel is moved from the fully closed position. These interlocks can be overridden as described in paragraph 2h; this is to be done only by qualified personnel, with prior approval of the radiation protection officer.

2. Radiation Shielding: The radiation enclosure is tin-impregnated plastic, designed to stop the X-rays from leaving the enclosure. Furthermore, lead beam stops are positioned inside the enclosure to prevent the X-ray beam from exiting the enclosure. The shutters on the X-ray tube also act as shields, reducing the X-ray levels outside the tube to low levels. The collimator between the X-ray tube and the monochromator is shielded. The level of X-rays emerging from the monochromator is a factor of 100 lower than the primary beam level.

3. Warning Lights: The device is equipped with an "X-ray on" warning light, located above and near the left front corner of the radiation enclosure, to indicate when power from the generator is being supplied to the X-ray tube. The shutter on the X-ray tube is equipped with a "shutter open" light to indicate when the shutter is open and X-rays are present outside the tube.

4. Warning Stickers: A warning sticker is placed on the radiation cabinet just below the "X-ray on" light warning personnel not to open the radiation enclosure when the light is on. Additional stickers are placed at other points on the enclosure to warn that the instrument produces ionizing radiation.

b. Procedural Controls:

1. Training: Candidates for operator status must view the videotape entitled "The Double-Edged Sword", read and sign this SOP acknowledging understanding of its requirements and provisions, and receive training in the operation of the instrument by the responsible technical person. Furthermore, each operator must be appointed in writing at the end of this SOP by the Branch Chief.

2. Personnel Monitoring: Operators will wear a whole body dosimetry badge and a ring badge whenever power is to be supplied to the X-ray tube. Exposure should be precluded by the engineering controls, but use of the badges is required to assess any accidental exposure that might occur. Extremity badges must be used whenever the interlock override is used.

3. Radiation Survey: The radiation protection officer, or his designated representative, shall periodically survey the instrument outside the radiation enclosure using a Geiger-type counter.

4. Monochromator Alignment: Alignment of the monochromator requires override of the enclosure interlock and shall be performed only by the responsible technical person or a representative of the manufacturer. The radiation protection officer shall be informed in advance and reserves the right to be present during this operation. It is expected that this operation will need to be performed only about once a year. *No other person shall attempt to align the monochromator.*

5. Maintenance: Maintenance, modification, and repair of the generator and the X-ray tube and housing shall be performed by service personnel from the manufacturer, with prior notification and approval of the Radiological Protection officer. Such operations may require override of the interlocks. Operators shall not attempt any service or repair of these components. Following any repair or maintenance of this nature, operation shall not resume without the approval of the radiation protection officer..

6. Indicator Light and Interlock Testing: At the beginning of each working day, the operator shall turn on the generator, power up the X-ray tube, check to see that the "X-ray on" light is functioning, open the shutter, and check that the shutter open light is functioning.

The operator shall check the interlocks by setting the tube at minimum voltage and current, opening the shutter , opening each sliding door on the radiation enclosure, and checking to ensure that the shutter closes. (Listen for the shutter click, check the shutter indicator light, and check the green light on the interlock box. Both these lights must now be off. The shutter must be reset to open after each sliding door is re-closed.) The operator shall inform the responsible technical person if any of the above tests fails; the responsible technical person shall take action to see that any deficiencies are corrected.

7. SOP Posting: This SOP must be posted at all times on the radiation enclosure for easy access and reference by operators.

8. Removal of Tube Components or Power Supply Panels: Removal of tube components or power supply cabinet panels by an operator is strictly prohibited. The panels and tube components serve to protect personnel from the dangerous high voltages within the tube and power supply. Maintenance on these items is to be performed only by manufacturer service representatives.

9. Prohibited:

(a) Overriding any portion of the interlock circuit except as described above for maintenance, monochromator alignment, or radiation surveys.

(b) Operating with any panels removed from the generator or detector power supply.

(c) Unattended operation of the instrument without locking the lab bay door or the radiation enclosure.

(d) Unattended operation with the interlock override key in place.

(e) Removal of any warning stickers or lights, or modification of interlock circuits.

(f) Removal of any X-ray shields.

(g) Operation without the proper functioning of all warning lights and interlock circuits.

(h) Handling, cutting, machining, cleaning, or removing the beryllium windows on the X-ray tube housing.

10. Medical Surveillance: All new operators shall receive a preplacement medical examination, as recommended by paragraph 7.2 of NBS Handbook 111. Appropriate periodic medical surveillance shall continue thereafter.

7. OPERATION OF THE DIFFRACTOMETER:

The following procedures shall be followed by all operators of the X-ray diffraction equipment:

a. Turning Equipment On: Equipment is turned on in the following sequence:

1. Water chiller
2. Generator (power on only)
3. Detector electronics (main power on and HV on)
4. Optical encoder (located at the rear of the unit)
5. Stepper-motor controller
6. Computer, monitor, printer, and plotter (if required for data acquisition, analysis, and output)

At this point the operator should put on a whole-body and ring dosimetry badge, and the X-ray tube can be powered up. Insert the key, turn it to the right, and push the "X-rays on" button. Go through the procedure for indicator light and interlock testing described above. After this is done, normal operations can begin.

b. Sample Mounting and Alignment: The following procedures are to be followed when inserting a new sample onto the sample holder:

1. Close the shutter on the X-ray tube, checking the "shutter open" light to ensure it is not lit.
2. Turn off the high voltage to the x-ray tube; check that the "X-rays on" light is off.
3. Using the allen wrench in the radiation enclosure, loosen the set screw that holds the sample mount in place. The sample mount may now be removed from the rear of the sample holding stage. (It may be necessary to tilt the sample forward somewhat using the external control to allow clearance for the mount.)
4. If there is already a sample on the sample mount, remove it using a scalpel or razor blade.
5. Mount the new sample onto the mount using a small amount of finger wax (the wax for this purpose is in the radiation enclosure). Use a glass slide to carefully press the sample onto the mount. Make sure the sample adheres well to the mount before placing it back onto the sample holder.
6. Insert the mount back into the sample holder, from the rear, set the azimuthal positioning as desired, then tighten down on the set screw to fasten the mount in place.

7. Back off a couple of turns on the micrometer that controls translation of the sample perpendicular to the surface. Bring up the sample position indicator, drive the micrometer forward until the sample surface nearly touches the indicator. At this point, check the horizontal positioning of the sample; if it is not as desired, use the appropriate micrometer drive to translate the sample parallel to the surface. Let the sample positioner back down and give the micrometer a final "tweak." The sample is now positioned correctly.

8. If necessary, do a final adjustment of the azimuthal angle using the appropriate micrometer drive.

9. Disengage the stepper motor from the goniometer and set the goniometer angle properly. Rotate the detector to the proper angle and set it in place.

10. Adjust the sample tilt using the external control until the sample is oriented vertically.

11. Close the radiation cabinet; check that the green light on the interlock box is on. Set the beam voltages and currents as desired (step them slowly, voltage first, current last) and open shutter 3.

12. Set the rate meter on the lowest scale and turn the audio volume up until you hear intermittent clicks.

13. Use the stepper motor controller (set on MANUAL) to drive the goniometer in both directions (using the JOG+ and JOG- controls) until you see (and hear) a sharp rise in the detected X-ray level. When this occurs, you should be able to increase the full scale setting on the rate meter several times; when the display is on scale, step the goniometer in several single steps until a maximum is reached.
14. Use the external control for the tilt angle to "tweak up" the detected signal. Slowly scan the tilt angle in both directions until a maximum is obtained. Iterate this step and the previous one until no further improvement in the detected X-ray level is obtained. For most samples, you should now be detecting in excess of 3000 CPS. If what you observe is much lower than this, you are probably not on the largest Tray peak. Move the goniometer angle to try to find a larger peak and repeat the procedure. The sample should now be fully aligned.

15. Reset the zero on the optical encoder (if desired) and on the stepper-motor controller. Set the stepper-motor controller to AUTO mode.

16. Under no conditions shall you attempt to override the interlocks in an effort to align the sample.

c. Data Acquisition: Once the sample is aligned, data scans can be taken. The computer has a program called XRAY that does this. Simply type XRAY on the computer after it is booted up and the program will run. The program is menu-driven and is nearly self-explanatory.

The following are some helpful hints:

1. Go to option 1 and rename the default file for data after inserting a new sample. If possible, use a file name that includes the sample number so it will be easy to find later.

2. Make sure the angular setting displayed by the computer (option 1) matches that displayed by the stepper-motor controller. If it doesn't, reset it.

3. Option 3 allows for setting up a number of different data scans. Make sure that each scan steps in a *negative* direction, otherwise the computer will attempt to correct for backlash following each step.

4. While executing a positive step, the computer attempts to remove backlash of the stepper motor by moving forward an extra 100 arc seconds and then moving back. Sometimes this doesn't work properly. To ensure your **data scan comes** out right, have the computer move the goniometer at least 100 arc seconds beyond the largest angle you want (using option 2) before initiating the scan.

5. Each time you run a scan (using option 4) without changing the file name, the computer updates the extension by one. For example, if you specify the file HDL30, the first data scan will be in HDL30.001, the second in HDL13.002, and so on.

6. The program FIT can be used to analyze the collected data and/or plot out the results .

d. Shutting down: After you have finished operations for the day, shut down the instrument in the opposite order from that given above for starting up. Be sure to turn the current and voltage settings on the generator to the minimum values before shutting it down (current first, voltage last). After the X-rays are turned off, allow the water to flow for a few minutes before shutting down the water chiller. Return the dosimeter to the dosimeter rack

8. EMERGENCIES:

In the event of an emergency, immediately shut down power to the X-ray tube using either the key or the off button on the generator. In the event of a safety system failure or accidental or suspected personnel exposure, suspend operations immediately and contact the radiation protection officer at 43112.

STANDING OPERATING PROCEDURE

SOP NO: EC-407

TITLE: SEM (Amray 1610)

DIVISION/BRANCH: EDRD/Electronic Materials, Processes and Analysis Branch (AMSRL-EP-EC)

PLACE OF OPERATION OR TEST: Room 2C131A Myer Center
AMSRL-PS-DB

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Officer, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page ii.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: Kenneth A. Jones

KENNETH JONES
Printed/Typed Name

APPROVED: M R Walterschied

MICHAEL R. WALTERSCHIED
Safety/Environmental Officer

DATE: 08/26/1994

SOP NO: EC-407

EXPIRES: 08/26/1995

SUBMITTED BY: Richard T Lareau
Signature

Dr. Richard Lareau
Printed/Typed Name

Research Chemist
Title

08 August 1994
Date Submitted

SIGNATURE

I have read and understand the contents of SOP NO. EC-407. Further, I agree to follow all these procedures when performing this operation/test.

SIGNATURE	DATE	SIGNATURE	DATE
Donald W. Eckert	2 Nov 94		
Joseph R. Klomrists	2 Nov 94		

ARMY RESEARCH LABORATORY (ARL)

SOP NO: EC-407

TITLE: STANDING OPERATING PROCEDURE FOR SEM (Amray 1610)

1. STATEMENT OF WORK: The AMRAY 1610 scanning electron microscope is used to obtain microstructural and microchemical data on solids such as semiconductors, electronic and magnetic materials.

2. HAZARDS INVOLVED: Because of the presence of high voltages (as high as 30,000 Volts), the use of liquid nitrogen, and the generation of X-rays, special safety precautions must be taken by those personnel operating and maintaining this system. This SOP is to be considered a supplement to the OEM operations manual. Before anyone may operate the Amray 1610 system they must be thoroughly familiar with the operations manual and this SOP.

3. PROTECTION STANDARDS/LIMITS: The X-rays generated by this instrument are not considered hazardous due to their containment in the instrument.

4. SAFETY CONTROLS: The system has the following engineering and procedural controls.

a. Engineering Controls:

(1) Interlocks: System interlocks are instituted with this instrument to prevent accidental contact with High Voltage. If interlock system does not work, do not use system and call for qualified service. For details on the safety interlock system, please refer to the OEM operations manual.

(2) Shielding: The Amray 1610 high voltage power supply(s) safety covers are designed to shield operators from High Voltages. Removal of any of these covers may expose personnel to High Voltage sources. NEVER remove these covers while the instruments power, or power to individual high voltage supplies are ON. Repair of high voltage power supplies should be performed by qualified personnel.

b. Procedural Controls:

(1) Clothing: Protective face mask and gloves to be worm when transferring liquid nitrogen.

(2) First Aid/Fire Fighting Equipment: In case of fire, ~~a fire extinguisher is located in the room with the instrum~~ent.
call 911

(3) Access Control: The Amray 1610 Scanning Electron Microscope is located in the SEM room of EPSD's Device Microanalysis Center (Rm 2C131, Bldg 2700). The surrounding rooms are mag. locked at all times and access is limited to authorized personnel only.

(4) Special Precautions: Use extreme caution when working on or near electrical connectors or power supplies. NEVER remove safety covers from any power supply when they are ON. The operator shall inform adjacent personnel of high voltage hazards.

5. SEQUENCE OF OPERATIONS: Please refer to the OEM operations manual for a full detailed operational procedure. Verify that all safety interlocks are energized. Check that the electron source covers and high voltage power supply covers are securely in place.

6. EMERGENCY PROCEDURES: Follow standard emergency procedures in case of fire, shock, or injury. General emergency phone numbers are listed below.

	Fire Department, First Aid, Police	- 911
	CECOM Health Clinic	- x22452/x44484
	Building Security	- x44684/x42222
	Building Manager	- x44238/x42981 Beeper: 517-6560
	EPSD Branch Office	- x43552/x42556
	EPSD Division Office	- x42452/x42080
	EPSD Division Safety	- x44418/x43635 Beeper: 517-7859
	EPSD Safety Office	- x44936
POC:	Team Leader (Lareau)	- x20119
	Operator (Eckart)	- x42635

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

---

1. USER: Steve Slane
Physical Sciences Dir., ARL
ATTN: AMSRL-PS-PB
BLDG 2700, RM 2C201

2. PERMIT NUMBER: 062

3. EXPIRATION DATE: 1 MAY 97

---

4. MATERIAL/DEVICE	5. CHEMICAL/PHYSICAL FORM	6. ACTIVITY
Phillips PW 1840 X-Ray Diffractometer	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the device is in operation.

4. Instrumentation, provided by CECOM Safety Office, should be used whenever system is energized to produce X-Rays.

5. System to be used IAW SOP No. PB-1, 12 JAN 95.

APPROVED: Joseph M. Santarsiero 4/25/95
JOSEPH M. SANTARSIERO
Chief, Radiological and
Environmental Division
Radiation Protection Officer

DATE: 1 MAY 95

RADIOLOGICAL PERMIT APPLICATION

Check One　　　　　　Date 3/2/95

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

✓ Applications for Renewal of Permit No. 62

1. To: CECOM Safety Office
AMSEL-SF-RER
FT MON, NJ 07703

2. Organization Applying for Permit:
ARL, PSD,

3. Radiation Area Supervisor: Name STEVE SLANE

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
Cu, 29	N/A	X-RAYS	
Co, 27	N/A	X-RAYS	

5. Other Sources of Ionizing Radiation Producing Devices:

PHillips PW X-RAY DIFFRACTOMETER

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

STEVE SLANE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

Bldg 2700, Rm 2C201

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

SOP ATTACHED

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

SElf CONTAINED UNIT. ONSITE MONITORS (1) EBERLINE RO-2, (2) Red Alert MONITOR No 4, (3) ENVIRONMENTAL MONITORING DEVICES, BADGE ON MACHINE And NEARby wall.

10. Signature of Director of Responsible Individual:

Name R.P. Hamlen Signature R. Hamlen

CECOM SAFETY USE ONLY:

Instrumentation: One (1) RADIAC meter provided by the CECOM Safety Office to be used by authorized user.

Dosimetry: None provided

Reviewed by: Hugo Bianchi Date: 25 Apr 95

Approved by: Joseph M. Santarsiero Date: 4/25/95

Radiological Permit Application Supplement

Name: SLANE STEVE MICHAEL
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
In House By Phillip's Rep.	16 hours	YES NO	YES NO
Rutgers University	48 hours	YES NO	YES NO

2. Experience: 8 years with this equipment

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURE

SOP NO: PB-1

TITLE: X-RAY DIFFRACTOMETER

DIVISION/BRANCH: POWER SOURCES DIVISION/ENERGY SCIENCES BRANCH

PLACE OF OPERATION OR TEST: MYER'S CENTER, 2C201

This standing operating procedure (SOP) will be in effect for one year from the date of approval unless sooner rescinded or superseded.

No deviation from this SOP will be permitted. Whenever the approved method is changed, the SOP will be revised and signed by the Branch Chief, Safety/Environmental Manager, and all operators.

Supervisory personnel will assure that all personnel involved with this SOP, including any subsequent approval revisions, have been properly trained and instructed in its provisions and attest to this condition by requiring them to affix their signature on page II.

A copy of this SOP will be posted at the job site at all times.

BRANCH CHIEF: [signature]

Sol Gilman
Printed/Typed Name

APPROVED: [signature]
MICHAEL R. WALTERSCHIED
Safety/Environmental Manager

DATE: 12 Jan 95

EXPIRES: 12 Jan 96

SOP Submitted By: Steve Slane

Steve Slane
Research Chemical Engineer

Date Submitted: September 16, 1994

Signatures:

I have read and understand the contents of this SOP. Further, I agree to follow all these procedures when performing this operation.

Printed Name	**Signature**	**Date**

STANDARD OPERATING PROCEDURE FOR X-RAY DIFFRACTOMETER

1. STATEMENT OF WORK:

This Standard Operating Procedure (SOP) covers the safe operation and maintenance of the Philips Compact X-ray Diffractometer System PW1840 located in the Myer Center, Bldg 2700, Room 2C201.

2. SYSTEM DESCRIPTION:

a. General: The diffractometer consists of a goniometer driven by a stepper motor and a solid-state detector, all protected by a dust cover enclosure; a high-voltage generator and an x-ray tube, a personal computer to control the system. The X-ray tube is cooled by water from a heat-exchanger-type water chiller.

b. Operating Conditions: The maximum operating voltages and currents, or ranges of voltages or currents, are set at or established by the factory and should not be altered. By exceeding established limitations, the effectiveness of the incorporated shielding may be reduced to a point where the penetrating or emergent radiation may exceed safe values. If radiation shielding shows chemical or mechanical damage, service personnel should be notified immediately to prevent accidental radiation exposure.

c. Interlocks: Interlock switches are built into all access doors and cabinets. These switches should under no circumstances be tampered with and should be maintained in proper operating condition. In no case should they be defeated or wired out, since failure of automatic high voltage protection will then result.

d. Maintenance: All parts of the equipment, particularly interlock switches, should be carefully maintained for proper operation. Doors should close sufficiently to prevent access before interlock switches close. Tube operating voltage and current should be checked whenever the equipment is operated by service personnel.

e. Servicing Precaution: Before changing tubes or making any internal adjustments, the equipment shall be disconnected for the power supply in insure that no x-ray emission can occur. Care should be taken to assure that all high voltage condenser charges are removed using an insulated grounding lead, before personal contact is established.

f. Supervision: X-ray producing equipment should be used only under the guidance and supervision of a responsible qualified person. the instruction manual supplied with each unit clearly specifies the system's intended operation. All equipment operators must be given adequate safety instructions.

3. HAZARDS INVOLVED:

a. X-Ray: Exposure to excessive quantities of X-radiation may be injurious to health. therefore users should avoid exposing any parts of their persons, not only to the direct beam, but also to secondary or scattered radiation which occurs when an X-ray beam strikes or has passed through any material.

Human beings have no senses for x-rays. Therefore x-ray measuring instruments, like low energy x-ray Geiger counters, must be used to detect x-ray emission or leakage radiation. No x-ray exposure to human beings is permitted unless proper personnel monitoring devices are employed.

X-ray producing equipment supplied by Philips Electronic Instruments Inc. is usually installed in a room or cabinet providing adequate radiation barrier. The user should always be aware that the useful x-ray beam can constitute a distant hazard if not employed in strict accordance with instructions contemplated to provide maximum safety for the operator.

b. Beryllium: The windows on the X-ray tube are made of beryllium, which is a toxic material. Exposure to the X-radiation promotes oxidation of beryllium; as a result, the windows will develop a chalky coating, which can rub off onto the skin if touched. Contact with the skin is prohibited. Any cutting or machining o the windows is strictly prohibited.

c. High Voltage: Lethal voltages exist within the X-ray tube and the generator.

4. GENERAL CONSIDERATIONS:

Before proceeding to the details of potentially hazardous X-ray device operations, we present some general ground rules for use of the X-ray diffraction equipment.

a. Responsible Persons: Steve Slane of the Energy Sciences Branch is the technical person responsible for the operation of the X-ray diffraction system. No person shall conduct any operation on the X-ray diffraction system without his authorization.

b. Manuals: This SOP is not intended to be a full description of the operation of the X-ray diffraction system. Therefore, all users should acquaint themselves with all portions of the X-ray system manuals that are relevant to their activities in the X-ray lab. A complete set of manuals is located in the X-ray lab, room 2C201, and should not be removed from the lab.

c. American National Standard N43.2: All users of the X-ray diffraction equipment should become acquainted with American National Standard N43.2-1977, *Radiation Safety for X-Ray Diffraction and Fluorescence Equipment.*

d. Instrument Classification: According to the classification scheme of Standard N43.2, the X-ray diffraction system in the Power Sources Division meets all requirements for an enclosed beam X-ray system during normal operation. The region within the radiation enclosure is considered a radiation area, and the region area, and the region external to the enclosure is considered a non-controlled area.

5. SAFETY CONTROLS:

a. Engineering Controls:

1. Interlocks: Each tube port has an electro-magnetically operated shutter, which is only opened when power is supplied. In addition a spring loaded rotating disc is always in the closed position unless an accessory is fitted and fully interlocked.

2. Radiation Shielding: The x-ray tube in a diffractometry system is fully enclosed in a Tube Shield (e.g. type PW1316/91). This tube shield is mounted on top of the generator cabinet. X-rays can be beamed from ports, one on each of the four sides of the tube shield.

3. Warning Lights: The device is equipped with an "X-ray on" warning light, located above and near the right back corner of the radiation enclosure, to indicate when power from the generator is being supplied to the X-ray tube. Each shutter on the X-ray tube is equipped with a "shutter open" light to indicate when the shutter is open and X-rays are present outside the tube.

4. Warning Stickers: A warning sticker is placed on the radiation cabinet just below "X-ray on" light warning personnel not to open the radiation enclosure when the light is on. Additional stickers are placed at other points on the enclosure to warn that the instrument produces ionizing radiation.

b. Procedural Controls:

1. Access Control:. During normal operations, the door to the lab bay must be locked (or the enclosure locked) before the instrument can be left running unattended.

2. Training: Candidates for operator status must read and sign this SOP acknowledging understanding of its requirements and provisions, and receive training in the operation of the instrument by the responsible technical person.

3. Personnel Monitoring: A Geiger-type counter must be used. Periodic sampling before and after sample loading is advised.

4. Radiation Survey: The radiation protection officer, or his designated representative, shall periodically survey the instrument outside the radiation enclosure using a Geiger-type counter.

5. Maintenance: Maintenance, modification, and repair of the generator and the X-ray tube and housing shall be performed by service personnel from the manufacturer, with prior notification and approval of the Risk Management Directorate. Such operations may require override of the interlocks. Operators shall not attempt any service or repair of these components. Following any repair or maintenance of this nature, operation shall not resume without the approval of the radiation protection officer.

6. Tube Changing: Changing of the x-ray tube will only be performed by a manufacturer representative or by the Division technical person responsible for the operation of the X-ray diffraction system (Steve Slane).

7. Indicator Light and Interlock Testing: At the beginning of each working day, the operator shall turn on the generator, power up the X-ray tube, check to see that the "X-ray on" light is functioning, open shutter 4, and check that the shutter open light is functioning. The operator shall inform the responsible technical person if any of the above tests fails; the responsible technical person shall take action to see that any deficiencies are corrected.

8. SOP Posting: This SOP must be posted at all times on the radiation enclosure for easy access and reference by operators.

9. Removal of Tube Components or Power Supply Panels: Removal of tube components or power supply cabinet panels by an operator is strictly prohibited. The panels and tube components serve to protect personnel from the dangerous high voltages within the tube and power supply. Maintenance on these items is to be performed only by manufacturer service representatives or by the Division technical person responsible for the operation of the X-ray diffraction system (Steve Slane).

10. Prohibited:

(a) Overriding any portion of the interlock circuit except as described above for maintenance, monochromator alignment, or radiation surveys.

(b) Operating with any panels removed from the generator or detector power supply.

(c) Unattended operation of the instrument without locking the lab bay door or the radiation enclosure.

(d) Removal of any warning stickers of lights, or modification of interlock circuits.

(f) Removal of any X-ray shields.

(g) Operation without the proper functioning of all warning lights and interlock circuits.

(h) Handling, cutting, machining, cleaning, or removing the beryllium windows on the X-ray tube housing.

11. Medical Surveillance: All new operators shall receive a replacement medical examination, as recommended by paragraph 7.2 of NBS Handbook 111. Appropriate periodic medical surveillance shall continue thereafter.

6. OPERATION OF THE DIFFRACTOMETER:

The following procedures shall be followed by all operators of the X-ray diffraction equipment:

a. Turning Equipment On: Equipment is turned on in the following sequence:

1. Water chiller.
2. Computer controller
3. Generator
4. Turn up voltage (kV), then turn up current (mA)
5. Run APD software
6. Load sample
7. Open shutter 4, two button operation.

b. System Shut Down

1. Close all shutters on the X-ray tube, checking the "shutter open" light to ensure it is not lit.
2. Turn down current (mA), the turn down voltage (kV).
3. Turn off the generator; check that the "X-ray on" light is off.

4. Remove sample

5. Let cooling water circulate for about 15 minutes before turning off.

7. Emergency:

In case of an emergency or accident, the following should be contacted immediately.

Risk Management: X44936, Beeper - 724-6548

Division Office: X -

Fire Dept: X 911

RADIOLOGICAL PERMIT

In reliance on statements and representations made by the applicant, authority is hereby granted to receive, utilize and store the materials and/or devices designated in item 4.

1.	**USER:** Dr. E. B. Hakim ET & DL ATTN: AMSRL-EP-ME BLDG 2700, RM 4d204	**2.** **3.**	**PERMIT NUMBER:** 025 **EXPIRATION DATE:** 1 MAY 95

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4. MATERIAL/DEVICE	**5. CHEMICAL/PHYSICAL FORM**	**6. ACTIVITY**
TORREX 150 Radiographic/ Fluoroscopic Inspection System	N/A	N/A

CONDITIONS:

1. Facility to be surveyed on a semi-annual basis by CECOM Safety Office.

2. Device may not be removed or reconfigured without first informing and receiving permission from the installation Radiation Protection Officer.

3. No unauthorized personnel allowed in room when the Fluoroscopic Inspection System is in operation.

4. Device to be used IAW SOP number R-002.

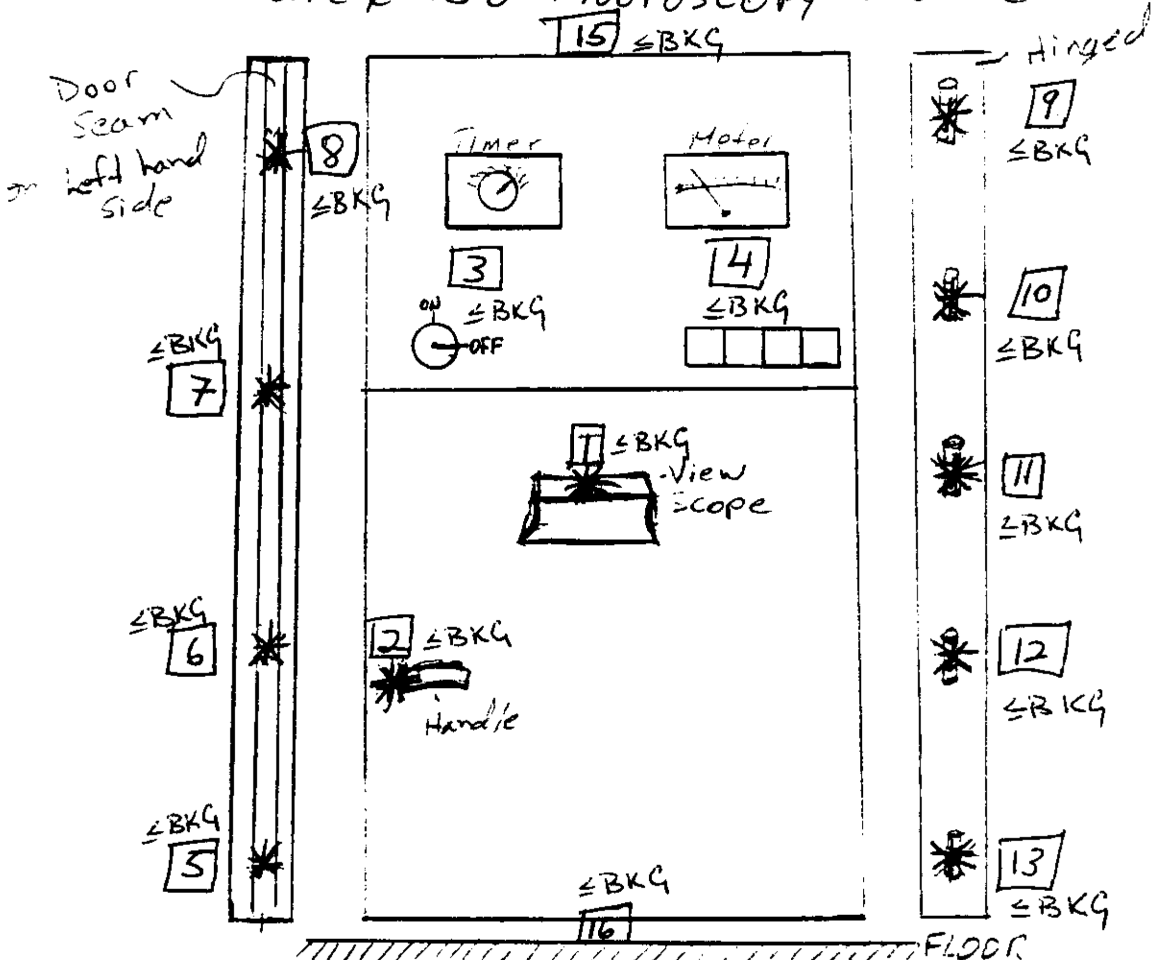
APPROVED: for JOSEPH M. SANTARSIERO
Chief, Radiological Engrg Br.
Radiation Protection Officer

DATE: 1 MAY 92

MYER CTR
Rm 4D204

RADIATION SURVEY

Torrex 150 Fluoroscopy Machine



Legend: * Contact reading
☐ Primary survey location

Background <0.2

Postings

SOP ✓

Section 206 N/A

Caution Radioactive Mat'l N/A

NRC Form 3 N/A

Notice To Workers ✓

COMMENTS: All readings are in mR/hr at waist level (36") unless otherwise indicated.

Survey instrument: EBERLINE RO2

Calibration Due Date: 13 JAN 94 Serial #: 3511

Surveyor: WILLIAM CRAIG Date: 7 DEC 93

RADIOLOGICAL PERMIT APPLICATION

Check One Date 2/25/92

___ Initial Permit Application

___ Application for Amendment to Permit No. ____

X Applications for Renewal of Permit No. 025

1. To: CECOM Safety Office AMSEL-SF-RER FT MON, NJ 07703	2. Organization Applying for Permit: ET&DL SLCET-RR FT. MON. NJ 07703

3. Radiation Area Supervisor: Name EDWARD B. HAKIM

4. Radioactive Material:

Element & Mass Number	Chemical Form	Physical Form	Activity (mCi)
N/A			

5. Other Sources of Ionizing Radiation Producing Devices:

Torrex-150 Fluoroscopic Insp. Sys.

6. Authorized Users:
Note: Attached Radiological Permit Supplement must be filled out for each person named below.

1. E. HAKIM
2. K. CUNEO
3. R. SARTORE

7. Locations where source(s) of ionizing radiation will be used (Bldg, rm):

MEYER CENTER, BLDG 2700, ROOM ~~4C205~~ 4D204
X42185

8. Describe procedure(s) in which radioisotope(s) and/or other sources of ionizing radiation will be used or attach current SOP.

COPY ATTACHED

9. Describe laboratory facilities and equipment, (containers, shielding, fume hoods, protective clothing, etc.)

FLUORO UNIT INTERLOCKED WITH DOOR FOR SAFETY

10. Signature of Director of Responsible Individual:

Name JOSEPH A. KEY Signature Joseph A. Key

CECOM SAFETY USE ONLY:

Instrumentation: ~~[illegible]~~, Not Required HB
~~IC To be provided by CSO~~

Dosimetry: ~~Not Required~~ Not Required HB
~~To be provided by CSO~~, ~~[illegible]~~
~~approved users~~

Reviewed by: Hugo Bianchi Date: 26 Mar 92

Approved by: Joseph M. Santarsiero Date: 26 Mar 92

Radiological Permit Application Supplement

Name: SARTORE, RICHARD G.
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth, NJ	1 hour	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use
Torrex		4C205	5 years	X-Ray Research

Radiological Permit Application Supplement

Name: HAKIM, EDWARD B.
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. Monmouth, NJ	1 hour	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

Radiological Permit Application Supplement

Name: KUNEO, KERRY R
(Last) (First) (Middle)

List below your training and experience with radioisotopes and/or other sources of ionizing radiation:

1. Training:

Where Trained	Duration of Training	On the Job (Circle)	Formal Course (Circle)
Ft. MON., NJ	1 Hr.	YES NO	YES NO
		YES NO	YES NO

2. Experience:

Isotope or other Source(s)	Maximum Amount or Description of Source	Location	Duration	Type of Use

STANDING OPERATING PROCEDURES

ELECTRONICS TECHNOLOGY AND DEVICES LABORATORY

SOP NO: R-002

TITLE OF SYSTEM OR PROCESS

RADIATION PRECAUTION X-RAY INSPECTION SYSTEM (TORREX-150)

ROOM NO.: 4C205

BUILDING: Myers Center

BRANCH: Reliability Testability and Quality Assurance	POC:
DIVISION: Reliability, Logistics & Standardization	EXTENTION:

DATE OF PUBLICATION

STANDING OPERATING PROCEDURE

TITLE: Radiation Precaution X-Ray Inspection System (Torrex-150)

DIVISION: Reliability, Logistic and Standardization

BRANCH: Reliability, Testability and Quality Assurance

PLACE OF OPERATION OR TEST: Reliability Test Lab - Room 4C205

This standing operating procedure (SOP) will be effective for 1 year from the date of approval unless sooner rescinded or superseded.

No deviation from the SOP will be permitted. Whenever the approved method is changed, the SOP will be revised unless approved in writing by the Safety Office.

Supervisory personnel will assure that all personnel involved with this SOP have been trained properly and instructed in its provisions and attest to this requirement by causing them to affix their signatures on Page 3.

A copy of this SOP will be posted at the job site at all times.

1. PURPOSE: Define the responsibilities for operator protection against x-ray radiation hazards.

2. PROCEDURE:

   a. Read operating manual.

   b. Use key to turn machine on.

   c. Place item to be x-rayed in machine.

   d. Close door to engage safety interlock.

   e. Press button to activate x-rays.

   f. Stand back several feet from machine until exposure is complete (precautionary measure to reduce any possible exposure).

   g. Retrieve sample, shut off machine and close door.

Branch Chief: Edward B. Hakim
Signature

Edward B. Hakim
Printed Name

APPROVED: ______________________________
ETDL SAFETY REPRESENTATIVE

DATE: ____________

SOP NO: ____________

EXPIRES: ____________

____
LABCOM SAFETY OFFICE

____
CECOM SAFETY OFFICE